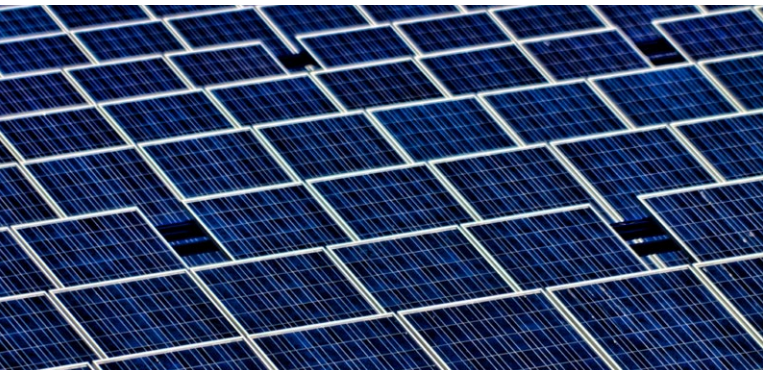
U.S. Solar MARKET TRENDS 2011

AUGUST 2012 *Larry Sherwood*

IREC
Interstate Renewable Energy Council



Photovoltaic array

U.S. Solar MARKET TRENDS 2011

Interstate Renewable Energy Council, Inc.
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EXECUTIVE SUMMARY

Solar markets are booming in the United States due to falling photovoltaic prices, strong consumer demand, and financial incentives from the federal government, states and utilities.

Photovoltaic trends:

- The capacity of photovoltaic (PV) installations completed in 2011 doubled compared to the capacity installed in 2010.
- PV capacity installed in 2011 more than doubled for larger systems in the utility sector and the non-residential sector. Residential capacity installed in 2011 grew by 24% compared with 2010. State renewable portfolio requirements are an important reason for the large growth in the utility sector.
- The amount of PV capacity installed in Arizona, California, Hawaii, New Jersey, New Mexico and New York in 2011 was at least double the capacity installed in each state in 2010. California remains the largest U.S. market, with about 29% of the U.S. capacity installed in 2011. This is consistent with California's market share in 2010, but represents a significant drop in market share from the 68% recorded five years earlier, in 2006.

Concentrating solar power trends:

- No new concentrating solar power (CSP) plants were connected to the grid in 2011, though several plants are under construction for completion in 2012 and later years.

Over the near term, the prospect for growth in solar installations is bright. Early indicators point to continued market growth in 2012 due to the federal solar investment tax credit (ITC), state renewable portfolio standards, and completion of installations begun by the end of 2011 in order to participate in the 1603 Treasury Grant Program. Companies have announced plans for many large solar electric projects, including both PV and CSP projects. Some of these projects are under construction and will come on-line between 2012 and 2016.

About the Interstate Renewable Energy Council, Inc.

The **Interstate Renewable Energy Council, Inc.** (IREC) is a non-profit organization accelerating the use of renewable energy since 1982. IREC's programs and policies lead to easier, more affordable connection to the utility grid; fair credit for renewable energy produced; best practices for states, municipalities, utilities, and industry; and quality assessment for the growing clean energy workforce through the credentialing of trainers and training programs. www.irecusa.org.

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INTRODUCTION

The solar market, while relatively young, is an increasingly important and vital part of the American economy. What are the trends in this market, and what forces are at work? Which sectors of the market are strongest, and why? What are the prospects for solar energy in the near future?

This report provides public data on U.S. solar installations by technology, state and market sector. Public data on solar installations help industry, government and non-profit organizations improve their efforts to increase the number (and capacity) of solar installations across the United States. Analysis of multi-year installation trends and state installation data helps these stakeholders learn more about state solar markets and evaluate the effectiveness of marketing, financial incentives and education initiatives.

Different solar energy technologies create energy for different end uses. This report covers solar technologies that produce electricity, including photovoltaics (PV) and concentrating solar power (CSP). Other solar technologies provide hot water, space heat, and space cooling, but are not included in this report.

Photovoltaic cells are semi-conductor devices that generate electricity when exposed to the sun. Manufacturers assemble the cells into modules, which can be installed on buildings, parking structures or in ground-mounted arrays. PV was invented in the 1950s and first used to power satellites. As prices declined, PV systems were installed in many off-grid installations — installations not connected to the utility grid. In the last decade, and especially in the last several years, grid-connected installations have become the largest sector for PV installations. Most of these installations are on the customer-side of the meter, although the last two years have seen an explosion of installations on the utility-side of the meter.

35 MW_{DC} utility installation for Austin Energy in Webberville, Texas

Concentrating solar power (CSP) systems use mirrors and collecting receivers to heat a fluid to a high temperature (from 300°F to more than 1,000°F), and then run the heat extracted from the fluid through a traditional turbine power generator or Stirling engine. CSP can also be paired with existing or new traditional power plants, providing high-temperature heat into the thermal cycle. These generating stations typically produce bulk power on the utility side of the meter rather than generating electricity on the customer side of the meter. CSP plants were first installed in the United States in the early 1980s, and installations continued through the early 1990s. Although many of these installations still generate power today, until recently, few new systems had been installed since the early 1990s. Installations have resumed, with one large plant constructed in 2010 and a significant number of announcements for new plants projected to be completed between 2012-2015. In another application, concentrating solar thermal can provide high temperature solar process heat for industrial or commercial applications. A few systems are installed each year using this technology.

For all solar technologies, the United States is only a small part of a robust world solar market. Product availability and pricing generally reflect this status. Globally, Germany is the strongest market for PV and Spain is the top market for CSP. In North America, Ontario, Canada, ranks as one of the largest PV markets and is discussed briefly in Section 2. (Other than Ontario's market, this report does not analyze markets outside the United States.)

The data-collection methods and the assumptions used in this report are described in detail in Appendices A and B.

