

CONSULTANT REPORT

THE CALIFORNIA ENERGY COMMISSION'S NEW SOLAR HOMES PARTNERSHIP PROGRAM CASE STUDY

Promoting Greener, Better Housing in California

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About the Clean Energy States Alliance: The Clean Energy States Alliance (CESA) is a national nonprofit coalition of public agencies and organizations working together to advance clean energy. CESA members—mostly state agencies—include many of the most innovative, successful, and influential public funders of clean energy initiatives in the country. CESA works with state leaders, federal agencies, industry representatives, and other stakeholders to develop and promote clean energy technologies and markets. CESA promotes information sharing, provides technical assistance, coordinates multistate collaborative projects, and communicates the positions and achievements of its members. For more information, visit www.cesa.org.

About the California Energy Commission: The California Energy Commission is the state's primary energy policy and planning agency. It has seven core responsibilities: advancing state energy policy, encouraging energy efficiency, certifying thermal power plants, investing in energy innovation, developing renewable energy, transforming transportation, and preparing for energy emergencies. The Energy Commission is the program administrator for the California New Solar Homes Partnership. For more information, visit www.energy.ca.gov.

About Peregrine Energy Group: Peregrine Energy Group is an energy consulting firm based in Boston, Massachusetts. Founded in 1992, Peregrine specializes in energy efficiency and renewable energy, and in the collection, analysis, and presentation of energy data. For more information, visit www.peregrinegroup.com.

ABSTRACT

This case study analyzes data from the California Energy Commission's New Solar Homes Partnership Program, part of California's comprehensive statewide solar program, the California Solar Initiative. At the time this study was conducted, the New Solar Homes Partnership Program had installed 14,100 solar energy systems totaling 45 megawatts of capacity. Key findings about market impacts of the program include the following:

- Fourteen times more solar energy systems have been installed in single-family homes than in multifamily homes.
- The majority of solar installations took place in Southern California, with market penetration reaching 27 percent of the new single-family homes with building permits issued in 2012.
- Program participation is distributed evenly across communities by income.
- The program primarily serves production homes, also known as subdivisions.
- Direct purchases have been the dominant finance structure, with leases becoming more common in the last two years and power purchase agreements remaining uncommon.
- The rebate design has helped lower-income residents, with affordable housing and multifamily housing receiving higher average rebates per watt of solar capacity.

Keywords: California Energy Commission, Clean Energy States Alliance, New Solar Homes Partnership Program, California Solar Initiative, solar power, zero-net-energy homes, production homes, custom homes, affordable housing, single-family homes, multi-family homes, rebates, incentives, net-energy metering

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Introduction

New homes in California are becoming more energy-efficient and have lower energy bills, thanks, in part, to the California Energy Commission's New Solar Homes Partnership (NSHP). This initiative provides financial incentives and other support to homeowners, builders, and developers to encourage the construction of new, energy-efficient solar homes. Because houses last for many decades, it makes sense to construct them so that the ongoing energy use and energy costs will be small.

The NSHP began in 2007 and has a 10-year goal of installing 360 megawatts (MW) of new residential solar capacity in California. It aims to have at least half of all new homes include solar by 2020. The long-term goal of the NSHP is to create a self-sustaining residential solar market in California.

As the state agency responsible for developing the energy efficiency standards for all new construction, the California Energy Commission administers the NSHP program. The NSHP is part of the state's comprehensive statewide solar program, the California Solar Initiative (CSI). The California Public Utilities Commission oversees a solar rebate program, also known as CSI, for commercial, agricultural, government, and existing residential projects that get electricity from one of three investor-owned utilities: Pacific Gas and Electric, San Diego Gas & Electric, and Southern California Edison. The program goals include installing 1,940 MW of new solar generation capacity by the end of 2016 and establishing a self-sufficient solar industry whereby solar energy systems are a viable mainstream option. This program is well on the way toward achieving those goals.

Figure 1: Lennar Homes Subdivision Shenandoah at Blackstone in El Dorado Hills



Photo Credit: Sherrill Neidich

The NSHP's more than 14,100 completed installations have led to the creation of more than 44 MW of installed residential solar capacity in California. The NSHP has 19,000 new homes under construction with a total solar capacity of more than 56 MW, and an additional 5,000 new homes in development.

Benefits to Homeowners From Solar and Energy Efficiency

Solar power combined with energy efficiency not only benefits the environment and strengthens the renewable energy market; it also has important financial benefits for homeowners. Homeowners save money on their utility bills because they are using less energy. Energy efficiency measures and solar energy systems also protect homeowners from rising energy costs. Furthermore, homeowners can qualify for federal income tax credits for solar energy systems and energy efficiency measures.

The NSHP focuses on new home construction as a way to lower the upfront installation costs of solar energy systems by incorporating the solar energy system design seamlessly into the design of a building and installing the solar energy system while all the other construction activities of the home are underway.

Figure 2: Affordable Housing Townhomes Project



Photo courtesy of Habitat for Humanity, East Bay

Eligibility Requirements

Only new residential construction projects qualify for NSHP incentives. Eligible projects include common areas of housing developments, total building renovations, and certain mixed-use projects. To be eligible for the program, the building must be within the electric service territories of Pacific Gas and Electric, San Diego Gas & Electric, or Southern California Edison.

