

PA Sunshine Counts

Our Common Solar Wealth

Report prepared by:

Mid-Atlantic Renewable Energy Association

www.themarea.org

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Introduction

The PA Sunshine Solar Program opened on May 18, 2009 and accepted rebate applications until funds were exhausted, Nov 25, 2013. Administered by the Pennsylvania Department of Environmental Protection (PA DEP), the Program provided rebates for solar electric (photovoltaic), solar hot water and battery backup systems for homeowners and small businesses in Pennsylvania.

This report deals solely with rebates provided for solar electric projects.

The program distributed over \$100 million in rebates to solar electric systems, supporting nearly 100,000 kW of new photovoltaic capacity in Pennsylvania. More than 7,000 homeowners and small business owners received rebate checks for solar electric projects.

To administer the program, the PA DEP maintained a list of approved solar installers. Rebate applications could be filed *only* by an installer from this list. The application information, which included contact and location details as well as extensive technical, pricing and design data, was collected through an automated online service called PowerClerk. (For more details on installer qualifications and program administration, see Appendix A, *Pennsylvania Sunshine Guidelines for the Residential and Small Business Solar Program, Rev 0340-BK-DEP4245 Rev. 1/2013*)

MAREA recognized the program's rebate application information as a significant set of data describing a large sample of photovoltaic systems installed in a well-defined geographical area and limited time span. It represented a promising research opportunity to advance our shared understanding of solar in use.

In June 2011, MAREA wrote to the PA DEP requesting information collected during the online application process. In August 2011, the PA DEP's Open Records Officer denied the request, beginning a prolonged legal process finally resolved in Commonwealth Court in September 2012, when a panel of three judges ruled to "deny the Department's application to suppress." (For details, see http://www.pacourts.us/assets/opinions/Commonwealth/out/2035CD11_9-12-12.pdf?cb=1). In October 2012, the PA DEP provided the requested data to MAREA.

In December 2013, weeks after the Sunshine Program announced it had no funds available for rebates, MAREA made a new request to the PA DEP asking for information about all PV systems receiving rebates from the program's inception until funds were exhausted. The requested information was received in January 2014. Spot checks identified significant errors in the data. The PA DEP was notified and promptly provided corrected data in March 2014.

The information in this report, PA Solar Counts, is based entirely on the Excel file received on March 7, 2014 from the PA DEP, for solar electric rebates paid over the duration of the PA Sunshine Solar Program. The file does not include information about incomplete or otherwise unpaid rebate applications.

The provided data consists of one Excel file with 7,035 rebate records (“rows”) and 184 data fields (“columns”). The data fields are listed in *Appendix B Data Profile and Review*, along with a discussion of data completeness, quality and review.

Objectives

In seeking this data, MAREA had two goals:

- 1) to understand and shed light on the aggregate accomplishments of the Pennsylvania Sunshine Solar Program, by looking to extract trends and patterns in the data that may be of use to industry, policy makers and system owners (current and prospective).
- 2) to set the stage for a new MAREA project that will both help solar electric system owners find and share information with one another and provide the means to follow PA DEP-supported solar electric installations over their full system life. This will be accomplished through on-going interaction with system owners to learn about system performance and a wide range of other issues, over time. The findings of this long-term longitudinal research will be published annually, providing a fresh kind of quantified data about the actual experience of solar electric system owners. MAREA hopes this data will be used to support fact-based decision making and policy planning.

This report is MAREA’s fulfillment of the first goal.

MAREA is not releasing the full data set received from the PA DEP. However, if other parties have specific queries, unanswered in this report, for information that will be of use for a specific cause in the interest of promoting sound solar policy and practice, they are encouraged to contact MAREA with a request. Let us know! This has happened on several occasions, even before this final report was released. MAREA is pleased to contribute.

At the time of this writing, findings from this data have been used by a township interested in electricity generation from solar within its boundaries, by researchers to identify municipalities with most solar permitting experience (to include in study and advisory group), by MAREA to provide NREL with efficiency data for installed inverters, by policy analysts to evaluate net metering considerations, and by regional collaborative planners working to make solar more affordable and accessible. Please contact MAREA if you would like help using this data in support of your work on behalf of sound solar.

About MAREA

Founded in 2005, the Mid-Atlantic Renewable Energy Association (MAREA) is a nonprofit 501(c)3 organization, dedicated to informing and educating the public on renewable energy production, energy efficiency, and sustainable living through meetings, workshops, educational materials, and energy fairs.

