

PUBLIC UTILITIES COMMISSION

505 VAN NESS AVENUE
SAN FRANCISCO, CA 94102-3298



June 28, 2016

Daniel Alvarez
Secretary of the Senate
State Capitol, Room 400
Sacramento, CA 95814

RE: CALIFORNIA SOLAR INITIATIVE ANNUAL PROGRAM ASSESSMENT TO THE CALIFORNIA STATE LEGISLATURE

Pursuant to Public Utilities Code 2851 (Statutes of 2006, Chapter 132), enclosed is the California Solar Initiative 2016 Annual Program Assessment. The report summarizes the program's progress towards achieving the installed capacity goals set by statute.

Please contact Edward Randolph (415) 703-2083, edward.randolph@cpuc.ca.gov, if you have any questions.

Sincerely,

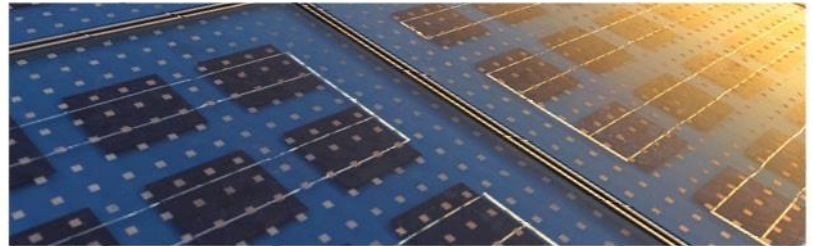
A handwritten signature in blue ink that reads "Timothy J. Sullivan".

TIMOTHY J. SULLIVAN
Executive Director



California Solar Initiative

Annual Program Assessment



June 2016

California Solar Initiative Annual Program Assessment

June 2016

Prepared by the
California Public Utilities Commission

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1 Executive Summary

1.1 Introduction

In January 2007, California began a \$3.3 billion ratepayer-funded effort to install 3,000 megawatts (MW) of new solar over the next decade and transform the market for solar energy by reducing the cost of solar generating equipment. The California Public Utilities Commission's (CPUC) portion of the solar effort is known as the California Solar Initiative (CSI) program. The CSI program goal is to install 1,940 MW¹ of customer-sited solar capacity by the end of 2016, and, along with other statewide solar programs, transition the solar industry to a point where it can be self-sustaining without subsidies.

This Annual Program Assessment meets the statutory requirement for an annual report to the Legislature on the progress of the CSI program.² Other state authorized programs, including the New Solar Homes Partnership (NSHP) and publicly-owned utilities' solar offerings, are not included in this report.³

The market for solar generating equipment in California has grown at a rapid pace since the beginning of the CSI program. Through increasing annual rates of new solar installations and cumulative installed capacity over the life of the program, California has already installed enough solar capacity to achieve the CSI General Market Program goal of installing 1,750 MW of capacity by the end of 2016 set forth by the legislation authorizing the CSI program, Senate Bill (SB) 1 (Murray, 2006).

1.2 Key Report Contents

This report contains current information on distributed solar energy systems in California, including systems installed through the CSI General Market program, and those installed through other solar incentive programs. The report includes detailed information on program participation, installed capacity, equipment costs, and program impacts for all the CSI program components, including the General Market program, Single-Family Affordable Solar Homes program (SASH); the Multifamily Affordable Solar Housing program (MASH); the CSI Thermal program; the CSI Thermal Low-income program; and the Research, Development and Demonstration (RD&D) program. This report also includes information on Net Energy Metering (NEM) and other relevant policy updates.

¹ This goal includes the CSI General Market Program goal of installing 1,750 MW of capacity by the end of 2016.

² Public Utilities (PU) Code Section 2851 (c)(3) states, "On or before June 30, 2009, and by June 30th of every year thereafter, the CPUC shall submit to the Legislature an assessment of the success of the California Solar Initiative Program." The CPUC submitted the first CSI Annual Program Assessment on June 30, 2009, available at: (<http://www.cpuc.ca.gov/General.aspx?id=3747>).

³ Information on non-CPUC jurisdictional solar programs is available at (www.gosolarcalifornia.ca.gov).

1.2.1. Installed Solar Highlights

- Through the end of 2015, an estimated 3,570 MW of solar capacity has been installed at 451,597 customer sites in the large investor-owned utility (IOU) territories.⁴
- A record 1,041 MW was installed in 2015 in the IOU territories, 55 percent more than was installed in 2014.⁵
- Between the last quarter of 2008 and the last quarter of 2014, the average cost of installed residential systems has decreased 53 percent from \$10.87 per watt to \$5.14 per watt.⁶ In the same time period, non-residential system costs have decreased 62 percent from an average of \$10.30 per watt to \$3.93 per watt.⁷
- Statewide solar installations continued to increase in 2015 despite the fact that many of the IOU's CSI General Market rebate programs were closed, demonstrating that the program has substantially reached its goal of stimulating widespread adoption of solar and creating a self-sustaining market, free of direct cost-support in the form of program rebates.

1.2.2. CSI General Market Program Highlights

- The CSI General Market program has exceeded its goal of installing 1,750 MW by the end of 2016. As of December 31, 2015, the CSI General Market Program had installed 1,753.6 MW with another 139.7 MW reserved in pending projects.^{8,9}
- Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE) and San Diego Gas and Electric Company (SDG&E)¹⁰ have either reserved or installed enough solar capacity for both their residential and non-residential (commercial, industrial, government, non-profit, and agricultural properties) CSI sub-programs to exceed their installation goals. All General Market sub-programs are now closed to new reservations.¹¹
- As the CSI program nears its end, NEM and the Federal Investment Tax Credit (ITC) are playing a larger role in making customer-sited solar generation cost-effective relative to

⁴ Source: California Solar Statistics - Currently Interconnected Data Set (https://www.californiasolarstatistics.ca.gov/data_downloads/). Data updated May 18, 2016.

⁵ Ibid.

⁶ The capacity figures are based on CEC-AC rating standards, with monetary amounts adjusted for inflation.

⁷ 2014 was the last year in which sample sizes were large enough to produce reliable average system cost data for CSI projects.

⁸ California Solar Statistics – Program Totals, data through December 31, 2015

(https://www.californiasolarstatistics.ca.gov/reports/agency_stats/). Data updated June 1, 2016.

⁹ The overall MW totals exceed the 1,750 MW CSI goal due to additional CSI incentive funding that was authorized in SB 585. This funding was authorized as a result of different rebates being offered to taxable and non-taxable entities, which caused CSI budgeting uncertainty. See D.11-12-019 for more details.

¹⁰ The Center for Sustainable Energy (CSE) administers the CSI Program in SDG&E's service territory.

¹¹ SDG&E's non-residential program was the last CSI General Market sub-program to close on May 9, 2016.

available CSI incentives. A significant portion, 89 percent, of customer-sited solar projects interconnected through the NEM tariff in the three large IOU territories in 2015 without participating in the CSI program.¹²

- Statewide solar installations continued to increase in 2015 despite the declining incentive levels and the fact that many of the IOU’s CSI programs are now closed. This suggests that the CSI program’s use of declining incentive levels as the market matures has been successful.
- In 2015, the CPUC and Program Administrators successfully transferred the responsibility for collecting solar project data from CSI to the NEM interconnection process, per CPUC Decision (D.)14-11-001. The solar data collected through the NEM interconnection process is now downloadable from the California Solar Statistics website, and later this year the website will be further updated so that the new data populates the website’s charts and tables.

1.2.3. Other Program Highlights

- **Single-Family Affordable Solar Homes (SASH)**
 - Since the program was launched in 2008, SASH has completed a total of 5,681 projects, representing 17.2 MW of installed capacity on eligible homes. There are an additional 317 SASH projects in progress, with a total capacity of over 1.0 MW.¹³
 - 100 percent of the original \$92 million SASH incentive budget has been fully subscribed in all three IOU territories.
 - SASH applicants have received or reserved a total of \$6.2 million of the available \$46 million incentive budget authorized for the extended SASH program.

¹² Source: California Solar Statistics – Monthly, Quarterly, and Annual Statistics, data updated June 1, 2016 (https://www.californiasolarstatistics.ca.gov/reports/monthly_stats/); California Solar Statistics - Currently Interconnected Data Set, data updated March 31, 2016 (https://www.californiasolarstatistics.ca.gov/data_downloads/).

¹³ These numbers include both SASH 1.0 and SASH 2.0 projects. A more detailed breakdown between the original SASH 1.0 program and reauthorized SASH 2.0 program can be found in Section 4.2.

- **Multifamily Affordable Solar Housing (MASH)**
 - Since the program was launched in 2008, MASH has completed 372 projects, representing 24.67 MW of installed capacity. There are an additional 214 MASH projects in progress or under review, with a total capacity of 38.6 MW.¹⁴
 - MASH applicants have received or reserved 100 percent of the original \$95 million MASH incentive budget.
 - The additional \$50 million incentive budget authorized for the extended MASH program is also fully subscribed in all three IOU service territories.

- **CSI Thermal Program**
 - Since January 2010, the program has approved 3,407 applications for \$47.5 million in incentives of the available \$205 million CSI Thermal incentive budget.
 - On May 6, 2016, Energy Division approved temporary additional incentives for the installation of solar water heating systems to address the need to reduce natural gas use in the Aliso Canyon impacted area.

- **Research, Development, Demonstration and Deployment (RD&D) Program**
 - The CSI RD&D program has conducted five project solicitations since its inception, resulting in grant funding for 36 projects, totaling \$44.4 million. Funded projects have focused on the following areas:
 - Integration of solar photovoltaics (PV) into the electricity grid
 - Energy generation technologies and business development
 - Grid integration and production technologies
 - No additional project solicitations are planned.

1.2.4. Net Energy Metering (NEM)

- As of December 31, 2015, 3,544 MW out of the 3,825 MW of customer-sited solar capacity interconnected to the grid in the three large IOU territories was enrolled in NEM. Only 7 percent of customer-sited solar capacity was not enrolled in a NEM tariff.
- In January 2016, the CPUC approved D.16-01-044 2016 adopting a NEM successor tariff that continues the existing NEM structure while making adjustments to align the costs of

¹⁴ These numbers include both MASH 1.0 and MASH 2.0 projects. A more detailed breakdown between the original MASH 1.0 program and reauthorized MASH 2.0 program can be found in Section 4.3.

NEM successor customers more closely with those of non-NEM customers. The NEM successor tariff will take effect on the earlier of July 1, 2017, or the date on which a utility reaches its 5% NEM program cap.

2 Introduction

2.1 Background on California Solar Initiative

The CSI program is the solar rebate program for the large California IOUs: PG&E, SCE, and SDG&E. The CSI program incentivizes customer adoption of solar PV systems and solar thermal technologies through financial rebates. Existing residential homes, as well as all commercial, industrial, government, non-profit, and agricultural properties within the service territories of the large electric and gas IOUs are eligible for CSI program participation.¹⁵

The goals of the CSI program are to:

- Install 1,940 MW of distributed solar generation capacity in the large electric IOU service territories, and displace 585 million therms of natural gas usage, or the equivalent output of 200,000 solar thermal systems; and
- Transform the market for solar energy systems to be price competitive and self-sustaining.

The CSI program focuses exclusively on solar energy systems used by IOU customers who want to offset some or all of their onsite energy consumption. In the case of the CSI General Market program, the solar energy systems funded under the program reduce the customer's electricity consumption from the grid. In the case of the solar thermal program, the solar energy systems reduce the customer's gas or electricity consumption, depending upon the customer's energy source for their existing hot water system. The CSI program does not fund wholesale solar power plants, which are designed to serve the electric grid and contribute to the state's Renewables Portfolio Standard (RPS) requirement.¹⁶ The electricity generated by CSI systems, however, does contribute indirectly to California's RPS by reducing demand when serving customer load. In addition, the owner of the CSI system owns the renewable energy credits

¹⁵ The electric-displacing portion of the CSI Program, which covers solar PV and some solar thermal systems, was authorized by the CPUC in a series of regulatory decisions between 2006 and 2011. In addition, the Legislature expressly authorized the CPUC to create the CSI Program in 2006 in SB 1 (Murray, 2006). The gas-displacing solar thermal portion of the CSI was authorized by the Legislature in AB 1470 (Huffman, 2007) and implemented by the CPUC in early 2010 after the required evaluation of a pilot program in the San Diego area.

¹⁶ See SB 2 (2011).

(RECs) associated with the system’s generation and may sell the RECs to retail sellers to contribute to the RPS targets.

2.2 CSI Program Components

The CSI program has several components, as shown in Table 1. Each component has a Program Administrator for each large IOU territory, and its budget is overseen by the CPUC:

- **The CSI General Market Solar Program** provides incentives for residential and non-residential systems from one kilowatt (kW) to one MW. The General Market program Administrators are PG&E, SCE, and Center for Sustainable Energy (CSE) in SDG&E’s territory. The goal of the general market rebate program is to incentivize 1,750 MW of customer-side solar capacity using a ten-year budget of \$2.1 billion for both incentives and program administration. The General Market solar program funds solar PV technologies through the end of 2016.
- **The CSI Single-Family Affordable Solar Homes (SASH) Program** provides solar incentives to qualifying single-family, low-income households. The SASH program is administered through a statewide Program Manager, GRID Alternatives (GRID). The original SASH program had a budget of \$108 million and the reauthorized SASH program has a budget of \$54 million. The SASH program offers job training to volunteers and workforce development participants, and offers competitive opportunities for solar installers through a subcontractor program.
- **The CSI Multifamily Affordable Solar Housing (MASH) Program** provides solar incentives to multifamily low-income housing facilities. The original MASH program had a budget of \$108 million and the newly reauthorized MASH program will have a budget of \$54 million. The MASH program is administered by PG&E, SCE, and CSE (in SDG&E’s service territory). The popularity of this fully subscribed program resulted in the expansion of the VNEM tariffs, which allow a building owner to share bill credits for solar production with the building’s tenants.
- **The CSI Research, Development, Demonstration and Deployment (RD&D) Program** provides grants to develop and deploy solar technologies that can advance the overall goals of the CSI program, including achieving targets for capacity, cost, and a self-sustaining solar industry in California. The RD&D program is administered through the RD&D Program Manager, Itron Inc., and has a budget of \$50 million.
- **The CSI Thermal Program** provides incentives to eligible solar thermal technologies such as gas or electric-displacing solar water heating (solar water heating) systems. The CSI Thermal program has separate sources of funding depending upon whether the project is electric-displacing or gas-displacing. Program Administrators for the CSI

Thermal program are PG&E, SCE and CSE (on behalf of SDG&E) for the the electric-displacing portion of the program, and PG&E, Southern California Gas Company (SoCalGas) and CSE for the gas-displacing portion. The CSI Thermal program now consists of three sub-programs: single-family residential, multifamily/commercial, and solar pool heating. Additionally, there are separate low-income programs for the single-family residential and multifamily/commercial sub-programs.