The NSHP requires that projects meet minimum energy efficiency levels, and applicants are encouraged to achieve energy efficiency levels substantially greater than the current legal standard. The installed solar energy systems must also meet specific program requirements to qualify for an incentive.

Complete eligibility requirements, rules, and application guidelines are outlined in the *New Solar Homes Partnership Guidebook*.¹ The latest edition was released in August 2014.

Incentives

Unique from previous solar incentive programs, the NSHP and other CSI programs base the solar incentive on the expected performance of the solar energy system to be installed. This encourages high-quality installations with optimal designs. The NSHP also takes into account and offers higher incentives for qualified affordable housing projects, as well as for installations on buildings that achieve higher levels of energy efficiency. Energy efficiency measures are not eligible for NSHP incentives, but NSHP applicants are encouraged to seek out energy efficiency incentives offered by their utilities' new residential construction energy efficiency programs.

NSHP incentive levels will gradually decline in the coming years as the program achieves its megawatt capacity goals. NSHP incentives are paid once the solar energy system is installed and operational and has met all program requirements.

Evaluating Program Success

To better gauge the effect the NSHP has had on the new home market in California, the Clean Energy States Alliance (CESA) and Peregrine Energy Group analyzed data measuring the results of the NSHP in the first eight years.

Data were provided by the Energy Commission and was assessed in the following categories:

- Region

¹ The *New Solar Homes Partnership Guidebook* is available on the Energy Commission's website at <http://www.energy.ca.gov/2014publications/CEC-300-2014-001/CEC-300-2014-001-ED8-CMF.pdf>

- Market penetration
- Household income
- Project category
- Building type
- Financing method

Summary Statistics

- Total number of solar energy systems installed: > 14,100
- Total installed capacity: > 45 megawatts (MW) AC
- Total project applications received: > 3,100 (~ 240 under review, 2,900 approved)
 - Corresponding number of systems: >38,200 (~5,000 under review, 33,100 approved)

Key Findings

- Fourteen times more solar energy systems have been installed in single-family homes through the NSHP than in multifamily residences.
- The majority of NSHP solar installations took place in Southern California. The market penetration in that region is quite high, reaching 27 percent of new single-family homes with building permits issued in 2012.
- Program participation is distributed evenly across communities by income.
- The program primarily serves production homes, also known as subdivisions.
- Direct purchases have been the dominant finance structure, with leases becoming more common in the last two years, and power purchase agreements (PPAs) remaining uncommon.
- The rebate design has helped lower-income residents. Affordable housing and multifamily housing received higher average rebates per watt of solar capacity.

The following pages provide an overview of the data analysis by category.²

Unless otherwise noted, the Energy Commission provided all data, which include the period from November 6, 2007, to October 28, 2014. The data provided by the Energy Commission include only approved projects and installed solar energy systems and do not include information on applications or projects under review.

Region

For this study, California was grouped into three main geographical regions: Northern, Central, and Southern California. The boundaries of these regions as defined by this report are outlined in the map below.

² These statistics reflect NSHP participation at the time of publication. The analysis in this report was done using data that are several months old. Therefore the data analysis in the following pages indicates a total of 13,581 installed solar energy systems, with some minor variation due to data inconsistencies.

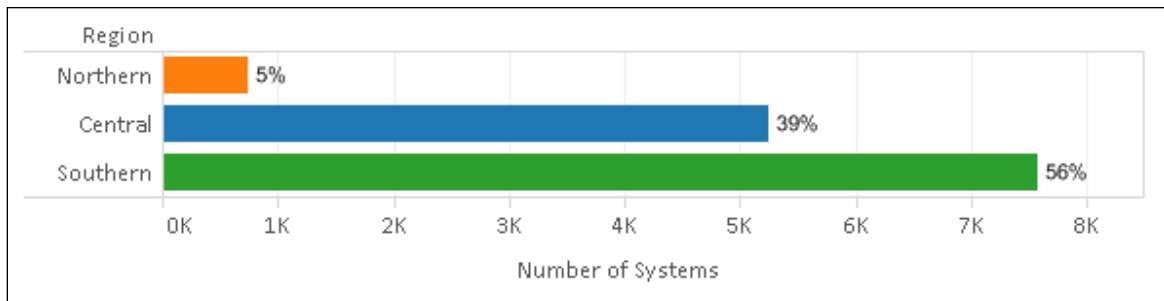
Figure 3: Geographic Regions of California



Source: Clean Energy States Alliance based on data provided by the California Energy Commission

The chart below shows installed solar energy systems by region.