The organization is funded entirely through memberships, events, grants and donations. Your support is needed and genuinely appreciated.

In the interest of good solar, MAREA has chosen to provide this report at no charge to members and nonmembers alike. MAREA believes strongly that the more informed voices in the conversation the better the outcome. Thank you for reading this report.

MAREA Contributors

Since the idea for this work was conceived nearly three years ago, this project has been buoyed by the full support of MAREA's dedicated and talented board. Current members are listed below.

The principal investigator for this work is Vera Cole, PhD. She is current president of MAREA and lead faculty for the Energy and Sustainability Policy program at Penn State. Also making significant contributions are MAREA Board members Dave Bascelli, Don Bucci, Bill Hennessy, Tom Green and Phil Jones.

Geographic Information System (GIS) reports were prepared and contributed by Ron Santini, a current Penn State instructor and former senior environmental scientist for Duke Energy Corporation.

Ron Celentano of PASEIA provided valuable review and comment.

MAREA Board 2014

David Bascelli, owner, Presentation Graphics, member Richmond Township Planning Commission

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Bill Zimmerman (*treasurer*), retired CFO for Veterans Administration-Wilmington, DE

Summary of Findings

Overview

The information in this report is based entirely on the file received March 7, 2014 from the PA DEP, for solar electric rebates paid over the duration of the PA Sunshine Solar Program.

The Pennsylvania Sunshine Rebate program distributed \$103,782,757 in rebate checks to support the installation of 7,034 photovoltaic systems. Of these, 6,170 (87.7%) systems were Residential and 864 (12.3%) were Commercial. Of total rebate dollars, \$60,406,587 (58.2%) supported Residential projects and \$43,376,171 (41.8%) supported Commercial projects.

The total capacity of PV systems supported with rebates was 98,033 kW. Of this, 47,439 kW (48.4%) was Residential and 50,594 kW (51.6%) was Commercial.