2.3 CSI Program Budget

The CSI program has two funding streams, depending upon whether the rebated technology displaces electricity or natural gas. The electric portion of the CSI program has a 10-year budget of \$2.4 billion, collected from electric ratepayers as authorized by SB 1 (Murray, 2006). AB 217 (Bradford, 2013) extended the CSI low-income programs with \$108 million in new funding, to continue until the incentives are claimed or 2021, whichever is earlier. The natural gas-displacing portion of the CSI program, known as CSI Thermal, is funded by AB 1470 (Huffman, 2007), which authorized \$250 million in incentives for solar thermal technologies to be collected from gas ratepayers through 2017.

Table 1: CSI Budget by Program Component

Program Component	Budget*** (\$ Millions)	Goal
General Market Solar Program (includes PV and electric-displacing solar thermal technologies)	\$2,098	1,750 MW
Single-family Affordable Solar Homes (SASH)	\$108	95 MW*
Multifamily Affordable Solar Housing (MASH)	\$108	95 MW*
Research, Development, Demonstration, and Deployment (RD&D)	\$50	N/A
Solar water heating Pilot Program (SWHPP)**	\$2.6	750 systems
Sub-Total: CSI Electric Budget (Electric-Displacing)	\$2,367	1,940 MW
CSI Thermal Program (Gas-Displacing)	\$250	200,000 systems
Total CSI Budget	\$2,617	
Re-authorized SASH Program	\$54	15 MW
Re-authorized MASH Program	\$54	35 MW
Total CSI Budget including re-authorized SASH/MASH programs	\$2,724	

Notes: CPUC D.06-12-033 established a 1,750 MW goal for the General Market Program and a 1,940 MW goal for the overall CSI program. D.10-01-022 established the CSI Thermal Program pursuant to AB 1470. D.11-12-019 approved an extra \$200 million of funding for the CSI General Market program. D.15-01-027 reauthorized \$108 million in additional funds for the CSI low-income programs and adopted a 50 MW low-income capacity goal separate from the CSI goals established in SB 1.

*The CPUC decisions on MASH and SASH did not explicitly adopt a 95 MW per program goal; however, the CPUC did adopt a total CSI program goal of 1,940 MW in D.06-12-033.

**The SWHPP was a pilot program that preceded the CSI Thermal Program and is now closed.

***Total budget over life of program

In most cases, the budgets are allocated across the IOUs in proportion to their annual electric sales: PG&E at 43.7 percent, SCE at 46.0 percent, and SDG&E at 10.3 percent.

Weekly and daily budget updates for the CSI General Market incentive buckets are available online at (http://www.californiasolarstatistics.ca.gov/reports/budget_forecast/) and budget updates for the CSI Thermal incentive buckets are available online at (<http://csithermalstats.org/>). The online reports provide each program's capacity goals, original dollar allocations, and capacity and dollars confirmed, under review, and remaining. The sites also break down the CSI dollars confirmed, under review, and paid, according to the type of project and sub-program.

2.4 CSI Program Regulatory Process

Between 2006 and 2015, the CPUC adopted a number of regulatory decisions establishing the CSI program, as well as various CSI program components.¹⁷ Rules and procedures for the CSI program are currently developed within Rulemaking (R.)12-11-005.

In addition to formal regulatory decisions, the CPUC and CSI Program Administrators have made numerous CSI program changes based on regular informal feedback from program stakeholders and in response to issues that arise during program implementation. To gather feedback on the program, the CSI Program Administrators host quarterly public CSI program forums to discuss potential program changes with stakeholders.

The Program Administrators periodically file requests with the CPUC to change program rules. These requests are referred to as advice letters and are consistent with the CPUC-established CSI program Handbook process. The advice letters are processed by CPUC staff in accordance with General Order (G.O.) 96-B.¹⁸ As a result, the CPUC has revised and reissued the CSI program Handbook numerous times since the program first began.

2.4.1.CSI General Market Program Decisions

Key CPUC decisions related to the CSI program include (but are not limited to):

- D.06-01-024 adopted the CSI program.

¹⁷ The CPUC has developed the CSI Program in a series of Rulemakings (R.) since 2006, including R.08-03-008 and R.06-03-004, with precedents from earlier proceedings such as R.04-03-017. Each of the decisions noted herein occurs in one of those dockets, unless otherwise noted.

¹⁸ See, General Order 96-B here: http://docs.cpuc.ca.gov/PUBLISHED/GENERAL_ORDER/164747.htm

- D.06-08-028 adopted Performance-based Incentives (PBI), an administrative structure, and other program start-up elements.
- D.06-12-033 modified earlier decisions to conform to SB 1.
- D.07-05-007 modified the incentive adjustment mechanism to account for program dropouts.
- D.07-05-047 established interim marketing and outreach objectives for the program.
- D.07-07-028 and D.08-01-030 modified metering and performance monitoring requirements for the program.
- On July 29, 2008, the Assigned Commissioner issued a Ruling establishing a Evaluation Plan for the CSI program.
- D.10-09-046 modified the CSI General Market budget, and shifted \$40 million from the program administration budget into the incentive budget as partial mitigation for higher than anticipated performance payments under the PBI mechanism.
- D.11-07-031 modified prior CSI decisions, including D.06-08-033 and D.08-10-036, based on a comprehensive CPUC staff proposal.
- D.11-12-019 modified the CSI budget requirement, effectively adding \$200 million in rebate funding, in response to SB 585 (Kehoe, 2011).
- D.13-10-026 modified the CSI budget requirement in response to a petition for modification submitted by the Center for Sustainable Energy.
- D.13-10-026 modified the CSI General Market budget.
- D.14-11-001 transferred the responsibility for collecting solar statistics from CSI to the NEM interconnection process.
- D.15-12-023 shortened the Performance-Based Incentive Payment of the CSI Programs.

2.4.2. Other CSI Program Component Decisions

- D.06-08-028 established the Solar water heating Pilot program in SDG&E territory.
- D.07-09-042 established the CSI RD&D program.
- D.07-11-045 established the CSI SASH program.
- D.08-10-036 established the CSI MASH program.
- D.10-01-022 established the CSI Thermal program to provide solar water heating incentives statewide.
- D.11-10-015 established the Low-income Solar water heating Component of the CSI Thermal program.
- D.11-11-005 established the eligibility of propane-displacing technologies for the CSI Thermal program.
- D.12-08-008 modified incentives for the CSI Thermal program.
- D.13-02-018 established a PBI structure for the CSI Thermal program and expanded program eligibility to process heat, solar cooling and combination systems.
- D.13-08-004 established the eligibility of swimming pool technologies for the CSI Thermal program.

- D.14-03-041 established a transition period pursuant to AB 327 for customers enrolled in NEM tariffs.
- D.15-01-027 extended the CSI MASH and SASH programs.
- D.15-01-035 increased early-stage CSI Thermal incentives and revised the CSI Thermal sub-program budgets.
- D.15-10-004 expanded the eligibility requirements of the CSI Thermal Programs for a single-family low income customer.
- D.16-01-044 adopted a NEM successor tariff that continues the existing NEM structure while making adjustments to align the costs of NEM successor customers more closely with those of non-NEM customers.

3 Solar Installed Through 2015

This section of the report summarizes data on the cumulative installed capacity¹⁹ and number of solar projects installed in California IOU territories and provides a table showing all customer-sited solar generation installed statewide. The IOU data includes solar projects interconnected under any of the IOU non-wholesale solar programs, including CSI, New Solar Homes Partnership (NSHP), Emerging Renewables Program (ERP), and the SGIP. IOU data does not include solar projects installed in Publicly-Owned Utility (POU) areas, such as Los Angeles Department of Water and Power (LADWP) or Sacramento Municipal Utility District (SMUD), nor does it include data from multi-jurisdictional utilities, such as Pacific Power’s California Solar Incentive Program (CSIP).²⁰ However, any references to “statewide” data in this report include solar installations within POU service territories.²¹

3.1 Investor-Owned Utility Territory Solar Installations

Through the end of 2015, there were an estimated 3,570 MW of solar capacity installed at 451,597 sites in the IOU territories.²²

Figure 1 shows the amount of solar capacity installed by customers by year in IOU territories. This figure relies on interconnection data submitted to the CPUC by the utilities (rather than data specific to the CSI program featured elsewhere in this report), and it does not distinguish which

¹⁹ All data in this assessment are for grid-tied solar PV (i.e., interconnected to the utility grid), unless otherwise noted. All solar in this report is customer-side of the meter self-generation designed to serve onsite load. All references to capacity are reported in “CEC-AC” units, which is the industry standard for net electricity output in MW based on the California Energy Commission’s Alternating Current rating of solar panels. The “CEC-AC” rating tends to be slightly less than the nameplate capacity.

²⁰ The CSIP is authorized to provide incentives for 4 MW of solar energy through July 1, 2015.

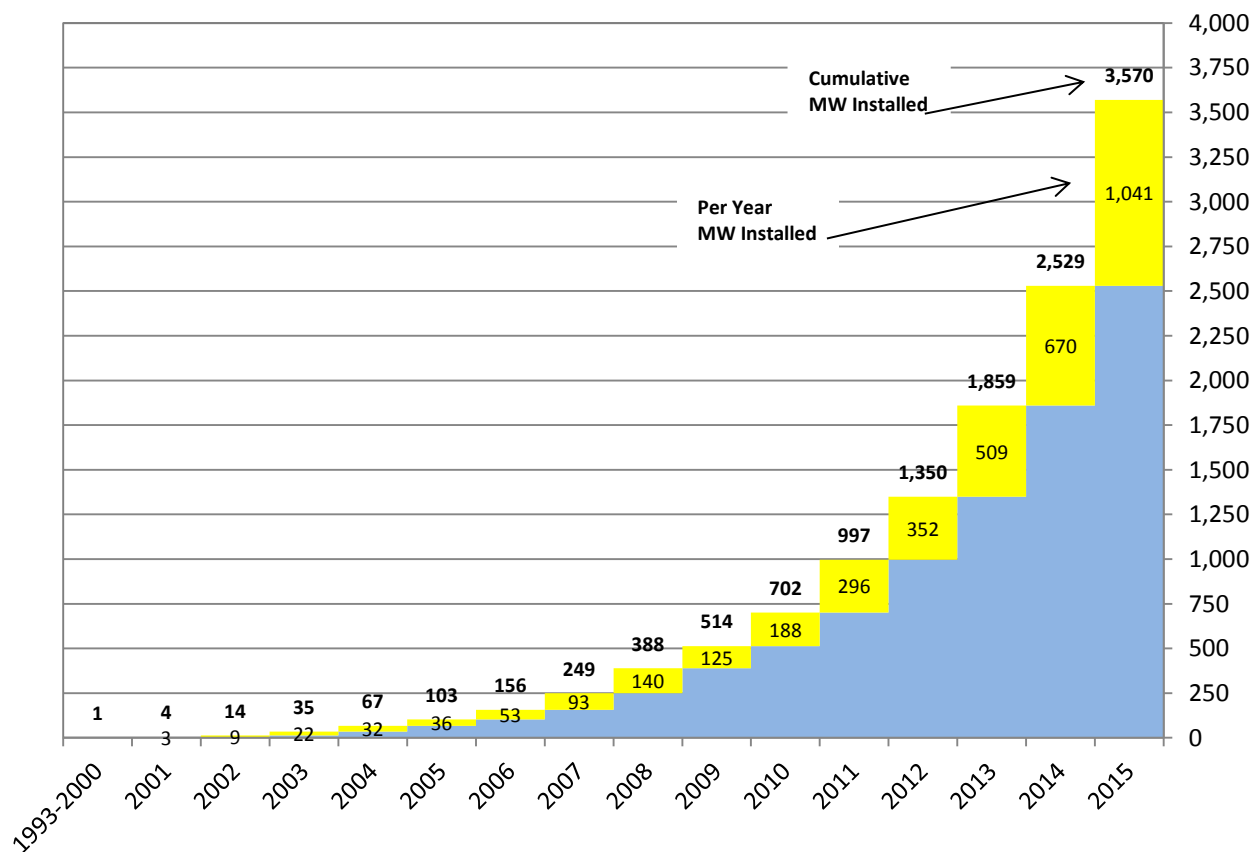
²¹ Data on the POU’s customer-sited solar programs can be found on the CEC’s website at: (http://www.energy.ca.gov/sb1/pou_reports/index.html.)

²² Source: California Solar Statistics - Currently Interconnected Data Set (https://www.californiasolarstatistics.ca.gov/data_downloads/). Data updated May 18, 2016.

solar program provided funding for the solar project. Customers installed 1,041 MW in 2015, a 55 percent increase in annual installed capacity from 2014.²³ This is a significant increase over the prior year, when there was a 31 percent increase in installations from 2013 to 2014.

Figure 2 uses the same data as Figure 1, but shows the data as the number of installations. There were 149,331 solar projects installed in the IOU territories in 2015, 57 percent more than were installed in 2014. All of the solar capacity identified in Figures 1 and 2 is installed on customer sites, and does not include customer-sited installations in POU territories or solar power plants installed on the wholesale side of the meter for use in compliance with the RPS.