Figure 4: Solar Installations by Region

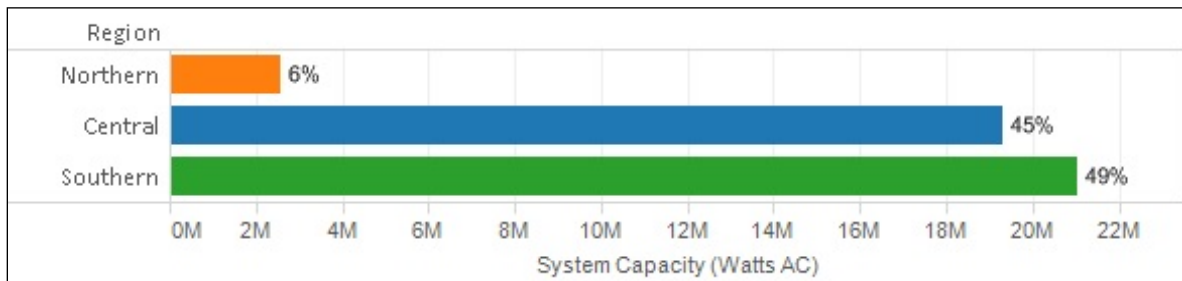


Source: Clean Energy States Alliance based on data provided by the California Energy Commission

Southern California has had the most NSHP systems overall (56 percent) and experienced especially impressive growth between 2012 and 2013. Before 2012, many production builders had projects focused in Central California. Thanks to a variety of factors, such as builder

education and outreach by solar retailers and installers, many production builders are offering solar energy systems in their Southern California communities. As cities, such as Lancaster, adopt increasingly stringent building requirements that require high levels of energy efficiency and solar energy system installations, this trend may continue.

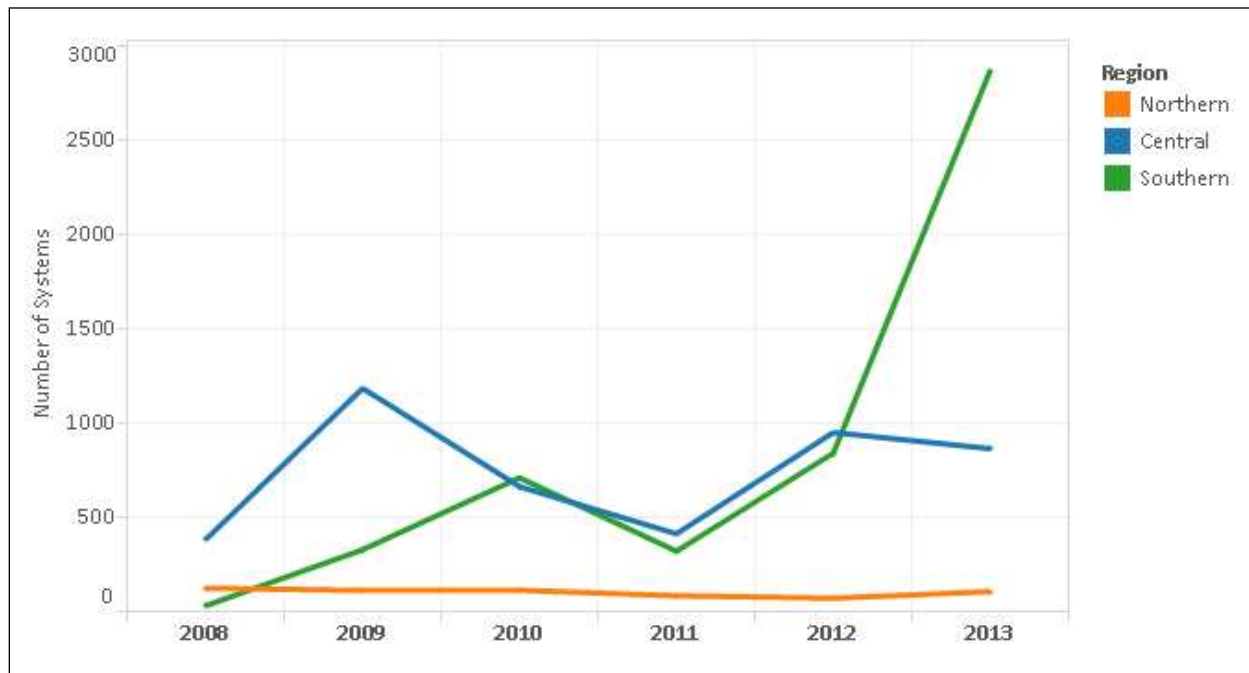
Figure 5: Installed Solar Capacity by Region



Source: Clean Energy States Alliance based on data provided by the California Energy Commission

A graph of installed solar capacity by region shows the same ranking among the regions. However, a smaller average system size in Southern California means that the installed solar capacity in Central California is nearly as great. Northern California ranks last, with the smallest percentage of installed capacity (5 percent) and the fewest installed systems (6 percent).

Figure 6: Solar Installations by Region by Year



Source: Clean Energy States Alliance based on data provided by the California Energy Commission

Northern California accounted for 5 percent of the total NSHP systems installed, and program participation has remained relatively even over the years.

Central California has had more dynamic growth trends, with a decrease in installations between 2009 and 2011 but with positive growth during the other years. Central California accounts for 39 percent of total NSHP systems installed.