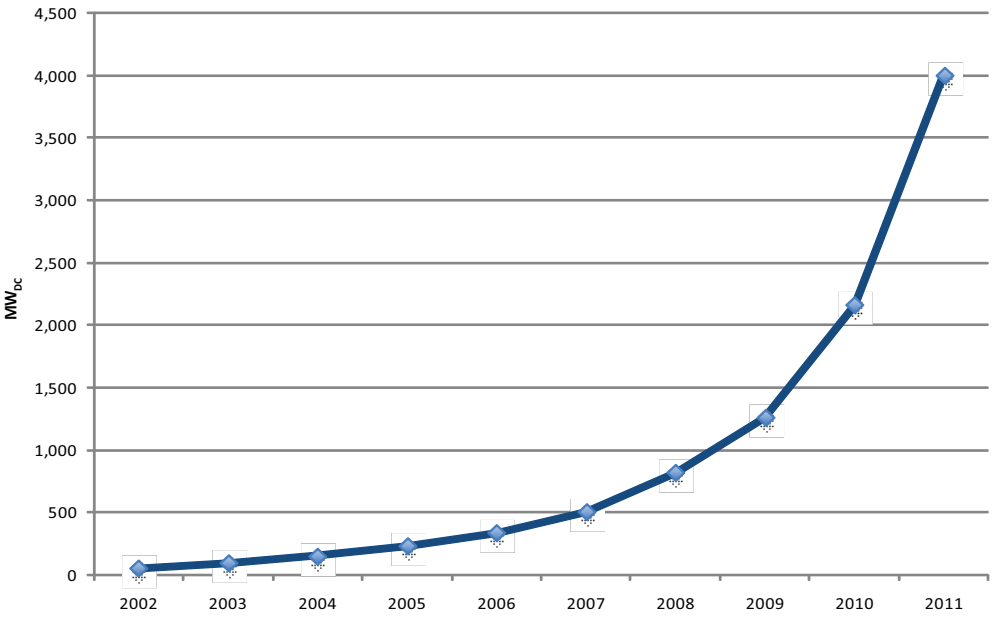
PHOTOVOLTAICS

Overall Trends in Installations and Capacity

Solar enjoyed another banner year in 2011, with large increases in both the number and average size of PV installations. The capacity of PV installations in 2011 more than doubled, compared with 2010 installations. More utility-scale systems and an increase in the average system size accounted for this dramatic growth. The total installed capacity of utility and non-residential systems increased by 145% and 132% respectively compared with 2010. Residential installations only grew by 24% on a capacity basis. The average size of all PV installations grew 64% in 2011, to 29 kW_{DC} compared with an average size of 18 kW_{DC} in 2010.

The cumulative installed grid-connected PV capacity increased to 4 GW_{DC} (see Figure 1). The capacity of PV systems installed in 2011, 1,845 MW_{DC}, was more than ten times the capacity of PV installed in 2007, just four years earlier. In 2011, 324 MW_{DC} were installed on residential buildings, 822 MW_{DC} at non-residential sites and 698 MW_{DC} in the utility sector (see Figure 2).

Figure 1: Cumulative U.S. Grid-tied Photovoltaic Installations (2002-2011)



Some PV installations are off-grid and are used to power facilities that are too expensive to interconnect to the grid, such as cabins, telecommunications facilities, and road signs. Based on anecdotal information, the size of this market is very small compared with grid-connected installations. IREC has not collected data for these off-grid installations, and they are not included in this report's charts.

More than 64,000 grid-connected PV installations were completed in 2011, a 30% increase over the number of installations in 2010. Residential systems accounted for 88% of these installations (see Figure 3). By contrast, residential systems accounted for only 24% of the PV capacity installed in 2011, as discussed previously. At the end of 2011, nearly 220,000 PV installations were connected to the U.S. grid, of which 188,000 were residential installations.

The average size of grid-connected PV installations varies from state-to-state, depending on available incentives, interconnection standards, net metering regulations, solar resources, retail electricity rates, and other factors. The Interstate Renewable Energy Council provides summary tables of state net metering and interconnection policies (see references at end of report), and the Database of State Incentives for Renewables & Efficiency (DSIRE) provides summary tables of state and utility financial incentives (DSIRE 2012).

In 2011, photovoltaic installations were 7% of new electricity generation installed that year. In 2010, photovoltaic installations were 4% of new additions. The electricity generated by photovoltaic and CSP installations were 0.12% of all electricity generation in the U.S. during 2011.

The following factors helped drive PV growth in 2011:

- There was stability in federal tax credits. Tax credits for both residential and commercial installations are currently in place through 2016. Developers and installers can plan and market their products and consumers can make rational decisions without arbitrary incentive deadlines.
- In February 2009, as part of the American Recovery and Reinvestment Act (ARRA), Congress enacted the U.S. Treasury Grant in Lieu of Tax Credits Program. This program, commonly known as the 1603 Treasury Grant Program, provides commercial installations with the alternative of a cash grant instead of the tax credit. The Program was originally scheduled to expire at the end of 2010, but was extended through the end of 2011. This expiration caused many projects to begin construction late in 2011 to qualify for the program, with completion scheduled in 2012 or later. Congress could decide to re-instate the 1603 Treasury Grant Program, though those prospects are uncertain at best. In 2011, 2,235 completed projects were awarded $795 million in cash grants (Treasury 2012). This is more than double the number in 2010 and represents 29% of all non-residential and utility sector installations. Solar projects received 17% of 1603 Treasury Grant funding in 2011. Most such funding went to wind projects.
- State renewable portfolio standard (RPS) requirements are encouraging investments in utility-scale solar plants. Utility sector investments increased by 2-1/2 times in 2011 compared to 2010, and this sector seems poised to continue its rapid growth over the next several years. In some states, RPS requirements have led to solar renewable energy credit (SREC) markets, which in turn have resulted in increased demand for and installation of distributed solar installations. In some states, SREC prices fell in 2011 and this could reduce future installations. Of the 2011 Annual Top Ten States (see Table 2), eight have RPS requirements.
- State financial incentives continue to be an important factor, especially for residential and commercial distributed installations. Of the 2011 Top Ten States (see Table 2), nine have state or utility rebate programs, though the magnitude of the impact of these rebates varies greatly from state to state. In general, rebates per watt have decreased as the cost of a PV installation has decreased. The federal incentives are important, but they are generally insufficient to create a market by themselves.
- The price of PV modules declined. Based on cost data for a sample of 2011 installations, total installed cost dropped by 14% for residential installations and 20% for non-residential installations. The actual cost decline was likely even larger.

