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CPUC California Solar Initiative

2010 Impact Evaluation

Final Report

Submitted to:

Southern California Edison
and
California Public Utilities Commission
Energy Division

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Glossary

Abbreviations & Acronyms

Term	Definition
BIPV	Building Integrated Photovoltaics
CAISO	California Independent System Operator
CCA	Community Choice Aggregator
CCSE	California Center for Sustainable Energy
CEC	California Energy Commission
CEC PTC AC W	California Energy Commission PVUSA Test Conditions (PTC) Alternating Current (AC) Watts (W)
CO2	Carbon Dioxide
CO2Eq	CO_2 equivalent
CPUC	California Public Utilities Commission
CSI	California Solar Initiative
CSI GM	California Solar Initiative General Market
EPBB	Expected Performance Based Buydown
ESP	Energy Service Provider
IOU	Investor-owned Utility
LSE	Load-serving Entity (in this report IOUs, energy service providers (ESPs) and community choice aggregators (CCAs) are collectively referred to as LSEs)
MASH	Multifamily Affordable Solar Housing
NEM	Net Energy Metering
NOx	NOx refers to nitric oxide (NO) and nitrogen dioxide (NO2).
NQC	Net Qualifying Capacity
NSHP	New Solar Homes Partnership
PA	Program Administrator
PBI	Performance Based Incentive
PDP	Performance Data Provider
PG&E	Pacific Gas and Electric Company
PM-10	Particulate matter (PM) with diameter of 10 micrometers or less.
POU	Publicly-owned Utility
PPA	Power Purchasing Agreement
PV	Photovoltaics
PY	Program Year
QC	Qualifying Capacity
SASH	Single-family Affordable Solar Housing
SCE	Southern California Edison
SDG&E	San Diego Gas and Electric Company
SGIP	Self-Generation Incentive Program

Key Terms

Term	Definition
Applicant (as defined for CSI)	The entity, either the Host Customer, System Owner, or third party designated by the Host Customer, that is responsible for the development and submission of the CSI application materials and the main point of communication between the CSI Program Administrator for a specific CSI Application.
Azimuth	The horizontal angular distance between the vertical plane containing a point in the sky and true south. All references to azimuth within the CSI Program, unless expressly stated otherwise, refer to true, not magnetic, azimuth.
Building Integrated Photovoltaics (BIPV)	Building integrated PV systems are solar electric systems in which the PV panels constitute part of the building's roof or facade, replacing conventional building materials. For example, solar shingles may replace conventional asphalt shingles, providing roof protection while producing electricity.
California Independent System Operator (CAISO)	A non-profit public benefit corporation charged with operating the majority of California's high-voltage wholesale power grid.
Capacity Factor	The ratio of the electrical energy produced by the generating system during a specific period, to the electrical energy the generating system could have produced if it had operated at full capacity rating during the same period.
Capacity Rating	The capacity rating is a load that a power generation unit, such as a photovoltaic system, is rated by the manufacturer to be able to meet or supply. The Program Administrator will verify system capacity rating to confirm the final incentive amount.
CEC-AC Rating	The CSI Program Administrators use the California Energy Commission's CEC-AC method to measure nominal output power of photovoltaic cells or modules to determine the system's rating in order to calculate the appropriate incentive level. The CEC-AC rating standards are based upon 1,000 watt/m2 solar irradiance, 20 degree Celsius ambient temperature, and 1 meter/second wind speed. The CEC-AC watt rating is lower than the Standard Test Conditions (STC).
CO2 Equivalent (CO2Eq)	When reporting emission impacts from different types of greenhouse gases, total GHG emissions are reported in terms of tons of CO_2 equivalent so that direct comparisons can be made. To calculate the CO2Eq, the global warming potential of a gas as compared to that of CO2 is used as the conversion factor (e.g., The global warming potential of CH4 is 21 times that of CO2. Thus, to calculate the CO2Eq of a given amount of CH4, you multiply that amount by the conversion factor of 21.
Commercial	Commercial entities are defined as non-manufacturing business establishments, including hotels, motels, restaurants, wholesale businesses, retail stores, and for-profit health, social, and educational institutions. For the purpose of CSI, commercial sectors include agricultural and industrial customers.
Community Choice Aggregator (CCA)	Community choice aggregation allows communities to offer energy service to electric customers within their boundaries. A Community choice aggregator is any marketer, broker, public agency, city, county, or special district that combines the loads of multiple end-use customers in negotiating the purchase of electricity, the transmission of electricity, and other related services for these customers.

Term	Definition
Confidence Interval	A particular kind of interval estimate of a population parameter used to indicate the reliability of an estimate. It is an observed interval (i.e., calculated from observations), in principle different from sample to sample, that frequently includes the parameter of interest, if the experiment is repeated. How frequently the observed interval contains the parameter is determined by the confidence level or confidence coefficient. A confidence interval with a particular confidence level is intended to give the assurance that, if the statistical model is correct, then taken over all the data that might have been obtained, the procedure for constructing the interval would deliver a confidence interval that included the true value of the parameter the proportion of the time set by the confidence level.
Confidence Level (also Confidence Coefficient)	The degree of accuracy resulting from the use of a statistical sample. For example, if a sample is designed at the 90/10 confidence (or precision) level, the resultant sample estimate will be within ±10 percent of the true value, 90 percent of the time.
CSI-Thermal Program	A California utility ratepayer-funded program that provides incentives for solar water heating and other solar thermal technologies to residential and commercial customers of PG&E, SCE, SoCal Gas, and SDG&E
Customer (also Host Customer)	An individual or entity that meets all of the following criteria: 1) has legal rights to occupy the Site, 2) receives retail level electric service from PG&E, SCE, or SDG&E, 3) is the utility customer of record at the Site (GM CSI only) or owns the site, 4) property owner or persons/entity responsible for the building at the location where the generating equipment will be located (MASH only), 5) is connected to the electric grid, and 6) is the recipient of the net electricity generated from the solar equipment (GM CSI only).
Design Factor	A ratio comparing a proposed system's expected generation output with that of a baseline system. The Design Factor is used in calculating the EPBB incentive (it is multiplied by the system rating and the incentive rate to determine EPBB incentives). A Design Factor is also used by Program Administrators to allocate applications against their MW in step.
Diversity Benefit Factor	The diversity benefit factor is a factor used by the CAISO to account for higher output from some wind/solar resources offsetting lower output of other resources.
Energy Service Provider (ESP)	A non-utility entity that offers energy service to customers within the service territory of an energy utility.
Expected Performance Based Buydown (EPBB)	The EPBB incentive methodology pays an up-front incentive to participants installing systems less than 100 kW in size that is based on a system's expected future performance. EPBB incentives combine the performance benefits of PBI with the administrative simplicity of a onetime incentive paid at the time of project installation. The EPBB Incentive will be calculated by multiplying the incentive rate by the system rating by the Design Factor.
Fixed (PV) System	Fixed systems are literally fixed in their orientation (i.e., direction in which the panels face) and tilt, and are categorized in this analysis as "near flat" (tilt of less than 20 degrees) and "tilted" (tilt of 20 degrees or greater).

Term	Definition
Greenhouse Gas (GHG) Emissions	For the purposes of this analysis GHG emissions refer specifically to CO_2
Heterojunction with Intrinsic Thin Layer (HIT) Si Cell	HIT cells are made up of a thin crystalline silicon wafer surrounded by ultra-thin amorphous silicon layers that are bonded with an undoped thin film (the intrinsic thin layer) in between. The HIT cells have higher efficiency than conventional crystalline cells, and do not degrade over time like amorphous thin film cells. HIT solar cells can also achieve higher energy yield at high temperature, as compared to crystalline solar cells.
Host Customer (also Customer)	An individual or entity that meets all of the following criteria: 1) has legal rights to occupy the Site, 2) receives retail level electric service from PG&E, SCE, or SDG&E, 3) is the utility customer of record at the Site (GM CSI only) or owns the site, 4) property owner or persons/entity responsible for the building at the location where the generating equipment will be located (MASH only), 5) is connected to the electric grid, and 6) is the recipient of the net electricity generated from the solar equipment (GM CSI only).
Insolation	A measure of solar radiation energy received on a given surface area in a given time. It is commonly expressed as average irradiance in watts per square meter (W/m2) or kilowatt-hours per square meter per day (kWh/(m2·day)) (or hours/day). In the case of photovoltaics it is commonly measured as kWh/(kWp·y) (kilowatt hours per year per kilowatt peak rating).
Interconnection Agreement	A legal document authorizing the flow of electricity between the facilities of two electric systems. Under the CSI Program, eligible renewable energy systems must be permanently interconnected and operating in parallel to the electrical distribution grid of the utility serving the customer's electrical load. Portable systems are not eligible. Proof of interconnection and parallel operation is required prior to receiving an incentive payment.
Interval Data Recorder (IDR)	IDR is a metering device capable of recording minimum data required. Minimum data requirements include (a) hourly data required for the Direct Access settlement process; and (b) data required to bill the utility's distribution tariffs including 15-minute demand data—also referred to as Hourly Metering.
Inverter	An electric conversion device that converts direct current (DC) electricity into alternating current (AC) electricity.
Inverter Efficiency	The AC power output of the inverter divided by the DC power input.
Load	Either the device or appliance which consumes electric power, or the amount of electric power drawn at a specific time from an electrical system, or the total power drawn from the system. Peak load is the amount of power drawn at the time of highest demand.
Load-serving Entity	Utility, marketer (ESP) or aggregator which provides electric power to a large number of end-use customers. In this report investor-owned utilities (IOUs), energy service providers (ESPs) and community choice aggregators (CCAs) are collectively referred to as LSEs.

Term	Definition
Marginal Heat Rate	Heat rate is measurement used to calculate how efficiently a generator uses heat energy (or its efficiency in converting fuel to electricity). It is expressed as the number of BTUs of heat required to produce a kilowatt-hour of energy. The marginal heat rate is the amount of source energy that is saved as a result of a change in generation.
Module	Under the CSI Program, a module is the smallest complete environmentally protected assembly of interconnected photovoltaic cells. Modules are typically rated between 50 and 300 W.
Mono-crystalline Silicon (c-Si) Cell	Mono-crystalline cells are made from thin slices (wafers) cut from a single crystal of silicon, which is produced by immersing a crystal nucleus with a defined orientation into a bath of melt-silicon and very slowly drawing the crystal from the bath. The wafer is doped with impurities to form p-type areas and n-type areas. After that, electrical leads are attached to the wafers, thus forming the mono-crystalline cells. Since they are cut from cylindrical ingots, single-crystal wafers do not completely cover a square solar cell module without a substantial waste of refined silicon. These cells tend to be more expensive than multi-crystalline silicon cells, but also more efficient.
Multi-crystalline Silicon (mc-Si) Cell	Multi-crystalline cells are made from thin slices (wafers) cut from a large square cast silicon block. After doping the wafer with impurities and attaching electrical leads to the wafer, multi-crystalline cells are formed. Since crystals of various orientations are formed during block casting, the surface of a polycrystalline cell has an appearance of shattered glass. Multi-crystalline silicon cells are less expensive to produce than single-crystal silicon cells, but tend to be less efficient
Net Energy Exports	Electricity generated by PV systems in excess of on-site demand which is exported to the utility grid
Net Energy Metering (NEM) Agreement	An agreement with the local utility which allows customers to reduce their electric bill by exchanging surplus electricity generated by certain renewable energy systems such as the PV systems the CSI subsidizes. Under net metering, the electric meter runs backwards as the customer-generator feeds extra electricity back to the utility. The CSI Program permits net energy metering agreements.
Net Qualifying Capacity (NQC)	The amount of a resource's capacity that can actually be counted for resource adequacy compliance filings.
Orientation	The direction and tilt of a PV system.
Participant	The CSI GM System Owner.
Peak Load	The amount of power drawn at the time of highest demand.
Performance Based Incentive	The CSI Program will pay Performance Based Incentives (PBI) in monthly payments based on recorded kilowatt hours (kWh) of solar power produced over a five-year period. Solar projects receiving PBI incentives will be paid a flat per kWh payment monthly for PV system output that is serving on Site load. The monthly PBI incentive payment is calculated by multiplying the incentive rate by the measure kWh output.
Performance Data Provider	Service provider that monitors and reports the energy production data from the solar energy system to the Program Administrator to serve as the basis for PBI payments.

Term	Definition
Power Purchase Agreement	An agreement for the sale of electricity from one party to another, where the electricity is generated and consumed on the host customer site. Agreements that entail the export and sale of electricity from the host customer site do not constitute on-site use of the generated electricity and therefore are ineligible for the CSI.
PowerClerk	The online application system for the California Solar Initiative. Applicants can use PowerClerk to create and submit a new incentive application or check the status of an existing application
Public Purpose Program	Public Purpose Programs in California are the state-mandated programs funded through surcharges on utility rate payer bills. These programs support renewable energy generation and energy efficiency incentives; research, development, and demonstration; and low-income programs.
Qualifying Capacity (QC)	The amount of a resource's capacity, prior to adjustment for deliverability, which can be counted towards meeting the resource adequacy procurement obligation.
Rebated Capacity	The capacity rating associated with the rebate (incentive) provided to the program participant. The rebated capacity may be lower than the typical "nameplate" rating of the technology.
Residential	Residential entities are private household establishments that consume energy primarily for space heating, water heating, air conditioning, lighting, refrigeration, cooking, and clothes drying. The classification of an individual consumer's account, where the use is both residential and commercial, is based on principal use. A power purchase agreement on a residence is considered a residential application.
Resource Adequacy	Resource adequacy is used for determining the amount of resources that must be procured by load-serving entities (LSEs) to ensure supplies are sufficient to meet anticipated demand. "Resource procurement traditionally involves the CPUC developing appropriate frameworks so that the entities it regulates will provide reliable service at least cost. This involves determining an appropriate demand forecast and then ensuring that the utility either controls, or can reasonably be expected to acquire, the resources necessary to meet this demand, even under stressed conditions such as hot weather or unexpected plant outages. 'Resource adequacy' seeks to address these same issues. In developing policies to guide resource procurement, the CPUC is providing a framework to ensure resource adequacy by laying a foundation for the required infrastructure investment and assuring that capacity is available when and where it is needed." (CPUC D.04-01-050, pp. 10-11. http://docs.cpuc.ca.gov/published/Final_decision/33625.htm)
Solar Irradiance	Radiant energy emitted by the sun, particularly electromagnetic energy. In the CSI Program the CEC-AC rating standards are based upon 1,000 Watt/m2 solar irradiance, 20 degree Celsius ambient temperature, and 1 meter/second wind speed. The CEC-AC watt rating is lower than the Standard Test Conditions (STC), a watt rating used by manufacturers.

Term	Definition
Solar Noon	The moment when the sun appears highest in the sky (nearest zenith), compared to its positions during the rest of the day. It occurs when the sun is transiting the celestial meridian.
Surface Orientation Factor (SOF)	The ratio of the annual incident solar radiation on a surface for a specific tilt and orientation (MJ/m2/year) divided by the annual incident solar radiation on a surface for a south-facing surface with optimal tilt (MJ/m2/year).
System Owner	The owner of the PV system at the time the CSI GM incentive is paid. For example, in the case when a vendor sells a turnkey system to a Host Customer, the Host Customer is the System Owner. In the case of a leased system, the lessor is the System Owner.
System Size	Generally, under the CSI, system size is defined as the capacity of a given photovoltaic system based upon CEC-AC rating standards. Under the CSI Program, the incentive is determined based on the expected production of electricity by the system, which may not exceed the actual energy consumed during the previous 12 months at the project site. However, for purposes of determining the capacity a given project contributes to a given step in the incentive schedule, system size is defined as the system size rating times a Design Factor
Thin film Cadmium Telluride (CdTe) Cell	CdTe cells are thin film cells with cadmium telluride as the active semiconductor material. The cadmium telluride layer acts as the p-type absorber layer and is coated on top of an n-type cadmium sulphide layer. Thin-film technologies reduce the amount of material required in creating a solar cell. Though this reduces material cost, it may also reduce energy conversion efficiency. Thin-film silicon cells are flexible, lightweight, and more easily integrated than wafer silicon cells, but tend to also be more expensive.
Third-party Owner	A non-Host Customer owner of the PV system at the time the CSI GM incentive is paid. In the case of a leased system, the lessor is the third-party owner (also referred to as System Owner).
Tilt	The angle at which a PV system's panels are set. In this analysis, a system with a tilt of 20 degrees or greater is considered "tilted" (while a system with a tilt of less than 20 degrees is considered "near flat.”)
Title 24	Title 24 refers to the California Energy Code, or Title 24, Part 6 of the California Code of Regulations, also titled "The Energy Efficiency Standards for Residential and Nonresidential Buildings." These standards were established in 1978 in response to a legislative mandate to reduce California's energy consumption. The standards are updated periodically by the California Energy Commission to allow consideration and possible incorporation of new energy efficiency technologies and methods. The current 2008 standards went into effect January 1, 2010.
Tracking (PV) System	Tracking systems use single- or dual-axis mechanical sub-systems to follow the path of the sun across the sky. Tracking systems can harvest more sunlight than fixed systems but have higher capital costs and require more maintenance due to their moving parts.

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Executive Summary

ES.1 On the CSI 2010 Impact Evaluation

The purpose of an impact evaluation is to assess the changes resulting from a program or policy. The evaluation seeks to answer the questions of how well the program is working and the affects on both participants and non-participants. As the California Solar Initiative (CSI) enters its fifth year, the 2010 impact evaluation investigates how the CSI has affected California's electricity system, the California solar PV market, and the environment.

The 2010 impact evaluation also looks at the CSI within the historical context of the development of California's solar PV industry. California has long been a leader in renewable energy and the CSI is built on a foundation of supportive solar policies and past solar programs. Consequently, impacts of the CSI are measured against this broader solar backdrop.

An impact evaluation should also help inform future direction. To that extent, this impact evaluation examines and makes recommendations regarding interconnection, market transformation, and the potential implications of Net Energy Metering (NEM) PV systems.

There are two caveats to this 2010 impact evaluation. First, we were not always able to obtain statistically valid random sample sizes. Metered data are provided by some but not all participants. In those few instances where we did not have a random sample population, we took steps to minimize sample bias with the data provided. Second, we provide statistically valid impact results only for the CSI General Market (CSI GM) and the Self-Generation Incentive Programs as metered data were not available for the other programs.[1]

[1] Please see sections 3 and 6 for additional descriptions of sampling and impacts estimation methods.

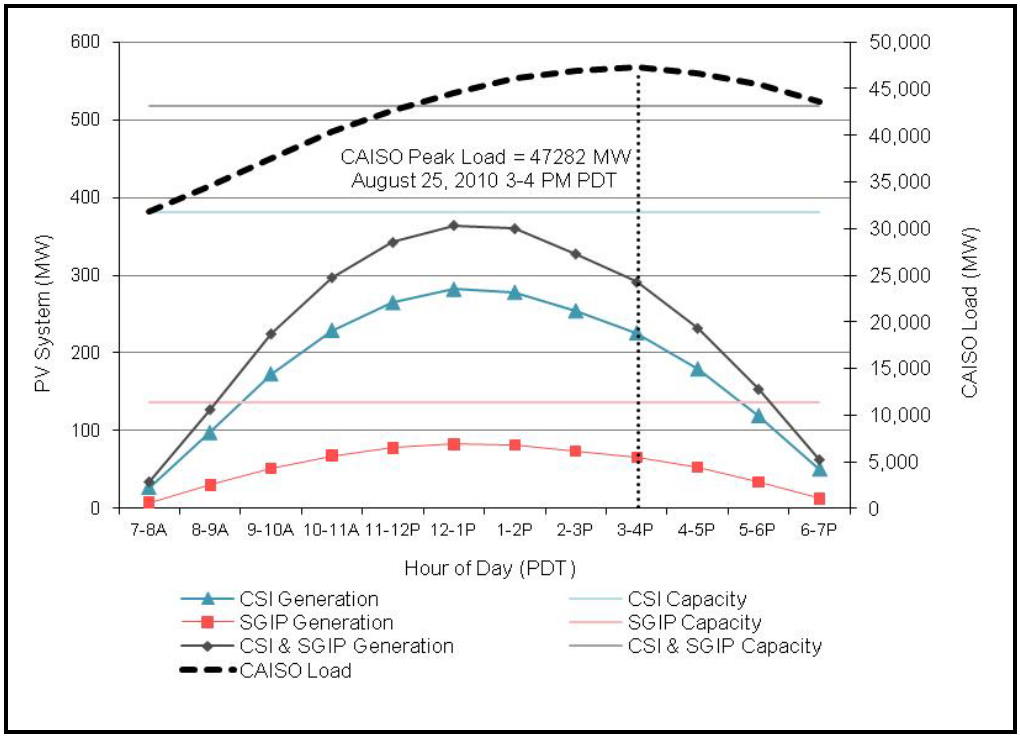
ES.2 Key Findings

The following represent key findings from the report.

ES.2.1 2010 Impacts of CSI GM and SGIP

- **Energy delivery**: CSI GM and SGIP PV systems generated over 800,000 MWh of electricity during 2010. That is enough energy to meet the electricity requirements of approximately 135,000 homes for a year. CSI GM systems contributed over 620,000 MWh of this total; a 59% increase from the amount generated in 2009.
- **Capacity factor**: The weighted annual average estimated capacity factor for all CSI GM and SGIP PV systems in 2010 was 0.19 (0.20 for CSI GM systems and 0.16 for SGIP systems).
- **Coincident peak**: The 2010 CAISO load peaked on August 25 from 3:00 to 4:00 PM Pacific Daylight Time (PDT) at 47,282 MW. In 2010, there were over 36,600 CSI GM and SGIP PV systems online at the time of the CAISO system peak. CSI GM and SGIP PV systems had a capacity factor of 0.56 for the 2010 CAISO system peak hour.

Figure ES-1: CAISO Peak Day CSI and SGIP PV Performance



- **GHG and Air Pollution Emission Reductions**:

  Overall, the CSI GM program and the SGIP provided nearly 400,000 tons of CO_2 emission reductions during 2010. In addition, the CSI GM program and the SGIP provided over 52,000 pounds of PM10 and over 92,000 pounds of NOx emissions reductions during 2010.

ES.2.2 Estimated 2010 Impacts of Examined Public Purpose Programs

Table ES-1: Annual Energy Generation and Capacities—CA Public Purpose Program PV Systems

Program	PV Systems (n)	Rated Capacity (MW)	Generation (MWh)*	Annual Capacity Factor (kWh/kW rebated)
CSI - General Market	41,663	438	622,031	0.20
CSI - MASH	49	2	1,925	0.19
CSI - SASH	372	1	907	0.19
Subtotal - All CSI	*42,084*	*441*	*624,863*	*0.20*
SGIP	890	136	191,512	0.16
ERP	28,033	123	168,580	0.16
NSHP	3,282	9	14,392	0.19
Subtotal - Non-CSI	*32,205*	*268*	*374,483*	*0.16*
All	**74,289**	**709**	**999,347**	**0.18**

* The uncertainty on all estimates in Table ES-1 is better than 90/10 confidence level.

- **Energy delivery**: All programs (i.e., CSI GM, SGIP, ERP, MASH, SASH, and NSHP) combined contributed nearly 1,000,000 MWh of electricity during 2010.

  On an annual basis, the CSI GM program contributes 62% of the total generation, and is orders of magnitude larger than its counterparts, MASH and SASH. The other major contributions are from SGIP and ERP PV systems, with 19% and 17%, respectively.

- **GHG emission reductions**: All programs combined provided over 486,000 tons of GHG emissions reduction (as CO_2Eq).

  The CSI GM program contributes the most reduction at 62%, or over 300,000 tons, while the SGIP contributes over 93,000 tons or approximately 19%. ERP PV systems contribute another 17%, or 82,000 tons; and NSHP, MASH, and SASH combine to make up the remaining 1.7%.

Section 6 and Appendix C of the main report have more detail and information on the energy and emission impacts of CSI and other programs.

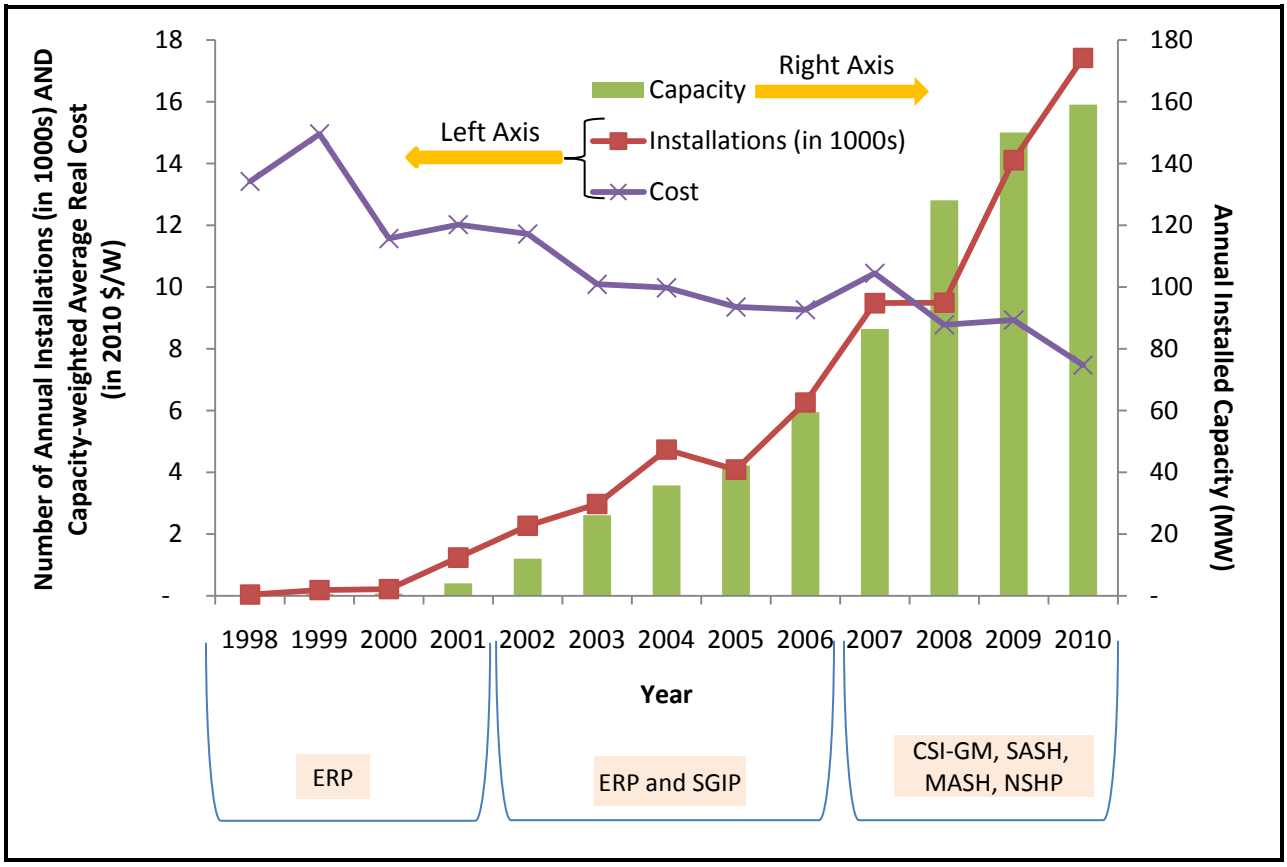
ES.2.3 The CSI in Perspective

- **The CSI has accelerated both the growth of PV systems and installed capacity in California's PV market**

  As a result of the CSI, California represents the fastest growing PV market in the country and provides nearly two-thirds of the country's total amount of installed PV capacity.[2]

- **PV costs under the CSI have decreased rapidly**

Figure ES-2: California IOU Public Purpose Program PV Systems—Trend in Annual Installed Capacity, Number of Installations, and Costs



- **While the CSI is only mid-way to its 2016 goal, additional pressure for PV growth is likely and may pose challenges**

  As of the end of 2010, there were close to 42,000 PV systems installed under the CSI, representing nearly 440 MW of capacity. For the CSI to reach its goal of 1,940 MW by the end of 2016, 60,000 additional PV systems will need to be added for an installed

[2] Sterkel, M. "California Perspective on High Penetration PV," CPUC presentation at High Penetration Solar Forum, March 2011

capacity of nearly 1,500 MW. As California already has over 70,000 installed PV systems, this will bring the total number of PV systems to over 140,000 by the end of 2016.

This may be a conservative estimate of the future number of installed PV systems in California. California's policy goals on the Renewables Portfolio Standard (RPS) and Governor Brown's Distributed Generation (DG) target may increase this number five-fold, bringing the total number of installed systems to well over 500,000 and the total installed capacity to over 5,000 MW by 2020.[3]

- **Rapid growth in the CSI is leading to changes in California's PV markets**

  At the end of 2010, the top 10 module manufacturers accounted for 86% of the total CSI GM installations and 83% of the total installed CSI GM capacity. However, new players have been entering the market and changing the dynamics of the top 10 players. In the first two years of the CSI GM, the top 10 module manufacturers held 95% of the residential market share, but by the end of 2010, this had dropped to 75%. Even more dramatic change has occurred in the non-residential sector, where the top 10 module manufacturers' market share dropped from 95% in 2007 to 69% by the end of 2010.

- **The number of third-party-owned systems has been growing under the CSI GM**

  Overall, 16% of the systems accounting for 37% of installed capacity were owned by third parties.

Table ES-2: CSI GM Systems—Trend in Third-Party Ownership

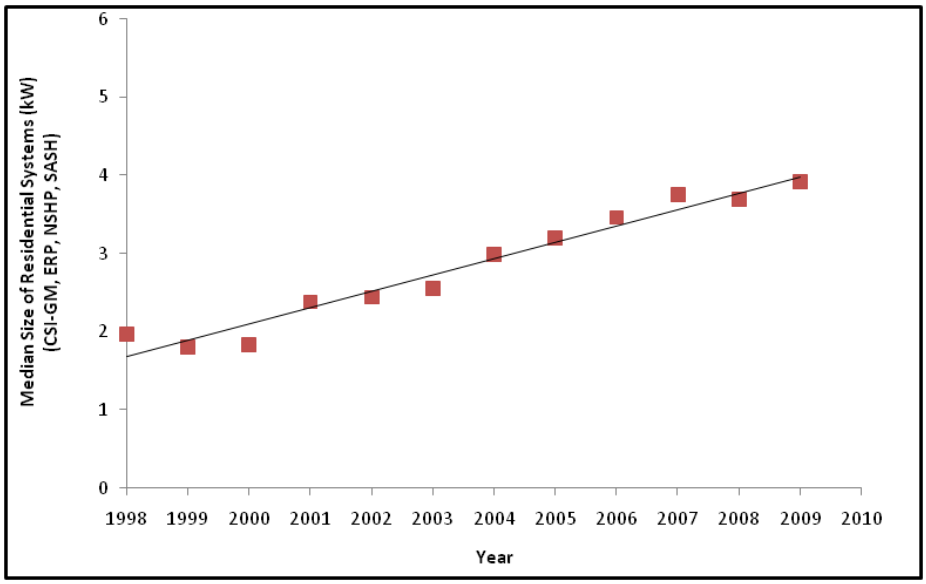
Year	Installed Systems –All CSI GM	Installed Systems –Third-Party-Owned (% of Total)	Installed Capacity –All CSI GM (MW)	Installed Capacity –Third-Party-Owned (% of Total)
2007	3,440	10%	25	29%
2008	8,435	10%	113	43%
2009	13,044	13%	145	39%
2010	16,744	22%	155	31%
Total	**41,663**	**16%**	**438**	**37%**

[3] See CPUC, "33% Renewables Portfolio Standard: Implementation Analysis Preliminary Results," June 2009 discussion of the high DG case

- **The size of residential PV systems is growing**

  Between 1998 and the end of 2010, the median size of residential PV systems more than doubled; going from approximately 1.8 kW to 3.7 kW. This follows somewhat the decline in PV system costs that have decreased by 44% from $13.4/W in 1998 to $7.5/W in 2010.

Figure ES-3: Median Residential System Size



- **Incentive structures have led to growth but not market optimization**

  While there has been rapid growth of solar PV in California, statistical analysis indicates purchasers of PV systems do not necessarily take advantage of solar resources appropriately or that there is insufficient benefit for them to take advantage of good solar resources. If the purpose of future solar PV growth is to encourage PV electricity production at lower costs, incentives may be restructured to help the market allocate PV systems to maximize solar resources.

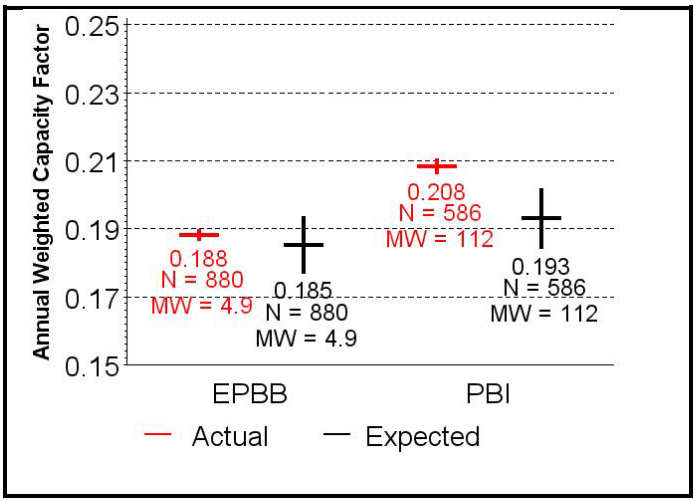
Section 2 of the main report presents more detailed information on program status.

ES.2.4 PV System Performance

- **Overall, CSI GM systems perform better than expected**

  Similar to 2009,[4] Performance Based Incentive (PBI) systems delivered 7.8% more energy than expected and EPBB systems performed 1.6% better than expected. Much of the PBI overperformance appears to be linked to tracking systems.

Figure ES-4: Actual and Expected Performance by Incentive Type



- **Parallel metering validated third-party data values**

  Analysis of parallel metering data showed there is not a statistical difference between Itron and third-party data. Third-party metering showed very slightly higher energy than Itron metering but not in a statistically significant manner.

- **Examination of capacity changes showed a trend that residential customers could be installing additional PV capacity without recourse to incentives**

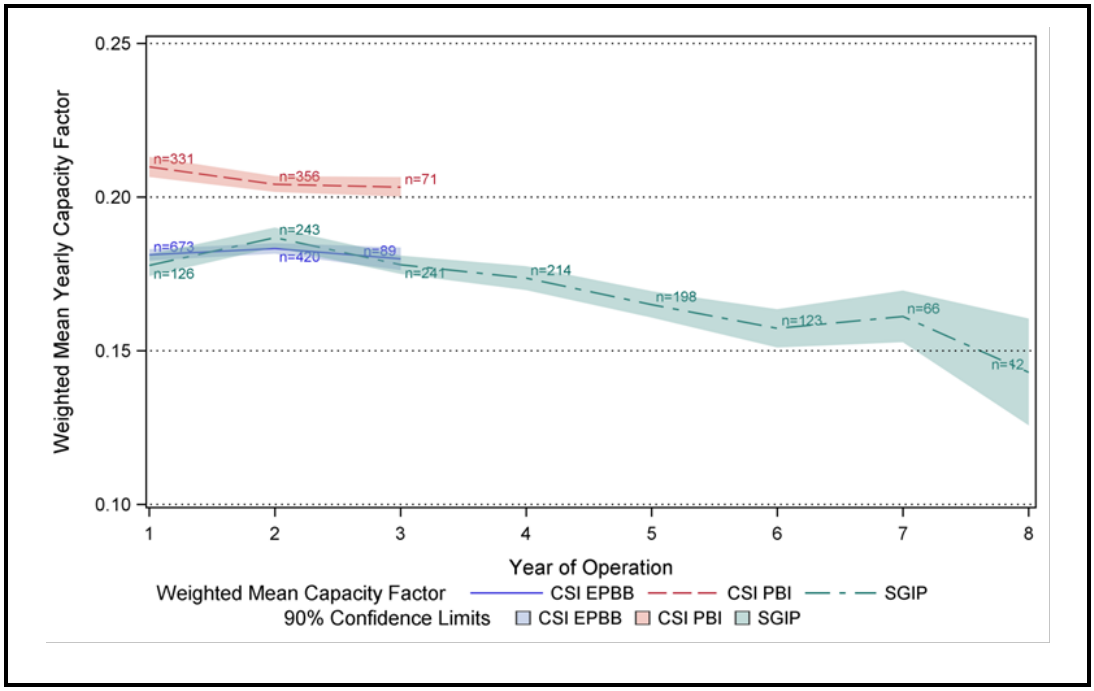
  The residential sector shows an increase in added generation capacity to already installed EPBB systems. While capacity additions on a few systems showed significant changes for individual systems, we found there to be little overall impact on the program for PBI systems.

[4] Itron, Inc., *CPUC California Solar Initiative: 2009 Impact Evaluation Final Report*, June 2010, http://www.cpuc.ca.gov/PUC/energy/Solar/eval09.htm

- **PBI PV systems tend to performance better initially, as well as over time**

  Overall, the better initial performance is due in part to more tracking systems. The better performance over time may be evidence that the additional financial incentive act to ensure continued maintenance of the system.

Figure ES-5: PV Performance over Time by Incentive Type

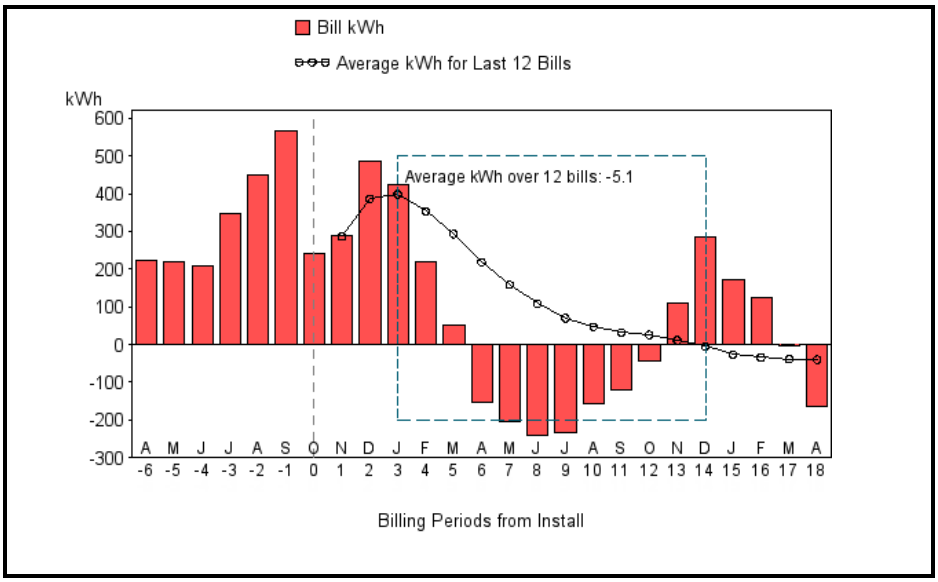


Sections 4 and 5 of the main report present more detailed information on PV performance.

ES.2.5 Energy Exports

- **More than half of the sites (52%) had at least one billing period where the systems generated net excess energy**

Figure ES-6: Graph Example of Frequency of Export over 12-Bill Period



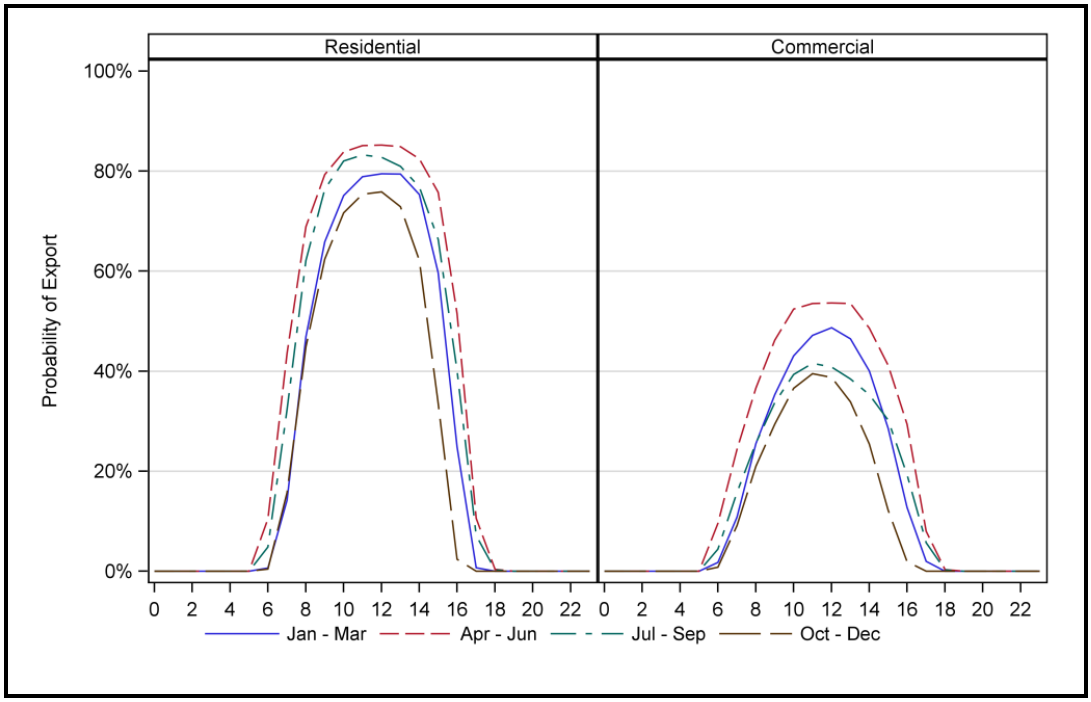
- **Nearly 14% of examined sites qualified as annual net exporters**

  For the residential CSI GM participants, who account for 23,959 of the total sites, there is a clear relationship between system size and the frequency of 12-bill net exports. The percentage of residential yearly net exporters across PAs increases from 12.1% for the smaller systems to 18.6% for systems 7.5 kW and larger.

- **Annual net exporters have lower pre-installation consumption**

  For all three PAs the influence of PV generation on billed consumption is clear and the post-installation bill kWh is lower year round. It is also clear that the combination of high PV generation and low AC loads in the spring contributes to higher exports for the annual net export group during this time period.

Figure ES-7: Likelihood of Export by Hour and Quarter for CCSE Sites



- **Hourly analysis indicates a high probability of export during mid-day hours, especially residential systems**

  There is a very high probability that PV generation will be exported to the grid for the mid hours of the day. Residential systems are far likelier to export mid-day than commercial systems. The analysis of the monthly bills as well as the interval data however, indicate that only a fraction of sites will actually show an annual net export of electricity. This implies that, for most sites, there is a substantial amount of consumption off the grid during non-generation hours, making up for the exported PV electricity.

ES.2.6 Recommendations

1. **The CPUC and PAs should increase efforts to streamline interconnection processes as well as PV permitting and plan check processes**.

   The IOUs have stated they are already challenged by the existing level of interconnection requests being received. Installers have repeatedly noted the delays and costs caused by varying permitting practices. However, PV system installations are expected to double for the CSI to meet the 2016 capacity targets. In addition, growth in third-party-owned systems can be expected to continue in both the residential and non-residential sectors. Lastly, implementation of the RPS and DG policies may result in increased levels of PV installations.

2. **The CPUC should investigate the major drivers that would lead homeowners and businesses to install PV without recourse to incentives.**

   The results of our analysis on capacity additions indicates that some small portion of the residential sector may be moving forward with installing additional PV capacity without using incentives. Given the low incentive levels for residential systems in the CSI, continued development of PV may be driven either by third-party owner models or an innovative approach to financing systems at low cost to the homeowner or business owner. A market analysis should be able to identify the financial and demographic characteristics of the homeowners and businesses that can benefit by pursuing PV systems without the use of incentives, the number of utility customers who fit these characteristics, and the overall magnitude of additional PV capacity that could be expected to result. The study should also investigate how possible loss of the ITC would affect the economics of a non-incentive approach. Understanding and even fostering this growth will aid the transition of PV from an incentive driven industry to a mature and self sustaining industry in California.

3. **The CPUC and utilities should investigate the potential grid impacts associated with the high amount of mid-day export occurring as more PV systems are integrated ino the grid. This investigation should include examining synergies between mid-day export from PV systems on commercial centers and location of electric vehicle charging stations associated with increased growth in electric vehicles.**

   The export analysis done in this study suggests that NEM practices enable a high degree of electricity export into the grid during mid-day hours. As the number of PV systems increases, this reverse flow of electricity has implications on sizing and operation of distribution feeders. In addition, there is movement towards HEV, EV, and PHEV vehicles that may have synergy or conversely, may cause adverse affects with mid-day export of electricity. The time needed to charge an EV/PHEV, at eight hours, may result in EV/PHEV users charging their vehicle both at home and at work. Since residential systems are more likely than commercial systems to export energy in mid-day hours, harnessing this excess using vehicles might be prove challenging if most of the HEV, EV, and PHEV vehicles are driven as daily commuters and parked at commercial facilities during the day.

1

Introduction

1.1 Program Background

Initiated in January 2007, the California Solar Initiative (CSI) is a comprehensive 10-year, statewide program that provides incentives for the installation and operation of solar energy systems. Legislatively established by Senate Bill 1 (SB 1)[1] and enacted by the California Public Utilities Commission (CPUC) in late 2006[2], the CSI has a total budget of $2.167 billion, funded by California electricity ratepayers.[3] The CPUC provides oversight of the CSI while Program Administrators (PAs) implement it. The PAs represent California's three major electric investor-owned utilities (IOUs): Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E).[4] As of December 31, 2010, the CSI ended its fourth year of operation and in 2011 entered the mid-way point of the program.

The CSI has four components: a general market (GM) program (from hereon referred to as the CSI GM); a solar thermal incentive (CSI Thermal) program; a single-family affordable solar home (SASH) incentive program; a multifamily affordable solar home (MASH) incentive program; and a solar research, development, demonstration and deployment (Solar RD&D) program.[5] Through these four primary programs, the CSI works to achieve its overarching goals to increase new solar generation capacity and help transform solar energy into a commonplace

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1 California Senate Bill 1 (SB 1, Murray), signed into law August 21, 2006. http://www.leginfo.ca.gov/pub/05-06/bill/sen/sb_0001-0050/sb_1_bill_20060821_chaptered.html

2 CPUC Decision 06-08-028, August 24, 2006. http://docs.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/59186.htm

3 An additional budget of $250 million to promote the installation of 200,000 solar water heating (SWH) systems in homes and businesses that displace the use of natural gas by 2017was authorized by Public Utilities Code 2860-2867, (http://www.leginfo.ca.gov/cgi-bin/waisgate?WAISdocID=72013412770+0+0+0&WAISaction=retrieve) as created by Assembly Bill (AB) 1470 (Huffman, 2007) (http://www.leginfo.ca.gov/pub/07-08/bill/asm/ab_1451-1500/ab_1470_bill_20071012_chaptered.html)

4 The California Center for Sustainable Energy (CCSE) acts as the PA for SDG&E in its service territory.

5 The CPUC adopted the framework for the SASH program in Commission Decision (D.) 07-11-045 (http://docs.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/75400.htm), and for the MASH program in D.08-10-036 (http://docs.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/92455.htm). Ten percent of the overall CSI budget, or $216 million was allocated for incentives for the two programs, with each program receiving half, or $108 million.

and unsubsidized part of the state's energy mix. The CSI is designed to help reduce peak electricity demand; add clean distributed energy resources to California's generation supplies; reduce risk by diversifying California's energy portfolio; reduce harmful greenhouse gas (GHG) emissions by avoiding the use of carbon-based energy sources; and reduce loads on California's transmission and distribution system. The CSI's specific solar generation capacity objectives are to install 1,750 MW of photovoltaic (PV) capacity under its GM program and 190 MW under the MASH and SASH programs within the IOU service territories before the end of calendar year 2016.

The CSI acts to encourage IOU electricity customers to install PV systems that help meet the customer's electricity demands by providing financial incentives and information. When used in conjunction with energy efficiency measures, PV systems can help significantly reduce the amount of electricity transferred through California's already congested transmission and distribution systems. By requiring that energy efficiency measures be adopted before installing a CSI-incented PV system, the CSI can also support California's "loading order"[6] and energy efficiency goals. SB1 explicitly states that the CSI should "….require reasonable and cost effective energy efficiency improvements in existing buildings as a condition of providing incentives for eligible solar energy systems."[7]

CSI financial incentives are provided for IOU electricity customers to install PV and solar thermal electric systems on commercial[8] and government/non-profit buildings, and existing homes. Two types of incentives, which cover only the first MW of the system's capacity, are available. The Expected Performance-Based Buy-down (EPBB) incentive is a one-time lump-sum up-front payment for smaller PV systems based on the expected performance of the

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6 California's Energy Action Plan "envisions a 'loading order' of energy resources that will guide decisions made by the [state's principal energy] agencies jointly and singly. First, the agencies want to optimize all strategies for increasing conservation and energy efficiency to minimize increases in electricity and natural gas demand. Second, recognizing that new generation is both necessary and desirable, the agencies would like to see these needs met first by renewable energy resources and distributed generation. Third, because the preferred resources require both sufficient investment and adequate time to 'get to scale,' the agencies also will support additional clean, fossil fuel, central-station generation. Simultaneously, the agencies intend to improve the bulk electricity transmission grid and distribution facility infrastructure to support growing demand centers and the interconnection of new generation." California Energy Commission California Public Utilities Commission and California Power Authority, *State of California Energy Action Plan*, as adopted May 2003, available at: http://docs.cpuc.ca.gov/published/report/28715.htm.

7 California Public Utility Code Section 2851-2852 http://www.leginfo.ca.gov/cgi-bin/waisgate?WAISdocID=71999911955+0+0+0&WAISaction=retrieve

8 For the purposes of the CSI, the commercial segment includes agricultural and industrial customers.

system.[9] The Performance-Based Incentive (PBI) is an incentive paid over a period of five years based on metered kilowatt-hour (kWh) production.[10] While smaller systems may be eligible for the EPBB or the PBI, the PBI payment is mandatory for larger systems. The maximum size threshold under which a system qualifies for an EPBB incentive has been dropping since the start of the CSI. The original size threshold in 2007 was less than 100 kW. In 2008 and 2009, only those systems smaller than 50 kW were eligible for EPBB. Beginning in 2010, the EPBB threshold fell to less than 30 kW.

While continuing to innovate and adapt its structure to the market and industry landscape, the CSI grows from a strong history of state promotion of renewable energy sources. California has long been a leader in the solar energy arena, with support provided to the solar industry by the state's investor- and publicly owned utilities, the California Energy Commission (CEC) and the CPUC. One of the earliest solar incentive programs in the state was the Sacramento Municipal Utility District (SMUD) PV Pioneer I Program, which started in 1993. The CEC's Emerging Renewables Program (ERP) began offering incentives for solar PV systems in 1998. The CSI builds on over half a decade of solar rebates for California IOU customers through the Self-Generation Incentive Program (SGIP), which began in 2001 and offered incentives for PV systems until the CSI's inception. The CSI has replaced the ERP and SGIP in targeting solar electrical applications for the commercial, government/non-profit and existing residential sectors. The CEC's New Solar Homes Partnership (NSHP) program, which began in 2007, is complementary to the CSI and offers financial incentives for new residential homes in IOU service territories. In addition, SB1 authorized and provided guidelines for publicly owned utilities (POUs) to fund and administer their own solar energy programs, which together with the CSI and the NSHP compose the "Go Solar California!" campaign.[11]

1.2 Impact Evaluation Requirements

SB 1 requires the CPUC to report annually to the California legislature on the progress of the CSI. Among other information, the CPUC report must include the number of residential and non-residential installations, the dollar value of incentives granted, the electrical generating capacity of the installed systems, the impact of the installations on the electricity grid (both on and off-peak) and the GHG emission reductions associated with CSI projects. The CSI impact evaluations gather and analyze project and related data to provide this information.

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[9] EPBB incentives are paid per watt based on PV system's expected future performance. Factors used to determine anticipated performance include CEC-AC system rating, location, orientation and shading.

[10] Metered PV performance data are provided to the IOUs by certified Performance Data Providers (PDPs).

[11] For more on Go Solar California!, see http://www.gosolarcalifornia.org/.

1.3 Report Scope

The primary purpose of this evaluation is to assess the impacts of the CSI during 2010. This includes not only PV systems installed during calendar year 2010, but also those systems installed since the program's inception in 2007 and operational by the end of 2010. A secondary evaluation purpose is to provide an "overall report card" on the progress of PV systems installed in California over the past decade. This involves identifying the overall magnitude of PV systems installed in California under all legislated solar incentive programs; assessing the progress made in system efficiencies and costs over the past decade; and providing rough estimates of the impacts associated with the aggregated set of all PV systems installed in California as of the end of 2010. The present report provides the analyses and findings of this impact evaluation.

1.3.1 Impact Evaluation Objectives

Specific objectives of the 2010 CSI impact evaluation are as follows:

- Identify the capacity and system characteristics of PV systems installed under the CSI as of December 31, 2010
- Identify the overall capacity and system characteristics of PV systems installed in areas served by investor owned utilities (IOUs) in California under the CSI, ERP, SGIP, NSHP, and MASH and SASH programs
- Identify performance differences, trends and benchmarks (i.e., what constitutes a "well performing PV system") between systems installed under the CSI and other earlier California PV incentive programs using available metered performance data
- Quantify the difference between expected performance (as listed in PowerClerk[12]) and measured (metered) performance of PV systems installed under CSI
- Identify if there are any significant differences in PV performance values from third-party metering systems and those from independent, parallel metering systems
- Identify and quantify impacts of the CSI on statewide and utility-specific electricity energy production and coincident peak demand
- Determine if differences in PV system ownership or PV materials (e.g., module materials and inverters) influence PV system performance over time

[12] PowerClerk is the online application system for the CSI available at https://csi.powerclerk.com/default.aspx. Applicants can use PowerClerk to create and submit a new incentive application or check the status of an existing application.

- Provide "ballpark" estimates[13] of the impacts of the aggregated set of California PV systems installed under the CSI, ERP, SGIP, NSHP, and MASH and SASH programs on statewide and utility-specific electricity energy production and coincident peak demand
- Estimate GHG, NOx,[14] and PM-10[15] emissions reductions associated with CSI solar installations and, to the extent possible, provide "ballpark" estimates of the impacts of the aggregated California PV systems on GHG, NOx and PM-10 emissions
- Estimate the magnitude and frequency of net energy exports occurring under the CSI

1.4 Data Sources

Data sources for the 2010 CSI impact evaluation fall into two categories: data that support the CSI-specific impact analysis and data that support comparison of the CSI systems to PV systems installed under other California incentive programs. Most of the data for the CSI-specific analysis come from the CSI's primary application database (PowerClerk), CSI participant billing data provided by the IOUs, and third-party generation data used to derive the estimated generation of PV systems. Data for comparison of PV systems installed under the CSI and other PV programs came from the IOUs, the CPUC or external sources such as the CEC, Energy and Environmental Economics, Inc. (E3) and GRID Alternatives.[16] Table 1-1 summarizes major data sources and how they were used in the 2010 impact evaluation.

Table 1-1: Summary of Data Sources

Data Source	Generation Impacts	Trends Across Programs	NEM Exports
PowerClerk	❖	❖	❖
Bill data from IOUs			❖
ERP system characteristics from the CEC		❖	
MASH & SASH system characteristics from the CPUC/GRID Alternatives		❖	
CAISO generation and load data	❖		
E3 avoided cost model to estimate GHG, NOx, PM-10[17]	❖		

[13] Evaluation analysts did not have access to metered data for the ERP, NSHP, MASH and SASH programs. Thus, these estimates are considered "ballpark" estimates, as opposed to the more precise estimates determined using metered data.

[14] NOx refers to nitric oxide (NO) and nitrogen dioxide (NO_2).

[15] PM-10 refers to particulate matter with diameter of 10 micrometers or less.

[16] E3 developed the avoided cost model used to analyze CSI cost-effectiveness. GRID Alternatives, a non-profit solar organization, manages the SASH Program on the CPUC's behalf.

[17] CO_2 emissions from the E3 avoided cost model are used to determine GHG emissions. The bulk of the GHG-associated emissions avoided by use of PV systems are the CO_2 emissions resulting from natural gas fueled utility power plants

1.5 Report Organization

This report consists of the Executive Summary, seven sections, and five appendices, organized as follows:

- **Executive Summary -** Provides an overview and summarizes the key findings of the 2010 impact evaluation.
- **Section 1: Introduction** – Provides an introduction to the CSI and its impact evaluation
- **Section 2: Program Status** – Summarizes the status of the CSI program through the end of 2010 and provides information on characteristics and demographics of PV systems installed through other California solar incentive programs.
- **Section 3: PV Performance Data Collection** – Identifies the sources for PV performance data, describes the metering system characteristics and provides comparisons between expected and metered PV performance.
- **Section 4: PV Performance Results** – Provides the results of the processed PV data to identify differences between expected versus measured performance, examines if there are significant differences between third-party metered and Itron metered results, and investigates the extent to which additions to PV system capacity or changes in system equipment may be affecting estimates of PV production.
- **Section 5: PV Performance Over Time** – Identifies and discusses PV performance trends over time, and how PV performance may be influenced by such factors as system ownership, module material or inverter type.
- **Section 6: Program Impacts** – Discusses the 2010 impacts associated first with just the CSI-GM projects at program and IOU-specific levels including impacts associated with energy delivery; peak demand reduction; effective load carrying capacity; and GHG emissions reductions. The latter part of the section expands the impacts to examine all public purpose programs considered in the evaluation.
- **Section 7: Analysis of Billing Data and Energy Exports** – Discusses the extent to which energy export occurs with PV systems installed under the CSI by different customer sectors and within each IOU service territory, and the frequency and magnitude of the export.
- **Appendix A** – Additional Tables Detailing PV Performance Over Time
- **Appendix B** – Impact Estimation Methodologies
- **Appendix C** – Detailed Impact Results for all Programs
- **Appendix D** – Detailed Tables on Export Frequency
- **Appendix E** – Detailed Tables on Export Magnitude and Timing
- **Appendix F** – Additional Detailed Tables for Program Status

2

Program Status

2.1 Introduction

This section provides information on the status of the California Solar Initiative (CSI) as of December 31, 2010 and describes the basis for the 2010 impact evaluation analysis. Status is based on project data provided by the Program Administrators (PAs) on all applications extending from 2007 through the end of 2010. This section provides an overview of CSI projects included in the impact evaluation as well as information about the status of CSI projects, the associated amount of rebated capacity deployed under the CSI to date, PV system costs and cost trends, and the geographical distribution of the projects.[1]

In addition to summarizing projects completed under the CSI General Market (CSI GM) program, this section also discusses five other California public purpose[2] solar PV programs. Information on these other programs provides additional context for the 2010 CSI statistics. It provides the historical landscape on solar PV development in California over the past decade.

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[1] Installed system size is generally reported in terms of the California Energy Commission's (CEC) PVUSA Test Conditions (PTC) Alternating Current (AC) Watts (W). However, as most systems discussed in this report are larger than 1,000 watts, capacity is reported herein by kW.

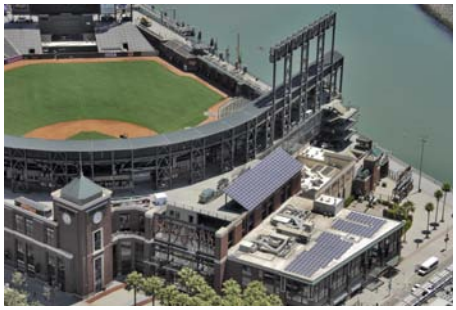
[2] California's state-mandated energy public purpose (or public benefits) programs are funded by a portion of utility rates paid by customers. The underlying premise of such programs, including those for low-income assistance, energy efficiency, and distributed generation, is that California as a whole benefits from them. In particular, the programs serve to ensure that all of the state's residents have access to affordable energy, and from more reliance upon energy efficiency and alternative energy sources to fossil- or nuclear-fueled power plants, including renewables such as solar.

The additional public purpose programs examined include (in the chronological order of their start date):

- Emerging Renewables Program (ERP)—managed by the California Energy Commission (CEC), the ERP was established in 1998 to stimulate market demand for renewable energy systems by offering rebates to reduce (or buy-down) the initial cost of the system to the customer. The goal of the ERP was to help develop a self-sustaining market for "emerging" renewable energy technologies in distributed generation applications. From 1998 to 2006, the program provided incentives to grid-connected PV systems less than 30 kW in capacity. With the emergence of the CSI in 2007, the ERP was refocused solely on wind and fuel cells less than 30 kW in capacity.[3]
- Self-Generation Incentive Program (SGIP)—initiated in 2001 to help address California's peak electricity demand issues, the SGIP has provided incentives to a wide variety of distributed generation technologies including solar PV technologies greater than 30 kW in capacity. Beginning in 2007 with the establishment of the CSI, PV systems were no longer eligible for incentives under the SGIP. Currently, wind turbines, fuel cells, and corresponding energy storage systems are eligible for incentives under the program.[4]

Image courtesy of Cooperative Community Energy

Image via: Grid Alternatives



CSI image: AT&T Park

[3] In March 2011, the CEC suspended the ERP in order to address deficiencies with program requirements. For more information on the ERP and its suspension, see http://www.energy.ca.gov/renewables/emerging_renewables/index.html.

[4] While PV technologies were no longer eligible for the SGIP as of January 1, 2007, approved "legacy" PV projects for which applications had been received prior to this date were funded through the program but became operational after this date. For more on the SGIP, see http://www.cpuc.ca.gov/PUC/energy/DistGen/sgip/.

- CSI Other Sub-Programs:
  - Single-Family Affordable Solar Housing (SASH) Program—created as part of the CSI in November 2007, the SASH program provides incentives that fully cover the costs of 1 kW-sized PV systems to very low-income households, and highly subsidized systems to other low-income households. Five percent of the overall CSI budget, or $108 million, was allocated for the program. GRID Alternatives, a non-profit solar organization, manages the SASH program on the CPUC's behalf.[5]
  - Multifamily Affordable Solar Housing (MASH) Program—complementary to the SASH program and also a part of the CSI, the MASH program provides incentives for installing PV systems within multifamily affordable housing. Five percent of the overall CSI budget, or $108 million, was allocated for the program, and its framework was adopted in October 2008.
- New Solar Homes Partnership (NSHP)—managed by the CEC, the NSHP was established in 2007. The NSHP is complementary to the CSI and focuses on the integration of solar PV into energy-efficient residential new construction. It provides financial incentives and other support to home builders to encourage the construction of energy-efficient solar homes.[6]

SOLAR AMERICA COMMUNITIES

The U.S. Department of Energy (DOE) has named 25 U.S. cities as Solar America Cities. DOE recognizes Solar America Cities as partners highly committed to solar technology adoption at the local level. The awards are intended to accelerate solar adoption in cities—our nation's electricity load centers—by supporting cities' innovative efforts with financial and technical assistance. The cities selected are prepared to take a comprehensive, city-wide approach to solar technology that facilitates its mainstream adoption.

- *Berkeley: www.solaramericacities.energy.gov/cities/berkeley/*
- *Sacramento: www.solaramericacities.energy.gov/cities/sacramento/*
- *San Diego: www.solaramericacities.energy.gov/cities/san_diego/*
- *San Francisco: www.solaramericacities.energy.gov/cities/san_francisco/*
- *San Jose: www.solaramericacities.energy.gov/cities/san_jose/*
- *Santa Rosa: www.solaramericacities.energy.gov/cities/santa_rosa*

5 A fully subsidized 1 kW system is available to households that meet the legal definition of "very low-income" defined as 50 percent or below the area median income. Eligibility for a highly subsidized solar system is determined by the applicant's Federal Income Tax liability and eligibility for the California Alternative Rates for Energy (CARE) Program. For more on SASH, see http://www.gosolarcalifornia.org/affordable/sash.php.

6 For more on the NSHP, see http://www.gosolarcalifornia.org/about/nshp.php.

Table 2-1 provides summary information on these five public purpose programs and the CSI GM program.