Table 1: Solar Installations by Region by Year

Region	2008	2009	2010	2011	2012	2013	2014	Grand Total
Northern	125	113	114	85	72	107	130	746
Central	383	1,184	663	413	950	864	791	5,248
Southern	32	329	710	321	841	2,868	2,485	7,586

Source: Clean Energy States Alliance based on data provided by the California Energy Commission

Market Penetration

The research team assessed market penetration by calculating the number of systems installed as a percentage of the number of building permits issued for new, single-family homes in areas served by the program.³ The analysis was limited to single-family homes because comparable program data and building permit data are available for only that building type. The analysis was performed for 2012 because the most complete data were available for that year.⁴

Table 2: Market Penetration – New Single-Family Homes, 2012

Region	Total Building Permits Issued	Permits in IOU Territories	NSHP Systems	NSHP Share of Potential Market
Northern California	8,558	5,732	440	8%
Central California	8,384	7,380	307	4%
Southern California	10,618	7,249	1,986	27%

Source: Clean Energy States Alliance based on data provided by the California Energy Commission

The NSHP had the highest market penetration in Southern California, reaching 27 percent of new single-family homes in 2012. Market penetration was 8 percent in Northern California and 4 percent in Central California.

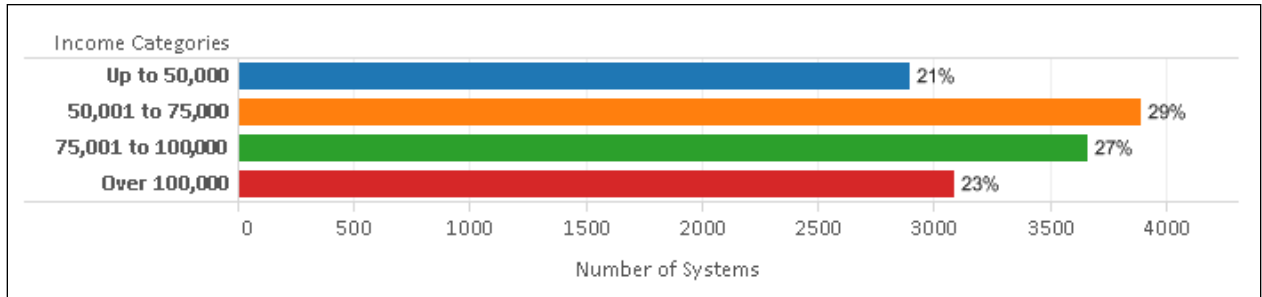
Household Income

Solar energy systems installed through the NSHP were grouped according to the median household income of the ZIP code where the home is located. The income data come from the American Community Survey.

3 This analysis uses building permit data by county as reported by the Construction Industry Research Board.

4 The data in Tables 1 and 2 of this report do not match up because 1) the data in Table 2 include only single-family homes whereas the data in Table 1 include single- and multifamily homes; 2) the data are grouped differently by year—in Table 1, "year" refers to the year the system was installed, and in Table 2, "year" refers to the year the building permit was issued. Since systems are often installed a year or even two years after the permit is issued, the numbers per year won't match between the two tables.

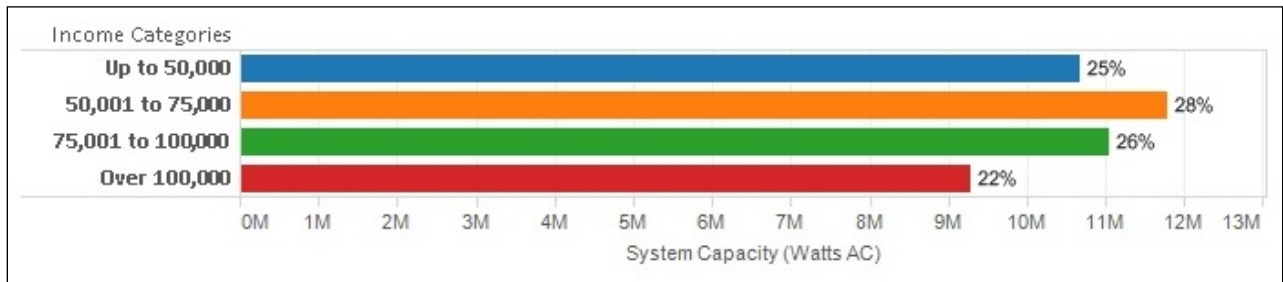
Figure 7: Solar Installations by Community Median Household Income



Source: Clean Energy States Alliance based on data provided by the California Energy Commission

A slight majority (56 percent) of NSHP installations have been in communities where the median household income is \$50,000-100,000. Wealthier communities (those where the median household income is greater than \$100,000) are participating at a slightly higher rate than communities with median household incomes less than \$50,000.