Figure 1: Customer-Sited Solar MW Installed Capacity in CA’s IOU Territories, 1993-2015



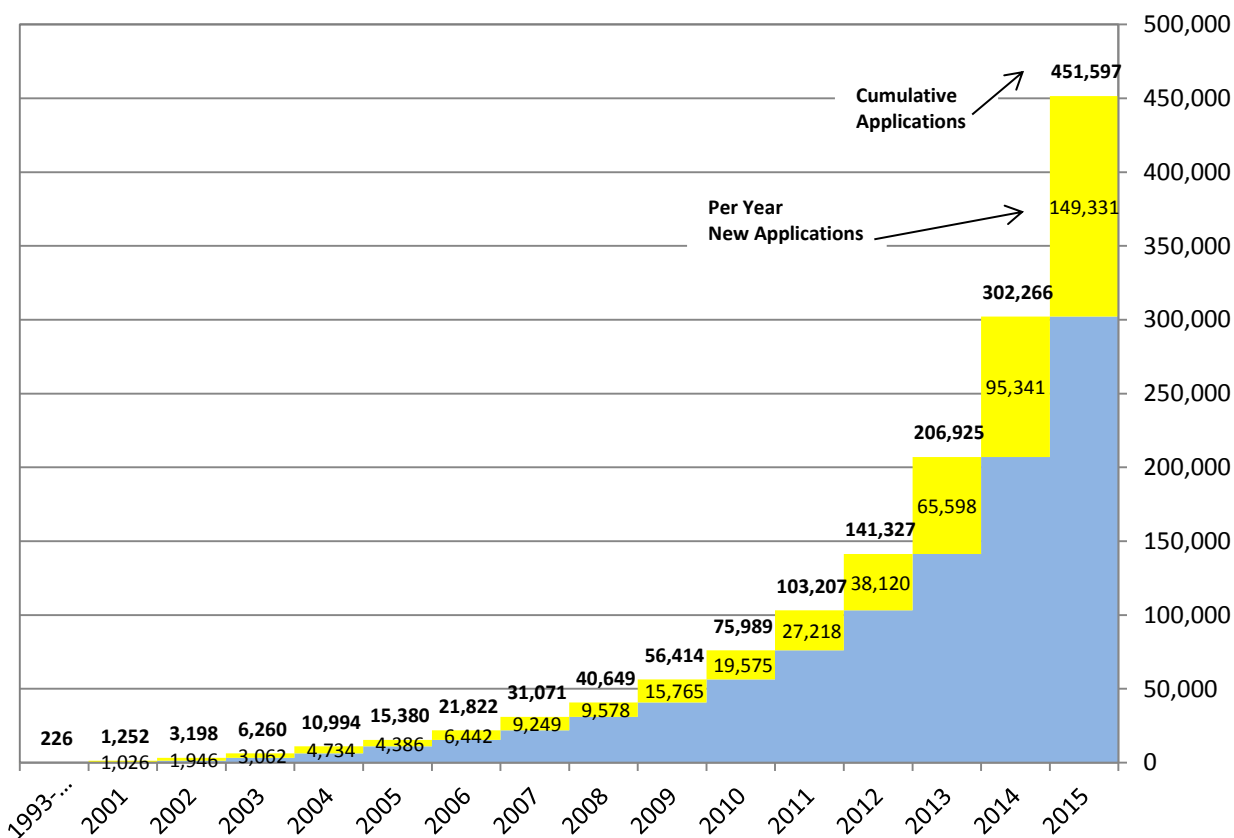
Source: California Solar Statistics - Currently Interconnected Data Set

(https://www.californiasolarstatistics.ca.gov/data_downloads/).

Notes: Data includes all interconnected solar PV (NEM) systems within PG&E, SCE, and SDG&E service territories. Data does not include wholesale systems or systems within POU territories.

²³ Source: California Solar Statistics - Currently Interconnected Data Set (https://www.californiasolarstatistics.ca.gov/data_downloads/). Data updated May 18, 2016.

Figure 2: Number of Installed Customer-Sited Solar Projects in CA's IOU Territories, 1993-2015



Source: California Solar Statistics - Currently Interconnected Data Set (https://www.californiasolarstatistics.ca.gov/data_downloads/).

Notes: Data includes all interconnected solar PV (NEM) systems within PG&E, SCE, and SDG&E service territories. Data does not include wholesale systems or systems within POU territories.

3.2 Net Energy Metering

3.2.1. Program Background

The vast majority of solar customers are enrolled in NEM tariffs, established under Public Utilities Code (PU Code) Section 2827. The NEM program supports onsite solar installations up to 1 MW in capacity designed to offset a portion, or all, of the customer’s electrical load. CSI program participants are eligible for utility interconnection and NEM tariffs that facilitate solar by allowing solar customers to feed limited amounts of excess electricity into the grid. Under NEM, customers receive a bill credit (in dollars) based on the full retail rate (including generation, transmission, and distribution rate components) for any excess generation (in kWh) that is exported back to the grid. In periods when a customer’s bill is negative (because the value of the energy produced by the distributed generation facility exceeds the value of the energy consumed on site), the negative balance is carried forward up to one year, at which point

customers may elect to receive net surplus compensation for any electricity produced in excess of on-site load, or apply the net surplus compensation credit towards future consumption.

Some solar projects, especially those that are unlikely to export generation to the electric grid, opt to take utility service under a non-NEM tariff. Table 2 shows the total solar interconnections compared to the number of interconnected systems on solar NEM tariffs in IOU territories. Only 281 MW, or 7 percent, of customer-sited solar capacity in the state does not take service under a NEM tariff.

Table 2: Solar Interconnections and Solar NEM Projects through December 31, 2015

	MWs Interconnected	Projects Interconnected	MWs on NEM tariffs	Projects on NEM Tariffs
PG&E	1,874 MW	219,705	1,807 MW	219,395
SCE	1,412 MW	158,775	1,198 MW	158,620
SDG&E	539 MW	75,898	539 MW	75,807
Total	3,825 MW	454,378	3,544 MW	453,822

Source: IOU Quarterly Interconnection Reports 2015 Q4. Data is through December 31, 2015.

Notes: Data includes all interconnected solar PV systems within PG&E, SCE, and SDG&E service territories. Data does not include wholesale systems or systems within POU territories.

3.2.2. NEM Program Cap

Pursuant to AB 327 (Perea, 2013), every large electrical corporation is required to make a NEM tariff available to eligible customer-generators until July 1, 2017, or the date when a utility reaches its 5 percent NEM program cap, whichever is earlier. Table 3 shows the IOUs’ current progress towards the 5 percent NEM program cap.

Table 3: Progress Towards the 5 Percent NEM Program Cap²⁴

	MWs on NEM Tariffs	Aggregate Customer Peak Demand	Percentage Achieved
PG&E	2,027 MW	48,177 MW	4.21%
SCE	1,391 MW	44,807 MW	3.10%
SDG&E	565 MW	12,340 MW	4.58%

Source: IOU NEM progress reports through April 2016.

AB 327 also directs the CPUC to establish a transition period for customers enrolled in the current NEM program, and to adopt a successor tariff or contract to NEM by December 31, 2015. The successor tariff or standard contract to NEM will take effect on the earlier of July 1,

²⁴ The NEM program cap is reached when the total installed NEM capacity exceeds 5% of the total non-coincident peak demand of every customer within an IOU’s territory.

2017, or the date on which a utility reaches its 5% NEM program cap. In March 2014, the CPUC adopted D.14-03-041, establishing a 20-year transition period for customers to remain on NEM tariffs.²⁵ Specifically, the decision established a transition period of 20 years, beginning the year the system was interconnected, during which participating systems may continue to take service under NEM.

3.2.3. NEM Successor Tariff

In January 2016, the CPUC approved D.16-01-044 2016 adopting a NEM successor tariff that continues the existing NEM structure while making adjustments to align the costs of NEM successor customers more closely with those of non-NEM customers. The Decision added a number of new elements to the NEM tariff, including the following:

- Customers with systems under 1 MW²⁶ will pay a pre-approved one-time interconnection fee, based on each IOU's historical interconnection costs. The fee will likely be approximately \$75 - \$150.²⁷
- NEM successor customers must pay non-bypassable charges on each kilowatt-hour (kWh) of electricity they consume from the grid in each metered interval.
- All residential NEM successor customers must take service on an available time of use rate.

Customers are eligible to continue enrolling in the current NEM tariff until the earlier of July, 2017 or the date on which their utility reaches its NEM program cap. After this date, the NEM successor tariff will be available to new customers.

3.3 California Statewide Solar Installations

By the end of 2015, California had installed over 3,886 MW of solar capacity at over 488,541 customer sites. As detailed in Table 4, this statewide solar data combines information on IOU interconnections through 2015 with data on POU solar installations through 2014. The CPUC tracks IOU interconnection data on a quarterly basis and CSI program data is available weekly. POU solar data is collected by the California Energy Commission (CEC), and the information for the previous year's installations is published annually in July. The statistics shown in Table 4 provide the best available minimum estimate of California statewide solar installations.

²⁵ See (<http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M089/K386/89386131.PDF>).

²⁶ The Decision extends eligibility for the NEM successor tariff to eligible systems larger than 1 MW in size, however these customers are required to pay all Rule 21 interconnection study and distribution system upgrade fees for the facility.

²⁷ Each IOU has proposed the amount of its interconnection fee via Advice Letter, which are pending CPUC approval at the time of this report.

Table 4: California Statewide Solar Installations

Data Source and Dates	Total MWs	Total Projects
Solar Installations in California IOU Territories		
All IOU Interconnections, 1993-2015	3,570	451,597
Solar Installations in California POU Territories		
CEC through 2014	316	36,944
Total California Solar Installations	3,886	488,541

Sources: Currently Interconnected Data Set (https://www.californiasolarstatistics.ca.gov/data_downloads/) and Publicly Owned Utilities Report Summary, January 1, 2014 to December 31, 2014 (http://www.energy.ca.gov/sb1/pou_reports/index.html).

4 CSI Program Components

The overarching CSI program contains multiple program components, or sub-programs. These include the CSI General Market program, which provides incentives to solar electric technologies. The CSI program also includes the CSI Thermal program, which provides incentives to solar thermal technologies that displace electricity and gas usage. Both the CSI General Market and CSI Thermal programs also include low-income components. These programs are discussed in more detail below.

4.1 General Market Solar Program

4.1.1. General Market Program Background

The CSI General Market solar program is the largest CSI program component. It offers incentives to all eligible customers in the large IOU territories who install solar electric generating systems (typically PV) on their property. These incentives are based on either the actual or expected performance of a solar system, so that higher performing systems receive a larger incentive than lower performing systems. The emphasis on performance in the CSI program is designed to optimize California ratepayer investment in solar. In addition, the CSI program requires program participants to complete energy efficiency audits before installing their systems to encourage applicants to invest in cost-effective energy efficiency measures prior to sizing their solar system, consistent with the state's Energy Action Plan and "loading order."²⁸

The General Market program is divided into residential and non-residential programs and is administered by three Program Administrators: PG&E, SCE and CSE. CSE administers the CSI program in SDG&E's service territory. Through December 31, 2015, the CSI program has

²⁸ The "loading order" was introduced in the Energy Action Plan, which was jointly adopted in 2003 by the CPUC, the CEC and the California Power Authority. The loading order is a list of preferred energy resources - the first of which is energy efficiency.

achieved a total of 1,753.6 MW of installed capacity since program inception.²⁹ This was achieved through installations in the General Market, SASH and MASH programs.

On May 9, 2016, the last of the General Market sub-programs became fully subscribed and closed to new applications, marking the conclusion of the General Market program. Moving forward, the CPUC will continue to work with utilities to execute Assembly Bill 217 (Bradford, 2013), implemented through Decision D.15-01-027, which authorized the utilities to use General Market program funds that remain unencumbered after December 31, 2016, to reduce the amounts collected for funding the Multifamily Affordable Solar Housing Program and Single Family Affordable Solar Homes programs. The CPUC will also initiate a final impact evaluation to study the General Market Program’s impact on solar deployment and the solar industry in California. Quarterly newsletters published by utilities will end in 2016.

4.1.1.1 General Market Incentive Types

The CSI General Market program pays solar energy system owners an incentive based on system performance. The incentives are either an upfront lump-sum payment based on expected performance, or a monthly payment based on actual performance over five years.

The Expected Performance Based Buy down (EPBB) incentive is the upfront lump-sum incentive and is available only for smaller (less than 30 kW) systems. The EPBB incentive is a capacity-based incentive that is adjusted based on expected system performance calculated using an EPBB calculator.³⁰ The calculator considers major design characteristics of the solar energy system, such as panel type, installation tilt, shading, orientation, and solar insolation available by location.

The second type of incentive is a performance based incentive (PBI), which is paid out based on actual measured performance of a solar energy system over the course of five years. The PBI is paid on a fixed dollar per kilowatt-hour (\$/kWh) of generation basis and is the required incentive type for larger systems, although smaller systems may opt to be paid based on PBI. Beginning in January 2010, all systems 30 kW and larger have been required to take the PBI incentive. Because PBI systems are large solar arrays that primarily serve commercial and institutional customers, cumulative payments to PBI system owners sometimes exceed one million dollars per project. The average reserved incentive for PBI systems from the beginning of the CSI program to December 31, 2015 was \$285,390.³¹

²⁹ California Solar Statistics – Program Totals (https://www.californiasolarstatistics.ca.gov/reports/agency_stats/). Data updated June 1, 2016.

³⁰ The EPBB calculator is publicly available at <http://www.csi-epbb.com/>.

³¹ Source: California Solar Statistics - CSI Working Data Set (https://www.californiasolarstatistics.ca.gov/data_downloads/). Data updated May 18, 2016. Calculation includes only projects reported as “In Payment” by December 31, 2015.

4.1.1.2 General Market Incentive Level Design

The CSI program’s financial incentives decline in steps as more capacity is installed. The declining incentives, required by PU Code Section 2851, are intended to help the program meet its goal of creating a self-sustaining solar industry by reducing rebates as the solar industry grows. Each step has an installed MW target that triggers the subsequent step down in incentive level. The capacity targets per incentive step are further broken down into allocations across customer type and across the three IOU service territories. Table 5 presents the rebate levels by incentive step, rebate type (EPBB or PBI), and customer sector. It is worth noting that the EPBB rebates in step 10 for residential and commercial are less than 5% of the average system installed cost.