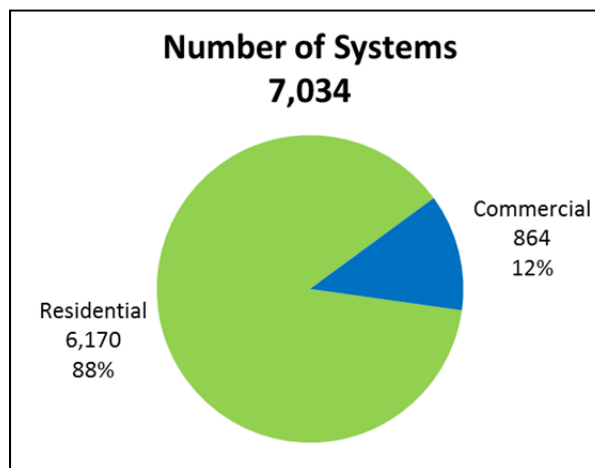


Figure 1. Number of Systems

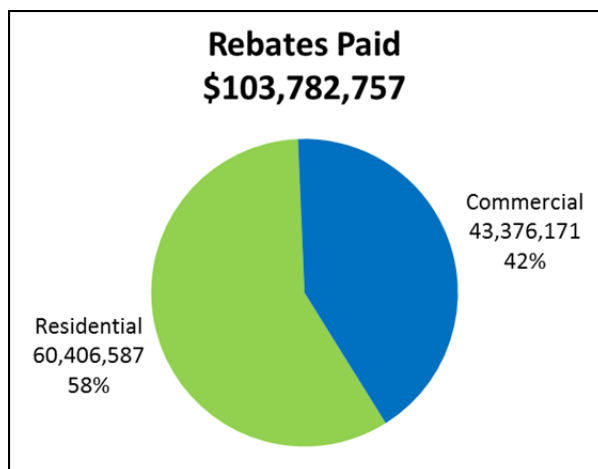


Figure 2. Rebates Paid

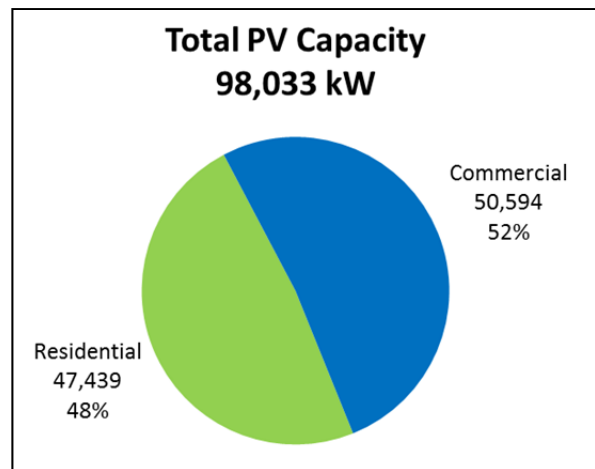


Figure 3. Total PV Capacity

System Size and Rebate Caps

Overall, average system size is 13.9 kW. The majority of systems (67.0%) are smaller than 10 kW, with 90.7% of systems smaller than 20 kW. Only 4.5% of all systems are larger than 50 kW.

In the Residential sector, 74% of all systems are smaller than 10 kW, with 99.8% smaller than 30 kW. The average Residential system is 7.7 kW. In the Commercial sector, 40.9% of all systems are smaller than 25 kW and 17.9% are larger than 100 kW. The average Commercial system is 58.6 kW.

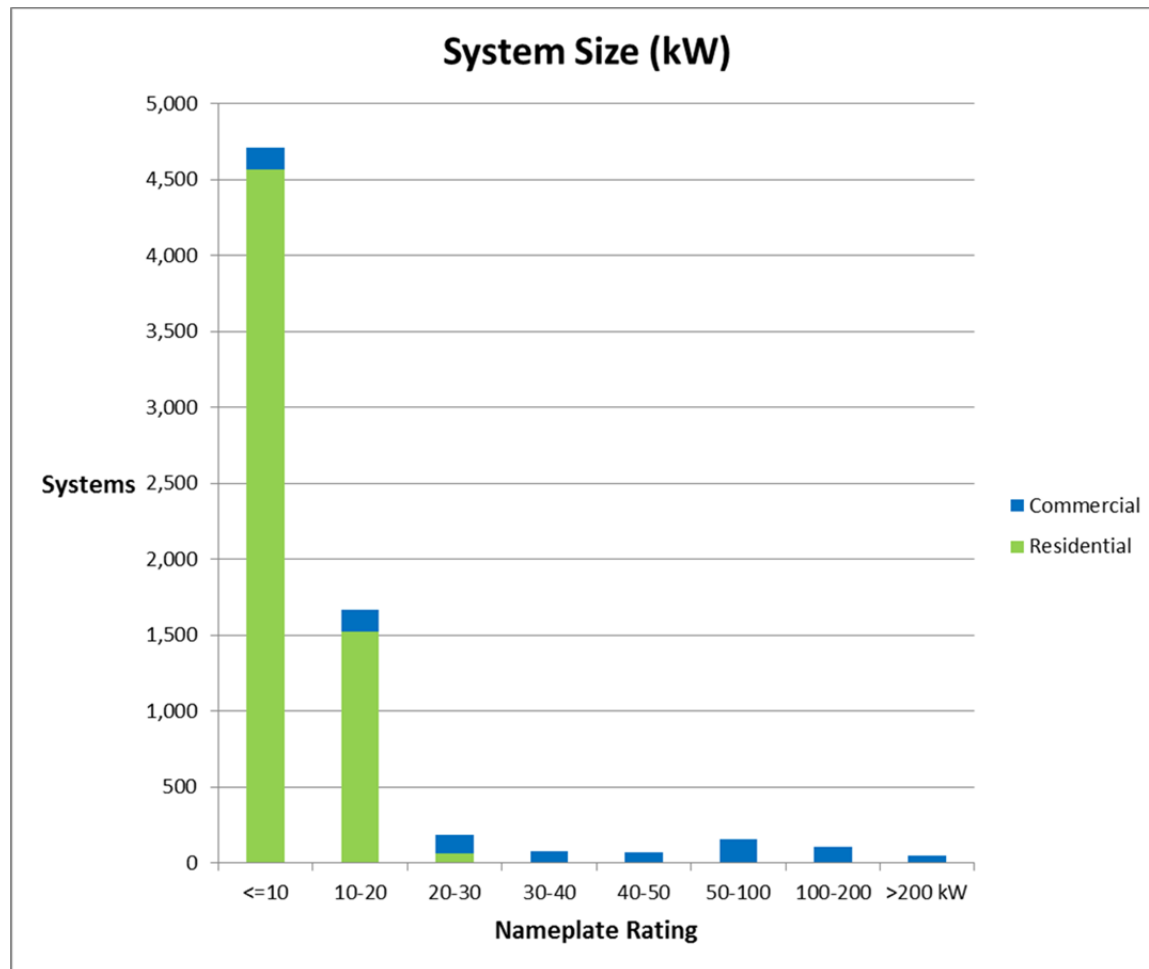


Figure 4. System Size

The PA Sunshine Rebate program covered Residential systems up to 10 kW and Commercial systems up to 100 kW or 200 kW, depending on the step. In all cases, larger systems were eligible but rebates were only paid up to the prevailing cap.