Figure 2: Annual Installed Grid-Connected PV Capacity by Sector (2002-2011)

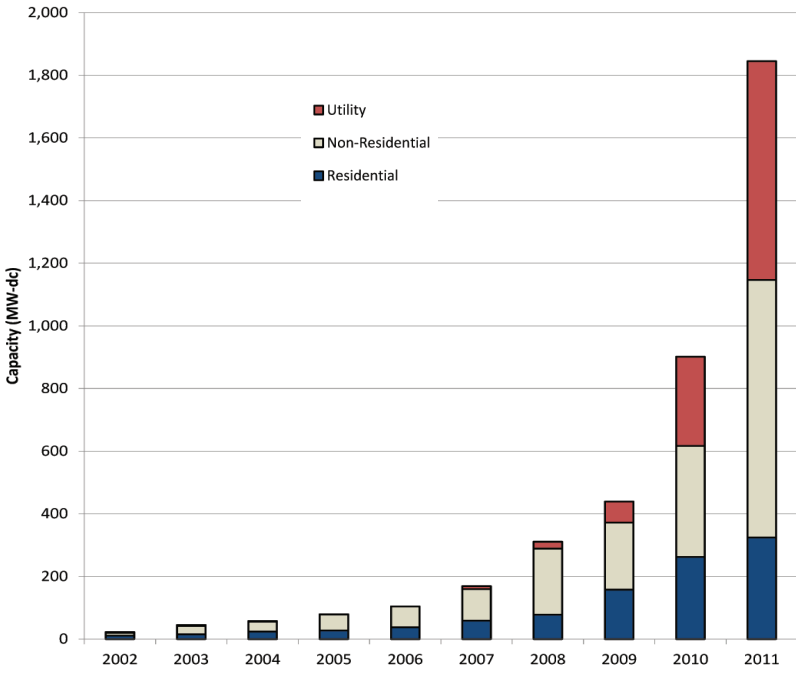
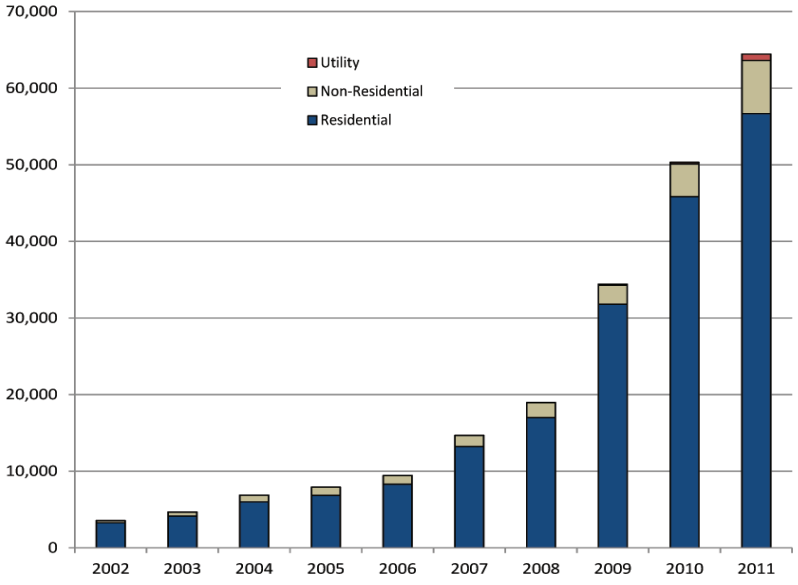


Figure 3: Number of Annual U.S. Grid-Connected PV Installations (2002-2011)



Grid-Connected Installations by Sector

The growth rate of grid-connected PV varied by market sector: residential, non-residential and utility. Distributed installations are on the customer's side of the meter and produce electricity used on-site and include both residential and non-residential facilities. Examples of non-residential facilities are government buildings, retail stores and military installations. In contrast, utility installations are on the utility's side of the meter and produce bulk electricity for the grid. Table 1 shows examples of installations in each sector.

Table 1: SAMPLE INSTALLATIONS BY SECTOR

Sector	Example Installations
Residential	● Residential installation owned by homeowner or building owner; electricity generated is used on-site ● Residential installation owned by third party, with electricity sold to the homeowner or building owner
Non-Residential	● Non-residential installation owned by building owner; electricity generated is used on-site ● Non-residential installation owned by third party, with electricity sold to the building owner and used on-site
Utility	● Installation owned by utility; electricity generated goes into bulk power grid ● Installation owned by third party; electricity generated goes into bulk power grid ● Installation owned by building owner; electricity generated goes into bulk power grid through a feed-in tariff or similar incentive

Utility-Sector Installations

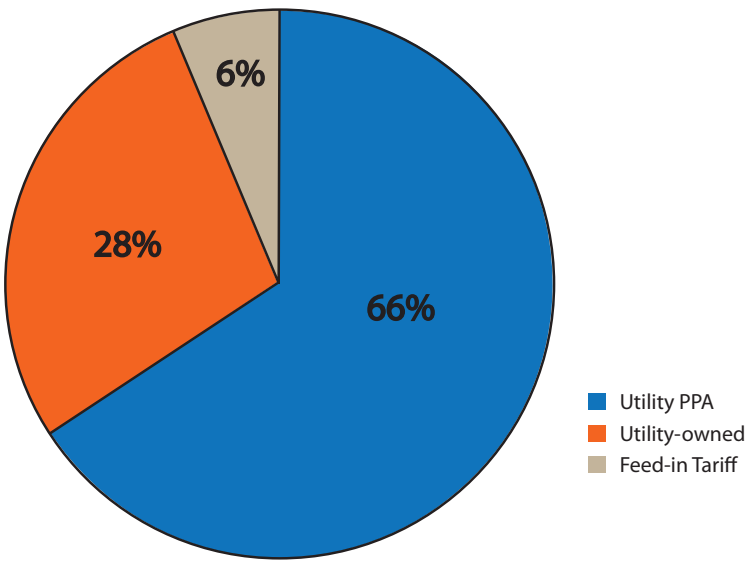
Utility-sector PV installations more than doubled in 2011 compared to 2010. The utility sector's share of all U.S. grid-connected PV installations grew from virtually none in 2006 to 15% in 2009, to 32% in 2010, and to 38% in 2011. Of the 10 largest PV installations in the United States, five were installed in 2011. In 2011, 81 utility-sector installations larger than 1 MW_{DC} were installed with a total capacity of 640 MW_{DC}. These large installations were 92% of the utility-sector installations in 2011.

