



US Market Development IEA PVPS Task 1 September 30, 2013

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Quality solar market research products – release no analysis before the data are gathered, bias is eliminated, and objectivity is achieved

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"There are only two ways to live your life. One is as though nothing is a miracle. The other is as though everything is a miracle." Albert Einstein



Research Methodology

Market research is a specific discipline where something is counted from point a to point b, then point b to point c, and so on. The point is to eliminate double counting and arrive at specific metrics to define a market

Focus on quantifiable metrics (data), announcements are not data

In solar, when following the module it is from manufacturer to first point of sale, then first point of sale to the next point and so on, until the module is installed.

Market research is the objective study of a subject using data gathered through primary research to characterize, analyze and forecast demand and supply for, in this case, the photovoltaic industry.

Market research makes use of data to identify trends and customers, and analyze competitors.

In the case of this practice, the data go back >30 years. In market research, you get the data, get the data, get the data and then interpret the data.

Primary research is direct contact with the person buying and selling the product, technology, widget, etc.

The purpose is to provide an objective analysis that managers and executives can use for business planning purposes.



The US is a complex market – not just one market, not just 50 markets – it is a myriad of federal, state and local markets that do not always work together well.

Because of its complexity, the US is an ideal training ground for other difficult markets.



US Market Highlights

- PV deployment in the U.S. grew by a compound annual rate of 54% from 2007 through 2012.
 - state renewable portfolio standards (RPS)
 - state incentives of various types (capacity based, FiT, SRECs, tax equity such as the ITC, and others)
 - government and utility projects,
 - business models (PPA and lease),
 - inexpensive price of modules and other components, and
 - ongoing dedication of the US solar industry.
- 3rd-party power purchase agreement (PPA) policies: electricity is sold to a utility from a host roof or investor/developer owned land
- Solar leases: very popular but overtime higher cost than system purchase
- Federal Modified Accelerated Cost Recovery System (MACRS): currently 5 years for depreciation
- Clean Renewable Energy Bonds (CREBs) are zero interest bonds that pay investors returns through tax credits
- The industry is VERY aware that the investment tax credit (ITC) reduces from 30% to 10% after December 2016 → 2013 and early 2014 the last period for beginning planning for big projects (takes about two years)



US Market Highlights: States

Electricity rates range: >\$0.37/kWh (Hawaii) -- <\$0.084/kWh (North Dakota)

California:

- AB327 eliminates the cap on Net metering (theoretically) and opens the
 potential of an increase to 37% of the RPS while also passing higher costs onto
 ratepayers and changing the rate structure. There will be a \$5 to \$10 monthly
 fee for those installing solar
- PG&E has added a \$300 per kWp deposit effectively discouraged less serious under bidders
- 2012 into 2013, residential electricity rates increased by 4%, commercial rates by 4%, industrial rates by 3% while transportation rates decreased by 6%.

Arizona: Continues to create roadblocks for solar deployment

Nevada:

- Feeds California market
- Governors of Nevada and California are negotiating sharing the cost of building transmission so that more solar can be installed in Nevada to feed into the California market

Colorado:

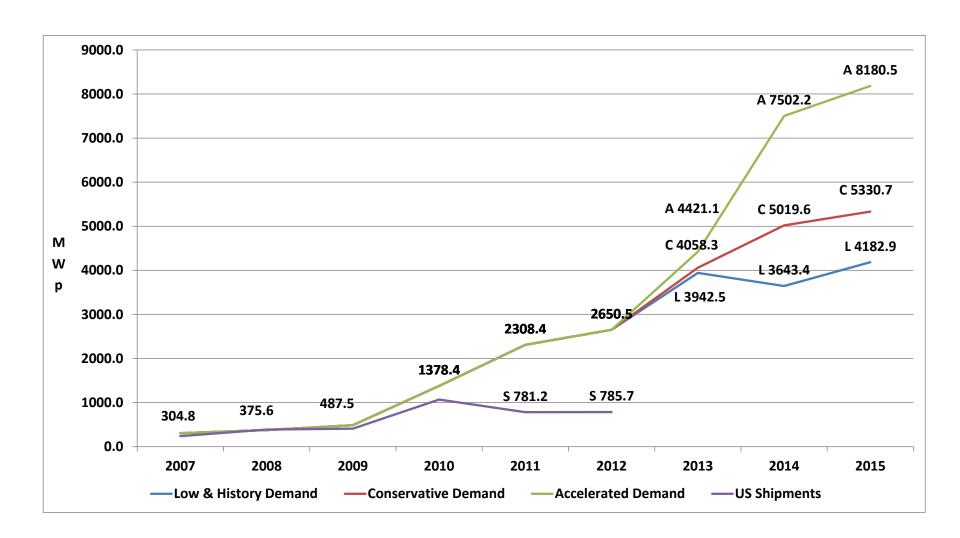
 Xcel Energy (utility) is adding a further 2-MWp of solar gardens – basically, these systems are owned by the community through the selling of shares – the benefits are transferrable.