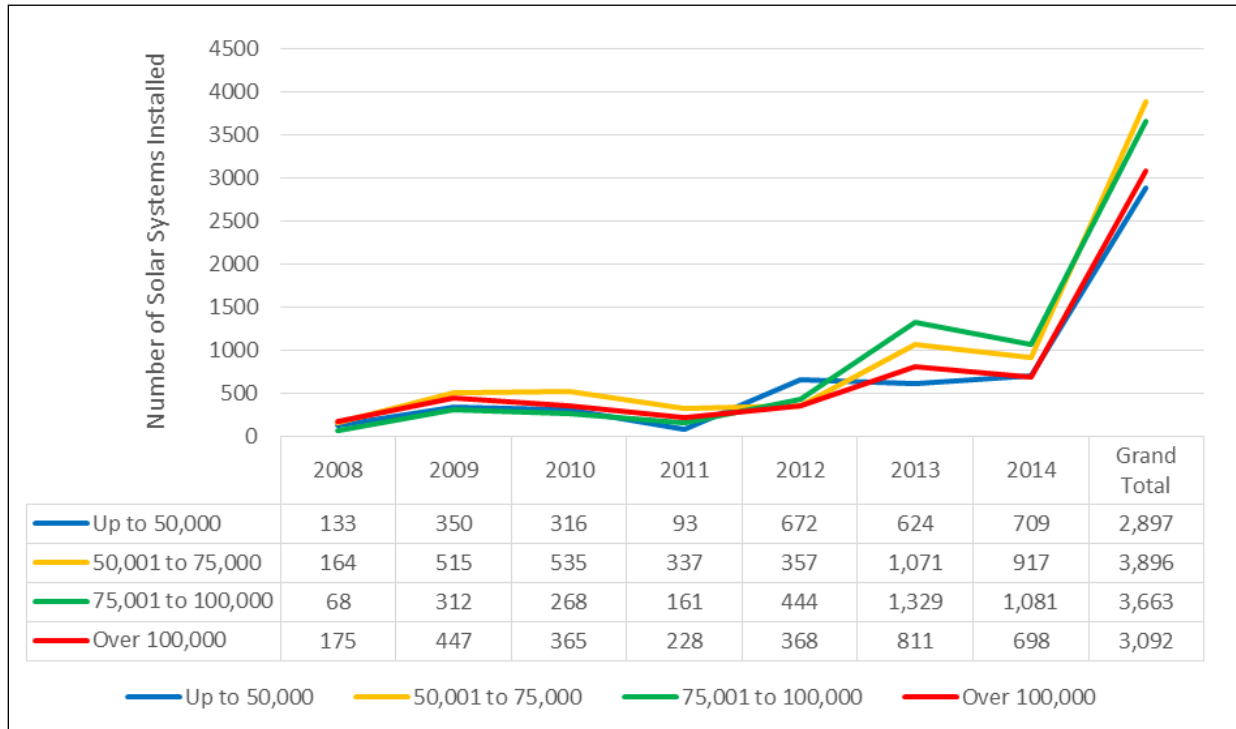
Figure 8: Installed Solar Capacity by Community Median Household Income



Source: Clean Energy States Alliance based on data provided by the California Energy Commission

Figures 7 and 8 show similar results. But because the average system size is greatest in communities with incomes up to \$50,000, fully 25 percent of all capacity has been installed in those communities.

Figure 9: Solar Installations by Community Median Household Income by Year



Source: Clean Energy States Alliance based on data provided by the California Energy Commission

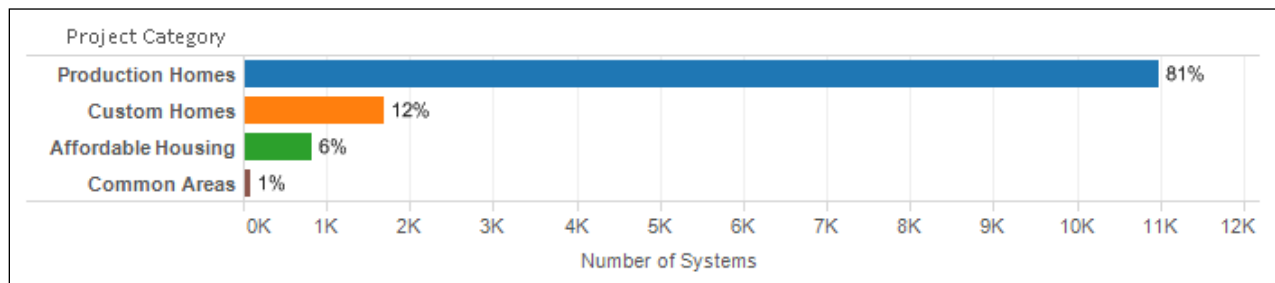
Overall, these data show strikingly similar trends in communities of all income levels.

Project Category

The NSHP has provided incentives to four types of building projects:

- Production homes, also known as subdivisions.
- Custom homes
- Affordable housing
- Common areas (an area within a multifamily building or development for use of the residents). Examples include recreation centers, hallways, security lighting, parking lots, and computer rooms.