The two largest U.S. PV installations installed in the U.S. in 2011 were the 49 MW_{DC} Mesquite Solar 1 Plant in Arlington, Arizona, which supplies power to Pacific Gas and Electric Co. customers in northern California, and the 35 MW_{DC} plant in Webberville, Texas, which supplies power to Austin Energy.

State RPS requirements with solar carve-outs are encouraging investments in utility-scale solar plants in some states. In 2011, 626 MW_{DC} or 90% of the utility-sector installations are in states with RPS requirements. Federal tax incentives, grants and the lower cost of PV modules also made these investments attractive. Construction began in 2011 on many additional utility-sector installations, and utilities and developers have announced plans for even more projects to be built in the next few years. Installations in this sector seem poised for continued growth.

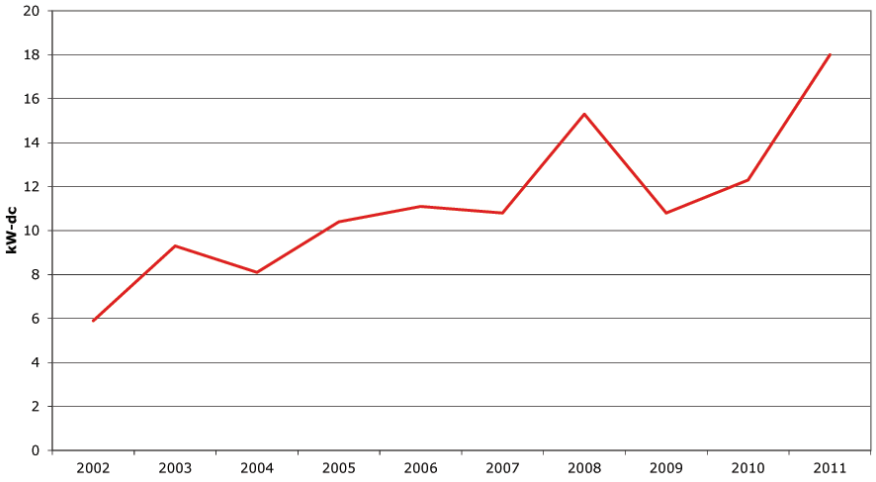
Figure 4 shows the ownership status of utility-sector installations. About two-thirds of these installations utilize utility power purchase agreements (PPA). In this arrangement, a third-party builds and owns the PV facility and the electricity is sold to a utility, through a long-term power purchase agreement. Most of the remaining installations are owned by utilities. More than 99% of the utility-sector installations owned by utilities are owned by investor-owned utilities. This is because federal tax incentives are available to investor-owned utilities, which are tax-paying corporations, and not available to tax exempt entities such as public utilities.

Figure 4: Ownership Status for 2011 Utility Sector PV Installations



About 6% of the utility-sector installations are through feed-in tariff programs or similarly structured programs. In these programs, the utility pays the customer for the PV electricity produced and then sells the electricity as part of their regular electricity sales. These are defined as utility-sector installations because the electricity serves utility customers generally rather than the customer where the installation is located. However, the size of these installations is more similar to the size of distributed installations with an average size of 54 kW_{DC}. By contrast, the average size of the other utility-sector installations is 4,600 kW_{DC}.

Figure 5: Average Capacity of Distributed Photovoltaic Installations (2002-2011)



Distributed Installations

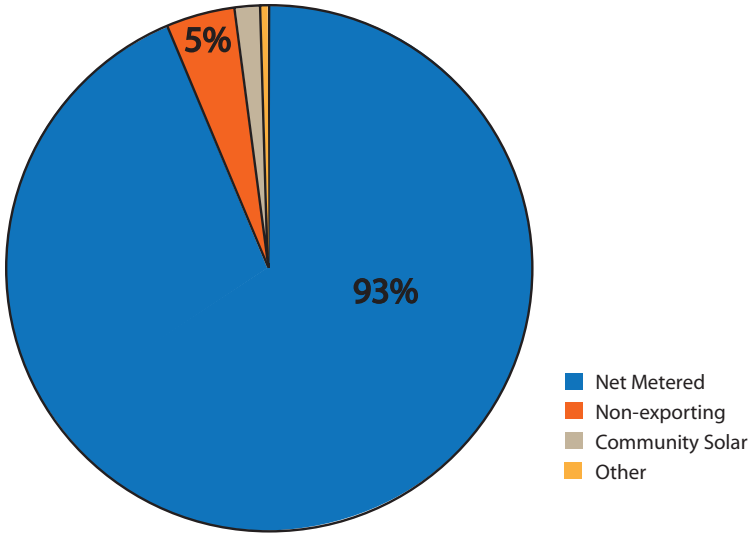
Distributed installations provide electricity for use at the host customer's site, like a home or business. In 2011, the amount of distributed grid-connected PV capacity installed annually in the United States doubled to 1.3 GW_{DC}. More than 64,000 distributed PV systems were installed in 2011, a 24% increase over the number of distributed PV systems installed in 2010. The distributed growth was heavily concentrated in larger, non-residential installations. The average size of distributed installations increased by 46% to 18 kW_{DC} (See Figure 5).

The capacity of non-residential sector installations, which includes sites such as government buildings, retail stores and military installations, increased by an astounding 236% in 2011 compared with 2010 (see figure 2). The average size of a non-residential distributed installation grew by 43%. The largest installations in 2011 in this sector were a 9 MW_{DC} installation at Gloucester Marine Terminal in Gloucester City, New Jersey, and a 6 MW_{DC} installation at the U.S. Air Force Academy in Colorado Springs, Colorado. Favorable economics for consumers and a rush to complete installations before the expiration of the 1603 Treasury Grant Program at the end of 2011 fueled this explosive growth.