In the Residential sector, 1,602 systems exceeded the 10 kW cap installing, collectively, 3,563 kW of PV capacity that did not receive rebate support.

Similarly, in the Commercial sector, 100 systems exceeded the prevailing cap, installing 5,325 kW of PV capacity that did not receive rebate support.

Rebates

The average Residential rebate was \$9,790. The average Commercial rebate was \$50,204. (For other detail, see Figure 2.)

Overall, the PA Sunshine Program paid \$1.06/W for all new PV capacity in systems receiving rebate support. In the Residential sector, the average rebate was \$1.27/W. In the Commercial sector, the average rebate was \$0.86/W.

Using a statewide average of 1,200 kWh of annual generation per installed kW (allowing for some drop in performance over system life), the expected total annual generation from solar electric systems installed with the support of PA Sunshine rebates is about 117,639,600 kWh per year, or enough to power about 12,000 Pennsylvania homes. For a 25-year system life, total generation from rebate-supported PV systems is estimated at 2,941 GWh.

Installation Costs

Cost trends were developed using a linear regression analysis of all system costs reported to the PA Sunshine Program. Per these trend lines, costs (before applying any incentives) were \$7.59/W for Residential and \$6.80 for Commercial. At the end of the Sunshine Program, these cost trended down to \$4.59 for Residential and \$3.99 for Commercial.

As the Sunshine Program progressed, the rebate payment levels decreased from as high as \$2.25/W to as low as \$0.75/W for Residential and \$0.50/W for Commercial (and lowered cap).

For both the Residential and Commercial sectors, the final after-rebate cost was lower at the end of the Program than it was at the beginning of the program, even though rebate levels themselves were much smaller.

During the course of the PA Sunshine Program, the after-rebate cost for Residential fell from \$5.34 to \$4.13. For Commercial, it fell from \$5.22/W to \$3.72/W.

These costs do not include other local, state or federal incentives.