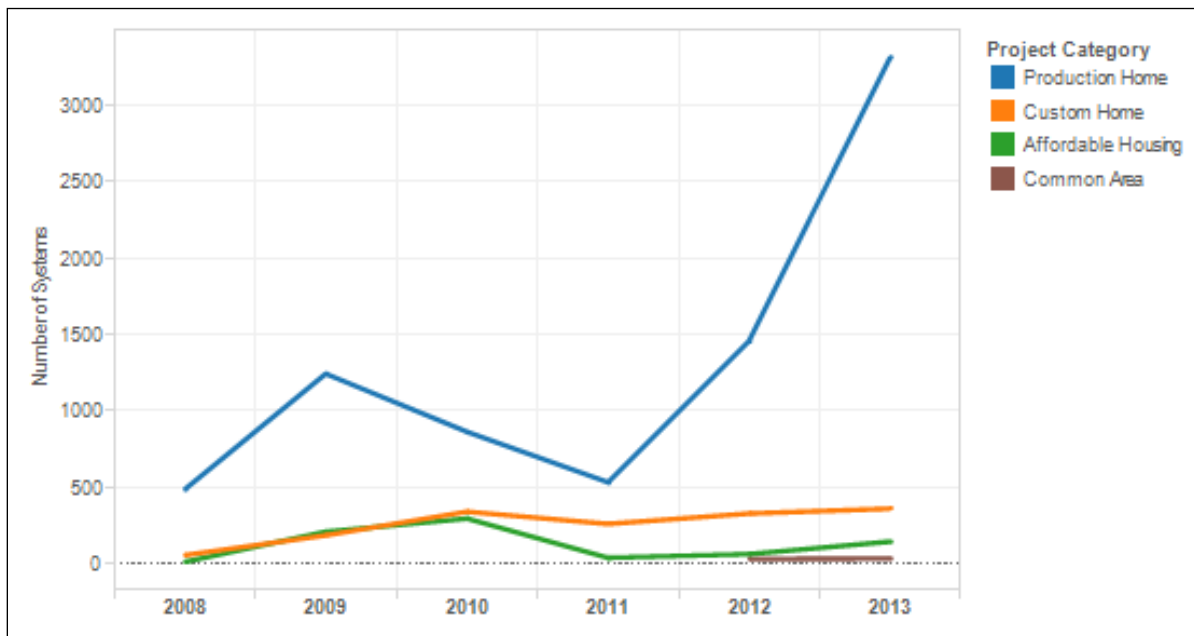
Figure 10: Solar Installations by Project Category



Source: Clean Energy States Alliance based on data provided by the California Energy Commission

Production homes are by far the most common category at 81 percent. Because production homes are the dominant form of housing in California and were the primary target audience of the NSHP, these data are not surprising. There were twice as many custom homes (12 percent) as there were affordable housing projects (6 percent). The smallest project category was common areas at 1 percent.

Figure 11: Solar Installations by Project Category by Year



Source: Clean Energy States Alliance based on data provided by the California Energy Commission

In addition to having the highest overall number of sites, production homes have also had the steepest growth curve. There was a decline in activity between 2009 and 2011, coinciding with California's largest ever housing downturn, followed by impressive growth from 2011 to the present as the new home market in California has picked up steam.

Growth trends have remained relatively steady with slight growth for custom homes. Affordable housing experienced a decline between 2010 and 2011 and has been increasing since then. Common area projects have not had high levels of participation and have seen minimal growth since 2012.

Table 3: Systems, Capacity, and Rebate Amount by Project Category

Project Category	Total Number of Systems	Total System Capacity (Watts AC)	Average System Capacity (Watts AC)	Average Rebate	Average Rebate per Watt⁵
Affordable Housing	826	6,935,394	8,396	\$26,029	\$3.10
Common Area	78	2,347,379	30,094	\$72,031	\$2.39
Custom Home	1,689	9,987,793	5,913	\$12,794	\$2.16
Production Home	10,989	23,21,763	2,150	\$5,211	\$2.42

Source: Clean Energy States Alliance based on data provided by the California Energy Commission

Common areas, which serve many people and may have specialized or energy-intensive purposes, had the highest average system capacity. Affordable housing units, which tend to house a higher number of people and may contain some shared community facilities, had the second highest average system capacity. Custom homes, which tend to be larger than production homes, have the third highest average system capacity, followed by production homes. The average rebates correlated in size to the average system capacity.

On a rebate-per-watt basis, affordable housing received the highest rebates, followed by production homes, common areas, and custom homes.

NSHP incentive rates were tied to only the energy efficiency of a project starting in 2012. Before 2012, incentive rates were based on the amount of solar to be installed in a project, meaning that larger projects such as subdivisions received

⁵ Current incentive rates range from \$0.75/watt to \$1.50/watt for market-rate housing projects and \$1.50/watt to \$1.85/watt for affordable housing projects.

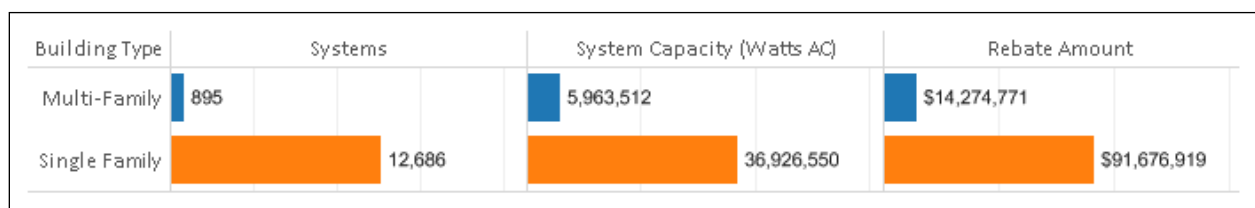
higher incentive rates than custom homes. This change in incentive structure could have favored production homes in the years prior to 2012.