The 1603 Treasury Grant Program expired at the end of 2011. This expiration caused many projects to begin construction late in 2011 to qualify for the Program. Projects begun in late 2011 will be completed in 2012 or later.

In contrast to the explosive growth in non-residential PV installations, the number of residential installations increased by 21%, accounting for only 16% of all PV capacity in 2011 (See Figure 2). While still very healthy, this growth rate is the lowest for any of the PV market segments. Federal incentives for residential installations remained stable in 2011, and incentive levels are set through 2016. Stable incentives encourage more homeowners to purchase solar. In addition to federal incentives, most residential installations occur in states with state or local incentives. Because the tight economy makes large capital purchases more difficult for many Americans, the residential sector has seen a large shift toward leases or third-party power purchase agreements over the past several years. For example, in the California Solar Initiative, the percentage of residential systems owned by a third-party has increased from 7% in 2009 to 25% in 2011. The average size of a residential PV system was unchanged in 2011 and remains 5.7 kW_{DC}.

Figure 6: Generation Status for 2011 Distributed PV Installations



In 2011, more than 93% of the distributed PV installations were net-metered as shown in Figure 6. In a net-metered system, electricity provided by the customer to the utility can be used to offset electricity purchased from the utility. The rules governing net metering transactions vary widely from state-to-state and utility-to-utility. In states where net-metering data was unavailable, IREC assumed that systems meeting the local rules for net-metered systems were net-metered. About 5% of the distributed PV systems are non-exporting, meaning that all of the solar generated electricity is used on the customer's site.

About 1.5%, or 17 MW_{DC} of distributed PV systems use a Community Share Solar model. A Community Share Solar installation is a facility interconnected to the utility distribution system and the electricity generated is credited to subscribers of the installation. Community share solar allows customers who are otherwise unable to have a solar system, such as renters or property owners with poor solar access, to receive solar electricity.

Grid-Connected Installations by State

In 2011, more than two-thirds of grid-connected PV system installations were concentrated in California, New Jersey, Arizona and New Mexico, as shown in Table 2. Of the 2011 Top Ten States, Arizona had the highest growth, with more than 4-1/2 times as many installations as the year before. The capacity installed in 2011 more than tripled in New Mexico and New York, and more than doubled in California, New Jersey and Hawaii. New York and Hawaii rejoined the Top Ten States list this year.

With the exception of Texas, all states on the 2011 Top Ten States list have strong state renewable portfolio or financial incentive programs or both. Texas made the 2011 Top Ten States list because of the 35 MW_{DC} utility installation constructed for Austin Energy. Nevada, which was ranked #3 last year, fell from the Top Ten this year. Nevada has a small number of large installations in 2010 and did not have any such installations in 2011. However, large installations are under construction and planned, so we can expect to see Nevada return to the Top Ten in the future.

Although the market remains concentrated in a few states, the number of states with significant markets is slowly increasing. On a per capita basis, six states — Arizona, Colorado, Delaware, Hawaii, New Jersey and New Mexico — had more installations than California in 2011, demonstrating how the market is diversifying across the country. On a cumulative basis, New Mexico, New Jersey, Hawaii, Arizona, and Nevada each now have more per capita installed capacity than California. (See Table 4)

Table 2: 2011 TOP TEN STATES
Ranked by Grid-Connected PV Capacity Installed in 2011

2011 Rank by State	2011 (MW_{DC})	2010 (MW_{DC})	10-11 % change	2011 Market Share	2010 Rank
1. California	537.8	255.6	110%	29%	1
2. New Jersey	306.1	132.4	131%	17%	2
3. Arizona	287.8	63.6	352%	16%	4
4. New Mexico	122.1	40.9	199%	7%	7
5. Pennsylvania	78.2	46.5	68%	4%	6
6. Colorado	75.5	62.0	22%	4%	5
7. New York	68.3	21.6	217%	4%	11
8. Texas	51.1	25.9	97%	3%	10
9. North Carolina	45.5	28.7	59%	2%	9
10. Hawaii	40.5	18.5	119%	2%	14
All Other States	232.0	208.5	11%	13%	--
Total	1,844.9	904.1	104%	--	--

2010 and 2011 columns include installations completed in those years. "2011 Market Share" means share of 2011 installations.
"2010 Rank" is the state ranking for installations completed in 2010.

Incentives by State

Solar electric market activity has more to do with state incentives and policies than with the amount of available sunlight or solar resource. Most of the top states for grid-connected PV offer financial incentives and/or have an RPS policy with a solar mandate. The combination of state and/or local incentives and the federal ITC created strong markets for most of the installations around the country. There are relatively few installations in locations with no state, utility or local incentives or with no RPS policy that includes a solar mandate. This section describes the incentives offered in the states with the largest number of installations.

Table 3: CUMULATIVE TOP TEN STATES Ranked by Grid-Connected PV Cumulative Installed Capacity through 2011

	MW_{DC}	Market Share
1. California	1,564	39%
2. New Jersey	566	14%
3. Arizona	398	10%
4. Colorado	197	5%
5. New Mexico	165	4%
6. Pennsylvania	133	3%
7. Nevada	124	3%
8. New York	124	3%
9. Florida	95	2%
10. Texas	86	2%
All Other States	560	14%
Total	4,011	--

Table 4: PER CAPITA TOP TEN STATES Ranked by Cumulative Installed PV Capacity per Capita (W_{DC}/person) through 2011

	Cumulative through 2011 (W_{DC}/person)	2011 Installations (W_{DC}/person)
1. New Mexico	80.4	59.3
2. New Jersey	64.4	34.8
3. Hawaii	62.6	29.7
4. Arizona	62.2	45.0
5. Nevada	45.9	7.2
6. California	42.0	14.4
7. Colorado	39.1	15.0
8. Delaware	29.4	23.2
9. District of Columbia	19.3	11.9
10. Vermont	18.7	12.4
National Average	13.0	6.0

In 2007, **California** launched its 10-year, $3 billion *Go Solar California* campaign. The largest part of this campaign is the California Solar Initiative (CSI), overseen by the California Public Utilities Commission (CPUC). The CSI awards rebates and performance-based incentives for customers serviced by the state's three investor-owned electric utilities: Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric. With $307 million in CSI incentives, more than 300 MW_{DC} of PV was installed in 2011 through this program.[1] These incentives are based on actual system performance for larger systems and expected system performance for smaller systems. Incentive levels are reduced over the duration of the program in 10 "steps," based on the aggregate capacity of solar installed. Because of these step reductions, the incentives paid by the program decreased in 2011, but the capacity installed through the program increased. The CSI was prudently designed as a 10-year program, so the industry in California can rely on long-term policy stability. The program is now in Steps 8 through 10 depending on the utility and sector and will reach the end in some sectors this year. CSI payments are becoming insignificant and some people are not even bothering to apply for the few hundred dollars available for a small residential system. California's steep tiered rate schedule and large peak period time-of-use rates appear to be enough to drive a market.