US Demand for Solar Products

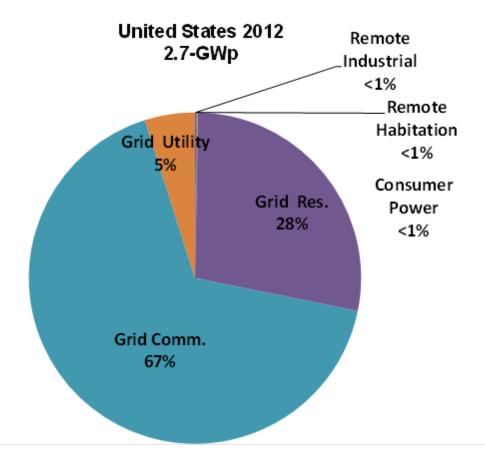


US Forecast to 2015





US Application Split





US Application Forecast to 2015

										CAGR	
										2007-	Cumulative
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2015	2007-2015
Low	304.8	375.6	487.5	1378.4	2308.4	2650.5	3942.5	3643.4	4182.9	39%	19274.0
Grid Comm.	148.4	176.5	287.6	819.0	1226.0	1770.8	2633.2	2323.0	2718.1	44%	12102.7
Grid Utility	9.1	26.3	34.1	110.3	145.2	129.9	106.4	109.3	117.1	38%	787.8
Grid Res.	97.5	139.0	146.2	413.4	925.7	742.1	1195.0	1202.3	1338.5	39%	6199.7
Remote	49.7	33.8	19.5	35.7	11.5	7.7	7.9	8.7	9.0	-19%	183.5
Conservative	304.8	375.6	487.5	1378.4	2308.4	2650.5	4058.3	5019.6	5330.7	43%	21913.7
Grid Comm.	148.4	176.5	287.6	819.0	1226.0	1770.8	2709.8	3208.5	3455.9	48%	13802.5
Grid Utility	9.1	26.3	34.1	110.3	145.2	129.9	121.8	145.6	159.9	43%	882.1
Grid Res.	97.5	139.0	146.2	413.4	925.7	742.1	1218.3	1656.5	1705.8	43%	7044.5
Remote	49.7	33.8	19.5	35.7	11.5	7.7	8.5	9.0	9.1	-19%	184.5
Accelerated	304.8	375.6	487.5	1378.4	2308.4	2650.5	4421.1	7502.2	8180.5	51%	27608.9
Grid Comm.	148.4	176.5	287.6	819.0	1226.0	1770.8	2732.3	4791.6	5399.2	57%	17351.4
Grid Utility	9.1	26.3	34.1	110.3	145.2	129.9	132.6	150.0	245.4	51%	983.0
Grid Res.	97.5	139.0	146.2	413.4	925.7	742.1	1547.4	2550.7	2525.3	50%	9087.3
Remote	49.7	33.8	19.5	35.7	11.5	7.7	8.8	9.8	10.6	-18%	187.1