As a percentage of the total installed program capacity, production homes are the largest portion at 55 percent. The second highest are custom homes at 23 percent, followed by affordable housing at 16 percent, and common areas at 5 percent.

Building Type (Single/Multifamily)

Many more single-family homes than multifamily buildings have installed solar energy systems through the NSHP, by a ratio of roughly 14:1. Out of the 13,581 total systems installed, 12,686 (93 percent) were on single-family homes, and 895 (7 percent) were on multifamily residences.

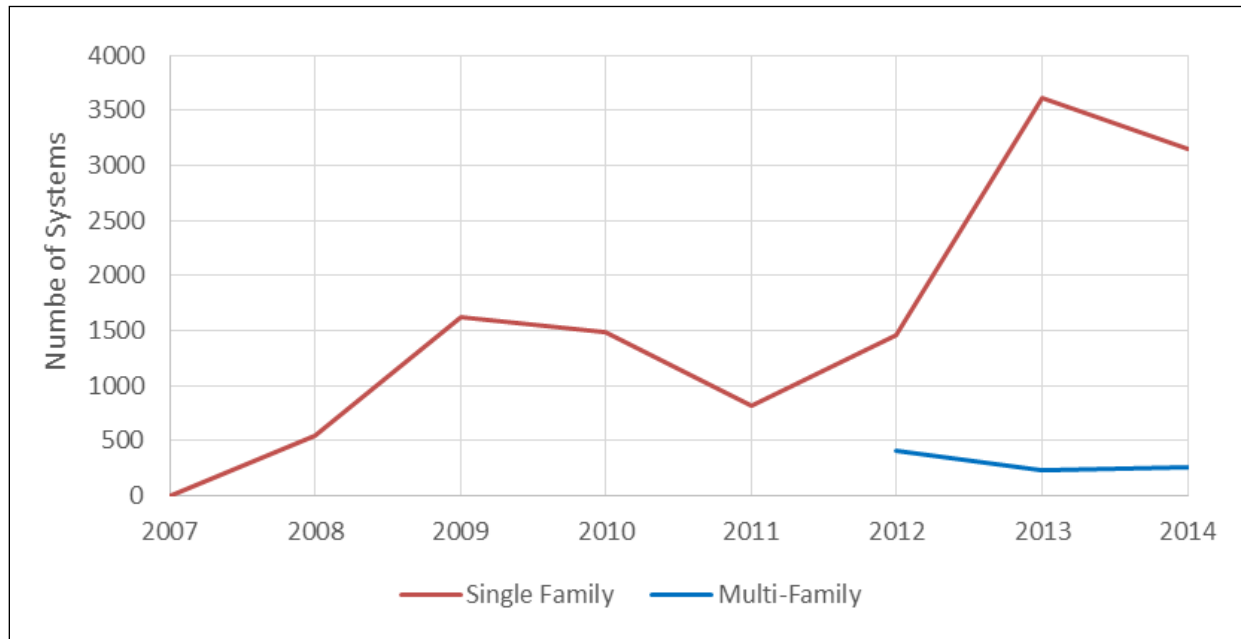
Figure 13: Solar Installations by Building Type



Source: Clean Energy States Alliance based on data provided by the California Energy Commission

A chart of installed solar energy systems by building type by year (Figure 14) shows that multifamily homes were slower to get involved in the NSHP program. This may have been due to other California Solar Initiative (CSI) programs that offered similar incentives for affordable housing projects without the increased energy efficiency requirements of the NSHP. Over time, decreasing CSI incentives and California's adoption of virtual net metering likely encouraged the participation of affordable housing projects seeking to install solar energy systems that would offset tenant electricity usage.

Figure 14: Solar Installations by Building Type by Year⁶



Source: Clean Energy States Alliance based on data provided by the California Energy Commission

Table 4: Rebate Amount, System Capacity, and Rebate per Watt by Building Type by Year

Year of Payment	Average Rebate Amount		Average System Capacity (Watts AC)		Average Rebate Per Watt	
	Single Family	Multi-Family	Single Family	Multi-Family	Single Family	Multi-Family
2007	\$7,332		2,626		2.79	
2008	\$6,932		2,481		2.79	
2009	\$6,784		2,037		3.33	
2010	\$10,022		3,496		2.86	
2011	\$11,071		4,089		2.70	
2012	\$9,085	\$12,064	3,428	4,477	2.65	2.69
2013	\$6,621	\$20,108	2,805	7,945	2.36	2.53
2014	\$5,014	\$18,297	2,538	8,917	1.97	2.05
Total Program Averages	\$7,226	\$15,949	2,910	6,666	\$2.48/watt	\$2.39/watt

Source: Clean Energy States Alliance based on data provided by the California Energy Commission

⁶ There was limited multifamily participation in the NSHP prior to 2012, but those projects were not included due to data entry discrepancies.