Table 2-1: California IOU Public Purpose Solar PV Programs

Program	Year Program Started (for Solar PV only)	End Date (for Solar PV only)	Type of Support (for Solar PV only)	Eligibility Criteria (for Solar PV only)
ERP	1998	12/31/2006	Capacity-Based Rebate	Customer Type: All System Size: <30 kW Project Type: Retrofit only
SGIP	2001	12/31/2006	Capacity-Based Rebate	Customer Type: All System Size: >30 kW Project Type: Retrofit only
CSI GM	2007	Ongoing—Scheduled to end 12/31/2016	Expected Performance Based Buydown (EPBB) Performance-based rebate (PBI)	Customer Type: All System Size: 1 kW–1 MW Project Type: Retrofit only
SASH	2009	Ongoing—Scheduled to end 12/31/2015	Capacity-Based Rebate	Customer Type: Residential Single-Family Low-Income System Size: >1 kW Project Type: Retrofit only
MASH	2008	Ongoing—Scheduled to end 12/31/2015	Capacity-Based Rebate	Customer Type: Residential Multifamily Low-Income System Size: 1 kW–5 MW Project Type: Retrofit only
NSHP	2007	Ongoing	Expected Performance-Based Incentive	Customer Type: Residential New Construction System Size: N/A Project Type: New construction only

2.1.1 CSI Program Goals

The CSI has an over-arching goal of installing 1,940 MW of new solar capacity by 2016.[7] This goal includes 1,750 MW from the CSI GM program and a combined goal of 190 MW from the SASH and MASH programs. Table 2-2 shows the goals of the CSI GM program by customer sector for each PA. The non-residential sector will provide 67% of the total CSI GM program MW goal, with the residential sector contributing the remaining third of the target.[8]

Table 2-2: CSI GM Program MW Targets by Customer Sector and PA

PA	MW Target			Percent of Total Target		
	Residential	Non-Residential	Total	Residential	Non-Residential	Total
CCSE	59.5	120.8	180.3	3.4%	6.9%	10.3%
PG&E	252.4	512.3	764.7	14.4%	29.3%	43.7%
SCE	265.6	539.5	805.1	15.2%	30.8%	46.0%
Total	**578**	**1,173**	**1,750**	**33%**	**67%**	**100%**

[7] CSI projects are deemed complete and "installed" when the respective Incentive Claim Form (ICF) and supporting documentation including verification of project costs and expected system performance have been approved by the PA. The PA also verifies that projects have been correctly connected to the utility grid prior to approving the ICF.

[8] All customer segments are eligible for the CSI GM program. These include residential, commercial, and government and non-profit. For the purposes of the CSI, the commercial segment includes agricultural and industrial customers. It should be noted that frequently program goals, status and other informational items are discussed in terms of the two customer sectors, residential and non-residential, the latter including all customer segments other than residential.

2.2 Installed Capacity and Number of Installations

As shown in Figure 2-1, over 72,000 solar PV systems have been installed over the past decade by the six public purpose programs described above. The installed PV systems accounted for 705 MW of capacity as of December 31, 2010. Since the beginning of 2007 (and the start of the CSI), total installed PV capacity has grown by a factor of four, while the total number of PV installations has grown by nearly three and a half times.

Figure 2-1: California IOU Public Purpose Program PV Systems—Cumulative Installations and Installed Capacity

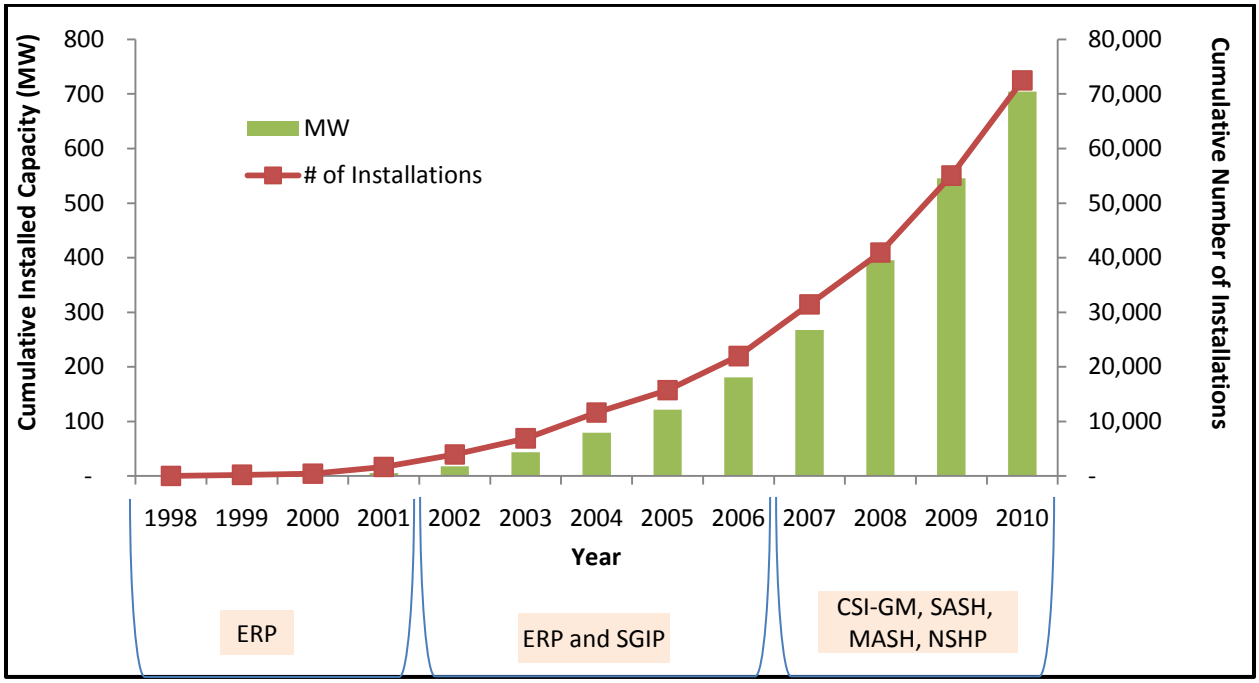
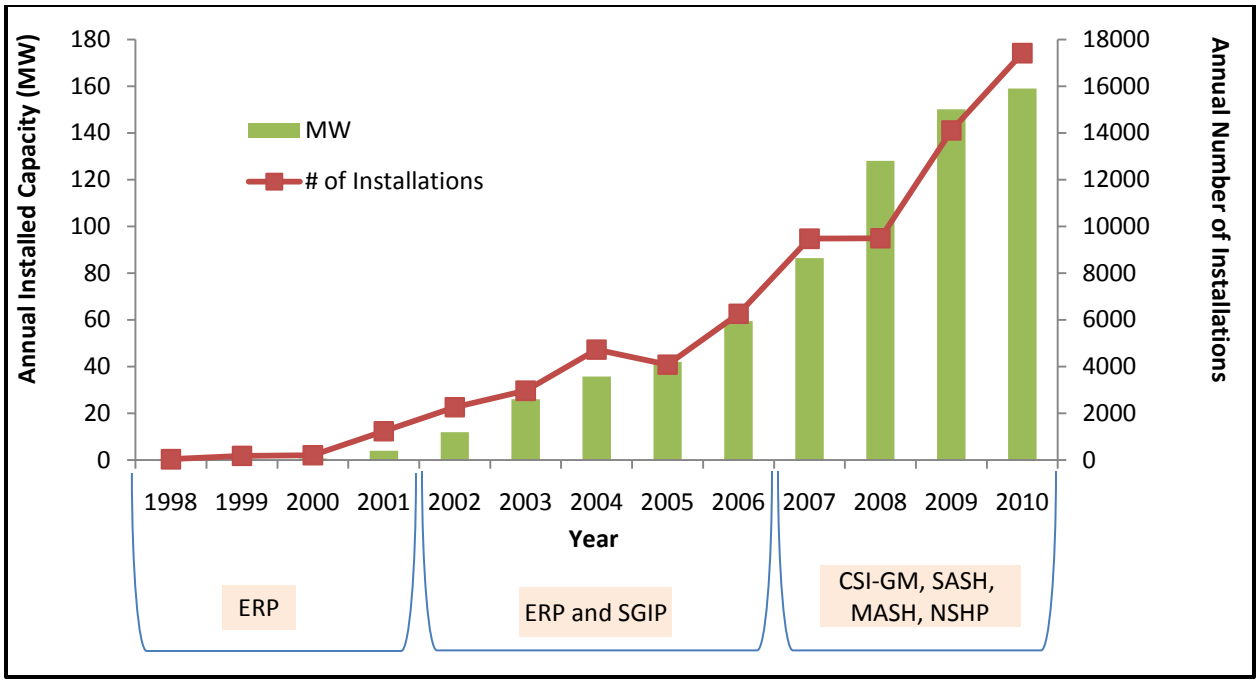


Figure 2-2 shows the annual growth in PV capacity and number of installations between 1998 and 2010.

Figure 2-2: California IOU Public Purpose Program PV Systems - Annual Installations and Installed Capacity



From 1998 through 2001, the number of systems installed under the ERP remained below 2,000 systems per year and annual installed capacity remained below 20 MW. In 2001, the SGIP also began providing incentives for PV systems. Under a combined ERP/SGIP offering, the number of installed PV systems increased to over 6,000 systems per year by the end of 2006. In addition, the amount of annual capacity installed had tripled from 20 MW in 2001 to nearly 60 MW per year by 2006.[9] There is a considerable increase in the growth rate of PV starting in 2007 that reflects the emergence of the CSI. Between the start of 2007 and the end of 2010, the number of installed PV systems rose from 10,000 to over 18,000 systems per year. Similarly, annual installed PV capacity climbed from 100 MW to over 180 MW per year.

The growth trend between 2009 and 2010 is interesting to note. Although the annual installed capacity stayed more or less constant between 2009 and 2010, the number of installations shot up from 14,106 to 17,419, suggesting a shift towards the installation of smaller systems over those two years. A more detailed discussion about trends in sizes is provided in Section 2.3.

[9] These estimates include some SGIP PV systems that were installed later than 2007. Although PV incentives were not available under the SGIP after January 1, 2007, some PV systems had received incentives at earlier dates but had not yet been installed.

Figure 2-3 illustrates the trend in annual installed capacity by PA. Between 1998 and 2010, PG&E accounted for the largest installed capacity and number of installations among the three PAs at 59% and 60%, respectively. SCE accounted for the second largest portion at 30% by capacity and 26% by number of installations, with the rest accounted for by CCSE. However, from 2009 to 2010, CCSE showed the largest growth in installed capacity (32%), with growth in PG&E and SCE staying relatively flat.

Figure 2-3: California IOU Public Purpose Program PV Systems—Trend in Annual Installed Capacity by PA

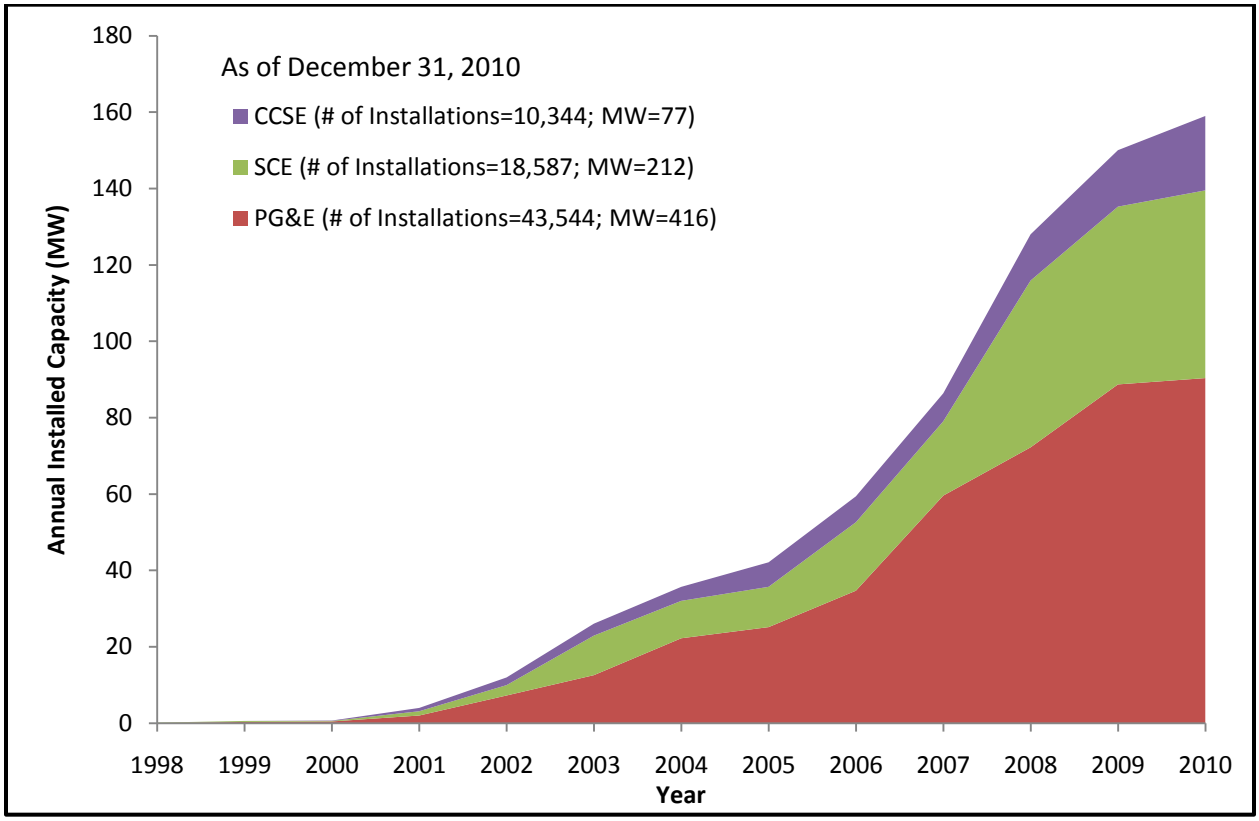


Table 2-3 provides a breakdown on the number of residential and non-residential PV systems and capacity installed by PA from 1998 to the end of 2010.

Table 2-3: California IOU Public Purpose Program PV Systems—Total Installed Number and Capacity by Customer Sector and PA*

Customer Sector	PG&E		SCE		CCSE		TOTAL	
	Installed systems (#)	Installed Capacity (MW)	Installed systems (#)	Installed Capacity (MW)	Installed systems (#)	Installed Capacity (MW)	Installed systems (#)	Installed Capacity (MW)
Non-residential	1,766	230	832	131	313	37	2,911	399
Residential	41,778	186	17755	80	10031	40	69,564	306
TOTAL	43,544	416	18,587	212	10,344	77	72,475	705

* 1998–December 31, 2010

Figure 2-4 depicts the chronological growth trends in the residential and non-residential sectors from 1998 to the end of 2010. Except during 2009 and 2010, residential systems accounted for substantially less than 50% of annual installed capacity across all programs and PAs. In addition, while residential systems made up 96% of the total number of installed projects, they only accounted for 42% of total installed capacity.

Between 2009 and 2010, the annual installed capacity in the non-residential sector dipped; decreasing from 86 MW to 75 MW. In contrast, annual installed capacity in the residential sector grew significantly from 64 MW to 84 MW. 2010 represents the first year in the entire history of customer-side solar PV installations, when the annual capacity in the residential sector exceeded that in the non-residential sector.

Non-residential systems accounted for the majority of both PG&E's and SCE's total installed PV capacity at 56% and 65%, respectively. Conversely, residential systems accounted for the majority (52%) of CCSE's total installed PV capacity.

Solar Maps

Several cities have created maps for locating the specific solar installations. Some of them are listed below:

- *http://www.gosolarcalifornia.ca.gov/communities/nshp.php*
- *http://berkeley.solarmap.org/*
- *http://smud.solarmap.org/*
- *http://sf.solarmap.org/*

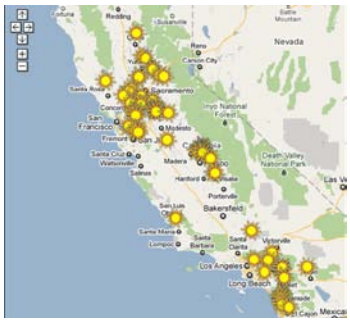


Figure 2-4: California IOU Public Purpose Program PV Systems—Trend in Annual Installed Capacity by Customer Sector

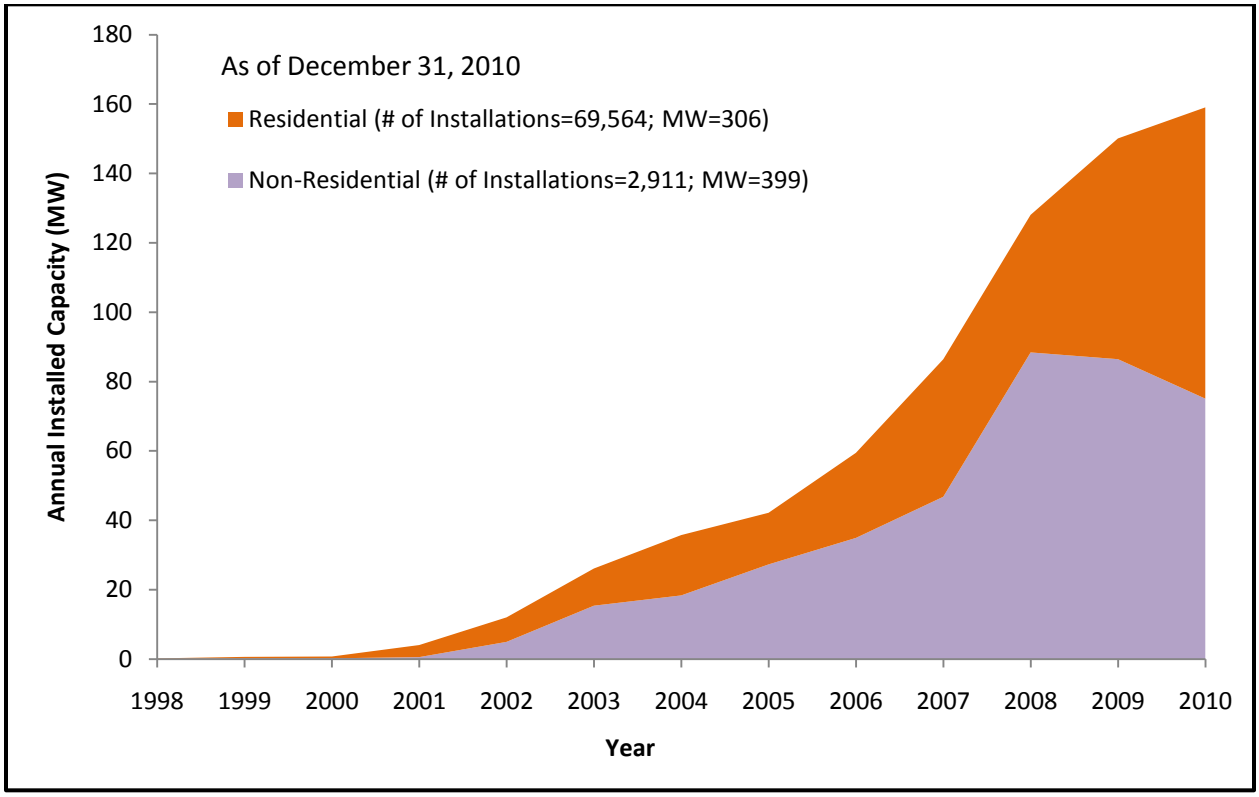


Table 2-4 and Table 2-5 provide a breakdown of the number of installed PV systems and capacity by all six of the examined public purpose PV programs. The CSI GM program accounts for the largest portion of installed solar PV systems (59%), followed by the ERP (nearly 38%). The CSI GM program also has the greatest installed solar PV capacity (64%), followed by the SGIP (19%) and the ERP (16%). The three most recent programs (SASH, MASH, and NSHP) combined account for less than 4% of total installed PV systems and less than 2% of total installed capacity.

Table 2-4: California IOU Public Purpose Program PV Systems—Total Installed Number and Capacity by Program and PA*

Incentive Program	PG&E		SCE		CCSE		TOTAL	
	Installed PV Systems (#)	Installed Capacity (MW)	Installed PV Systems (#)	Installed Capacity (MW)	Installed PV Systems (#)	Installed Capacity (MW)	Installed PV Systems (#)	Installed Capacity (MW)
CSI GM	24,459	252	11,499	140	5,705	46	41,663	438
SGIP	494	81	291	41	105	14	890	136
Sub-Total	*24,953*	*333*	*11,790*	*181*	*5,810*	*60*	*42,553*	*574*
ERP	17,568	79	6,167	29	4,123	15	27,858	122
MASH	34	1	9	1	6	0	49	2
NSHP	792	2	516	1	335	1	1,643	5
SASH	197	1	105	0	70	0	372	1
Sub-Total	*18,591*	*83*	*6,797*	*31*	*4,534*	*16*	*29,922*	*131*
Grand Total	**43,544**	**416**	**18,587**	**212**	**10,344**	**77**	**72,475**	**705**

* 1998–December 31, 2010

Table 2-5: CSI Program PV Systems—Total Installed Number and Capacity by Program and PA*

Incentive Program	PG&E		SCE		CCSE		TOTAL	
	Installed PV Systems (#)	Installed Capacity (MW)	Installed PV Systems (#)	Installed Capacity (MW)	Installed PV Systems (#)	Installed Capacity (MW)	Installed PV Systems (#)	Installed Capacity (MW)
CSI GM	24,459	252	11,499	140	5,705	46	41,663	438
MASH	34	1	9	1	6	0	49	2
SASH	197	1	105	0	70	0	372	1
Total	**24,690**	**254**	**11,613**	**141**	**5,781**	**46**	**42,084**	**441**

* January 1, 2007–December 31, 2010

Table 2-6 shows the total installed PV solar capacity and number of PV solar installations by program and customer sector from 1998 through December 31, 2010. By design, the MASH, SASH, and NSHP programs are restricted to the residential sector. The ERP did not restrict eligibility to residential PV systems but had a maximum system size limit of 30 kW. Under the ERP, the residential sector accounted for 98% of PV installations and 86% of the installed capacity. The SGIP had a minimum size requirement of 30 kW, which essentially limited it to non-residential PV applications. Under the CSI GM program, for which system size eligibility ranges from 1 kW to 1 MW, the residential sector accounted for 97% of installations, but only 43% of installed capacity.

Table 2-6: California IOU Public Purpose Program PV Systems—Total Program Installed Number and Capacity of PV Systems by Customer Sector*

Incentive Program	Non-Residential		Residential		TOTAL	
	Installed PV Systems (#)	Installed Capacity (MW)	Installed PV Systems (#)	Installed Capacity (MW)	Installed PV Systems (#)	Installed Capacity (MW)
CSI GM	1,361	246	40,302	192	41,663	438
SGIP	890	136	-	-	890	136
Sub-Total	*2,251*	*382*	*40,302*	*192*	*42,553*	*574*
ERP	660	17	27,198	106	27,858	122
MASH	-	-	49	2	49	2
NSHP	-	-	1,643	5	1,643	5
SASH	-	-	372	1	372	1
Sub-Total	*660*	*17*	*29,262*	*114*	*29,922*	*131*
Grand Total	**2,911**	**399**	**69,564**	**306**	**72,475**	**705**

* 1998–December 31, 2010

The CSI GM program accounts for 58% of all installed residential systems and 47% of non-residential systems. However, the program accounts for 62% of non-residential, 63% of residential, and 62% of combined residential and non-residential installed capacity. The ERP accounts for 23% of non-residential systems, but only 4% of installed capacity for the sector. The SGIP accounts for 31% of non-residential systems and 34% of the non-residential installed capacity.

Figure 2-5 shows the trend of annual installed capacity of PV systems for each of the public purpose programs from 1998 to 2010. Over the period from 2002 to 2006, both ERP and SGIP accounted for similar amounts of installed capacity, with the SGIP having a slightly larger amount of installed capacity by the end of 2006. Combined, SGIP and ERP were responsible for the addition of close to 29,000 PV systems and nearly 260 MW of capacity in eight years. The CSI GM showed phenomenal growth, adding nearly 42,000 PV systems and close to 440 MW in just four years.

Figure 2-5: California IOU Public Purpose Program PV Systems—Trend in Annual Installed Capacity by Program

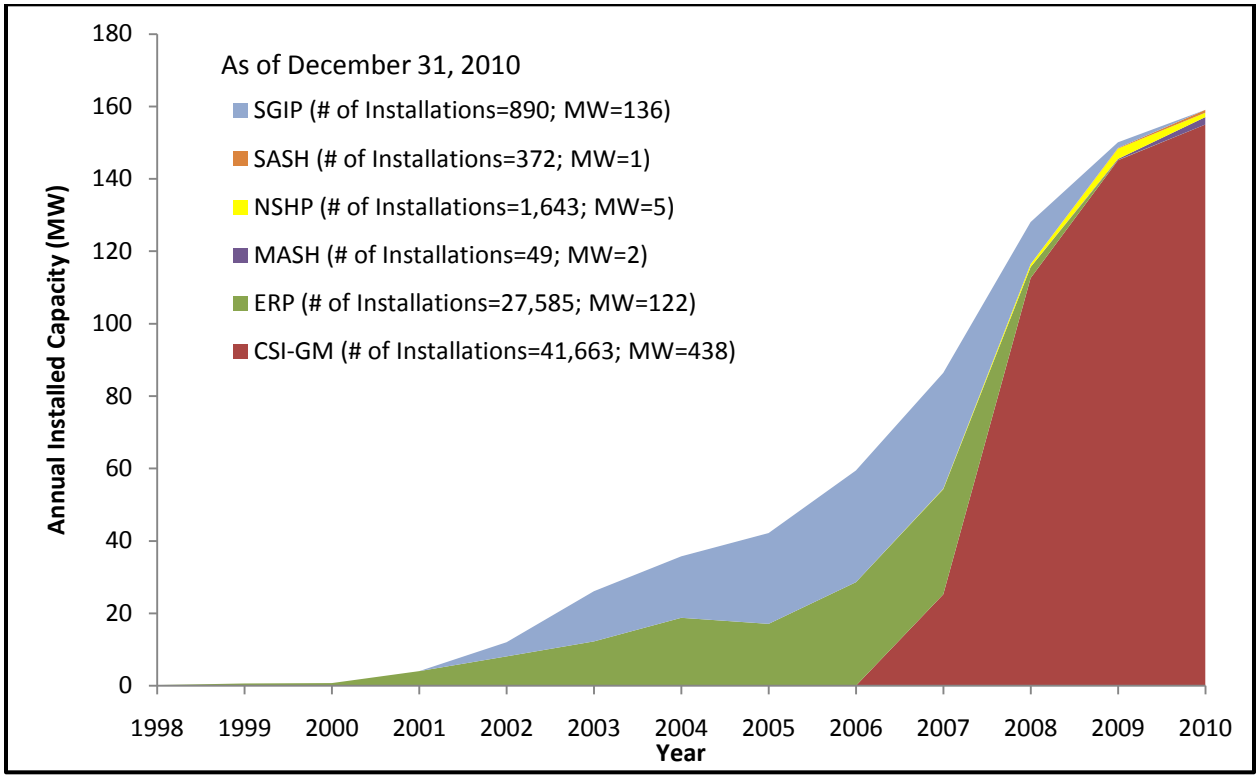
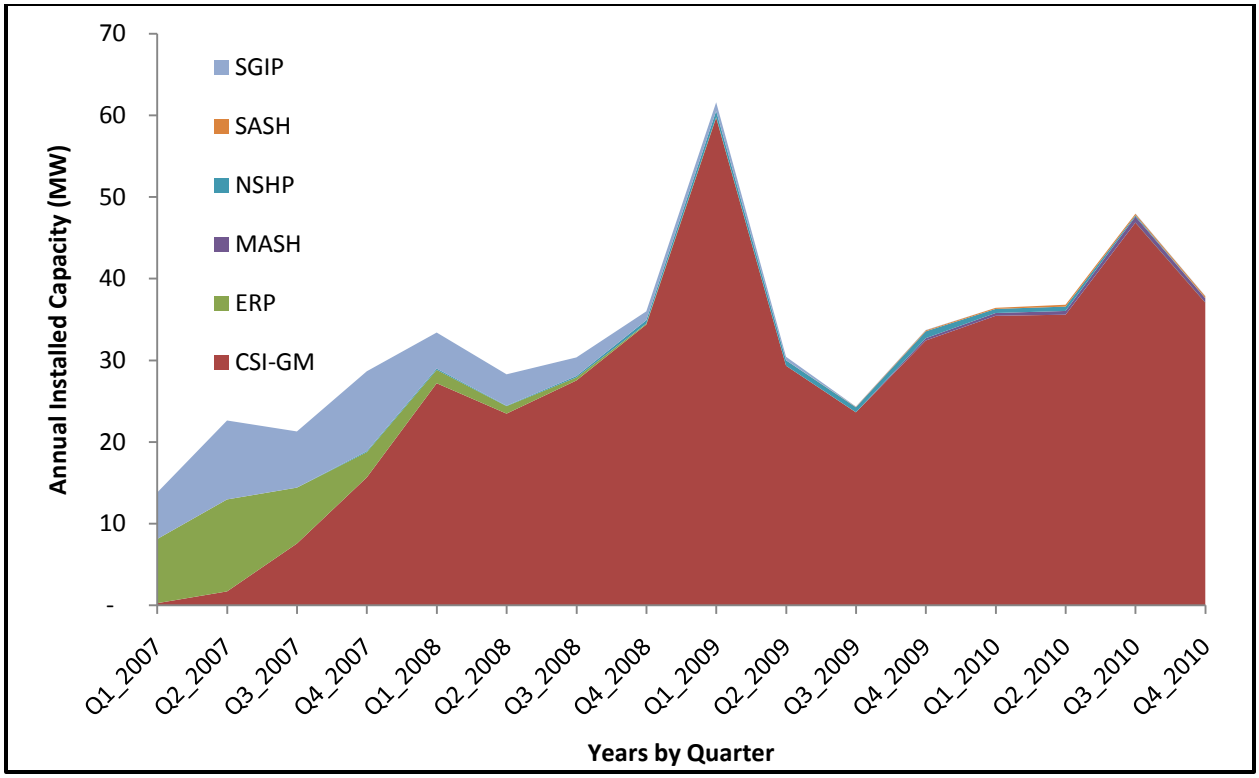


Figure 2-6 shows a different perspective on annual capacity by presenting information on additions by quarter. Although the growth in annual capacity appears smooth, the trend in capacity added each quarter from the beginning of 2007 to the end of 2010 shows there is not a steady and smooth increase. Rather, there are a number of spikes and troughs in the number of installations over the four-year timeframe. This is especially marked in the first six months of 2009 when the added capacity almost doubled in the first quarter as compared with the previous quarter (fourth quarter of 2008) and then dropped back to almost the same amount in the second quarter. We can only speculate as to the reason for the abrupt rise and fall in the number of installations. For example, the spike may have resulted from customers rushing to install system before the potential cancellation of the federal government's investment tax credit (ITC) for solar PV. Once the ITC was extended, the growth rate in system installation stabilized in subsequent quarters. Regardless of the causes for the sudden rises and falls in the number of installations in each quarter, it is evident that the growth in PV installations and capacity are tied to a number of market factors that make it difficult to predict with a high degree of accuracy.

Figure 2-6: California IOU Public Purpose Program PV Systems—Quarterly Trend in Annual Installed Capacity by Program, 2007–2010



2.3 System Size Distribution

Table 2-7 provides information on the mean and median sizes of PV systems installed under the six examined public purpose programs. The mean and median sizes of residential systems installed under the CSI GM program are larger than those installed under the ERP, NSHP, and SASH.[10] Overall, the average size for all systems is 4.4 kW for the residential sector and 136.9 kW for the non-residential sector. The median for both residential and non-residential sectors is substantially smaller at 3.7 kW and 41 kW, respectively. The difference between the mean and median values indicates a positively skewed distribution, where a few systems with very large size affect the average value.

Table 2-7: California IOU Public Purpose Program PV Systems—Mean and Median System Size by Customer Sector

Program	Mean System Size (kW)		Median System Size (kW)	
	Residential	Non-Residential	Residential	Non-Residential
CSI GM	4.8	52.6	4.1	52.6
SGIP	*N/A*	152.6	*N/A*	77.9
ERP	3.9	21.1	3.1	21.1
MASH	47.9	*N/A*	39.0	*N/A*
NSHP	3.1	*N/A*	1.9	*N/A*
SASH	2.6	*N/A*	2.2	*N/A*
ALL	4.4	136.9	3.7	41.0

It is important to note that PV systems installed under the NSHP are by design likely to be smaller than systems installed in older homes under the CSI GM. New homes that qualify for the NSHP are designed and built with advanced energy efficiency measures (exceeding Title 24 requirements substantially). The NSHP approach reduces electric demand at the home and consequently reduces the required size of the PV system. Unlike homes in the NSHP, homes installing PV systems under the CSI GM were not specifically designed for reduced energy demand. While a number of homes installing PV systems under the CSI GM may have employed energy efficiency measures, they had a weaker mandate for energy efficiency; hence, their PV system sizes tended to be larger.

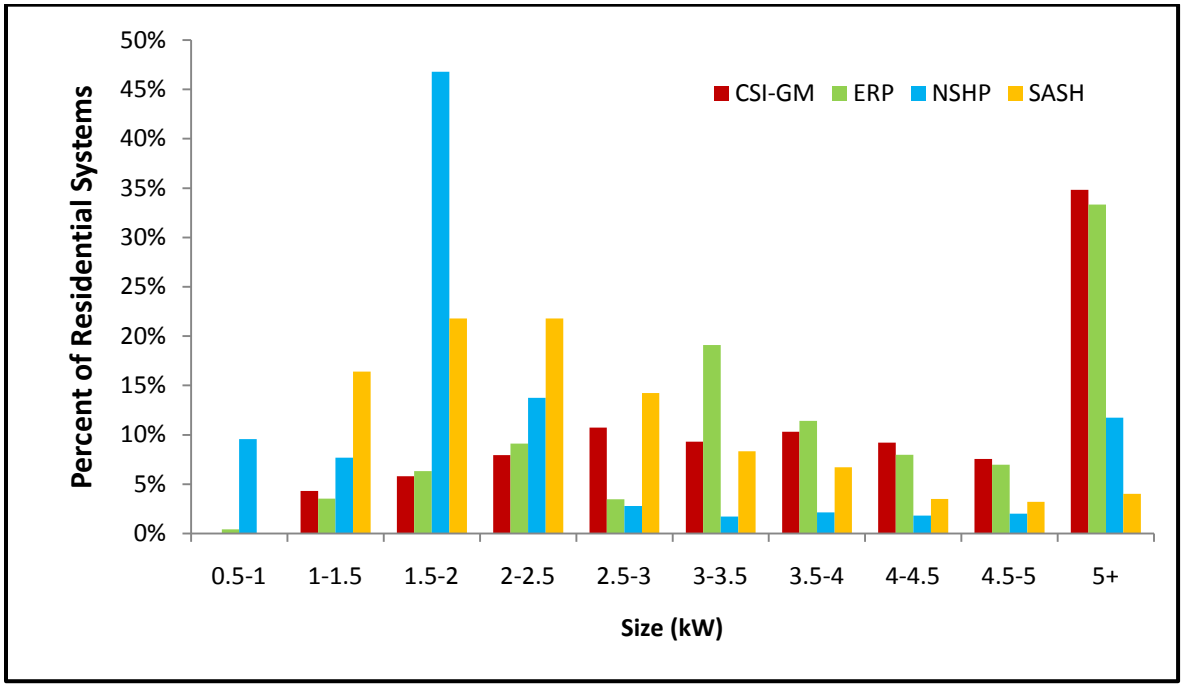
PV systems installed under the MASH program serve multifamily buildings with commensurately larger overall electrical loads. As such, PV systems installed under the MASH

[10] Various metrics can be used to summarize trends in system size such as average, median, range (e.g., maximum – minimum), and standard deviation. Given that outliers can skew the average, range, and standard deviation estimates, we provide results primarily in terms of mean and median values.

program tend to be substantially larger than those installed under the SASH program, the NSHP, and the residential systems installed under the CSI GM program and the ERP, all of which serve single-family residences. The non-residential systems installed under the ERP, which has an eligibility maximum size limit of 30 kW, are substantially smaller than those installed under the SGIP, which has a minimum size requirement of 30 kW. In addition, ERP systems tend to be smaller than those installed under the CSI GM program.

Figure 2-7 shows the size distribution of residential systems by program. The majority of the residential systems are less than 4 kW and 81% are less than 6 kW. The majority of residential systems installed under the ERP, NSHP, and SASH are less than 2.5 kW while the majority of those installed under the CSI GM program are larger than 2.5 kW. Interestingly, approximately 50% of the systems installed under the NSHP are in the 2.0–2.5 kW range suggesting, as mentioned above, that program-required compliance with stringent building codes (e.g., the most recent version of Title 24[11]) led to more energy-efficient homes requiring smaller PV systems.

Figure 2-7: California IOU Public Purpose Program PV Systems—Size Distribution of Single Household Systems*

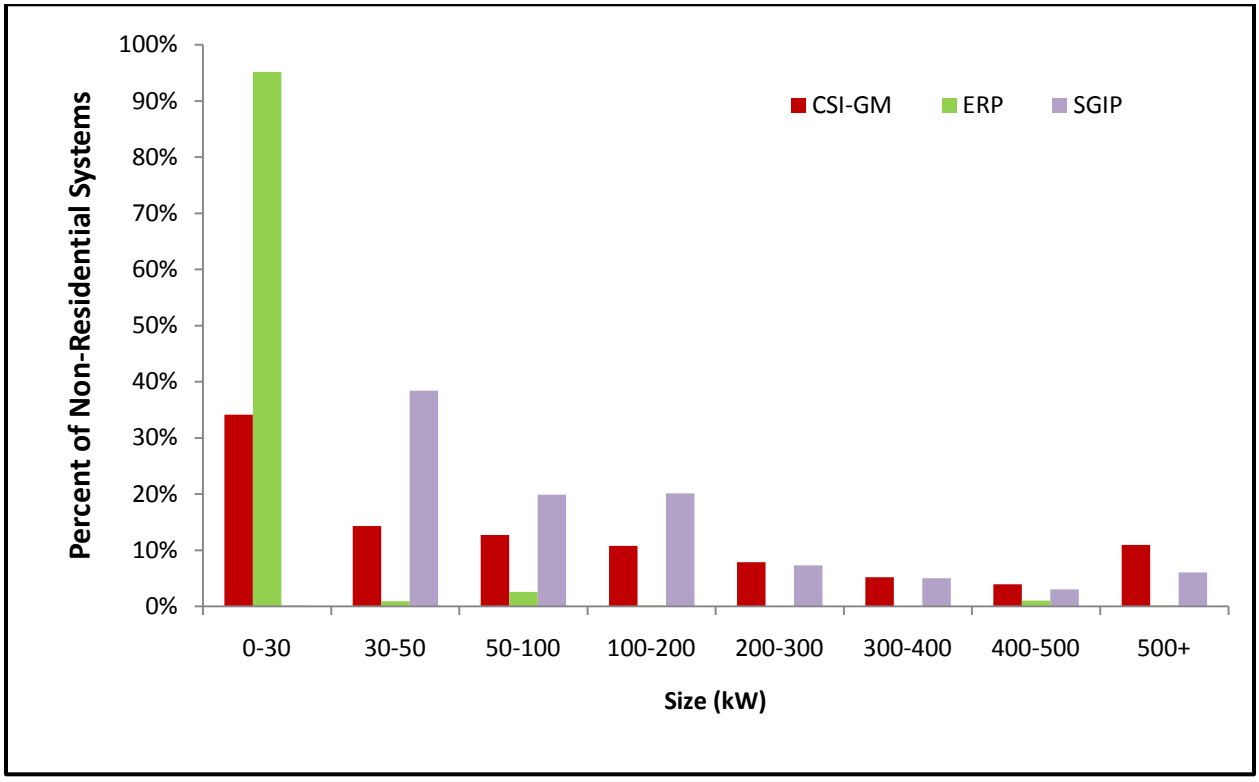


* No single household systems were installed under the MASH program.

[11] Title 24, Part 6, of the California Code of Regulations. The Energy Efficiency Standards for Residential and Nonresidential Buildings were established in 1978 in response to a legislative mandate to reduce California's energy consumption. The standards are updated periodically to allow consideration and possible incorporation of new energy efficiency technologies and methods. The 2008 Standards went into effect January 1, 2010 and supersede the 2005 Standards.

Figure 2-8 shows the size distribution of non-residential systems by program. As expected, almost all of the non-residential systems installed under the ERP are smaller than 30 kW while all those installed under SGIP are larger than 30 kW.[12] The majority of the non-residential systems are less than 50 kW and 80% are less than 200 kW. Although the "0–30 kW" category is the single segment that includes the largest number of non-residential installations for the CSI GM program, more than 60% of systems installed under this program are larger than 30 kW, with more than 10% larger than 500 kW.

Figure 2-8: California IOU Public Purpose Program PV Systems—Size Distribution of Non-Residential Systems*



* No non-residential systems were installed under MASH, SASH, or NHSP.

[12] Early on in the ERP, there were no strict guidelines limiting the maximum size to less than 30 kW. Consequently, there are some larger PV systems found in the ERP.

Figure 2-9 depicts the trend in median size of residential PV systems across the CSI GM, ERP, SASH, and NSHP programs. Overall, the median size of residential PV systems appears to be unambiguously increasing. Between 1998 and the end of 2010, the median size of residential PV systems more than doubled; going from approximately 1.8 kW to 3.7 kW.

Figure 2-9: California IOU Public Purpose Program PV Systems—Trend in Median Size for Residential Customers

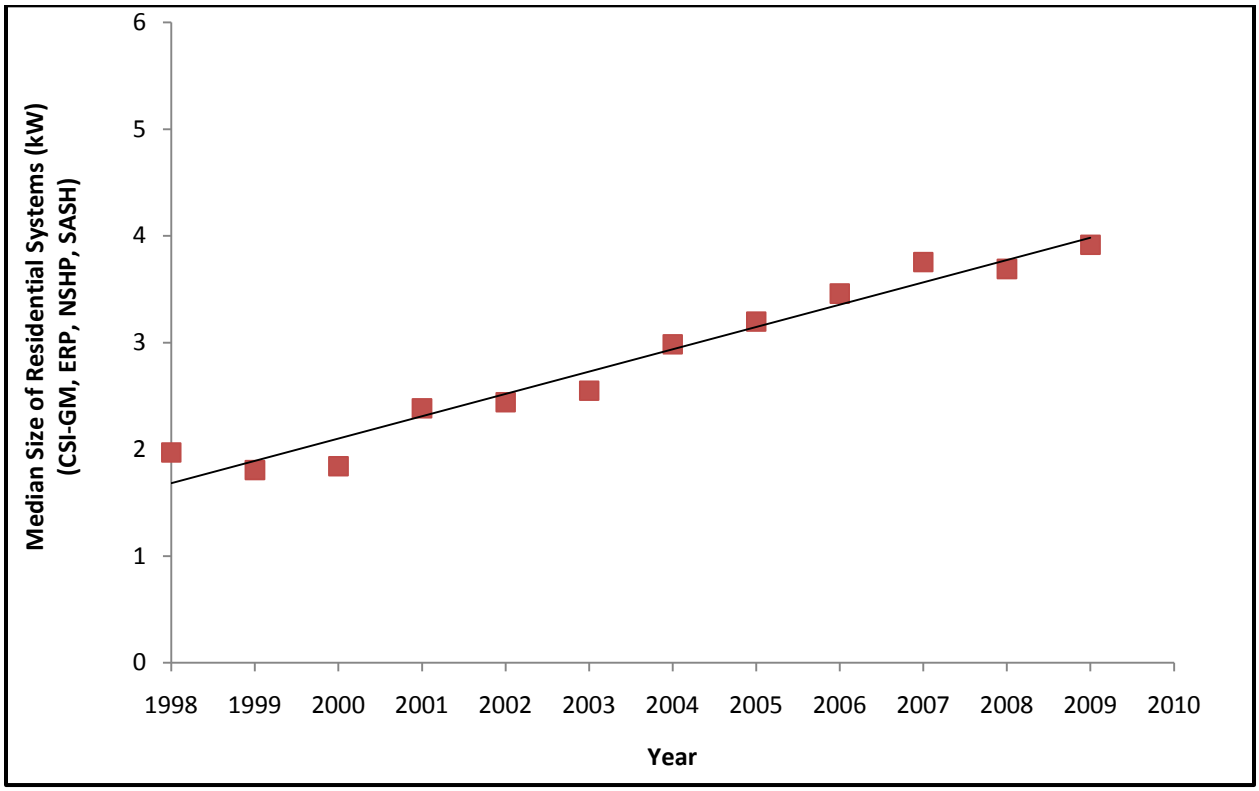


Figure 2-10 shows the trend in median size of PV systems in the non-residential sector across the CSI GM program and the SGIP. While the non-residential sector shows a fair amount of variation in median system size from year to year, overall it has remained notably constant. The spike in non-residential median size in 2001 should not be considered significant as the population size is just six installations. The 2008 non-residential spike is more meaningful as the population size is 559 installations.

Figure 2-10: California IOU Public Purpose Program PV Systems—Trend in Median Size for Non-Residential Customers

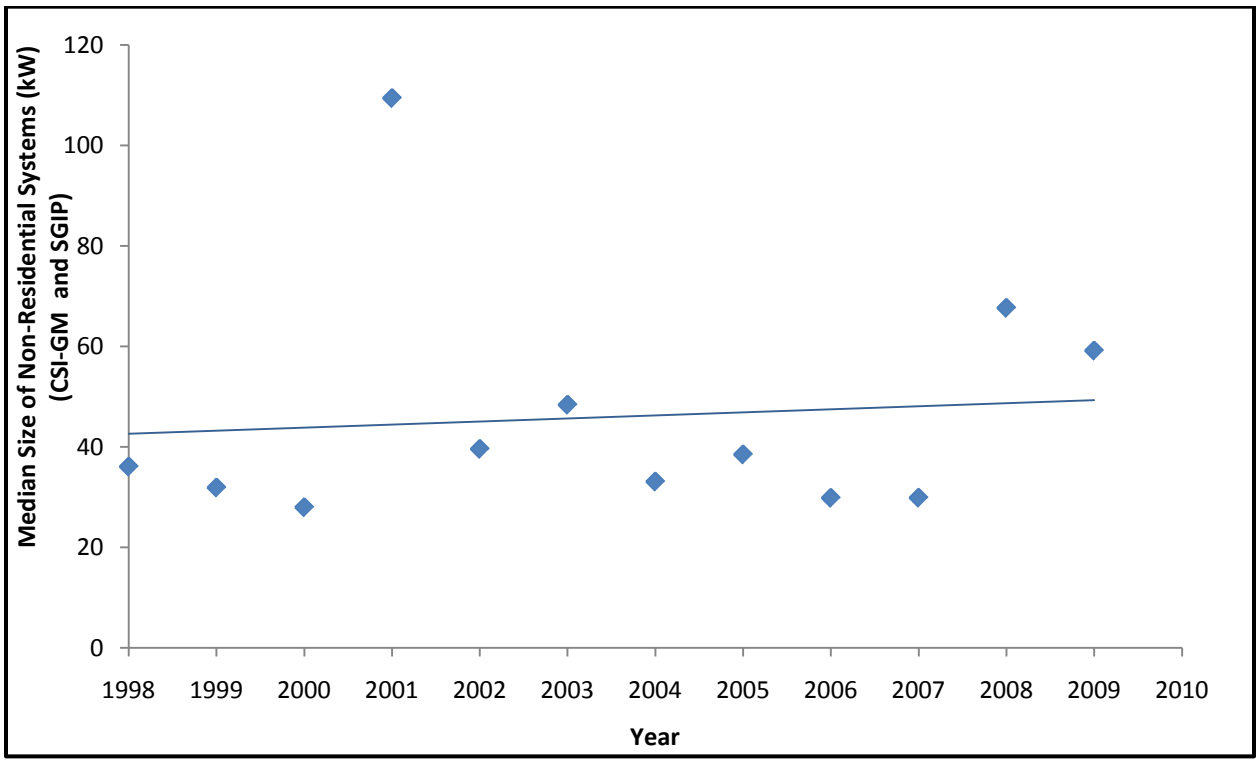


Figure 2-11 shows the trend in median size of residential systems by PA for the CSI GM program only. In general, the linear trend-line indicates a decrease in residential PV system size in SCE's service territory, and an increase in PG&E's and CCSE's territories. The median residential system size ranges from 3.4 kW to 5 kW for all three PAs.

Figure 2-11: CSI GM PV Systems—Trend in Median Size of Residential Installations by PA

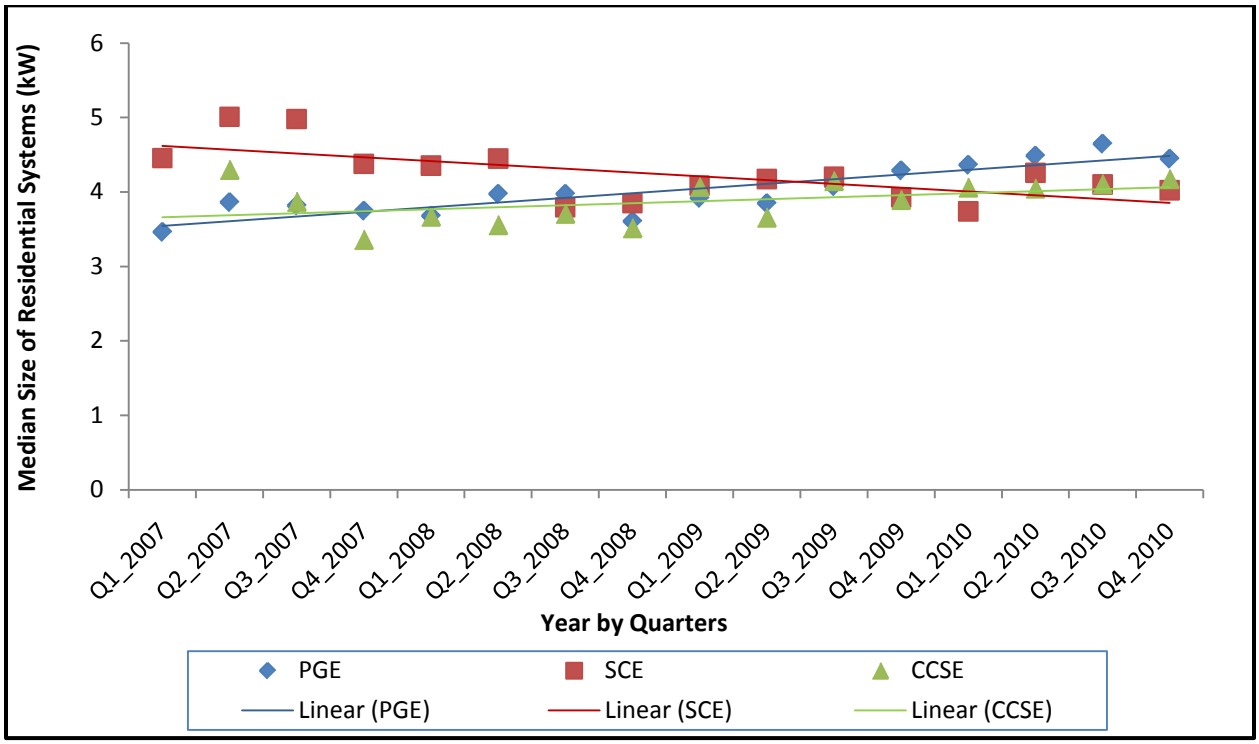
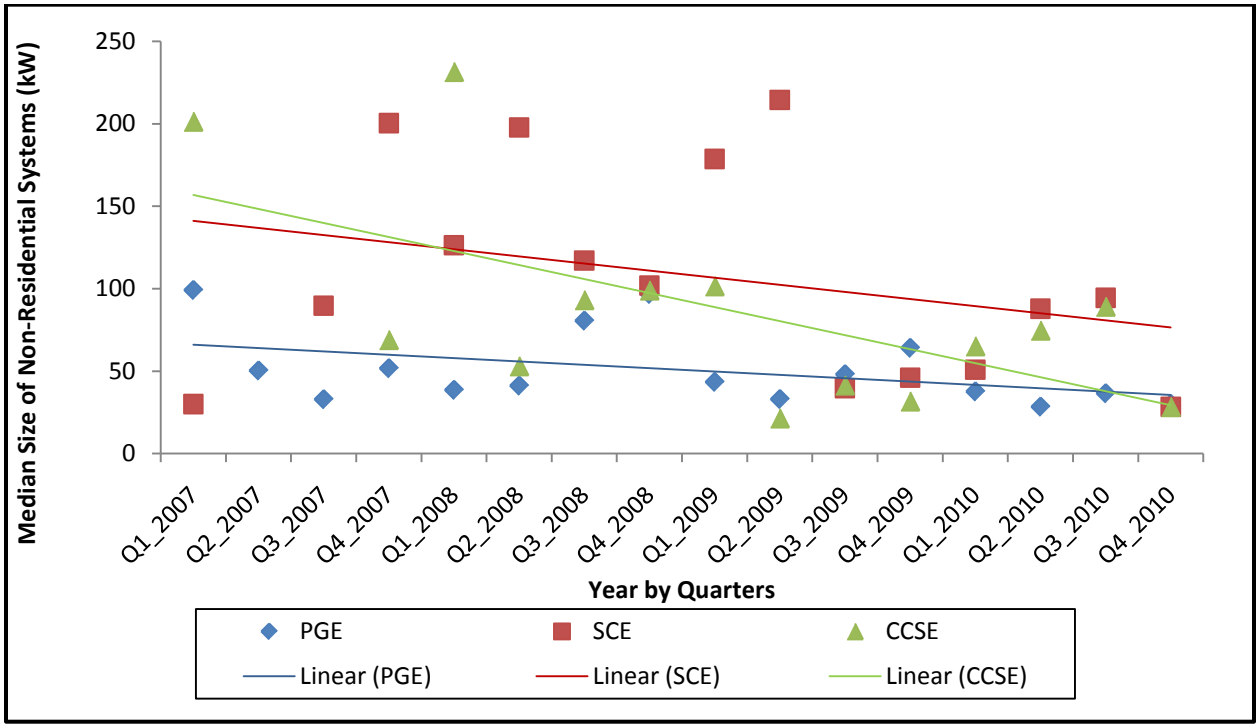


Figure 2-12 shows the trend in median size of non-residential PV systems by PA for the CSI GM program only. Median size appears to be trending towards smaller systems for all three PAs in the non-residential sector. It should be noted that there is a substantial amount of variation across quarters for all PAs with median system sizes ranging from less than 20 kW to over 325 kW. Installations in SCE's territory show the widest such variation, while those in PG&E's exhibit the narrowest.[13]

Figure 2-12: CSI GM PV Systems—Trend in Median Size of Non-Residential Installations by PA



2.4 Cost of PV Systems

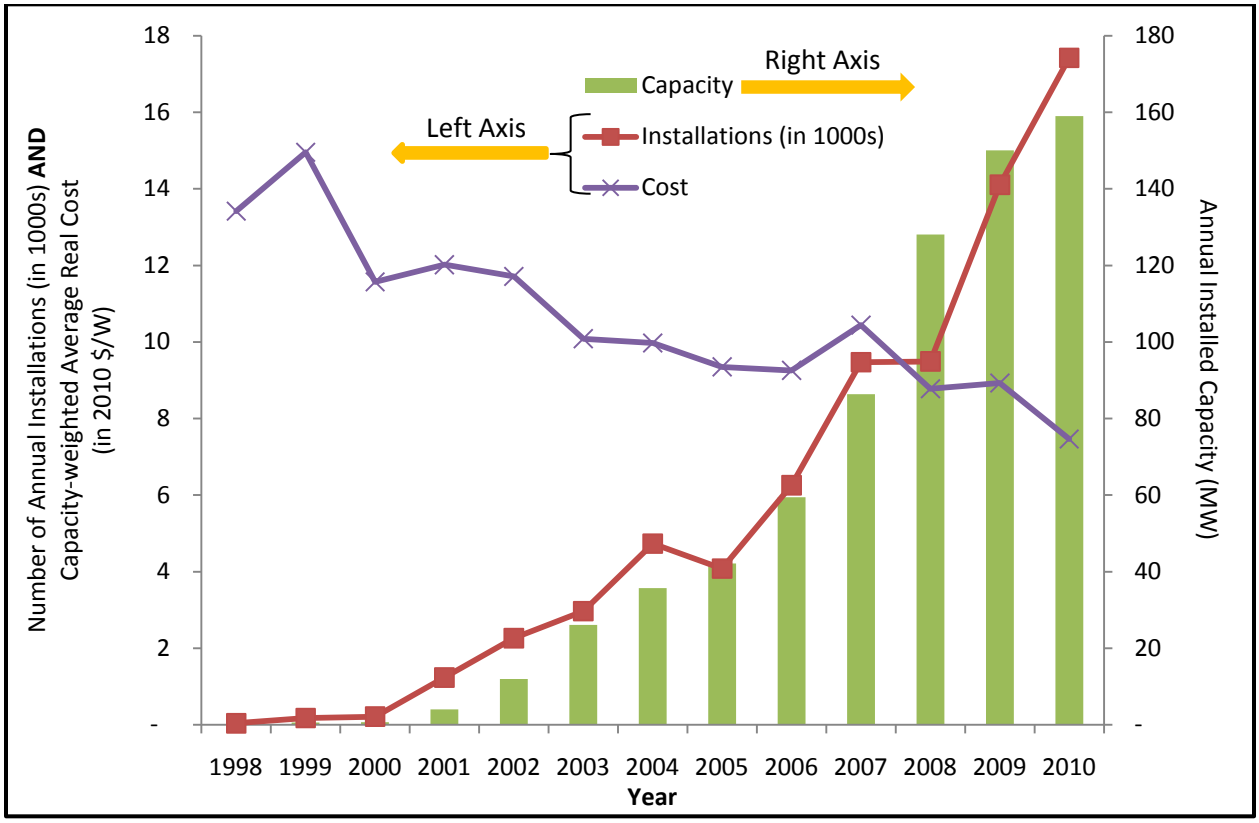
One of the key goals of the CSI program is to help drive PV system costs down to help create a sustainable solar industry. This section presents results from analysis of PV system costs for systems installed between 1998 and December 31, 2010. We examined not only costs under the CSI GM but also costs for other California public purpose programs discussed in earlier sections. Cost data were available for five programs, the CSI GM program, SGIP, ERP, MASH program, and NSHP. The cost data for the NSHP do not appear to be of consistently good quality and

[13] It should be noted that the sample sizes by year and quarter for non-residential sector for all three PAs are small and hence, these observations are not robust from a statistical perspective.

have been excluded from this analysis.[14] Cost data for the SASH program were not available for this analysis. Costs are provided in terms of capacity-weighted average inflation-adjusted (or Real 2010) dollars per rated capacity in CEC PTC AC W ($/W). Program incentives are not included in system costs.

Figure 2-13 shows PV system cost trends from 1998 to the end of 2010 under the ERP, SGIP, CSI GM, and MASH programs (both residential and non-residential). We have included the installed PV capacity and number of PV installations to help identify relationships. All system costs represent capacity-weighted averages adjusted for inflation.

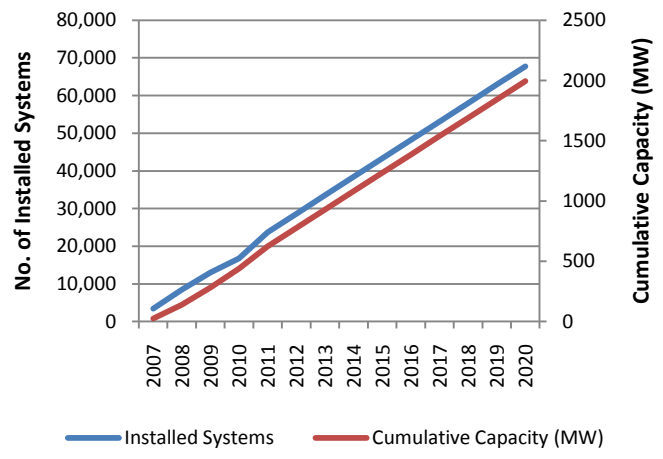
Figure 2-13: California IOU Public Purpose Program PV Systems*—Trend in Annual Installed Capacity, Number of Installations, and Costs



* CSI GM, SGIP, MASH, and ERP.

[14] There were several inexplicable outliers in the cost data for NSHP. As this report is primarily focused on the CSI GM program, no additional effort was made to ascertain the quality of NSHP cost data.

Overall, PV system costs have decreased by 44% from $13.4/W in 1998 to $7.5/W in 2010.[15] Prior to the CSI (i.e., 1998–2006), costs decreased by 31% over eight years (or $4.2/W) down to $9.3/W. During the three years following startup of the CSI (i.e., 2007–2010) costs decreased by 28% (or $3/W), ending at approximately $7.5/W. It should be noted that the CSI had a significant impact on both installed PV capacity and number of installations. Seventy-one percent of all installations and 76% of all installed PV capacity occurred between 2007 and 2010.



At Current Trends, the CSI Must Add Over 67,000 New PV Systems into the Grid to Achieve 1,940 MW by 2016

The solar PV manufacturing industry is global in nature. PV products manufactured in various countries such as China are sold in other countries such as Germany. In addition, the worldwide market for PV is very large compared to California's market. The annual global installed capacity for solar PV in 2010 was 17,500 MW while the cumulative global installed capacity to date was greater than 40,000 MW.[16] Out of the 2010 global installed capacity, CSI GM accounted for 155 MW (or less than 1%). Similarly, out of the total global capacity, CSI GM accounted for 438 MW (or just over 1%). Consequently, it is not clear the extent to which the CSI influenced PV system cost reductions, especially with respect to module costs. As pointed out in the LBNL cost study, both market-scale and local market changes can influence overall system costs.[17]

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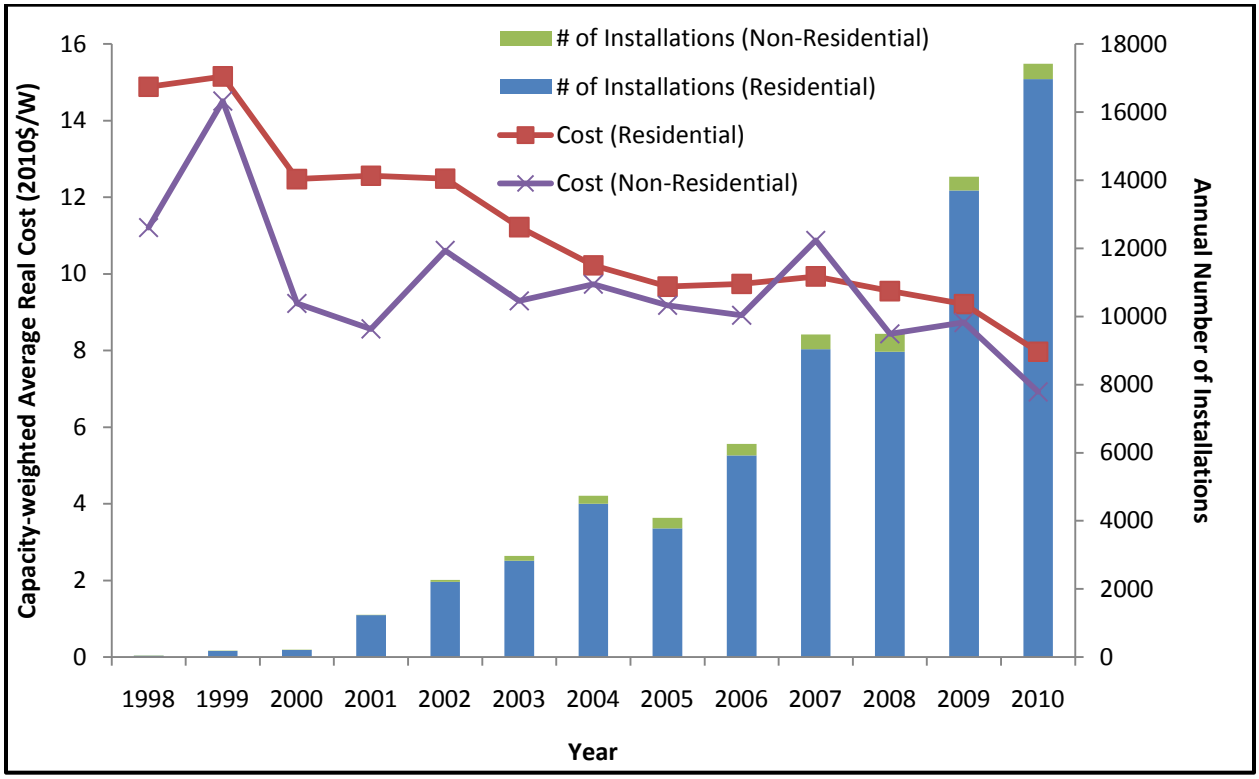
[15] In their recently published LBNL report, Wiser et al. find a similar trend in solar energy system prices across the United States during a similar timeframe: $10.8/W-DC in 1998 decreasing to $7.5/W-DC in 2009. The LBNL study reports cost trends in terms of DC Watts units while costs in this analysis are reported in terms of AC Watts. The difference in units is simply because of the form in which the data was made available to both research teams. G. Barbose, N. Darghouth, and R. Wiser, *Tracking the Sun III: The Installed Cost of Photovoltaics in the U.S. from 1998-2009*, LBNL-4121E, December 2010, http://eetd.lbl.gov/ea/emp/reports/lbnl-4121e.pdf

[16] http://www.greentechmedia.com/articles/read/pv-news-annual-data-collection-results-cell-and-module-production-explode-p/

[17] G. Barbose, *op.cit.*, pg. 2.