Table 5: CSI Rebate Levels by Incentive Step and Rebate Type

Step	Statewide MW in Step	EPBB Payments (per Watt)			PBI Payments (per kWh)		
		Residential	Non-Residential		Residential	Non-Residential	
			Commercial	Government/ Non-Profit		Commercial	Government/ Non-Profit
1	50	n/a	n/a	n/a	n/a	n/a	n/a
2	70	\$2.50	\$2.50	\$3.25	\$0.39	\$0.39	\$0.50
3	100	\$2.20	\$2.20	\$2.95	\$0.34	\$0.34	\$0.46
4	130	\$1.90	\$1.90	\$2.65	\$0.26	\$0.26	\$0.37
5	160	\$1.55	\$1.55	\$2.30	\$0.22	\$0.22	\$0.32
6	190	\$1.10	\$1.10	\$1.85	\$0.15	\$0.15	\$0.26
7	215	\$0.65	\$0.65	\$1.40	\$0.09	\$0.09	\$0.19
8**	250	\$0.35	\$0.35	\$1.10	\$0.05 (a)/\$0.044 (b)	\$0.05 (a)/\$0.044 (b)	\$0.15 (a)/\$0.139 (b)
9**	285	\$0.25	\$0.25	\$0.90	\$0.03 (a)/\$0.032 (b)	\$0.03 (a)/\$0.032 (b)	\$0.12 (a)/\$0.114 (b)
10**	350	\$0.20	\$0.20	\$0.70	\$0.025	\$0.025	\$0.088

*The non-residential customer class includes commercial, private, government, and non-profit participants.

**Per Senate Bill 585, PBI payments have been revised to reflect a 4% discount rate which creates new PBI rates for Steps 8, 9, & 10. Steps 8a and 9a are the original CSI incentive rates, while 8b and 9b are the revised rates. In compliance with the Final Decision released by the California Public Utilities Commission, these new incentive rates are effective 12/2/2011.

Source: California Solar Initiative - Statewide Trigger Tracker (<http://www.csi-trigger.com/>).

Table 6 presents the capacity target by utility territory and customer class, showing how all of the incentives were originally allocated over the expected 10-step life of the program. Actual allocations by step have varied due to dropouts and other factors.

Table 6: CSI General Market MW Targets by Utility and Customer Class

Step	MW in Step	PG&E (MW)		SCE (MW)		SDG&E (MW)	
		Res	Non-Res	Res	Non-Res	Res	Non-Res
1	50	--	--	--	--	--	--
2	70	10.1	20.5	10.6	21.6	2.4	4.8
3	100	14.4	29.3	15.2	30.8	3.4	6.9
4	130	18.7	38.1	19.7	40.1	4.4	9
5	160	23.1	46.8	24.3	49.3	5.4	11
6	190	27.4	55.6	28.8	58.6	6.5	13.1
7	215	31	62.9	32.6	66.3	7.3	14.8
8	250	36.1	73.2	38	77.1	8.5	17.3
9	285	41.1	83.4	43.3	87.8	9.7	19.7
10	350	50.5	102.5	53.1	107.9	11.9	24.2
Subtotals (Res and Non-Res)		252.4	512.3	265.6	539.5	59.5	120.8
Totals		764.8		805		180.3	
Percent		43.7%		46.0%		10.3%	

Source: D.06-12-033, Appendix B, Table 11.

Notes: The MWs for Incentive Step 1 were reserved under the Self-Generation Incentive program in 2006. Non-Residential (Non-Res) includes commercial, government, and non-profit facilities.

Once the incentives reserved for each customer class within a utility territory reach the capacity target for a given step, the incentive level offered drops to the next lower step. Once the MW capacity in step 10 has been reserved, the program closes or the program administrator can elect to open a waitlist.

As indicated in Table 7, PG&E, SDG&E and SCE's CSI programs are fully subscribed and are no longer accepting applications. SDG&E's non-residential program was the last to close on May 9, 2016.

Table 7: Current General Market Statewide Solar Incentive Levels

Program Administrator	Customer Class	Current Step	EPBB Incentive Value (\$/Watt)	PBI Incentive Value (\$/kWh)	MW Remaining in Step	MW Under Review
CSE (on behalf of SDG&E)	Residential					Program Fully-Subscribed*
	Commercial					
	Government/ Tax-exempt					
PG&E	Residential					Program Fully-Subscribed*
	Commercial					
	Government/ Tax-exempt					
SCE	Residential					Program Fully-Subscribed*
	Commercial					
	Government/ Tax-exempt					

Source: California Solar Initiative - Statewide Trigger Tracker (<http://www.csi-trigger.com/>).

4.1.2. General Market Program Progress

All six General Market sub-programs have exceeded their capacity targets. Table 8 denotes the amount of MW that are either actively reserved or completed in each step and will be paid out at the given incentive level, compared to the original number of MW allocated to the step set by CPUC decision D.06-12-033. The "Actual" MW numbers are equal to the "Original" MW numbers minus dropouts from previous steps.

Table 8: Incentive MW Available by Step, by Program Administrator and Customer Class

Step	MW In Step	PG&E (MW)				SCE (MW)				CSE in SDG&E Territory (MW)			
		Residential		Non-Residential		Residential		Non-Residential		Residential		Non-Residential	
		Original	Actual	Original	Actual	Original	Actual	Original	Actual	Original	Actual	Original	Actual
1	50	0.0	0.0	27.8	11.4	0.1	0.0	12.4	6.0	0.0	0.0	6.4	0.9
2	70	10.1	11.9	20.5	17.6	10.6	9.3	21.6	15.4	2.4	2.2	4.8	7.0
3	100	14.4	13.0	29.3	21.8	15.2	14.1	30.8	24.8	3.4	3.3	6.9	4.3
4	130	18.7	17.9	38.1	28.2	19.7	19.3	40.1	19.9	4.4	4.3	9.0	5.2
5	160	23.1	22.8	46.8	51.5	24.3	22.0	49.3	69.4	5.4	5.1	11.0	14.6
6	190	27.4	26.3	55.6	68.1	28.8	23.7	58.6	38.4	6.5	5.8	13.1	9.1
7	215	31.0	28.2	62.9	61.9	32.6	30.9	66.3	62.0	7.3	6.6	14.8	13.9
8	250	36.1	38.2	73.2	69.0	38.0	40.6	77.1	105.3	8.5	9.2	17.3	25.3
9	285	41.1	45.0	83.4	83.0	43.3	42.1	87.8	90.7	9.7	9.9	18.9	18.8
10	350	50.5	68.1	102.5	132.3	53.1	97.4	107.9	211.1	36.9	48.3	8.2	12.4
Subtotal													
Totals		764.7				805.1				180.3			
Percent		43.7%				46.0%				10.3%			

Source: California Solar Initiative - Statewide Trigger Tracker (<http://csi-trigger.com/dataAnnex.aspx>). Last updated 5/26/2016.

The charts and tables in this section illustrate the CSI General Market solar program progress to date, with data from the California Solar Statistics (CSS) web page.³² In addition, the CSI program releases a Data Annex annually with key program application processing metrics, such as application processing times.³³ The CSS website and the Data Annex are discussed further in Section 5.1.

There are many ways to measure the progress of the CSI General Market program, including progress towards the two stated goals of the program: 1) Install 1,750 MW of solar PV capacity; and 2) Transform the market for solar to be price competitive and sustainable. This section reports on the installations, pending and complete, the solar price trends, program participation rates, and program budgets, as well as the program’s effect on the transformation of the solar market. The CSI Measurement and Evaluation (M&E) program component performs more detailed analyses, including cost benefit analyses, impact analyses, and other studies intended to help understand and improve the program’s performance.³⁴ The progress of the M&E component is reported in Section 5.2.

³² California Solar Statistics can be accessed here: (www.californiasolarstatistics.ca.gov).

³³ The current Data Annex can be accessed here: (http://www.californiasolarstatistics.ca.gov/reports/data_annex/).

³⁴ All CSI Program Measurement and Evaluation reports are available at (<http://www.cpuc.ca.gov/General.aspx?id=7623>).

4.1.2.1 General Market Program Trends

Several trends have emerged since the CSI program’s inception in 2007 suggesting that the program has substantially reached its goal of stimulating widespread adoption of solar and creating a self-sustaining market, free of direct cost-support in the form of program rebates.³⁵

4.1.2.2 Average System Costs for Program Participants

Between the last quarter of 2008 and the last quarter of 2014, the average cost of installed residential systems decreased 53 percent from \$10.87 per watt to \$5.14 per watt (CEC-AC, with figures adjusted for inflation). In the same time period, non-residential system costs decreased 62 percent from an average of \$10.30 per watt to \$3.93 per watt. These significant cost decreases point to the success of the CSI in contributing towards a sustainable solar industry in California.³⁶

Since July 2010, the CSI program has imposed a “soft cap” on per watt system costs to encourage an ongoing reduction in system costs. If an application comes in above the cap, the applicant must submit an explanation for the high cost; the host customer must acknowledge that the project is higher than the cap; and the Program Administrator must find the explanation reasonable.

As directed by SB 585, the CPUC revised the methodology to calculate the system cost cap to be based on national and state installed cost data. The cost cap was originally set at two standard deviations above the program’s average cost per watt, but was lowered by CPUC Resolution E-4476³⁷ to \$1.00 per watt above the 12-month rolling average of CSI system costs. In addition, the CPUC set separate cost caps for residential and non-residential projects by calculating this average cost for systems under 10 kW (largely residential projects) and for those over 10 kW (largely non-residential projects). These average cost figures are recalculated and published on www.californiasolarstatistics.ca.gov on a weekly basis.

³⁵ The solar industry may continue to require the support of Federal Tax Credits and Net Energy Metering, or a successor tariff, for a longer term before achieving self-sustainability.

³⁶ 2014 was the last year in which sample sizes were large enough to produce reliable average system cost data for CSI projects.

³⁷ See, http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_RESOLUTION/167385.PDF

4.1.2.3 Solar Installations outside the CSI Program

Since many of the CSI sub-program incentives have been exhausted over the last few years, a significant portion of customer-sited solar projects have interconnected through the NEM tariff in the three large IOU territories without participating in the CSI program.³⁸ Table 9 below shows that 89 percent of customer-sited solar projects interconnected in 2015 did not receive any CSI incentives. Furthermore, statewide solar installations increased in 2015 even though the majority of the IOUs' CSI sub-programs had exhausted all of their funding.

Table 9: Solar PV Capacity Installed in 2015: CSI vs. Non-CSI

	CSI	Non-CSI	Installations not receiving CSI rebates
PG&E	31.6 MW	465.6 MW	94%
SCE	64.9 MW	310.1 MW	83%
SDG&E	22.7 MW	146.1 MW	87%
Total	119.2 MW	921.8 MW	89%

Sources: CSI installed capacity from California Solar Statistics – Monthly, Quarterly, and Annual Statistics, data updated June 1, 2016 (https://www.californiasolarstatistics.ca.gov/reports/monthly_stats/); Non-CSI installed capacity from Solar Statistics - Currently Interconnected Data Set, data updated March 31, 2016 (https://www.californiasolarstatistics.ca.gov/data_downloads/).

4.1.2.4 General Market Program Activity

The CSI General Market program has exceeded the program goal of installing 1,750 MW by the end of 2016. Table 10 shows the program's current progress. As of December 31, 2015, the CSI General Market had installed 1,753.6 MW of capacity, with 139.7 MW of applications pending approval.

³⁸ Note: Participation in the CSI Program is not a requirement for customers installing solar energy systems.

Table 10: All CSI General Market Projects Pending and Installed through December 31, 2015

Installed Projects	
Applications	142,804
Capacity (MW)	1,753.6
Incentive (\$ million)	\$1,782
Pending Projects	
Applications	407
Capacity (MW)	139.7
Incentive (\$ million)	\$39
Total CSI Activity	
Applications	143,211
Capacity (MW)	1,893.4
Incentive (\$ million)	\$1,821

Source: California Solar Statistics – Program Totals, data through December 31, 2015
https://www.californiasolarstatistics.ca.gov/reports/agency_stats/. Data updated June 1, 2016.

Statewide solar installations continued to increase in 2015 despite the declining incentive levels and the fact that many of the IOU's CSI programs are now closed. This suggests that the CSI program's use of declining incentive levels as the market matures has been successful. In the final incentive steps of the CSI, NEM and the Federal ITC provide a much greater level of financial support to solar projects than the CSI incentives.

Table 11: CSI General Market Applications Received by Year (MW)

Year	Annual Stats - Capacity (MW)		
	Non-Residential	Residential	Total
2006	18.4	0	18.4
2007	104.5	30	134.5
2008	65.1	43.2	108.3
2009	88.5	63.6	152.1
2010	271.4	90.6	362
2011	122	101	223
2012	130	165.8	295.8
2013	126	168	294
2014	222.5	32.1	254.6
2015	61.6	2.7	64.3

Source: California Solar Statistics – Monthly, Quarterly, and Annual Statistics, data through December 31, 2015
https://www.californiasolarstatistics.ca.gov/reports/monthly_stats/.

4.1.2.5 General Market Progress towards Program Goals

The CSI General Market program has exceeded its goal of installing 1,750 MW by the end of 2016. As of December 31, 2015, the CSI General Market Program had installed 1,753.6 MW with another 139.7 MW reserved in pending projects.³⁹ On May 9, 2016, SDG&E’s non-residential program became fully subscribed and closed to new applications, the last of the General Market sub-programs to do so. All six sub-programs have exceeded their installation goals and are now closed to new applications.

Table 12: CSI General Market Progress toward IOU Program Goals as of December 31, 2015

	Goal (MW)	Installed (MW)	Pending (MW)
SCE	805	769.7	116.5
Non-Residential	539	447.4	116.1
Residential	266	322.3	0.5
PG&E	764	789.9	5.1
Non-Residential	512	511.7	5.1
Residential	252	278.1	0
SDG&E (CSE)	181	194.2	18.1
Non-Residential	96	98.3	18
Residential	85	95.9	0.1
Total	1,750	1753.6	139.7

Sources: Program goals from California Solar Statistics – Program Goals, data updated May 18, 2016 (https://www.californiasolarstatistics.ca.gov/reports/agency_goals/); Installed and pending capacity from California Solar Statistics – Program Totals, data updated June 1, 2016 (https://www.californiasolarstatistics.ca.gov/reports/agency_stats/).