US State Attractiveness 2013

	2013 Category							New	New	North			
Category	Rank	Az.	Calif.	Colo.	Florida	Hawaii	Mass			Carolina	Nevada	Texas	Weight
Category	Rank	72.	Oaiii.	0010.	Tiorida	i law an	mass.	ocracy	MCXICO	Oai Oiiiia	14C Vada	TCAGS	Weight
State of Transmission	н	6	6	6	5	6	6	7	6	6	6	7	8%
Demand/Population	Н	5	10	5	5	4	8	8	5	5	4	6	8%
Electricity													
Rate/Volatility of	Н	6	9	7	7	10	9	8	6	5	5	5	9%
Culture/Politics	L	4	10	8	1	3	9	4	2	1	3	1	3%
Regulations,													
interconnection, net													
metering	Н	10	8	7	6	3	7	10	8	3	3	0	10%
Utility Participation	Н	1	8	7	1	4	6	8	5	3	7	2	8%
RPS	Н	4	10	10	0	10	10	10	10	5	10	5	16%
Incentives including													
RECs	Н	1	9	8	3	6	7	2	6	5	3	4	25%
Insolation	М	10	7	6	9	10	6	5	10	7	10	8	5%
Competition (with													
substitutes)	L	7	8	5	1	5	6	6	6	4	7	1	2%
Access to Western													
Grid	M	10	10	10	0	0	0	0	10	0	10	0	6%
2013 State													
Attractiveness Rank		4.8	8.8	7.6	3.4	6.1	7.2	6.2	7.0	4.4	5.8	3.9	100%
Assessment		M	Н	M	L	M	M	M	M	M	M	L	
H = 8 - 10, M = 4 - 7, L 1-													
3 and negative													
numbers													



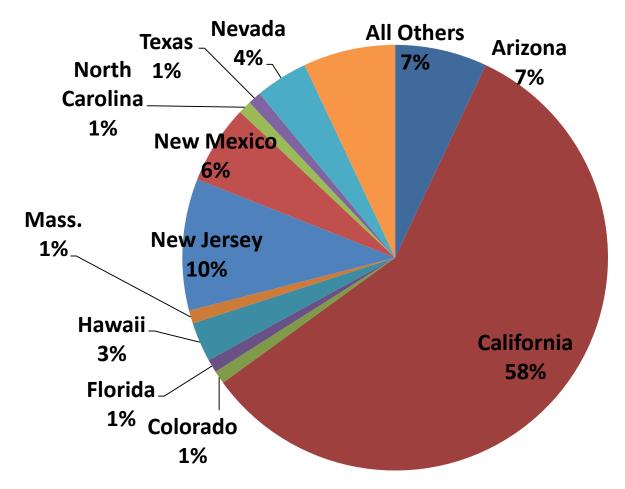
US State Attractiveness 2015

	2015 Category							New	New	North			
Category	Rank	Az.	Calif.	Colo.	Florida	Hawaii	Mass.			Carolina	Nevada	Texas	Weight
cute get y	7.0	7 1		00.01	1101100	110.11 0.11					1101000	1000	
State of Transmission	Н	7	8	7	6	7	7	7	7	7	7	7	11%
Demand/Population	М	5	10	6	6	5	8	8	5	6	4	6	7%
Electricity													
Rate/Volatility of	Н	7	10	7	7	10	9	9	5	5	6	5	9%
Culture/Politics	L	3	10	8	4	4	8	4	2	2	3	1	2%
Regulations,													
interconnection, net													
metering	Н	10	8	7	5	2	7	10	8	2	2	0	12%
Utility Participation	Н	1	8	7	1	4	7	8	4	3	7	1	10%
RPS	Н	4	10	10	0	10	10	10	10	5	10	5	16%
Incentives including													
RECs	Н	0	7	7	2	4	7	3	5	4	3	4	23%
Insolation	М	10	7	6	9	10	6	5	10	7	10	8	4%
Competition (with													
Substitutes)	L	6	7	8	2	6	5	5	6	5	6	0	1%
Access to Western													
Grid	М	8	8	9	0	0	0	0	8	0	8	0	5%
2015 State													
Attractiveness Rank		4.6	8.4	7.5	3.3	5.7	7.3	6.8	6.6	4.3	5.7	3.8	100%
Assessment		М	Н	М	L	М	M	М	М	M	M	Г	
H = 8 - 10, M = 4 - 7, L 1-													
3 and negative													
numbers													