Figure 2-14 shows cost trends of PV systems for both the residential and non-residential sectors from 1998 to the end of 2010.

Figure 2-14: California IOU Public Purpose Program PV Systems*—Trend in Annual Installed Capacity, Number of Installations, and Costs by Customer Sector

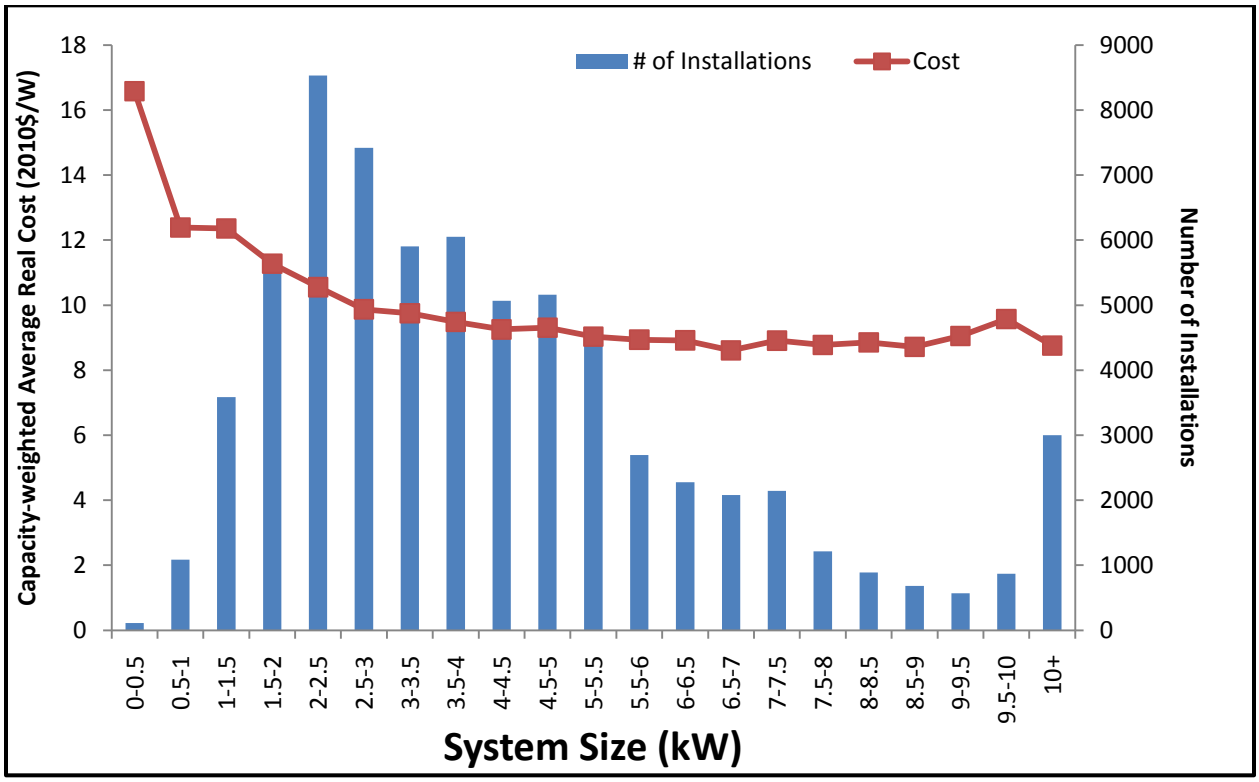


* CSI GM, MASH, SGIP, and ERP for residential; and CSI GM, SGIP, and ERP for non-residential.

Except for a brief period from 2000 to 2002, we see a dramatic increase in the difference between average costs of residential and non-residential systems from $1.4/W (in 2003–2004) to $0.6/W (in 2009).

Figure 2-15 provides a more in-depth look at how system size may be affecting PV system costs within the residential sector. PV system costs are shown as of December 31, 2010. In general, larger residential systems (larger than 3.5 kW) cost substantially less (ranging from $8.6/W–$9.9/W) than smaller systems (less than 3.5 kW), which can cost as much as $13.2/W.

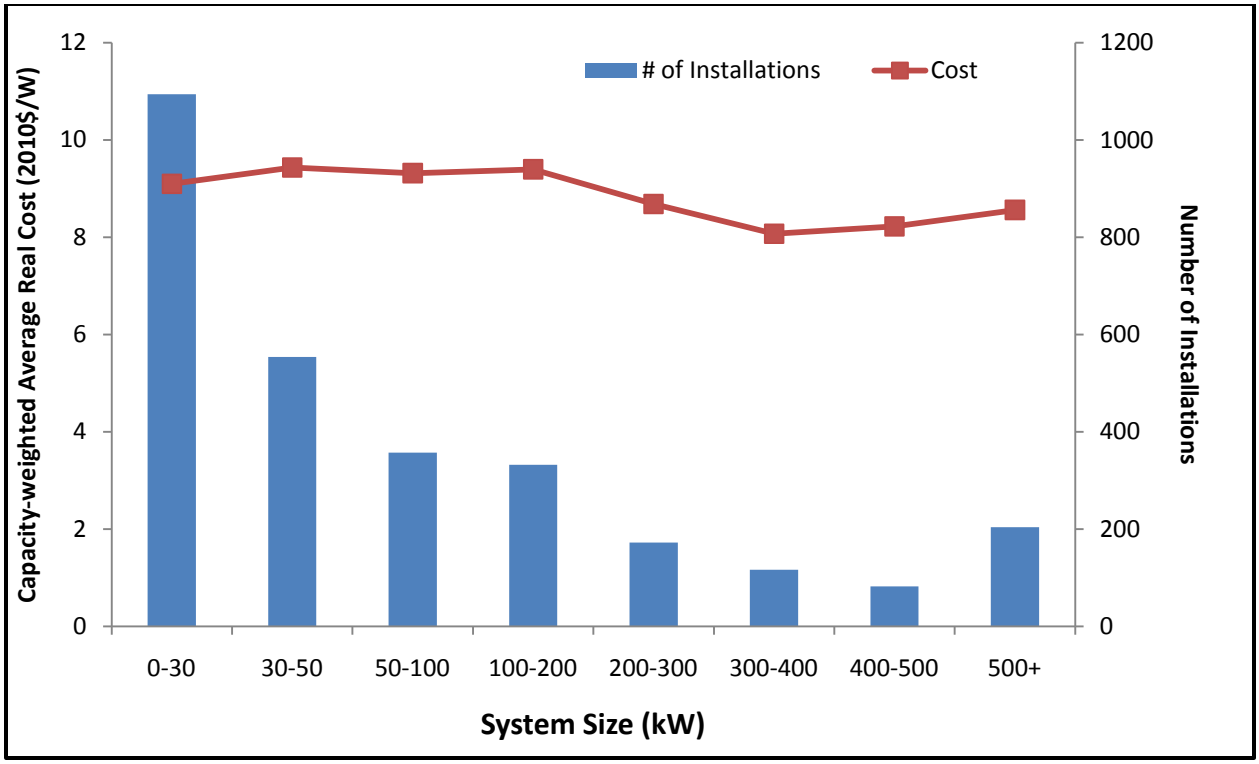
Figure 2-15: California IOU Public Purpose Program PV Systems*—Cost of Residential Systems by Size



* CSI GM, MASH, SGIP, and ERP. Costs as of December 31, 2010.

Figure 2-16 shows the relationship between PV system size and cost in the non-residential sector. As in the residential sector, there appears to be an economy of scale at work, with the cost of larger non-residential systems being lower than the smaller ones. However, the range among costs of all non-residential systems is substantially smaller (i.e., $1.4/W or $7.7/W–$9.1/W) as compared with that for residential systems (i.e., $7.8/W or $8.7/W–$16.6/W).

Figure 2-16: California IOU Public Purpose Program PV Systems*—Cost of Non-Residential Systems by Size



* CSI GM, SGIP, and ERP. Costs are as of December 31, 2010.

In Table 2-8, the costs of PV systems for both customer sectors are compared across the three PAs. The cost of non-residential systems installed in SCE's and CCSE's service territories is substantially lower than those installed in PG&E's service territory. In contrast, the cost of residential systems installed in SCE's area is higher than those installed in PG&E's and CCSE's.

Table 2-8: California IOU Public Purpose Program PV Systems*—Cost by PA and Customer Sector

Customer Sector	PV System Cost ($/W)		
	PG&E	SCE	CCSE
Non-Residential	9.0	8.4	8.5
Residential	9.3	9.5	9.0

* CSI GM, MASH, and ERP for residential; and CSI GM and ERP for non-residential. Costs are as of December 31, 2010.

2.5 CSI GM Statistics by Incentive

CSI GM PV systems can also be classified by type of incentive payment. As described in the report introduction, two types of incentive payments are available. The Expected Performance-Based Buy-down (EPBB) usually applies to smaller PV systems (usually residential and small commercial applications). The Performance-Based Incentive (PBI) is mandatory for larger systems.[18]

[18] Based on CSI GM program rules, from January 1, 2007 through December 31, 2007 all systems 100 kW and greater were required to receive PBI payments. From January 1, 2008 through December 31, 2009, systems 50 kW and greater were required to receive PBI payments. From January 1, 2010 onwards, systems 30 kW and greater are required to receive PBI payments. This provided the industry time to adjust to the PBI payment mechanism.

Table 2-9 provides a summary of the number and installed capacity of CSI GM projects by incentive type as of the end of 2010.[19] While PV systems receiving EPBB incentives make up the of the vast majority of installations under the CSI GM (97%), systems receiving PBI payments are larger and consequently make up 49% of the installed capacity.

Table 2-9: CSI GM Systems and Installed Capacity by Incentive Type

Incentive Type	Installed Systems (#)	Installed Systems (% of Total)	Installed Capacity (MW)	Installed Capacity (% of Total)
EPBB	40,552	97%	223	51%
PBI	1,111	3%	215	49%
Total	**41,663**	**100%**	**438**	**100%**

Table 2-10 shows the cost of CSI GM systems by incentive type and customer sector. While non-residential systems receiving EPBB incentives tended to cost more than those receiving PBI payments in that sector, the opposite was true for residential systems.

Table 2-10: CSI GM System Costs by Incentive Type and Customer Sector

Customer Sector	System Cost ($/W)	
	EPBB	PBI
Non-residential	8.4	8.0
Residential	8.8	8.9

2.6 CSI GM Statistics by Mount Type

The degree to which PV systems capture and convert sunlight to electricity is influenced partly by system configuration. PV systems are installed (or mounted) as either "fixed" or "tracking" systems. Fixed systems are literally fixed in their orientation (i.e., direction in which the panels face) and tilt. Fixed systems are categorized in this analysis as "near flat" (tilt of less than 20 degrees) and "tilted" (tilt of 20 degrees or greater).[20] Tracking systems use single- or dual-axis mechanical sub-systems to follow the path of the sun across the sky. Tracking systems can

[19] The EPBB incentive methodology pays an up-front incentive to participants installing systems less than 30 kW. The EPBB incentive is calculated by multiplying the incentive rate by the system rating by the CSI design factor (a ratio comparing a proposed system's expected generation output with that of a baseline system). The PBI is paid over a five-year period in monthly payments based on recorded kilowatt-hours (kWh) of solar power produced. The monthly PBI incentive payment is calculated by multiplying the incentive rate by the measured kWh output.

[20] Systems are listed as "near flat" due to the reporting that was conducted under the SGIP within the field inspection reports. In a number of instances, system configuration was listed as "near flat" instead of having a specified tilt.

harvest more sunlight than fixed systems but have higher capital costs and require more maintenance due to their moving parts. Smaller PV systems (e.g., less than 20 kW) are typically mounted as fixed systems. Table 2-11 is a summary of the number and capacity of PV systems installed under the CSI GM program as of the end of 2010 by mount type. Almost all (over 99%) CSI GM systems are fixed, with a close split between tilted and near-flat mounts.

Table 2-11: CSI GM Systems and Installed Capacity by Mount Type

Mount Type	Installed Systems (#)	Installed Systems (% of Total)	Installed Capacity (MW)	Installed Capacity (% of Total)
Fixed–Near Flat (< 20 degrees tilt)	19,528	47%	208	48%
Fixed–Tilted	21,969	53%	178	41%
Tracking	166	0.4%	52	12%
Total	**41,663**	**100%**	**438**	**100%**

Table 2-12 presents the costs ($/W) of PV systems installed under the CSI GM by mount type and customer sector. Residential tracking systems are the most expensive, while non-residential tracking systems have the lowest cost. This is likely due to system size differences between the two sectors. Since tracking systems are typically more expensive but produce more energy than fixed systems, larger non-residential systems will tend to cost less on a $/W basis than smaller residential ones.

Table 2-12: CSI GM Systems—Cost by Mount Type and Customer Sector

Customer Sector	Cost ($/W)		
	Fixed–Near Flat	Fixed–Tilted	Tracking
Non-Residential	8.6	8.4	8.3
Residential	9.3	9.1	10.7

2.7 Distribution of Ownership

Typically, a CSI GM program participant applies for the program and incentive, and owns the PV system on her property. However, third-party ownership of PV systems may be advantageous in some situations and is allowable under the CSI GM. In these cases, a third party owns the system which is located on the host customer's property and either sells the host customer electricity from the PV system through a Power Purchase Agreement (PPA) or leases the PV system to the host.

Table 2-13 shows trends in third-party ownership of CSI GM PV systems over the first four years of the program (2007–2010). Overall, 16% of the systems accounting for 38% of installed capacity were owned by third parties; indicating that larger systems were more likely to be owned by third-parties than smaller ones. The portion of systems owned by third parties was the same in 2007 and 2008 (approximately 11% each year), but doubled by 2010 (22%). However, the portion of installed capacity of third-party-owned systems showed a marked increase from 30% in 2007 to 46% in 2008 and then decreased to 39% in 2009 and fell back to 30% in 2010. The end result is that while there was a marked increase in the number of third-party-owned systems going into 2010, the overall capacity was decreasing. Some of this trend could be attributed to differences occurring with third-party ownership within the residential and non-residential sectors.

Table 2-13: CSI GM Systems—Trend in Third-Party Ownership

Year	Installed Systems –All CSI GM	Installed Systems –Third-Party-Owned (% of Total)	Installed Capacity –All CSI GM (MW)	Installed Capacity –Third-Party-Owned (% of Total)
2007	3,440	10%	25	29%
2008	8,435	10%	113	43%
2009	13,044	13%	145	39%
2010	16,744	22%	155	31%
Total	**41,663**	**16%**	**438**	**37%**

Table 2-14 provides information on third-party ownership within the residential and non-residential sectors. The portion of third-party-owned residential systems and the associated installed capacity was roughly stable from 2007 to 2009, but almost doubled in 2010. In the non-residential sector, third-party ownership increased substantially from 2007 to 2008, especially for larger systems. However, third-party ownership has continued to decrease steadily since then, with 2010 achieving the smallest contributions in both number of systems and installed capacity as compared with all previous years. The contrasting trends in residential and non-residential systems, particularly in 2010, suggest that third-party owner models are shifting their focus from the non-residential to the residential sector and to smaller systems.

Table 2-14: CSI GM Systems—Trend in Third-Party Ownership by Customer Sector

Year	Non-Residential				Residential			
	Installed Systems – All Non-Res	Installed Systems –Third-Party-Owned (% of Non-Res)	Installed Capacity – All Non-Res (MW)	Installed Capacity –Third-Party-Owned (% of Non-Res)	Installed Systems – All Res	Installed Systems –Third-Party-Owned (% of Res)	Installed Capacity –All Res (MW)	Installed Capacity –Third-Party-Owned (% of Res)
2007	67	34%	10	57%	3,373	10%	15	11%
2008	443	40%	76	60%	7,992	8%	37	8%
2009	398	36%	85	57%	12,646	12%	60	12%
2010	453	24%	75	41%	16,291	22%	80	22%
Total	**1,361**	**34%**	**246**	**53%**	**40,302**	**15%**	**192**	**16%**

In Table 2-15, trends in third-party ownership are compared across the two types of CSI GM incentives. Third-party ownership accounts for more than double the number of installations and almost three times the installed capacity under PBI as compared with EPBB. Over time, third-party owners have accounted for an increasingly larger share (both in terms of number of systems and installed capacity) under EPBB as compared with PBI. Since most residential systems receive EPBB incentives, this is consistent with findings about trends in third-party ownership by customer sector.

Table 2-15: CSI GM Systems—Trend in Third-Party Ownership by Incentive Type

Year	EPBB				PBI			
	Installed Systems –All EPBB	Installed Systems –Third-Party-Owned (% of EPBB)	Installed Capacity –All EPBB (MW)	Installed Capacity –Third-Party-Owned (% of EPBB)	Installed Systems –All PBIs	Installed Systems –Third-Party-Owned (% of PBI)	Installed Capacity –All PBI (MW)	Installed Capacity –Third-Party-Owned (% of PBI)
2007	3,365	10%	18	14%	75	21%	8	64%
2008	8,104	9%	54	21%	331	41%	58	64%
2009	12,684	12%	67	16%	360	33%	78	58%
2010	16,399	22%	84	22%	345	24%	71	42%
Total	**40,552**	**15%**	**223**	**19%**	**1,111**	**32%**	**215**	**55%**

Third Party Ownership and Solar Power Purchase Agreements

The solar services provider (third party) finances, designs, installs, monitors, and maintains the solar equipment on a host customer property or rooftop. As a result, solar installations are easier for customers to afford because they do not have to pay upfront costs for equipment and installation. The customers however pay to purchase the electricity generated by the equipment and the agreement is known as a Power Purchase Agreement.

Table 2-16 provides a comparison of PV system size for customer-owned versus third-party-owned systems for both the residential and non-residential sectors. System sizes are substantially larger for third-party-owned systems as compared with those that are customer-owned consistently across all years, both customers sectors, and using either average or median as the comparison metric. For the non-residential sector, the median size of third-party-owned systems is at least 3.7 times to as much as six times that of customer-owned systems. In contrast, the difference in system size is relatively small between third-party- and customer-owned systems in the residential sector.

Table 2-16: CSI GM Systems—Trend in Size by Ownership Type and Customer Sector

Year	PV System Size (kW)							
	Non-Residential				Residential			
	Median		Average		Median		Average	
	Third-Party-Owned	Customer-Owned	Third-Party-Owned	Customer-Owned	Third-Party-Owned	Customer-Owned	Third-Party-Owned	Customer-Owned
2007	166.6	45.1	246.4	96.7	4.4	3.9	4.9	4.5
2008	205.1	37.0	257.1	114.1	3.9	3.8	4.5	4.6
2009	221.8	35.4	335.5	143.1	4.2	4.0	4.9	4.7
2010	149.4	30.3	278.5	129.5	4.6	4.2	5.1	4.9

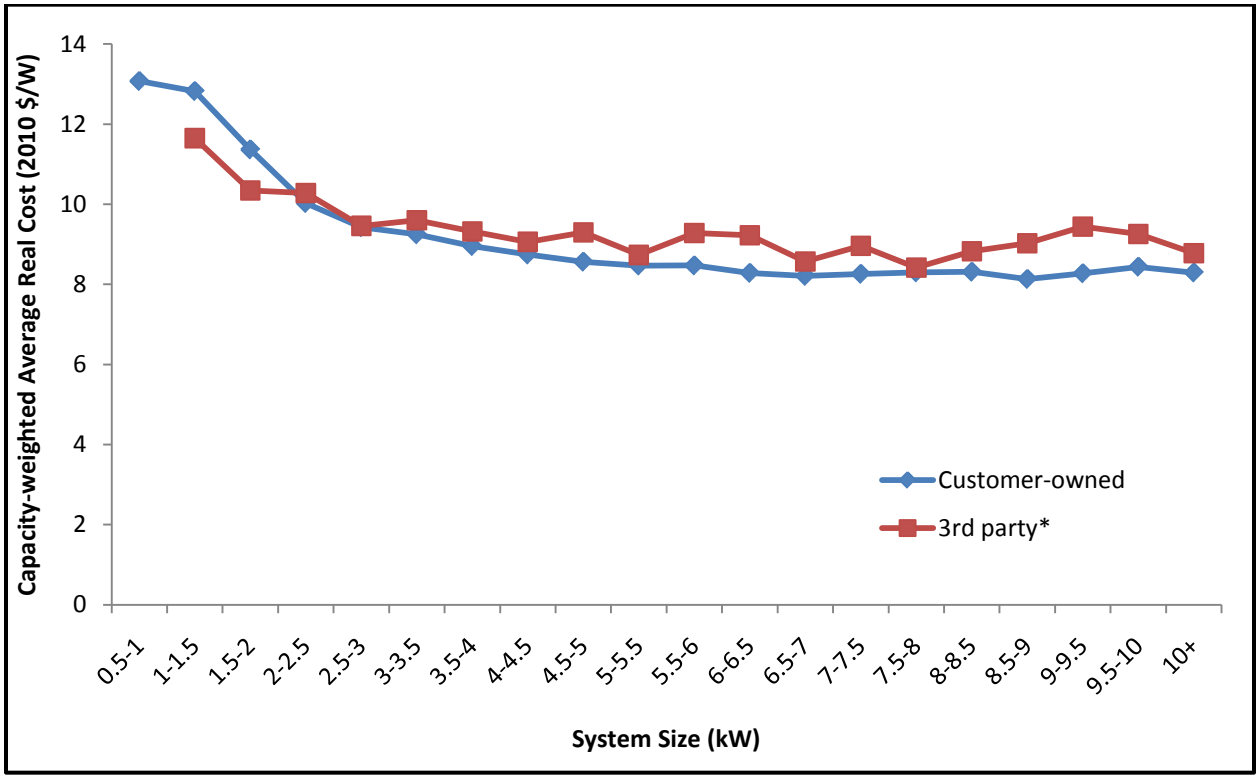
Table 2-17 compares PV system size by type of ownership and incentive type. Consistent with previous observations, the median size of third-party-owned systems receiving PBI payments is substantially larger (e.g., 50 times larger in 2007 and five times larger in 2010) than customer-owned systems receiving such incentives. The difference in size for systems receiving EPBB incentives is relatively minor between the two types of ownership.

Table 2-17: CSI GM Systems—Trend in Size by Ownership Type and Incentive Type

Year	System Size (kW)							
	EPBB				PBI			
	Median		Average		Median		Average	
	Third-Party-Owned	Customer-Owned	Third-Party-Owned	Customer-Owned	Third-Party-Owned	Customer-Owned	Third-Party-Owned	Customer-Owned
2007	4.5	3.9	7.1	5.0	288.3	5.8	305.9	45.9
2008	4.1	3.9	15.9	5.8	215.1	8.9	276.3	106.3
2009	4.2	4.0	6.9	5.1	253.0	11.2	385.5	133.9
2010	4.6	4.2	5.2	5.1	250.9	50.7	355.7	158.2

Figure 2-17 portrays the relationship between PV system size and cost by the two different ownership models in the residential sector. The cost of larger residential systems (larger than 3.5 kW) is consistently lower for those that are customer-owned than for those that are third-party-owned and vice-versa for smaller systems (smaller than 3.5 kW).

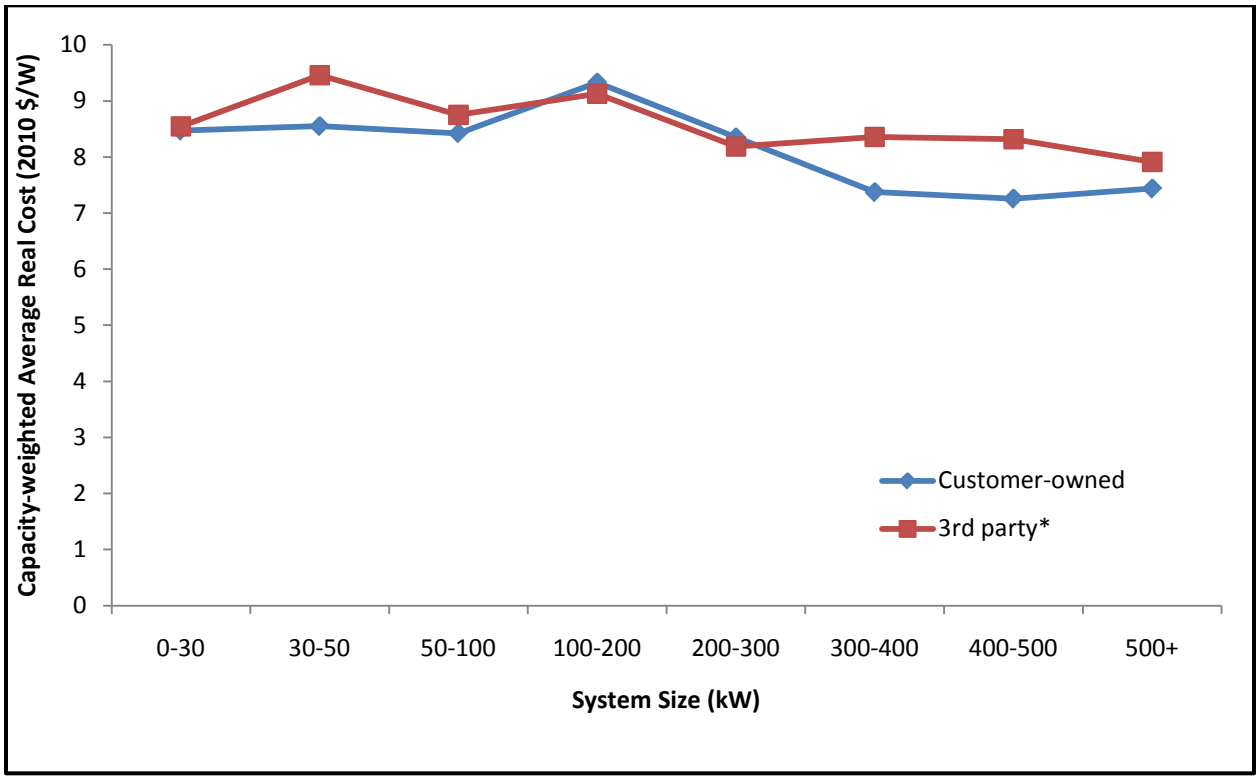
Figure 2-17: CSI GM Systems—Residential—Cost* by Size and Ownership Type



* Caution should be exercised when comparing third-party costs to customer-owned costs. Third-party costs are reported as a single cost that represents the total cost of the lease or PPA payments. As such, some third-party costs may include interest on lease payments maintenance and other items not typically included in costs of customer-owned systems.

Figure 2-18 provides similar information for the non-residential sector. We see that the cost of larger non-residential systems (larger than 300 kW) is consistently lower for those that are customer-owned. For smaller non-residential systems, no clear difference between costs of third-party-owned and customer-owned systems is observed.

Figure 2-18: CSI GM Systems—Non-Residential—Cost* by Size and Ownership Type



* Caution should be applied when comparing third-party costs to customer-owned costs. Third-party costs are reported as a single cost that represents the total cost of the lease or PPA payments. As such, some third-party costs may include interest on lease payments maintenance and other items not typically included in costs of customer-owned systems.

Table 2-18, Table 2-19, and Table 2-20 provide information on third-party ownership of CSI GM systems for PG&E, SCE, and CCSE, respectively. There are similar portions of installed capacity attributable to third-party-owned systems in CCSE's and PG&E's service territories (33% and 31%, respectively). However, SCE has a substantially larger portion of third-party-owned capacity (47%). The number of third-party-owned installations has grown steadily for PG&E and CCSE over the past four years. However, third-party ownership accounted for 32% of installations in SCE service territory in the first year of the CSI (2007) and then dropped substantially to 11% the following year. In 2010, PG&E and SCE had similar portions of both third-party-owned systems and related installed capacity, while CCSE had relatively smaller percentages.

Table 2-18: CSI GM Systems—Trend in Third-Party Ownership for PG&E

Year	Installed Systems –PG&E Total	Installed Systems –Third-Party-Owned (% of PG&E Total)	Installed Capacity –All PG&E (MW)	Installed Capacity –Third-Party-Owned (% of PG&E Total)
2007	2,482	6%	16	20%
2008	5,527	10%	61	41%
2009	7,575	13%	87	32%
2010	8,875	23%	88	31%
Total	**24,459**	**15%**	**252**	**33%**

Table 2-19: CSI GM Systems—Trend in Third-Party Ownership for SCE

Year	Installed Systems –SCE Total	Installed Systems –Third-Party-Owned (% of SCE Total)	Installed Capacity –All SCE (MW)	Installed Capacity –Third-Party-Owned (% of SCE Total)
2007	638	32%	7	53%
2008	2,150	10%	40	49%
2009	3,418	13%	44	53%
2010	5,293	24%	48	33%
Total	**11,499**	**19%**	**140**	**45%**

Table 2-20: CSI GM Systems—Trend in Third-Party Ownership for CCSE

Year	Installed Systems –CCSE Total	Installed Systems –Third-Party-Owned (% of CCSE Total)	Installed Capacity –All CCSE (MW)	Installed Capacity –Third-Party-Owned (% of CCSE Total)
2007	320	1%	2	16%
2008	758	9%	11	39%
2009	2,051	12%	14	32%
2010	2,576	14%	19	27%
Total	**5,705**	**11%**	**46**	**31%**

2.8 PV Module Manufacturers—Trends in CSI GM Market Share

The landscape of the PV industry has changed markedly over the last decade, likely in large part due to legislation, public purpose programs targeting the deployment of solar technologies, and such initiatives as "Million Solar Roofs." In California, these changes have arguably been greatest over the last five years, which witnessed the establishment of the "Go Solar California!" campaign. This section summarizes trends in the CSI GM market shares of PV module manufacturers since the program's inception in 2007.

As shown in Table 2-21, the top ten PV module manufacturers with the largest share of the CSI GM market cumulatively accounted for 86% of systems and 83% of capacity installed under the program as of December 31, 2010. SunPower claimed the largest share by far, accounting for more than 20% of installations and capacity, followed by Sharp, accounting for 19% of installations and 13% of capacity. The remaining eight manufacturers of this group of top 10 manufacturers each accounted for less than 10% of the CSI GM market share.

Table 2-21: CSI GM Market Share—Top 10 Module Manufacturers

Top 10 by Number of Installations			Top 10 by Installed Capacity		
Module Manufacturer	**Total Number of Installations**	**Percent of Total Installations**	**Module Manufacturer**	**Total Installed Capacity (MW)**	**Percent of Total Installed Capacity**
SunPower	9,457	22%	SunPower	95	21%
Sharp	8,120	19%	Sharp	60	13%
BP Solar	3,490	8%	Kyocera Solar	38	8%
Evergreen Solar	3,183	8%	Evergreen Solar	38	8%
Kyocera Solar	2,910	7%	Suntech Power	34	7%
Sanyo Electric	2,711	6%	BP Solar	28	6%
Suntech Power	2,121	5%	Mitsubishi Electric	27	6%
SolarWorld	1,459	3%	Sanyo Electric	25	6%
Mitsubishi Electric	1,393	3%	SolarWorld	23	5%
Andalay Solar	1,375	3%	Schott Solar	12	3%
All Other	6,056	14%	All Other	77	17%

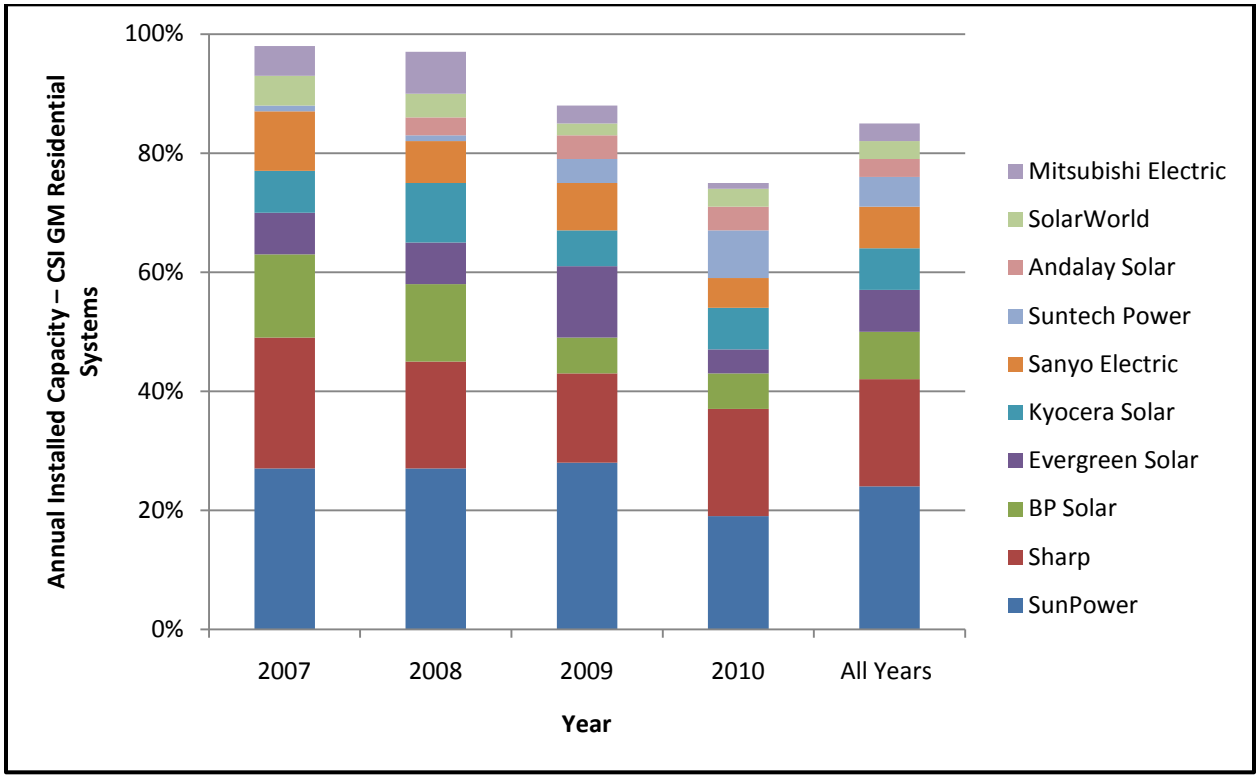
Trends in the rankings of the top 10 manufacturers with the largest share of the CSI GM residential market exhibited some movement over the last four years. Table 2-22 shows that some of the manufacturers with large shares in the early years of the program more or less disappeared by 2010. However, new manufacturers have made their presence felt in just the last two years. SunPower and Sharp have garnered the lion's share of the CSI GM market over the four years since the program start, maintaining their first and second ranks, respectively. One of the early market entrants, SolarWorld, lost its place in the top 10 in 2009 and 2010. On the other hand, Suntech, which was ranked ninth and tenth in 2007 and 2008, respectively, moved up to the third rank by 2010.

Table 2-22: CSI GM Market Share—Residential—Trend in Top 10 Module Manufacturer Ranking by Annual Installed Capacity

Module Manufacturer	Ranking				
	2007	2008	2009	2010	All Years
SunPower	1	1	1	1	1
Sharp	2	2	2	2	2
BP Solar	3	3	6	5	3
Evergreen Solar	5	7	3	9	4
Kyocera Solar	6	4	5	4	5
Sanyo Electric	4	5	4	7	6
Suntech Power	9	10	7	3	7
Andalay Solar	Not in Top 10	9	8	10	8
SolarWorld	8	8	Not in Top 10	Not in Top 10	9
Mitsubishi Electric	7	6	9	Not in Top 10	10

Figure 2-19 graphically displays the breakout in the trend in annual CSI GM residential market share by the top 10 manufacturers in terms of installed capacity. Cumulatively, the top 10 manufacturers' share of the CSI GM residential market, which was greater than 95% in the first two years of CSI, fell to 75% in 2010 indicating that competition in the market is growing. SunPower's share of approximately 27% in the first three years of the CSI decreased dramatically to 18% by 2010. Similarly, BP Solar's share fell from approximately 14% in 2007–2008 to 6% in 2009–2010.

Figure 2-19: CSI GM Market Share—Residential—Trend in Top 10 Module Manufacturer by Annual Installed Capacity



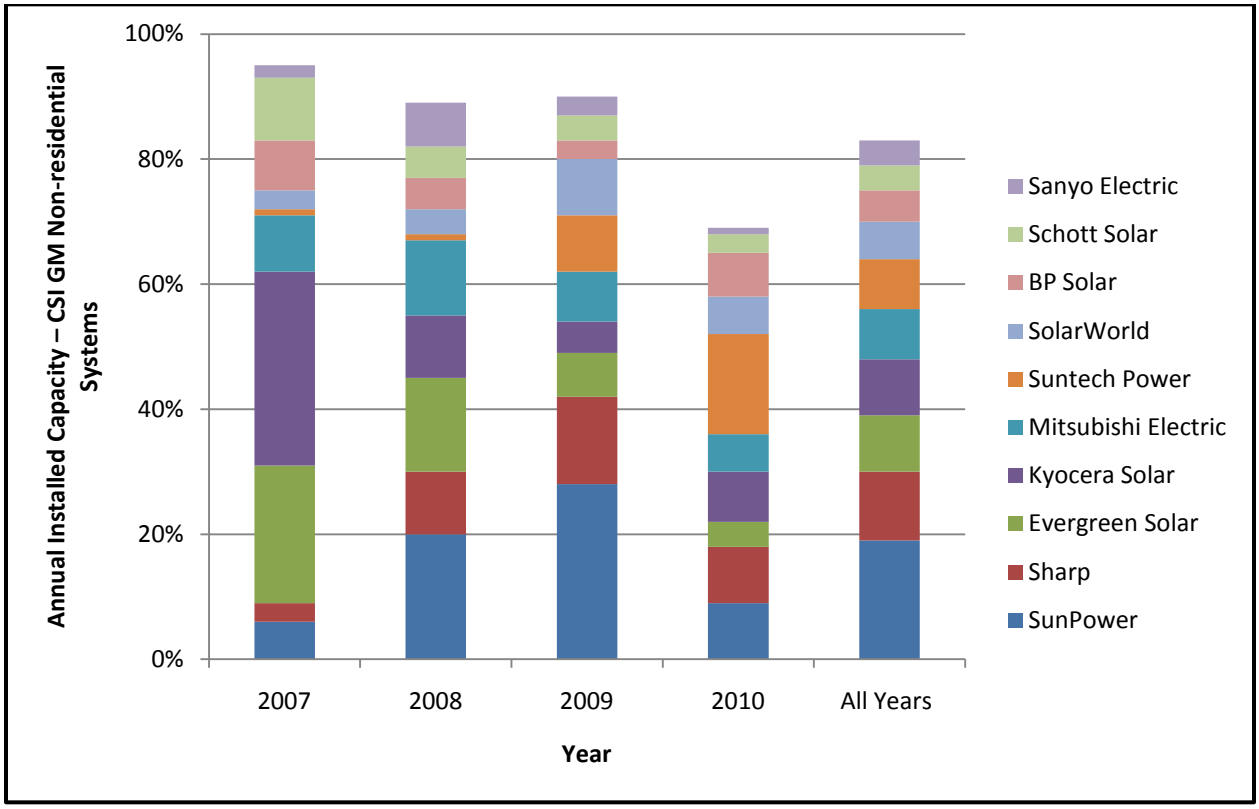
The trends in CSI GM market share for the non-residential sector are somewhat different than those for the residential, as evidenced in Table 2-23. Neither SunPower nor Sharp, consistently ranked one and two for the CSI GM residential market share, have similar dominance in the non-residential sector. In 2007, SunPower and Sharp were ranked sixth and seventh, respectively. By 2010, though, SunPower was ranked second and Sharp ranked third. The largest CSI GM non-residential market share in 2010 was garnered by SunTech, which was not even in the top 10 in 2007 and 2008. Three of the early market entrants, Evergreen, Schott, and Sanyo, no longer ranked among of the top 10 by 2010.

Table 2-23: CSI GM Market Share—Non-Residential—Trend in Top 10 Module Manufacturer Ranking by Annual Installed Capacity

Module Manufacturer	Ranking				
	2007	2008	2009	2010	All Years
SunPower	6	1	1	2	1
Sharp	7	5	2	3	2
Evergreen Solar	2	2	6	Not in Top 10	3
Kyocera Solar	1	4	7	4	4
Mitsubishi Electric	4	3	5	8	5
Suntech Power	Not in Top 10	Not in Top 10	4	1	6
SolarWorld	8	9	3	9	7
BP Solar	5	7	10	7	8
Schott Solar	3	8	8	Not in Top 10	9
Sanyo Electric	9	6	9	Not in Top 10	10

Figure 2-20 displays the breakout in the trend in annual CSI GM non-residential market share by the top 10 manufacturers in terms of installed capacity. From a high of 95% market share in 2007 for the top 10 manufacturers serving the non-residential section, the decrease to 69% is even more dramatic than in the residential sector. Over the first three years, SunPower steadily increased its share in the non-residential market from 6% all the way up to 28%. However, in 2010, their market share fell below the 10% level. SunTech's market share grew from barely 1% in 2007–2008 to 9% in 2009 and 16% in 2010.

Figure 2-20: CSI GM Market Share—Non-Residential—Trend in Top 10 Module Manufacturer by Annual Installed Capacity



The relatively minor shift in rankings, but substantial shifts in actual CSI GM market shares indicate that new entrants continue to join the California PV module marketplace. The different trends in the residential and non-residential sectors suggest differing and changing business strategies of module manufacturers. For example, in the first year of the CSI GM, SunPower, and Sharp focused heavily on the residential sector while Kyocera focused on the non-residential. In 2008-2009, the top 10 manufacturers started expanding into sectors in which they were not dominant.

However, new entrants such as SunTech reduced the overall program market share of the top 10 manufacturers in both sectors by 2010.[21]

2.9 Inverter Manufacturers—Trends in CSI GM Market Share

In contrast to the module manufacturing market, the inverter manufacturing is much more consolidated relative to the CSI GM program. As shown in Table 2-24, just five manufacturers accounted for 88% of program installations and 84% of installed capacity. It should be noted that SunPower does not manufacturer inverters but, rather, procures inverters from other manufacturers (e.g., Xantrex and SMA) and sells them to the retail market under the SunPower brand.[22] Taking this into account, it appears that the CSI GM inverter market is dominated by just four manufacturers.

SMA America has the largest share of the CSI GM inverter market in terms of number of installations (36%), but the second highest share in terms of installed capacity (23%). On the other hand, SatCon Technology is not even among the top five inverter manufacturers in terms of number of installations but still accounts for 25% of CSI GM installed capacity. Clearly, SMA America is focusing on the smaller installations while SatCon is focusing on larger projects.

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[21] It is worth noting that wherever a module manufacturer is headquartered, its supply chains are global. For example, although FirstSolar and SunPower are U.S.-based companies, their manufacturing operations occur outside of the country. Similarly, SunTech is a Chinese company that has recently opened a major manufacturing facility in the U.S.

[22] "We sell a line of SunPower branded inverters manufactured by third parties" – page 11 of 2010 Annual Report, (http://files.shareholder.com/downloads/SPWR/1240702142x0x453648/9577388E-424A-41E2-BE32-B7BF46C2BBA1/2010AR.pdf); http://us.sunpowercorp.com/about/newsroom/press-releases/?relID=205094; http://us.sunpowercorp.com/about/newsroom/press-releases/?relID=260082

Table 2-24: CSI GM Market Share—Top Five Inverter Manufacturers*

Top Five by Number of Installations			Top Five by Installed Capacity		
Inverter Manufacturer	**Total Number of Installations**	**Percent of Total Installations**	**Inverter Manufacturer**	**Total Installed Capacity (MW)**	**Percent of Total Installed Capacity**
SMA America	15,063	36%	SatCon Technology	114	25%
SunPower	8619	20%	SMA America	103	23%
Fronius USA	7,442	18%	Xantrex Technology	86	19%
Xantrex Technology	3,150	7%	SunPower	46	10%
PV Powered	2,969	7%	Fronius USA	35	8%
All Other	5,032	12%	All Other	73	16%

* SunPower does not manufacturer inverters but, rather, procures inverters from other manufacturers (e.g., Xantrex and SMA) and sells them to the retail market under the SunPower brand.

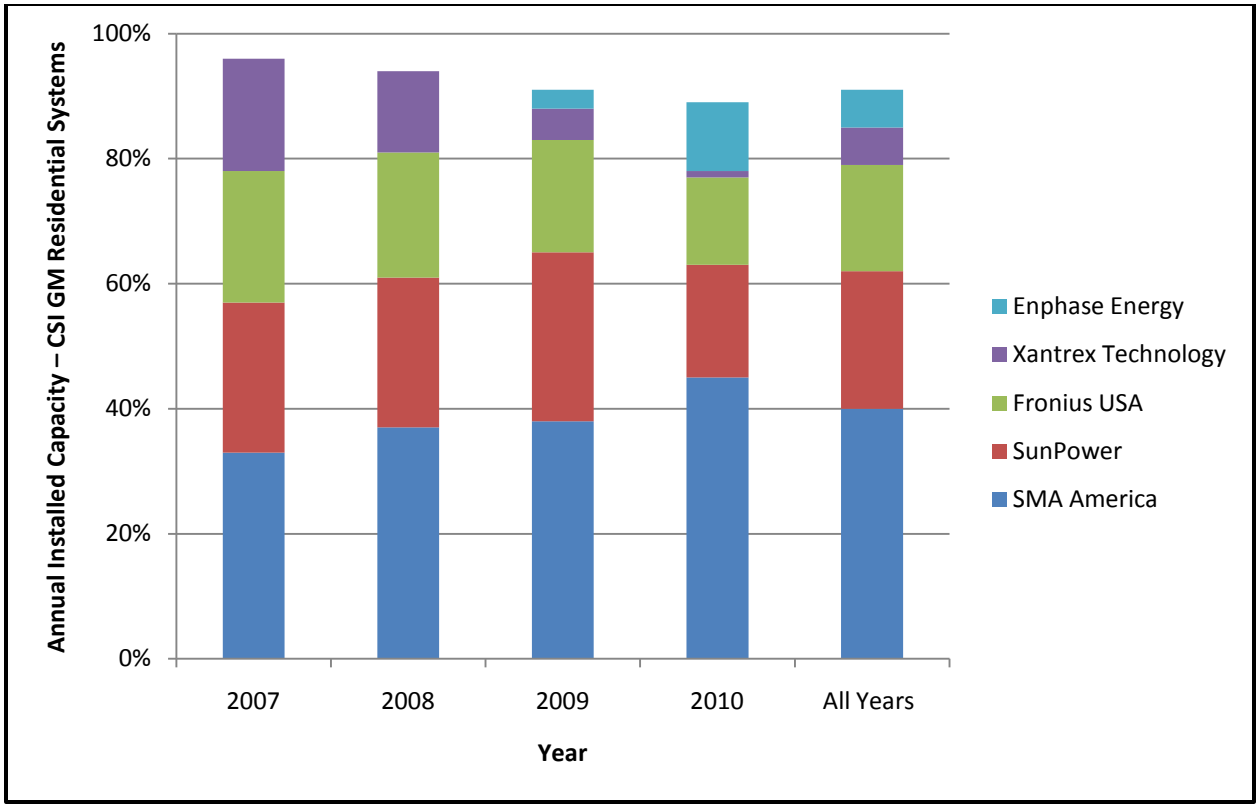
Table 2-25 provides information on the trends of the top five inverter manufacturers within the CSI GM residential market in terms of annual installed capacity. In general, there is not much movement among the top four inverter manufacturers with SMA, SunPower, and Fronius consistently maintaining their first, second, and third positions, respectively. However, Xantrex, which was ranked fourth in 2007, 2008, and 2009, dropped out of the top five in 2010 and a new entrant, Enphase, moved to the fourth rank in 2010.

Table 2-25: CSI GM Market Share—Residential—Trend in Top Five Inverter Manufacturer Ranking by Annual Installed Capacity

Inverter Manufacturer	Ranking				
	2007	**2008**	**2009**	**2010**	**All Years**
SMA America	1	1	1	1	1
SunPower	2	2	2	2	2
Fronius USA	3	3	3	3	3
Xantrex Technology	4	4	4	Not in Top 5	4
Enphase Energy	Not in Top 5	Not in Top 5	Not in Top 5	4	5

Figure 2-21 illustrates that the cumulative CSI GM residential market share of the top five manufacturers has decreased slightly, from a high of 96% of annual installed capacity in 2007 to 89% in 2010. SMA America's share has steadily increased while that of SunPower, Fronius, and Xantrex has steadily decreased. Since 2009, Enphase has increased its share from none in 2007 and 2008 to 11% in 2010.

Figure 2-21: CSI GM Market Share—Residential—Trend in Top 10 Inverter Manufacturer by Annual Installed Capacity



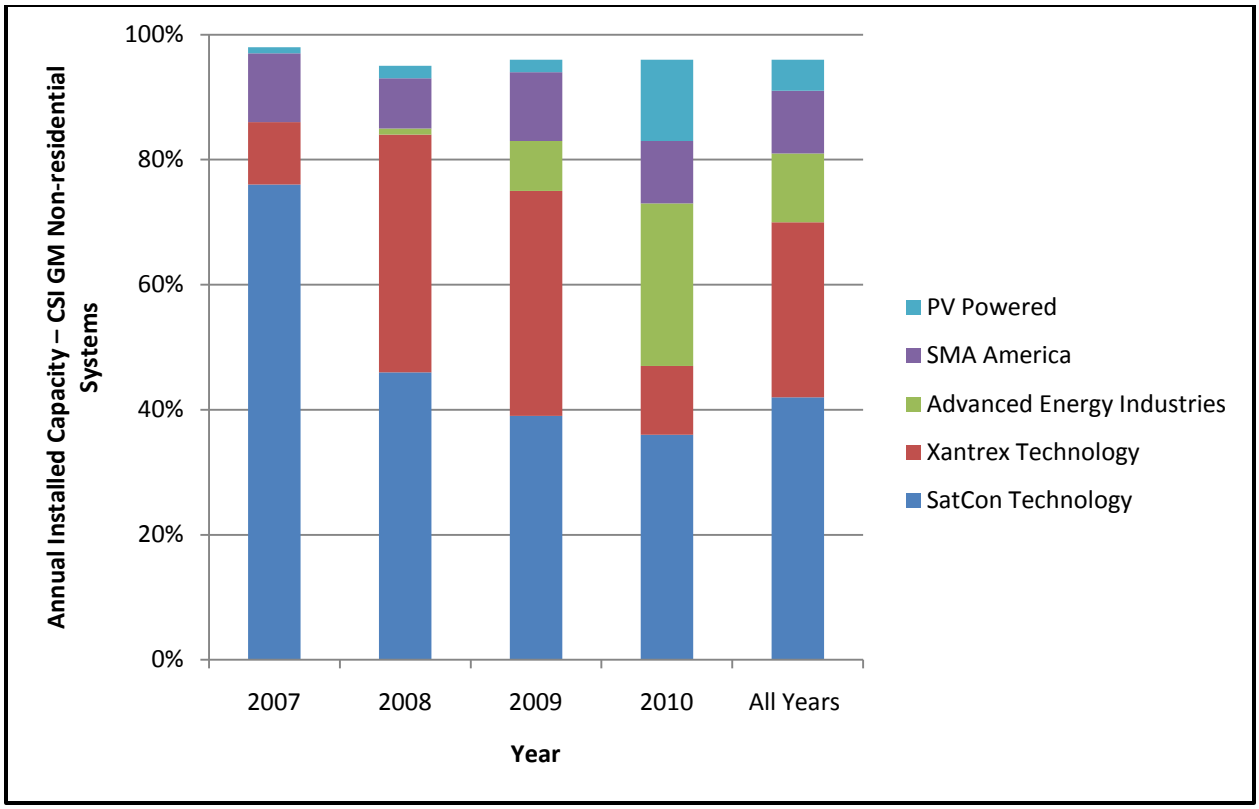
In contrast, there has been substantial churn in the CSI GM non-residential market rankings among the top five manufacturers as seen in Table 2-26. SatCon has consistently maintained its top rank since the start of the CSI. Like Enphase in the CSI GM residential market, Advanced Energy Industries was not among the top five inverter manufacturers for the CSI GM non-residential market until 2009, but ranked second in 2010. SMA America was ranked second in 2007 but moved to fifth rank by 2010.

Table 2-26: CSI GM Market Share—Non-Residential—Trend in Top Five Inverter Manufacturer Ranking by Annual Installed Capacity

Manufacturer	Ranking				
	2007	2008	2009	2010	All Years
SatCon Technology	1	1	1	1	1
Xantrex Technology	3	2	2	4	2
Advanced Energy Industries	Not in Top 5	Not in Top 5	4	2	3
SMA America	2	3	3	5	4
PV Powered	Not in Top 5	5	Not in Top 5	3	5

Figure 2-22 graphically displays the movement in CSI GM market share for inverter manufacturers in the non-residential sector. While there is substantial movement, the top five manufacturers are cumulatively serving more than 95% of the CSI GM non-residential market even in 2010. SatCon started with a share of 76% in 2007 but lost more than half of it by 2010. Xantrex started with a share of 10% in 2007, increased it rapidly to approximately 37% in 2008 and 2009, but was back down to 11% by 2010. Advanced Energy has enjoyed the largest increase in CSI GM non-residential market share, which grew from just 1% in 2008 to 26% by 2010.

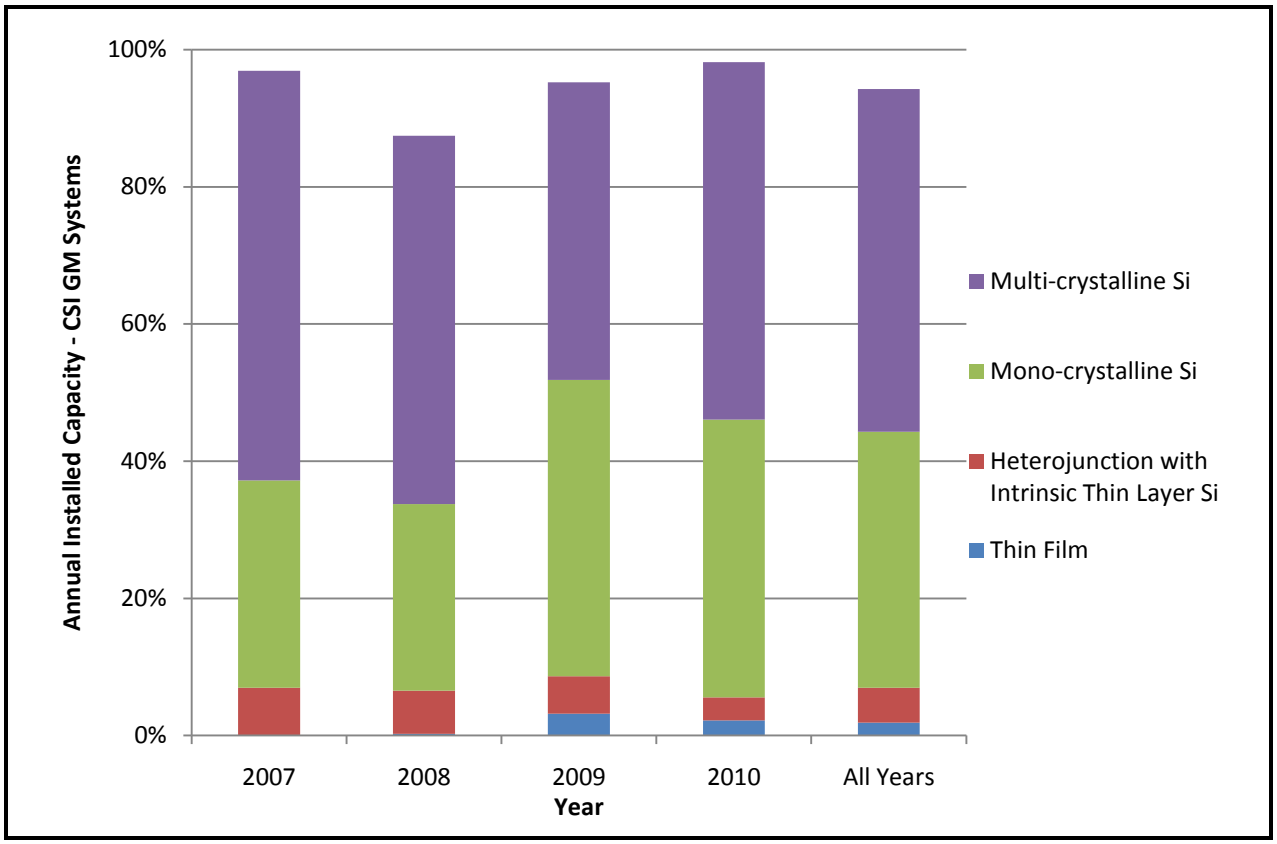
Figure 2-22: CSI GM Market Share—Non-Residential—Trend in Top 10 Inverter Manufacturer by Annual Installed Capacity



2.10 Trends in Share Module Types

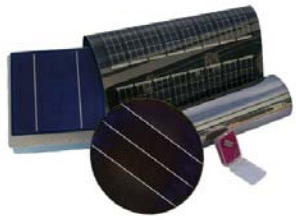
The main module types deployed in California are multi- and mono-crystalline silicon-based modules. Together, these to module types account for approximately 90% of the CSI GM market share, as seen in Figure 2-23. Multi-crystalline modules were dominant in 2007 and 2008 accounting for more than 50% of the CSI GM market share. However, since 2009 mono-crystalline technology has increased its share from below 30% to above 40%. Two other module technologies round out the CSI GM market: thin film and heterojunction with intrinsic thin layer Si.[23] Since 2009, the thin film technology started gaining share, primarily at the expense of the heterojunction technology.

Figure 2-23: CSI GM Market Share—Trend in Module Type by Annual Installed Capacity



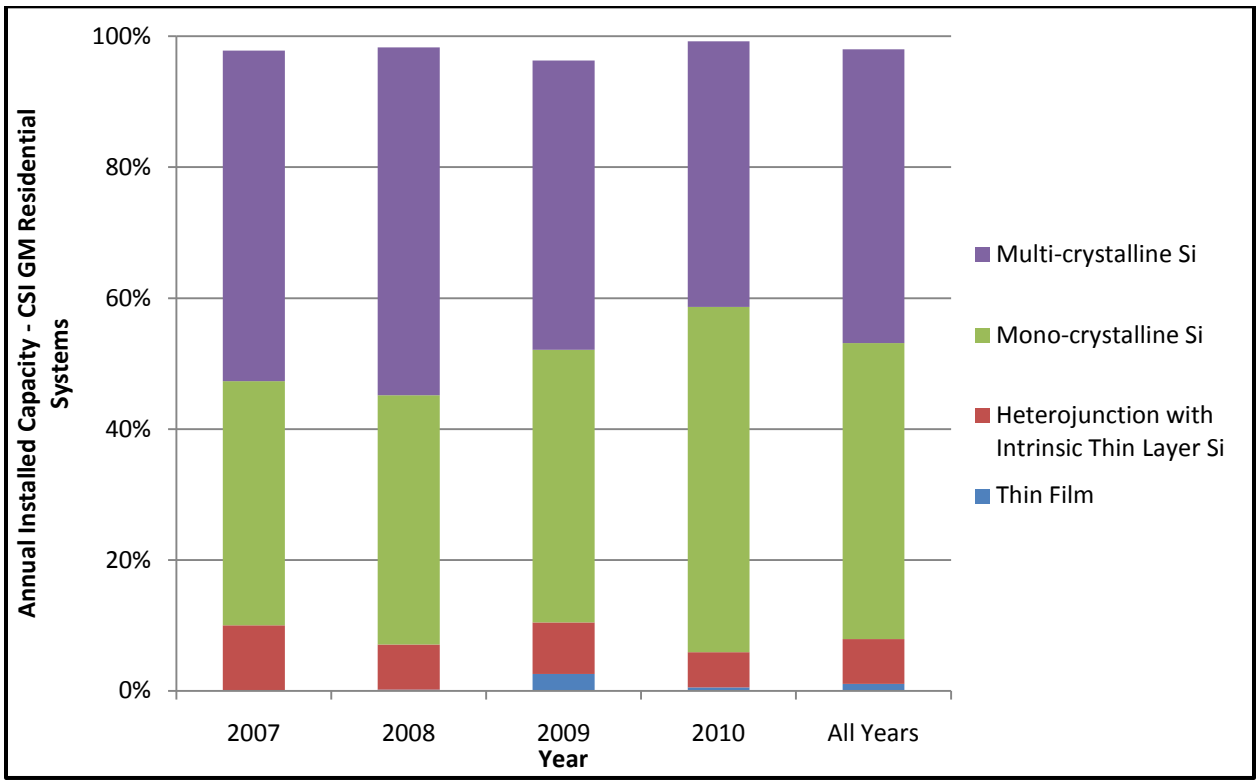
[23] Thin film modules include amorphous silicon, cadmium telluride (CdTe), copper indium selenide (CIS), and copper indium gallium (di) selenide (CIGS).

Figure 2-24 displays the trend in module type by annual installed capacity in just the residential sector of the CSI GM. Multi-crystalline technology has steadily decreased in its share of the CSI GM residential market from approximately 52% in 2007 and 2008 to 41% in 2010. Mono-crystalline technology has increased its share from approximately, 38% in 2007 and 2008 to 53% in 2010. Although thin film CdTe entered the residential market in 2009 with a 3% share, it all but vanished by 2010, suggesting that its manufacturers focused instead on the non-residential sector.