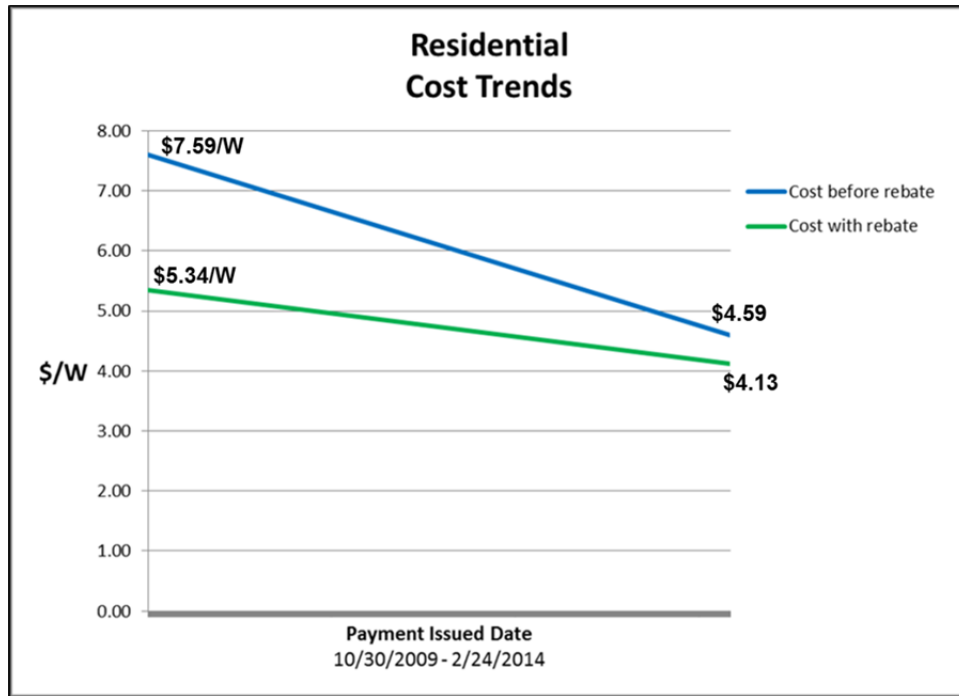


Figure 5. Residential Cost Trends

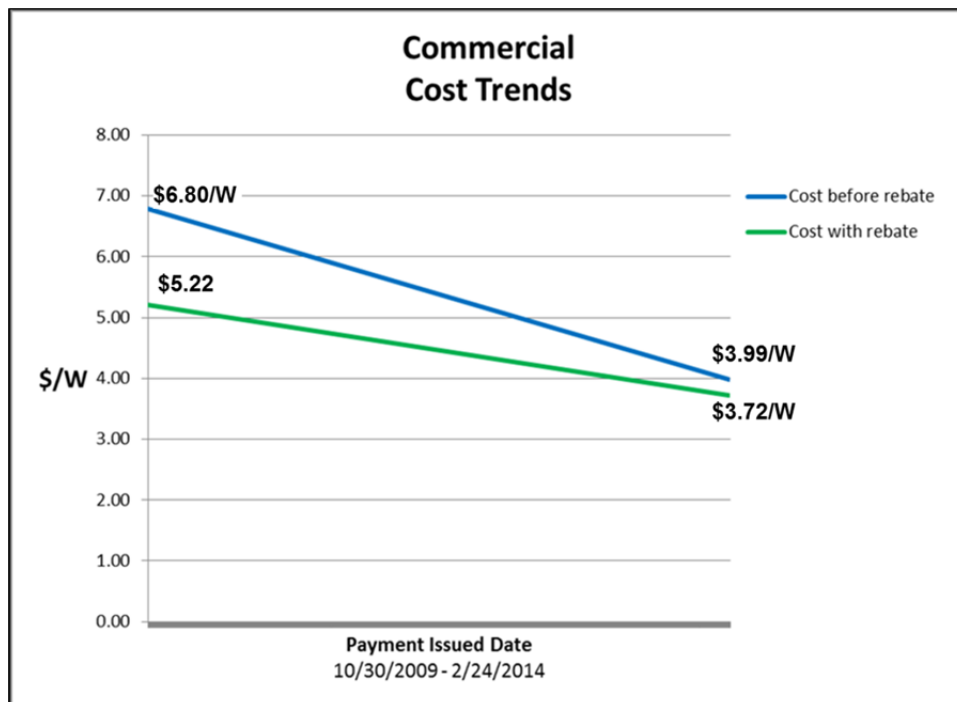


Figure 6. Commercial Cost Trends

Rebate Distribution by Utility

Overall, 82.2% of rebate dollars was used to support systems served by three Utilities: PPL (39.8%), PECO (25.1%) and Met-Ed (17.3%). The Residential sector followed roughly the same profile.

In the Commercial sector, 46.4% of rebate dollars for Commercial projects supported installations served by PPL.