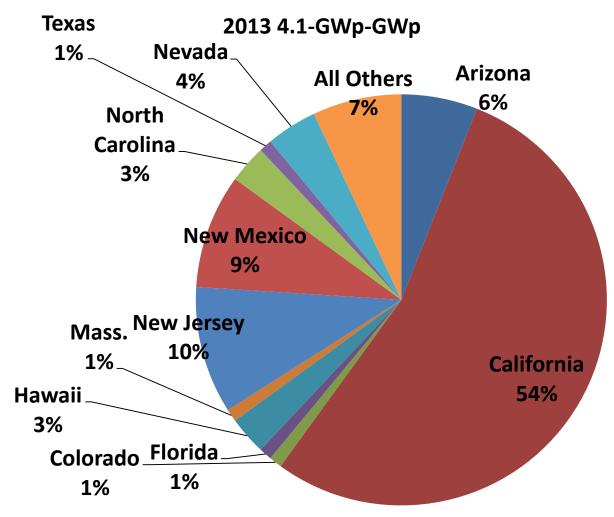
US State Demand Shares 2012

2012 2.7-GWp





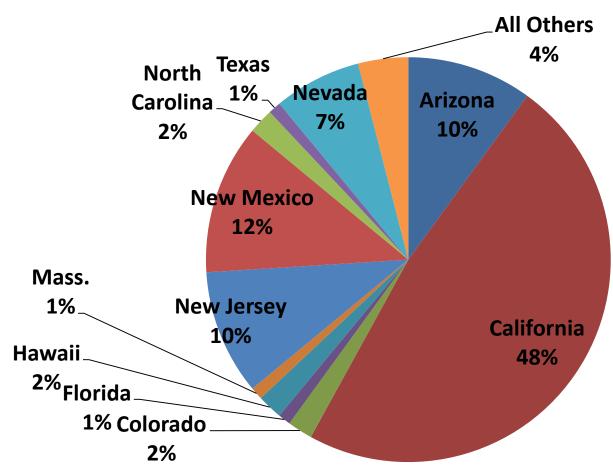
US State Demand Shares 2013





US State Demand Shares 2015







Prices the slippery slope downhill

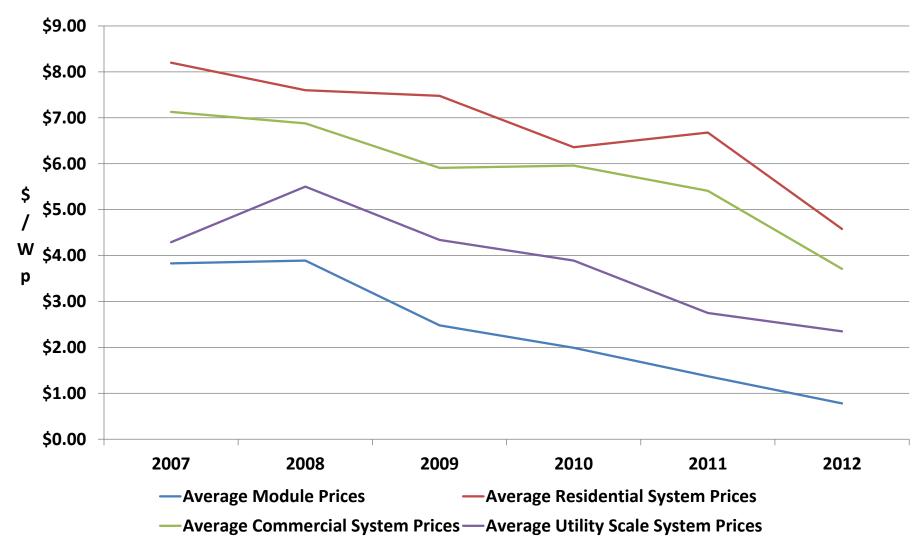


US Average prices for various metrics

2012 US Demand Metrics	p/kWp	p/kWh
Average Module Prices	\$0.77	
Average Residential System Price	\$4.35	
Average Commercial 1-100/kWp	\$3.22	
Average Commercial 100-500/kWp	\$3.01	
Average Commercial 500/kWp1/MWp	\$2.80	
300/KVV p 1/MVV p	Ψ2.00	
Average Multi Megawatt	\$1.87	
Average String Inverter	\$0.34	
Average Central Inverter	\$0.23	
Average Micro Inverter	\$0.56	
Average PPA		\$0.10
Average O&M (1)	\$0.12	
Average Labor Cost (2)	\$0.59	
Average Electrical/Hardware (2)	\$0.47	
Average Permitting (3)	\$0.24	