4.1.2.6 Impacts of Tax Credits and Net Energy Metering

Since 2005 the Federal Investment Tax Credit (ITC) has provided a tax credit of up to 30 percent of the total installed cost of solar systems. In December 2015, Congress extended the tax credit through 2023. At 30 percent of total installed cost, the ITC is a much more significant incentive for customer-sited solar projects than that provided by the CSI in the last program steps. Similarly, in the 2013 NEM Ratepayer Impacts Evaluation Report, it was found that NEM represents a levelized incentive equivalent to approximately \$5.40 per watt (on average, using IOUs’ 2011 retail rates and accounting for the total generation over the lifetime of the system), in addition to any rebates received under the CSI program.⁴⁰ The value of the ITC and NEM credits can be compared to the last-offered CSI per watt rebates, which range from \$0.20 to \$0.70 per watt for non-residential customers in SDG&E’s service territory.

³⁹ The overall MW totals exceed the 1,750 MW CSI goal due to additional CSI incentive funding that was authorized in SB 585. This funding was authorized as a result of different rebates being offered to taxable and non-taxable entities, which caused CSI budgeting uncertainty. See [D.11-12-019](#) for more details.

⁴⁰Page 49 of the Report which can be found at: (<http://www.cpuc.ca.gov/workarea/downloadasset.aspx?id=5724>).

4.1.2.7 CSI Program Impact on Solar PV Market Transformation

One of the goals of the CSI program is to create a self-sustaining solar PV market in California. In 2013, the CPUC hired Navigant Consulting, Inc. to evaluate the extent of the transformation of California’s customer-side solar PV market since the adoption of the CSI program, and to assess the degree to which the customer-side solar PV market will be sustainable after the CSI program sunsets.⁴¹ The study, released in April 2014, found:

- The customer-side solar PV market has shown significant progress toward market transformation since the initiation of the CSI program;
- While other regulatory and global market factors played an important role, the CSI program played an indispensable role in transforming the solar PV market in California, especially in terms of creating a long-term policy signal to in-state suppliers of customer-sited solar PV products and services; and
- The long-term sustainability of the solar PV market in California will depend on the next phase of NEM regulation and the retail rate reform process that was under consideration before the CPUC in 2014 and 2015.

The study also provided recommendations for continuing to ensure the sustainability of the transformation going forward, which included resolving uncertainty related to the future of NEM regulation as quickly as possible and ensuring that market data is collected and publicly reported once the CSI program sunsets.

4.1.3. Marketing and Outreach Efforts

The CPUC provides guidance for statewide CSI Marketing and Outreach (M&O) activities. The overall CSI M&O budget was established in D.11-07-031 at \$21,625,000. M&O activities include free trainings for professionals and consumers on a wide range of solar-related topics at various level of technical expertise. The Program Administrators also issue a quarterly electronic newsletter through 2016, distributed to thousands of subscribers. Sponsorships and solar promotions provide opportunities for program representatives to interact with various solar audiences, and the program features a main solar web site, www.GoSolarCalifornia.ca.gov. Each Program Administrator also maintains a website with information specific to their particular territory. Program Administrators actively promote integration with other demand-side programs, particularly in the development of online customer decision making tools like online energy analyzers, as well as “welcome kits” that cover the range of energy services available to new utility customers.

⁴¹ See <http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=7699>.

4.2 Single-Family Affordable Solar Homes (SASH) Program

4.2.1.SASH Program Background

The SASH program, one of the two low-income components of the CSI program, provides incentives for solar PV systems for eligible low-income homeowners. The CPUC approved the SASH program in November 2007 in D.07-11-047 as part of the CSI program. GRID was selected as the statewide Program Manager for the SASH program.⁴² GRID is a non-profit organization providing renewable energy services, equipment, and training in low-income communities throughout California since 2001. As Program Manager for the SASH program, GRID identifies eligible low-income households, markets the SASH program, and installs PV systems for eligible SASH participants.⁴³

In January 2015, pursuant to AB 217, the CPUC reauthorized the SASH program in D.15-01-027. In this Decision, the CPUC authorized the extension of SASH with an additional \$54 million in funding and an installed capacity goal for the program of 15 MW. The SASH program is reauthorized through 2021, or until all available incentives are encumbered, whichever occurs first. The reauthorized SASH program opened in May 2015.

The SASH program is designed to be a comprehensive low-income solar program. In addition to providing incentives, SASH is structured to promote or provide energy efficiency services, workforce development and green jobs training opportunities, and broad community engagement with low-income communities. To achieve this, the SASH program provides consumer education on solar and energy efficiency technologies to the diverse volunteer base that contributes to SASH installations. This outreach helps further the broader goals of promoting the use of PV-solar technology statewide and helping build broad-based community support for solar electric technologies and energy efficiency. In addition, GRID sub-contracts with qualified solar contractors to install SASH projects through the SASH Sub-Contractor Partnership Program (SPP).

For the purpose of clarity in this report, the original SASH program is referred to as SASH 1.0 and the recent reauthorization of the SASH program is referred to as SASH 2.0. At the time of this report, SASH 1.0 incentive funding is fully encumbered in all three IOU service territories

⁴² D.07-11-045 ordered the SASH Program to be administered by a single statewide program manager to “ensure consistency and equity in program delivery statewide while working with a diverse group of stakeholders and service providers.” (p. 45, Conclusion of Law 10). GRID Alternatives was selected through a competitive solicitation process.

⁴³ For more information about the SASH Program, including GRID’s latest quarterly program status report, see: (<http://www.cpuc.ca.gov/general.aspx?id=3043>). For more details on the SASH program’s rules and requirements, see Appendix D to the CSI Handbook, available at: (<http://www.cpuc.ca.gov/workarea/downloadasset.aspx?id=4585>).

and the program has moved on to issuing incentive reservations under SASH 2.0. PG&E and SDG&E transitioned to SASH 2.0 in January 2015 and SCE transitioned in October 2015.

4.2.1.1 SASH Program Budget

The SASH 1.0 budget was \$108.3 million, allocated according to the information in Table 13 and Table 14.

Table 13: SASH 1.0 Budget Allocations by IOU Service Territory

Utility	PG&E	SCE	SDG&E	Total
Percentage	43.7%	46%	10.3%	100%
Total Budget (millions)	\$47.3	\$49.8	\$11.2	\$108.34

Source: D.07-11-045

Table 14: SASH 1.0 Budget Allocations by Functions

Function	Allocation
Administration	10%
Marketing and Outreach	4%
Measurement and Evaluation	1%
Incentives	85%

Source: D.07-11-045

The SASH 2.0 budget is \$54 million, allocated according to the information in Table 15 and Table 16.

Table 15: SASH 2.0 Budget Allocations by IOU Service Territory

Utility	PG&E	SCE	SDG&E	Total
Percentage	43.7%	46%	10.3%	100%
Total Budget (millions)	\$23.6	\$24.84	\$5.56	\$54

Source: D.15-01-027

Table 16: SASH 2.0 Budget Allocations by Functions

Function	Allocation
Administration	10%
Marketing and Outreach	4%
Measurement and Evaluation	1%
Incentives	85%

Source: D.15-01-027

4.2.1.2 SASH Program Eligibility

The SASH program is open to customers of the large electric IOUs who qualify as single-family, low-income households as defined in PU Code Section 2852 (described further below). PU Code Section 2852 allows owner-occupied residences that are part of a larger multifamily complex to qualify under certain conditions. GRID has created a statewide database of eligible homes in collaboration with the California Housing Partnership Corporation (CHPC), which is instrumental in the effort to establish relationships and identify resources within targeted local jurisdictions.

4.2.1.3 SASH Program Incentives

The SASH incentives are higher than the CSI General Market program on a \$/watt basis. The SASH 1.0 incentives varied depending on the household's income level and eligibility for the California Alternate Rates for Energy (CARE)⁴⁴ program. The SASH 2.0 incentives are set at the same level for all SASH customers. The SASH 1.0 and 2.0 incentive rates do not decline over time like the incentive rate in the market-transforming CSI General Market program.

Under SASH 1.0, eligible participating households were provided a one-time payment under the CSI EPBB structure to help reduce the up-front cost of installation. The SASH 1.0 program had one *fully-subsidized* (i.e., covers the full installed cost of the system) and six highly-subsidized incentive payment levels based on the applicant's income compared to the area median income (AMI), tax liability, and eligibility for the CARE program. The incentive rates shown in Table 17 were intended to provide low-income residents who have no federal tax liability with a positive cash flow in the first year of solar installation.

Under SASH 2.0 eligible participating households are provided a one-time payment under the CSI EPBB structure to help reduce the up-front cost of installations. However, due to the significant reduction in funding for SASH 2.0 compared to SASH 1.0, the CPUC authorized GRID to develop and utilize a Third-Party Ownership (TPO) Model for SASH to help finance the installation of solar PV projects for low-income customers at no upfront cost. The TPO model allows GRID to leverage Federal Investment Tax Credit financing and is expected to play a significant role in funding SASH 2.0 projects. To date, of the 429 SASH 2.0 projects completed, 301 are third-party owned and total over 74% of all capacity installed under SASH 2.0.

⁴⁴ CARE provides a minimum 20 percent discount on the energy bills of qualifying low-income customers.

4.2.1.4 SASH 1.0 Incentive Structure

The SASH 1.0 incentive structure was available to customers whose total household income was below 80 percent of the AMI. The incentive was calculated on a sliding-scale, based on the homeowner's tax liability and eligibility for the CARE program. If the customer qualified for the CARE program but was not enrolled in the program, GRID would work with the customer to enroll them in CARE. Table 17 shows the sliding-scale incentive rates:

Table 17: SASH 1.0 Incentive Rates in \$/watt

Federal Income Tax Liability	Low-income CARE-Eligible	Low-income Residents Not Eligible for CARE
\$0	\$7.00	\$5.75
\$1 – \$1000	\$6.50	\$5.25
\$1001 +	\$6.00	\$4.75

Source: D.07-11-045.

Note: For comparison, the average installed cost for PV systems below 10 kW is \$5.24 per watt as of May 18, 2016 (see <http://www.californiasolarstatistics.ca.gov/> for up-to-date average system costs).

4.2.1.5 SASH 2.0 Incentive Structure

SASH 2.0 provides incentives at \$3.00/watt to all customers whose total household income is below 80 percent of the AMI.

4.2.2. SASH Program Progress

Since the SASH program launched in 2008, it has experienced heavy growth in program applications and made significant progress in key areas since the initiation of the program including: expanding the SPP; increasing marketing and outreach efficiency; building partnerships with volunteers and job training/workforce programs; and broadening the affordable housing client database.

Under SASH 1.0, a total of 5,252 projects or 16 MW has been installed on eligible homes, with another 0.04 MW currently in progress.⁴⁵ 100 percent of the available \$92 million SASH 1.0 incentive budget has been encumbered. SASH 2.0 has completed a total of 429 projects, resulting in 1.2 MW of installed capacity, with another 1.0 MW currently in progress. These applicants have received or reserved over \$6.2 million of the available \$46 million SASH 2.0 incentive budget for their residential solar systems.

Nearly all of the completed SASH installations were made at no cost to the homeowners. In addition to ratepayer funding, GRID leveraged funding from local jurisdictions, project

⁴⁵ All SASH Program Progress data as reported by GRID through 5/18/16.

sponsorships, and through general non-profit fundraising. Since the SASH incentive does not cover 100 percent of installation costs and individual homeowners are largely unable to fund the additional incremental costs, identifying gap financing from third-party sources was critical to achieving the long-term goals of SASH. As mentioned previously, the recently approved TPO model is expected to play a key role in funding SASH 2.0 projects. Under the SASH TPO model, participating homeowners agree to pay a client contribution (not to exceed 50% of the customer's savings from the installation) on a quarterly basis. GRID treats these payments as a contribution to help fund future PV installations for low-income customers and there is no penalty for non-payment.

Between 2006 and 2015, the SASH program paid an average of \$5,729 in incentives per kilowatt installed. The General Market program paid an average of \$1018 per kilowatt installed over the same time period.⁴⁶

4.2.2.1 SASH Workforce Development Efforts

Every SASH installation provides workforce development opportunities. In implementing the SASH program, GRID provides opportunities for job trainees and local volunteers to assist with installations, to engage their communities, and to participate in solar and energy efficiency programs. As a result of these training sessions, many participants have gone on to receive NABCEP (North American Board of Certified Energy Professionals) certifications, the gold standard for PV installation work.

GRID reserves at least 20 percent of all SASH installations for solar-installer job trainees, often targeting low-income communities. This becomes a double benefit to low-income communities, since GRID recruits job trainees from the same communities that the SASH program aims to serve. Through the end of 2015, the SASH program has filled over 32,000 workday positions with volunteer participants and has dedicated an additional 8,500 workday positions specifically for job trainees. SASH will continue its workforce development efforts under SASH 2.0.

Under both SASH 1.0 and SASH 2.0 the SASH SPP provides opportunities for licensed California contractors to participate in SASH installations, not limited to GRID employees, volunteers, and workforce program trainees. Qualified contracting companies agree to a reduced cost model and commit to hiring at least one eligible job trainee for each SASH installation. Though the SASH program requires contractors to hire only one eligible job trainee per installation, some sub-contractors have exceeded this expectation by having more than one eligible trainee work on their SASH installations.

⁴⁶ California Solar Statistics – Program Totals (https://www.californiasolarstatistics.ca.gov/reports/agency_stats/). Data updated June 15, 2016.

4.3 Multifamily Affordable Solar Housing (MASH) Program

4.3.1. MASH Program Background

The second low-income solar program in the CSI Program targets affordable multifamily housing. In October 2008, the CPUC adopted D.08-10-036, which established the \$108.3 million MASH program for solar installations on existing multifamily affordable housing that meet the definition of low-income residential housing established in PU Code Section 2852.⁴⁷ The MASH program was designed to operate until January 1, 2016, or until all funds available from the program’s incentive budget were allocated, whichever event occurred first.

In January 2015, pursuant to AB 217, the CPUC reauthorized the MASH program through D.15-01-027. In this Decision, the CPUC authorized the extension of MASH with an additional \$54 million in funding and a 35 MW installed capacity goal for the program. The MASH program is reauthorized through 2021, or until all available incentives are encumbered, whichever occurs first.

The goals of the MASH program are to: (a) Stimulate adoption of solar power in the affordable housing sector; (b) Improve energy utilization and overall quality of affordable housing through application of solar and energy efficiency technologies; (c) Decrease electricity use and costs without increasing monthly household expenses for affordable housing building occupants; and (d) Increase awareness and appreciation of the benefits of solar among affordable housing occupants and developers.