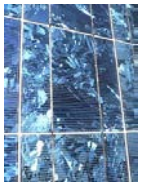
Types of Solar cells
Source: NREL

Figure 2-24: CSI GM Market Share—Residential—Trend in Module Type by Annual Installed Capacity

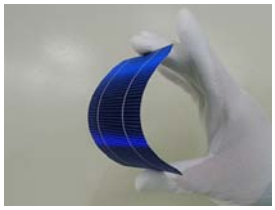


Types of Solar cells

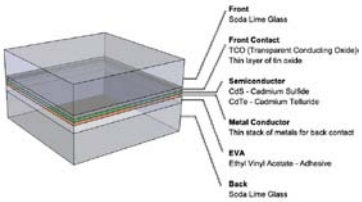
Mono-crystalline Si



Multi-crystalline Si



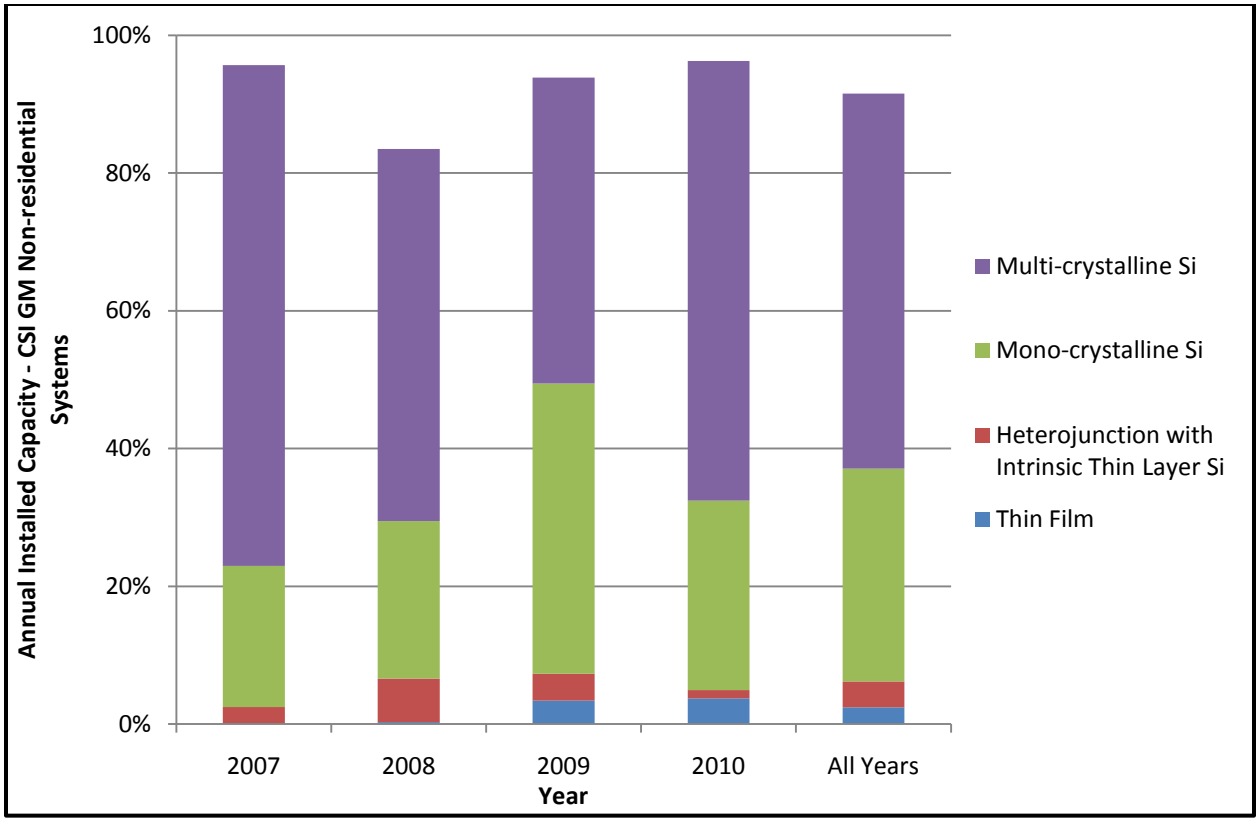
Heterojunction with Intrinsic Thin Layer Si



CdTe, one of the Thin Film technologies

Figure 2-25 shows the trend in module type within the non-residential sector of the CSI GM. From 2007 to 2009, multi-crystalline technology steadily lost its CSI GM non-residential market share to mono-crystalline. However, the trend reversed itself in 2010. Similar to the trend in the overall CSI GM market, thin film modules appear to be gradually increasing their share of the non-residential sector.

Figure 2-25: CSI GM Market Share—Non-Residential—Trend in Module Type by Annual Installed Capacity



2.11 Geographic Distribution of Installed Capacity

As discussed in the 2009 CSI Impact Evaluation Report,[24] there are distinct locations in which it would be beneficial to have high deployment of solar PV systems. For example, locating PV systems in geographical areas having very high quality solar resources would provide more electricity benefits than locating PV systems in areas of low quality solar resources. Similarly, deploying large amounts of PV in an area with poor air quality or congested distribution systems

[24] Itron, Inc., *CPUC California Solar Initiative: 2009 Impact Evaluation Final Report*, June 2010, http://www.cpuc.ca.gov/NR/rdonlyres/70B3F447-ADF5-48D3-8DF0-5DCE0E9DD09E/0/2009_CSI_Impact_Report.pdf

may help provide other types of location-specific benefits. This section provides results on an examination of any specific drivers that may systematically explain geographic distribution of CSI GM projects. The analysis was conducted looking at distributions at the five-digit zip code level.

Key drivers considered in this analysis that may have possibly influenced geographic distribution of PV installations included:

- Political preferences as expressed from the recent voting patterns for a key climate change mitigation proposition in California. For the sake of this analysis, this driver was characterized in terms of the percent "No" vote on Proposition 23 by zip code.[25]
- Quality of solar resources characterized in terms of the average annual global horizontal irradiance (units are in W/m^2).[26]
- Total Population as obtained from the 2001 census.
- Total Households as obtained from the 2001 census.
- Median Home Value as obtained from the 2001 census.
- Median Income as obtained from the 2001 census.

Table 2-27 provides summary statistics (i.e., minimum, maximum, mean, median, and standard deviation) for each of these drivers (or explanatory variables). In general, we found there was very high variation in the way in which people voted on climate change legislation, their income levels, their home values, and population numbers across the analyzed geographical area. In contrast, there was little variation in the amount and quality of sunlight (or solar resource) across the examined geographical area.

[25] Source: California Secretary of State website: http://vote.sos.ca.gov/ (accessed on: 05-25-2011).

[26] Source: National Aeronautical Space Administration: http://eosweb.larc.nasa.gov/cgi-bin/sse/sse.cgi?+s01#s01 (accessed on: 05-25-2011).

Table 2-27: Summary Statistics for Explanatory Variables, by Zip Code

Variable	Sum	N	Minimum	Maximum	Mean	Median	Std Dev
Percent "No" on Proposition 23	N/A	1,433	0	82%	60%	57%	10%
Average Annual GHI (W/m2)	N/A	1,377	3,817	5,761	4,977	4,974	291
Total Population	30,736,760	1,381	0	105,275	22,257	17,923	20,726
Total Households	10,441,418	1,381	0	33,572	7,561	6,431	6,708
Median Home Value	N/A	1,381	0	1,000,001	233,174	178,400	171,670
Median Income	N/A	1,381	0	200,001	59,828	55,402	24,414

Before assessing the correlations of the explanatory variables with the total number of CSI GM system installations and installed capacity in each zip code, it is necessary to understand whether the explanatory variables themselves are correlated among each other.

Two metrics of correlation, Pearson and Spearman,[27] were considered at a statistical significance level of 90% and above. Under the Pearson method, the correlation coefficients are calculated directly between the values of the two variables under consideration. Under the Spearman method, the correlation coefficients are calculated between the relative ranks of each value within each variable.

The sign of the correlation coefficient indicates the direction of the correlation. A positive estimate indicates that one variable increases as the second variable increases and vice-versa. A negative estimate indicates that one variable decreases as the second variable increases and vice-versa.

The absolute value of the correlation coefficient can range from zero to one (either positive or negative) with a value closer to one indicating a high degree of correlation. A value closer to zero indicates no or minimal correlation.

[27] The Pearson product-moment correlation coefficient (sometimes referred to as the PMCC), is a measure of the correlation (or linear dependence) between two variables X and Y, giving a value between +1 and −1 inclusive. It is widely used in the sciences as a measure of the strength of linear dependence between two variables. Spearman's rank correlation coefficient is a non-parametric measure of statistical dependence between two variables. It assesses how well the relationship between two variables can be described using a monotonic function. If there are no repeated data values, a perfect Spearman correlation of +1 or −1 occurs when each of the variables is a perfect monotone function of the other. The Spearman correlation coefficient is defined as the Pearson correlation coefficient between the ranked variables.

Table 2-28 and Table 2-29 show the results of the correlation analysis among the explanatory variables using the Pearson and Spearman methods, respectively. As expected, "total population" and "total households" are strongly positively correlated. Similarly, "median home value" and "median income" are also strongly positively correlated. In effect, one can choose to use only one of the variables in each pair for correlating with the solar capacity and installations variables.

Interestingly, there is medium level of negative correlation between the political preference variable (i.e., percent "No" on Proposition 23) and the quality of solar resource, indicating that voters in areas with relatively better quality of solar resource are less likely to support strong environmental protection policies.

The political preference variable exhibits a medium level of positive correlation with the median home value (and also median income) indicating that wealthier voters are more likely to support stronger environmental protection policies.

It should also be noted that the total households (or population variables) are either not correlated or only weakly correlated with the median home value (or income) and political preference variables.

Table 2-28: Correlation Analysis Results—Pearson Method

Pearson Correlation Coefficient	Average Annual GHI (W/m2)	Total population	Total households	Median Home Value	Median Income
Percent "No" on Proposition 23	-0.50	0.16	0.20	0.50	0.41
Average Annual GHI (W/m2)		Not Significant	Not Significant	-0.34	-0.20
Total Population			0.96	Not Significant	0.18
Total Households				0.11	0.25
Median Home Value					0.85

Table 2-29: Correlation Analysis Results—Spearman Method

Spearman Correlation Coefficient	Average Annual GHI (W/m2)	Total population	Total households	Median Home Value	Median Income
Percent "No" on Proposition 23	-0.46	0.19	0.21	0.56	0.43
Average Annual GHI (W/m2)		0.10	0.05	-0.37	-0.21
Total Population			0.98	0.18	0.35
Total Households				0.24	0.40
Median Home Value					0.87

Having gained an understanding of the correlation among the explanatory variables themselves, we may now assess the correlations of the explanatory variables with the total number of CSI GM system installations and installed capacity in each zip code.

An expected outcome of this analysis could be a strong positive correlation between installed capacity (or the number of installations) and the political preference variable, and installation and median home value (or income) variables. Voters preferring strong environmental protection policies might be expected to be more likely to install solar energy systems. Wealthier customers are more likely to be able to afford PV systems, which, despite ratepayer and federal government subsidies, are still relatively large financial investments.

Table 2-30 presents the results of the correlation analysis for installed capacity and number of installations using both the Pearson and Spearman methods. None of the correlation coefficients estimated using the Pearson method show a strong correlation (positive or negative) between any of the explanatory variables and the capacity (and installation) variable. The Spearman method does suggest that there is a medium level of positive correlation between median income and both installed capacity and number of installations. Similar level of positive correlation exists between the total number of households and the installed capacity.

The lack of strong positive correlation between the solar resource quality variable and the installed capacity would seem to indicate that PV system owners do not necessarily take advantage of solar resource appropriately or that there is insufficient benefit for them to take advantage of good solar resource. From a policy perspective, this may be an issue of concern.

Table 2-30: Correlation Analysis Results: Number of CSI GM PV Installations and Installed Capacity—Residential

Variable	Installed Capacity				Number of Installations			
	Pearson		Spearman		Pearson		Spearman	
	Coeff.	Statistically Significant	Coeff.	Statistically Significant	Coeff.	Statistically Significant	Coeff.	Statistically Significant
Percent "No" Vote on Prop 23	0.09	Yes	0.13	Yes	0.14	Yes	0.17	Yes
Average Annual GHI (W/m^2)	0.00	No	-0.02	No	-0.06	Yes	-0.05	Yes
Population	0.27	Yes	0.45	Yes	0.30	Yes	0.49	Yes
Number of Households	0.34	Yes	0.50	Yes	0.38	Yes	0.54	Yes
Median Home Value	0.32	Yes	0.42	Yes	0.32	Yes	0.45	Yes
Median Income	0.40	Yes	0.50	Yes	0.40	Yes	0.52	Yes

2.12 Overall Findings

Based on trends from the CSI GM and in comparison with other IOU public purpose solar PV programs in California, we make the following conclusions.

2.12.1 All Programs (ERP, SGIP, CSI GM, SASH, MASH, and NSHP)

- The total installed capacity of solar PV since 1998 is 705 MW (CEC-AC size rating) from a total of 72,475 installations.
- The costs (stated in capacity-weighted average inflation-adjusted or Real 2010 dollars per rated capacity in CEC PTC AC Watts—i.e., $/W) of PV systems have decreased by 47% from $14.1/W in 1998 to $7.5/W in 2010.
- Costs of residential installations have been consistently larger than that of non-residential installations; probably as a result of economies-of-scale. Within both residential and non-residential sectors, the costs of larger systems are consistently lower than smaller systems.
- Ideally, higher capacity should be installed in geographic regions with relatively better quality of solar resource as compared with regions having lower quality. However, the results of correlation analysis do not indicate such a relationship.

2.12.2 CSI GM Only

- Among all six programs that have provided incentives for solar PV systems, the CSI GM program accounts for the largest portion of systems (59%) and installed capacity (64%) followed by the SGIP (19% of installed capacity) and the ERP (16% of installed capacity).
- The average and median sizes of residential systems installed under the CSI GM program are larger than those installed under ERP, NSHP, and SASH.
- While PV systems receiving EPBB incentives make up the largest number of systems under the CSI GM, systems receiving PBI payments make up more than half the installed capacity of the CSI GM due to their larger capacities.
- The vast majority of the systems installed under the CSI GM at the end of 2009 were fixed systems; with a close split between tilted and near-flat mounting types.
- Overall, 16% of the CSI GM systems—accounting for 38% of the MW—were owned by third parties, indicating that larger systems were more likely to be owned by third parties, compared with smaller systems. However, the contrasting trends in residential versus non-residential systems suggest that third-party owners appear to be shifting their focus from non-residential to residential sector and to smaller systems.
- Consistently across all years and both customer sectors, as measured by either median or mean, PV system sizes in the CSI GM are substantially larger for third-party-owned systems as compared with customer owner systems.
- The top 10 module manufacturers in terms of market share within the CSI GM account for 86% of the number of installations and 83% of the total installed capacity. Overall, the top 10 manufacturers' share of the residential market which was greater than 95% in the first two years of CSI GM has fallen to 75% in 2010 indicating that the competition in the market is growing as new manufacturers continue to increase their share. From a high of 95% market share in 2007 for the top 10 manufacturers serving the non-residential section, the decrease to 69% is even more dramatic than in the residential sector.
- In contrast to the market of module manufacturing, the inverter manufacturing market within the CSI GM is much more consolidated with just five manufacturers accounting for 88% of the installations and 84% of the capacity. For the residential sector, there is not much movement among the top 4 inverter manufacturers with SMA, SunPower, and Fronius consistently maintaining their first, second, and third positions. For the non-residential sector, there is a substantial churn in the rankings among the top 5 manufacturers although SatCon has maintained its top rank consistently.
- From a technology perspective, the main module types deployed in the CSI GM are multi- and mono-crystalline silicon-based modules, which together account for approximately, 90% of the market share.

3

PV Performance Data Collection

This section describes the method of processing, collecting, and analyzing data on PV systems installed under the CSI GM program and SGIP. Among other purposes, the data are used in the 2010 CSI impact evaluation assessment of annual and peak electricity contributions.[1] PV performance data for systems installed under other programs as described in Section 2 (i.e., SASH, MASH, ERP, and NSHP) were not readily available.

3.1 Data Objectives

PV generation data were collected for systems that received incentives under the SGIP and CSI. They were processed and some were sampled with the objective of determining the following.

- **Overall PV System Impacts**
  - Peak-hour and -day energy production[2]
  - Annual energy production
  - GHG, NOx and PM-10 emission reductions
- **Comparisons**
  - Actual to expected system performance
  - Performance of different groups of systems
  - Performance trends over time for different groups of systems

[1] The primary purpose of this evaluation was to assess the impacts of the CSI GM during 2010. This includes not only PV systems installed during calendar year 2010, but also those systems that have been installed since the program's inception in 2007 and operational by the end of 2010. A secondary evaluation purpose was to provide an "overall report card" on the progress of PV systems installed in California over the past decade. For this reason, SGIP PV system data were included in the assessment. Since data from other program incenting PV systems were not readily available, we simulated PV performance for these systems. However, we present results for programs without metered data separately.

[2] Generation during the CAISO peak was targeted for sampling for 90/10 confidence. The single-hour metric was chosen because of its importance in assessing statewide peak demand. In addition, the single peak- hour shows more variation that annual generation, which enables it to be a better statistical test metric.

3.2 Data Sources for Metered Systems

PV generation data were collected from several third parties as well as directly from meters installed specifically for CSI and SGIP measurement and evaluation (M&E) purposes. A list of data sources is provided below. The list of data sources is followed by a summary of PV system characteristics for which metered electricity generation data were available.

3.2.1 Data Sources

Data for CSI GM systems were collected from multiple sources that can be classified as one of the following:

- **Performance Data Providers (PDP),** which provide data to the PAs for PBI payment calculation (PBI PDP),
- **Performance Monitoring Reporting Services (PMRS),** which provide data to host customers on EPBB systems requiring monitoring[3] (EPBB PMRS),
- **EPBB-Exempt System Service Providers,** which provide data on systems that have non-required PV monitoring systems[4] (EPBB exempt), and
- **Itron Meters,** which were installed at randomly selected sites in the latter part of 2010 to provide a statistically significant random sample of CSI systems beyond that available from EPBB system data sources.[5]

[3] EPBB systems less than 30 kW are exempt from metering if they show that metering would cost more than 1% of the system cost. Under current CSI rules, systems over 30 kW are required to receive PBI payments and therefore must be metered. Previously, EPBB systems over 30 kW had a cost limit for metering of 0.5% of system cost.

[4] Ibid.

[5] Relatively few of these meters were in place outside of PG&E territory for the CAISO peak on August 25, 2010.

Data for PV systems installed under the SGIP were provided by third parties and meters installed specifically for SGIP M&E purposes. Table 3-1 presents summarizes the data available at the end of 2010 from these types of data providers.

Table 3-1: Data Sources for Metered CSI GM and SGIP PV Systems

Data Source	Number of Systems		Capacity of Systems	
	(N)	(%)	(MW)	(%)
CSI GM - PBI PDP	916	14.3%	180	62.3%
CSI GM - EPBB PMRS	1,622	25.3%	9	3.2%
CSI GM – EPBB-Exempt	3,017	47.0%	24	8.2%
CSI GM - Itron Meters	449	7.0%	3	0.9%
SGIP - All	418	6.5%	74	25.4%
Total	**6,422**	**100.0%**	**290**	**100.0%**

It is notable that almost half of the generation data for analysis (by site count) came from EPBB-exempt data providers. This is significant because generation data are not required from EPBB-exempt systems. The EPBB-exempt data and the other metered data were valuable in providing accurate estimates of the total generation provided by the installed SGIP and CSI systems.

3.3 Characteristics of Metered Systems

As of December 31, 2010, over 43,000 CSI GM and SGIP PV systems were considered "complete" or "active on-line" systems.[6] These systems represent over 592 MW (CEC PTC AC System Rating) of rebated CSI and SGIP system capacity.[7] Metered data were available from a subset of 6,422 of these active on-line systems for analysis.

While the CSI GM provides both performance-based and estimated performance-based incentives (PBI and EPBB, respectively), the SGIP provided only lump-sum capacity-based incentives for PV systems. Table 3-2 provides a summary of metered systems by incentive type and the distribution as a percent of the obtained metered data.

[6] Complete systems means the PV system has been installed, verified through on-site inspections, and an incentive check has been issued. All complete projects are considered as "on-line" projects for impact evaluation purposes. Active on-line systems are those that have entered normal operations (i.e., projects are through the "shakedown" or testing phase and are expected to provide energy on a relatively consistent basis).

[7] Rebated capacity refers to the rating associated with the rebate (incentive) provided to the program participant. The rebated capacity may be lower than the typical "nameplate" rating of the system.

Table 3-2: Incentive Types for Metered CSI GM and SGIP PV Systems

Incentive Type	Number of Systems			Capacity of Systems		
	(N)	(% of Metered)	(Metered as a % of Population)	(MW)	(% of Metered)	(Metered as a % of Population)
CSI GM EPBB	5,088	79.2%	12.5%	223	38.9%	16.0%
CSI GM PBI	916	14.3%	82.4%	215	37.5%	83.9%
SGIP	418	6.5%	47.0%	136	23.7%	54.1%
Total	**6,422**	**100.0%**	**15.1%**	**574**	**100.0%**	**50.5%**

Over 85% of metered systems received single-payment incentives (i.e., CSI GM EPBB and SGIP) and accounted for almost 65% of the capacity. As metering is required for PBI systems, it might seem odd that Table 3-2 shows only 82% of the PBI systems as metered. This is explained by the two- to three-month lag between the initiation of the system operation (approximately when the incentive claim form is filed) and when data become available.

3.4 Data Types, Availability over Time, and Sampling

Data for the three incentive types varied widely in availability and were treated in different ways according to that availability. One of the largest issues involved obtaining statistically valid samples for the CSI GM EPBB sites. As indicated earlier, EPBB-exempt sites are not required to install metering or provide metering data. A significant number of EPBB sites were listed as EPBB-exempt sites during 2008 through 2010. Due to the lack of metered data for EPBB sites, Itron was directed to install approximately 500 meters on randomly selected unmetered systems. Itron installed these metering systems between June 2010 and February 2011, with most being installed in the fall and winter of 2010. Due to the timing of the meter installations, only a small fraction of Itron-metered data was available for the 2010 CAISO summer peak. As a result, it was not possible to conduct random sampling from the population for CSI GM EPBB systems in 2010. Instead, we pursued a different sampling approach for sampling of EPBB systems as described below.

3.4.1 CSI GM EPBB Sampling

EPBB data for the 2010 evaluation were limited to what was provided by third-party data providers. As such, this left us with a sample of convenience rather than a random sample. We employed stratified random sampling of data from the four largest third-party data providers of the EPBB systems to minimize potential bias. In addition, we added the PV generation data that had been collected from Itron meters and validated.

The resulting sample frame was further limited to available data from third parties rather than sampling from the population of EPBB data providers as a whole. Given the substantial increase in the total number of systems with available data since 2009, it would have been prohibitively expensive to validate data for every metered system as was done in previous CSI impact evaluations. Furthermore, use of data from all metered EPBB systems would have introduced potential bias due to the different amounts of data available from the different providers.[8]

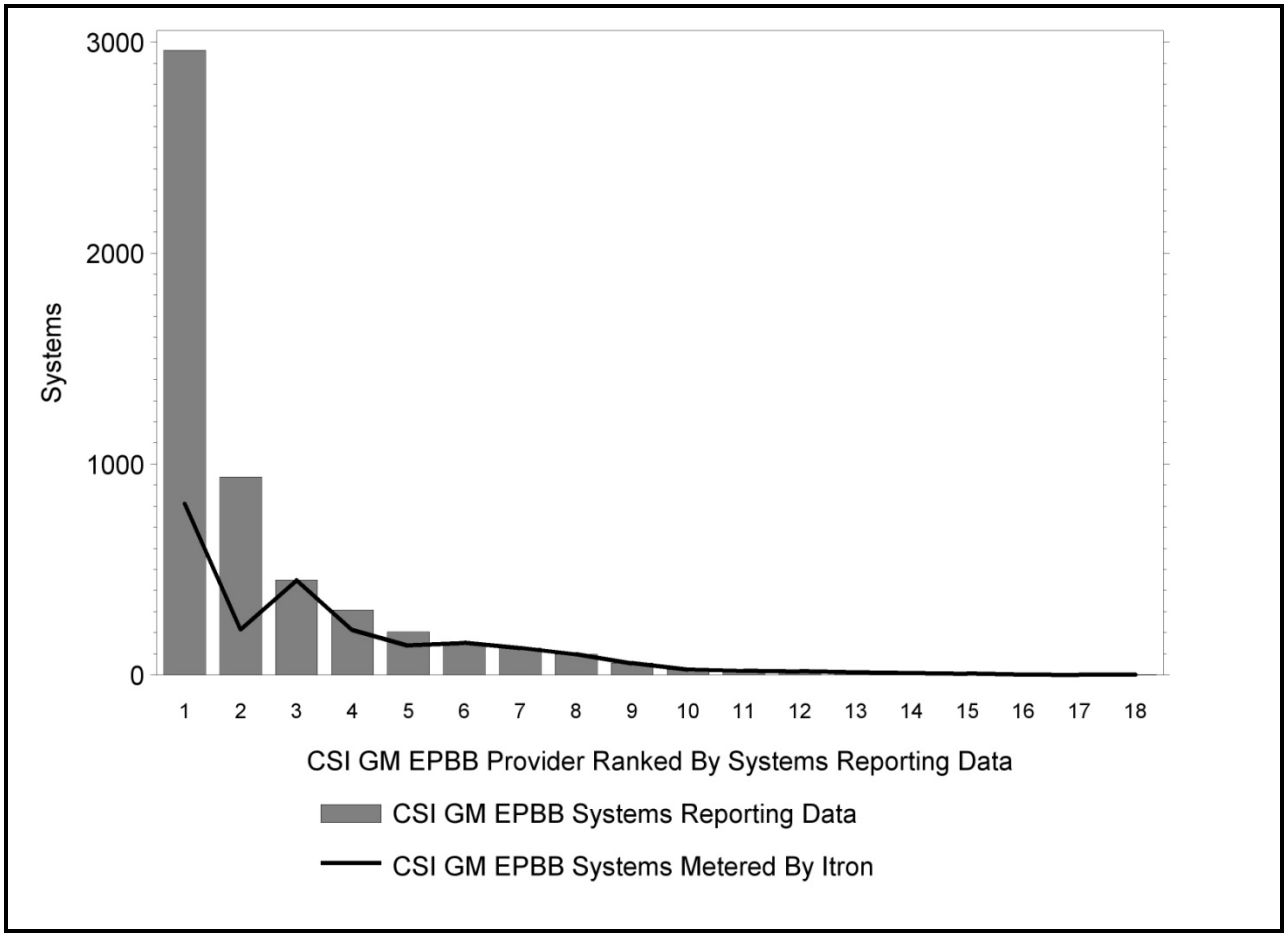
Figure 3-1 shows the availability of metered data by data provider, as well as the amount of the data that was validated and used in this analysis. The bars reflect the number of EPBB sites reporting data from each data provider. The line refers to the number of sites for which Itron had installed meters and was collecting data.

Available and Validated data are defined as follows:

- **Available Data**: Data that were available to Itron and processed to a common format.
- **Validated Data**: Available data that were further processed by Itron and passed quality control. This validation provides a higher level of confidence that data are reasonable and are matched to the system indicated. The validation process excludes outliers where, for example, a 5 kW system consistently reports at 500 kW, indicating a mismatch between the interval data and system information.

[8] One data provider accounted for roughly 95% of the metered data, but only represented approximately 20% of the population for certain strata.

Figure 3-1: CSI GM EPBB Systems—Available and Validated Metered Data by Provider[9]



Sampling for the four larger CSI GM EPBB data providers was done using the following stratification variables to define an individual stratum:[10]

1. Program Administrator,
2. Configuration (near flat (<20°), tilted (≥20°), tracking),
3. Locale (inland, coastal),
4. Program and incentive type (CSI GM residential and small commercial (<10kW) EPBB, CSI GM residential and small commercial (<10kW) PBI, CSI GM large commercial (≥10 kW) EPBB, CSI GM large commercial (≥10 kW) PBI, SGIP >300 kW, SGIP ≤300 kW) (note that sampling was only done for EPBB systems),

[9] For evaluation reporting purposes, data providers are not named. Numbers indicate ranking of providers by number of CSI GM EPBB systems for which each provides data.

[10] These are the same strata used in the ratio estimation described in Section 6.

5. Installation year group[11] (2002-2004, 2005-2007, 2008-2010), and
6. Year of installation.

Each system may belong to only one fully defined stratum as defined by each of the six stratification variables. There are conceivably 2,916[12] unique strata based on a full factorial of all six stratification variables. However, only 357 unique strata have systems identified within them. Quotas for random sampling from these four providers were based on the sampling approach for stratified ratio estimation presented in the *California Evaluation Framework*,[13] using the measure of the variability between peak hour energy production and rated CEC PTC AC capacity as error ratio. In other words, for this analysis the error ratio is essentially a measure of how well the system capacity will predict the system's peak hour energy production. Historical data for 2009 were used to estimate error ratios for 2010. This method is only recommended when a large sample (approximately $n \geq 25$) is expected.

Figure 3-2 provides an example to help illustrate this approach. It shows the 2010 CAISO peak hour net generation versus system capacity for the stratum identified by:

- Program Administrator: PG&E,
- PV configuration: fixed tilted,
- Local: coastal,
- Program and incentive: CSI residential and small commercial (<10 kW) EPBB,
- Installation year group: 2008-2010, and
- Year of installation: 2009.

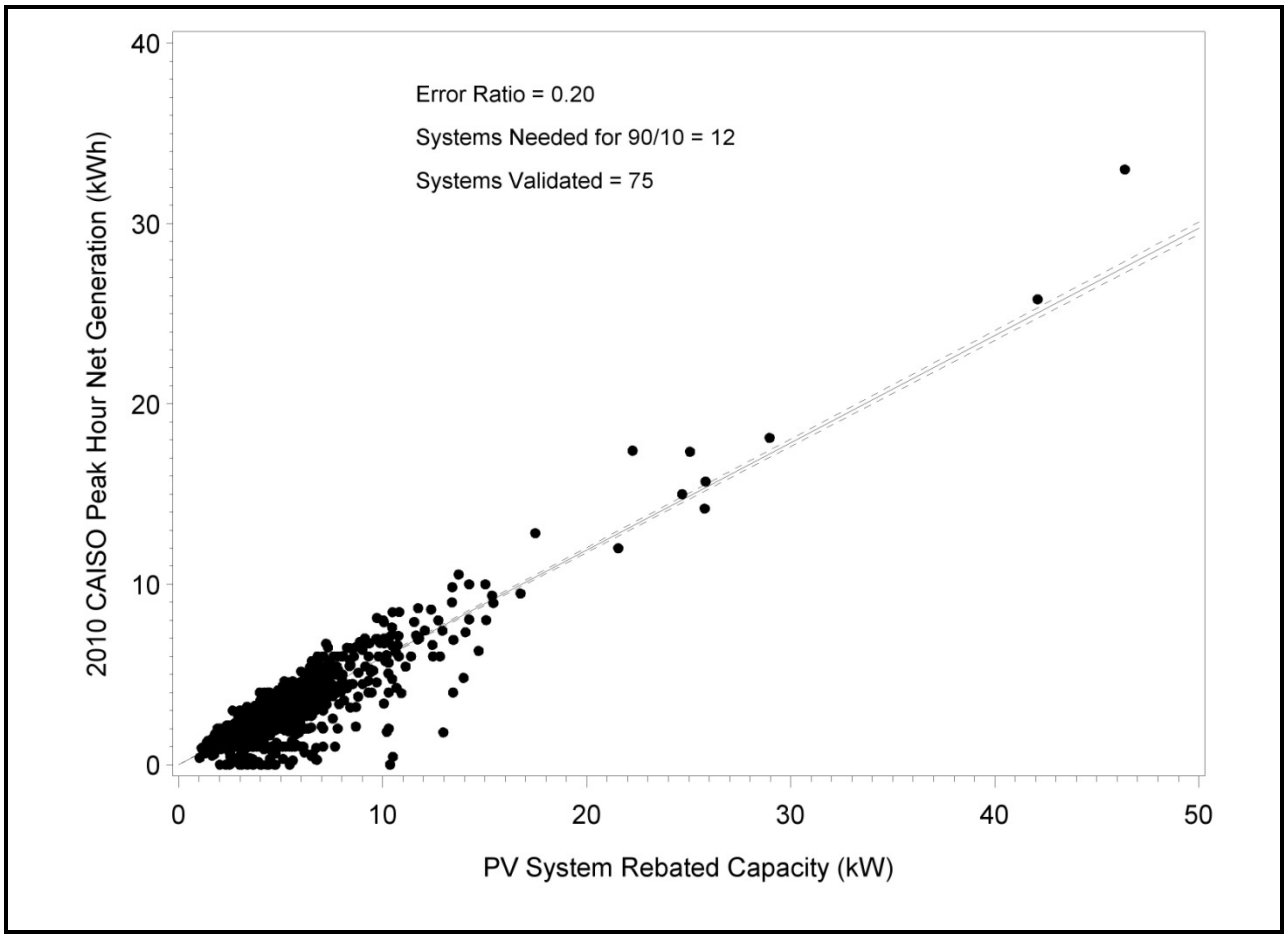
[11] "Installation Year Group" refers to a grouping of systems by three successive years of installation, as opposed to "Year of Installation," which is when the system was actually installed.

[12] Three program administrators × three configurations × two locales × six programs and incentives ×three installation year groups × nine installation years.

[13] http://www.calmac.org/publications/California_Evaluation_Framework_June_2004.pdf, Chapter 13.

Figure 3-2 also shows the linear fit line, the slope of which represents the peak hour capacity factor (0.59) for this particular stratum.

Figure 3-2: 2010 CAISO Peak Hour Net Generation (v) PV System Rebated Capacity*



* Error ratio for stratum: PG&E, Tilted Fixed, Coastal, CSI Residential and Small Commercial (<10 kW) EPBB, 2008-2010, 2009.

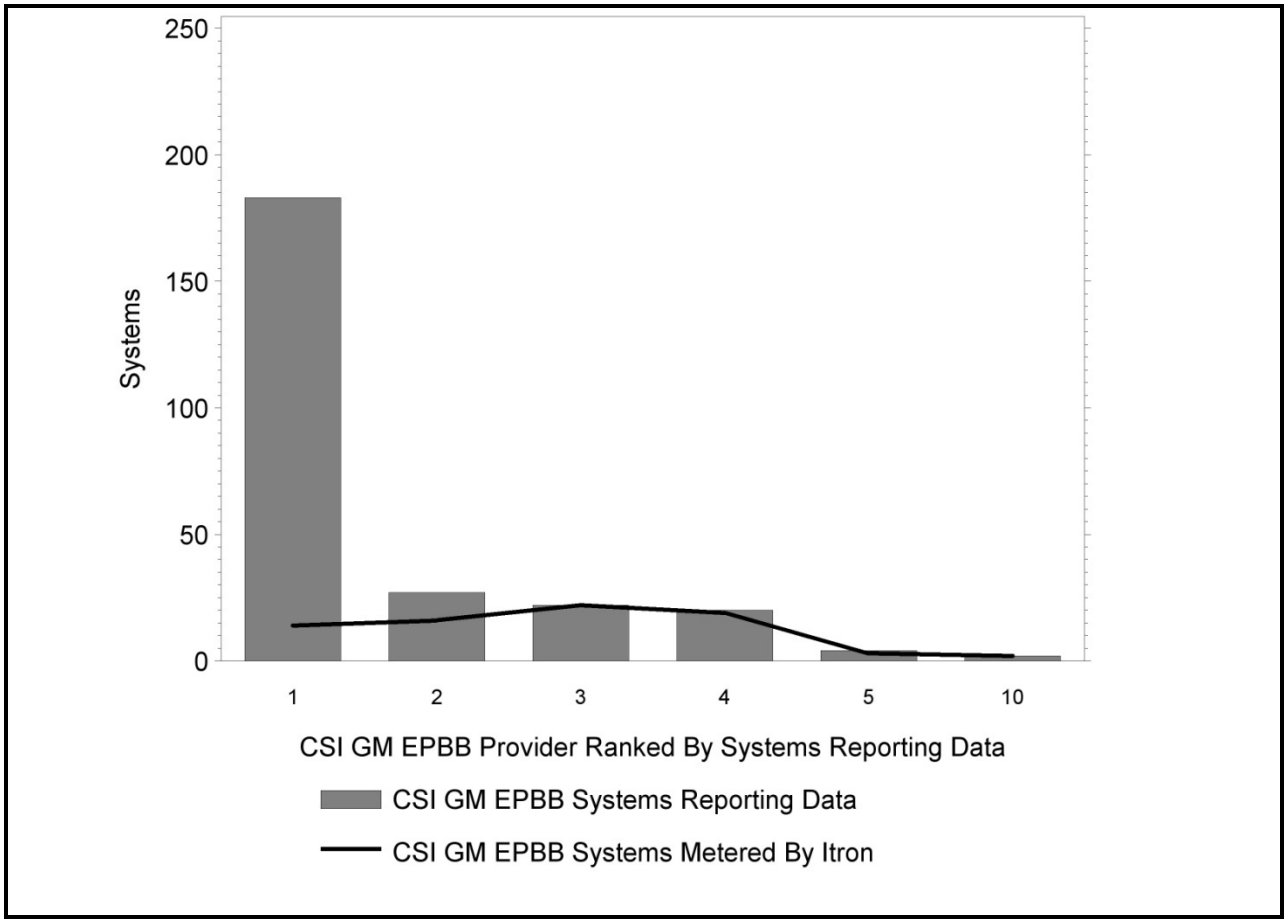
The error ratio associated with this stratum is 0.20, which means that the rebated capacity is a good linear fit to the peak hour generation.[14] This error ratio suggests that a sample size of only 12 systems would be sufficient to achieve a 90% confidence interval and 10% level of precision. Nearly all strata defined uniquely by the permutations of all six strata variables in this analysis have an error ratio below 0.4, which means that 25 or fewer systems would be needed for 90/10 confidence of CAISO peak hour generation. If a provider reported data for less than 25 systems

[14] From a very simplistic perspective, an error ratio of 0 would indicate an exact linear fit, while an error ratio of 1 billion would indicate no such fit.

within a stratum, all of those systems were selected for validation.[15] As mentioned earlier, we also limited the number of sites for which we processed and validated data as processing data for all sites would be cost prohibitive and would introduce bias.

Figure 3-3 shows the availability of metered data by data provider for the example stratum used in Figure 3-2.

Figure 3-3: Available and Validated Metered Data by Provider for Stratum PG&E, Tilted Fixed, CSI Residential and Small Commercial (<10 kW) EPBB, 2008-2010, 2009



[15] In cases when there were less than two metered systems in a specific stratum, estimates were calculated at the next higher stratum level. For example, if it was not possible to match strata all the way down to the year of installation (progressing through the above list of characteristics used to define strata), estimates were calculated at the installation vintage level. See Section 6 for a more detailed discussion of this topic.

In this example stratum:

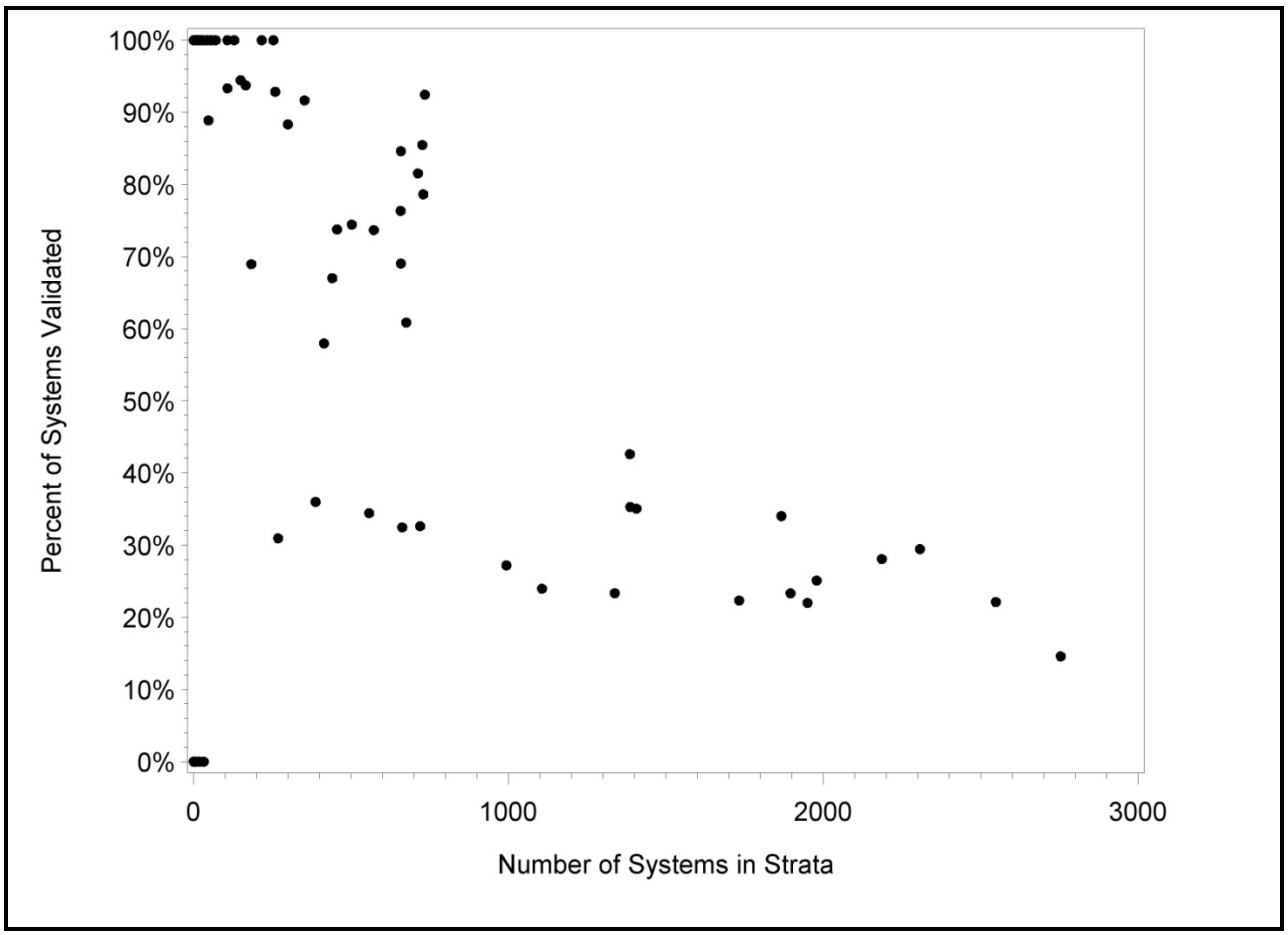
- There were 2307 PV systems overall,
- Data for 258 systems were received,
- Data for 75 systems were validated, and
- The provider labeled "1" reported data for 183 systems (70% of the data received) but only represented 9% of the population in the stratum.

This particular stratum was chosen as an example to show how we used a limited number of the sites reporting data in order to prevent bias. In this example, data provider 1 was reporting data from 183 sites, well above the 25 sites needed for sampling. Even though data provider 1 had additional sites from which we could process data, we chose to limit the amount of data we used form data provider "1" to minimize possible bias. For example, assume that data provider 1 is not only a data provider, but also a PV system installer[16] who does an incredibly great job when installing PV systems (e.g., they may have used larger diameter wiring, taken more care to match panel performance within the array to minimize mismatch, or taken significant steps to ensure that the array has minimal shading). If the PV performance data from data provider 1 is not typical of the PV performance data being supplied by other data providers, and if we had used more data from data provider 1 because it was available, we would have then introduced bias into the sample. By limiting the data processed per installer or manufacturer, this potential for bias should be reduced within each stratum, but not as well as in a truly random stratified sample drawn from the population.

Not all strata were as affected as this particular stratum. Larger strata were much more likely to have data limited by provider as shown in Figure 3-4. Note that the percent of systems validated is generally larger (i.e., in some instances ranging from 60% up to 100%) when the number of sites in the strata is below 1,000. When the number of sites in the strata goes above 1,500, the percentage of systems validated tends to range from 15% to 45%.

[16] Within the CSI GM, data providers are allowed to also install systems and there are a number of instances where the data providers are, in fact, system installers.

Figure 3-4: CSI GM EPBB Data Processed by Strata Size

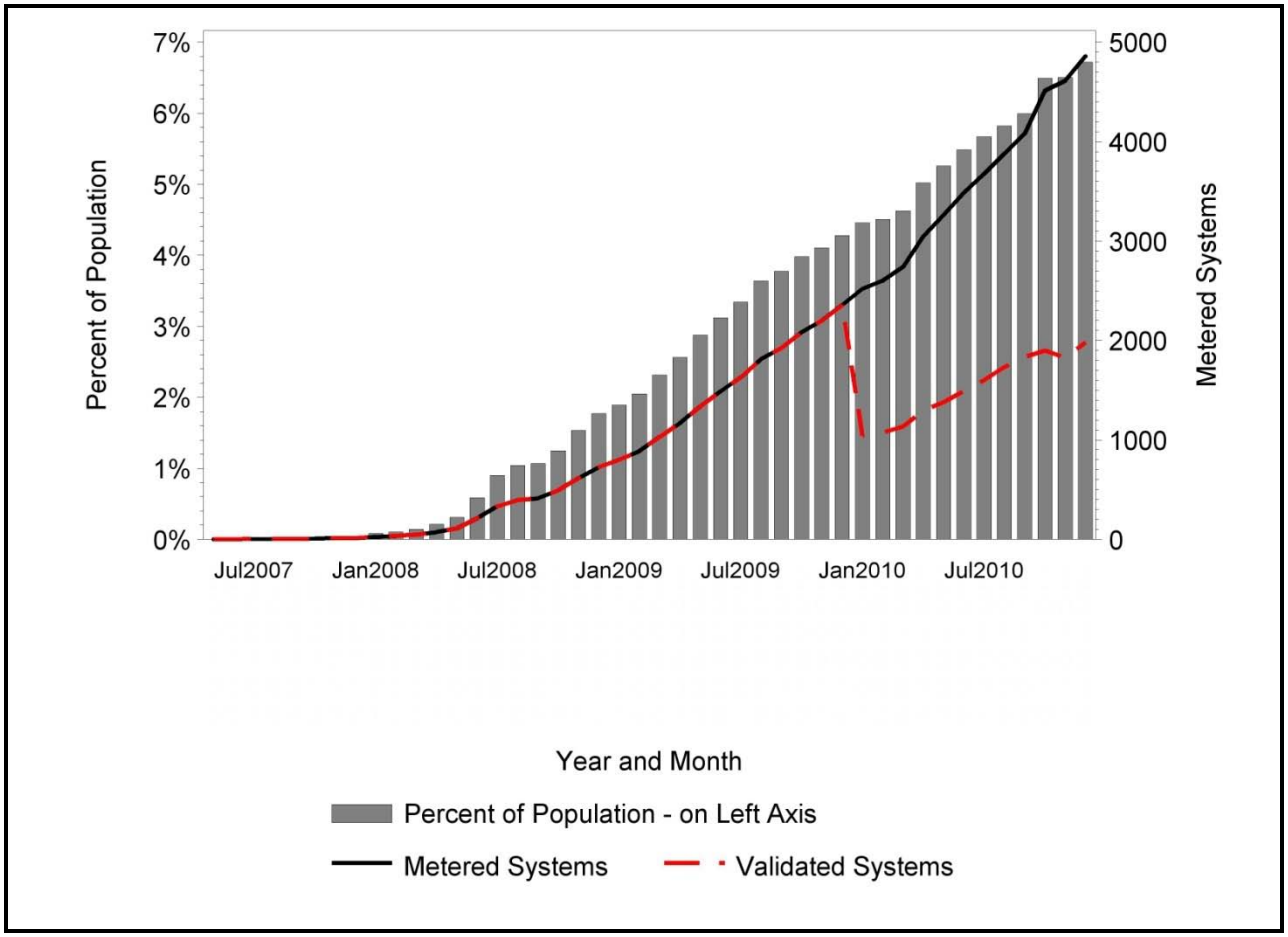


There were a number of strata containing very few systems (less than 10) and which had no available data. These were primarily strata identified by the PV configuration variable of 'Tracking.' An example would be the strata SCE, Tracking, Coastal, Residential and Small Commercial (<10 KW), EPBB; Year Group 2005-2007; Year 2007 with only a single (unmetered) system. Performance of PV systems in these strata was estimated using the methods outlined in Section 6.

3.4.2 CSI GM EPBB Data

CSI GM systems that receive an EPBB incentive are required to be metered unless it is shown that the cost of metering exceeds a prescribed percentage of systems cost. This cost cap exemption means that only a small percentage of CSI GM EPBB systems will have performance data available and these systems may be subject to self-selection bias. Figure 3-5 displays the availability of metered data for CSI GM EPBB systems. It shows the effect of sampling on the number of systems with validated data (data is only validated for sampled systems). This method of sampling began with the 2010 impact evaluation in January 2010.

Figure 3-5: CSI GM EPBB Data Availability



The percentage and availability of data for CSI GM EPBB systems are, very different (and substantially less) than that for CSI GM PBI systems.[17] However, the trend indicates a steady movement toward having more metered data available for EPBB systems. As Figure 3-5 illustrates, toward the middle of 2008 and through 2009 and 2010, the availability of metered data increased dramatically for CSI GM EPBB systems. This corresponds with the increase in

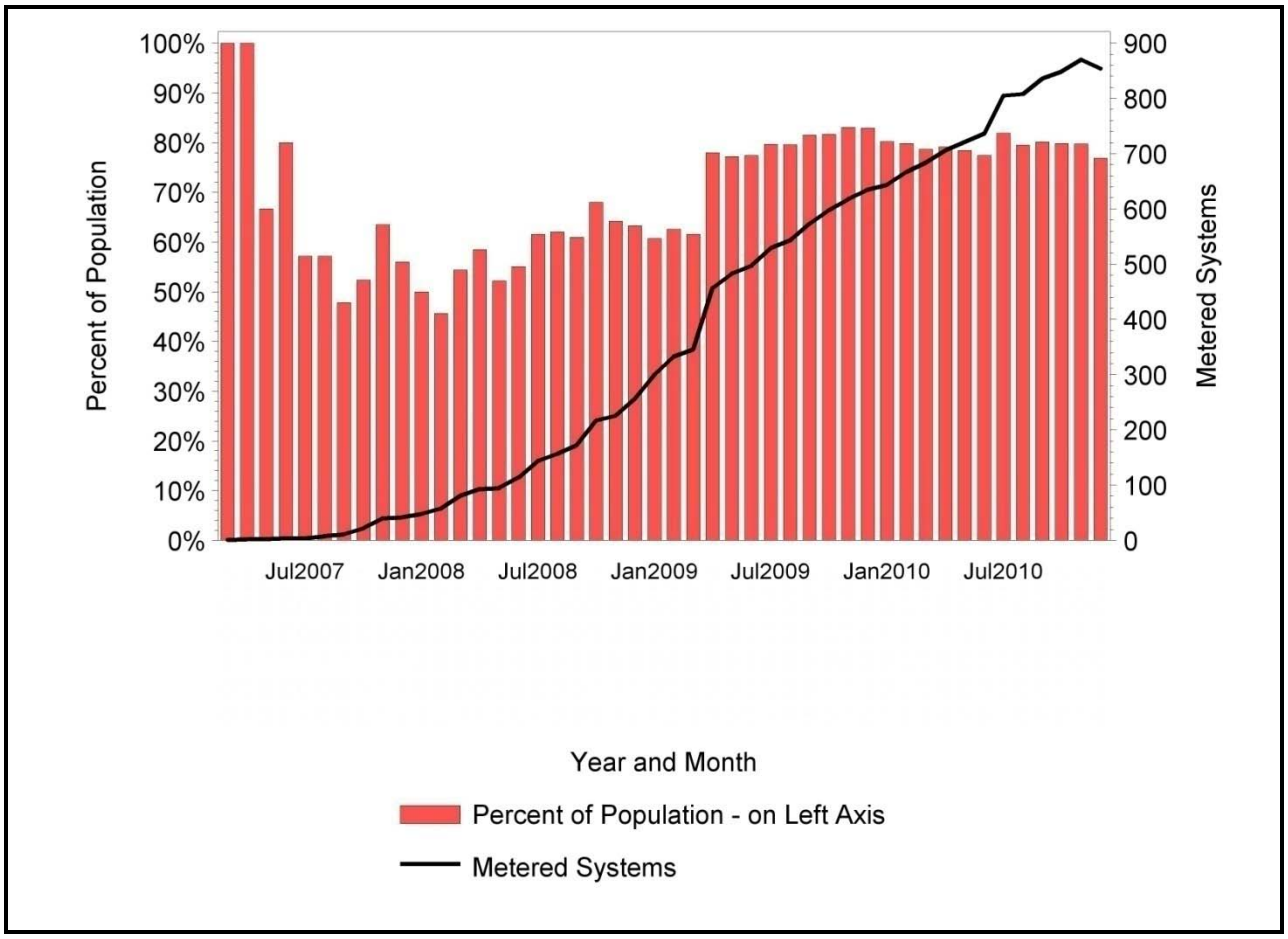
[17] This is expected given that metering is required to receive a PBI.

installed metered systems during this time for EPBB systems and the availability of data from solar firms providing monitoring services for EPBB-exempt systems.

3.4.3 CSI GM PBI Data

Systems receiving a PBI are required to transmit performance data to the respective PA. Therefore, data should be available for PBI systems once metering is operational. All data for CSI GM PBI systems were validated. The availability of metered data for CSI GM systems that received a PBI over time and as a percentage of installed systems is shown in Figure 3-6.

Figure 3-6: CSI GM PBI Data Availability

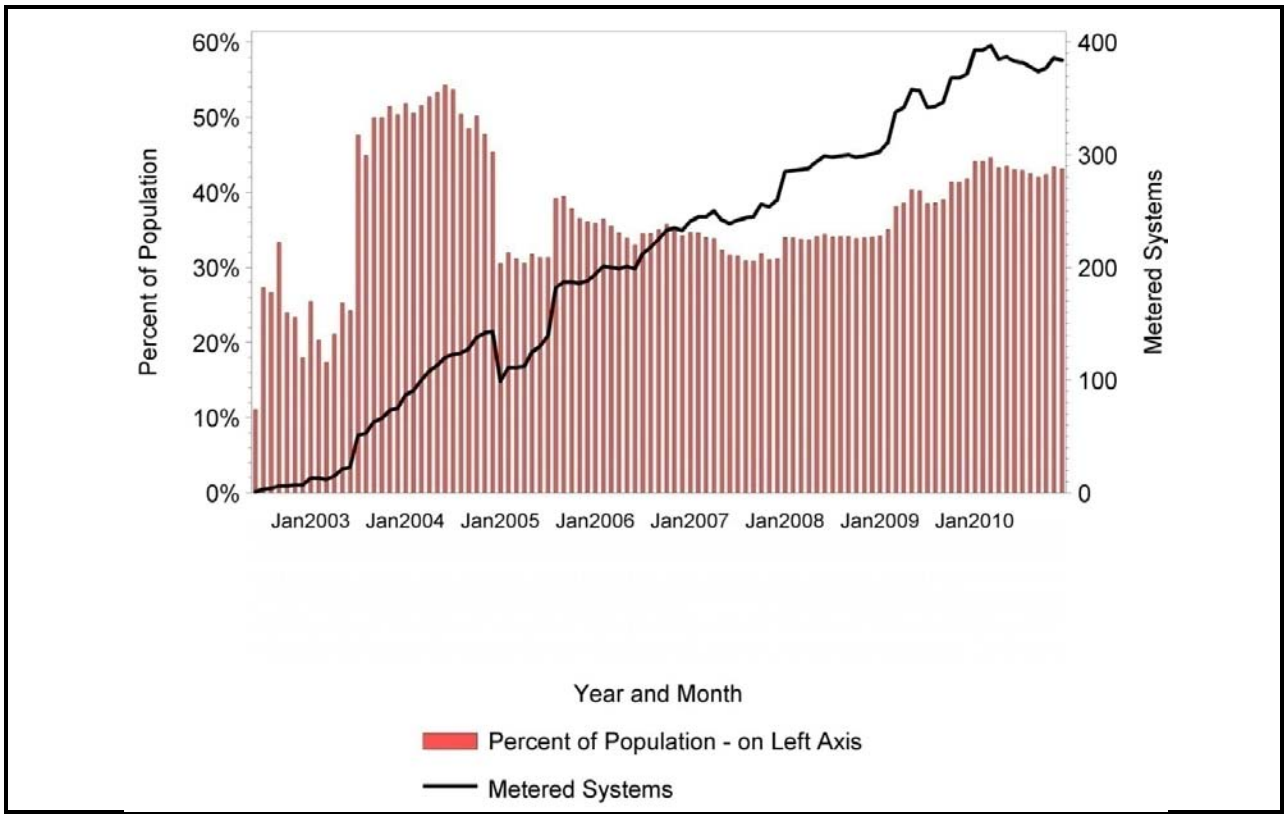


Data were available for approximately 80% of all PBI systems installed by December 31, 2010. As discussed above, the primary reason data were not available for 100% of these systems is the time lag between initiation of system operation (approximately when the incentive claim form is filed) and when data become available. Additionally, interval data contained numerous gaps. This was especially true before mid-2009 when most providers were only transmitting cumulative data to PAs and manually sending interval data to the evaluation team. As 80% is still very close to a census, no sampling was done for this category of systems.

3.4.4 SGIP PV System Data

Performance data for SGIP PV systems were collected from a variety of sources including meters installed by host customers, applicants, and third parties[18] and meters that Itron installed on SGIP systems under the direction of the PAs as part of program M&E activities.[19] Data were available for approximately 45% of all SGIP PV systems, and all available data from the total 418 existing meters were validated. Note that data for every metered system were not always available due to communication problems, equipment failures, and similar problems, meaning the total number of systems with data for any single month were often less than 418. Overall availability of metered data over time and as a percentage of installed systems is summarized in Figure 3-7 for SGIP systems. In December 2010, approximately 390 metered systems provided data, representing approximately 58 % of all installed SGIP PV systems.

Figure 3-7: SGIP PV System Data Availability



[18] As defined by the SGIP, the host customer is the SGIP incentive reservation holder. The host customer may also be the applicant and/or system owner. The SGIP applicant is defined as the entity responsible for completion and submission of the SGIP application and the main point of contact with the PA. The applicant may be the host customer, the system owner, or a third party designated by the host customer.

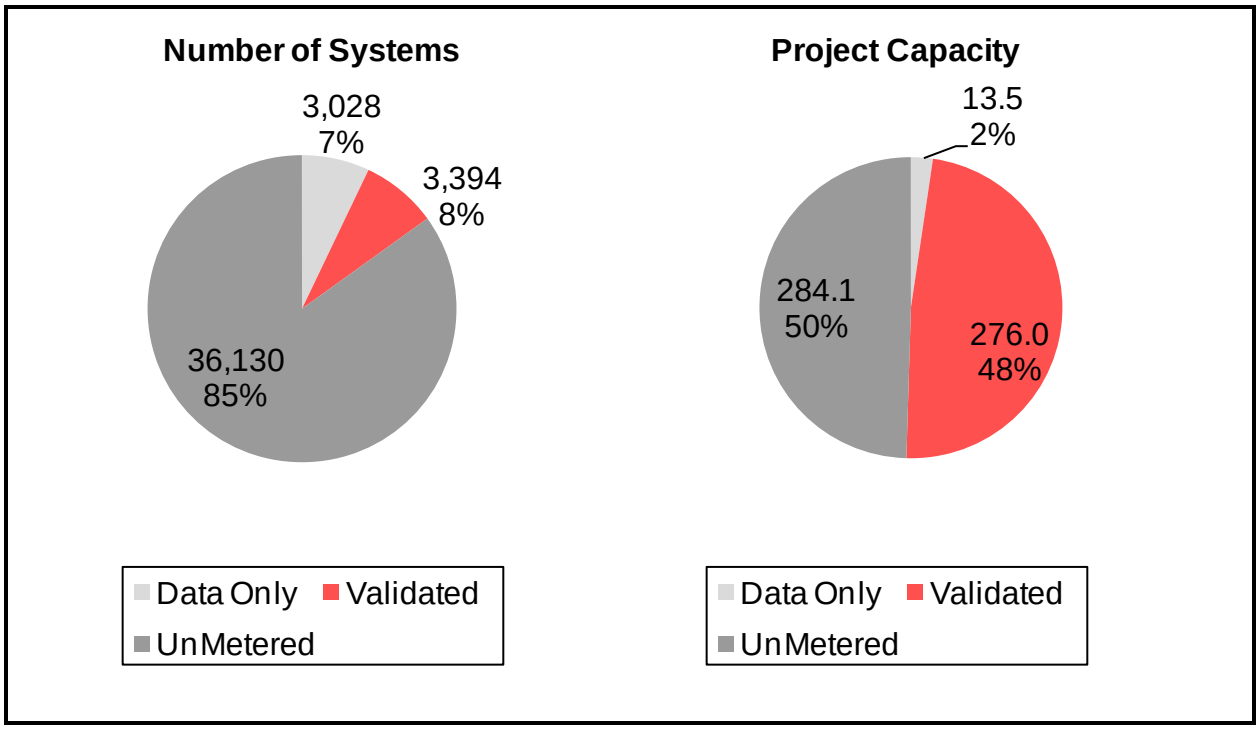
[19] Itron's meter installation activities were designed to enable achievement of 90/10 accuracy for unbiased estimates of total strata-level peak hour performance. Through December 31, 2010, this effort had yielded installation of electric metering for 173 systems of the total of 418 metered systems (~41%) that are currently operational.

3.5 Summary

The status of metered energy output data availability as a percent of the total PV systems installed under the CSI GM program and the SGIP is summarized in Figure 3-8. Three categories are shown in this figure:

- Unmetered – systems that had no metered data available,
- Validated – systems that reported interval data which were processed and validated for use in analysis, and
- Data only – systems that reported interval data that were processed but NOT validated and therefore not used in the analysis as described in Section 3.4.

Figure 3-8: Data Availability for CSI GM and SGIP PV Systems by Number and Capacity



Similar information, along with sampling descriptions, is shown by incentive type in tabular form in Table 3-3.

Table 3-3: CSI GM and SGIP PV System Data by Incentive Type, Validation Status, and Population Total

Type of Incentive	Sampling	Systems With Data (N)	Systems With Validated Data (N)	Population		
				Systems (N)	Capacity (MW)	% of Total Capacity
CSI GM EPBB	Sampled from available data	5,088	2,060	40,552	222.9	38.9%
CSI GM PBI	Near census	916	916	1,111	215.0	37.5%
SGIP	Stratified random sample	418	418	890	135.8	23.7%
Total	**Mixed per above**	**6,422**	**3,394**	**42,553**	**573.7**	**100.0%**

Of the 42,553 PV systems installed under the SGIP and CSI GM program, 15% (or 6,422 systems) had metered data available at the end of 2010. This represented slightly more than 50% (or 290 MW) of the total installed capacity of 574 MW. Validated data were available for approximately 53% of systems with available data, which represents approximately 8% of the total population of systems.

The dataset for CSI GM EPBB systems was the only dataset sampled from anything less than the population as a whole. These systems represented less than 39% of the total number of PV systems installed under the CSI GM and SGIP through December 31, 2010. In future CSI impact evaluations, the randomly selected sites with Itron-installed meters will allow for a more random sample selection of CSI GM EPBB sites. Section 6 describes how the data discussed in this section were used to estimate population level impacts.

4

PV Performance Results

Section 3 provided information on the approach of processing, collecting, and analyzing data on PV systems for use in the 2010 Impact Evaluation. This section provides the results of the processed and analyzed PV data. We first examine how PV performance results based on metered data compare to expected values used in PowerClerk. Secondly, we investigate differences in metered values obtained from metering systems installed by the host site, the PV system installer or third parties; and values obtained from metering systems installed by Itron in parallel to the other metering systems. Parallel metering allows us to check or validate the metered values being used by PAs to make performance payments under the Performance-Based Incentive (PBI) structure. Lastly, we explore the extent to which additions or changes in PV generation capacity at a site may affect the metered values relative to the values contained in PowerClerk. In addition, considering capacity additions or changes that occur outside of PowerClerk may shed some light on the extent to which utility customers are adding PV capacity with and without the use of incentives.

4.1 Expected and Metered PV Performance Results

The expected annual average output of CSI GM systems is currently calculated during the incentive application process.[1] These expected average outputs are used to establish incentive payments for Expected Performance-Based Buy-down (EPBB) systems and help PAs to plan payments for PBI systems. SGIP systems did not calculate an expected annual output so are not included in this analysis.

One way to assess actual performance of installed systems is to compare capacity factors based on metered data to expected annual capacity factors. While this comparison is a meaningful cross-check, it is subject to the limitation that information of expected performance pertains to average performance over a 12-month period. Information regarding expected performance during any individual part of the year is not available. In the context of these individual year comparisons, expected performance encompasses a range bounding the average expected performance.