In addition, the California Energy Commission (CEC) administers the New Solar Home Partnership Program for PV installations on new homes, and the CPUC manages the Multi-Family Affordable Solar Housing and the Single-Family Affordable Solar Housing Programs.

Beginning in 2008, California required municipal utilities to offer solar incentives. Installations in municipal utility service territories in California totaled over 98 MW_{DC} in 2011, more than double the 2010 installations. A number of municipal utilities have offered incentives for many years, and the larger municipal utilities in Sacramento and Los Angeles have installed a large number of PV systems over the past decade or more.

In addition, California has an RPS requirement of 20% by 2013 and 33% by 2020. This includes all renewable technologies

1 Note that California agencies typically report in MW_{AC} and the data are presented here in MW_{DC}.

and partially inspired some PV installations in 2011. This requirement led to 177 MW_{DC} of utility sector installations in California in 2011 plus an additional 49 MW_{DC} at an installation in Arizona where the electricity produced flows to California. The RPS requirement will lead to more utility-sector solar installations in future years.

In **New Jersey**, an RPS with a solar requirement built a strong PV market. The solar requirement is 306 GWh in 2011 increasing to 5,316 GWh in 2026. In the early years of the New Jersey program, rebates were the most important driver for solar installations. Rebate expenditures peaked in 2006 at $78 million. In 2011, rebate expenditures were $14 million for 13 MW_{DC} of installations. This is less than half the capacity of installations supported with financial incentives in 2010. Now, for larger installations, the capacity-based rebate program has been converted into a performance-based incentive that involves payments based on the actual energy production of a PV system. This performance-based program created a market for solar renewable energy credits (SRECs), which New Jersey utilities use to comply with the RPS. In 2011, new installations with a combined capacity of 294 MW_{DC} were selling SRECs, representing 96% of new installations in New Jersey. New Jersey installations continue to grow in 2012. Through April 30, 2012 installed capacity is triple the installed capacity for the similar period in 2011.

Arizona's solar policy has evolved over the past several years. The current requirement is that 15% of electricity generated come from renewable sources by 2025. Distributed generation must provide 30% of this energy, divided equally between residential and non-utility, non-residential installations. Solar water heaters may also provide RECs for RPS compliance in Arizona. The current program has resulted in the tripling of annual installed capacity in each of the past two years. Arizona (along with California, Nevada, Colorado and New Mexico) is a very favorable site for future utility-scale PV and CSP plants, and a number of such future plants have been announced.

New Mexico has a renewable portfolio standard, which requires 20% of retail sales from renewables by 2020 for investor-owned utilities and 10% for rural electric cooperatives by 2020. The standard includes interim steps and a requirement that investor-owned utilities meet their target through a "fully diversified renewable energy portfolio," which includes at least 20% solar among other requirements. Fifteen utility scale installations with a combined capacity of 110 MW_{DC} were built in 2011 to meet these regulations.

Installation on building at the University of Colorado - Boulder

Pennsylvania offers rebates for PV and solar thermal systems through the *Pennsylvania Sunshine Solar Rebate Program* funded with $100 million in state bonds. The program began in May 2009 and rebate levels have declined over the life of the program. The program is currently operating under a waiting list system, where rebates will be granted only if additional funding is received. Both 2010 and 2011 will see the most installations through this program.

In 2005, **Colorado** voters passed Amendment 37, which created an RPS with a solar mandate equal to 0.4% of retail electricity sales. Later, the legislature doubled the overall RPS requirements and the solar mandate. The current requirement is 3% distributed generation by 2020 with half of that total serving retail customers. Xcel Energy is by far the largest utility in the state; more than 85% of Colorado's PV installations in 2010 were part of Xcel's programs. Xcel offers capacity-based rebates for smaller, customer-sited PV systems. For these systems, part of the capacity credit involves a purchase of the renewable energy credits (RECs) for 20 years, based on expected

Two utility installations totaling 38 MW_{DC} in Brookhaven, New York

performance. For larger PV systems, Xcel purchases the RECs based on actual energy production.

For a long time, **New York** has had significant rebate programs operated by the New York State Energy Research and Development Authority (NYSERDA) and the Long Island Power Authority (LIPA). In addition to these programs, BP Solar built two large utility installations with a combined capacity of 37.6 MW_{DC}. The owners of these systems have long-term PPAs with LIPA for this power.

Texas made the 2011 Annual Top Ten State list primarily due to the single large 35 MW_{DC} utility sector installation for Austin Energy. A number of utilities offer rebates for distributed installations, but the number of installations through these programs is not large compared with other top states.

North Carolina has a renewable portfolio standard requiring 0.2% from solar by 2018. Some utilities purchase renewable energy credits from PV installations and some provide rebates.