For the purpose of clarity in this report, the original MASH program is referred to as MASH 1.0 and the reauthorization of the MASH program is referred to as MASH 2.0. By the end of 2013, MASH 1.0 incentive funding was fully encumbered in all three IOU service territories. The CPUC authorized the MASH Program Administrators to implement MASH 2.0 in each service territory upon complete subscription of the incentive funding in that service territory, and CPUC approval of an advice letter implementing the new program rules. The MASH Program Administrators began implementation of MASH 2.0 in all three IOU service territories in August 2015. Due to significant demand, at the time of this report, MASH 2.0 incentive funding was fully subscribed in all service territories.

4.3.1.1 MASH Program Budget

The MASH 1.0 budget was \$108.3 million, allocated according to the information in Table 18 and Table 19.

⁴⁷ D.08-10-036, Appendix A, *mimeo.*, p. 1

Table 18: MASH 1.0 Budget Allocations by IOU Service Territory

Utility	PG&E	SCE	SDG&E	Total
Percentage	44%	46%	10%	100%
Total Budget (millions)	\$47.3	\$49.8	\$11.2	\$108.34

Source: D.08-10-036.

Table 19: MASH 1.0 Budget Allocations by Function

Function	Allocation
Administration and Marketing and Outreach	10%
Measurement and Evaluation	2%
Incentives	88%

Source: D.08-10-036.

The MASH 2.0 budget is \$54 million, allocated according to the information in Table 20 and Table 21.

Table 20: MASH 2.0 Budget Allocations by IOU Service Territory

Utility	PG&E	SCE	SDG&E	Total
Percentage	43.7%	46%	10.3%	100%
Total Budget (millions)	\$23.6	\$24.84	\$5.56	\$54

Source: D.15-01-027

Table 21: MASH 2.0 Budget Allocations by Function

Function	Allocation
Administration and Marketing and Outreach	6%
Measurement and Evaluation	1%
Incentives	93%

Source: D.15-01-027

4.3.1.2 MASH Program Eligibility

The MASH program is open to multifamily affordable housing properties that meet the definition of “low-income residential housing” per PU Code Section 2852, which requires that at least 20 percent of the onsite tenants are low-income.

The MASH program also provides eligibility for certain pre-identified tenant units to enroll with their utility’s VNEM tariffs, as described in the VNEM section below.

In implementing the new energy efficiency and job training policy requirements of AB 217, the CPUC required that, in order to be eligible for MASH 2.0, MASH properties must conduct an energy efficiency walkthrough audit, and must provide a job training opportunity to up to five trainees per MASH system installation.

4.3.1.3 MASH Program Incentives

As shown in Table 22, the CPUC originally adopted a two-track incentive structure for MASH 1.0: Track 1, which provides up front incentives to systems that offset either common area (Track 1A) or tenant load (Track 1B), and Track 2, which provides an opportunity every six months to compete for higher incentives through a grant program. D.11-07-031 eliminated Track 2 in favor of a more robust Track 1 incentive budget. Track 1 incentive funding in all three service territories was quickly exhausted and new applications were placed on waitlists.

Table 22: MASH 1.0 Incentive Tracks, Revised as of D.11-07-031

Track 1A PV System Offsetting Common Area Load	Track 1B PV System Offsetting Tenant Area Load	Track 2 (Grant) PV System Providing Enhanced Tenant Benefits CLOSED in 2011
\$1.90/Watt	\$2.80/Watt	\$/Watt not specified; determined by proposal

Source: D.11-07-031.

Note: For comparison, the average installed cost for PV systems below 10 kW is \$5.24 per watt as of May 18, 2016 (see <http://www.californiasolarstatistics.ca.gov/> for up-to-date average system costs).

Due to reduced funding levels for the MASH 2.0 program compared to the MASH 1.0 program, the CPUC reduced the incentive levels for both of the common area and tenant load incentive tracks. The CPUC renamed the new incentive levels Track 1C and 1D. The CPUC also created an additional requirement that, in order to receive the higher incentive level for tenant load, a MASH project would have to allocate generation to MASH property tenants by utilizing VNEM to share bill credits and guarantee that the tenants would retain at least 50% of the economic benefits of the generation allocated to them. Table 23 below displays the MASH 2.0 incentive tracks, 1C and 1D, and the eligibility requirements for MASH 2.0.

Table 23: MASH 2.0 Incentive Tracks

Track	Incentive Amount	Eligibility Requirements
1C: PV System	\$1.10/watt	<ul style="list-style-type: none"> Provide job training opportunity to more than one

Track	Incentive Amount	Eligibility Requirements
Offsetting Common Area Load, Non-VNEM Tenant Load, or VNEM Tenant Load with <50% Tenant Benefit		trainee, with one additional trainee for each 10 kW up to 50 kW <ul style="list-style-type: none"> • Conduct onsite walkthrough energy audit at American Society of Heating, Refrigerating, Air-Conditioning Engineers (ASHRAE) Level I or higher, or enroll in a utility, Regional Energy Network (REN), Community Choice Aggregator (CCA) or federally-provided whole-building multifamily energy efficiency program • Portion of system allocated to offsetting one of the following: <ul style="list-style-type: none"> ○ Common Area Load ○ Non-VNEM Tenant Load ○ VNEM Tenant Load where tenant receives less than 50% of economic benefit of allocated generation
1D: PV System Offsetting VNEM Tenant Load with ≥50% Tenant Benefit	\$1.80/watt	<ul style="list-style-type: none"> • Provide job training opportunity to more than one trainee, with one additional trainee for each 10 kW up to 50 kW • Conduct onsite walkthrough energy audit at ASHRAE Level I or higher, or enroll in a utility, REN, CCA or federally provided whole-building multifamily energy efficiency program • Portion of PV system allocated to offsetting: <ul style="list-style-type: none"> ○ VNEM Tenant Load where tenant receives at least 50% of economic benefit of allocated generation

4.3.2.MASH Program Progress and Project Attributes

Since the MASH 1.0 incentives are fully subscribed, the progress of the program has been measured in terms of reserved projects reaching completion and waitlisted projects being brought into the incentive reservation queue when additional funds are made available via system resizing and project dropouts.

To date, MASH 1.0 has completed 363 projects, representing 23.9 MW of installed capacity. There are an additional 19 MASH 1.0 projects in process, with a total capacity of 4.7 MW.⁴⁸

To date, 9 projects representing 0.77 MW of capacity have been completed under MASH 2.0. There are 149 MASH 2.0 projects in process, with a total capacity of 24.2 MW and an additional 46 MASH 2.0 applications, representing 9.86 MW are currently under review.⁴⁹

Table 24: MASH Program Progress

Status of Application		Total	CSE	PG&E	SCE
MASH 1.0 Completed	Number	363	41	187	135
	Capacity (MW)	23.9	2.6	10.9	10.4
MASH 1.0 Pending	Number	19	0	11	8
	Capacity (MW)	4.7	0	2.31	2.4
MASH 2.0 Completed	Number	9	3	0	6
	Capacity (MW)	0.77	0.49	0	0.28
MASH 2.0 Pending	Number	149	21	77	51
	Capacity (MW)	24.2	2.9	13.2	8.1

Source: CSI working data set as of May 12, 2016.

Between 2006 and 2015, the MASH program paid an average of \$3,215 in incentives per kilowatt installed. The General Market program paid an average of \$1018 per kilowatt installed over the same time period.⁵⁰

4.4 Virtual Net Metering (VNEM)

Multi-tenant buildings are a challenging segment for solar PV adoption due to the problem of distributing the benefits of system output among individually metered occupants. To help address this issue, the CPUC directed the IOUs to file tariffs for VNEM in 2008.⁵¹

Under VNEM, the utility meters the PV system’s output, then allocates energy credits for the energy produced by the PV system to the building owners’ and/or tenants’ individual utility accounts, based on a pre-arranged allocation agreement. The MASH program piloted the VNEM tariffs; the original intent of VNEM was to help low-income multifamily residents receive direct benefits of a building’s solar system under VNEM.

⁴⁸ Data as of May 12, 2016 from CSI working data set on (https://www.californiasolarstatistics.ca.gov/data_downloads/).

⁴⁹ Ibid.

⁵⁰ California Solar Statistics – Program Totals (https://www.californiasolarstatistics.ca.gov/reports/agency_stats/). Data updated June 15, 2016.

⁵¹ D.08-10-036

Based on the merits of these tariffs, the CPUC expanded VNEM to all multi-tenant, multi-meter properties in 2011 and included all NEM-eligible technologies for eligibility. As of the end of 2015, in PG&E, SCE, and SDG&E’s service territory there were 274 projects with a combined 8.1 MW of solar capacity on the VNEM tariff who are not participants in the MASH program.

Table 25: VNEM Projects Outside of the MASH Program by Utility Territory

Utility	PG&E	SCE	SDG&E	Total
Projects on NEM-V Tariff	222	13	39	274
Total Capacity (kW, CEC-AC)	6,926	132	1,086	8,143

Source: Data request to IOUs.

Note: Data is through December 31, 2015 and includes CSI, NSHP, ERP and SGIP data, but not POU or RPS data.

4.5 CSI Thermal Program

4.5.1.CSI Thermal Program Background and Overview

The CSI Thermal program is an incentive program for solar water heating technologies that displace natural gas, electricity, or propane usage. The CSI Thermal program was originally established by legislative language in SB 1, which contains a provision that allows for up to \$100.8 million of CSI General Market program funds to be used for incentives for solar thermal technologies that displace electricity. AB 1470 later authorized the creation of a \$250 million program to promote the installation of 200,000 solar water heating systems in homes and businesses that displace the use of natural gas by the end of 2017.

The CPUC established the CSI Thermal program in January 2010 through D.10-01-022. The program began accepting applications from single-family residential customers that install solar water heating systems on May 1, 2010 and from multifamily and commercial customers on October 8, 2010. In March 2012, the CSI Thermal Low-income program, which provides higher incentives for low-income residences, began accepting applications. In 2013, the CPUC issued two decisions authorizing new incentives. D.13-02-018 allowed incentives for process heating and cooling, and for space heating. D.13-08-004 allowed incentives for swimming pools at multifamily and commercial sites. Subsequently, D.15-01-035 increased early-step incentive levels for the single-family and multifamily/commercial gas-displacing sub-programs, and revised project rebate caps and sub-program budgets.

On May 6, 2016, Energy Division approved temporary additional incentives for the installation of solar water heating systems to address the need to reduce natural gas use in the Aliso Canyon impacted area. The new rules will apply only to systems in SoCalGas service territory that are installed by the end of 2016. The modifications include increased rebate rates for general market single family and multifamily/commercial applications, reallocated funds from later Steps 3 and 4 to the new, higher Step 1 incentives for single family and multifamily/commercial general

market funds, and removal of the 50% rebate cap that limits the swimming pool incentive from covering more than 50% of a project’s cost.⁵²

Incentives for natural gas-displacing systems come from a statewide budget of \$250 million, as described in detail below. Incentives for electric or propane-displacing systems were drawn from the CSI PV budgets in each utility territory, which are now fully reserved. Per legislative direction, the CPUC has established three primary program elements corresponding to the type of water heating fuel being displaced by solar technologies. The CSI Thermal program consists of:

- 1) Incentives for natural gas-displacing systems (including swimming pools);
- 2) Incentives for natural gas-displacing systems serving low-income customers, and;
- 3) Incentives for electric or propane-displacing systems.

The four Program Administrators of the CSI Thermal program are: PG&E, SoCalGas, SCE,⁵³ and CSE (on behalf of SDG&E).

4.5.2.CSI Thermal Budget

4.5.2.1 Natural Gas-Displacing Program

For the natural gas-displacing portion of the program, the \$250 million program budget will be collected during the duration of the program by the three gas IOUs based on the percentages in Table 26.

Table 26: CSI Thermal Gas-Displacing Budget Allocation

Utility	Budget Allocation	Total Program Collections (in millions)
PG&E	39%	\$97.5
SDG&E	10%	\$25.0
SoCalGas	51%	\$127.5
Total	100%	\$250 million

Source: D.10-01-022.

The gas-displacing program budget is divided as shown in Table 27.

⁵² For more information, please consult the CSI Thermal Program Incentives webpage on the CPUC website at (<http://www.cpuc.ca.gov/General.aspx?id=3785>).

⁵³ Note: As an electric-only utility, SCE only offers incentives for electric or propane-displacing systems in their service territory. Similarly, as a gas-only utility, SoCalGas only offers incentives for natural gas-displacing systems in their service territory.

Table 27: CSI Thermal Gas-Displacing Program Budget

CSI Thermal Program Elements	CSI Thermal Program Sub-Elements	Budget (\$ Millions)
Incentives (82%)	General Market Incentive	\$155
	Low-income Incentive (20% of total funds)*	\$50
	Subtotal	\$205
Market Facilitation (10%)	Marketing & Outreach	\$25
	Subtotal	\$25
Program Administration (8%)	General Administration	\$15
	Measurement and Evaluation	\$5
	Subtotal	\$20
Total		\$250

Source: D.10-01-022.

*On March 17, 2016, the CPUC approved a joint CSI Thermal Advice Letter (PG&E 3694-G/4800-E, CSE 69, SoCalGas 4930) from the Program Administrators to refresh the CSI Thermal low-income program by shifting \$25MM from the general market incentive budget to the low-income incentive budget

4.5.2.2 Low-income (Natural Gas-Displacing) Program

For the low-income program, \$50 million of CSI Thermal incentives are allocated to promote the installation of gas-displacing solar water heating systems on both single-family and multifamily low-income housing. The program budget will be collected by the three gas utilities based on the percentages in Table 28.

Table 28: CSI Thermal Low-income Program Budget Allocation

Utility	Budget Allocation	Total Program Collections (in millions)
PG&E	39%	\$19.5
SDG&E	10%	\$5
SoCalGas	51%	\$25.5
Total	100%	\$50 million

Source: D.11-10-015.

4.5.2.3 Electric or Propane-Displacing Program

The electric-displacing program incentive budget of up to \$100.8 million, if utilized, reduces the amount of incentives available for the CSI General Market program, and shall be allocated as shown in Table 29. Because the CSI General Market PV program budget is fully subscribed in all three program territories, there are no funds available for the CSI Thermal electric-displacing program.