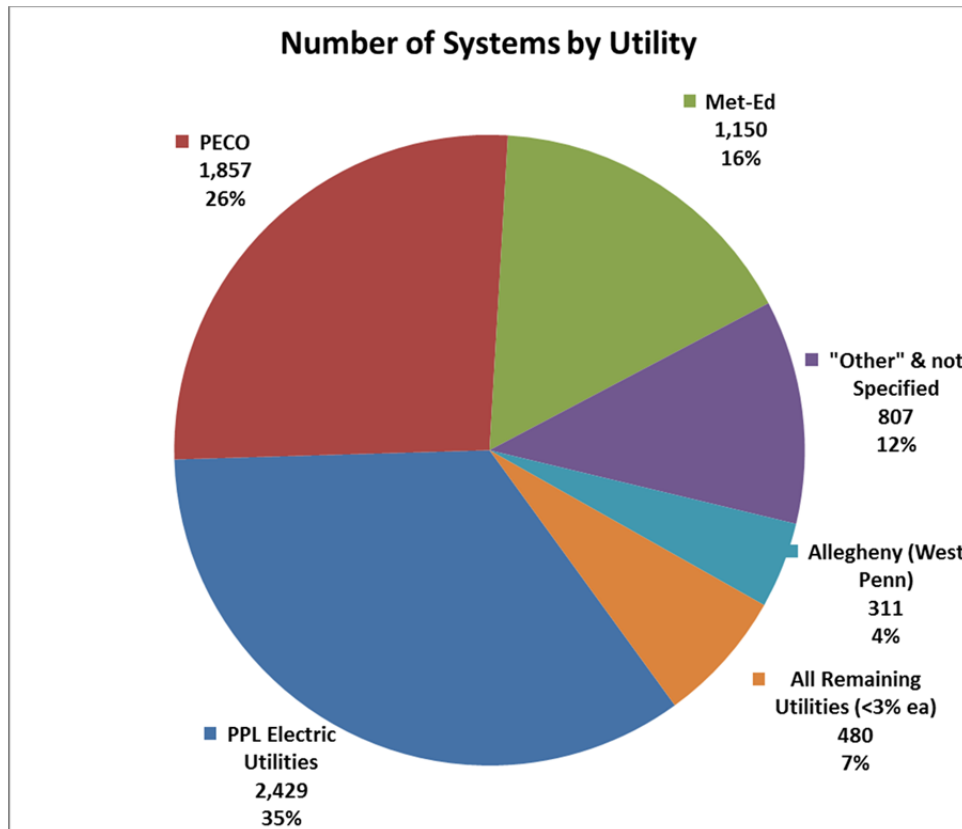


Figure 7. Number of Systems by Utility

Rebate Distribution by County

Based on the reported values for Host Customer Physical Address County, 64 counties have at least one PV installation receiving a PA Sunshine Program rebate. (For more detail see Appendix C GIS Reports) Commercial installations were reported in 55 counties. Three counties (Greene, McKean or Warren) have no reported installations receiving PA Sunshine rebates.

Of all rebate dollars, 64.1% was used to support installations in a 10-county area of southeast Pennsylvania: Lancaster (16.9% of all rebate dollars), Chester (8.9%), Montgomery (8.4%), Berks (8.3%), Bucks (7.4%), Lehigh (3.1%), Northampton (3.5%), Delaware (3.0%), Schuylkill (2.5%) and Philadelphia (2.0%). Together, this 10-county region accounted for 55.7% of all installations and 64.3% of the total installed capacity (kW) receiving PA Sunshine program rebates.

Other counties of overall significance, not located in this southeast region, include York (6.2% of all projects, 4.3 % of all kW, 5.0% of all rebate dollars) and Cumberland (3.7% of all projects, 3.2 % of all kW, 4.2% of all rebate dollars).

Considering only the Residential sector, the 10-county southeast region accounted for 54.8% of all residential projects, 55.1% of residential PV capacity and 57.9% of PA Sunshine program rebates paid to the Residential sector. Again, other counties of overall significance, not located in this southeast region, include York and Cumberland, with a total of 10.6% of residential projects, 10.9% of residential PV capacity and receiving 11.0% of rebate dollars paid to the residential sector.

Considering only the Commercial sector, the 10-county southeast region accounted for 37.2% of all commercial projects, 38.4% of commercial PV capacity and 39.2% of PA Sunshine program rebates paid to the Commercial sector. Other counties of overall significance, not located in this southeast region, include Allegheny, Cumberland, Luzerne, Monroe, and Lebanon with a total of 14% of commercial projects, 9.2% of Commercial PV capacity and receiving 10.3% of rebate dollars paid to the commercial sector.

Geographic Information System (GIS) Studies

A series of GIS studies were developed to explore the location of rebate-funded installations relative to a number of factors. By no means exhaustive, this work illustrates some patterns and possible correlations. Appendix C contains the following:

- Location of Installed Systems
- Heat Map of Installation Density
- Installations by Payment Year (2009 – 2014)
- Installations Normalized by County Population

- Installations and County Rural Population
- Installations and County Poverty Population
- Installations and Higher Ed Locations

These maps illustrate the location findings elsewhere in this report (eg, installation density in southeastern part of state) and provide possible insight into other factors corresponding with this pattern.

For example, a strong affinity is visually apparent between the locations of higher education institutions and PV installation density.

Modules

Modules were sourced from 89 different manufacturers. The most widely installed modules were from Schuco USA, totaling 10,950 kW or 11.2% of all kW. Closely clustered in the next three positions are Suntech Power (8,787 kW, 9.0%), Sharp (8,843 kW, 9.0%) and SolarWorld (8,339, 8.5%). All in all, modules from six suppliers made up 52.4% of installed capacity. The four listed above, plus ET Solar Industry (7,701 kW, 7.9%) and SunPower (6,730 kW, 6.9%).