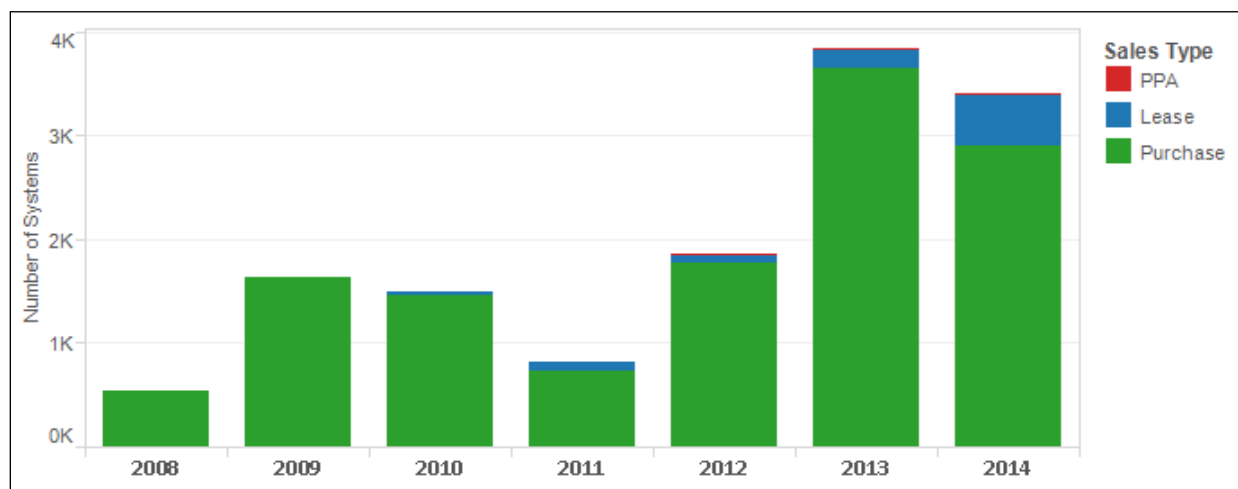
Systems installed on multifamily homes were more than twice as large on average as those installed on single-family residences. The average multifamily system was 6,666 watts, and the average single family system was 2,910 watts. Correspondingly, multifamily homes received average rebates that were twice as large as those received by single-family homes.

During the program, the average rebate-per-watt was \$2.48 for single-family homes and \$2.39 for multifamily buildings. During the three-year period between 2012 and 2014, when both single-family and multifamily projects received rebates, the average rebate per watt for single-family homes was \$2.32/watt, and the average rebate per watt for multifamily buildings was slightly higher at \$2.42/watt. Due to the program design, there is a lag of up to three years between the time the project is issued a reservation at a certain incentive rate and the payment is issued. Many of the systems above are from older reservations approved at higher incentive levels. As these projects expire out of the program and more systems are installed and submitted for payment, the average rebate per watt will decrease.

Sales Type

There are three ways that homeowners can finance solar installations: through the direct purchase of the solar system, through a lease arrangement, or through a power purchase agreement (PPA). Until 2010, direct purchases were the only financing option available for NSHP participants.

Figure 15: Solar Installations by Sales Type by Year



Source: Clean Energy States Alliance based on data provided by the California Energy Commission

Throughout the NSHP, purchases have been the most common financing method by far. Leases have grown in popularity, especially since 2013, but PPAs remain uncommon.

Table 5: Average System Capacity and Average Rebate by Financing Method

Financing Method	Average System Capacity (Watts AC)	Average Rebate (\$)
Lease	3,013	6,820
PPA	7,020	16,302
Purchase	3,164	7,860

Source: Clean Energy States Alliance based on data provided by the California Energy Commission

The chart above shows a relationship between system capacity and financing method. Systems that were leased and purchased had roughly the same average capacity. A small number of customers opted to finance their solar installations through PPA financing. While the table shows they had projects that were twice as large on average as systems financed by leases and direct purchases, this is due to the influence of a few large systems among smaller systems in a small sample group.

Future Data Collection and Program Evaluation

This data analysis was completed using information provided by applicants in their NSHP program applications. As funding for the NSHP and the CSI is exhausted and those programs eventually end, the problem of continuing to collect data on solar energy systems installed in California will arise.

Foreseeing that the end of the CSI would end data collection on many solar installations, the California Public Utilities Commission required the investor-owned electric utilities (IOUs) to amend the customer net energy metering interconnection application requirements to include data fields being provided to the NSHP and the CSI. The decision also ordered the IOUs to create an online interconnection application, if not already available to customers, and to report that information regularly. The automated data collection process and regular reporting will be important for continuing to gauge the effect of the NSHP on the new solar homes market and for evaluating whether the program met the goals of creating a self-sustaining solar market and placing solar on 50 percent of new homes by 2020.

Conclusion

The New Solar Homes Partnership has been showing considerable growth and is moving the market for new homes in California toward greater energy efficiency and the incorporation of solar energy systems. The data analysis also indicates that the NSHP has been helping residents at all income levels. At this time, it is too early to draw final conclusions about the success of the program because it is only partially completed.

For More Information

The New Solar Homes Partnership website: <http://www.gosolarcalifornia.org/about/nshp.php>

New Solar Homes Partnership Guidebook, 8th Edition, August 2014. 113 pages.

<http://www.energy.ca.gov/2014publications/CEC-300-2014-001/CEC-300-2014-001-ED8-CMF.pdf>. This guidebook details the eligibility requirements, rules, and process for reserving and claiming an incentive under the New Solar Homes Partnership Program.