[1] This is done using http://www.csi-epbb.com that runs the PVWatts simulation with a simplified set of assumptions.

To perform this comparison, we chose to compare metered versus estimated annual capacity factors for the same installed systems. We followed the following steps to derive an annual capacity factor for the metered systems:

- Identified the CSI systems for which metered interval data were available for 90% or more of the days in 2010. This eliminated potential bias caused by more solar production in the summer months versus the winter months. Limiting the data in this way reduced the sample of metered systems to 880 EPBB systems and 586 systems that received a PBI payment.
- Calculated an expected annual capacity factor for each site. We did this by dividing the expected annual production reported in PowerClerk by installed capacity by 8,760 (i.e., the number of hours in one year).
- Reviewed the expected capacity factors and eliminated outliers by excluding capacity factors over 0.3 and under 0.11. We viewed these outliers as likely to be erroneous.
- Excluded large systems initially rebated under SGIP that transitioned to the CSI program. These systems do not have accurate data for expected capacity factors.
- Calculated an actual capacity factor for each site by summing the energy produced and dividing by the product of rated AC capacity, days of data, and 24 hours in a day.
- Estimated a 90% confidence limit based on the weighted average capacity factor. For metered performance the 90% confidence limit is based on the on standard error of capacity factors. For

TOP 3 REASONS TO MONITOR PERFORMANCE OF PV SYSTEMS:

Owner Perspective

1. *Early fault detection and minimizing down time of system to maximize investment.*
2. *Comparing system historic performance or weather data to detect degradation otherwise not perceptible as complete shut down*
3. *Understanding the net metered utility bills with a better idea of PV production information to offset consumption.*

TOP 3 REASONS TO MONITOR PERFORMANCE OF PV SYSTEMS:

Program Perspective

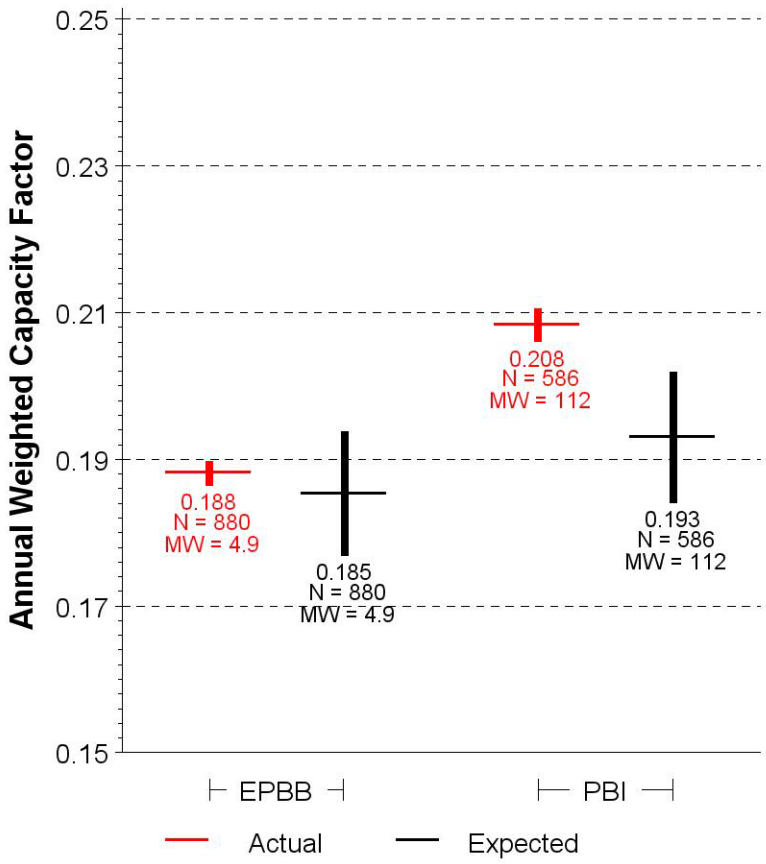
1. *Is the program meeting its objective of using incentives to encourage optimal system performance?*
2. *To what extent are solar systems connected to the electrical grid contributing to peak load and greenhouse gas reductions*

3. *How does solar system performance vary geographically?*

the expected performance, this confidence limit is based on the standard error of estimated capacity factors with an additional 4% buffer to account for expected year-to-year solar insolation variation.[2]

Figure 4-1 shows the actual and expected weighted annual capacity factors for 2010 by incentive type.

Figure 4-1: Metered vs. Expected Annual Capacity Factors by Incentive Type



Similar to 2009,[3] PBI systems delivered more energy than expected, showing capacity factors of 0.208 versus 0.193; a difference of 7.8%. EPBB systems slightly outperformed the expected results, showing capacity factors of 0.188 versus 0.185; a difference of 1.6%. One potential explanation for this overproduction would be sunnier weather (i.e., more insolation) in both 2009

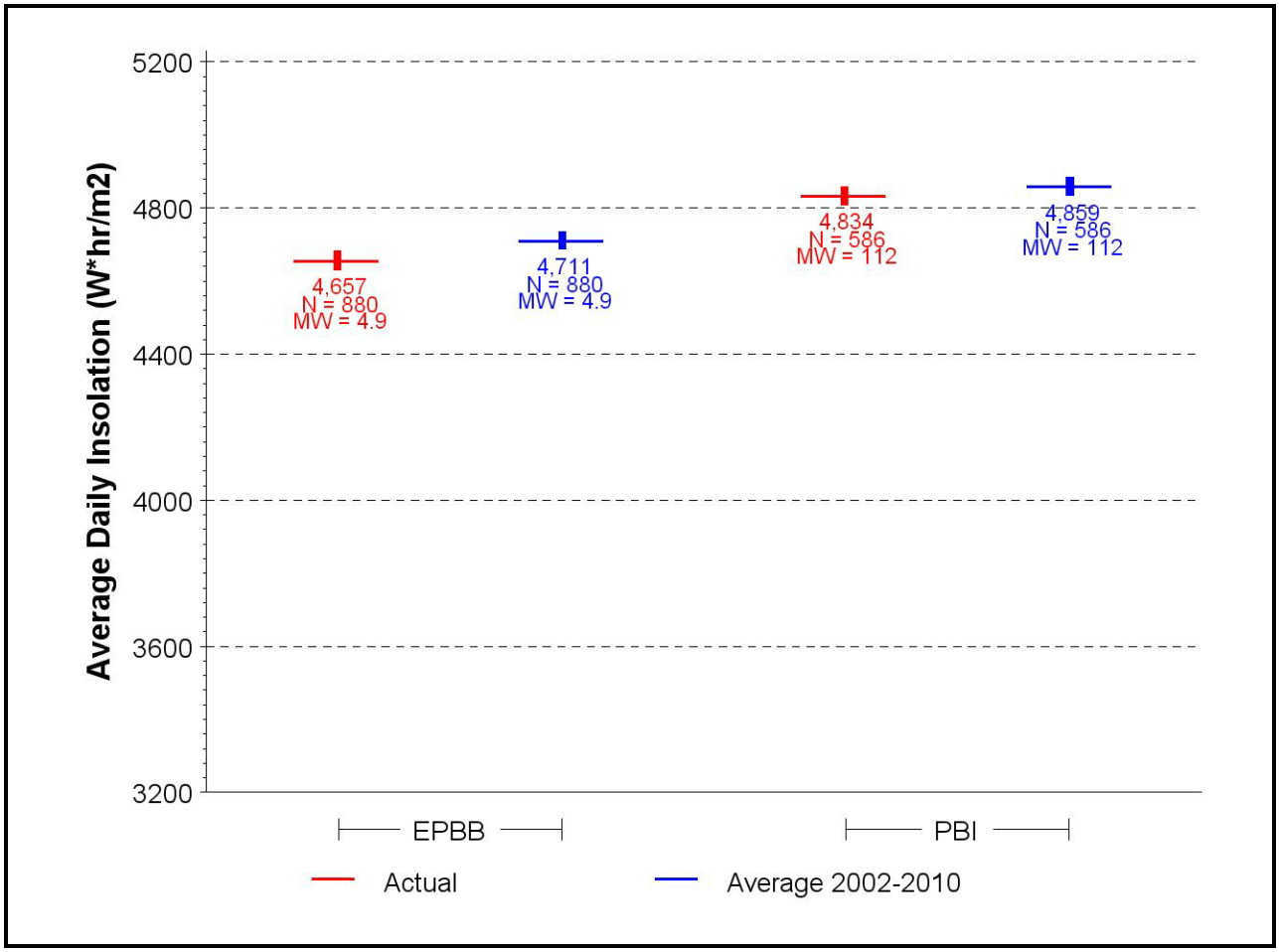
[2] Based on variation presented in the National Renewable Energy Laboratory (NREL) Red Book; http://rredc.nrel.gov/solar/pubs/redbook/

[3] Itron, Inc., *CPUC California Solar Initiative: 2009 Impact Evaluation Final Report*, June 2010, http://www.cpuc.ca.gov/PUC/energy/Solar/eval09.htm

and 2010 than expected. In order to determine if 2009 or 2010 was in fact sunnier, we examined insolation values for 2009 and 2010 against other years.

Insolation is a measurement of how much sunlight strikes the earth per day and is the dominant factor in PV system performance. Figure 4-2 shows the average daily global horizontal insolation versus the average from 2002 through 2010. These average daily insolation values are based on data from the California Irrigation Management Information System (CIMIS).[4] The nearest CIMIS site is used to estimate the global horizontal irradiance on an hourly basis for each system used in the analysis. The average distance between systems and CIMIS station is slightly over 10 miles.

Figure 4-2: Actual 2010 Insolation vs. 2002-2010 Average Daily Insolation

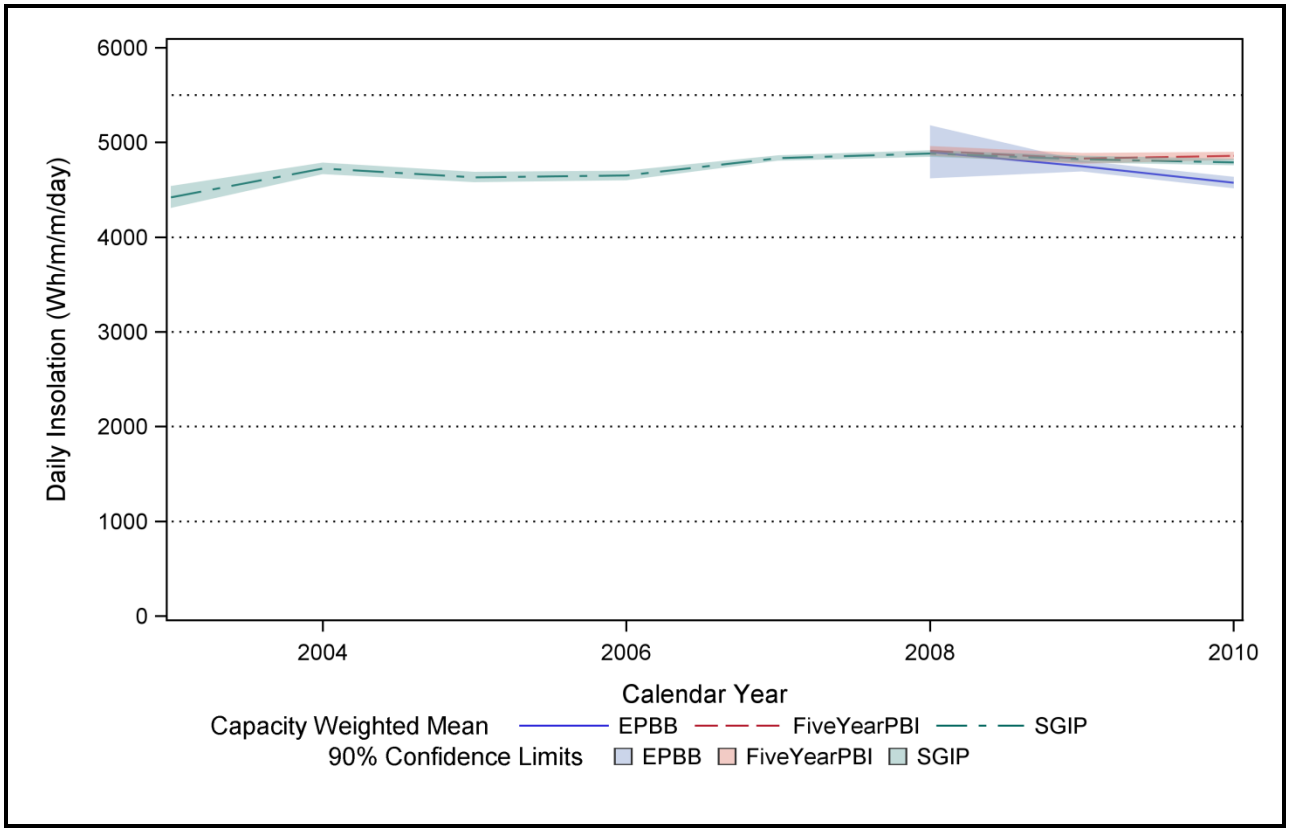


Unfortunately, the average insolation for 2002-2010 is not the same average used for performance estimation. We have presented it to provide an "apples-to-apples" comparison of insolation values. The insolation data used in PVWatts (the engine behind the EPBB calculator)

4 http://wwwcimis.water.ca.gov/cimis/welcome.jsp

is based on National Solar Resource Database (NSRDB) and Typical Meteorological Year 2 (TMY2) data over a period from 1961-1990.[5] Insolation data for 2010 across California are currently only readily available from CIMIS. The CIMIS data may not be directly comparable given issues with pyranometer soiling, calibration, and shading. Therefore, an average over many years for CIMIS data is presented for comparison. Based on this metric, insolation for EPBB sites was 1.1% below the nine-year average and for PBI sites was 0.5% below the nine-year average. Therefore, it does not appear that 2010 was a significantly sunnier year than the average over the prior eight years. In 2009, the weighted average daily insolation for PBI sites was slightly higher at 4,854 watt*hr/m^2 compared to a weighted average of 4,828 watt*hr/m^2; or 0.5% higher than average. That slight increase is not enough to fully explain the 7% difference of actual to expected capacity factors seen in the 2009 analysis. Figure 4-3 shows the mean daily insolation[6] per site by year and incentive type. This figure helps to illustrate some of the variability inherent with insolation year to year.

Figure 4-3: Mean Daily Insolation per Year by Incentive Type

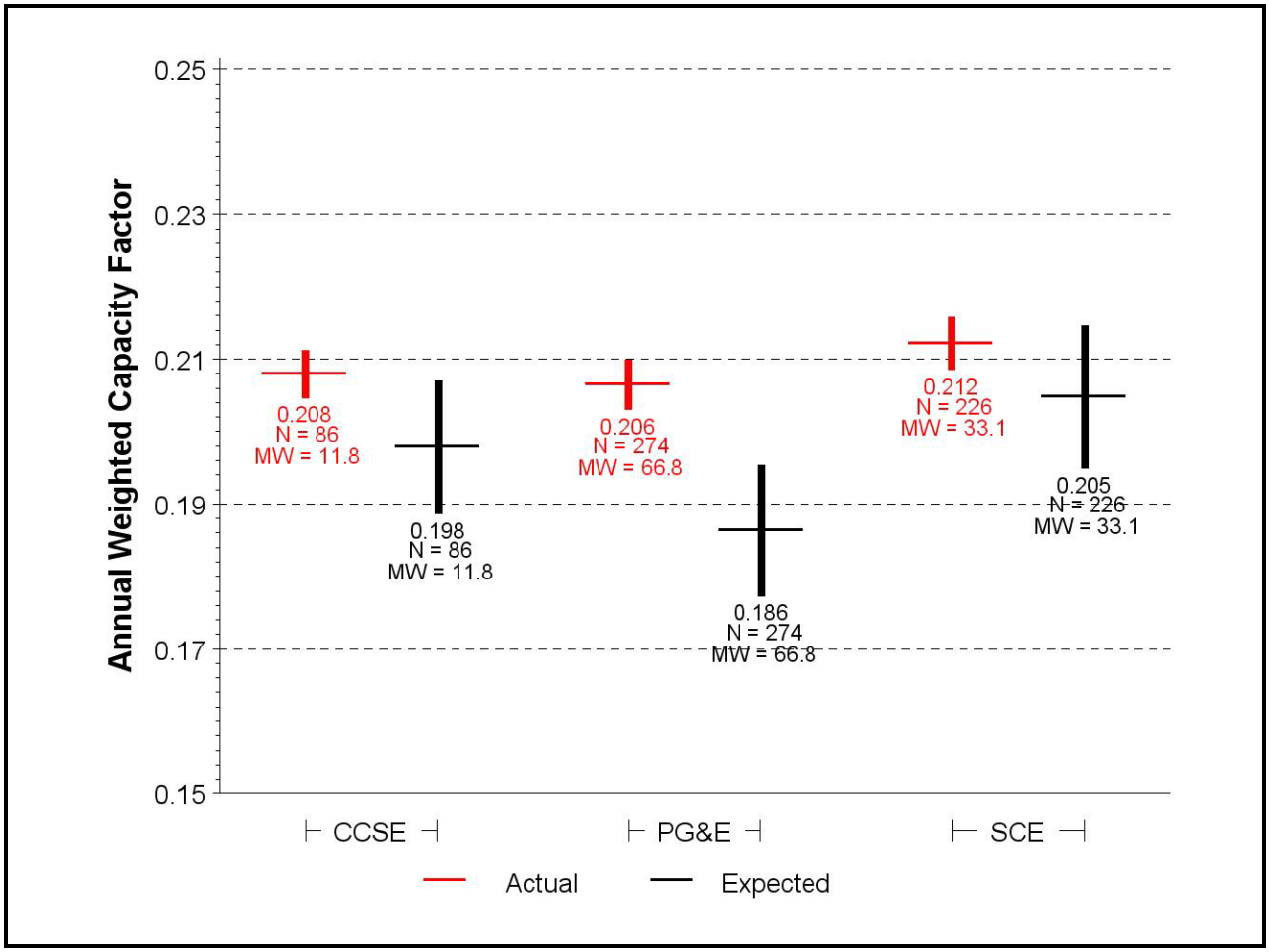


[5] http://rredc.nrel.gov/solar/old_data/nsrdb/tmy2/

[6] Based on CIMIS data.

We also examined the expected versus metered capacity factors associated with PBI systems. Each PA is required to reserve budget for both future incentives and to ensure sufficient funding to pay out the five-year performance based incentives throughout the five-year incentive period. To assist in this process, Figure 4-4 shows the actual and expected weighted average annual capacity factors for PBI systems by PA.

Figure 4-4: Metered vs. Expected Annual Capacity Factors for PBI Systems by Program Administrator

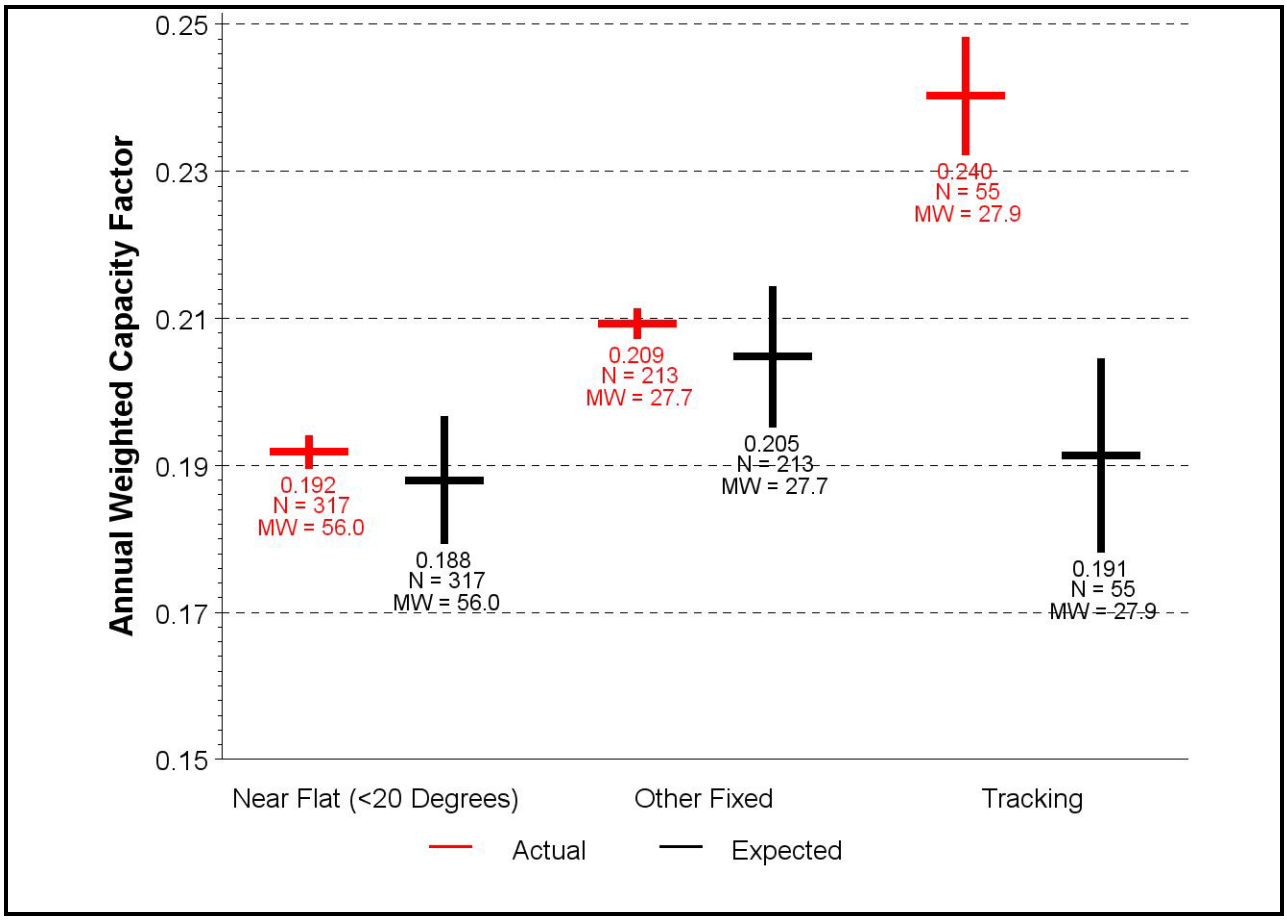


PBI systems in CCSE performed 5.1% better than expected, those in PG&E performed 10.7% better than expected, and those in SCE performed 3.7% better than expected. This difference in performance could be due to sunnier weather in 2010. As shown previously in Figure 4-2, it does not appear that 2010 was substantially sunnier than the 2002-2010 average. Conversely, the difference could be due to the higher capacity factor for tracking systems not being captured in the expected performance numbers until very recently.

Tracking systems usually have significantly higher capacity factors than fixed systems. Until recently, the estimates of annual performance did not take the different performance of tracking

systems into account. Consequently, tracking systems may have tended to skew performance comparisons. Figure 4-5 shows actual metered and. expected performance for PBI systems by mounting type. From this graph, it is obvious that tracking systems are performing significantly better than fixed systems.

Figure 4-5: Metered vs. Expected Annual Capacity Factors for PBI Systems by Configuration



Given the demonstrably better performance of tracking systems, we believe it makes sense to compare actual to expected performance by PA for fixed and tracking systems separately. The comparison for fixed PBI systems is shown in Figure 4-6. With tracking systems excluded, the performance of PBI systems is much closer to the expected system performance.

Figure 4-6: Metered vs. Expected Annual Capacity Factors for Fixed PBI Systems by Program Administrator

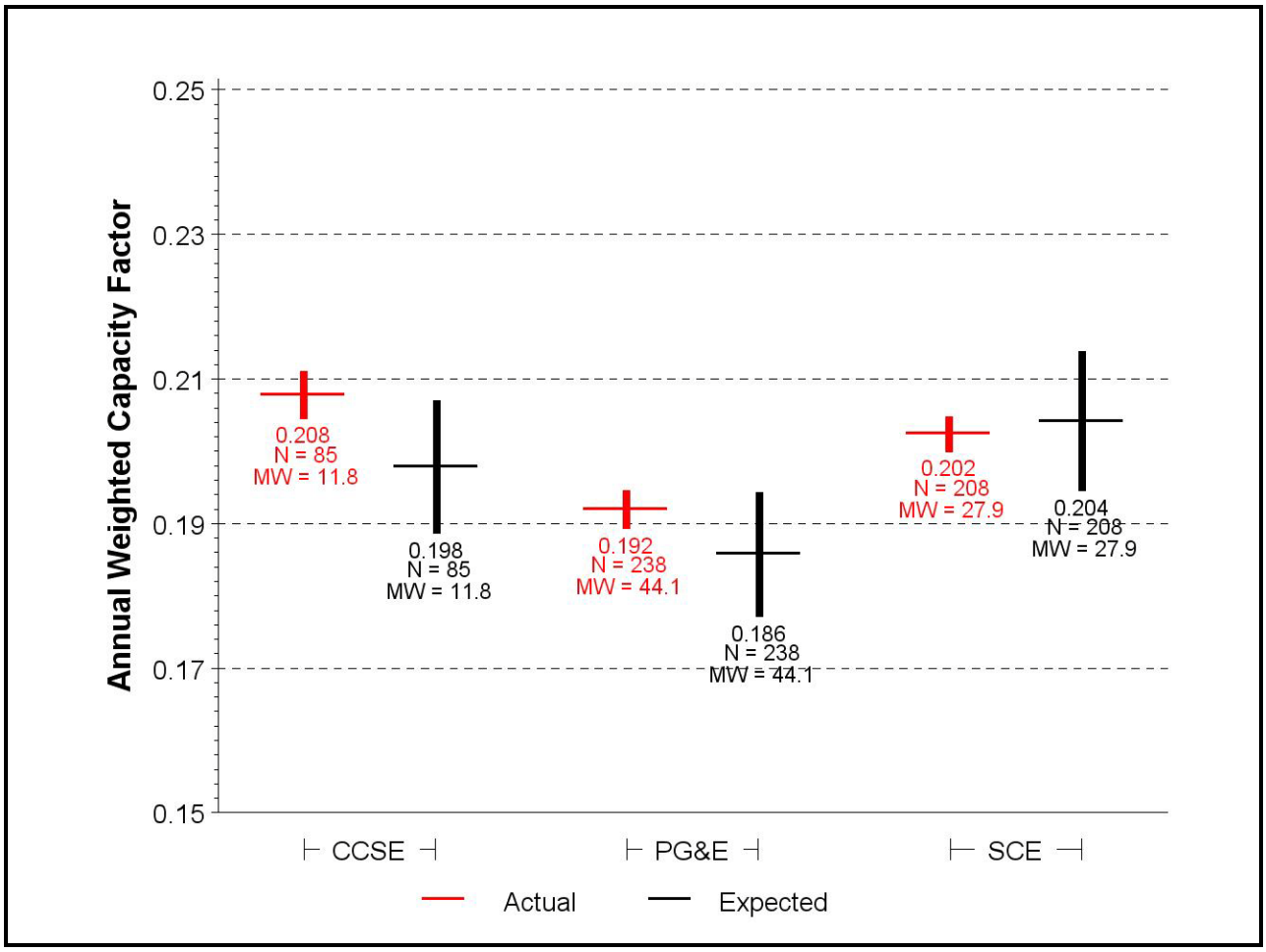
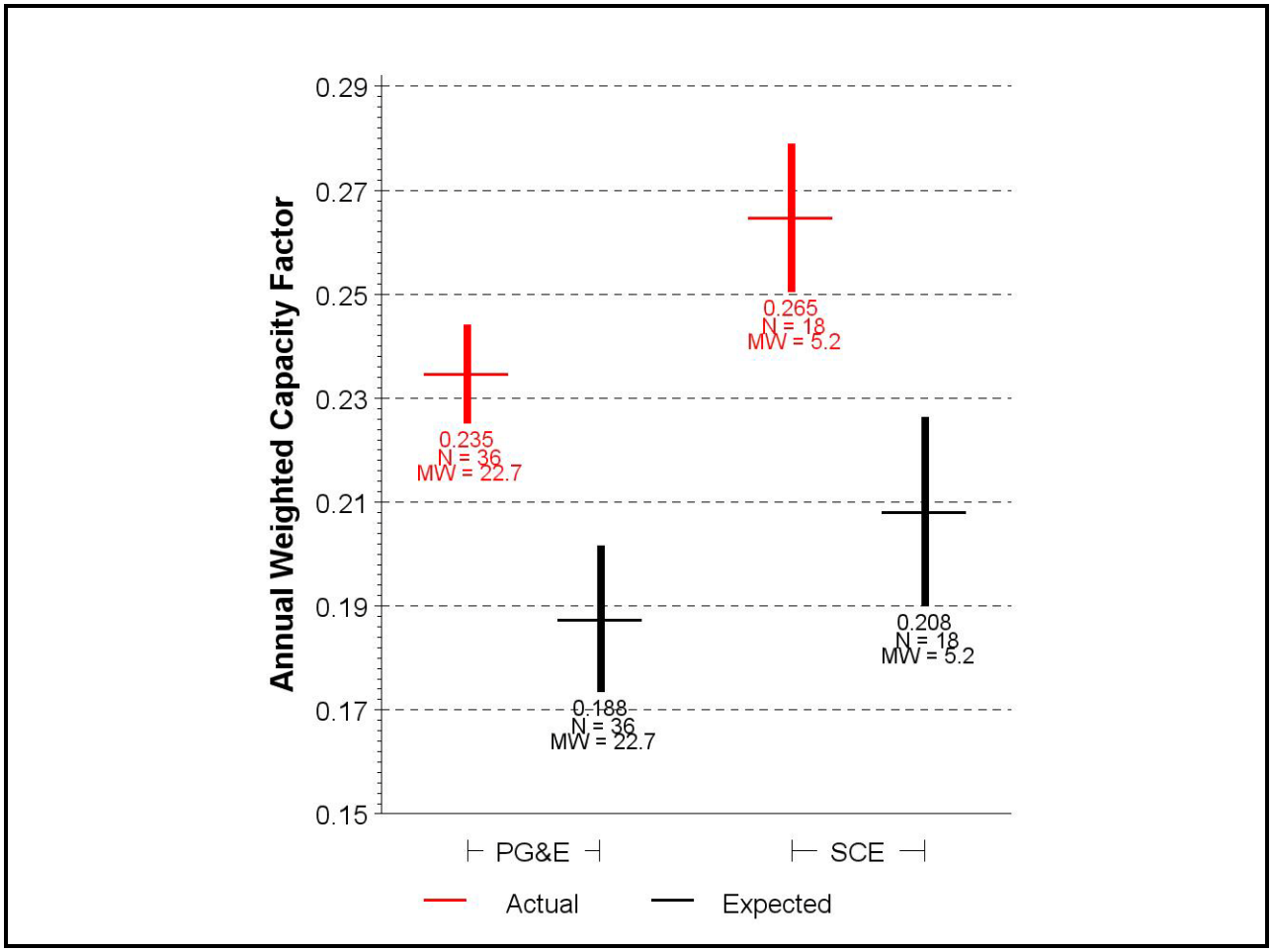


Figure 4-7 shows actual to expected performance by PA for PBI tracking systems. Data for only a single CCSE system met the filtering criteria. In order to maintain confidentiality of customer sites, we have not shown the data for CCSE.

Figure 4-7: Metered vs. Expected Annual Capacity Factors for Tracking PBI Systems by Program Administrator



In the PG&E service territory, tracking systems constituted nearly a third of the PBI capacity examined in this analysis. The analysis shows these tracking systems significantly outperformed the expected production values. We believe the installed capacity and the significant overproduction of tracking systems explains a large portion of the 10.7% difference between actual and expected production values. In SCE territory, the analysis also shows the tracking PBI systems significantly outperformed the expected production values. However, the SCE tracking systems represent only one-fifth of the installed PBI capacity. Consequently, the overall effect of tracking systems on overall SCE PBI performance is less than what was seen in PG&E. We also investigated the daily output profiles for tracking systems included in this analysis to assess if any of the systems classified as tracking appeared to be fixed systems. The results of this analysis are shown in Table 4-1. We found a single 164 kW_{AC} tracking system in PG&E territory that is actually a fixed system.

Table 4-1: Check of System Status for Tracking Systems

PA	Non Tracking Systems (N)	Total Systems (N)	% of Systems That Are Not Tracking	Non Tracking Capacity (MW)	Total Capacity (MW)	% of Capacity That Is Not Tracking
CCSE	0	1	0.0%	0.00	0.02	0.0%
SCE	0	18	0.0%	0.00	5.16	0.0%
PG&E	1	36	2.8%	0.16	22.7	0.7%
All	1	55	1.8%	0.16	27.9	0.6%

In addition to comparing the means and confidence limits, we also looked at the distributions of actual and expected capacity factors for PBI systems. Understanding these distributions should help the PAs plan for PBI payments in the future. Figure 4-8 shows the capacity factor distributions for fixed PBI systems by PA. PG&E and SCE show slightly more spread than expected. Systems in CCSE territory show a slight skew upward. Given that only a single tracking PBI system was available from CCSE for this analysis, the upward skew may indicate there are a few tracking systems currently mistakenly classified as fixed systems in CCSE territory.

Figure 4-8: Capacity Factor Distributions for PBI Fixed Systems

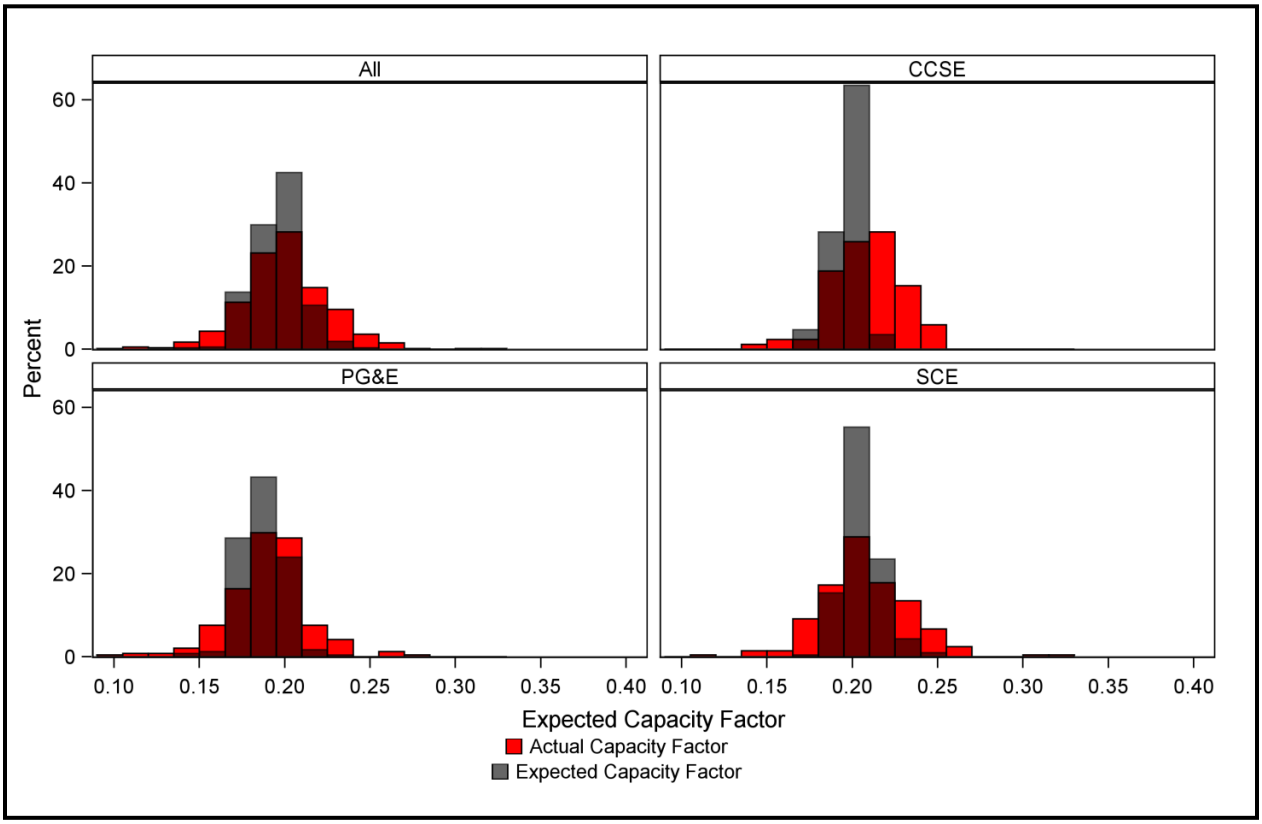


Figure 4-9 shows the capacity factor distributions for tracking PBI systems in PG&E and SCE territories. The actual capacity factors skew somewhat higher than expected. Also, there are a few systems in PG&E territory that may not be actually tracking as evidenced by lower capacity factors for those systems (i.e., they fall into the 0.10 and 0.15 ranges, which are unacceptably low for tracking systems).

Figure 4-9: Capacity Factor Distributions for PBI Tracking Systems

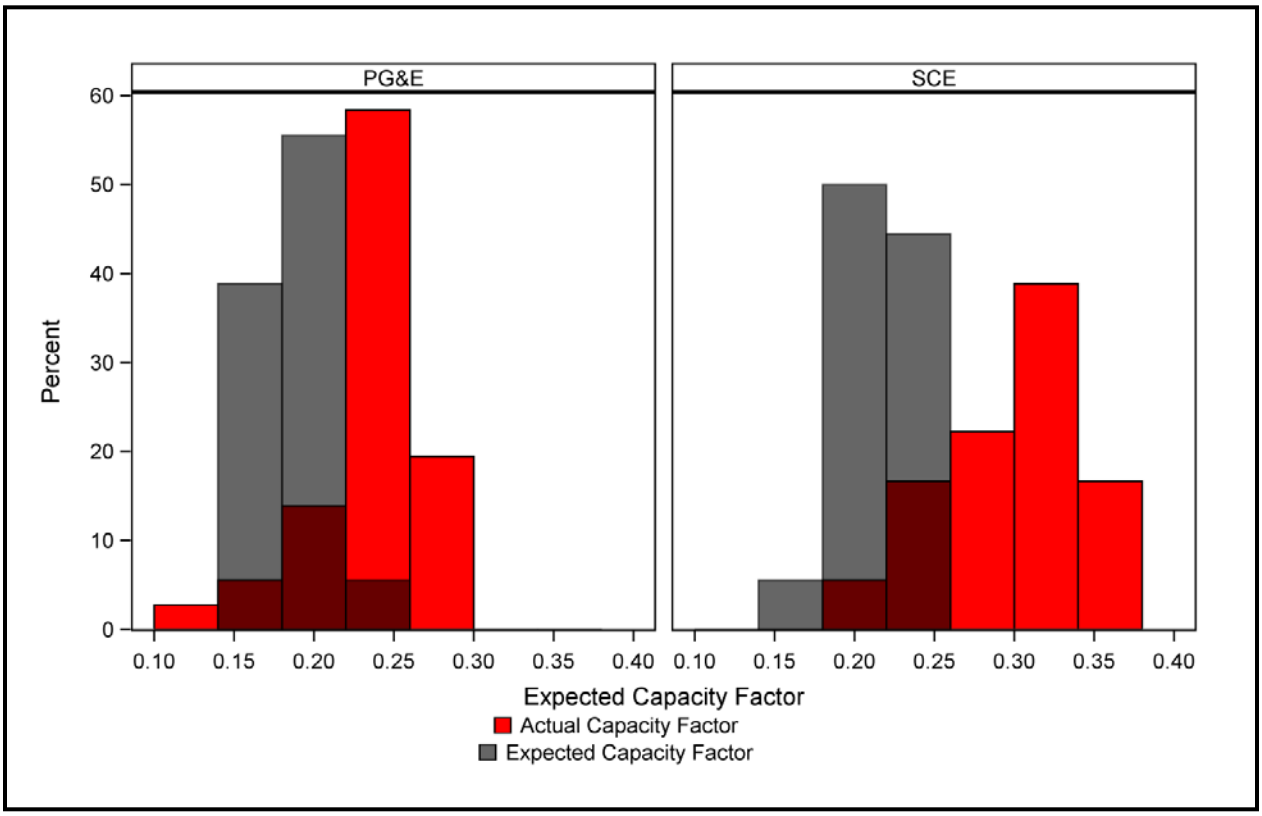
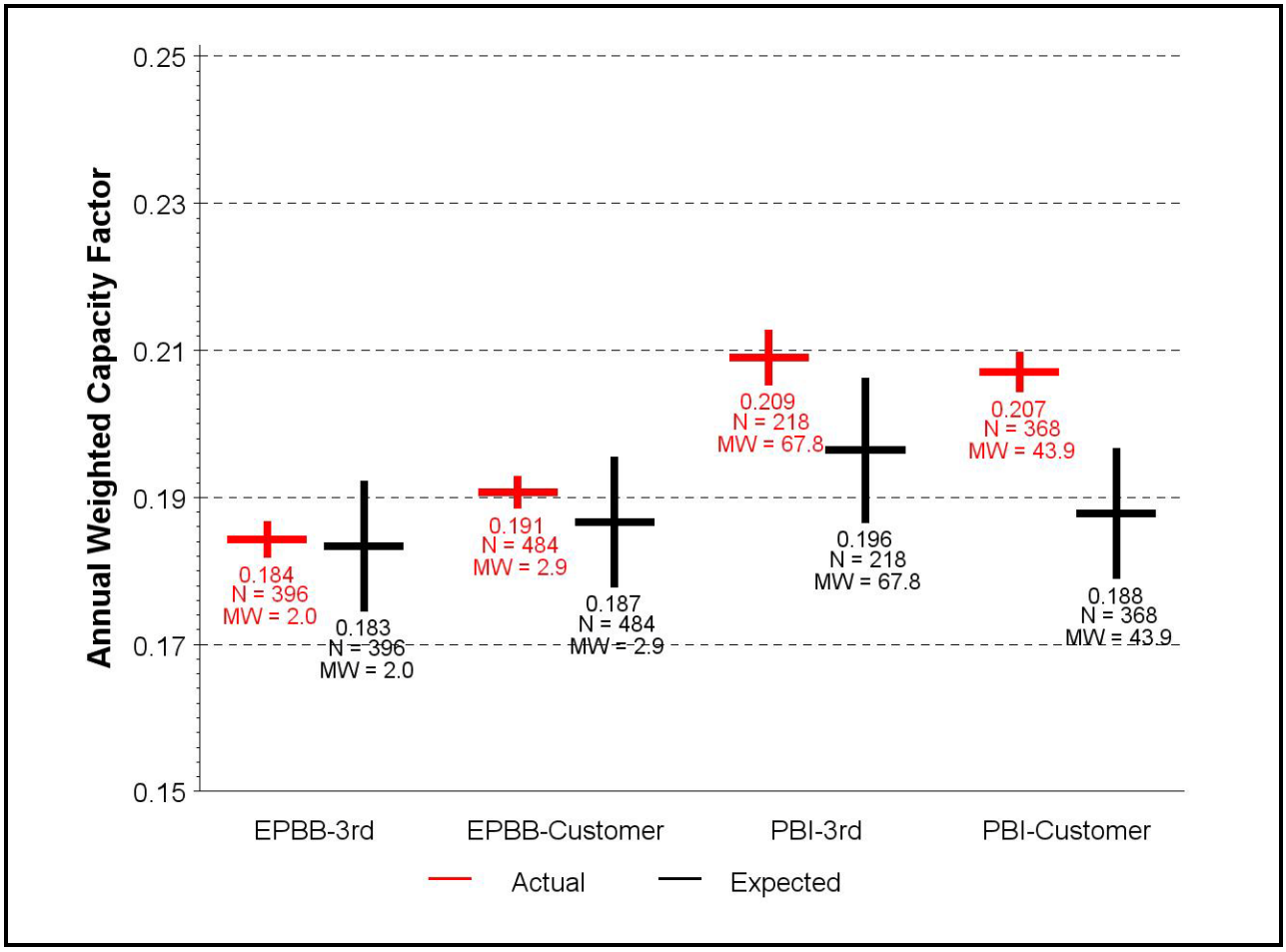


Figure 4-10 shows actual and expected performance by ownership and incentive type. The performance of third-party-owned systems receiving an EPBB is only slightly lower than customer-owned systems but does track the expected performance. It should be noted that most of the third-party EPBB data for our analysis was provided by a single installer. Consequently, the EPBB third-party results may be somewhat biased. Within the PBI grouping, third-party-owned systems performed slightly better than customer-owned systems. In addition, both PBI systems performed better than expected, likely due in large part to tracking systems.

Figure 4-10: Metered vs. Expected Annual Capacity Factors by Incentive and by Ownership



4.2 Parallel Site Validation

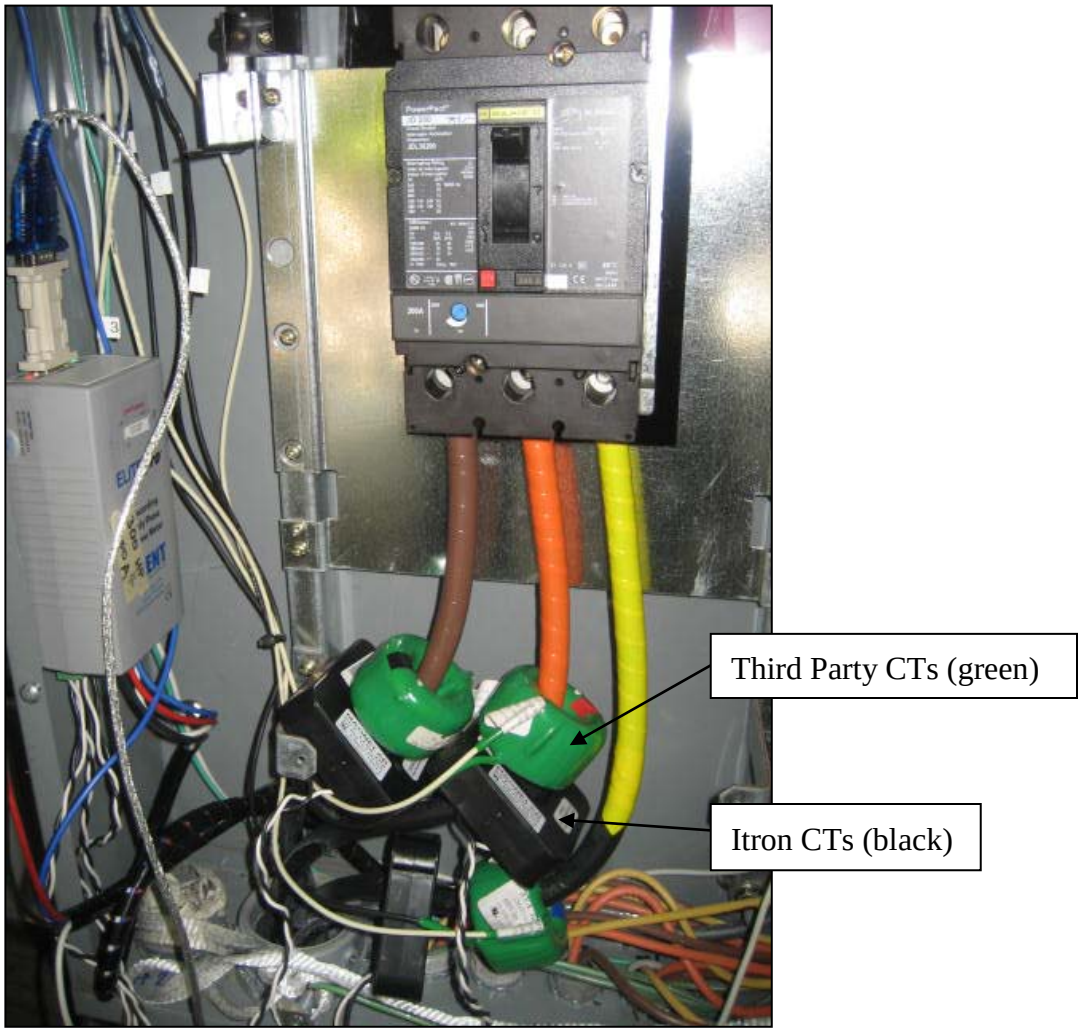
We installed meters on a sample of approximately 65 CSI GM PV systems to perform parallel validation. This entailed monitoring PV generation from each sample system via two independent metering systems. The purpose of this effort was to understand variation from

different metering systems and to uncover any widespread inaccuracies in generation reported for CSI systems.

4.2.1 Metering and Sample Approach

Itron installed metering equipment on systems where data was expected to be available from a third-party data provider. Current transducers (CTs) were placed on the PV system output wires, typically where the output of the inverter connected to the load distribution panel of the site. When the third-party monitoring system also used CTs, the Itron CTs were often located next to the third-party CTs. A typical arrangement of this type is shown in Figure 4-11. In other cases, the third-party data came directly from the PV inverter. Approximately two months of 15-minute interval data were collected for each site. The data were collected during the last half of 2010. As a result, some sites were parallel metered during late summer and other sites during late fall and winter.

Figure 4-11: Photo Showing Itron and Third-Party CT Placement

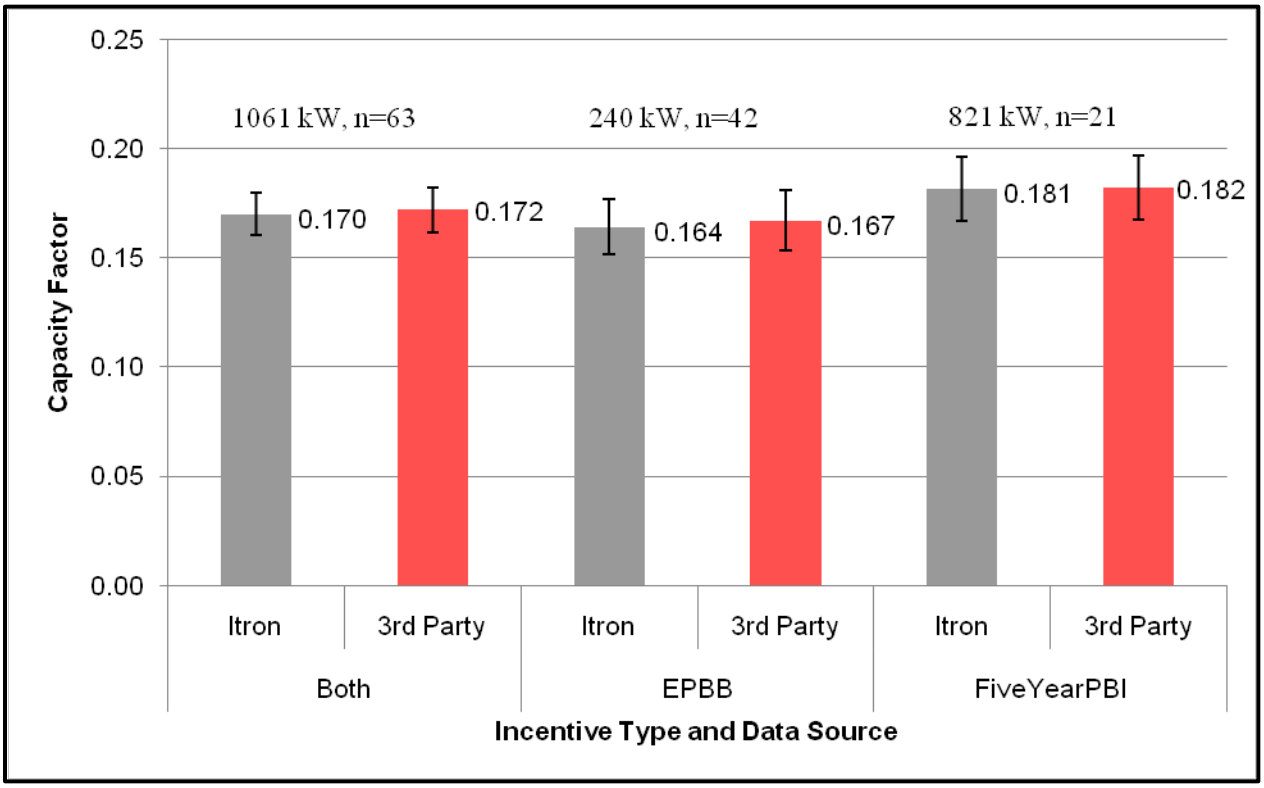


Sites for parallel metering were randomly selected from the group of sites where Itron had previously received third-party data and expected data to be available. The site selection was not designed to be a statistically representative random sample due to the small number of sites (i.e., less than 40). Sites were stratified among PAs and program type (residential and small commercial; large commercial). The large commercial sites selected were chosen from those that could be monitored with a single meter. Selection of commercial sites in this way likely resulted in monitoring of smaller systems within the large commercial group. Comparisons between the Itron and third-party datasets include calculation of percent difference between them and analysis of capacity factors. All data used in the comparisons have data points from both datasets for the same 15-minute interval.

4.2.2 Capacity Factor Analysis

Each dataset was used to calculate a site's capacity factor for the time period in which data was available. The mean of the capacity factors was calculated to produce a grand mean from each data set. Note that the results represent un-weighted capacity factors, meaning each site has equal influence in the grand mean regardless of its rated capacity. A t-test analysis was performed on the sets of capacity factors to establish if there was a statistically significant difference between the grand means from each dataset. The results are presented graphically in Figure 4-12. The results reflect capacity factors for all systems grouped together as well as separated by incentive type.

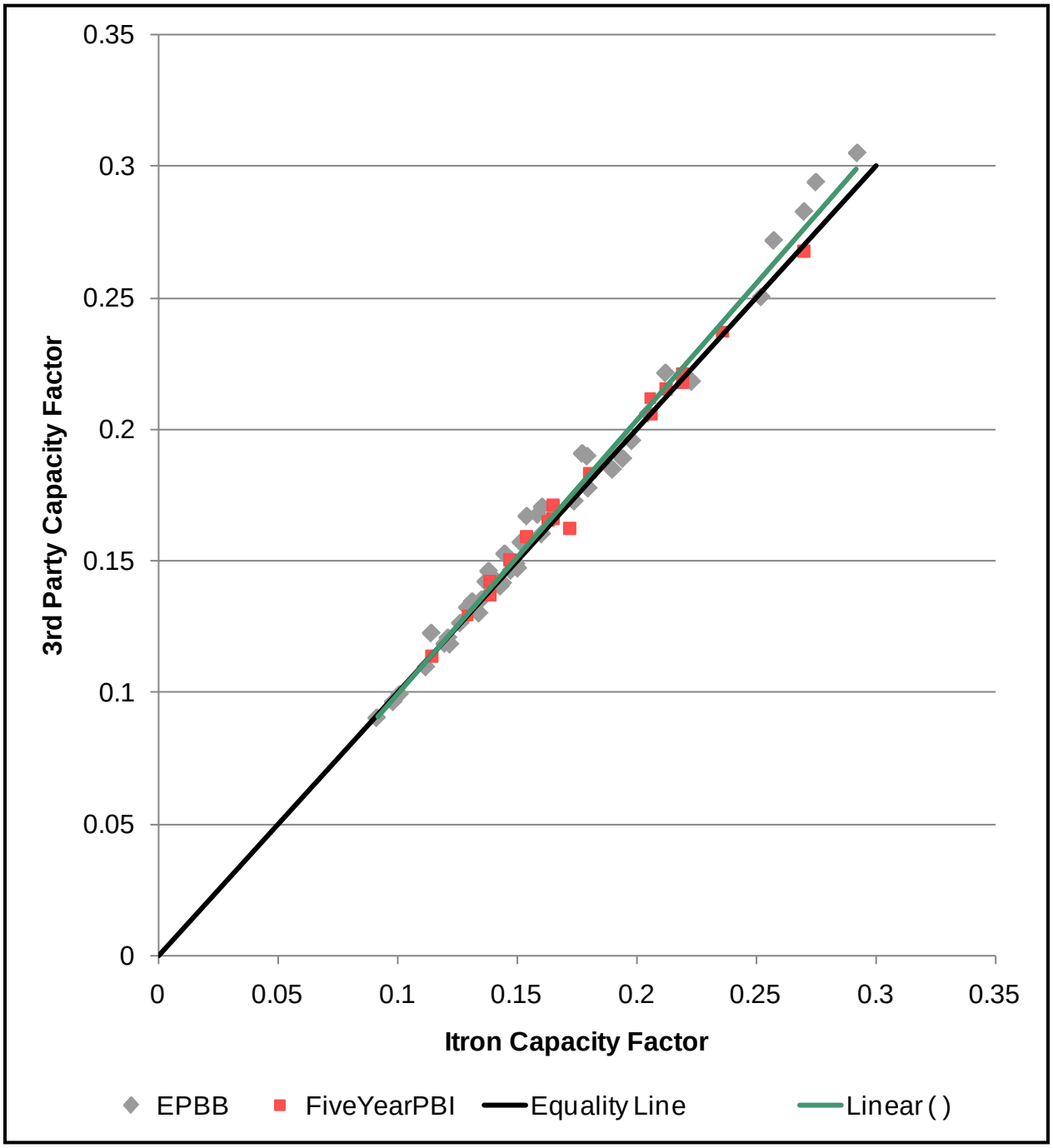
Figure 4-12: Capacity Factors from Parallel Analysis



The error bars represent the 90% confidence limits from the t-test and help to illustrate that there is not a statistical difference between the Itron and third-party data as the confidence intervals overlap. Third-party metering showed very slightly higher energy than Itron metering but not in a statistically significant manner.

Figure 4-13 shows each site's capacity factor as calculated from Itron and third-party data on an X-Y plot. If the two metering systems measured the exact same amount of generation the data point would fall on the *equality line*. If third-party metering measured more generation, the point would fall above the *equality line* and if third-party metering measured less generation than Itron metering, the point would fall below the *equality line*. Overall, the trend follows the *equality line* very well as evident from how closely the linear fit matches with the *equality line*. The range of capacity factor values reflect the time of year data was collected from the systems, with some being monitored during late summer and others being monitored during winter months.

Figure 4-13: Capacity Factor X-Y Scatter Plot



4.3 Effects of Capacity Additions or Changes

4.3.1 Capacity Additions in the Itron Metered Sample

In conjunction with the 2009 CSI impact evaluation, Itron was contracted to install 500 metering systems on CSI GM PV systems to help collect PV performance data and site demand data. While scheduling installation of the PV monitoring equipment, we learned that PV system owners were making changes to their PV systems or planned to add capacity in the future to their systems. Upon collecting and validating PV generation data from the installed metering systems, we observed some systems were producing more electricity than expected based on their PowerClerk ratings. Upon further investigation, we discovered that a number of sites had added PV capacity. In examining all 500 metered sites, we found that 23 sites or nearly 5% of our sample had already added capacity. We also found that five owners were planning on adding more capacity in the near term future. These discoveries led us to wonder about the extent of capacity additions throughout the CSI GM. We were specifically interested in determining if capacity additions were limited to sites that received EPBB incentives or if capacity additions also extended to sites receiving PBI. Lastly, we discovered several PV systems that were changed from fixed arrays to tracking, some with failed and recalled modules, and others that were altered due to theft of PV modules. Consequently, we were interested in assessing the extent of modifications to PV systems in the CSI GM and the influence of those modifications on expected PV performance.

4.3.2 Defining Capacity Additions or Changes

PV system capacity additions occur when a host customer or system owner adds panels or new arrays to a previously installed and rebated system under the same NEM agreement. Similarly, capacity changes can reflect modules that were replaced due to damage or theft; that have changed orientation or tilt; or changes in tracking features. The overall result is a possible change in the amount of electricity production from the original system.

Correctly accounting for capacity additions or changes is important for several reasons. First, the capacity addition or change may not be reflected in PowerClerk; the database used to track PV system capacities under the CSI. As a result, metered performance data will show higher PV production than what is associated with the system capacity listed in PowerClerk. If the system received a PBI incentive and the PV production captured by the metering system reflects the increased capacity, the utility may pay more for production than what was actually incented.

Second, non-participant capacity additions may reflect incipient changes in how customers are responding to changes in incentive structures. For example, some customers may be adding modules without pursuing the CSI incentives. These customers may have decided that with dropping PV system pricing, the investment tax credit and possible future increases in electricity prices, it makes sense to purchase additional PV capacity even if they do not receive an

incentive. Consequently, tracking the number and magnitude of PV capacity additions that are occurring without recourse to incentives provides insights into factors influencing the continued expansion of the PV market in California.

In this section, we investigate capacity additions or changes that have occurred to systems installed both outside and inside the CSI program. PV systems installed outside the CSI program represent systems installed by non-participants. Information on capacity additions by non-participants can help identify the extent to which utility customers may be electing to install PV systems without using incentives. We also examine capacity additions by CSI participants; utility customers who have received CSI incentives for installed PV systems. CSI incentives are provided in two main forms. The EPBB incentive is paid in a lump sum once the PV system is installed and commissioned. The PBI is an incentive paid over a period of five years and based on metered kilowatt-hour (kWh) production. Due to differences between the EPBB and PBI, we also examine if there are differences in capacity additions and changes between CSI participants who received EPBB versus PBI incentives.

4.3.3 Approach and Methodology

Determining Non-Participants

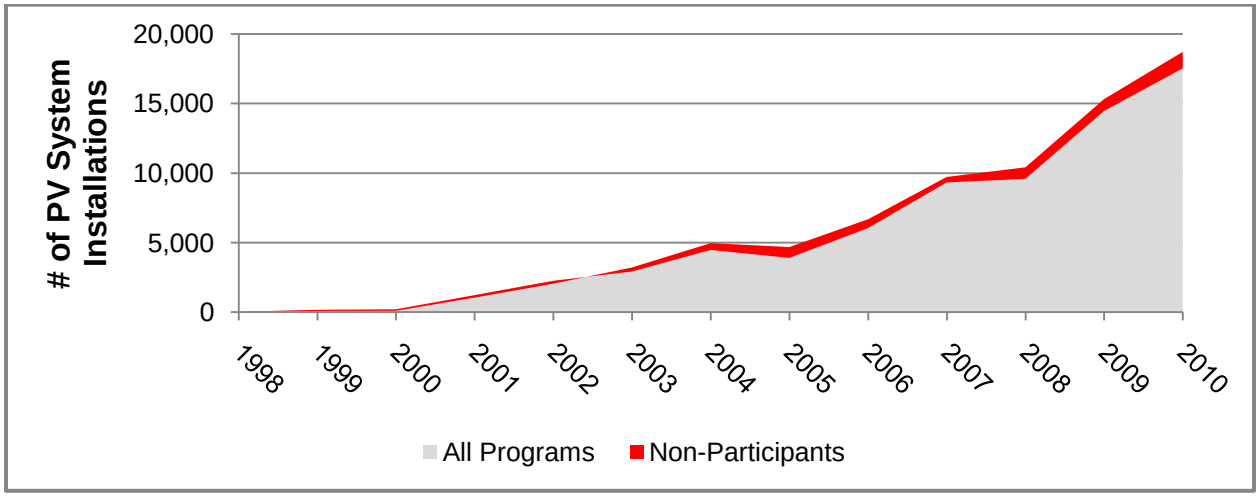
We used utility interconnection and PV incentive program statistics to determine the count of non-participant sites. PV systems that tie into the electricity system must be interconnected through the local electrical utility. As a result, one way to identify the number of PV systems that were installed without use of incentives is to compare the number of PV interconnections made through the utilities against the number of PV systems receiving incentives over the same time period.

The unmatched interconnect and PowerClerk data proved to be problematic, and therefore largely inconclusive. Although the two sources of data should theoretically match, we found significant discrepancies between the interconnection database and the PowerClerk database. It is noted that SCE systems showed the best matching between interconnection data and PowerClerk data that confirmed the findings in the 2009-2010 CSI Process Evaluation Report.[7]

[7] Opinion Dynamics Corporation, *California Solar Initiative 2009-2010 Process Evaluation*, January 2011, http://www.cpuc.ca.gov/NR/rdonlyres/843D400E-9E89-44AF-91B5-73E74D62031A/0/CSI200910ProcessEvaluationReport.pdf

Figure 4-14 shows the potential number of non-participant PV installations within the three IOUs' service territory. Unfortunately, data associated with ERP systems could not be easily identified without further research. Consequently, our efforts in assessing capacity changes were limited only to participants to the CSI GM.