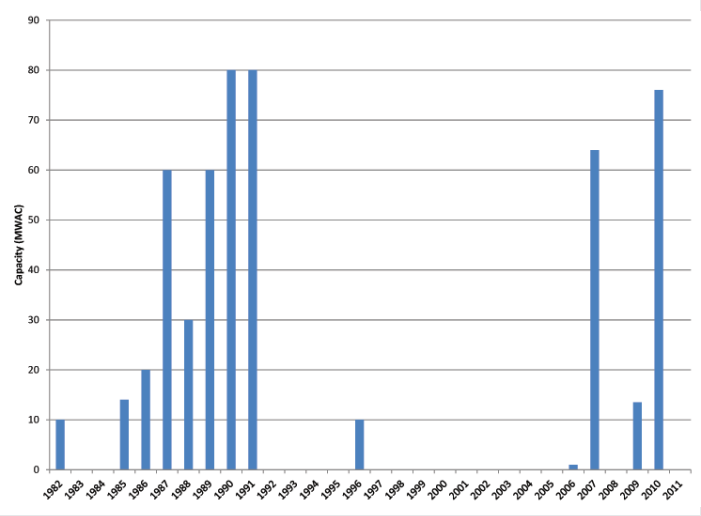
Hawaii has the highest electricity rates in the country and a state solar tax credit. Hawaii also has an established local solar industry that is perceived as credible. The financial benefits of PV are often more favorable in Hawaii than in any other U.S. state. These factors have made Hawaii one of the top states in per-capita solar installations for the past several years.

Although this report covers U.S. installations, the market across the border in the province of **Ontario, Canada**, is also noteworthy. In 2011, Ontario installations added a total of about 270 MW_{DC}. If Ontario were a U.S. state, it would have ranked fourth on IREC's list of states. A feed-in tariff program that begun in 2008 jump-started the burgeoning Ontario market.

CONCENTRATING SOLAR POWER

No new concentrating solar plants were completed in 2011. Several different companies have announced plans totaling over 10,000 MW of generating capacity, and about 1,000 MW was under construction at the end of 2011. These plants will be completed over the next few years. The dropping cost of PV has put pressure on CSP plants and at least one plant announced it will use PV instead of CSP.

Figure 6: Annual Installed U.S. CSP Capacity (1982-2011)



Commercial photovoltaic installation on commercial building and parking shade structure in San Ramon, California

PROSPECTS FOR 2012

What can we expect in U.S. solar markets this year? As of June 2012, indicators pointed to continued growth in grid-connected PV, and the continuation of the 2011 trend of higher growth rates for larger installations. Reductions in PV module prices, continuation of the federal investment tax credit and strong state RPSs will help drive market growth.

Many large solar projects began construction in 2011 in order to take advantage of the 1603 Treasury Grant Program. Most of these installations, both distributed and utility-sector projects, will be completed in 2012 through 2016. Since projects that begin construction in 2012 will no longer have the cash grant option, developers will need to find entities, such as banks and insurance companies, with tax bills large enough to take advantage of remaining tax credits.

Prices for PV installations fell at least 14% in 2011, and all indicators point to a continued decline in 2012. Lower PV prices raise the potential for installations in states without state or local incentives. The number of states with strong solar markets is increasing, although installations in 2012 will continue to be concentrated in states with strong solar policies.

Installation on building at Texas State Technical College Harlingen

Residential photovoltaic installation in Lafayette, Colorado

CONCLUSION

Photovoltaic markets continue to grow in the United States. More than 1.8 GW_{DC} of photovoltaic installations were completed in 2011 at 64,000 sites. The capacity installed was more than twice the amount installed in 2010. The markets for each solar technology are concentrated in a few states. These markets depend on the combination of federal and state policies and financial incentives, the most significant of which include:

- Federal Investment Tax Credit
- U.S. 1603 Treasury Grant Program
- State Renewable Portfolio Standards with solar requirements
- State, utility or local rebates or other financial payments
- State or utility net metering.

PV installations are getting larger. The average size of a distributed PV installation grew by 46%. The average size of a utility-sector installation (excluding feed-in tariffs) grew by 2-1/2 times to 4,620 kW_{DC}. At the same time, the price of PV installations fell by at least 14% in 2011.

U.S. PV market growth will continue in 2012, with larger utility-sector projects leading the way.

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DISCLAIMER

PHOTO CREDITS:

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Commercial photovoltaic installation at vineyard in New York State
Photo courtesy of Renewable Rochester, Jordan Energy, and Penguin Bay Vineyards

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Photovoltaic array
Photo courtesy of Mike VandeVen Jr.

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35 MW_{DC} utility installation for Austin Energy in Webberville, Texas
Photo courtesy of Austin Energy

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Installation on building at the University of Colorado – Boulder
Photo courtesy of Lighthouse Solar. Photo by Topher Donahue

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Long Island Solar Farm – two utility installations totaling 38 MW_{DC} in Brookhaven, New York
Photo courtesy of Long Island Power Authority

Page 11 lower
Commercial photovoltaic installation on commercial building and parking shade structure in San Ramon, California
Photo courtesy of SunPower

Page 12 upper
Residential photovoltaic installation in Lafayette, Colorado
Photo courtesy of Lighthouse Solar

Page 12 lower
Installation on building at Texas State Technical College Harlingen
Photo courtesy of Meridian Solar

Page 14
Commercial solar installation at Broomfield, Colorado Police Training and Detention Facility.
Photo courtesy of Bella Energy

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Residential photovoltaic installation in Laguna Beach, California
Photo courtesy of Lighthouse Solar

APPENDIX A
DATA SOURCES

Grid-Connected Photovoltaics

State data were obtained for grid-connected photovoltaic (PV) installations from the following sources:

- State agencies or organizations administrating state incentive programs
- Utility companies

GreenTech Media, in cooperation with the Solar Energy Industries Association, now collects solar installations data on a quarterly basis (GTM/SEIA 2011). The Solar Electric Power Association publishes an annual report on installation by utility that is based on an annual utility survey. For 2010 and 2011, IREC collaborated with both of these other installations reports and exchanged data. This collaboration resulted in better and more extensive installation data than in past years. With the growth of the PV market, data collection becomes more complex and multiple sources help improve data quality.

The data quality depends on the source. Certainly, this study misses some installations. Data based on incentives paid are usually the most reliable. Since grid-connected PV is the technology most reliant on incentives, the state-by-state installation data for grid-connected PV are the best.

Off-Grid Photovoltaics

IREC did not collect data for these installations and they are not included in this report's charts.

Solar Heating and Cooling

Previous editions of this report included data for solar heating and cooling installations. However, this year's report does not include this data.

Commercial solar installation at Broomfield, Colorado Police Training and Detention Facility.