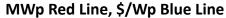


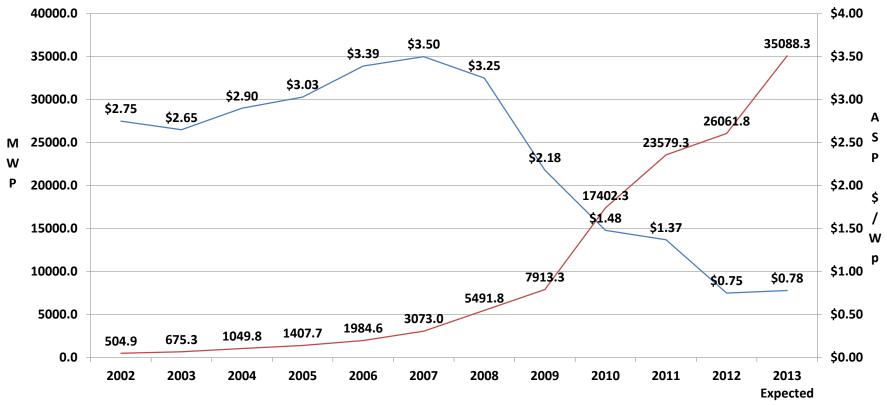
US Average prices for various metrics





Global Module ASPs and Shipments 2002 through 2013







And now a brief word about shipments (supply)



PV Industry Regional Shipment Shares, 1997 - 2012

							Total	
	U.S. %	Europe %	Japan %	ROW %	China %	Taiwan %	Shipments	Annual
Year	Total	Total	Total	Total	Total	Total	MWp	Growth
1997	42%	18%	25%	13%	1%	2%	114.1	38%
1998	38%	21%	27%	12%	1%	2%	134.8	18%
1999	32%	17%	39%	10%	1%	1%	175.5	30%
2000	30%	23%	38%	7%	1%	1%	252.0	44%
2001	27%	24%	41%	6%	1%	1%	352.9	40%
2002	19%	31%	42%	5%	0%	2%	554.9	57%
2003	14%	26%	52%	7%	0%	2%	675.3	22%
2004	13%	26%	52%	5%	1%	3%	1049.7	55%
2005	9%	29%	51%	5%	2%	3%	1407.7	34%
2006	7%	31%	44%	5%	8%	5%	1984.6	41%
2007	8%	32%	29%	5%	16%	9%	3073.0	55%
2008	7%	31%	22%	8%	20%	11%	5491.8	79%
2009	5%	18%	16%	14%	32%	14%	7913.3	44%
2010	6%	15%	12%	14%	37%	16%	17402.3	120%
2011	3%	7%	12%	15%	46%	17%	23579.3	35%
2012	3%	4%	12%	14%	48%	19%	26061.8	11%

It would be difficult for US manufacturing to recover



To sum up Economist Kenneth Boulding said: Anyone who thinks that exponential growth can go on forever in a finite world is either a madman or an economist.

I will go further ... anyone who thinks exponential growth can go on forever in a finite world AT A LOSS is perhaps mad, but definitely not an economist

Since 2004 the solar industry enjoyed extraordinarily strong growth. This growth was stimulated by the European FiT incentive model. This model led to innovation, and also to overheated markets. The current low prices are driving technology manufacturers into bankruptcy – growth that leads to failure is unhealthy.







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Market Realities and Policies



The United States is a country roughly half the size of Russia, about the same size as China, and fourteen times the size of France. The U.S. continues to struggle to emerge from recession, with the housing and building markets in a close to stagnant recovery and with housing foreclosures still complicating its recovery. The outcome of the 2012 presidential election could have a significant impact on incentives for and the implementation of renewables.

The U.S. has a population of 316.5-million (>4% of the global population), inflation of 1.96% (2012 inflation was 2.07%), per capita GDP (PPP) of \$49,965 in 2012, and unemployment of 7.6% as of August 2013, not counting discouraged job seekers and the underemployed. The U.S. is a wealthy, industrialized nation. An income of \$11,945 for one person is considered at the poverty line, with an income of \$23,681 for a family of four considered at the poverty line. In the US, on the order of 15% of the population is estimated as living below the poverty line.