Figure 4-14: Potential Quantity of Non-Participants



4.3.4 Determining Capacity Additions within the CSI

Itron used the merged and matched PowerClerk and interconnection data to examine possible system capacity additions. For example, we identified CSI host sites who had installed multiple arrays at different times on a given net meter. We were also able to identify other CSI host sites where the system owners were planning to add capacity in the near future (2011). We eliminated customers with multiple net energy meters with installed PV at the same premise, or PV installations of similar vintage as these customers would not meet our definition of added capacity. We excluded from the analyses PowerClerk records for host customers who applied for rebates but for which the system additions had not yet been completed prior to January 1, 2011.

EPBB Capacity Additions

Figure 4-15 provides information on the number of EPBB systems that had capacity additions and project additions into 2011. The 2011 value is projected based on the market sector, trends from the first four years of the CSI program, and on project applications that have been reserved in PowerClerk but have not been completed or interconnected as of January 2011. Figure 4-16 shows how the EPBB capacity additions translate into amount of increased capacity in kW by program year.

Figure 4-15: Number of EPBB Systems with Added Capacity

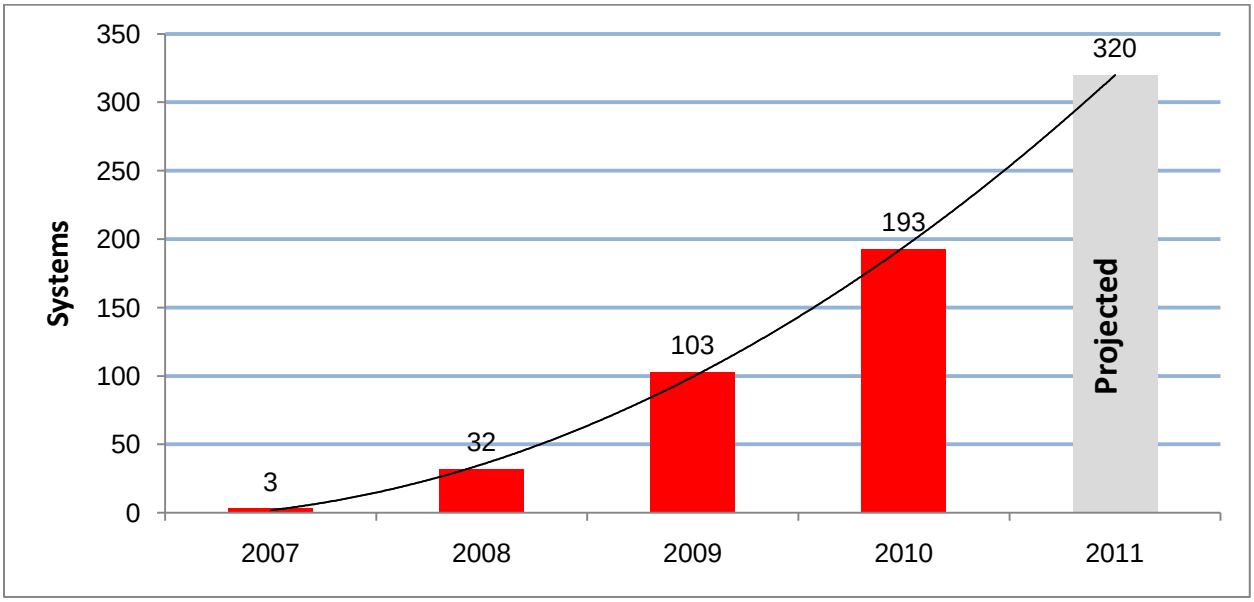


Figure 4-16: EPBB Added Capacity by Year

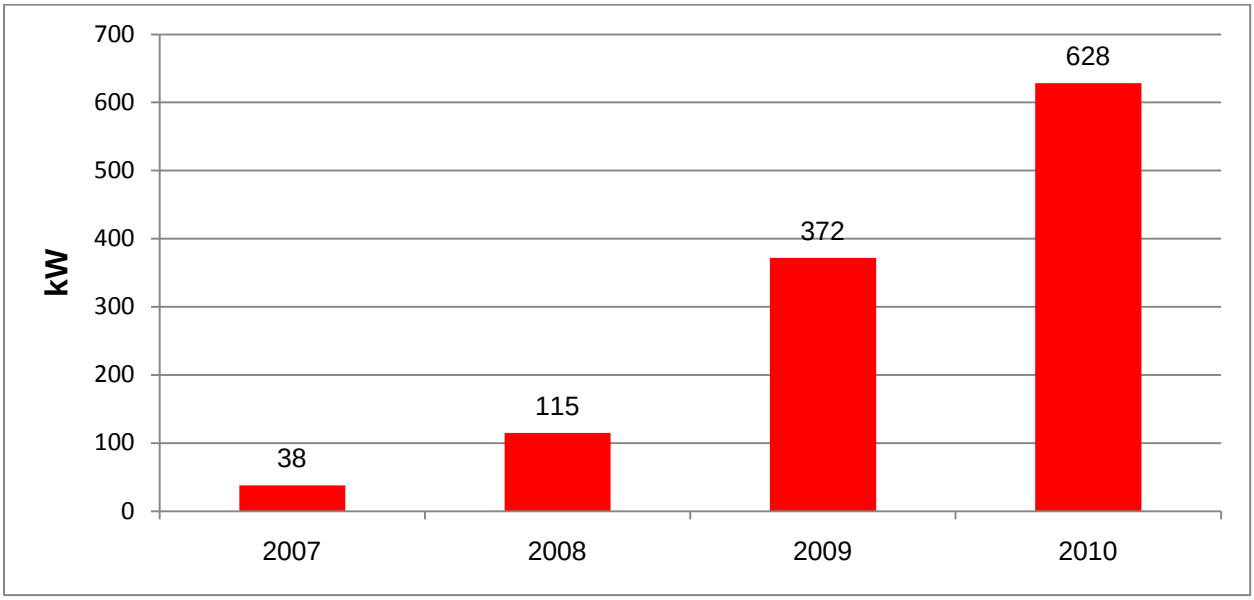


Figure 4-17 below shows the percentage of EPBB added generation as a percentage of cumulative CSI capacity by year. Note that the overall capacity reflects the combined PBI and EPBB capacities.

Figure 4-17: EPBB Added Capacity as Percentage of Cumulative CSI Capacity by Year

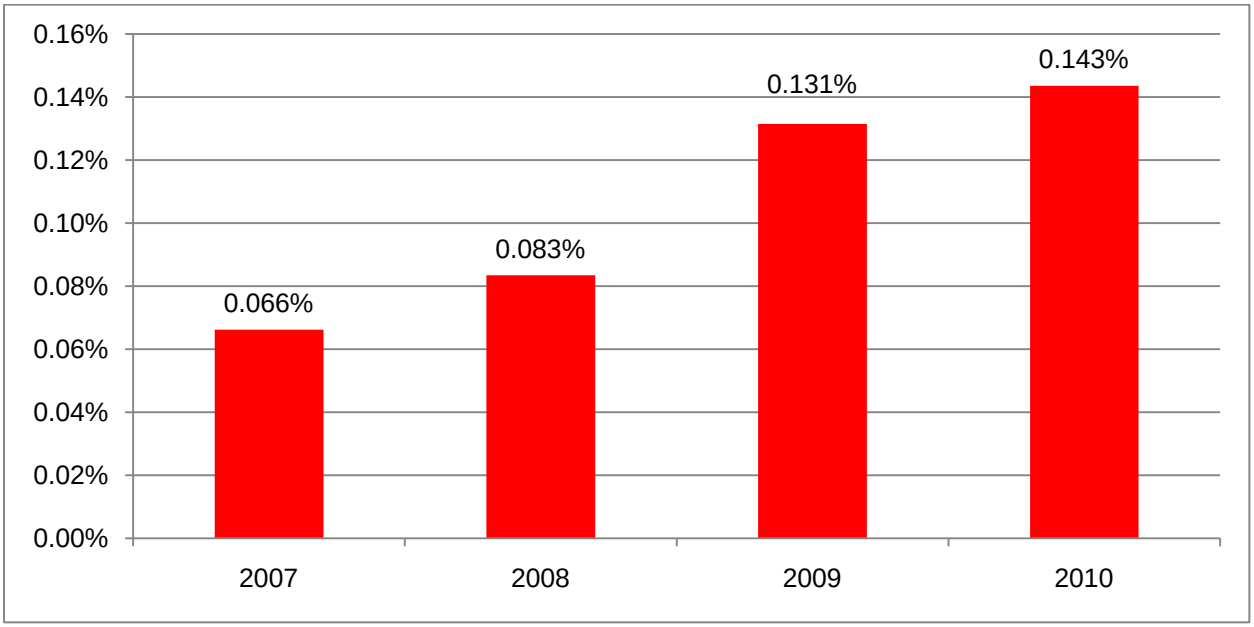


Table 4-2 shows the original average EPBB system capacities.

Table 4-3 shows the quantity, added capacity, and average added generation for EPBB systems by PA for the associated additions. Overall, the average EPBB system size of 6.4 kW was increased 57% with an average generating capacity increase of 3.5 kW.

Table 4-2: Average Original EPBB System Capacities (with Added Generation)

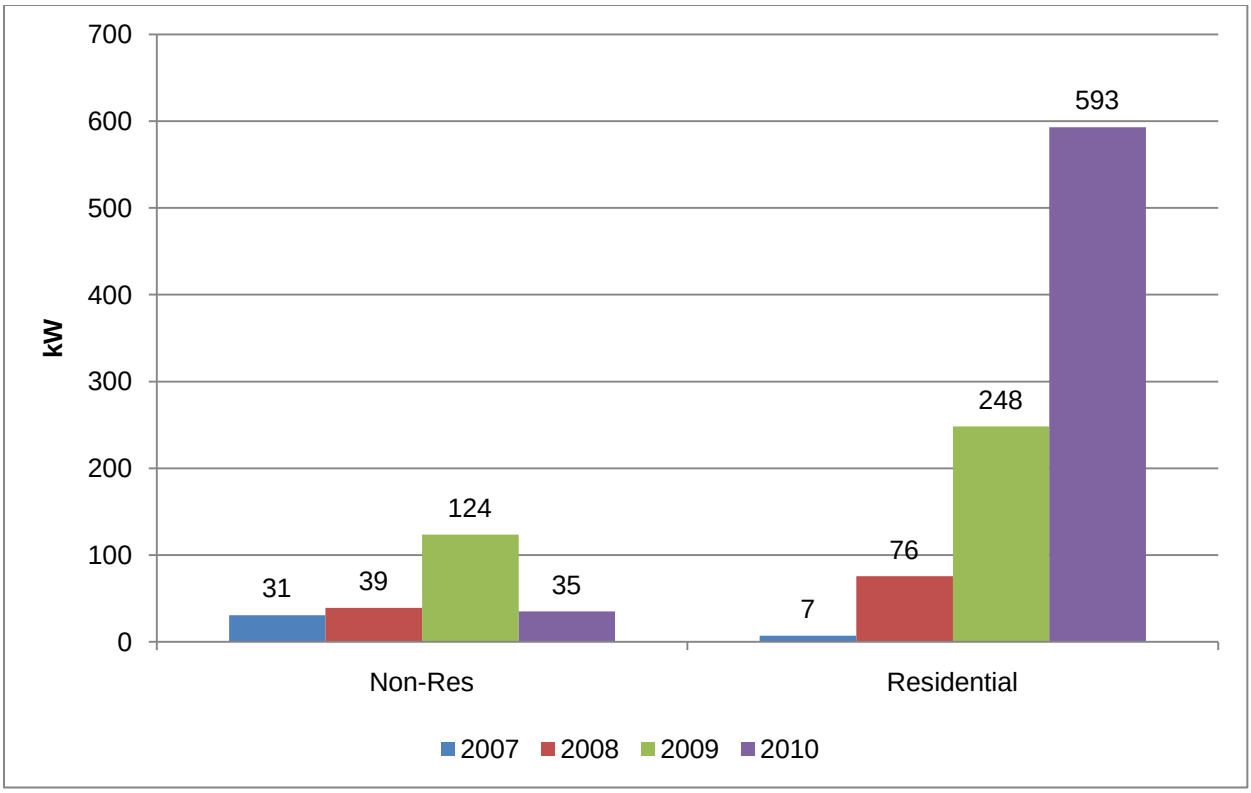
Program Administrator	Original Capacity EPBB (kW)	Total Number of Original PV Systems	Avg Original Cap (kW)
CCSE	221	37	5.98
PG&E	1,119	183	6.12
SCE	671	93	7.21
Total	**2,011**	**313**	**6.43**

Table 4-3: Average EPBB Added Generation Capacity

Program Administrator	Added Capacity EPBB (kW)	Total Number of PV Arrays as Added Capacity	Avg Cap Increase (kW)
CCSE	164	38	4.33
PG&E	677	194	3.49
SCE	311	99	3.14
Total	**1,153**	**331**	**3.48**

Figure 4-18 further breaks out the added generation capacity by EPBB by market sector. Although the non-residential sector does not indicate a trend, the residential sector clearly shows a ramping in added generation capacity.

Figure 4-18: EPBB Capacity Additions by Sector and Year



PBI Capacity Additions

Table 4-4 shows the average original PBI system capacities. Table 4-5 shows the associated PBI added generation capacity. Overall, the sparse number of examined PBI systems (eight in all) had a significant increase in generation capacity, comparable to the EPBB increases described in previous section. The average PBI system size of 326 kW was increased 122% with an average generating capacity increase of 348 kW.

With the additional rules that accompany PBI system installations it is not surprising that only a few systems added capacity during the four-year program cycle. In general, while capacity additions on a few systems can show significant changes for the individual system, we found there to be little overall impact on the program or on the program budget.

Table 4-4: Average Original PBI System Capacities (with Added Generation)

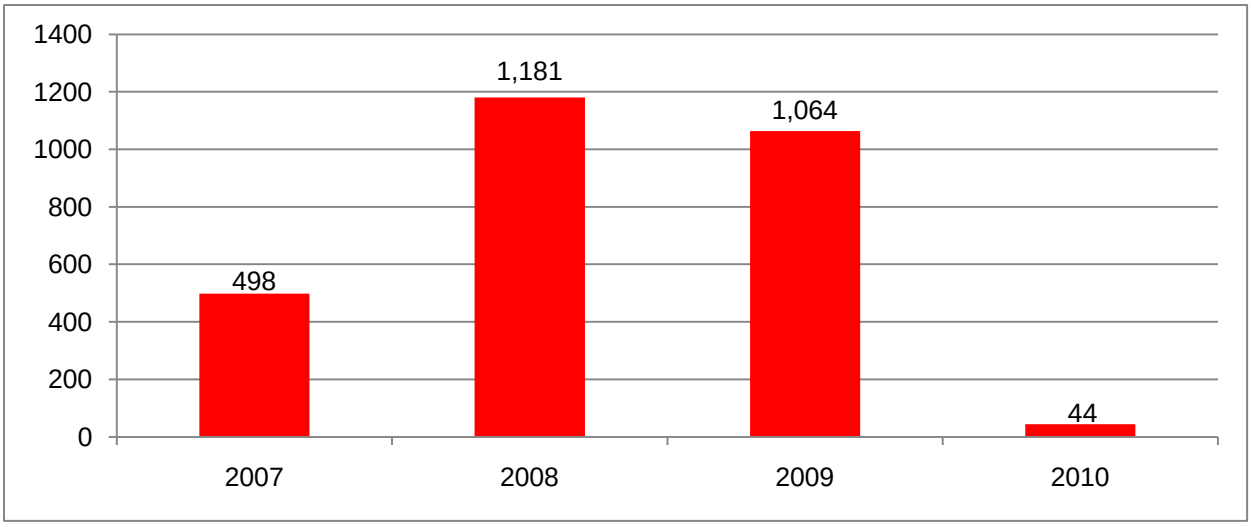
Program Administrator	Original Capacity EPBB (kW)	Total Number of Original PV Systems	Avg Original Cap (kW)
CCSE	7	1	7
PG&E	1,886	3	629
SCE	390	3	130
Total	**2,283**	**7**	**326**

Table 4-5: Average PBI Added Generation Capacity

Program Administrator	Added Capacity PBI (kW)	Total Number of PV Arrays as Added Capacity	Avg Cap Increase (kW)
CCSE	4	1	4
PG&E	1,350	3	450
SCE	1,433	4	358
Total	**2,787**	**8**	**348**

Figure 4-19 below shows a large drop in PBI capacity additions in 2010 compared to the first three years of the CSI program. Due to the small number of PBI systems that actually add capacity, no trends can be drawn and capacity additions will likely be sporadic from year to year.

Figure 4-19: PBI Added Capacity (kW)



4.4 Recommendations

For performance evaluation purposes significant system changes should be tracked. To maintain system accuracy, PowerClerk or interconnect data should record the following details of each significant system change pre- and post-retrofit:

- The date each modification occurred
- Description of PV system change
- The rated module capacities
- Accurate module quantities
- Any change to array orientation
- Any change to array tracking functions
- Any change to array tilt

One option will be to exclude systems that undergo changes from future evaluations, or adjust for the changes by re-categorizing strata or re-setting system capacity ratings. Over the 25-year expected life of these systems, system changes may become significant.

5

PV Performance over Time

5.1 Objectives and Scope

PV systems are expected to last at least 20 years. However, there is large uncertainty in the power output that consumers can expect from their systems after 20 years. Models often assume a performance degradation rate of 0.5 to 1.0% per year based largely on module degradation. Other factors such as soiling and downtime due to maintenance or failures are often accounted for separately. The purpose of this section is to investigate system performance over time for CSI GM and SGIP systems. While we originally intended to examine and quantify PV performance degradation over time, we encountered unexpected data collection and processing difficulties. We are re-examining the data and data collection/processing methodologies and will issue an addendum with PV degradation results.

5.1.1 Analysis Approach

The basis for this analysis is the weighted average capacity factor by year of operation. Data availability is presented in Section 3. Data for SGIP systems are available starting in mid-2002 through the end of 2010, and data for CSI systems are available starting in mid-2007 through 2010. Year of operation is based on the approximate date the system began generating energy. Grouping by year of operation minimizes the effects of year-to-year insolation variation. For example, systems in the third year of operation would include systems installed in June 2007 and their performance from June 2009 through May 2010. It would also include systems installed in March 2006 and their performance from March 2008 through February 2009, etc. To be included in a year of operation, a system must have data for 90% of the days in that period (328 days for non-leap years). By only including systems with this amount of data, we should minimize the potential for seasonal variation bias. However, the population of systems within each year of operation changes so analysis and quantification of degradation rates using this metric may not be representative.

5.1.2 Types of Comparisons

We investigate a number of different important factors or variables to determine the significance of their relationship to system performance as measured by annual capacity factor. Some of these include installation year group, location, Program Administrator (PA), incentive type,

customer type, system ownership, and module type. Each variable has levels within it. Location has two levels—coastal and inland—while PA contains three levels—CCSE, PG&E, and SCE.

5.2 The Statistics of Performance over Time

We employ two kinds of statistical analysis in this study: the t-statistic and the analysis of variance (ANOVA). The t-statistic enables the testing of the means of two variables. In the case of multiple variables, ANOVA allows the testing of variables with several kinds of methods, including main, crossed, nested, and sliced effects. ANOVA tests for differences in the means of variables. We use a significance-level threshold of 10% in the hypothesis tests. Most variables are analyzed using graphic, t-test, and ANOVA analysis.

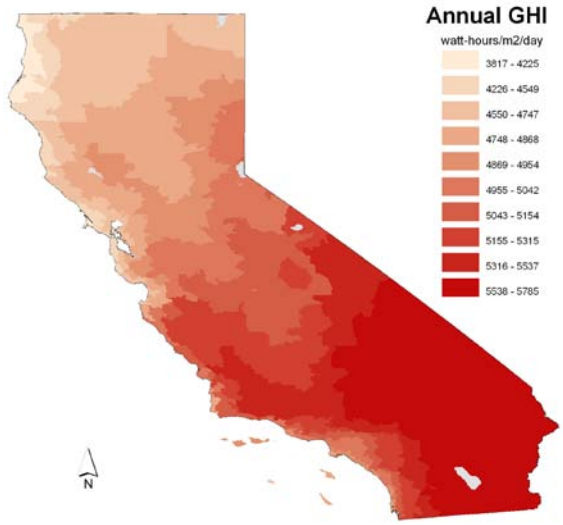
The statistical analysis is performed on CSI GM PV systems that have metered data for at least 90% of the year, accounting for seasonal variations. This accounts for three full years of data since the inception of the CSI GM program. ANOVA tests evidence for an effect at the Year 3 mark given that this is the latest period of CSI GM systems.

5.3 Average System Performance by Group by Year of Operation

In this section, we present a graphical analysis that provides information of how individual variables may influence PV system performed over time. The graphs provide a view of trends of variables and differences between those variables. Within each subsection below, a graphic representation is provided along with the relevant results of statistical tests. Tables detailing more data for performance over time are placed in Appendix A for additional reference.

5.3.1 Performance by Installation Year Group over Time

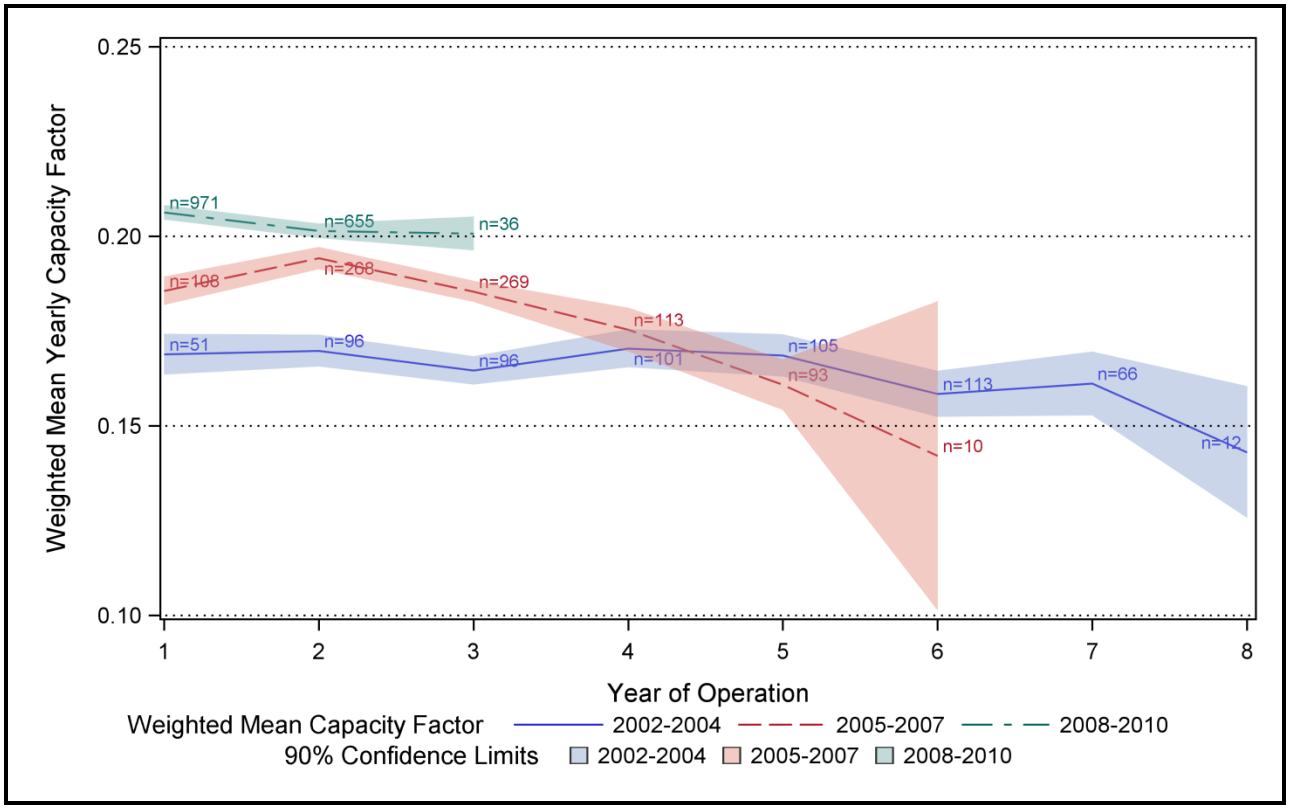
This section examines the performance of systems over time by year of installation. System installations were grouped by three-year intervals to allow for easier comparisons. SGIP systems largely fall into 2002-2004 and 2005-2007 groups, and CSI GM systems fall primarily in the 2008-2010 group. There are some CSI GM systems in the 2005-2007 group and there are some SGIP systems in the 2008-2010 group. The relative comparison of groups should allow for a better understanding of improvements in PV systems and installations over time.



The global horizontal irradiance (GHI) represents the total amount of sunlight received by a surface horizontal to the ground per day, or in other words, a measure of the solar resource available. It is clear from the figure in this box that California's solar resource varies significantly by geographical location. This is crucial when comparing program impacts by program administrator or location since those with a better solar resource should perform better.

Systems installed more recently appear to perform better. This could be due to technology or installation advancements. Figure 5-1 shows the weighted mean capacity factor by year of operation for systems grouped by years.

Figure 5-1: Performance by Year of Installation Group over Time



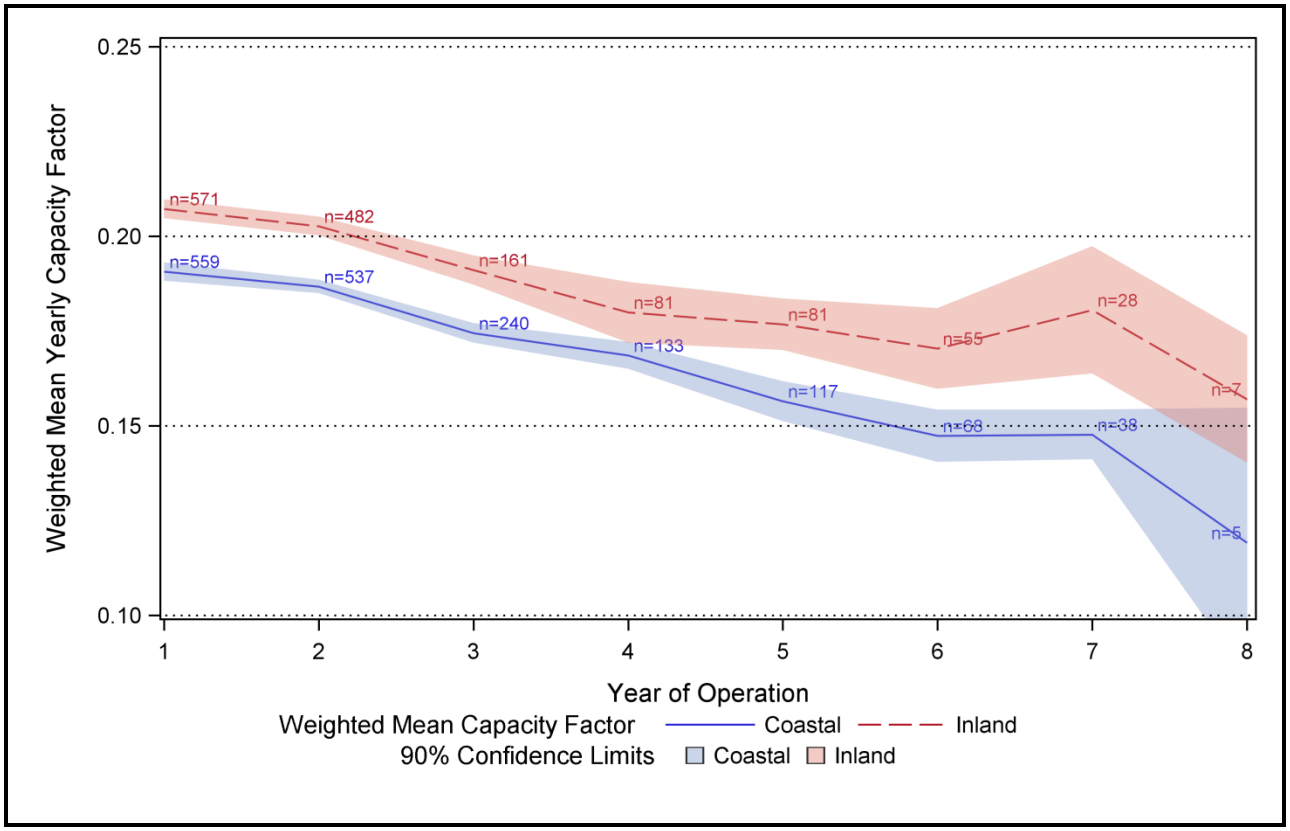
As shown in the graph, systems installed in 2008-2010 perform better in each year of operation than systems installed in 2002-2004 and 2005-2007. This does not appear to be driven by additional tracking systems in any particular year of installation group. More detail may be found in Appendix A, Table A-11.

- A 22% difference exists between the performance of systems installed in 2002-2004 (all SGIP at 0.169) and systems installed in 2008-2010 (predominantly CSI GM at 0.206) first-year systems.
- A 22% separation continues through the third year between systems installed in 2002-2004 (0.169 to 0.165) to between systems installed in 2008-2010 (0.201).

5.3.2 Performance by Location over Time

In this section, we examine performance over time between cool coastal climates and hot inland climates. Inland climates tend to receive more insolation than coastal areas but may also be subject to more soiling due to drier and dustier conditions, which acts to reduce performance.

Figure 5-2: Performance by Location over Time



Inland systems perform better than coastal systems, as shown in the graph. Some of this is likely due to more solar resource available in these areas. In addition, we find the following when the programs are examined separately.

- CSI GM inland systems perform 7% better than CSI GM coastal systems in the first year of operation. The difference decreases to 1.5% by the third year for CSI GM systems.
- SGIP inland systems perform 3.8% better over SGIP coastal systems. The difference also decreases to 1.1% by the fifth year for these systems.

T-test and ANOVA yields the following statistically significant results when variables are crossed with one another. Among the variables tested against location, PA, and incentive type prove to have significant affects on PV system output. Details of the means of location crossed with PA and incentive type are located in Appendix A, Section A-1.

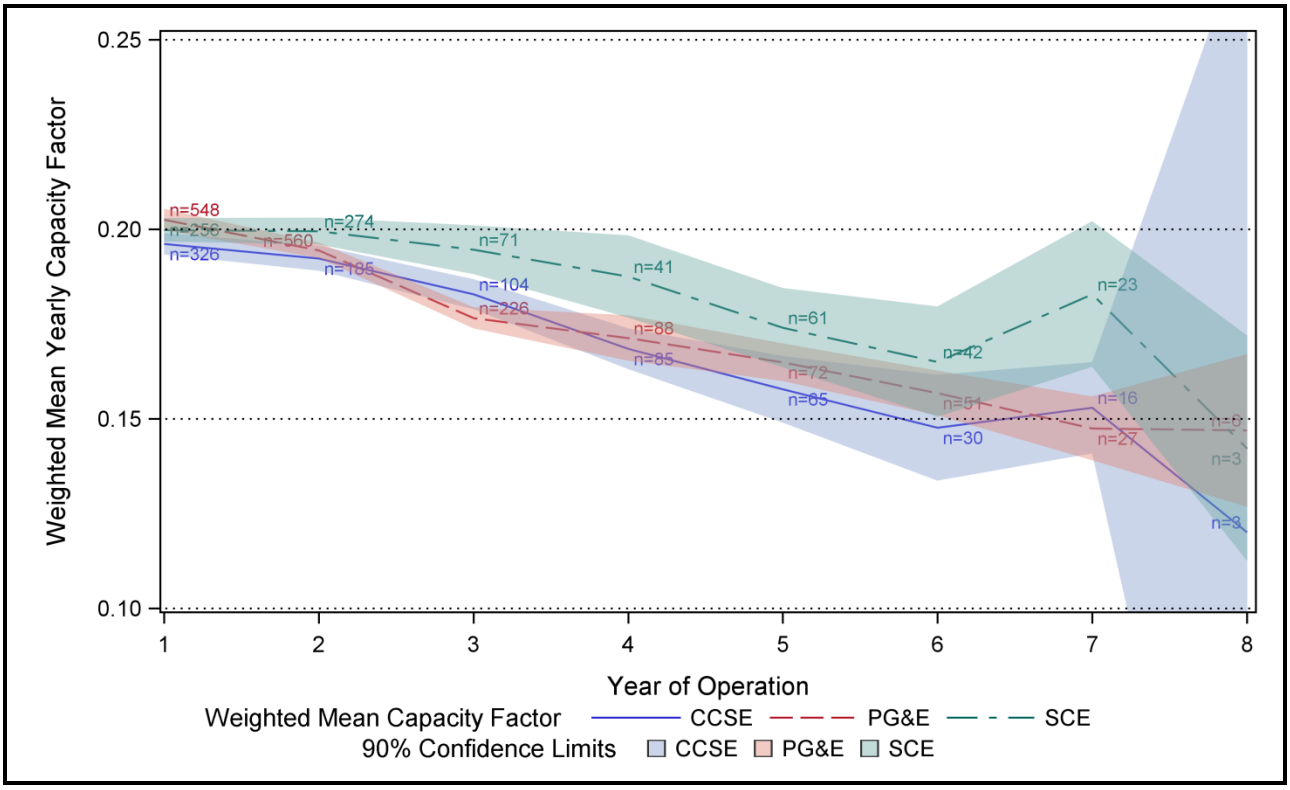
- CSI GM inland systems perform better than CSI GM coastal systems.
- CSI CCSE inland performs better than other regions.
- All CSI regions perform better than CSI PG&E coastal.
- There is, interestingly, no difference between coastal CSI GM PBI systems and inland CSI GM PBI systems.

In general, location of a system matters the most for PV system performance, as confirmed through statistical analysis. Most of the means of inland and coastal PV system performance are significantly different from one another, where inland performs higher in both CSI GM and SGIP programs. Specific results are located in the Appendix A, Tables A-1 through A-4 and A-12.

5.3.3 Performance by PA over Time

In this section, we look at the performance of systems based on the PA over time. The hypothesis is that there should be little or no difference except for the influence of latitude, in which case CCSE system output should be higher than PG&E system output.

Figure 5-3: Performance by PA over Time



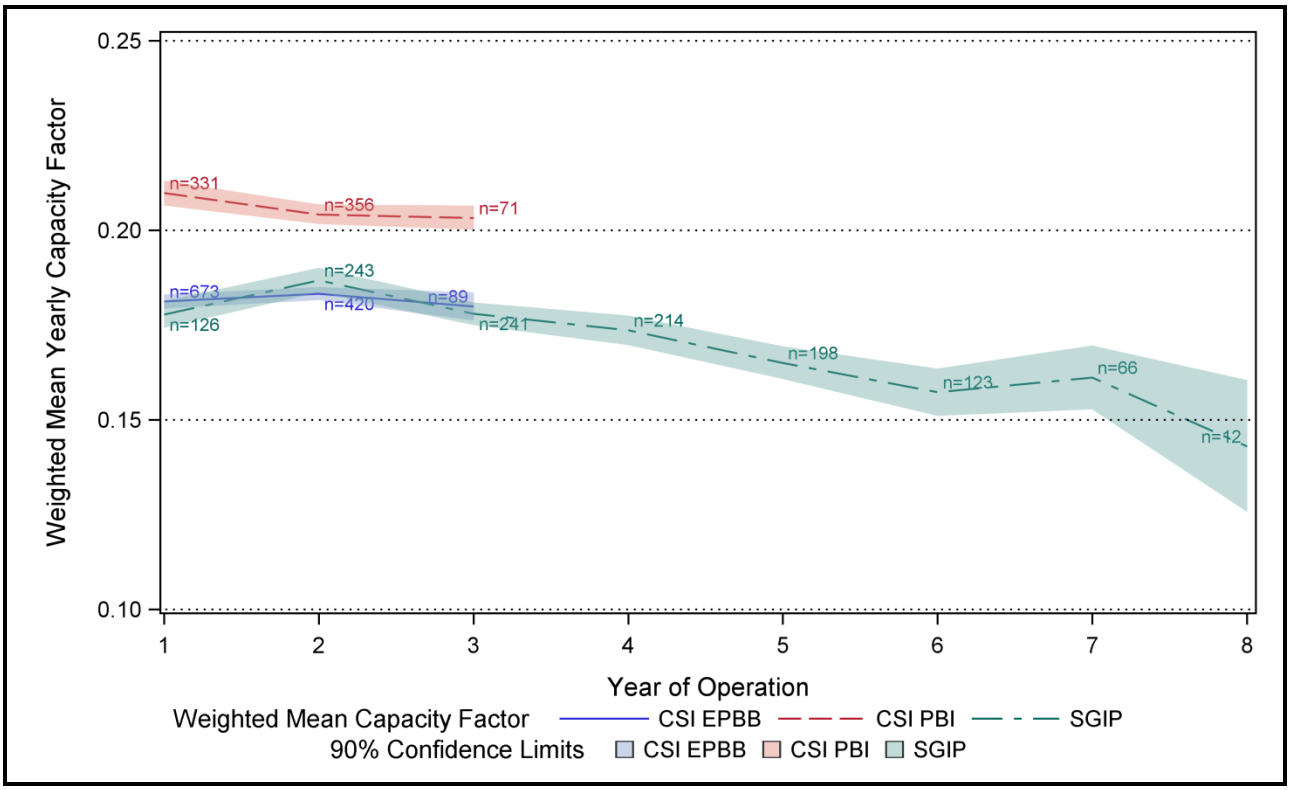
The above graph indicates the performance of systems under each of the PAs and provides different levels of output over time. When we again used ANOVA analysis to isolate the effects of a stratification variable at a finer level, incentive proved significant in explaining the variation between the different PAs. In general, with the inclusion of all variables, PBI systems perform better than EPBB systems. When viewed on a specific level of PA to incentive type, the results differ.

- CCSE five-year PBI systems perform no different than CCSE EPBB systems, but CCSE five-year PBI systems perform better than other PAs' PBI and EPBB systems.
- Only SCE five-year PBI systems perform better than its EPBB systems. Performance of PBI and EPBB systems are not significantly different for PG&E and CCSE.

5.3.4 Performance by Incentive Type over Time

This section looks at the performance of systems based on the type of incentive systems received or are currently receiving. Systems that receive PBI may perform better over time since there is an additional direct financial incentive to maintain the system besides energy output. Figure 5-4 shows the performance over time of CSI GM systems receiving PBI, CSI GM systems that received an upfront EPBB, and SGIP systems that received a capacity-based incentive.

Figure 5-4: Performance by Incentive Type over Time



As the graph illustrates, CSI GM PBI systems outperformed CSI GM EPBB systems in the first three years. Many variables contribute to this separation. The higher percentage of tracking PBI systems has some effect, but even when tracking systems are excluded, CSI GM PBI systems perform substantially better than CSI GM EPBB and SGIP systems

A general t-test analysis shows a significant difference in average output between PBI and EPBB systems: PBI systems perform on average higher than EPBB systems in the third year (note this includes no tracking systems). With a more specific treatment, an ANOVA analysis identifies the interaction of incentive type to both PA and location, as previously mentioned. ANOVA yields the following results.

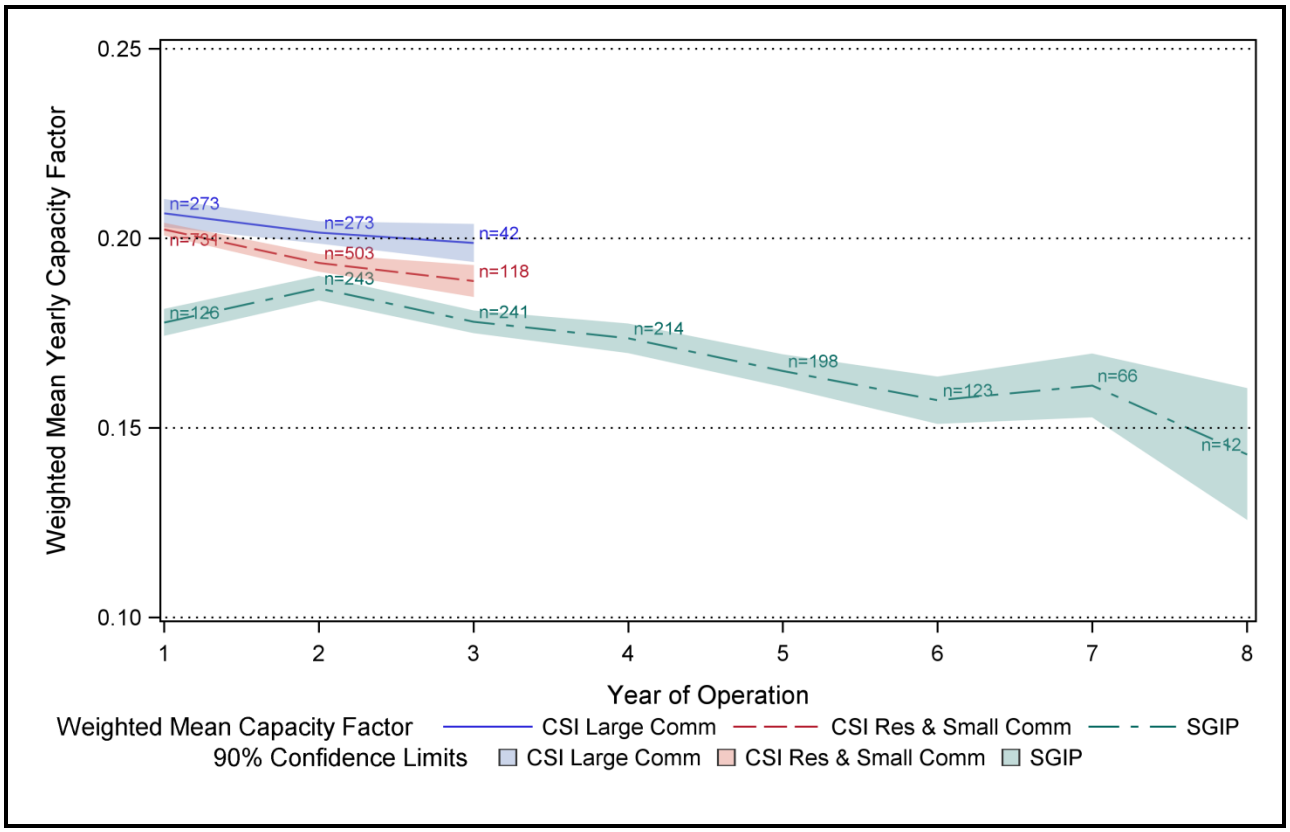
- CSI GM systems perform significantly better than SGIP for each incentive type and PA.
- The difference between EPBB and PBI for PG&E and CCSE is not significant.

Details are located in the Appendix A; Tables A-3 through A-6 and A-14.

5.3.5 Performance by Customer Type

In this section, we investigate performance over time by customer type. The three customer types are large CSI GM large commercial, CSI GM residential and small commercial, and SGIP systems that are predominantly large commercial. As shown in Figure 5-5, CSI GM large commercial systems performed better than CSI GM residential and SGIP systems.

Figure 5-5: Performance by Customer Type over Time



Large commercial CSI GM PV systems show a higher performance relative to capacity factor than CSI GM residential and CSI GM small commercial PV systems. As is evident from the graph, large commercial systems show higher performance than residential systems. Small commercial systems were too few in number to make any inferences.

- There is a 5.0% percentage difference between large and residential CSI systems in the third year.

CSI GM large commercial systems perform on average better than CSI GM residential and small commercial systems. A t-test analysis shows a significant difference in average output between CSI GM large commercial (0.199) and CSI GM residential and small commercial (0.189) CSI GM systems in the third year.

An ANOVA analysis concludes that incentive type has a significant interaction with the type of system. Results below all prove significant.

- PBI large commercial outperform both EPBB large commercial and EPBB residential systems.
- PBI residential systems perform better than EPBB large commercial and EPBB residential systems.
- No significant difference exists between PBI large commercial and PBI residential and small commercial systems.

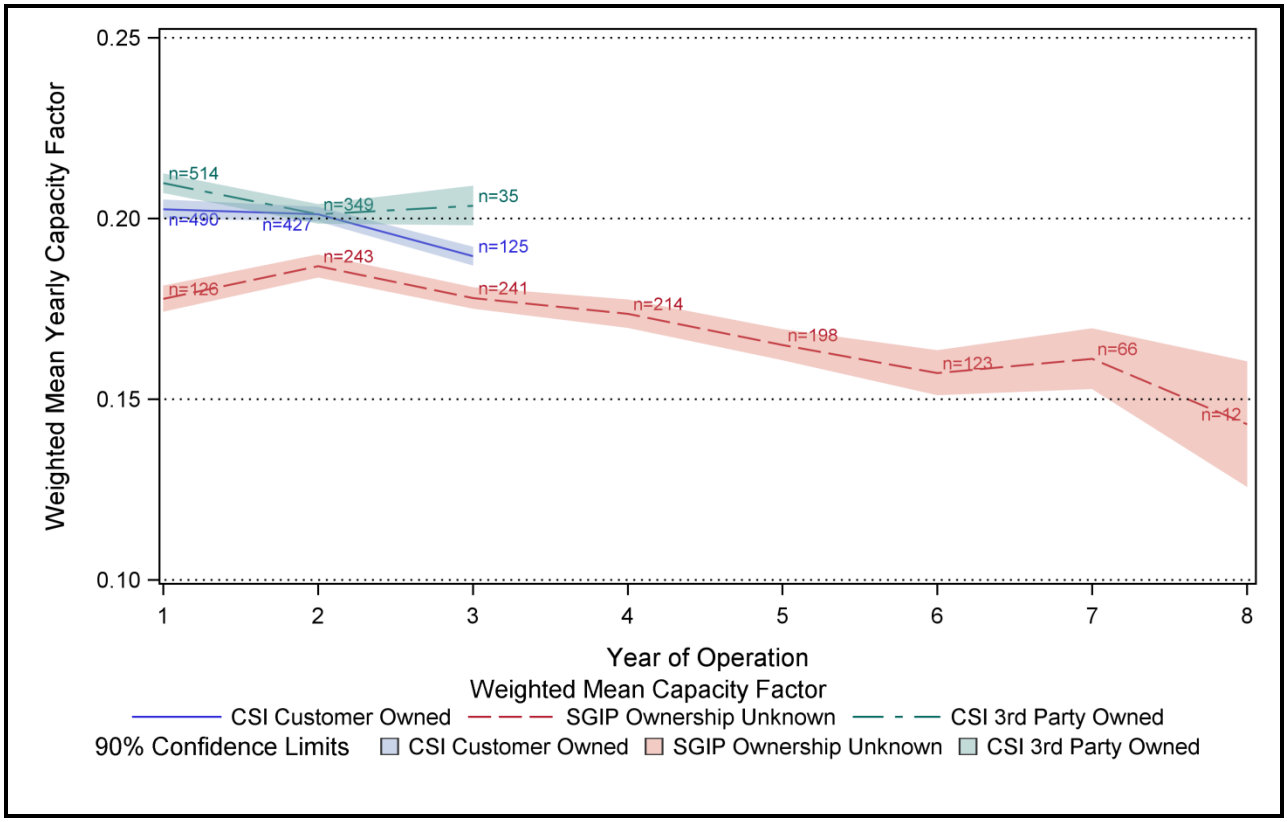
Details are located in the Appendix A Tables A-5 through A-9 and A-15.

Performance by Third-Party Ownership over Time

This section investigates performance over time of customer-owned or third-party-owned systems. The delineation between PPA and leased systems for those with third-party ownership is not readily available. Third-party ownership status for SGIP systems is not known, so these systems are presented separately. Third-party-owned systems are generally installed under one of two different arrangements: a Power Purchase Agreement (PPA) where the customer agrees to pay an agreed upon price for each kWh the system produces, or a lease where the customer pays a set amount per month. Many system agreements for large third-party-owned systems are structured under a PPA and many small residential systems are structured as a lease. However, there are a growing number of residential system ownership agreements structured as PPAs.

Figure 5-7 shows the performance over time results for CSI GM customer-owned systems, CSI GM third-party-owned systems, and SGIP systems.

Figure 5-6: Performance by Ownership over Time



As the graph shows, third-party systems performed better in the first year, about the same in the second year, and slightly better in the third year than customer-owned systems.

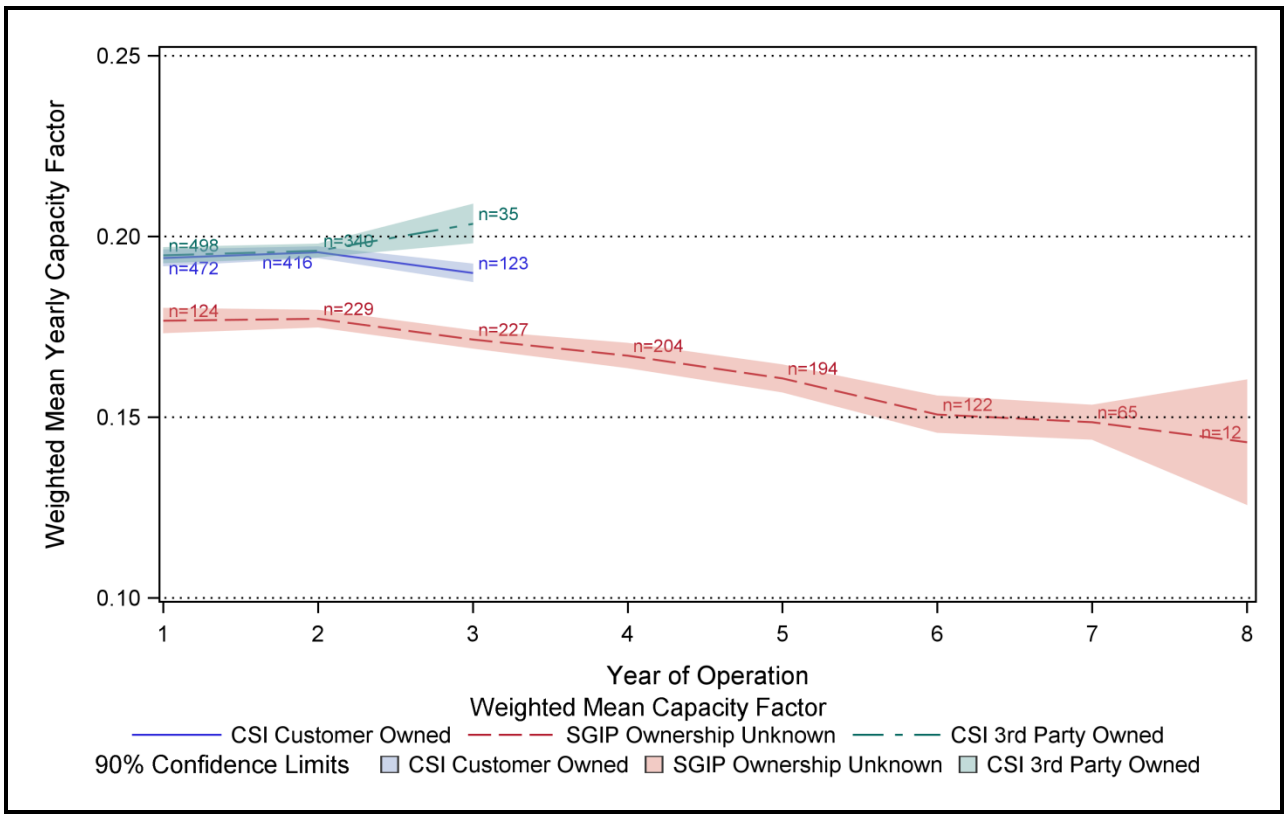
An ANOVA analysis validates that incentive type has a significant interaction with the type of ownership of the system on system performance, details of which may be found in Appendix A. Results below all prove significant in the difference of mean of capacity factors.

- PBI customer-owned and PBI third-party systems both perform better than EPBB customer-owned systems.
- PBI third-party systems perform better than to EPBB third-party systems.
- No significant difference exists between PBI third-party systems and PBI customer-owned systems.

Details are located in the Appendix A Tables A-8 through A-10 and A-16.

However, the better performance of third-party-owned systems can be attributed mostly to contributions from tracking systems. When tracking systems are excluded, customer-owned and third-party systems perform nearly identically, as shown in Figure 5-7. The uptick in third-party third-year performance may be due to a few well-maintained and oriented large commercial systems skewing the small sample. The third-party-owned systems in the third year of operation have a mean expected capacity factor of 0.192, whereas the third-party-owned systems in the second year of operation have a mean expected capacity factor of 0.180. This indicates that the older third-party systems with available data may be oriented and located more optimally than newer systems included in years 1 and 2.

Figure 5-7: Performance of Fixed Systems by Ownership over Time

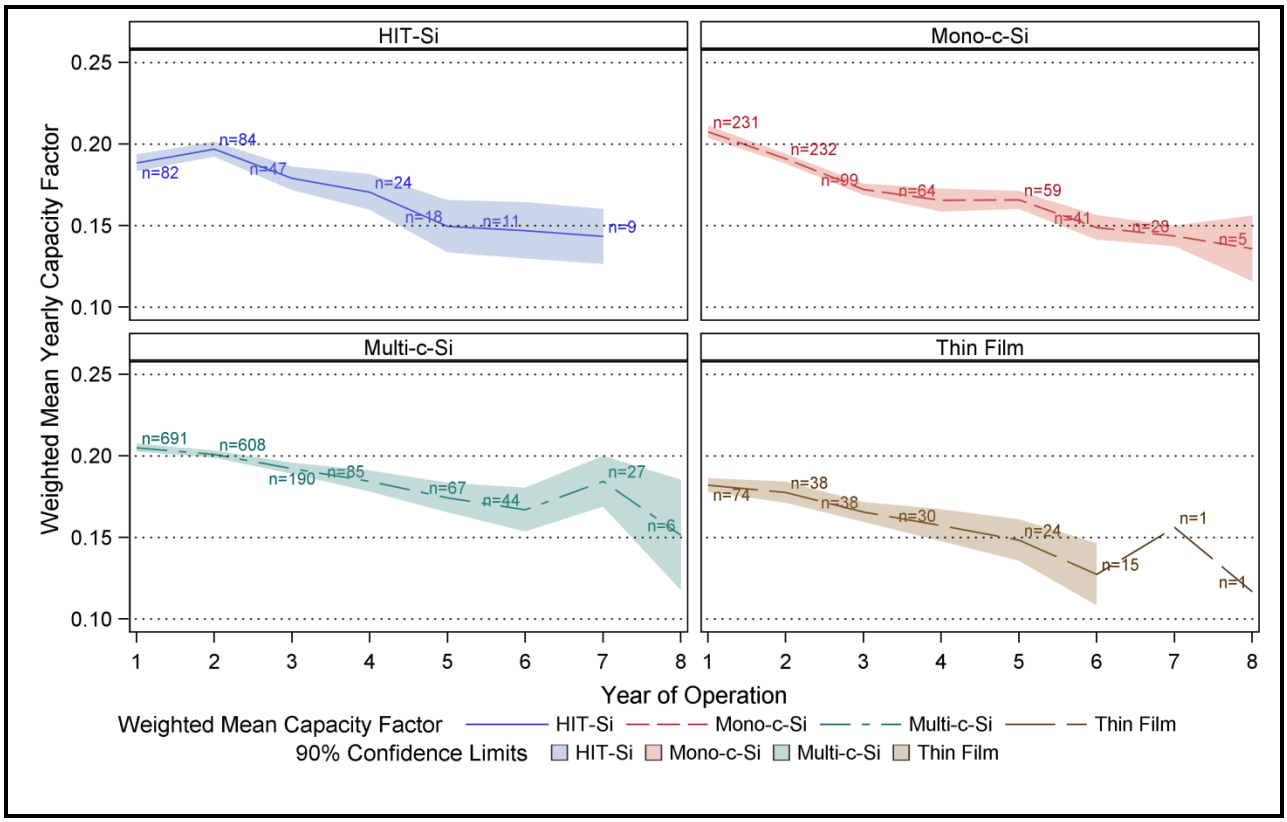


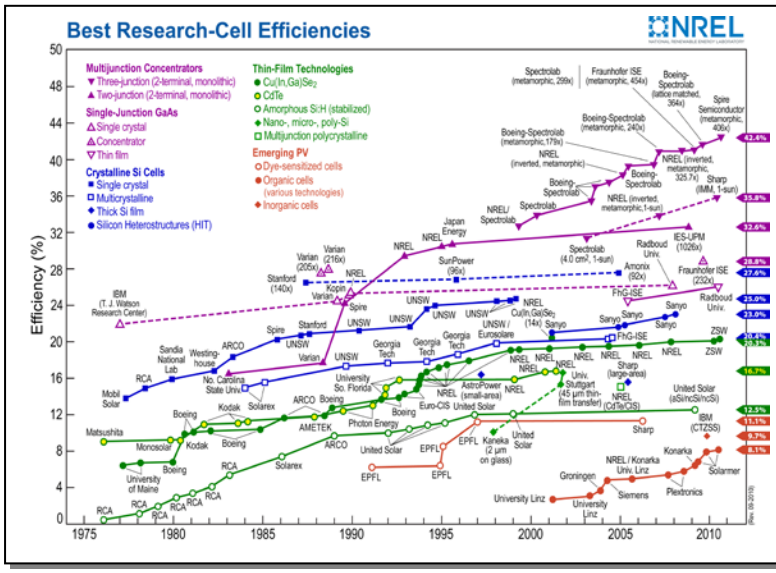
5.3.6 Performance by Module Type over Time

In this section, we investigate performance over time by module type. The four module types examined consist of different chemical and physical construction. Thin film modules include amorphous silicon, cadmium telluride (CdTe), copper indium selenide (CIS), and copper indium gallium (di)selenide (CIGS). Mono-c-Si modules include monocrystalline silicon. Multi-c-Si includes polycrystalline silicon and HIT stands for Heterojunction with Intrinsic Thin Layer.

Figure 5-7 illustrates the number of accounts, capacity factors, and confidence interval bands by year of operation for the different module types. All things equal, the degradation over the years reflects a decrease in module performance considering other system components and environmental factors. The panel allows for the individual analysis of systems based on module type.

Figure 5-8: Performance by Module Type over Time by Panel

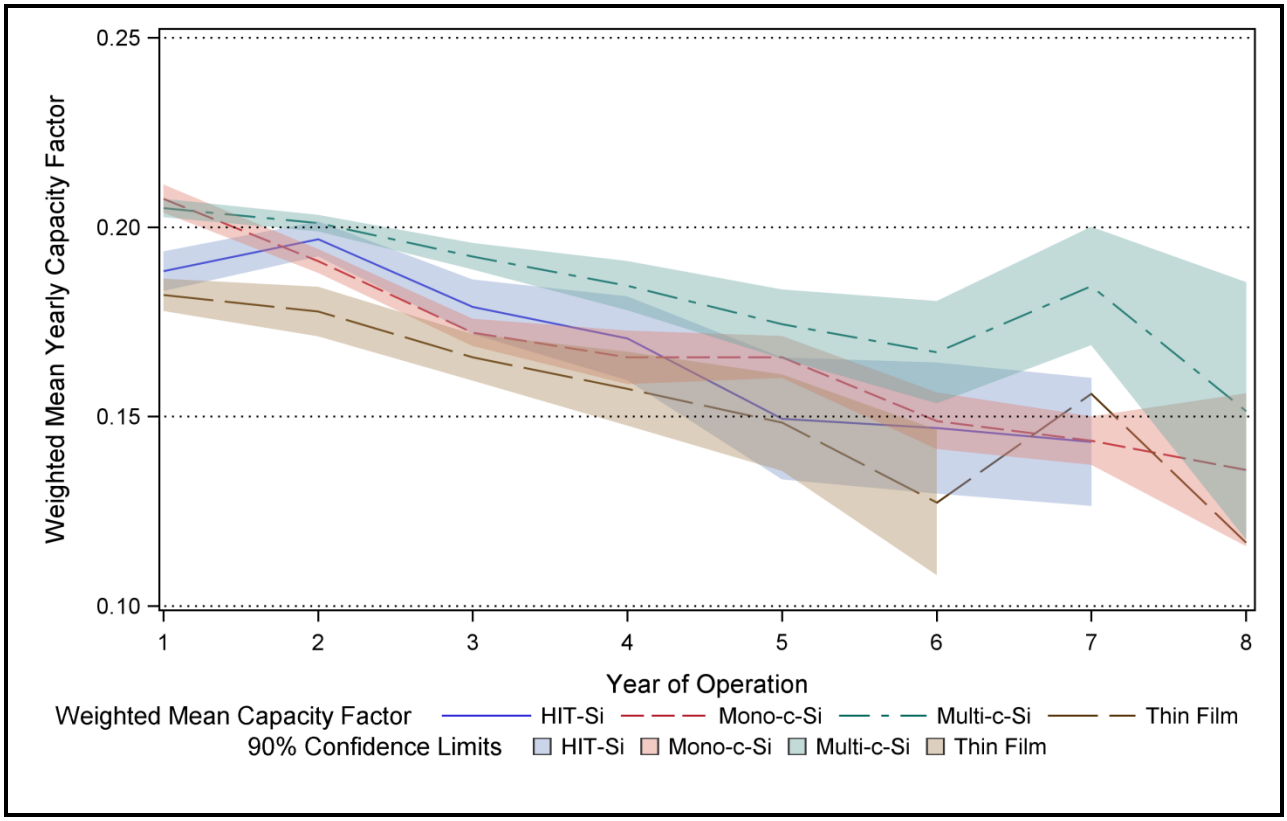




The chart alongside displays the increasing efficiencies of solar cells over time by various solar cell technology types. The range from multi-junction concentrator cells to emerging technology (in/organic cells) is 42% to 8%. Most crystalline Si and thin film cell technologies are currently in the 12 – 20% range. However, it is important to note that efficiency at the panel or module level is always much lower due to framing and encapsulation losses compared to cell efficiency. A typical rule of thumb for system space sizing is 100 sq ft of roof area per kW of rated capacity, which roughly translates to 11% module efficiency.

Figure 5-8 shows the relative degradation of modules to one another. Numbers are excluded for ease of understanding the performance of modules in comparison to one another.

Figure 5-9: Performance by Module Type over Time by Panel



As the graph indicates, multi-c-Si module systems perform better through the years of operations for PV systems.

5.4 Key Findings

Below we summarize and present some key findings for the analysis of CSI GM and SGIP PV performance over time.

- Performance over time analysis for CSI systems is somewhat difficult given the short time span in which these systems have been operational. Future years will provide significantly more data.[1] We will, however, perform further analysis using regression and other tools to attempt to attempt to accurately quantify degradation over time for CSI and SGIP systems as an addendum to this report.
- Systems that receive PBI perform better when initially installed and over time. The better initial performance is due in part to more tracking systems, but the better performance over time may be evidence that the additional financial incentive acts to ensure continued maintenance of the system.
- The impact of third-party ownership on performance over time is not yet clear. Additionally, there is the potential that leased systems may perform differently over time than systems installed under a PPA.

[1] In addition, better insolation data such as that presented by SolarAnywhere as part of a CSI RD&D grant should allow for more precise quantification of degradation corrected for weather. These data are now becoming available but 2010 data were not available in time for this report.

6

Program Impacts

This section presents the impacts of PV systems installed under the CSI GM program and the SGIP on energy delivery, peak demand reduction, air pollution emissions (PM-10 and NOx) and greenhouse gas (GHG) emission reductions.[1] In some cases, impacts of the CSI GM program are further separated by customer groupings of Residential and Small Commercial (<10 kW), and Large Commercial (≥ 10 kW). Rough estimates for contributions from other California public purpose programs offering incentives for the installation of PV (NSHP, MASH, SASH, and ERP) are presented in Section 6.8 and Appendix C.

6.1 Estimation Methodology

Impacts were calculated using a combination of metered and estimated energy. Sources of metered data used for this analysis are described in Section 3. Estimates for unmetered systems were calculated for each hour using data from metered systems. For estimation purposes, systems are grouped by similar characteristics, or strata. Estimates were calculated using data from metered systems within the same strata, to the extent practical.