Table 29: CSI Thermal Electric-Displacing Program Budget

CSI Thermal Program Elements	CSI Thermal Program Sub-Elements	Budget (\$M)
Incentives	General Market Incentive	No more than \$100.8
	Low-income Incentive ⁵⁴	\$0
	Subtotal	\$100.8
Market Facilitation	Marketing & Outreach	\$6.25
	Subtotal	\$6.25
Program Administration	General Administration	Subject to the overall CSI budget, but tracked separately
	Measurement and Evaluation	\$1.25
	Subtotal	\$1.25
Total		\$108.3 + CSI Admin Budget Costs

Source: D.10-01-022.

The Program Administrators perform marketing, outreach, and measurement and evaluation activities for all solar water heating systems, regardless if they displace gas or electricity. The Program Administrators fund these activities on a 4:1 ratio, so that for every \$4 spent from the gas-displacing budget, \$1 is spent from the electric-displacing budget.

4.5.3.CSI Thermal Program Eligibility

The CSI Thermal program provides incentives to customers who install solar water heating systems that have received a certification from the Solar Rating and Certification Corporation (SRCC) or from the International Association of Plumbing and Mechanical Officials (IAPMO). Single-family residential, multifamily, and commercial customers may apply for incentives. Contractors are required to be certified by the Contractor State Licensing Board, and all installers (self-installers and contractors) must complete a one-day training course provided by the utilities. Contractors must also submit to random inspections of projects by Program Administrators to ensure that those systems are properly installed in order to remain in good standing in the CSI Thermal program.

⁵⁴ Because the funds for the low-income portion of the CSI-Thermal Program come from natural gas ratepayers, and because separate low-income programs exist for electricity generation (the SASH and MASH programs), the low-income CSI-Thermal Program only provides incentives for natural gas-displacing SOLAR WATER HEATING systems. See Decision 11-10-015 for more information.

Eligibility for the low-income program requires all of the above mentioned requirements, and also that applicants meet the low-income residential housing definition in PU Code Section 2861 (e). PU Code Section 2861 (e) includes multifamily housing units and individual residences that are subject to a resale restriction or an equity sharing agreement.

The program also extends eligibility to participants in the Energy Savings Assistance (ESA) program on the condition that the participants either occupy a single-family home or at least 50 percent of all units in a multifamily unit.

Incentives are paid based on expected first-year energy displacement of the solar water heating system. Incentives are divided between the single-family and commercial/multifamily sectors, with 40 percent of incentives on the natural gas side reserved for single-family customers.

4.5.3.1 CSI Thermal Natural Gas-Displacing Program

For systems that displace natural gas, incentives are available for three different market segments (or sub-programs): single-family, commercial/multifamily, and solar pool heating. For the single-family market, the average system rebate starts at \$3,493 in step one and declines over four steps to an average of \$378. Commercial / multifamily systems are incentivized at a slightly lower rate, and solar pool heating systems are incentivized at substantially lower rates due to favorable project economics. Pursuant to D.15-01-035, all sub-programs have maximum system incentive caps.⁵⁵ Incentive levels decline when the total incentive budget for a particular step has been exhausted. Step incentive levels, sub-program budgets, and individual project caps for natural gas-displacing systems were revised in D.15-01-035 on January 30, 2015, and can be seen in Table 30. The temporary incentive levels for systems installed in SoCalGas territory can be found in Table 30.

⁵⁵ The single-family system maximum incentive level is set to 125% of the average system cost. Multifamily/commercial projects have a maximum incentive of \$800,000 per project. Solar Pool Heating systems have a maximum incentive level of 50% of total project costs up to \$500,000.

Table 30: Natural Gas-Displacing CSI Thermal Incentive Steps

Step	Customer Class	Incentive per Therm Displaced - SoCalGas only in parenthesis	Incentive for Average Solar Water Heating System	System Maximum Incentive	Funding Amount
1	Single-Family	\$29.85 (\$70)	\$3,493	\$4,366 (\$10,238)	\$5,714,636
	Commercial/Multifamily	\$20.19 (\$25) PBI - \$10.10 (\$12.50)	N/A	\$800,000	\$42,307,184
	Solar Pool Heating	\$5.00		50% of total project costs*	\$14,978,180
2	Single-Family	\$25.37	\$2,968	\$3,710	\$4,900,000
	Commercial/Multifamily	\$17.16 PBI - \$8.58	N/A	\$800,000	\$29,400,000
	Solar Pool Heating	\$5.00		50% of total project costs*	\$14,700,000
3	Single-Family	\$14.30 (\$0)	\$1,673	\$2,091	\$1,600,000
	Commercial/Multifamily	\$10.15 (\$0) PBI - \$5.08 (\$0)	N/A	\$800,000	\$9,600,000
	Solar Pool Heating	\$4.00		50% of total project costs*	\$4,800,000
4	Single-Family	\$3.23 (\$0)	\$378	\$472	\$2,700,000
	Commercial/Multifamily	\$3.13 (\$0) PBI - \$5.08 (\$0)	N/A	\$800,000	\$16,200,000
	Solar Pool Heating	\$3.00		50% of total project costs*	\$8,100,000
Total					\$155,000,000**

Source: D.15-01-035 (<http://www.cpuc.ca.gov/General.aspx?id=3785>).

*Solar Pool Heating systems have a maximum incentive cap of 50% of total project costs up to \$500,000.

**On March 17, 2016, the CPUC approved a joint CSI Thermal Advice Letter (PG&E 3694-G/4800-E, CSE 69, SoCalGas 4930) from the PAs to refresh the CSI Thermal low-income program by shifting \$25MM from the general market incentive budget to the low-income incentive budget.

4.5.3.2 CSI Thermal Low-income (Natural Gas-Displacing) Program

Incentives for qualifying single-family low-income customers are 200 percent of the applicable CSI Thermal solar water heating incentive level. Incentives for qualifying solar water heating installations on multifamily housing are 150 percent of the applicable CSI Thermal solar water heating incentive level. Incentives will decline in the CSI Thermal Low-income program as incentives in the larger CSI Thermal program decline.

Table 31: CSI Thermal Low-income Incentive Steps

Step	Single-Family Low-income Incentive per therm displaced	Incentive Cap for Single-Family Low-income Projects	Multifamily Low-income Incentive per therm displaced	Incentive Cap for Multifamily Low-income Projects
1	\$36.90	\$4,317	\$20.19	\$800,000
2	\$32.42	\$3,793	\$17.16	\$800,000
3	\$21.35	\$2,498	\$10.15	\$800,000
4	\$10.28	\$1,203	\$3.13	\$800,000

Source: D.15-01-035

4.5.3.3 CSI Thermal Electric or Propane-Displacing Program

Electric-displacing solar water heating systems are incentivized at a lower level than natural gas-displacing solar water heating systems to account for the fact that electric-displacing solar water heating systems are generally less expensive. Incentives for electric-displacing solar water heating systems also decline in four steps, but those incentive declines are triggered by step changes in the natural gas program, since the much larger natural gas market is likely to drive the industry. The adopted incentive levels for electric-displacing systems can be seen in Table 32. As mentioned previously, because the CSI General Market PV program budget is fully subscribed in all three program territories, there are no longer funds available for the CSI Thermal electric-displacing program.

Table 32: Electric-Displacing Solar Thermal Incentives

Step Level	Single-family incentive per kWh displaced	Average Incentive for Single-family System	Commercial/Multifamily incentive per kWh displaced
1	\$0.54	\$1,467	\$0.42
2	\$0.38	\$1,048	\$0.29
3	\$0.22	\$602	\$0.19
4	\$0.10	\$263	\$0.09

Source: D.12-08-008.

4.5.4.CSI Thermal Program Participation

4.5.4.1 CSI Thermal Program History and Application Statistics

The CSI Thermal program began accepting applications for single-family systems on May 1, 2010, from multifamily and commercial systems on October 8, 2010, and for solar pool heating

systems on January 14, 2014. The program has approved 3,407 applications for \$47.5 million in incentives (see Table 33.) As seen below, the single-family sub-program has received the greatest number of applications. However, due to their much larger average project size, the commercial/multifamily sub-program represents a larger portion of incentive amounts, project costs, and energy savings.

Table 33: CSI Thermal Installed Applications by Sector and Displaced Fuel

Sector	Number of Applications	Total Incentives (\$ thousands)	Total Project Costs (\$ thousands)	Total Annual Energy Savings
Commercial Pools (Gas)	525	\$7,374	\$18,179	1,142,491 therms
Commercial/Multifamily Residential	708	\$16,980	\$75,895*	1,163,597 therms 75,922 kWh
Gas	518	\$16,755	\$75,511	1,163,597 therms
Electric	5	\$30	\$364	75,922 kWh
Single Family Residential	1,284	\$2,175	\$15,673**	135,958 therms 841,927 kWh
Gas	1294	\$2,561	\$12,956	135,958 therms
Electric	242	\$269	\$2,096	664,792 kWh
Propane	47	\$74	\$479	177,135 kWh
Multifamily low-income (Gas)	567	\$19,883	\$60,996	968,179 therms
Single-Family low-income (Gas)	209	\$582	\$956	23,866 therms
Subtotal Gas	3,113	\$47,155	\$168,598	3,434,091 therms
Subtotal Electric	247	\$298	\$2,460	740,714 kWh
Subtotal Propane	47	\$74	\$499*	177,135 kWh
Total	3,407	\$47,527	\$171,699**	3,434,091 therms 917,849 kWh
per Therm	-	\$13.73/therm	\$49.10/therm	-
per kWh	-	\$0.41/kWh	\$3.22/kWh	-

Sources: Number of applications, total incentives, and total annual energy savings from the CSI Solar Thermal Statistics – Program Totals (<http://csithermalstats.org>); data is through May 11, 2016. Total project costs from the Current CSI-Thermal Program Data public export (<http://csithermalstats.org>); data is through May 13, 2016.

*Includes \$20,138 in project costs for Commercial/Multifamily Residential projects that displace propane usage

**\$142,040 in project costs for Single Family Residential projects are not reported as associated with gas, electric or propane displacement

4.5.5.CSI Thermal Program Administration

4.5.5.1 CSI Thermal Incentives Received

As mentioned above, the CSI Thermal program is jointly administered by PG&E, SoCalGas, SCE and CSE. While PG&E and CSE administer incentives for both natural gas and electric-displacing systems, SCE only administers incentives for electric-displacing systems, and SoCalGas only administers incentives for natural gas-displacing systems. As shown in Table 34, SoCalGas has received the most applications, followed by PG&E, CSE, and SCE.

Table 34: CSI Thermal Program Applications by Program Administrator

Program Administrator	Complete and Pending applications	Total Incentive (\$ thousand)
PG&E	1,336	24,514
CSE	448	8,778
SCE	45	67
SoCalGas	2,076	33,628
Total	3,905	\$66,987

Source: CSI Solar Thermal Statistics – Program Totals (<http://csithermalstats.org>); data is through May 11, 2016.

Most water in California is heated with natural gas, and as mentioned previously, because the CSI General Market PV program budget is fully subscribed in all three program territories, there are no longer funds available for the CSI Thermal electric-displacing program. Therefore, only about 6 percent of the applications received to date have been for electric-displacing solar water heating systems (see Table 33.)

4.5.5.2 CSI Thermal Marketing and Outreach Facilitation

D.10-01-022 set aside \$25 million from the \$250 million natural gas budget and \$6.25 million from the electric budget for market facilitation activities, particularly marketing and outreach, consumer education, workforce training, and reaching out to permitting officials to raise awareness. After the issuance of D.10-01-022, the CPUC directed the CSI Thermal program Administrators to file annual marketing and outreach facilitation plans (marketing plans). Since the initial marketing plans were filed in 2010, the four Program Administrators have subsequently filed annual marketing plans.

In late 2013, the IOUs filed extensive 2014 marketing plans with the CPUC, which proposed an ambitious statewide marketing campaign and significant overhauls to the CSI Thermal program's online presence. Upon CPUC approval, the Program Administrators began

implementing these plans in early 2014. However, in the IOUs' 2015 marketing plans, the Program Administrators requested to move away from statewide marketing tactics in favor of a more individualized marketing strategy for each Program Administrator's service territory. Additionally, the Program Administrators requested to focus their marketing and outreach strategies on digital efforts. After reviewing the marketing plans and collaborating with the Program Administrators, the CPUC approved the IOUs' 2015 CSI Thermal marketing plans.

4.5.5.3 CSI Thermal Measurement and Evaluation (M&E)

Unlike the CSI General Market program, where generation performance can be evaluated at the meter, CSI Thermal technologies offset electric or gas consumption. This requires evaluation of kilowatt-hour and therm savings to assess whether the program is meeting its goals.

D.10-01-022 adopted a \$6.3 million total budget for M&E of the CSI Thermal program. In February 2014, when program participation had risen to a level warranting M&E expenditures, the CPUC released a detailed M&E plan for the program. This plan, available on the CPUC's website, outlined both the field performance data to be collected from a sample of CSI Thermal systems, and the program evaluation studies to be performed with this data.⁵⁶ In accordance with the 2014 CSI Thermal M&E Plan, the CPUC retained Itron through a competitive solicitation to complete a Performance Data, Impact, and Technology Project, which includes the installation of meters on solar water heating systems that received CSI incentives in order to track their performance, and also the publishing of Technology Evaluation and Impact Evaluation Reports. Itron is currently in the process of deploying meters on 120 CSI Thermal solar water heating systems to gather data for the study.

4.6 Research, Development, Demonstration & Deployment

4.6.1.RD&D Program Background

The purpose of the CSI Research, Development, Demonstration and Deployment (RD&D) Program is to identify and support projects that help reach the program goals of installing 1,940 MW of distributed solar by the end of 2016 and creating a self-sustaining, subsidy-free solar market.