APPENDIX B
ASSUMPTIONS

Solar Capacity

Capacity measures the maximum power that a system can produce. For a solar energy system, the capacity is the output under "ideal" full sun conditions. Capacity is typically measured in watts (W) or kilowatts (kW). A kilowatt of one technology usually does not produce the same amount of energy, commonly measured in kilowatt-hours (kWh) for electricity, as a kilowatt of another technology. Thus, capacity for one energy technology is not directly comparable to the capacity for another technology.

Occasionally, data are only reported in terms of capacity or the number of installations, but not both. In these cases, typical data from other sources are used to obtain both pieces of data.

Photovoltaics

This study reports PV capacity in direct current (DC) watts under Standard Test Conditions ($W_{DC\text{-}STC}$). This is the capacity number that manufacturers and others typically report; it is also the basis for rebates in many states.

A number of states and utilities report capacity in alternating current (AC) watts. The California Energy Commission calculates AC watts by multiplying DC watts under PVUSA Test Conditions by the inverter efficiency at 75% of load. The resulting capacity ($W_{AC\text{-}PTC}$) is a more accurate measure of the maximum power output under real world conditions.

The California Solar Initiative (CSI) reports installation capacity in both DC and AC watts. Therefore, the average ratio between AC and DC watts can be determined for each year. According to the CSI data in 2007, AC watts were 84% of DC watts. In 2008, the ratio was 85.5%, and in 2009 the ratio was 86.2%. In cases where the data reported to IREC was in AC watts, IREC used the CSI ratios to convert the data to DC watts.

Number of Installations

For grid-connected PV installations, this study uses actual data on the number of installations. For the data, which show residential and non-residential installations, real data are used whenever possible. For data sources which only report the size of the installations, this study assumes all installations less than 10 kW_{DC} are residential installations. Analysis of data from the California Solar Initiative (CSI), which do include both residential and commercial data, indicates that the 10 kW_{DC} assumption probably underestimates the number of residential installations. In the CSI program, about 20% of the residential installations by capacity are larger than 10 kW_{DC}. The number of non-residential installations smaller than 10 kW_{DC} is considerably smaller.

The results for cumulative installations include all new installations 20 years or longer. No accounting was made for systems that are no longer operational.

Date of Installation

This report uses the best data available on the date of installation. Ideally for grid-connected PV installations, this is based on the date when the installation was connected and producing power.

In some cases, data are available for when the applicant finished the installation and applied for the incentive payment. When this information is available, it was used as the installation date.

In many cases, the agency that administers an incentive program reports the date on which the incentive payment was made. This is the date used for the installation date in past editions of this report. This is usually a month or more after the installation was complete. However, if these are the only data available, this is the installation date used in this report.

Calendar Year (CY) is used as the year basis for all data. When data is reported on a Fiscal Year (July 1 – June 30), this report assumes that half of the installations are in the first CY and half are in the second CY.

Solar and Other Electrical Generation

The data on the solar capacity additions compared with all electrical capacity additions and the data on electricity produced use general electricity data from the Energy Information Administration (EIA) (EIA2011 and EIA2012), as solar EIA only reports larger utility sector solar installations. The solar data was adjusted using data from this report. Electricity generated from PV installations was assumed to be 1400 MWH/MW.

Changes from Last Year's Report

This edition of this report uses the best available data for all years at the time of publication. Some data from past years were updated. Thus, installed capacity and number of installations shown in this report for 2010 and earlier are not always identical to what was reported in the 2010 edition of this report.

APPENDIX C

GRID CONNECTED PHOTOVOLTAIC INSTALLATONS BY STATE

State	Capacity Installed in 2010 (MW_{DC})	Capacity Installed in 2011 (MW_{DC})	Cumulative Installed Capacity (MW_{DC})
Alabama	0.2	*	0.5
Alaska	*	*	*
Arizona	63.6	287.8	397.6
Arkansas	0.6	*	1.1
California	255.6	537.8	1,563.6
Colorado	62.0	75.5	196.7
Connecticut	5.6	4.5	31.1
Delaware	2.4	20.9	26.5
District of Columbia	3.5	7.2	11.6
Florida	34.8	21.5	95.0
Georgia	1.6	5.1	6.9
Hawaii	18.5	40.5	85.2
Idaho	0.2	*	0.4
Illinois	11.0	0.7	16.2
Indiana	0.2	3.0	3.5
Iowa	*	*	0.1
Kansas	0.1	*	0.2
Kentucky	0.2	3.0	3.3
Louisiana	2.4	10.8	13.4
Maine	0.2	0.6	1.1
Maryland	5.3	24.3	37.1
Massachusetts	20.4	36.4	74.6
Michigan	1.9	6.2	8.8
Minnesota	1.7	1.2	4.8
Mississippi	0.1	0.3	0.6

Residential photovoltaic installation in Laguna Beach, California

GRID CONNECTED PHOTOVOLTAIC INSTALLATONS BY STATE continued

Missouri	0.5	1.3	2.0
Montana	*	*	0.7
Nebraska	0.2	0.1	0.3
Nevada	68.3	19.4	124.1
New Hampshire	1.3	1.0	3.1
New Jersey	132.4	306.1	565.9
New Mexico	40.9	122.1	165.5
New York	21.6	68.3	123.8
North Carolina	28.7	45.5	85.5
North Dakota	*	*	*
Ohio	18.7	10.9	31.6
Oklahoma	*	0.1	0.2
Oregon	9.9	11.9	35.8
Pennsylvania	46.5	78.2	133.1
Rhode Island	*	0.6	1.2
South Carolina	0.3	3.2	4.1
South Dakota	*	*	*
Tennessee	4.8	16.3	22.0
Texas	25.9	51.1	85.6
Utah	1.4	2.3	4.4
Vermont	2.2	7.8	11.7
Virgin Islands	*	0.4	0.4
Virginia	1.9	1.8	4.5
Washington	2.9	4.2	12.3
West Virgina	*	0.6	0.6
Wisconsin	3.5	4.2	12.9
Wyoming	0.1	*	0.2
TOTAL	**904.1**	**1,845.0**	**4,010.7**

* = less than 100 kW_{DC} or data not available

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