Inverters

Detail in the data is insufficient to associate an individual inverter with installed wattage. Many systems involve multiple inverters from different manufacturers. String inverters were used exclusively on 4,629 systems (76,663 kW). Microinverters were used exclusively in 2,347 systems (20,307 kW). Both string inverters(s) and microinverters were used in 58 systems (1,063 kW). Microinverters were used in 34% of all installations.

Overall, 9,409 string inverters from 22 different manufacturers were installed in systems receiving support from the PA Sunshine Program. By far, the main source of string inverters was SMA America with 41.8% of all installed string inverters. Next in line, Fronius USA (16.5%), PV Powered (15.0%), Sunpower (8.7%) and Schuco USA (7.8%).

Of seven microinverter manufacturers, Enphase was overwhelmingly dominate, providing 97.7% of the installed units.

Installers

In total, 362 installers filed for rebates that were paid. Of these, 190 (52%) of the installers did only Residential installations, 24 (7%) did only Commercial installations and 148 (41%) did some of both.

Overall, seven installers were responsible for 30.3% of all system installations. These systems represent 29.4% of program-supported capacity and received 27.3% of rebate dollars.

Astrum Solar, LLC (7.5% of systems, 5.3% of kW, 5.2% of rebate dollars), Greenspring Energy (5.0% of systems, 2.7% of kW, 3.1% of rebate dollars), SunLion Energy Systems, Inc (4.3% of systems, 6.4% of kW, 5.2% of rebate dollars), Endless Mountains Solar Services (3.7% of systems, 1.7% of kW, 1.9% of rebate dollars), J.K. Mechanical, Inc. (3.7% of systems, 5.8% of kW, 4.8% of rebate dollars), Advanced Solar Industries (3.1% of systems, 5.7% of kW, 4.2% of rebate dollars), Heat Shed(3.0% of systems, 1.8% of kW, 2.7% of rebate dollars).

In the Residential sector, installers followed similar line up with the same seven installers responsible for 31.2% of all Residential systems, which made up 32.7% of program-supported Residential capacity and received 32.2% of rebate dollars going to Residential projects.

In the Commercial sector, a somewhat different list of eight installers was responsible for 35.8% of all Commercial systems, which made up 49.0% of program-supported Commercial capacity and received 52.1% of rebate dollars going to Commercial projects. SunLion Energy Systems, Inc (7.2% of systems, 8.1% of kW, 5.9% of rebate dollars), J.K. Mechanical, Inc. (6.3% of systems, 8.1% of kW, 7.0% of rebate dollars), Paradise Energy Solutions LLC (4.9% of systems, 4.7% of kW, 3.1% of rebate dollars), Advanced Solar Industries (4.7% of systems, 7.7% of kW, 5.3% of rebate dollars), I Need Solar. Com (4.3% of systems, 6.2% of kW, 10.2% of rebate dollars), Borrego Solar Systems, Inc. (2.9% of systems, 7.8% of kW, 13.0% of rebate dollars), Dynamic Solar, LLC (2.8% of systems, 4.0% of kW, 5.4% of rebate dollars) and Moore Energy LLC (2.8% of systems, 2.3% of kW, 2.3% of rebate dollars).

Far more than half of the installers (212 or 58.6% of all installers), handled 5 or fewer projects that received Sunshine rebates. Ninety five installers (26%) filed for only 1 rebate.

Conclusion

This section has presented a Summary of Findings. For more detail, please see *Appendix D Detailed Findings*.

It is hoped that this report provides useful insight into the process and achievements of this solar rebate program. MAREA expects that it will also raise questions, hopefully productive ones, leading to advancements in policy planning and the ongoing support of effective solar installations.

Some questions have already been raised:

- 1) Why are the installations concentrated as they are? What set of conditions led to high levels of installations in some parts of PA and very low levels in other parts?
- 2) Of the 362 installers participating in the rebate program, how many are still in business? How many are still working in Pennsylvania?
- 3) Why did more than a quarter of the installers participating in the program file for only 1 paid rebate?

We are sure there are many others.

Please contact MAREA if you have questions about this report, would like to invite a presentation of the information in this report or if you have an additional query about data in this report. On all accounts, MAREA is glad to help.