Table 35 details the total CSI RD&D budget by funding area. The program is administered by Itron on behalf of the CPUC. Itron is responsible for developing requests for proposals (RFPs), evaluating grant requests, entering into grant agreements, and monitoring progress on all approved projects. The CSI RD&D Plan, established in September 2007 by D.07-09-042,

⁵⁶ The CSI Thermal Measurement and Evaluation Plan is available at: (<http://www.cpuc.ca.gov/General.aspx?id=7623>).

identifies criteria for the selection and funding of RD&D projects, and sets allocation guidelines for using incentive funds along three targeted areas: grid integration, storage, and metering; energy generation technologies; and business development and deployment. The RD&D portfolio allocation percentages are guidelines meant to help steer funds across a range of diverse projects, and should not be interpreted as firm limits. As required in D.07-09-042, \$10 million of the CSI RD&D grant funding was allocated to support construction of the Helios Solar Energy Research Center at U.C. Berkeley, which focuses on developing low-cost solar energy conversion technologies.

Table 35: CSI RD&D Program Budget Allocations

CSI RD&D Program Funding Areas	Estimated Budget (millions)
Administration	\$5.98
Triennial Evaluations	\$1.50
Grants/Incentives	\$42.52
Total	\$50.00

Source: D.07-09-042.

Note: The estimated budgets for administration and evaluation activities represent maximum amounts, and any unused funds may be reallocated to the grants/incentives budget.

4.6.2. RD&D Program Progress

The CSI RD&D program has conducted five solicitations for projects since it began. The first program solicitation focused on integrating solar PV into the electricity grid. The second program solicitation had two focus areas: energy generation technologies and business development and deployment. The third program solicitation had a primary focus of grid integration with a secondary focus of production technologies and business development and deployment. The fourth solicitation focused on cost-effective strategies and solutions for integrating large amounts of PV into distribution systems. The fifth solicitation focused on leveraging the value of past or current CSI RD&D investments or other publically funded research to address the goals of the CSI RD&D program.

The five CSI RD&D solicitations resulted in grant funding for 36 projects totaling \$34.4 million. With the additional award of \$10 million to the Helios Solar Energy Center at U.C. Berkeley, the total allocation of CSI RD&D funds to date is approximately \$44.4 million. The CSI RD&D program has completed all planned grant making activities and will not conduct any more solicitations.

Several CSI RD&D projects have made notable contributions to the grid integration of solar and the industry in general. The most recent example being the grant funding to EPRI for a project based in Fontana CA of 20 ZNE homes in a builder community, which has become a test bed for several research questions around both ZNE and grid integration of solar and storage. Detailed

profiles of all CSI RD&D funded projects, as well as all project documentation and reports can be found at (www.calsolarresearch.ca.gov).

4.6.3. RD&D Program Evaluation

Pursuant to requirements in D.07-09-042, the CPUC is commissioning an independent evaluation of the CSI RD&D program. Results of the evaluation will provide the Commission and stakeholders an independent, expert conclusion about the CSI RD&D program’s legacy impacts on the economics, deployment, and integration of innovative solar technologies in California. A competitive solicitation process in 2015 resulted in a contract with evaluation firm Evergreen Economics. The program evaluation is assessing the impact the CSI RD&D Program had on growing the distributed solar market in California to achieve the CSI goals, using the Emerging Technologies and Market Effects Evaluation Protocols.

The evaluation contract began in January 2016 and will conclude in December 2016. As of May 2016, Evergreen Economics is implementing its evaluation plan, including expert interviews and research. The evaluation contract is being administered by Pacific Gas and Electric Company, but the review, selection, and all ongoing non-administrative oversight of the contract is conducted by Commission staff.

5 Program Reporting and Evaluation

5.1 Program Reporting

5.1.1. Online CSI General Market Reporting

CSI General Market program data is provided online at the “Trigger Tracker”⁵⁷ and at the CSS website.⁵⁸ The CSS site, launched in 2010, is a collaborative effort between the CSI program Administrators and CPUC staff, and contains a wealth of program data. The website originally focused on the CSI General Market program, but later added data on the MASH and SASH programs. NEM interconnection data was added in 2015 to ensure CSS continues to provide useful solar data as the CSI program winds down.

CSS data is populated entirely from PowerClerk, the CSI program’s online database and application interface. The CSS data is updated weekly and includes the following features:

⁵⁷ See, www.csi-trigger.com. The Trigger Tracker is updated on a daily basis and informs the public which incentive step is in effect for a given CSI sub-program, and how many available MW currently remain available in that step.

⁵⁸ See, www.californiasolarstatistics.com.

- Charts and tables that display key program data and can be filtered by program administrator, application status, date ranges, sub-program, and system ownership.
- Data on individual CSI and NEM installations (while maintaining customer confidentiality).
 - System costs
 - Manufacturer, model, capacity, and other technical information
 - Geographic location
- A “Find an Active Solar Contractor” feature, which helps prospective solar buyers search local options for solar installations.
- Weekly (and daily, for the General Market) updates to the budget status of the General Market, SASH, and MASH programs.
- A Data Annex, containing information about the efficiency of the program’s administrative processing.

Market participants (installers, third party owners, manufacturers, etc.) have praised the benefits of this online data, because it is current (updated daily or weekly), comprehensive (covering the vast majority of California’s distributed generation PV installations), and in-depth (including many data fields). Outside agencies have modeled their public-facing solar energy databases after the CSS site.

As the various CSI sub-programs became fully subscribed and stopped accepting applications, there was a concern that this source of solar PV market data would become outdated. For this reason, the CPUC adopted D.14-11-001, which instructs the CPUC, CEC and Program Administrators to continue the collection of non-CSI solar PV installation data through the NEM interconnection process. The new solar data collected through the NEM interconnection dataset is now available on CSS. The availability of both data sets has been extremely valuable to those who use the CSS database, as the CSS site now extends beyond CSI to cover all distributed generation solar PV in the IOU territories.

As the CSI program ends, data from this expanded dataset will be more fully integrated into a new “California Distributed Generation Statistics” website that is now being built to use NEM data as the basis for its public reporting and applications to replace the California Solar Statistics website. This transition should happen sometime in 2016 (CSI data will still be available.) The site will initially host only solar data, but may ultimately include data on all distributed generation and storage resources.

5.1.2. Online CSI Thermal Reporting

Similar to the Trigger Tracker for the CSI General Market program, the CSI Thermal “Incentive Step Tracker”⁵⁹ informs the public which incentive steps are currently in effect for the various CSI Thermal sub-programs, including low-income sub-programs, and how much funding remains in each step.

Using CSS as a model, CPUC staff and the Program Administrators developed the CSI Thermal Statistics (CTS) site as a public-facing database for the CSI Thermal program. The CTS site launched in February 2015 and contains extensive CSI Thermal program data. The website contains data on all of the sub-programs, and can also be filtered by backup commodity (natural gas, electricity, or propane). CTS data is populated by the csithermal.com database, and uses Tableau software, which allows for user generation of unique charts and graphics. Video tutorials are posted on the website to assist users. The CTS data is updated weekly and includes the following features:

- Charts and Tables that display key program data and can be filtered by program administrator, application status, date ranges, sub-program, and system ownership.
- A master data set, which includes data on individual installations (while maintaining customer confidentiality).
 - System costs
 - Manufacturer, model, capacity, and other technical information
 - Geographic location and climate zone
- A “Find an Active Solar Contractor” feature, which helps prospective solar buyers search local options for solar thermal installations.
- Bi-weekly updates to the budget status of the CSI-thermal sub-programs.
- A Data Annex, containing information about the Program Administrators’ processing times for CSI Thermal applications.

5.1.3. Periodic CSI and CSI Thermal Reports

A number of periodic reports are filed publicly and posted to the CPUC’s CSI website.⁶⁰

⁵⁹ See (<https://www.csithermal.com/tracker/>).

⁶⁰ See (<http://www.cpuc.ca.gov/General.aspx?id=3747>).

- The CPUC’s Annual Program Assessment to the Legislature (this document), required by statute every year no later than June 30th.
- The Annual CSI Data Annex report. This elaborates on the data annex information available online, showing trends over time, including trends in NEM participation and Program Administrator efficiency in processing CSI applications.
- The Program Administrators’ MASH and SASH semi-annual progress reports.
- The Program Administrators’ CSI Thermal quarterly reports that provide programmatic updates and updates on the program’s progress towards its energy displacement goals.

5.2 Program Evaluation Plan

The CSI Evaluation Plan measures the CSI program’s progress towards its goals of deploying 1,940 MW of new solar capacity by 2017, and helping to create a self-sufficient solar industry in which solar energy systems are a viable mainstream option for both homes and businesses within 10 years, without ratepayer support.

A summary of CSI M&E reports conducted and commissioned to be completed is as follows:

- **PV Market Assessment Studies:** In April and May of 2014, the CPUC released three studies that address the core question of how much the distributed generation PV market has been transformed, how much we expect it will be transformed after the CSI program’s market interventions, and how we will know. The studies included:⁶¹
 - Third-Party Ownership Market Impact Study: This study found that third-party ownership has accounted for a significant portion of residential solar installs and demand for this model is growing.
 - CSI Market Transformation Study: This study found that significant market transformation has occurred, but that continued health to the industry is dependent in part on a speedy and favorable resolution of Net Energy Metering policies and of the pending residential rate reforms.
 - Solar PV and Residential Roof Study: This study assessed the relationship between roofing and the distributed generation PV market.
- **Impact Evaluations:** Three studies covering 2007-2010 have been published. These studies provide up to date information on the CSI program accomplishments, including

⁶¹ See (<http://www.cpuc.ca.gov/General.aspx?id=7623>).

energy, capacity, and environmental impacts and PV system performance degradation. A final impact evaluation for program years 2011-2016 will be conducted now that the CSI General Market program is closed to new applications.

- **Impact of Distributed Generation Reports:** These reports, as mandated in AB 578 and PU Code 913.10, are due every two years. The first report was completed in 2010. The second report, delivered in May 2013, showed that, while California’s solar distributed generation installed capacity is large compared to other states, the impact on the distribution and transmission infrastructures is relatively low. The third report, commissioned via a competitive solicitation and delivered in DATE, focused on the current effects of customer-sited solar on CAISO’s net load curve.⁶² The report’s primary findings include:
 - Customer-sited solar power is effective at reducing summer peak net load, but does not reduce winter and spring peak net load, when the “duck curve” effects are most pronounced.
 - There are tradeoffs in the effects of west-facing and south-facing customer-sited solar, but the findings alone do not support policy to incentivize one type of solar over the other.
 - A diverse portfolio of renewables produces a smoothing benefit to CAISO’s net load curve.
 - Large-scale deployment of energy storage, dispatchable demand-response, and time-of-use rates for consumers will help integrate increasing amounts of customer-sited solar.
- **External Financial Audit Report:** CPUC audit staff completed the 2007-2008 audit in 2010. The 2010-2011 audit was conducted by an outside firm, and was completed in May 2013.⁶³ The audit did not identify any significant issues with administration of the program. An audit for CSI program years 2012-2014 began in 2015 and the results of the audit will be published this year.
- **CSI Cost Effectiveness Study:** This study, completed in April 2011, looked at cost effectiveness from several perspectives – program administrators, ratepayers, and especially program participants and society as a whole.⁶⁴ Based on participant economics,

⁶² A competitive solicitation was issued in January 2015 to perform the third bi-annual study. The Commission retained DNV-GL in May 2015.

⁶³ See (<http://www.cpuc.ca.gov/General.aspx?id=7623>).

⁶⁴ See (<http://www.cpuc.ca.gov/General.aspx?id=7623>).

the study suggested that the residential solar PV market will be self-sustaining by 2017, with a mixed outlook for non-residential customers.

- **CSI Thermal Performance Data, Impact, and Technology Project:** In September 2015, the CPUC contracted with Itron to assess the performance of installed CSI thermal systems through metering and collecting data from solar water heating systems. Itron is currently in the process of deploying meters on 120 CSI Thermal solar water heating systems to gather data for the study. Once a robust dataset is collected, the project will include the publishing of two Technology Evaluation Reports, which will assess the costs and benefits of various solar thermal technologies amongst different markets. The project will also include the publishing of two Impact Evaluation Reports, which will assess the CSI Thermal program’s impact on electricity and natural gas demand, effectiveness in reducing greenhouse gas emissions, and will compare the actual performance of solar water heating systems against their expected performance.
- **CSI SASH and MASH Biennial Report:** In January 2016, the CPUC released Navigant Consulting’s evaluation of CSI SASH and MASH program design, delivery, operations and impact for program years 2011-2013. The evaluation consisted of a program administrator assessment and an impact and cost-benefit analysis, which built upon the previous MASH and SASH studies completed in 2011.
- **CSI RD&D Program Evaluation:** Pursuant to requirements in D.07-09-042, the Commission is contracting for an independent evaluation of the CSI RD&D program. Results of the evaluation will provide the Commission and stakeholders an independent, expert conclusions about the CSI RD&D program’s legacy impacts on the economics, deployment, and integration of innovative solar technologies in California. A competitive solicitation process in 2015 resulted in a contract with evaluation firm Evergreen Economics. The evaluation contract began in January 2016 and will conclude in December 2016. As of May 2016, Evergreen Economics is implementing its evaluation plan, including expert interviews and research.

6 CSI Program Links and Contact Information

The main web portal for the *Go Solar, California!* campaign provides comprehensive solar e-resources for consumers and professionals: www.GoSolarCalifornia.org.

The California Public Utilities Commission Energy Division web site provides information related to the CSI program, including regulatory updates and documents for the Distributed Generation Docket R.12-11-005: http://www.cpuc.ca.gov/Demand_Side/

E-mail for CSI inquiries: energy@cpuc.ca.gov

Telephone for CSI inquiries: 415-355-5586

The CSI Thermal program provides program information at www.CSIThermal.com

7 CSI and CSI Thermal Program Administrator Contacts

PG&E

CSI program:

www.pge.com/csi

E-mail: solar@pge.com

877-743-4112

CSI Thermal program:

www.pge.com/csithermal

Email: solar@pge.com

877-743-4112

Center for Sustainable Energy (San Diego territory)

CSI program:

www.energycenter.org

E-mail: csi@energycenter.org

858-244-1177

CSI Thermal Program:

www.energycenter.org/swh

Email: SWH@energycenter.org

877-333-SWHP

Southern California Edison

CSI program:

www.sce.com/csi/

E-mail Address: CSIGroup@sce.com

866-584-7436

CSI Thermal program:

www.sce.com/csithermal

Email: CSIGroup@sce.com

800-799-4177

So Cal Gas (CSI Thermal only)

www.socalgas.com/rebates/solar/

Email: swh@SoCalGas.com

1-800-Gas-2000