As described in Section 3, the characteristics used to define strata were:

1. Program Administrator
2. Configuration (Near Flat, Tilted, Tracking)
3. Locale (Inland, Coastal)
4. Program and Incentive Type (CSI GM Residential and Small Commercial (<10kW) EPBB, CSI GM Residential and Small Commercial (<10kW) PBI, CSI GM Large Commercial (≥ 10 kW) EPBB, CSI GM Large Commercial (≥ 10 kW) PBI, SGIP > 300 kW, SGIP ≤ 300 kW)
5. Installation Year Group[2] (2002-2004, 2005-2007, 2008-2010); and
6. Installation Year.

[1] GHG emissions are due primarily to CO_2 emissions and are reported as CO_2 equivalent

[2] "Installation Year Group" refers to a grouping of systems by three successive years of installation, as opposed to "Installation Year" which is when the system was actually installed.

In cases when there were less than two metered systems in a specific stratum, estimates were calculated at the next "higher" strata level (based on the order of the above list of characteristics used to define strata). For example, if it was not possible to match strata all the way down the list to Installation Year, estimates were calculated at the Installation Year Group level, and so on up through the list. Estimates calculated at less detailed strata levels (i.e., estimated at higher or less certain levels) accounted for only 8.3% of total generation in 2010. The remaining 91.7% of total generation was either directly metered or estimated at the lowest level (i.e., that with the most detailed strata, using all strata-defining characteristics), as detailed in Table 6-1.

Table 6-1: Distribution of Estimated Energy among Strata

Strata Level	Estimated Energy (MWh)	% of Estimated Energy	% of Total Energy*
PA	25	0.0%	0.0%
PA & PV Config	110	0.0%	0.0%
PA & PV Config & Location	15,354	3.5%	1.9%
PA & PV Config & Location & Program/Incentive Type	17,087	3.9%	2.1%
PA & PV Config & Location & Program/Incentive Type & Installation Year Group	34,804	8.0%	4.3%
PA & PV Config & Location & Program/Incentive Type & Installation Year Group & Installation Year	370,282	84.6%	45.5%
Directly Metered Energy	N/A	N/A	46.2%

* Percent of total energy entries appear to add up to more than 100% due to rounding of tabulated values.

Impacts were calculated for systems deemed to be operational ("complete" or "active on-line") on or before December 31, 2010. Information regarding system characteristics (i.e., capacity, location, and operational date) came from project tracking databases maintained by the PAs. Downtime due to maintenance or decommissioning (when a system was considered "off-line") was not tracked for individual systems, but these events were estimated through the sample of metered data. If a system within the metered data sample went off-line, data reflecting zero generation were included in the analysis. When the metered data was then used to calculate estimates for unmetered systems, the effects of downtime within the metered sample population were extrapolated to the estimated population.

Appendix B of this report provides further description of the data analysis, methodology, and treatment of statistical uncertainty used for this evaluation.

6.2 Total Energy Delivery

This section presents total annual and quarterly energy delivery for the CSI GM program and the SGIP. By the end of 2010, there were 41,663 complete or active on-line CSI GM PV systems

providing nearly 438 MW of electric generating capacity, and 890 SGIP PV systems with a capacity of 136 MW. Table 6-2 provides the estimated quantity of electric energy (in MWh) delivered by CSI GM and SGIP PV systems for each quarter of calendar year 2010.

Table 6-2: Energy Delivered by 2010 Quarter—CSI GM and SGIP PV Systems[3]

Program	Q1 (MWh)	Q2 (MWh)	Q3 (MWh)	Q4 (MWh)	Total (MWh)
CSI	98,655	195,220	210,561	117,594	622,031
SGIP	36,781	68,078	63,837	22,815	191,512
Both	**135,437**	**263,298**	**274,399**	**140,409**	**813,543**

CSI GM and SGIP PV systems generated over 800,000 MWh of electricity during 2010. That energy was enough to meet the electricity requirements of approximately 135,000 homes for a year.[4] CSI GM systems contributed over 620,000 MWh to the total; a 59% increase from the amount generated in 2009.[5] This increase is due to increased overall capacity of PV systems between 2009 and 2010. SGIP PV systems contributed over 190,000 MWh of electricity during 2010, a 5.7% decrease from 2009.[6] The decrease results from system degradation, time off-line and lower solar insolation during 2010, a year in which no new SGIP PV systems were installed. As expected, PV systems deliver substantially more energy in Q2 and Q3 than Q1 and Q4, due to seasonal variation. This seasonal variation is further explored in Section 6.3.

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3 The uncertainty for MWh values in Table 6-2 is better than 90/10 confidence/precision level (sample estimates are within ±10% of the true value, 90% of the time). See Section 3.4 on Data Types, Availability over Time, and Sampling for a more detailed discussion of the sampling approach used for this analysis to provide statistically significant estimates.

4 Assuming the typical home consumes approximately 5,914 kWh of electricity per year. KEMA-Xenergy, *California Statewide Residential Appliance Saturation Study Final Report*, June 2004, http://www.energy.ca.gov/reports/400-04-009/2004-08-17_400-04-009ALL.PDF.

5 In 2009, 390,750 MWh were estimated to be generated by CSI GM systems. In 2008, 118,489 MWh were estimated to be generated by CSI GM systems. The 2008 and 2009 CSI GM impacts are reported in the following reports, respectively:

Itron, Inc., *CPUC California Solar Initiative: Final 2007-2008 Impact Evaluation Final Report*, February 2010, http://www.cpuc.ca.gov/NR/rdonlyres/363B9946-1E9E-4A66-9F77-79CFDF3032F4/0/CSIFinal0708ImpactEvaluation.pdf

Itron, Inc., CPUC California Solar Initiative: 2009 Impact Evaluation Final Report, June 2010, http://www.cpuc.ca.gov/NR/rdonlyres/70B3F447-ADF5-48D3-8DF0-5DCE0E9DD09E/0/2009_CSI_Impact_Report.pdf

6 In 2009, 203,044 MWh were estimated to be generated by SGIP PV systems. Itron, Inc., *California Self-Generation Incentive Program: Ninth-Year Impact Evaluation Final Report*, June 2010, http://www.cpuc.ca.gov/NR/rdonlyres/B9E262AA-4869-461A-8D5C-EE3827E9AA9D/0/SGIP_Impact_Report_2009_FINAL.pdf

CSI GM and SGIP systems are located at utility customer sites where they help meet local electricity requirements. Consequently, the electricity provided by CSI GM and SGIP systems represents electricity that did not have to be generated by central station power plants or delivered by the transmission and distribution (T&D) system. Moreover, electricity generated by CSI GM and SGIP PV systems help reduce air pollution and GHG emissions that would have otherwise resulted from fossil-fueled utility generation systems.

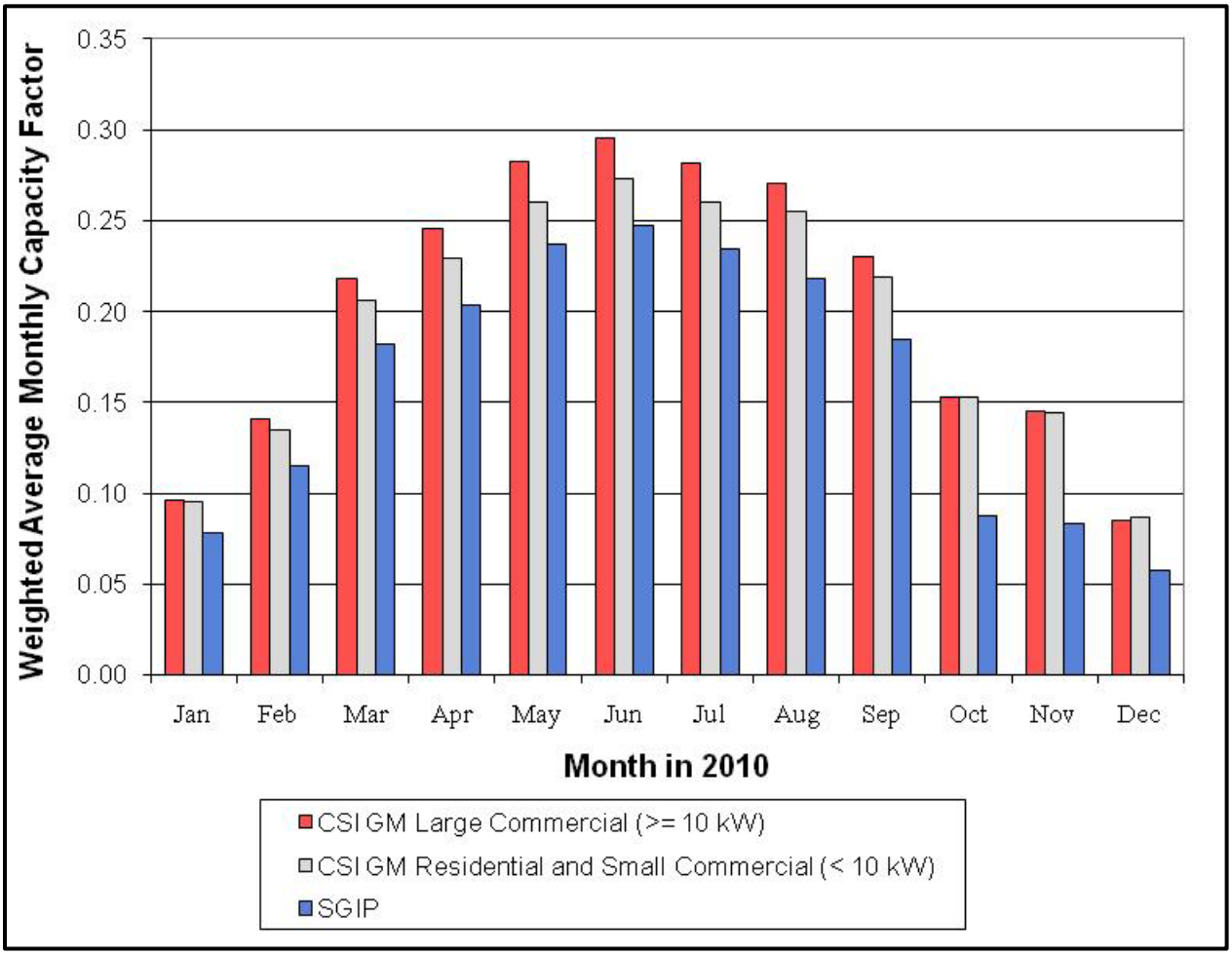
6.3 Monthly Capacity Factor Analysis

In addition to examining the amount of energy delivered annually by PV systems, it is also valuable to analyze the variation in energy delivery during the course of the year. For this evaluation, weighted average capacity factors (CFs)[7] were developed for all systems by comparing generation over a time period to rated capacity. For example, if a 1 kW PV system provided 6 kWh of energy over a 24-hour period, the daily capacity factor of that system would be 0.25 (i.e., 6 kWh divided by (1 kW times 24 hours)). Unless otherwise stated, capacity factors listed in this section refer to weighted capacity factors.

Capacity factor is useful in providing insights into the capability of a generating technology to provide power during a particular time period. For example, annual capacity factors indicate the fraction of energy that could, on average, be expected from that technology over the course of a year. Similarly, average monthly capacity factors represent the fraction available, on average, during any particular month. Weighted average monthly capacity factors for 2010 CSI GM and SIP PV systems are shown in Figure 6-1.

[7] Annual capacity factors are weighted by the rated capacity of each system.

Figure 6-1: Weighted Average 2010 Capacity Factors by Month—CSI GM* and SGIP PV Systems



* 39% of this impact is derived from CSI EPBB systems, by capacity.

As expected, capacity factors during 2010 were highest in summer months, peaking in June for all three system categories at 0.25 to 0.29, and lowest in wintertime, dropping below 0.1 for all categories in January and December. The weighted annual average estimated capacity factor for all CSI GM and SGIP PV systems in 2010 was 0.19 (2.0 for CSI GM systems and 0.16 for SGIP systems). The CSI GM large commercial systems had a higher capacity factor in part because a greater percentage of these systems were tracking systems (21% versus 0.31% for CSI GM Residential and Small Commercial systems), which have higher capacity factors than comparable fixed systems. Additionally, commercial systems may receive better maintenance and monitoring, which would tend to increase the capacity factor. As a group, residential systems may benefit during low-sun-angle- and wet months from having a higher average tilt associated with sloped rooftop installations (as opposed to the flat rooftop or ground installations more typical at commercial sites). This would result in higher solar radiation incident angles and cleaner modules. SGIP PV systems have a lower capacity factor at least partly because these

systems tend to be older and are more likely to be flat (as they are primarily commercial installations) than CSI GM systems.

6.4 PA-Specific Energy Delivery

Table 6-3 presents annual energy delivered by PV systems installed under the CSI GM program and SGIP individually and combined for each PA, the corresponding number of PV systems and capacity installed by the end of 2010, and the annual capacity factors.

Table 6-3: Annual Energy Impacts by PA and Program

Program Administrator	Program	PV Systems (n)	Rated Capacity (MW)	Generation (MWh)*	Annual Capacity Factor (kWh/kW rebated)
CCSE**	CSI	5,704	46	69,422	0.21
	SGIP	105	14	17,431	0.14
	Both	**5,809**	**60**	**86,853**	**0.19**
PG&E	CSI	24,461	252	347,728	0.19
	SGIP	494	81	111,490	0.16
	Both	**24,955**	**333**	**459,218**	**0.18**
SCE	CSI	11,498	140	204,880	0.20
	SGIP	291	41	62,591	0.18
	Both	**11,789**	**181**	**267,471**	**0.20**
All	CSI	41,663	438	622,031	0.20
	SGIP	890	136	191,512	0.16
	Both	**42,553**	**574**	**813,543**	**0.19**

* The uncertainty on all of generation (MWh) estimates presented in Table 6-3 is better than 90/10 confidence.

PV systems installed in the PG&E service area are estimated to have supplied 56% of the total electricity delivered statewide by the CSI GM program and SGIP in 2010. In comparison, PV systems in SCE and CCSE service areas supplied approximately 33% and 11%, respectively. The magnitude of electricity delivery in the PG&E territory is not surprising given that PG&E had over 24,900 PV systems representing 333 MW in 2010, accounting for 59% of all systems and 58% of the total installed capacity.

The 2010 average annual weighted capacity factors shown in Table 6-3 for CSI GM systems are higher than those seen for SGIP PV systems. This difference could be due to a number of factors, including:

- **System Degradation:** The average age of CSI GM systems is about 1.5 years, whereas the average of SGIP systems is over five years. Older systems tend to produce less

energy due to module degradation, and increased outages due to maintenance and component failures.

- **System Configuration:** CSI GM systems are more likely to be tilted and more likely to be facing southwest. The ratio of Near Flat to Tilted systems is approximately 1:1 in the CSI GM program and 3:1 in the SGIP. Tilted systems tend to have higher annual and peak capacity factors because the panels are pointed more directly at the sun.
- **System Technology and Installation Improvements:** Technological and service advances may increase efficiency of more recent installations.

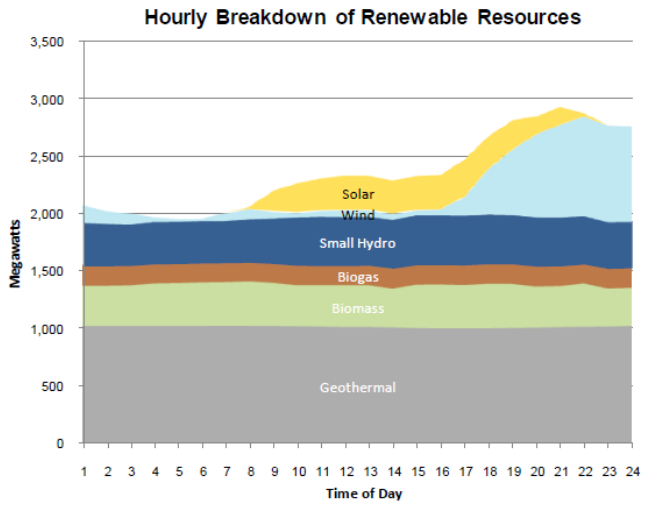
Note that the number of systems and capacities shown in Table 6-3 represents the number of systems on-line at the end of 2010, some of which came on-line mid-year and contributed to generation for only part of the year. The capacity factors shown result from calculations on hourly data throughout the year to accommodate for system additions. This is one reason why capacity factors cannot simply be calculated from generation and rated capacity values shown in the table.

6.5 Peak Hour Demand Impacts

This section presents the impact of the CSI GM program and the SGIP on peak electricity demand. Generation coincident with the CAISO system peak hour for 2010 is analyzed, along with the individual peak hours for each PA's system.

The ability of CSI GM and SGIP PV systems to supply electricity during times of peak demand represents a critical impact. By providing electricity directly at the customer site during peak hours, these PV systems potentially reduce the need for utilities to power up expensive generating facilities to supply electricity to these customers during these time periods. As a result, the CSI GM program and SGIP may provide grid benefits by alleviating the need to dispatch potentially older, more

CAISO Renewables Watch for Operating day: Aug 25, 2010 (2010 load peak occurred 3:00-4:00 pm)



The Renewables Watch provides important information about actual renewable production within the ISO grid as California moves toward a 33 percent renewable generation portfolio. The central station solar shown here can also be seen as a critical peak contributor with 342 MW on this particular day.

Source: CAISO

polluting and more expensive peaking generators, as well as decreasing transmission and distribution line congestion.

6.5.1 CAISO Peak Hour Demand Impact

The 2010 CAISO load peaked on August 25 from 3:00 to 4:00 PM Pacific Daylight Time (PDT)[8] at 47,282 MW.[9] This was a slight increase from the previous three years, each of which had CAISO peaks closer to 46,000 MW.

Table 6-4 shows the number of CSI GM and SGIP PV systems and their combined capacity online during the CAISO peak hour in 2010.[10] This table also presents generation and peak hourly capacity factor for each program individually and combined. Peak Hourly Capacity Factor is defined as the energy generated during that hour (kWh peak hour) divided by the nominal rated AC capacity (kW rebated.)

Table 6-4: Estimated Demand Impact Coincident with 2010 CAISO System Peak Hour*

Program Administrator	Program	PV Systems (n)	Rated Capacity (MW)	Generation (MWh)*	Peak Hourly Capacity Factor (kWh peak hour/kW rebated)
CCSE	CSI	4,967	42	22	0.53
	SGIP	105	14	5	0.33
	Both	**5,072**	**56**	**27**	**0.48**
PG&E	CSI	21,368	219	145	0.66
	SGIP	494	81	44	0.55
	Both	**21,862**	**299**	**189**	**0.63**
SCE	CSI	9,398	121	59	0.48
	SGIP	291	41	16 †	0.40
	Both	**9,689**	**162**	**75**	**0.46**
All	CSI	35,733	382	226	0.59
	SGIP	890	136	65	0.48
	Both	**36,623**	**517**	**291**	**0.56**

* No symbol indicates confidence is better than 90/10.

† indicates confidence is better than 70/30.

8 Unless otherwise stated, all times in this report are listed as Pacific Daylight Time.

9 CAISO peak demand information is determined from the actual system demand values provided by http://oasis.caiso.com/.

10 The number of systems online for the CAISO peak is slightly fewer than shown in Table 6-3 because new systems continued to come online throughout the remainder of the year.

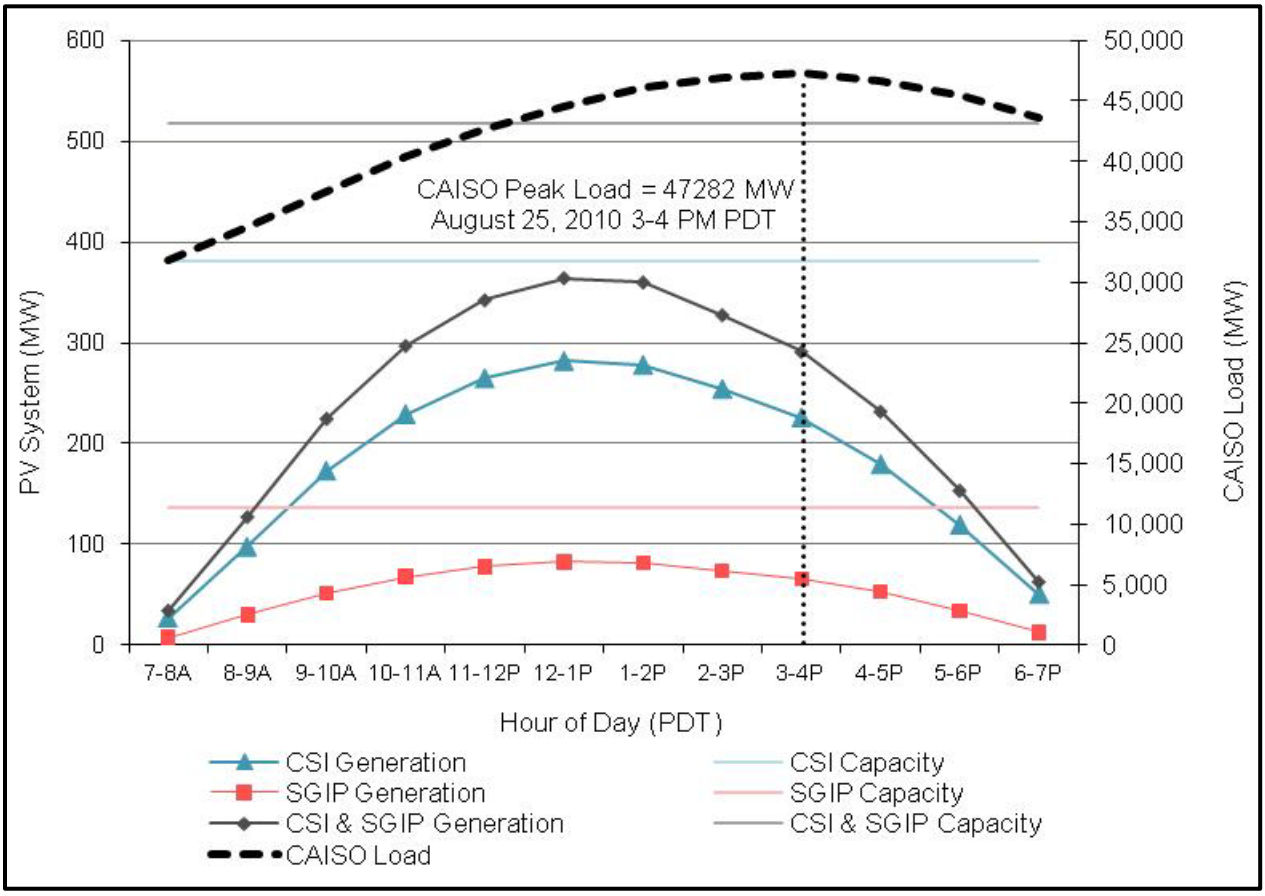
In 2010, there were over 36,600 CSI GM and SGIP PV systems online at the time of the CAISO system peak. While these online systems had a CEC AC capacity of approximately 517 MW, their generating output for that hour was estimated to be 291 MWh. Consequently, CSI GM and SGIP PV systems had a capacity factor of 0.56 for the 2010 CAISO system peak hour. The peak hour capacity factor for systems in PG&E territory was notably higher. The largest contributor to this difference is cloudy weather conditions in the Southern California region. It is worth noting that 85% of capacity in SCE territory is in "Inland" climate zones where higher temperatures have a greater impact on system efficiency, compared to around 50% for each PG&E and CCSE. Another small factor is that tracking systems, with higher performance in the late afternoon peak hour, make up almost 15% of installed capacity in PG&E territory; which is nearly 50 and 270% more than for systems in SCE and CCSE territory, respectively.

Figure 6-2 shows the estimated hourly impact of CSI GM and SGIP PV projects on the 2010 CAISO system peak day. Generating capacity increased steadily from 7:00 AM to 12:00 PM, remained fairly level from 12:00 PM to 2:00 PM, and then declined steadily through the rest of the afternoon. This overall generation profile is typical of PV systems. The peak capacity factor for this day occurs between 12:00 PM and 1:00 PM (approximately solar noon[11]) and is approximately 0.70. Possible reasons for this peak capacity factor being less than one include:

- The CAISO peak day load is usually driven by cooling demand on a hot day, when PV panels do not perform quite as efficiently as when tested at 20°C (68°F).
- In 2010, the CAISO fell relatively late in the summer when dust and dirt have typically built up on panels (also known as soiling), causing a reduction in performance, and before the winter rains typically wash those systems that are not cleaned through regular service.
- The estimated production includes metered data for some systems that are not generating due to maintenance or other problems.

[11] Solar noon is the moment when the sun appears highest in the sky (nearest zenith), compared to its positions during the rest of the day.

Figure 6-2: Estimated Hourly Impact of CSI GM and SGIP PV Systems on 2010 CAISO Peak



6.5.2 IOU Peak Hour Demand Impacts

A similar analysis was performed looking at the individual peaks of the three IOU[12] service areas. The PG&E peak occurred on the same day as the CAISO peak but one hour later (August 25, 2010 from 4:00 PM to 5:00 PM), while the two other IOU peaks both occurred on September 27, 2010 from 2:00 PM to 3:00 PM.[13]

[12] The non-profit organization CCSE is the PA for the SDG&E service territory.

[13] IOU peak demand information is determined from the actual system demand values provided by CAISO and available at http://oasis.caiso.com.

Table 6-5 shows the number and rated capacity of CSI GM and SGIP PV systems online during the IOU system peaks by PA, the associated impact on the IOU peak, and weighted capacity factor for the peak hour.

Table 6-5: Estimated PA-Specific IOU Peak Impacts

Program Administrator	Program	Peak Date and Time (PDT)	PV Systems (n)	Rated Capacity (MW)	Generation (MWh)*	Peak Hourly Capacity Factor (kWh peak hour/kW rebated)
CCSE	CSI	September 27, 2:00 to 3:00 PM	5,152	43.2	29.4	0.68
	SGIP		105	14.2	5.9	0.42
	Both		**5,257**	**57.4**	**35.3**	**0.62**
PG&E	CSI	August 25, 4:00 to 5:00 PM	21,368	218.6	119.4	0.55
	SGIP		494	80.9	37.0	0.46
	Both		**21,862**	**299.5**	**156.4**	**0.52**
SCE	CSI	September 27, 2:00 to 3:00 PM	10,015	129.7	80.3	0.62
	SGIP		291	40.8	21.9	0.54
	Both		**10,306**	**170.4**	**102.2**	**0.60**

* The uncertainty on all of these estimates is better than 90/10 confidence.

6.6 Impact during Top CAISO Demand Hours

As noted earlier, the ability of distributed generation systems to provide electricity at the time of the CAISO or utility-specific peak demand is important. Electricity generated from CSI GM and SGIP PV systems means potentially less need for the utility to rely on expensive peak generating systems and transfer of electricity through the T&D system. However, each of these peaks represent only a single hour out of the 8,760 hours in a year. Consequently, examining only the impact on the single peak hour demand, while helpful, does not indicate the extent to which the utilities can rely on obtaining electricity from the PV resource over the course of the year.

In late 2004, the CPUC began investigating standardized definitions and procedures for quantifying resource adequacy.[14] Resource adequacy is used for determining the amount of resources that must be procured by load-serving entities (LSEs)[15] to ensure supplies are sufficient to meet anticipated demand. Qualifying capacity (QC) is the amount of a resource's capacity, prior to adjustment for deliverability, which can be counted towards meeting the resource adequacy procurement obligation. Net qualifying capacity (NQC) is the amount of a

[14] On October 28, 2004, the CPUC issued an interim opinion on resource adequacy in Decision D.04-10.-035. http://docs.cpuc.ca.gov/published/Final_decision/41416.htm

[15] IOUs, energy service providers (ESPs) and community choice aggregators (CCAs) are collectively referred to as LSEs.

resource's capacity that can actually be counted for resource adequacy compliance filings. In Decision D.09-06-028, the CPUC revised the existing rule for the NQC of intermittent wind and solar power generation believing the existing method "significantly overstated the dependable level of generation that is available during peak hours." More specifically, the CPUC adopted a 70% "exceedance" method such that "the qualifying capacity of a wind or solar resource would be equal to the minimum output achieved by the resource for at least 70% of the hours in the data set of historical generation for each month."[16]

6.6.1 Demand Analysis Methodology

For PV systems, then, resource adequacy is fundamentally based on the calculation of a 70% exceedance. This essentially means that the PV system would have a 70% probability of exceeding that value. A "diversity benefit"[17] is then added to account for smoothing generation variability by combining additional resources and geographies. It is worth noting that CAISO resource adequacy analysis does not include distributed generation resources such as PV systems.

The evaluation of CSI GM and SGIP PV impacts on peak CAISO hours follows analysis similar to the resource adequacy framework outlined by the CPUC. However, it is difficult to assign the diversity benefit factor for distributed generation systems because of how the factor varies with the definition of a "site." For this reason the 70% exceedance value is used as the evaluation metric.

6.6.2 Effective Capacity Results

The weighted average capacity factors that have a 70% chance of being exceeded during the top CAISO demand hours are shown in Figure 6-3. These are grouped by orientation and presented for increasing ranges of the top CAISO demand hours. For example, the left most group, labeled 1-100, represents capacity factors for the 100 highest CAISO demand hours. The next group, labeled 1-200, represents the 200 highest CAISO demand hours, and so forth. Within each group, data is presented for the following system configurations: tilted (fixed) with any azimuth, labeled "Tilted – All"; tilted (fixed) with west facing azimuth (225° – 315°), labeled "Tilted – West"; and tracking systems, labeled "Tracking." Data for near flat systems and a population wide value are not presented because both are very close to the "Tilted – All" data.

[16] CPUC D.09-06-028, June18, 2009, page 2 http://docs.cpuc.ca.gov/published/FINAL_DECISION/102755.htm

[17] The diversity benefit is the result of higher output from some wind/solar resources offsetting lower output of other resources.

Figure 6-3: Capacity Factor (CF) 70% Probability to be Exceeded during Top 2010 CAISO Demand Hours

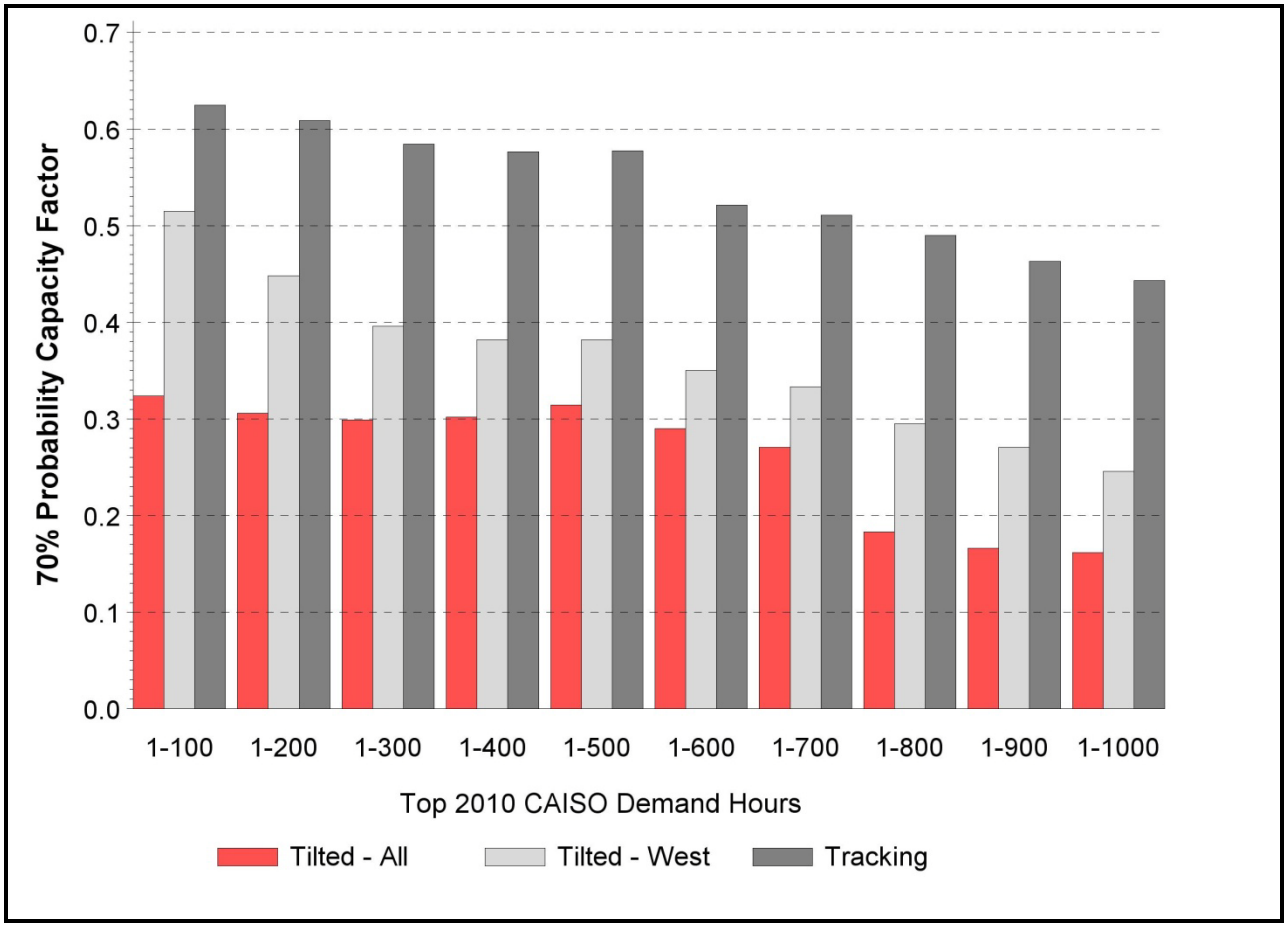


Figure 6-3 shows that most PV systems are likely to generate at about one-third of their rated capacity during top demand hours. Tracking systems perform much better, with a 70% probability-to-exceed 0.60 capacity factor. Facing fixed systems west increases the 70% probability-to-exceed capacity factor to above 0.50 during the top 100 hours, approaching the performance of tracking systems and out-performing all fixed systems by nearly 60%. This illustrates how west-facing systems are significantly better at off-setting peak load than south-facing ones, even though they have slightly lower annual energy yields. Incentives and rates that favor tracking and west facing systems, such as the CSI, encourage installation of systems that are more effective in generating energy during top demand hours.

6.7 GHG and Air Pollution Emissions Reductions

Interest in climate change has increased over the last several years with special emphasis being placed on reducing GHG emissions. Obtaining accurate measures of reductions in GHG emissions will increase in importance, particularly in the event of a cap and trade program for

carbon credits. This section describes the impacts of CSI GM and SGIP PV projects on CO_2, PM-10, and NOx emissions. GHG impacts primarily result from CO_2 reduction, while PM-10 and NOx reductions represent impacts on general air pollution levels.

6.7.1 GHG Emissions Analysis Approach

Solar PV systems convert sunlight to electricity via solid state processes that do not have associated emissions. Consequently, CSI GM and SGIP PV systems reduce GHG, NOx, and PM-10 emissions by displacing electricity that would otherwise have been generated by utility-based power plants. Emissions reduction estimates are based on emissions that would have been emitted to generate an equivalent amount of electricity by centralized power plants. These emissions are taken from hourly estimates developed by Energy and Environmental Economics, Inc. (E3).

E3 established hourly emissions estimates based on profiles of base-load power plants and peaking plants. The E3 emission estimates took into account the mix of generators for each utility. Unlike base-load power plants, the operation of peaking plants varies throughout the year. E3 assumed the dispatch of peaking facilities was based on avoided costs (i.e., peaking facilities would be brought online based on need and marginal heat rate). As a result, E3 established an avoided costs workbook that provided hourly estimates of GHG impacts per kWh and which reflected a full year of hourly CO_2 emission factors.[18]

6.7.2 GHG Emissions Analysis Results

Table 6-6 shows the impact of solar projects on CO_2, PM-10, and NOx emissions with splits by PA and program. When reporting emission impacts from different types of greenhouse gases, total GHG emissions are reported in terms of tons of CO_2 equivalent (CO_2Eq) so that direct comparisons can be made.[19] Overall, the CSI GM program and the SGIP provided nearly 400,000 tons of CO_2 emissions reductions during 2010. Over 57% of the emission reductions resulted from solar energy systems installed in the PG&E service territory, which follows the generation and installed capacity presented in Section 6.4. In comparison, PV systems installed in the SCE and CCSE (SDG&E) regions resulted in approximately 32% and 11% of the overall 2010 emission reductions, respectively.

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[18] Energy and Environmental Economics for the California Public Utilities Commission, "Methodology and Forecast of Long Term Avoided Costs for the Evaluation of California Energy Efficiency Programs," October 25, 2004.

http://ethree.com/CPUC/E3_Avoided_Costs_Final.pdf

Update provided via communication from E3 on May 16, 2011

[19] To calculate the CO_2Eq, the global warming potential of a gas as compared to that of CO_2 is used as the conversion factor (e.g., The global warming potential of CH_4 is 21 times that of CO_2. Thus, to calculate the CO_2Eq of a given amount of CH_4, multiply that amount by the conversion factor of 21.

Table 6-6: Estimated GHG Emissions Reductions—CSI GM and SGIP PV Systems

Program Administrator	Program	CO_2 Emissions Avoided (Tons)	Generation (MWh)	CO_2Eq Factor (Tons/MWh)	PM-10 Emssions Avoided (lbs)	NOx Emssions Avoided (lbs)
CCSE	CSI GM	33,380	69,422	0.481	4,459	7,663
	SGIP	8,315	17,431	0.477	1,113	1,892
	Both	**41,694**	**86,853**	**0.480**	**5,572**	**9,554**
PG&E	CSI GM	171,372	347,728	0.493	22,760	40,409
	SGIP	54,816	111,490	0.492	7,284	12,893
	Both	**226,187**	**459,218**	**0.493**	**30,044**	**53,302**
SCE	CSI GM	98,210	204,880	0.479	13,130	22,468
	SGIP	29,898	62,591	0.478	4,001	6,813
	Both	**128,108**	**267,471**	**0.479**	**17,131**	**29,281**
All	CSI GM	302,961	622,031	0.487	40,349	70,540
	SGIP	93,029	191,512	0.486	12,398	21,598
	Both	**395,990**	**813,543**	**0.487**	**52,747**	**92,137**

6.8 Contributions from ERP, NSHP, MASH, and SASH

The previous subsections, 6.1 through 6.7, have focused on impacts from the CSI GM program and the SGIP. This section discusses the contribution from the ERP, NSHP, and MASH and SASH programs.

6.8.1 Methodology and Sample (NSHP, MASH, SASH, ERP)

Generation from ERP, NSHP, and SASH systems is entirely estimated due to lack of available metered data. Similarly, about 92% of generation from MASH systems is estimated, with the remaining 8% coming from two systems with available metered data. Estimates for these programs are calculated using metered data from CSI GM and SGIP PV systems, and the strata methodology presented in Section 6.1, with adjustments as follows. Estimates for NSHP, MASH and SASH used metered data from systems with the CSI Residential and Small Commercial (<10kW) strata characteristic, while estimates for ERP systems use the appropriate SGIP strata characteristic based on system size. This mapping between metered data and program for which impacts were estimated is shown in Table 6-7.

Mounting type and tilt information was not available for ERP, NSHP and SASH systems to assign a specific configuration strata characteristic. Estimates for these programs used metered data from systems with Near Flat and Tilted configurations.

ERP PV systems installed prior to 2002 have no matching SGIP metered data since SGIP was just beginning. These ERP systems are assigned to the oldest SGIP Installation Year Group

strata (i.e., 2002-2004) and the estimates are further de-rated to account for the additional age of the ERP systems.

The Program Administrator strata characteristic was assigned based on the closest IOU service territory, although not all systems were administered by IOUs.

Table 6-7: Source of Metered Data Used for Estimates

Program Needing Estimation		Source of Metered Data Used for Estimates
Program	**Program Sub-Grouping**	
CSI GM	Residential and Small Commercial (< 10 kW) EPBB	CSI GM Residential and Small Commercial (< 10 kW) EPBB
	Residential and Small Commercial (< 10 kW) PBI	CSI GM Residential and Small Commercial (< 10 kW) PBI
	Large Commercial (>= 10 kW) EPBB	CSI GM Large Commercial (>= 10 kW) EPBB
	Large Commercial (>= 10 kW) PBI	CSI GM Large Commercial (>= 10 kW) PBI
ERP	Small (<=300 kW)	SGIP Small (<=300 kW)
	Large (>300 kW)	SGIP Large (>300 kW)
MASH	N/A	CSI GM Residential and Small Commercial (< 10 kW) EPBB
NSHP	N/A	CSI GM Residential and Small Commercial (< 10 kW) EPBB
SASH	N/A	CSI GM Residential and Small Commercial (< 10 kW) EPBB
SGIP	Small (<=300 kW)	SGIP Small (<=300 kW)
	Large (>300 kW)	SGIP Large (>300 kW)

6.8.2 Energy Delivery and GHG Emissions Reductions—Contributions from NSHP, MASH, SASH, and ERP

This section presents the contribution of PV systems in the NSHP, MASH program, SASH program, and ERP, and is a complement to Sections 6.2 and 6.4. Contributions from the CSI GM program and the SGIP PV systems are re-presented here for reference; along with subtotals for the three CSI programs (GM, MASH, and SASH), and subtotals for the three non-CSI programs (SGIP, ERP, and NSHP). Note that the term "all CSI" is used to refer to the combination of CSI GM, MASH, and SASH. See Appendix C for the contribution of these programs on peak demands and breakdowns by IOU service territory.

Table 6-8 shows the energy delivered from PV systems installed under each program in 2010 with quarterly and annual totals. As expected, Q2 and Q3 deliver nearly twice the amount of energy as Q1 and Q4, due to seasonal variation. On an annual basis, the CSI GM program contributes 62% of the total generation, and is orders of magnitude larger than its counterparts,

MASH and SASH. The other major contributions are from SGIP and ERP PV systems, with 19 and 17%, respectively. NSHP, MASH, and SASH fill in the remaining 1.7%, with 1.4%, 0.2%, and 0.1%, respectively. The programs with significant amounts of metered energy (CSI GM and SGIP) contribute 81% of total generation, with 38% of total generation being directly metered.

Table 6-8: Energy Delivered by 2010 Quarter—CA Public Purpose Program PV Systems*

Program	Q1 (MWh)	Q2 (MWh)	Q3 (MWh)	Q4 (MWh)	Total (MWh)
CSI - General Market	98,655	195,220	210,561	117,594	622,031
CSI - MASH	123	413	796	593	1,925
CSI - SASH	80	230	357	240	907
Subtotal - All CSI	*98,858*	*195,863*	*211,714*	*118,428*	*624,863*
SGIP	36,781	68,078	63,837	22,815	191,512
ERP	31,279	59,342	55,860	22,099	168,580
NSHP	2,427	4,705	4,803	2,456	14,392
Subtotal - Non-CSI	*70,488*	*132,125*	*124,500*	*47,371*	*374,483*
All	**169,346**	**327,988**	**336,214**	**165,799**	**999,347**

* The uncertainty on all estimates in Table 6-8 is better than 90/10 confidence level.

Each program's contribution to total annual energy is roughly proportional to its total installed rated capacity, as shown in Table 6-9. However, total annual energy does not correlate to the number of installed PV systems, as illustrated clearly with the SGIP. With only 1.2% of all PV systems, the SGIP contributes over 19% of total energy simply because the average system size is much larger than in other programs. The capacity factors for SGIP and ERP PV systems are lower than for the other programs. This follows what is shown in Table 6-3 and similar contributing factors apply here, with the note that tilt information was not available for ERP PV systems.

Table 6-9: Annual Energy Generation and Capacities—CA Public Purpose Program PV Systems

Program	PV Systems (n)	Rated Capacity (MW)	Generation (MWh)*	Annual Capacity Factor (kWh/kW rebated)
CSI - General Market	41,663	438	622,031	0.20
CSI - MASH	49	2	1,925	0.19
CSI - SASH	372	1	907	0.19
Subtotal - All CSI	*42,084*	*441*	*624,863*	*0.20*
SGIP	890	136	191,512	0.16
ERP	28,033	123	168,580	0.16
NSHP	3,282	9	14,392	0.19
Subtotal - Non-CSI	*32,205*	*268*	*374,483*	*0.16*
All	**74,289**	**709**	**999,347**	**0.18**

* The uncertainty on all estimates in Table 6-9 is better than 90/10 confidence level.

The relative contribution from each program to GHG emissions reduction, presented in Table 6-10, is very similar to their contribution to total energy generation. All programs combined to provide nearly 485,000 tons of GHG emissions reduction (as CO_2Eq). The CSI GM program contributes the most at 62%, or over 300,000 tons; add in contributions from SGIP PV systems and this becomes 81%. ERP PV systems contribute another 17%, or 82,000 tons; and NSHP, MASH, and SASH combine to make up the remaining 1.7%.

Table 6-10: Estimated Avoided GHG Emissions—CA Public Purpose Program PV Systems

Program	CO_2 Emissions Avoided (Tons)	Generation (MWh)	CO_2Eq Factor (Tons/MWh)	PM-10 Emssions Avoided (lbs)	Nox Emssions Avoided (lbs)
CSI - General Market	302,961	622,031	0.487	40,349	70,540
CSI - MASH	954	1,925	0.496	127	226
CSI - SASH	447	907	0.493	59	106
Subtotal - All CSI	*304,363*	*624,863*	*0.487*	*40,535*	*70,872*
SGIP	93,029	191,512	0.486	12,398	21,598
ERP	82,185	168,580	0.488	10,943	19,155
NSHP	7,034	14,392	0.489	936	1,644
Subtotal - Non-CSI	*182,248*	*374,483*	*0.487*	*24,277*	*42,397*
All	**486,611**	**999,347**	**0.487**	**64,812**	**113,268**

6.9 Key Findings

Energy Delivery: The CSI GM program provides the largest impacts among CA Public Purpose PV Programs included in this analysis, generating over 620,000 MWh in 2010. The program continued to see growth in installed capacity, with annual generation increasing by an average of 250,000 MWh for each of the last two years. Systems installed under the SGIP and ERP programs generated noteworthy amounts with 191,000 MWh and 168,000 MWh, respectively. When combined, systems from all analyzed programs generated nearly 1,000,000 MWh in 2010.

Capacity Factor: Generation varies seasonally, as expected, with Q2 and Q3 providing roughly two-thirds of total annual generation. Weighted monthly average capacity factors vary some between programs, but generally peak around 0.27 during the summer and drop just below 0.10 in the winter, with an annual average of 0.19.

Generation During High Electrical Grid Demand: CSI GM and SGIP combined to provide over 290 MWh (0.62% of total demand), during the CAISO peak hour in 2010. The PV generation peak occurred 3 hours earlier with 364 MWh of generation. Tracking systems and tilted fixed systems facing west provide significantly more production later in the day than flat or tilted systems facing in other directions. As a result, tracking systems and west facing tilted systems are a better match to peak and high grid demand.

GHG and Air Pollution Emission Reductions: CSI GM and SGIP combined to reduce GHG emissions by 400,000 tons (as CO_2Eq) in 2010. This increased to 485,000 tons when taking into account GHG emission reductions from ERP, NSHP, MASH, and SASH programs. All programs contributed to reductions of nearly 65,000 pounds of PM-10 and 113,000 pounds of NOx emissions during 2010.

7

Analysis of Billing Data and Energy Exports

While PV systems installed under the CSI GM are sized based on each participant's historical consumption to avoid the generation of excess energy, there are, nevertheless, many cases in which the electricity produced by a system exceeds a site's requirements. This section's purpose is to describe several types of analysis applied to the utility billing data of CSI GM host customers. The section characterizes the phenomenon of excess billing cycle and yearly electricity generation by CSI GM PV systems and its export to the utility grid. The section also incorporates a more limited analysis of CSI GM host customer hourly load data and the excess hourly electricity generation exported to the grid.

The analysis is divided into three main subsections. The first subsection relied on monthly billing histories to examine the frequency, timing, and magnitude of exports among CSI GM host customer sites. The analysis explores various factors by which export characteristics vary, including customer segment, system size, and program administrator (PA). The second subsection summarizes the results of statistical modeling used to quantify the usefulness of different factors in determining whether sites will be net exporters of electricity of over a one-year period. This modeling effort relied on monthly billing histories and incorporated weather data. The final subsection examined hourly interval billing records to look at the nature of exports at the daily and hourly level.

The analysis in this section relied on five data sources. The first two data sources were the utility historical monthly and hourly interval billing records for CSI GM participants, which were used to identify the frequency of exports and to quantify their magnitude. The monthly billing records were available for a majority of host customers and included all applicable dates going back to the beginning of 2007. The hourly interval records were only available for a small subset of sites for two of the PAs. The third data source was the PowerClerk database, which has key information used for participant stratification by customer segment, geography, and other characteristics. The fourth source was utility Interconnect information, which was used to either identify or validate the timing of system installation. The final source was weather data, including degree days, cloud cover, and several other variables by weather station.

7.1 Export with Monthly Billing Data

This section focuses on the likelihood and size of export using monthly billing data. The section examines both monthly export and yearly net export. The analysis will incorporate a presentation of the distribution by PA, customer segment, systems size, and electricity consumption, as well as a statistical model of the probability of yearly net export.

7.1.1 Initial Site Counts and Data Attrition

The initial sets of billing data provided by the IOUs included post-installation data for 37,695 unique program host customer sites. After subjecting the data to a series of diagnostic routines, many sites were removed because they had characteristics that would have led to potentially misleading results. Although the specific issues varied, the three main factors that led to attrition were 1) outlier values for the exported kWh values, 2) long bill periods, and 3) missing bill intervals. Table 7-1 summarizes the number of sites that were removed due to three main factors. Note that while more than one of the reasons for attrition could have applied to a single site, the flagging and removal followed the order of the three factors described above. This means that the sites removed at each level of attrition were free of any of the issues related to the previous level(s).

Table 7-1: Initial Site Counts and Data Attrition by Program Administrator

Program Administrator	Data Issue	Total Sites	Percent of Sites	Cumulative Sites	Cumulative Percent of Sites
PG&E	Export outlier(s)	200	0.9%	200	0.9%
	Long bill period(s)	341	1.6%	541	2.5%
	Missing bill interval(s)	587	2.7%	1,128	5.3%
	No problems found	20,334	94.7%	21,462	100.0%
SCE	Export outlier(s)	138	1.3%	138	1.3%
	Long bill period(s)	402	3.7%	540	5.0%
	Missing bill interval(s)	14	0.1%	554	5.1%
	No problems found	10,343	94.9%	10,897	100.0%
CCSE	Export outlier(s)	56	1.0%	56	1.0%
	Long bill period(s)	152	2.8%	208	3.9%
	Missing bill interval(s)	61	1.1%	269	5.0%
	No problems found	5,067	95.0%	5,336	100.0%
Total	Export outlier(s)	394	1.0%	394	1.0%
	Long bill period(s)	895	2.4%	1,289	3.4%
	Missing bill interval(s)	662	1.8%	1,951	5.2%
	No problems found	35,744	94.8%	37,695	100.0%

Overall, 35,744 of the original 37,695 CSI GM sites were not flagged with any significant issues, meaning that data attrition accounted for a loss of just over 5% of the sites. Outlier values in the exported kWh, which could have been due to anomalies in the billing data or incorrect information about the system size, accounted for 1% of the total loss of sites. The presence of long billing periods and missing bill intervals, both of which would have made it difficult or impossible to accurately calculate some of the summaries, led to the removal of 2.4% and 1.8%, respectively. All three utilities had sites removed for all three of the sources of data attrition, and though some issues were more common one utility compared to others, the differences were not stark.[1]

With respect to the final set of billing data used in the analysis, Table 7-2 shows the final number of sites by the PA, customer segment, and the total number of post-installation billing periods. The nearly 35,744 sites included in this analysis comprise the majority of CSI GM participants. Overall, around 95% of the sites are residential with little variation among the different PAs. PG&E is the PA with the largest share of sites, following by SCE and CCSE. These proportions are highly representative of those seen in the population.

Much of the analysis in this section required at least one year of post-installation billing history because partial years of billing records were insufficient to calculate some of the metrics or could introduce bias due to seasonality. The inclusion of the number of post-installation bills in Table 7-2 is provided to give an idea of how many sites were dropped from the analysis when the analysis needed to have at least a full year of data. For example, for the full set of residential sites, just over 30% have 11 or fewer post-installation bills, so those 10,307 sites had to be excluded from any summary that required at least one year of post-installation billing records.

[1] Some of the issues with the billing data were not necessarily problematic for all of the analyses applied to the data, but all sites with any of the issues were removed for the sake of keeping a consistent sample size across as many of the summaries as possible.

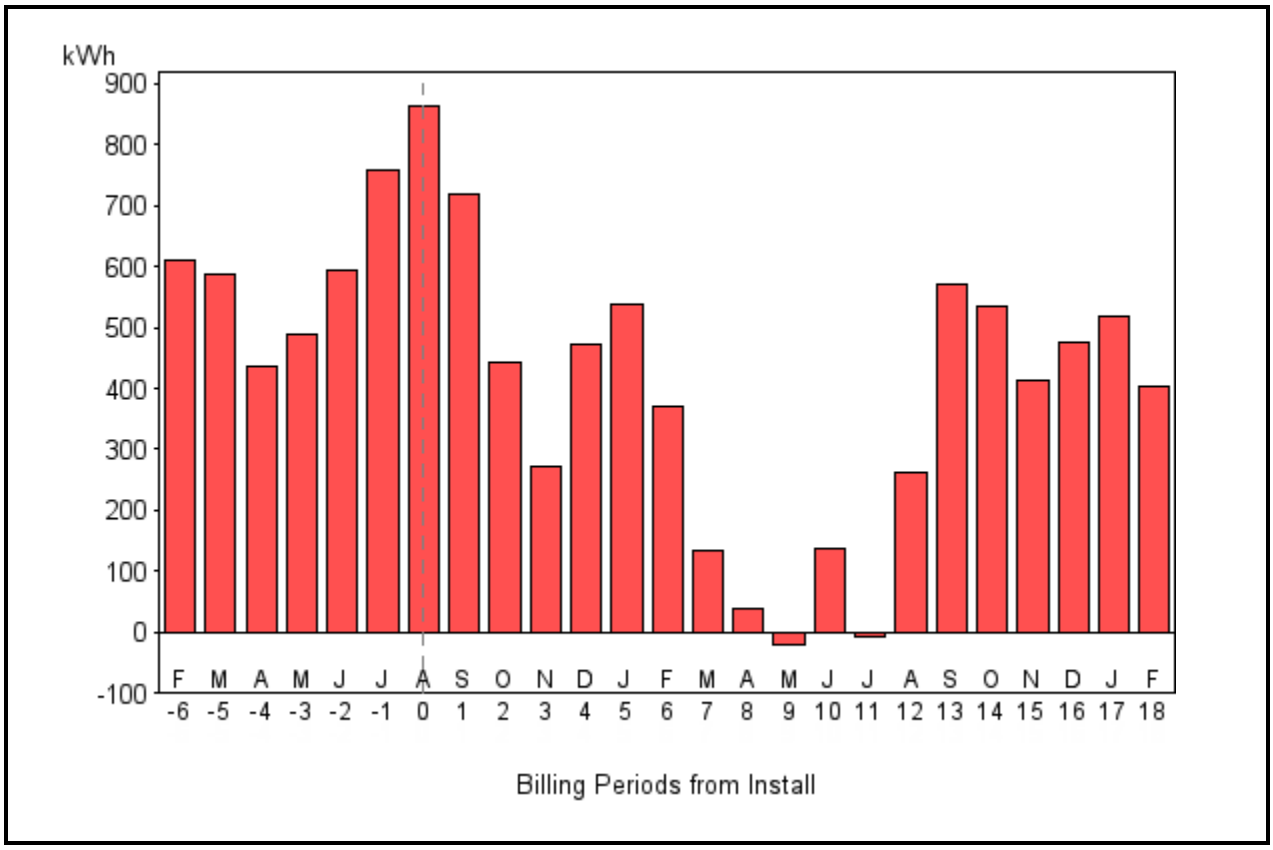
Table 7-2: Count of Sites with Post-Installation Billing Data by PA and Customer Segment

Customer Segment/Number of Post-Installation Billing Periods		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Sites	Post-Installation Bills Percent	PA Percent	Sites	Post-Installation Bills Percent	PA Percent	Sites	Post-Installation Bills Percent	PA Percent	Sites	Post-Installation Bills Percent	PA Percent
Residential	0-11	4,213	21.7%	40.9%	4,235	42.9%	41.1%	1,859	37.5%	18.0%	10,307	30.1%	100.0%
	12-23	6,278	32.3%	53.9%	3,247	32.9%	27.9%	2,123	42.8%	18.2%	11,648	34.0%	100.0%
	24-35	5,017	25.8%	68.8%	1,672	16.9%	22.9%	606	12.2%	8.3%	7,295	21.3%	100.0%
	36+	3,923	20.2%	78.2%	719	7.3%	14.3%	374	7.5%	7.5%	5,016	14.6%	100.0%
	Total	19,431	100.0%	56.7%	9,873	100.0%	28.8%	4,962	100.0%	14.5%	34,266	100.0%	100.0%
Commercial	0-11	107	17.6%	48.6%	94	26.9%	42.7%	19	25.3%	8.6%	220	21.3%	100.0%
	12-23	126	20.7%	52.1%	92	26.3%	38.0%	24	32.0%	9.9%	242	23.4%	100.0%
	24-35	218	35.8%	60.6%	124	35.4%	34.4%	18	24.0%	5.0%	360	34.8%	100.0%
	36+	158	25.9%	74.5%	40	11.4%	18.9%	14	18.7%	6.6%	212	20.5%	100.0%
	Total	609	100.0%	58.9%	350	100.0%	33.8%	75	100.0%	7.3%	1,034	100.0%	100.0%
Gov./Non-Profit	0-11	53	18.0%	51.0%	45	37.5%	43.3%	6	20.0%	5.8%	104	23.4%	100.0%
	12-23	73	24.8%	64.6%	32	26.7%	28.3%	8	26.7%	7.1%	113	25.5%	100.0%
	24-35	100	34.0%	70.9%	31	25.8%	22.0%	10	33.3%	7.1%	141	31.8%	100.0%
	36+	68	23.1%	79.1%	12	10.0%	14.0%	6	20.0%	7.0%	86	19.4%	100.0%
	Total	294	100.0%	66.2%	120	100.0%	27.0%	30	100.0%	6.8%	444	100.0%	100.0%
Total	0-11	4,373	21.5%	41.1%	4,374	42.3%	41.1%	1,884	37.2%	17.7%	10,631	29.7%	100.0%
	12-23	6,477	31.9%	54.0%	3,371	32.6%	28.1%	2,155	42.5%	18.0%	12,003	33.6%	100.0%
	24-35	5,335	26.2%	68.4%	1,827	17.7%	23.4%	634	12.5%	8.1%	7,796	21.8%	100.0%
	36+	4,149	20.4%	78.1%	771	7.5%	14.5%	394	7.8%	7.4%	5,314	14.9%	100.0%
	Total	**20,334**	**100.0%**	**56.9%**	**10,343**	**100.0%**	**28.9%**	**5,067**	**100.0%**	**14.2%**	**35,744**	**100.0%**	**100.0%**

7.1.2 Frequency of Any Single Bill Export

The first analysis examined the frequency with which participants had any single bill net export at any time following the installation of the PV system. For this summary, export was defined as when the total PV generation exceeded the total electricity consumed at the site over a billing period. This excess net electricity is reflected in the presence of a negative usage total in the billing records. A graphical representation of what export looks like in a billing record is presented in Figure 7-1, which shows billed consumption for six billing periods prior to the installation of a PV system, the billing record during which installation occurred, and 18 records following installation. The horizontal axis shows the count of billing periods from the month of system installation, which is represented by bill period zero. The installation billing period is also marked by a gray vertical dashed line. The first letter of the month from the bill date is provided along with the billing period count. The billed kWh totals in Figure 7-1 clearly show the expected decrease in the periods following installation. In the ninth and 11th post-install bills, the consumption is negative, and even though the amount of exported energy is relatively small, these two bill periods represent cases of exported energy for the billing period.

Figure 7-1: Graph Example of Exported Generation



As a high-level summary of this basic instance of export, Table 7-3 summarizes the frequency with which participants had any single bill exports in their billing records by PA, customer segment, and the number of post-installation bills available. To be clear, this summary makes no consideration of how often a site exported energy, the magnitude of those exports, or the total number of post-install bills, but simply shows how many sites had at least one bill period where energy was delivered back to the grid. Overall, of the 35,744 sites, more than 52% had at least one billing period where the systems generated net excess energy. This overall average was dominated by the large number of residential sites, for which 52.8% of sites had at least one billing period with exported energy. For commercial and government sites, the overall percentages with at least one net export billing period were 43.1% and 35.8%, respectively. There were some noteworthy differences in the percentages of sites with at least one export across the PAs. For example, for the residential segment, only 44.9% of the SCE sites had at least one billing period export, which is substantially lower than the 55.3% and 58.5% associated with PG&E and CCSE, respectively. There is also considerable variation in the non-residential customer segments, with PG&E's commercial sites showing a much higher percentage of sites with at least one billing period export.

With respect to the number of billing periods, the share of sites with at least one export was substantially lower for those sites that had 11 or fewer post-installation bills. This is logical, given that there were fewer opportunities for an export to occur. The likelihood of having an instance of exported energy tended to increase for sites with more billing periods, but the rise was not as dramatic as one might expect. Furthermore, there were cases, such as in the commercial customer segment, where the likelihood actually decreased slightly for sites with longer billing histories. Overall, the results suggest that if a site is going to export energy, it is nearly as likely to happen after a system has been installed for one full year as it is after two.

Table 7-3: Frequency of Sites with at Least One Single Bill Export by PA and Customer Segment

Customer Segment/Number of Post-Installation Billing Periods		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Export	Percent with Any Export	Total Sites	Sites with Any Export	Percent with Any Export	Total Sites	Sites with Any Export	Percent with Any Export	Total Sites	Sites with Any Export	Percent with Any Export
Residential	0-11	4,213	1,165	27.7%	4,235	1,173	27.7%	1,859	755	40.6%	10,307	3,093	30.0%
	12-23	6,278	3,840	61.2%	3,247	1,728	53.2%	2,123	1,392	65.6%	11,648	6,960	59.8%
	24-35	5,017	3,170	63.2%	1,672	1,040	62.2%	606	446	73.6%	7,295	4,656	63.8%
	36+	3,923	2,575	65.6%	719	495	68.8%	374	309	82.6%	5,016	3,379	67.4%
	Total	19,431	10,750	55.3%	9,873	4,436	44.9%	4,962	2,902	58.5%	34,266	18,088	52.8%
Commercial	0-11	107	42	39.3%	94	24	25.5%	19	5	26.3%	220	71	32.3%
	12-23	126	76	60.3%	92	29	31.5%	24	15	62.5%	242	120	49.6%
	24-35	218	135	61.9%	124	25	20.2%	18	6	33.3%	360	166	46.1%
	36+	158	77	48.7%	40	9	22.5%	14	3	21.4%	212	89	42.0%
	Total	609	330	54.2%	350	87	24.9%	75	29	38.7%	1,034	446	43.1%
Gov./Non-Profit	0-11	53	11	20.8%	45	5	11.1%	6	3	50.0%	104	19	18.3%
	12-23	73	27	37.0%	32	10	31.3%	8	2	25.0%	113	39	34.5%
	24-35	100	55	55.0%	31	9	29.0%	10	7	70.0%	141	71	50.4%
	36+	68	23	33.8%	12	4	33.3%	6	3	50.0%	86	30	34.9%
	Total	294	116	39.5%	120	28	23.3%	30	15	50.0%	444	159	35.8%
Total	0-11	4,373	1,218	27.9%	4,374	1,202	27.5%	1,884	763	40.5%	10,631	3,183	29.9%
	12-23	6,477	3,943	60.9%	3,371	1,767	52.4%	2,155	1,409	65.4%	12,003	7,119	59.3%
	24-35	5,335	3,360	63.0%	1,827	1,074	58.8%	634	459	72.4%	7,796	4,893	62.8%
	36+	4,149	2,675	64.5%	771	508	65.9%	394	315	79.9%	5,314	3,498	65.8%
	Total	**20,334**	**11,196**	**55.1%**	**10,343**	**4,551**	**44.0%**	**5,067**	**2,946**	**58.1%**	**35,744**	**18,693**	**52.3%**

7.1.3 Frequency of Highest Number of Exports over 12-Bills

The previous analysis illustrated that more than half of CSI GM participants have exported energy during at least one billing period after installing the PV system. Considering that patterns of demand and PV generation are unlikely to coincide perfectly, the large share of sites with at least one bill export is unsurprising. That analysis, however, did not reveal anything about how frequently individual sites exported energy throughout the year. To examine the frequency with which sites produced excess energy, the next stage of the analysis examined how many times individual sites exported energy over a 12-bill period. Most billing intervals are approximately 30 days in length, so the 12-bill period is intended to approximate a year. The purpose of looking at any 12-bill range instead of only the first year of billing records following installation was to capture any usage tendencies that might not have developed until the system had been used for a while. Furthermore, there is some uncertainty over the exact dates when systems became operational, which could bias results that look at only the first year of bills following installation.