Electricity rates in the US states vary, with residential rates range from an average of >\$0.37-Cents/kWh in Hawaii, to slightly less than \$0.084-cents/kWh in North Dakota. Table 4.5 provides an example of US average electricity rates. For California averages, from 2012 into 2013, residential electricity rates increased by 4%, commercial rates by 4%, industrial rates by 3% while transportation rates decreased by 6%.



PV deployment in the U.S. grew by a compound annual rate of 54% from 2007 through 2012. This strong growth is due to foundation state renewable portfolio standards (RPS), state incentives of various types (capacity based, FiT, SRECs, tax equity such as the ITC, and others), government and utility projects, business models (PPA and lease), the inexpensive price of modules and other components and frankly, the ongoing dedication of the US solar industry.

The US would be well served by a stable, federal incentive (similar to California's CSI), a federal carbon tax as well as a federal requirement for the deployment of renewable technologies. The potential for gigawatt level deployment on public lands (Bureau of Land Management, BLM) remains high. In some cases attempts to fast track projects on public lands have resulted in project setbacks when streamlined procedures failed to protect endangered species and uncover American Indian cultural burial grounds. In the US, federal law protects Indian cultural areas as well as endangered species.



3rd-Party PPA Policies: A solar power purchase agreement is simply a financial agreement whereby electricity is sold to a utility either from a host roof, land or investor/developer owned land. It is an instrument whereby electricity is bought and sold. Approximately 22 states as well as Washington DC and Puerto Rico allow PPAs. In these states investor owned utilities are typically purchasing the electricity. Not all municipals accept PPAs.

Solar Leases have become popular in the US but there is no standardization in escalation charges and other metrics. This instrument allows people to 'go' solar with a minimal upfront cost, but, overtime the monthly lease payments are a higher cost than purchasing the system up front, also, typically include charges for system removal and reinstall for roof repairs. Before leasing, the remaining life of the roof must be considered.

Modified Accelerated Cost Recovery System (MACRS) U.S. tax code dictates the period of time over which assets can be depreciated. The Modified Accelerated Cost Recovery Systems (MACRS) is a federal standard for the length of asset depreciation. The shorter the depreciation schedule the greater the incentive as investors/owners can write down a larger percentage of the eligible capital expenditure in the near term. Currently, solar assets can be depreciated over the course of five years. The Economic Stimulus Act of 2008 included a bonus whereby eligible RE systems placed in service in 2008 could be depreciated 50% in the first year with the balanced depreciated over the course of the ordinary MACRS schedule.



Clean Renewable Energy Bonds (CREBs) are zero interest bonds that pay investors returns through tax credits. The power to issue these bonds is vested with the Internal Revenue Service. CREBs can be used by state, local and tribal governments and electric cooperatives to raise capital for the construction of renewable generation and associated transmission assets. This instrument requires significant lead-time to apply for, and then monetize the bonds. Projects must be approved through an open IRS solicitation before the bonds are made available, a process that can take up to a year. This delay can be a significant barrier for projects financed through CREBs.

The Business Energy Tax Credit is one of a pair of tax subsidies commonly referred to as the Investment Tax Credit (ITC). Owners of a renewable energy generation facility can claim up to 30% of the invested capital as a tax credit in the year the system becomes operational or use the ITC as a grant. Only new or original equipment is eligible, second hand or re-powered technology is exempt from the credit. The extension of the ITC for commercial and residential solar electric systems remains very important to the continuing momentum in the U.S. market for solar, and as utilities can take advantage of the ITC, to encouraging the continued involvement of utilities. Use of the ITC as a grant was the driving force behind the multi-megawatt (utility scale) market in the US.



Loan Programs: The drawback for most energy consumers when considering a PV system purchase is the high upfront cost of installation. This is one reason for the popularity of solar leases. Forty one states offer loans for renewables.

Interconnection Policies: In order to use the utility grid as a battery, a grid-connected system owner must have an interconnection agreement with the utility. Forty-three US states as well as Washington DC and Puerto Rico allow interconnection. However, not all interconnection agreements are created equal and the queue connect can be long, potentially taking years for larger systems.

Net Metering Policies: The ability to net meter is as crucial as interconnection to the continued deployment of residential and commercial PV systems in the US. Most utility net metering programs have limits. These limits, of course, limit the potential of PV system deployment. With net metering the utility either credits or pays for the electricity that is fed into its grid. In some cases the utility absorbs the excess electricity, in some cases the utility rolls the excess over into another period and in some cases the system owner is paid a set rate for the excess electricity (similar in theory to a feed in tariff). Different utilities have limits as to how much electricity they will allow to be net metered. Forty three states, Washington DC and four territories allow net metering.

California's AB327 will do away with the cap on net metering but pass costs on to energy consumers.



PACE Financing Policies: Twenty nine states and Washington DC have enacted property assessed clean energy (PACE) programs. PACE is an assessment on a property, essentially a lien but similar to a loan, that provides a vehicle for a homeowner (traditionally) to install a PV system and repay the lien over a period of years as part of their property tax bills.

http://www.dsireusa.org/incentives/index.cfm?EE=1&RE=1&SPV=0&ST=0&searchtype=PTFAuth &technology=Photovoltaics&sh=1

Rebates: Simply, a rebate pays a system owner a certain amount per kilowatt installed. In the U.S., there are fifty states, one federal district, and a number of independent territories or tribal reservations. While federal powers supersede those of the states and other territories, there are still state and local tax codes, political assemblies, local government budgets, and regulatory frameworks that interact with, or modify, federal authority. States also exercise significant regulatory control over utilities within their jurisdiction, typically through the state public utility commission, (PUC). Sixteen states, Washington DC and two territories offer rebates for renewable installations.



State and Local Feed-in-Tariffs: US states did not immediately emulate the European FiT model, which is probably a good thing. In the U.S., Feed-in Tariffs are offered by various utilities and states, though some have yet to be implemented, while the FiTs currently active are also oversubscribed. A recent Federal Energy Regulatory Commission Ruling (FERC) ruling threatens to retard the spread of FiTs in the U.S. by inserting PURPA into the mix. The Public Utilities Regulatory Prices law (PURPA) was passed in 1978 by the U.S. Congress to encourage use of renewables by requiring utilities to buy electricity from RE sources at an avoided cost rate. Avoided cost refers to the price equivalent to what it would cost the utility to generate the electricity, or buy it from other conventional sources.

RPS Policies: Twenty nine states, Washington DC and two territories have renewable portfolio standards, RPS. An RPS is a mandate that requires the state's publically owned utilities to install a percentage of renewables in their territory, or, buy renewable generated electricity. RPS standards vary state by state. Typically, as states near the RPS requirement deployment slows, though this is not always the case. An RPS is an unfunded mandate requiring action. Rebate and other incentive programs are often set up to aid the utility in meeting its goal. The punitive actions a utility faces for noncompliance vary from state to state. Also, an RPS without a solar carve out (indicating how much of the mandate must be met with solar) has little ability to encourage utilities in the state to install solar.



Renewable Energy Credits are the non-electricity attributes of renewable energy generation, such as lower emissions or energy independence. Each REC is the equivalent of one MWh of renewable energy generation and conveys the right to the claim that the electricity one uses was generated at a specific renewable energy facility. Separating these attributes from the commodity electricity creates a separate fungible product that can be traded independently from the electricity generated.

RECs are used as compliance mechanisms in some state RPS markets. Utilities must generate or procure enough credits to meet their portfolio targets. RECs are also purchased by entities that do not have direct access to renewable electricity, as ownership of a REC grants one the claim that the energy being used or generated is from a specific renewable source.

Market prices for RECs range widely, as does ownership. In some cases, the utility retains ownership and in some cases, customers own the RECs. Compliance markets, where utilities must retire RECs to validate RPS obligations, typically command the highest prices. In voluntary markets, where commercial and residential customers are the primary participants the market clearing price is typically much lower. In some compliance markets, such as New Jersey, the value of RECs can be a significant incentive. However, the long-term value of a REC is uncertain, which can impose a significant financial risk on those business models that rely upon these instruments. To alleviate this concern some parties are able to secure long-term contract with set prices. These contracts can also act as a rebate, paying for future attribute production up front and helping offset the high initial cost of solar systems.