For this analysis, we looked at the maximum number of times a site had exports over any 12-bill period following the installation of the PV system. As an illustration of this metric, Figure 7-2 shows the billing series for a site that had multiple exports following system installation. For this site, the maximum number of exports to occur in a 12-bill period was seven, between the third and 14th bill periods. Had the analysis looked only at the first year, the number of exports would have been six.

Figure 7-2: Graph Example of Frequency of Export over 12-Bill Period

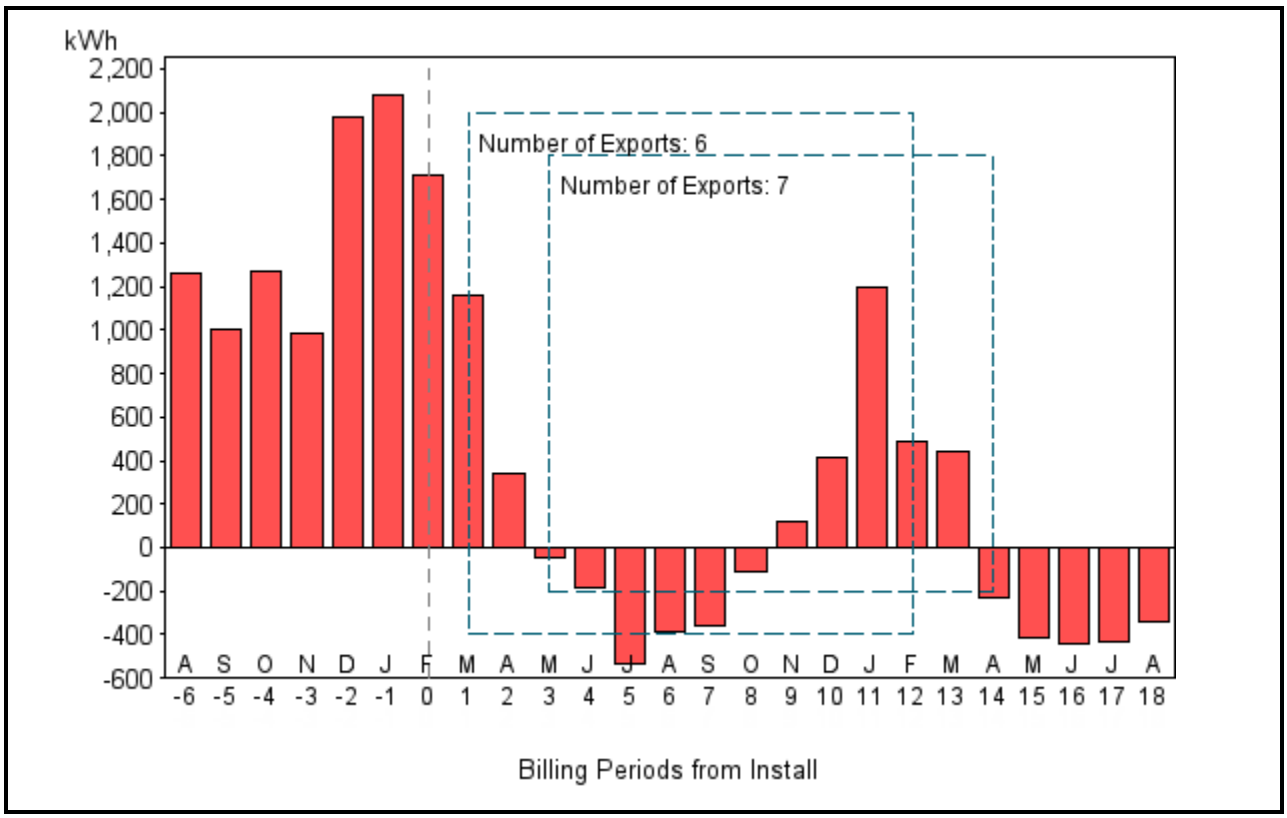


Table 7-4 summarizes the frequency of the maximum of number of exports over any 12-bill period by customer segment and PA. The sites included in this analysis are only those sites with at least one export that had 12 billing periods. Overall, the range of one to three billing periods with exports was the category with the most sites (41%). In addition, more than three-fourths had a maximum of six or fewer exports over a 12-bill period. However, this overall summary is dominated by the residential sites. There are different distributions for the non-residential customer segments. For commercial and government/non-profit sites, for example, the four to six exports category was the largest, with 36.8% and 39.3% of all exporters, respectively.

There is some interesting variation among the PAs in the summary in Table 7-4. Of the residential sites that had at least one export in a 12-bill period, both PG&E and SCE had more sites in the one to three exports category whereas most of CCSE's exporters (35.7%) had four to six bill periods of exports. In fact, a majority of CCSE's residential sites had more than six exports over a 12-bill period. In contrast, neither PG&E nor SCE had more than 25% of their sites with more than six exports over a 12-bill period. Similar patterns were present among the non-residential sites as well, though the small number of sites makes it difficult to infer much from the differences.

Table 7-4: Highest Number of Exports over any 12-Bill Period by Customer Segment and PA

Customer Segment/Maximum Number of Exports over 12-Billing-Period Interval		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent
Residential	1-3	4,199	43.8%	67.4%	1,396	42.8%	22.4%	637	29.7%	10.2%	6,232	41.6%	100.0%
	4-6	3,363	35.1%	64.5%	1,100	33.7%	21.1%	754	35.1%	14.5%	5,217	34.8%	100.0%
	7-9	1,764	18.4%	59.4%	646	19.8%	21.8%	559	26.0%	18.8%	2,969	19.8%	100.0%
	10-12	259	2.7%	44.9%	121	3.7%	21.0%	197	9.2%	34.1%	577	3.8%	100.0%
	Total	9,585	100.0%	63.9%	3,263	100.0%	21.8%	2,147	100.0%	14.3%	14,995	100.0%	100.0%
Commercial	1-3	77	26.7%	82.8%	13	20.6%	14.0%	3	12.5%	3.2%	93	24.8%	100.0%
	4-6	103	35.8%	74.6%	25	39.7%	18.1%	10	41.7%	7.2%	138	36.8%	100.0%
	7-9	86	29.9%	80.4%	15	23.8%	14.0%	6	25.0%	5.6%	107	28.5%	100.0%
	10-12	22	7.6%	59.5%	10	15.9%	27.0%	5	20.8%	13.5%	37	9.9%	100.0%
	Total	288	100.0%	76.8%	63	100.0%	16.8%	24	100.0%	6.4%	375	100.0%	100.0%
Gov./Non-Profit	1-3	32	30.5%	84.2%	2	8.7%	5.3%	4	33.3%	10.5%	38	27.1%	100.0%
	4-6	40	38.1%	72.7%	11	47.8%	20.0%	4	33.3%	7.3%	55	39.3%	100.0%
	7-9	27	25.7%	81.8%	6	26.1%	18.2%	.	.	.	33	23.6%	100.0%
	10-12	6	5.7%	42.9%	4	17.4%	28.6%	4	33.3%	28.6%	14	10.0%	100.0%
	Total	105	100.0%	75.0%	23	100.0%	16.4%	12	100.0%	8.6%	140	100.0%	100.0%
Total	1-3	4,308	43.2%	67.7%	1,411	42.1%	22.2%	644	29.5%	10.1%	6,363	41.0%	100.0%
	4-6	3,506	35.1%	64.8%	1,136	33.9%	21.0%	768	35.2%	14.2%	5,410	34.9%	100.0%
	7-9	1,877	18.8%	60.4%	667	19.9%	21.5%	565	25.9%	18.2%	3,109	20.0%	100.0%
	10-12	287	2.9%	45.7%	135	4.0%	21.5%	206	9.4%	32.8%	628	4.0%	100.0%
	Total	**9,978**	**100.0%**	**64.3%**	**3,349**	**100.0%**	**21.6%**	**2,183**	**100.0%**	**14.1%**	**15,510**	**100.0%**	**100.0%**

7.1.4 Frequency of Annual Net Exporters

The previous section shows that 3,737 sites (24%) have had bills with exported energy for at least half of the billing periods over a 12-bill year. This high frequency suggests that there is a good chance that some sites will have enough bills with excess energy that they will show a net export over a year. This section summarizes how many sites are exporting enough energy over a year (or 12 bills) that they show an annual net export of electricity. As with the previous section, this analysis looks at the presence of net exports over any 12-bill period. Again, this roughly equates to a full year and these sites will be referred to as annual net exporters. As an illustration of annual net export, Figure 7-3 shows the billing records for a site that begins to export electricity in the sixth billing period following installation. As the billing periods with exported electricity continue, the rolling 12-bill average for the site decreases so that by the 14th bill after installation, the total of the negative bills over the previous 12 months exceeds the total of the positive bills, making this site an annual net exporter.

Figure 7-3: Graph Example of a 12-Bill or Annual Net Exporter

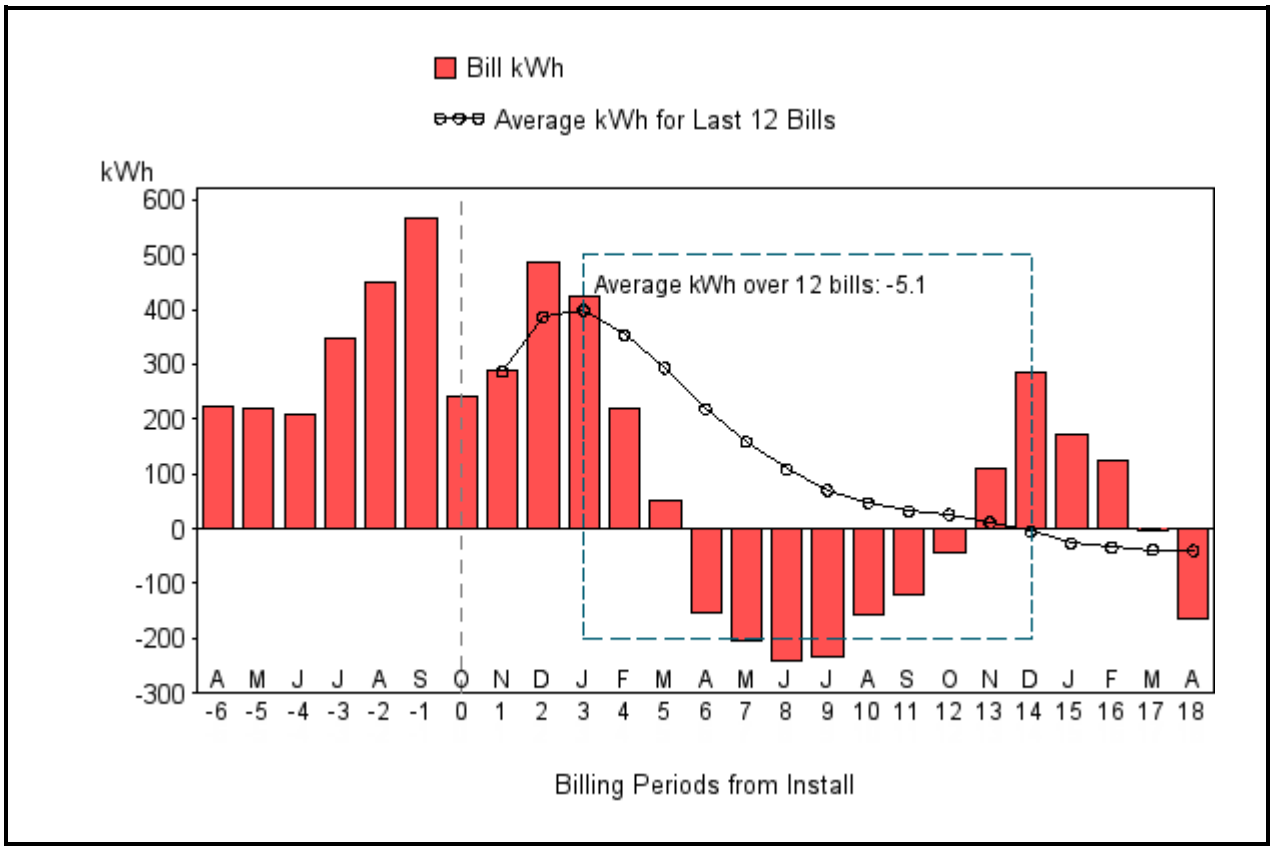


Table 7-5 shows a summary of the frequency with sites that had at least one 12-bill period with annual net exports by PA, customer segment, and system size. As before, this analysis excludes sites for which there were fewer than 12 post-install bills, since those sites could not possibly be 12-bill net exporters and they would distort the results. Across all sites, 3,482 of 25,113 sites (13.9%) had a 12-bill period over which generation exceeded the electricity needs, making them annual net exporters. For the residential CSI GM participants, who account for 23,959 of the total sites, there is a clear relationship between system size and the frequency of 12-bill net exports. The percentage of residential yearly net exporters across PAs increases from 12.1% for the smaller systems to 18.6% for systems 7.5 kW and larger. This pattern of increasing share of annual net exporters is not present for the two non-residential customer segments. For the commercial sector, 10 kW to 25 kW-sized systems had the highest percentage of annual net exporters (27.1%). For the government/non-profit sectors, the smallest system size category had the greatest percentage of annual net exporters (17.9%).

Table 7-5: Frequency of Sites with Annual Net Export by Customer Segment and System Size

Customer Segment/System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Annual Net Export	Percent With Annual Net Export	Total Sites	Sites with Annual Net Export	Percent With Annual Net Export	Total Sites	Sites with Annual Net Export	Percent With Annual Net Export	Total Sites	Sites with Annual Net Export	Percent With Annual Net Export
Residential	0-2.5 kW	2,627	332	12.6%	931	92	9.9%	625	83	13.3%	4,183	507	12.1%
	2.5-4 kW	5,060	547	10.8%	1,775	214	12.1%	988	247	25.0%	7,823	1,008	12.9%
	4-7.5 kW	5,855	598	10.2%	2,290	353	15.4%	1,234	356	28.8%	9,379	1,307	13.9%
	7.5+ kW	1,676	267	15.9%	642	112	17.4%	256	101	39.5%	2,574	480	18.6%
	Total	15,218	1,744	11.5%	5,638	771	13.7%	3,103	787	25.4%	23,959	3,302	13.8%
Commercial	0-5 kW	100	24	24.0%	30	7	23.3%	16	5	31.3%	146	36	24.7%
	5-10 kW	91	21	23.1%	32	2	6.3%	4	0	0.0%	127	23	18.1%
	10-25 kW	90	22	24.4%	37	11	29.7%	13	5	38.5%	140	38	27.1%
	25+ kW	221	29	13.1%	157	8	5.1%	23	2	8.7%	401	39	9.7%
	Total	502	96	19.1%	256	28	10.9%	56	12	21.4%	814	136	16.7%
Gov./Non-Profit	0-5 kW	58	10	17.2%	13	3	23.1%	7	1	14.3%	78	14	17.9%
	5-10 kW	34	3	8.8%	10	2	20.0%	3	0	0.0%	47	5	10.6%
	10-25 kW	46	7	15.2%	20	5	25.0%	3	0	0.0%	69	12	17.4%
	25+ kW	103	6	5.8%	32	4	12.5%	11	3	27.3%	146	13	8.9%
	Total	241	26	10.8%	75	14	18.7%	24	4	16.7%	340	44	12.9%
Total		**15,961**	**1,866**	**11.7%**	**5,969**	**813**	**13.6%**	**3,183**	**803**	**25.2%**	**25,113**	**3,482**	**13.9%**

Another summary of the annual net exporters is presented in Table 7-6, which shows the frequency of annual exporters based on the number of post-installation billing records instead of system size. The purpose of this summary is to examine whether expanding the data beyond the first 12 months increases the likelihood of finding annual net exporters. Overall, the presence of more data does increase the likelihood that a site will have a 12-bill period with net exports. However, the increase is not large and, depending on the customer segment and PA, not always constant. For example, for the residential sites the percentage of annual net exporters increases from 13.1% for those sites with fewer than two years of bills to 15% for sites with fewer than three years of bills. However, for the sites with at least three years of billing records, the percentage of annual net exporters actually declines to 13.7%. This suggests that the usage and generation patterns that will result in annual net export of energy are established early after system installation.

Table 7-6: Frequency of Sites with Annual Net Export by Customer Segment and Number of Post-Install Bills

Customer Segment/Post-Installation Billing Periods		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Annual Net Export	Percent with Annual Net Export	Total Sites	Sites with Annual Net Export	Percent with Annual Net Export	Total Sites	Sites with Annual Net Export	Percent with Annual Net Export	Total Sites	Sites with Annual Net Export	Percent with Annual Net Export
Residential	12-23	6,278	689	11.0%	3,247	394	12.1%	2,123	442	20.8%	11,648	1,525	13.1%
	24-35	5,017	640	12.8%	1,672	258	15.4%	606	193	31.8%	7,295	1,091	15.0%
	36+	3,923	415	10.6%	719	119	16.6%	374	152	40.6%	5,016	686	13.7%
	Total	15,218	1,744	11.5%	5,638	771	13.7%	3,103	787	25.4%	23,959	3,302	13.8%
Commercial	12-23	126	27	21.4%	92	10	10.9%	24	9	37.5%	242	46	19.0%
	24-35	218	53	24.3%	124	12	9.7%	18	3	16.7%	360	68	18.9%
	36+	158	16	10.1%	40	6	15.0%	14	0	0.0%	212	22	10.4%
	Total	502	96	19.1%	256	28	10.9%	56	12	21.4%	814	136	16.7%
Gov./Non-Profit	12-23	73	7	9.6%	32	6	18.8%	8	1	12.5%	113	14	12.4%
	24-35	100	13	13.0%	31	6	19.4%	10	3	30.0%	141	22	15.6%
	36+	68	6	8.8%	12	2	16.7%	6	0	0.0%	86	8	9.3%
	Total	241	26	10.8%	75	14	18.7%	24	4	16.7%	340	44	12.9%
Total	12-23	6,477	723	11.2%	3,371	410	12.2%	2,155	452	21.0%	12,003	1,585	13.2%
	24-35	5,335	706	13.2%	1,827	276	15.1%	634	199	31.4%	7,796	1,181	15.1%
	36+	4,149	437	10.5%	771	127	16.5%	394	152	38.6%	5,314	716	13.5%
	Total	**15,961**	**1,866**	**11.7%**	**5,969**	**813**	**13.6%**	**3,183**	**803**	**25.2%**	**25,113**	**3,482**	**13.9%**

7.1.5 Export Magnitude

The emphasis of the previous sections was the frequency with which systems produced a net excess of energy, whether for a single bill or over a full year based on a 12-bill period. How often sites export energy, however, does not necessarily reveal anything about how much excess energy they have generated. As an illustration of this, Figure 7-4 and Figure 7-5 show the billing records for two sites that exported energy four times in the 12 months following system installation. For the site depicted in Figure 7-4, however, the average amount of energy exported (60 kWh) was less than one third of the 190 kWh for the site in Figure 7-5. Given that the frequency of exports does not reveal anything about the quantity of energy exported, it is the goal of this section to characterize the size of exports among CSI GM participants.

Figure 7-4: Example of Site with Multiple Small Exports

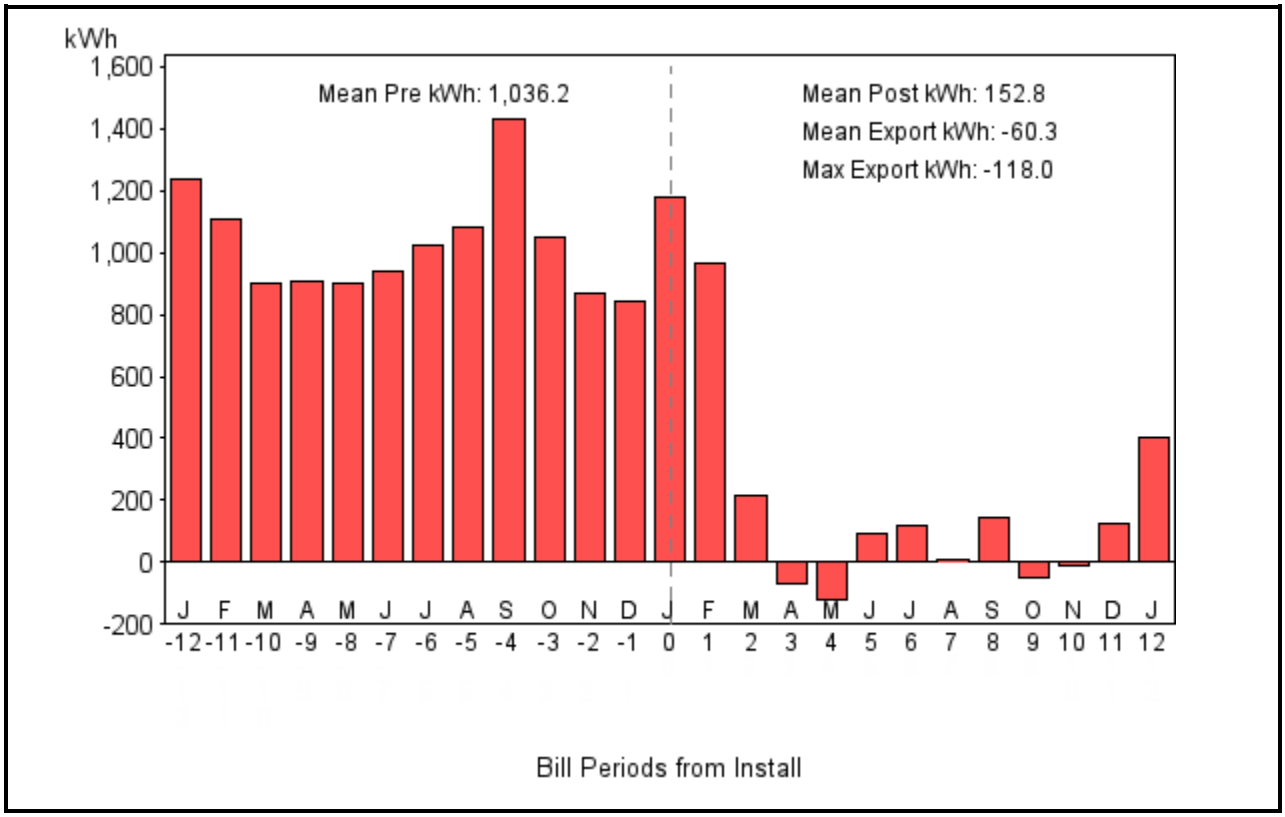
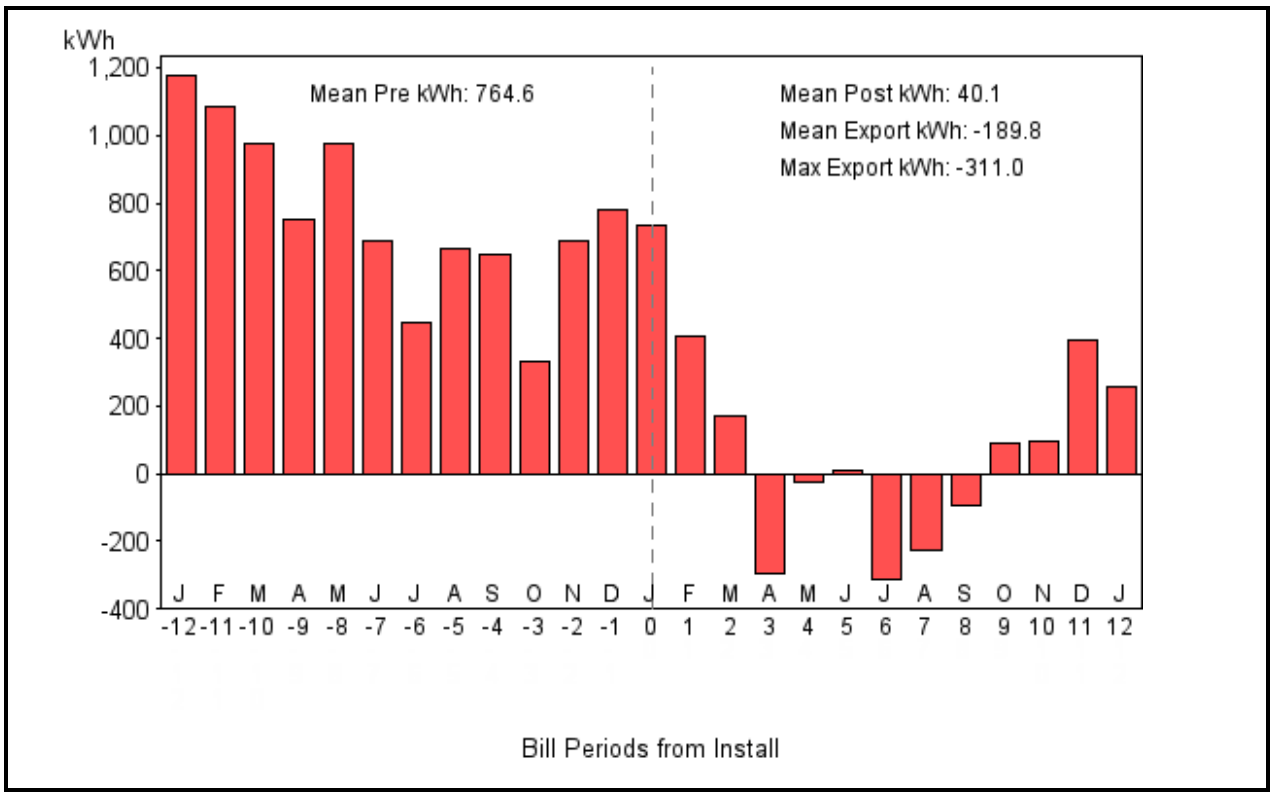


Figure 7-5: Example of Site with Multiple Large Exports



The analysis of export magnitude begins with a summary of the average amount of the monthly exported kWh for all sites using all available billing records where the billed amount was negative (Table 7-7). Note that the summary is not of the average bill, which would be a positive value and would not reveal anything about the size of exports, but rather represents the average of only the negative bills that indicate an export occurred. In addition to the average values, the summary shown in Table 7-7 is by PA, customer segment, and system size, also includes the 10th and 90th percentiles to show the variability in the size of the average bill exports. As a supplement to Table 7-7, Table 7-8 shows the number of sites associated with the summary statistics. This information is important in some cases because the average values are based on very few sites and it might be important to know the number of sites in the cell before drawing any conclusions.

For the residential sites, the overall average export was 202 kWh, with 80% of the bills falling between 23 kWh and 439 kWh. The size of average export amount increases predictably with the larger system sizes, going from 93 kWh for systems smaller than 2.5 kW to 448 kWh for system 7.5 kW and larger. Among residential sites, none of the results for the individual PAs was dramatically different from the overall average, showing the general homogeneity among residential participants. For the non-residential customer segments, however, there were some stark differences in average exports. SCE's commercial participants, for example, had average exports of 5,844 kWh, which is more than three times 1,334 kWh, the average export for CCSE.

Table 7-7: Average Amount of Monthly Bill Exports by Customer Segment, PA, and Size of Unit for All Sites

Customer Segment/System Size		Program Administrator									All		
		PG&E			SCE			CCSE					
		10th Percentile (kWh)	Average Export (kWh)	90th Percentile (kWh)	10th Percentile (kWh)	Average Export (kWh)	90th Percentile (kWh)	10th Percentile (kWh)	Average Export (kWh)	90th Percentile (kWh)	10th Percentile (kWh)	Average Export (kWh)	90th Percentile (kWh)
Residential	0-2.5 kW	13	93	198	14	94	195	13	91	190	13	93	196
	2.5-4 kW	19	135	287	19	133	274	21	136	279	19	134	284
	4-7.5 kW	27	206	443	29	217	458	31	216	448	28	211	448
	7.5+ kW	53	451	958	54	436	934	60	458	990	54	448	958
	All	22	198	431	25	215	470	25	200	428	23	202	439
Commercial	0-5 kW	39	251	577	28	176	373	32	163	338	33	229	491
	5-10 kW	72	425	846	36	319	719	12	192	376	65	410	826
	10-25 kW	125	765	1,581	98	667	1,390	47	564	1,193	120	720	1,493
	25+ kW	320	8,796	22,240	364	17,550	73,667	325	5,127	9,828	320	10,146	24,938
	All	83	3,464	5,560	55	5,844	4,306	44	1,344	2,463	75	3,774	5,200
Gov./Non-Profit	0-5 kW	13	106	211	25	175	369	56	191	393	17	129	290
	5-10 kW	48	364	781	32	238	469	-	-	-	40	328	680
	10-25 kW	103	776	1,840	137	765	1,494	109	529	1,040	120	764	1,600
	25+ kW	240	6,346	17,927	849	3,321	7,818	840	11,215	25,667	397	6,741	17,927
	All	45	2,473	6,600	59	1,138	2,812	93	6,283	18,482	52	2,602	6,720
All		**23**	**358**	**489**	**25**	**375**	**505**	**25**	**255**	**443**	**24**	**344**	**484**

Table 7-8: Supplemental Site Counts for Table 7-7

Customer Segment/System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Sites	System Size Percent	PA Percent	Sites	System Size Percent	PA Percent	Sites	System Size Percent	PA Percent	Sites	System Size Percent	PA Percent
Residential	0-2.5 kW	1,466	13.6%	66.9%	399	9.0%	18.2%	326	11.2%	14.9%	2,191	12.1%	100.0%
	2.5-4 kW	3,283	30.5%	61.2%	1,191	26.8%	22.2%	889	30.6%	16.6%	5,363	29.6%	100.0%
	4-7.5 kW	4,464	41.5%	55.8%	2,179	49.1%	27.2%	1,355	46.7%	16.9%	7,998	44.2%	100.0%
	7.5+ kW	1,537	14.3%	60.6%	667	15.0%	26.3%	332	11.4%	13.1%	2,536	14.0%	100.0%
	Total	10,750	100.0%	59.4%	4,436	100.0%	24.5%	2,902	100.0%	16.0%	18,088	100.0%	100.0%
Commercial	0-5 kW	62	18.8%	72.9%	16	18.4%	18.8%	7	24.1%	8.2%	85	19.1%	100.0%
	5-10 kW	69	20.9%	81.2%	14	16.1%	16.5%	2	6.9%	2.4%	85	19.1%	100.0%
	10-25 kW	80	24.2%	64.5%	33	37.9%	26.6%	11	37.9%	8.9%	124	27.8%	100.0%
	25+ kW	119	36.1%	78.3%	24	27.6%	15.8%	9	31.0%	5.9%	152	34.1%	100.0%
	Total	330	100.0%	74.0%	87	100.0%	19.5%	29	100.0%	6.5%	446	100.0%	100.0%
Gov./Non-Profit	0-5 kW	21	18.1%	65.6%	5	17.9%	15.6%	6	40.0%	18.8%	32	20.1%	100.0%
	5-10 kW	16	13.8%	76.2%	5	17.9%	23.8%	-	-	-	21	13.2%	100.0%
	10-25 kW	26	22.4%	65.0%	11	39.3%	27.5%	3	20.0%	7.5%	40	25.2%	100.0%
	25+ kW	53	45.7%	80.3%	7	25.0%	10.6%	6	40.0%	9.1%	66	41.5%	100.0%
	Total	116	100.0%	73.0%	28	100.0%	17.6%	15	100.0%	9.4%	159	100.0%	100.0%
Total		**11,196**	**100.0%**	**59.9%**	**4,551**	**100.0%**	**24.3%**	**2,946**	**100.0%**	**15.8%**	**18,693**	**100.0%**	**100.0%**

The summary in Table 7-7 is based on average exports for all sites. Of particular interest for this analysis are those sites that were found to have net exports over a 12-bill period, also referred to as the annual net export sites. To contrast this group with the overall sample, Table 7-9 shows the same summary as Table 7-7, but based on data for only those sites that had a 12-bill period over which they were a net exporter of energy. Again, a supplemental table with the count of sites contributing to the summary is provided (Table 7-10). Somewhat intuitively, the average exports for the 12-bill net exporter sites are larger than the average for the overall sample, but this is not always the case. For example, the average residential export of 259 kWh for the annual net exporters is 28% larger than the 202 kWh for the overall sample. In contrast, the average export for all sites in the commercial segment is actually larger than the average for the net exporters, but given the heterogeneity of non-residential sites, this result could be due to a number of different factors, including the higher share of larger systems in the overall sample.

Table 7-9: Average Amount of Bill Exports by Customer Segment, PA, and Size of Unit for Net Exporters

Customer Segment/System Size		Program Administrator									All		
		PG&E			SCE			CCSE					
		10th Percentile (kWh)	Average Export (kWh)	90th Percentile (kWh)	10th Percentile (kWh)	Average Export (kWh)	90th Percentile (kWh)	10th Percentile (kWh)	Average Export (kWh)	90th Percentile (kWh)	10th Percentile (kWh)	Average Export (kWh)	90th Percentile (kWh)
Residential	0-2.5 kW	24	122	229	24	113	213	23	109	208	24	118	223
	2.5-4 kW	39	188	354	34	161	304	30	157	302	35	175	334
	4-7.5 kW	56	300	592	41	268	529	40	253	501	47	279	554
	7.5+ kW	88	630	1,282	72	529	1,096	82	545	1,125	83	590	1,193
	All	41	273	567	37	252	529	34	234	480	38	259	537
Commercial	0-5 kW	51	291	666	32	199	401	33	176	348	39	260	528
	5-10 kW	103	476	869	194	441	771	-	-	-	108	474	869
	10-25 kW	169	811	1,581	145	761	1,493	57	708	1,716	151	787	1,553
	25+ kW	284	5,755	18,240	756	25,654	96,953	298	1,525	3,253	320	10,540	26,820
	All	103	2,000	3,317	72	8,666	7,280	52	565	1,565	87	3,337	3,600
Gov./Non-Profit	0-5 kW	15	91	161	54	181	369	70	233	411	21	116	233
	5-10 kW	87	418	953	27	221	419	-	-	-	30	320	670
	10-25 kW	155	1,007	2,160	187	912	2,035	-	-	-	159	973	2,041
	25+ kW	1,640	11,276	27,060	758	3,102	7,231	1,326	9,050	20,412	1,040	8,293	20,800
	All	31	2,463	6,755	70	1,233	3,019	157	7,152	20,067	49	2,650	7,818
All		**42**	**403**	**645**	**38**	**606**	**595**	**34**	**287**	**497**	**39**	**422**	**600**

Table 7-10: Supplemental Site Counts for Table 7-9

Customer Segment/System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Sites	System Size Percent	PA Percent	Sites	System Size Percent	PA Percent	Sites	System Size Percent	PA Percent	Sites	System Size Percent	PA Percent
Residential	0-2.5 kW	332	19.0%	65.5%	92	11.9%	18.1%	83	10.5%	16.4%	507	15.4%	100.0%
	2.5-4 kW	547	31.4%	54.3%	214	27.8%	21.2%	247	31.4%	24.5%	1,008	30.5%	100.0%
	4-7.5 kW	598	34.3%	45.8%	353	45.8%	27.0%	356	45.2%	27.2%	1,307	39.6%	100.0%
	7.5+ kW	267	15.3%	55.6%	112	14.5%	23.3%	101	12.8%	21.0%	480	14.5%	100.0%
	Total	1,744	100.0%	52.8%	771	100.0%	23.3%	787	100.0%	23.8%	3,302	100.0%	100.0%
Commercial	0-5 kW	24	25.0%	66.7%	7	25.0%	19.4%	5	41.7%	13.9%	36	26.5%	100.0%
	5-10 kW	21	21.9%	91.3%	2	7.1%	8.7%	-	-	-	23	16.9%	100.0%
	10-25 kW	22	22.9%	57.9%	11	39.3%	28.9%	5	41.7%	13.2%	38	27.9%	100.0%
	25+ kW	29	30.2%	74.4%	8	28.6%	20.5%	2	16.7%	5.1%	39	28.7%	100.0%
	Total	96	100.0%	70.6%	28	100.0%	20.6%	12	100.0%	8.8%	136	100.0%	100.0%
Gov./Non-Profit	0-5 kW	10	38.5%	71.4%	3	21.4%	21.4%	1	25.0%	7.1%	14	31.8%	100.0%
	5-10 kW	3	11.5%	60.0%	2	14.3%	40.0%	-	-	-	5	11.4%	100.0%
	10-25 kW	7	26.9%	58.3%	5	35.7%	41.7%	-	-	-	12	27.3%	100.0%
	25+ kW	6	23.1%	46.2%	4	28.6%	30.8%	3	75.0%	23.1%	13	29.5%	100.0%
	Total	26	100.0%	59.1%	14	100.0%	31.8%	4	100.0%	9.1%	44	100.0%	100.0%
Total		**1,866**	**100.0%**	**53.6%**	**813**	**100.0%**	**23.3%**	**803**	**100.0%**	**23.1%**	**3,482**	**100.0%**	**100.0%**

The summary of the average export quantity leads to the question of what the exported amounts represent relative to total consumption. Without knowing the total amount of PV generation, the total amount consumed at the site is an unknown. For many sites, however, there is a sufficient number of billing records prior to the installation of the system to use the average pre-installation kWh as a proxy for post-installation electricity consumption. While this cannot account for weather and a number of other factors that would influence consumption, it allows for a general approximation of how large the exported amounts are relative to a site's consumption.

To analyze the relative size of exports the data were reduced to a subset of sites that had at least one year of pre- and post-installation billing records available for comparison. Next the data were balanced so that each site had the same number of pre- and post-installation records, so that some sites had one year pre- and post-install while others had two years. Table 7-11 shows the total number of sites that had sufficient pre- and post-install records to include in the analysis by the number of years of data as well as customer segment and PA. Table 7-12 shows the same information for those sites identified as annual net exporters.

Table 7-11: Sites with Balanced Pre- and Post-Install Data, All Sites

Customer Segment/Number of Pre- and Post-Installation Bills		Program Administrator						All	
		PG&E		SCE		CCSE			
		Sites	Percent	Sites	Percent	Sites	Percent	Sites	Percent
Residential	12	8,603	62.5%	3,803	72.6%	2,505	99.1%	14,911	69.3%
	24	5,157	37.5%	1,432	27.4%	23	0.9%	6,612	30.7%
	All	13,760	100.0%	5,235	100.0%	2,528	100.0%	21,523	100.0%
Commercial	12	190	47.3%	114	51.8%	22	73.3%	326	50.0%
	24	212	52.7%	106	48.2%	8	26.7%	326	50.0%
	All	402	100.0%	220	100.0%	30	100.0%	652	100.0%
Gov./Non-Profit	12	92	50.5%	37	60.7%	9	60.0%	138	53.5%
	24	90	49.5%	24	39.3%	6	40.0%	120	46.5%
	All	182	100.0%	61	100.0%	15	100.0%	258	100.0%
All	12	8,885	61.9%	3,954	71.7%	2,536	98.6%	15,375	68.5%
	24	5,459	38.1%	1,562	28.3%	37	1.4%	7,058	31.5%
	All	**14,344**	**100.0%**	**5,516**	**100.0%**	**2,573**	**100.0%**	**22,433**	**100.0%**

Table 7-12: Site with Balanced Pre- and Post-Install Data, Annual Net Export Sites

Customer Segment/Number of Pre- and Post-Installation Bills		Program Administrator						All	
		PG&E		SCE		CCSE			
		Sites	Percent	Sites	Percent	Sites	Percent	Sites	Percent
Residential	12	893	59.6%	498	69.9%	564	97.9%	1,955	70.1%
	24	606	40.4%	214	30.1%	12	2.1%	832	29.9%
	All	1,499	100.0%	712	100.0%	576	100.0%	2,787	100.0%
Commercial	12	35	43.2%	15	71.4%	3	75.0%	53	50.0%
	24	46	56.8%	6	28.6%	1	25.0%	53	50.0%
	All	81	100.0%	21	100.0%	4	100.0%	106	100.0%
Gov./Non-Profit	12	9	47.4%	4	50.0%	1	25.0%	14	45.2%
	24	10	52.6%	4	50.0%	3	75.0%	17	54.8%
	All	19	100.0%	8	100.0%	4	100.0%	31	100.0%
All	12	937	58.6%	517	69.8%	568	97.3%	2,022	69.2%
	24	662	41.4%	224	30.2%	16	2.7%	902	30.8%
	All	**1,599**	**100.0%**	**741**	**100.0%**	**584**	**100.0%**	**2,924**	**100.0%**

Table 7-13 and Table 7-14 summarize the average pre-installation kWh and average post-installation export kWh for all sites and annual net exporters, respectively. Again, the data used in the analysis were balanced so that each site had an equivalent number of bills. A comparison of the data in the two summaries illustrates the clear differences between the overall sample and the annual net exporters in both the average amount of export and pre-installation consumption. While there are similar patterns in all three customer segments, the small site counts and high variability in customer characteristics for the non-residential sites makes it more difficult to make meaningful comparisons. Consequently, the focus of the discussion for the summaries presented in Table 7-13 and Table 7-14 is on the residential customer segment.

For the subset of residential sites with balanced pre- and post-installation bills, the annual net export sites' 272 kWh average export per billing period is 33% higher than the 204 kWh average for the overall group. This relationship between average export amount for all sites and net exporters varies between 20% and 48% depending on the PA and system size, but in every case the size of the export is higher for the annual net export group. These results help to explain in part why these sites produced an annual net excess of generation. Another important part of the equation is that the annual net exporters also have much a lower pre-installation average bill period consumption. The overall average bill period kWh for the residential net export sites was 804 kWh, which represents only 73% of the 1,101 kWh average for all residential sites. Again, there was substantial variation in this ratio, but in all cases the residential annual net exporters had lower average consumption in its pre-installation bills than the overall sample of sites.

Table 7-13: Average Monthly Pre-Install kWh and Export kWh for All Sites

		Program Administrator											
		PG&E			SCE			CCSE			Total		
Customer Segment	System Size	Average Pre-Installation kWh	Average Export kWh	Average Export as % of Pre-Install kWh	Average Pre-Installation kWh	Average Export kWh	Average Export as % of Pre-Install kWh	Average Pre-Installation kWh	Average Export kWh	Average Export as % of Pre-Install kWh	Average Pre-Installation kWh	Average Export kWh	Average Export as % of Pre-Install kWh
Residential	0-2.5 kW	580	90	15.5%	727	92	12.6%	602	88	14.6%	616	90	14.6%
	2.5-4 kW	809	134	16.5%	947	132	13.9%	747	135	18.1%	835	134	16.0%
	4-7.5 kW	1,232	206	16.7%	1,259	215	17.1%	1,109	219	19.7%	1,227	210	17.1%
	7.5+ kW	2,213	459	20.7%	2,317	430	18.6%	2,130	453	21.3%	2,233	451	20.2%
	Total	1,086	202	18.6%	1,191	210	17.7%	982	206	20.9%	1,101	204	18.5%
Commercial	0-5 kW	1,151	286	24.8%	3,996	198	5.0%	2,951	-	-	1,708	276	16.2%
	5-10 kW	4,818	410	8.5%	7,451	392	5.3%	1,987	-	-	5,351	409	7.6%
	10-25 kW	5,055	740	14.6%	4,084	732	17.9%	5,168	785	15.2%	4,822	742	15.4%
	25+ kW	56,465	8,227	14.6%	268,461	3,835	1.4%	292,074	8,894	3.0%	162,682	7,633	4.7%
	Total	24,964	2,989	12.0%	187,157	1,512	0.8%	147,338	2,882	2.0%	83,864	2,764	3.3%
Gov./Non-Profit	0-5 kW	9,230	148	1.6%	612,089	144	0.0%	557	208	37.3%	108,927	152	0.1%
	5-10 kW	8,573	423	4.9%	65,772	249	0.4%	21,012	-	-	21,786	386	1.8%
	10-25 kW	8,485	847	10.0%	29,946	517	1.7%	56,818	438	0.8%	16,789	759	4.5%
	25+ kW	51,837	6,138	11.8%	1,431,056	4,101	0.3%	69,369	14,416	20.8%	367,885	7,469	2.0%
	Total	25,582	3,007	11.8%	709,413	1,026	0.1%	52,776	11,302	21.4%	181,294	3,512	1.9%
Total	**Total**	**2,157**	**343**	**15.9%**	**18,150**	**245**	**1.3%**	**3,488**	**323**	**9.3%**	**6,121**	**319**	**5.2%**

Table 7-14: Average Monthly Pre-Install kWh and Export kWh for Annual Net Exporters

		Program Administrator											
		PG&E			SCE			CCSE			Total		
Customer Segment	System Size	Average Pre-Installation kWh	Average Export kWh	Average Export as % of Pre-Install kWh	Average Pre-Installation kWh	Average Export kWh	Average Export as % of Pre-Install kWh	Average Pre-Installation kWh	Average Export kWh	Average Export as % of Pre-Install kWh	Average Pre-Installation kWh	Average Export kWh	Average Export as % of Pre-Install kWh
Residential	0-2.5 kW	271	121	44.7%	306	111	36.3%	292	110	37.8%	281	118	42.0%
	2.5-4 kW	474	189	39.9%	512	163	31.8%	502	164	32.6%	487	179	36.6%
	4-7.5 kW	829	304	36.7%	856	265	30.9%	846	264	31.1%	840	285	33.9%
	7.5+ kW	1,953	647	33.1%	1,874	569	30.4%	1,734	546	31.5%	1,902	611	32.2%
	Total	788	283	36.0%	843	259	30.7%	804	253	31.5%	804	272	33.8%
Commercial	0-5 kW	541	338	62.5%	484	199	41.2%	-	-	-	532	316	59.3%
	5-10 kW	1,052	460	43.7%	642	492	76.6%	-	-	-	1,026	462	45.0%
	10-25 kW	1,601	861	53.8%	2,719	855	31.4%	2,870	947	33.0%	2,085	868	41.6%
	25+ kW	15,333	5,972	38.9%	6,839	2,021	29.6%	3,477	1,164	33.5%	14,094	5,319	37.7%
	Total	5,295	1,873	35.4%	2,816	869	30.9%	2,993	984	32.9%	4,797	1,672	34.9%
Gov./Non-Profit	0-5 kW	392	131	33.4%	439	183	41.6%	652	213	32.7%	437	157	36.0%
	5-10 kW	1,107	499	45.1%	892	235	26.3%	-	-	-	1,001	367	36.7%
	10-25 kW	2,313	1,033	44.7%	6,366	531	8.3%	-	-	-	3,566	915	25.7%
	25+ kW	32,337	11,364	35.1%	6,030	3,064	50.8%	31,704	10,240	32.3%	28,355	10,055	35.5%
	Total	14,121	4,990	35.3%	3,938	942	23.9%	27,117	8,754	32.3%	13,455	4,728	35.1%
Total	**Total**	**1,210**	**435**	**35.9%**	**936**	**284**	**30.3%**	**1,120**	**367**	**32.8%**	**1,126**	**386**	**34.3%**

The summaries in Table 7-13 and Table 7-14 show the annual average billing period kWh values. Electricity consumption, however generally varies throughout the year with the summer months having higher average consumption than winter months. As an illustration of the different seasonal load patterns for residential sites, Figure 7-6, Figure 7-7, and Figure 7-8 show the average pre- and post-installation monthly kWh bill totals for PG&E, SCE, and CCSE, respectively. The figures juxtapose the series for the overall sample with the annual net exporters. A shaded region shows the interquartile range, which represents the 25th and 75th percentiles, as a means of showing the variability associated with the average bills. The monthly billing values presented in the plots have been normalized so that they show amount of consumption based on a standard 30.14-day month. As a simple example, a monthly bill of 100 kWh from a billing period of 28 days represents 3.57 kWh per day of billed consumption, which over a 30.14-day month would amount to 107.6 kWh. This conversion allows for a more accurate comparability of the average values from month to month. Another factor to keep in mind when interpreting these results is that the month represents the month of the bill date. This means that a bill date of May 3, for example, will be considered to be May even though the majority of the billing period actually occurred in April. The distribution of billing days is fairly uniform, so the average across all sites for May is more accurately indicative of the middle of the April to the middle of May.

While the figures are fairly self explanatory, there are several observations worthy of discussion. For all three PAs the influence of PV generation on billed consumption is clear and the post-installation bill kWh is lower year round. The series are suggestive of the seasonality of PV generation, which starts to maximize in the spring to summer seasons, and is reflected in the largest differences between pre- and post-installation bills in the spring. It is also clear that the combination of high PV generation and low AC loads in the spring contributes to higher exports for the annual net export group during this time period. There are differences among the PAs that merit discussion. For PG&E and SDG&E, there is a broader range of months during which that average bill for the net exporters is negative. For PG&E and CCSE, the average post-installation net exporter bill goes negative around March or April and stay at or below zero until September or October. In contrast, the annual net exporters for SCE are negative in March, but by August the sites have a positive average monthly bill. This difference is likely associated with higher AC loads in SCE's territory. This hypothesis is supported by the higher summer loads visible in SCE's pre-installation monthly averages for both all sites and the net exporters when compared to the pre-installation summer monthly averages for PG&E and CCSE.

Figure 7-6: PG&E Residential Pre- and Post-Installation Average Monthly kWh

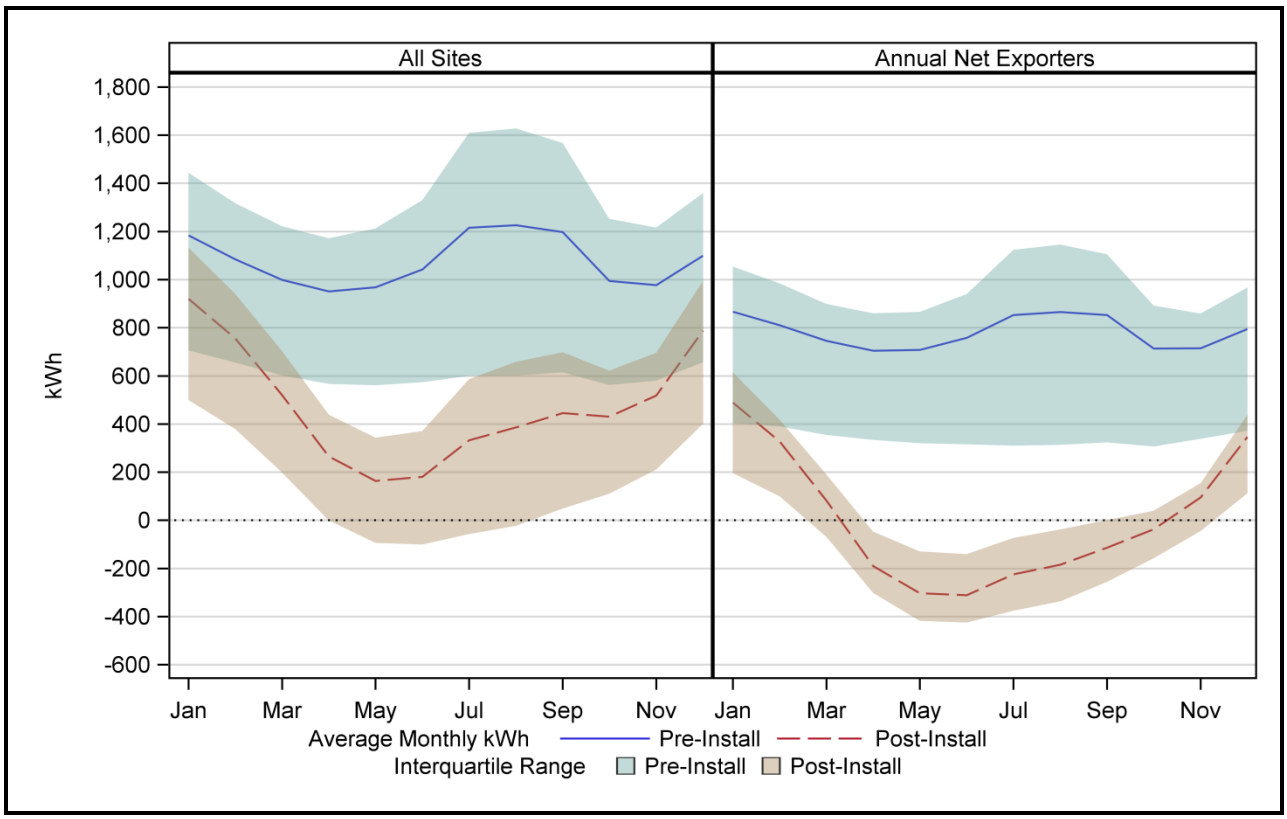


Figure 7-7: SCE Residential Pre- and Post-Installation Average Monthly kWh

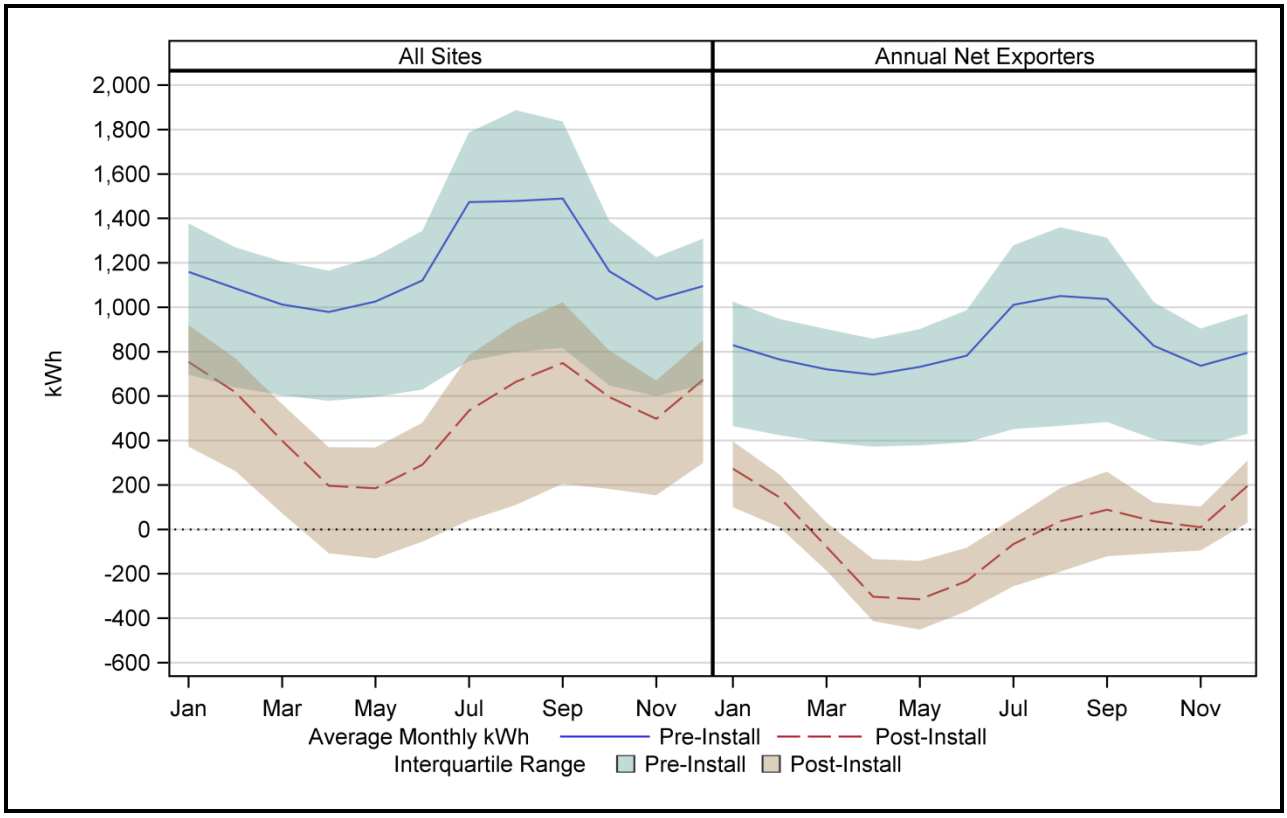
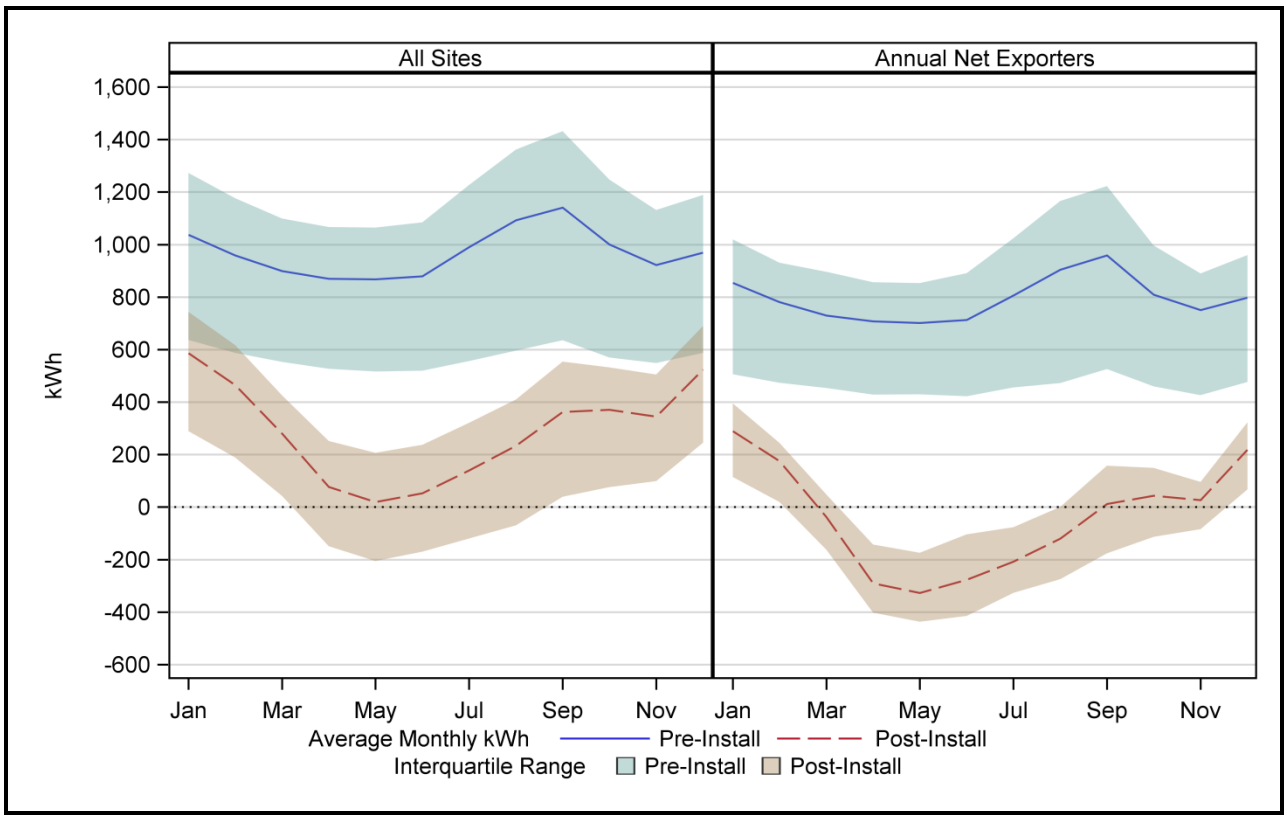


Figure 7-8: CCSE Residential Pre- and Post-Install Average Monthly kWh



Both PV generation and a site's electricity needs have a clear seasonality. The seasonality of PV electricity generation and electricity consumption affects both the timing and magnitude of exported electricity. Table 7-15 and Table 7-16 provide summaries of the probability and average magnitude of export by quarter, customer segment, and PA for all sites and annual net exporters, respectively. In the summaries, the incidence of export is simply the percentage of all billing records with a negative value. As with the figures above, the monthly values are normalized to a standard number of days.

For the summary of export probability and magnitude for all sites in Table 7-15, the clear pattern for residential customers is that both the likelihood of export and export quantities are markedly higher in the second quarter from April to June. The overall residential probability of export across PAs in the second quarter is 35.1%, which is more than ten percentage points higher than the next highest chance of export (24%) from August to September. Overall, for residential sites the first and fourth quarters both have substantially lower likelihood of export, less than 10% of the sites export electricity. While this general pattern is the same across PAs, it is worth noting that for CCSE the probability of export for residential customers is 48% in the second quarter.

Table 7-15: Chance of Export, Average kWh, and Average Export Amount by Quarter, All Sites

Customer Segment / Quarter		Program Administrator											
		PG&E			SCE			CCSE			Total		
		Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
Residential	Jan - Mar	3.3%	725	153	8.0%	586	174	9.6%	439	149	5.0%	664	161
	Apr – Jun	33.4%	196	220	35.2%	226	242	48.0%	52	242	35.1%	190	228
	Aug - Sep	26.0%	377	209	15.4%	649	186	31.0%	243	201	24.0%	431	204
	Oct – Dec	6.5%	580	140	7.8%	593	154	10.5%	416	133	7.2%	568	143
	All	17.4%	467	206	16.7%	514	211	25.0%	287	209	17.9%	461	207
Commercial	Jan - Mar	15.0%	19,613	2,471	4.8%	150,234	2,421	12.9%	135,747	7,119	11.5%	68,613	2,641
	Apr – Jun	35.5%	14,587	3,837	14.1%	146,976	1,403	23.9%	110,427	2,710	27.9%	62,836	3,391
	Aug - Sep	23.0%	19,491	3,139	7.0%	174,151	751	8.4%	162,988	1,308	17.0%	77,394	2,773
	Oct – Dec	12.5%	23,818	1,039	3.8%	163,636	2,212	5.6%	187,535	615	9.4%	77,533	1,193
	All	21.6%	19,348	3,009	7.5%	158,811	1,511	12.7%	149,177	3,333	16.5%	71,605	2,790
Gov./Non-Profit	Jan - Mar	3.6%	28,397	1,035	8.0%	638,405	321	8.5%	25,748	36,640	4.9%	170,834	4,214
	Apr – Jun	25.8%	19,616	3,344	21.3%	643,177	1,301	49.3%	28,904	14,667	26.2%	162,441	3,989
	Aug - Sep	27.0%	16,938	3,500	8.9%	744,940	1,210	27.3%	50,905	8,579	22.9%	189,179	3,578
	Oct – Dec	6.3%	23,282	871	4.3%	690,450	578	19.0%	41,976	9,221	6.5%	178,053	1,755
	All	**15.7%**	**22,012**	**3,040**	**10.7%**	**679,563**	**1,027**	**27.0%**	**36,781**	**14,311**	**15.2%**	**175,098**	**3,616**

Again, this general pattern of export probability for the residential segment is an intuitive result. The months of the second quarter are when weather is most conducive to PV production. At the same time, AC loads have not yet reached peak levels, resulting in more opportunities for generation to exceed a site's needs. PV production is also high in the third quarter, but at that point AC loads are high enough to consume more of the system generation, resulting in a lower probability of export. In the first and fourth quarters, the chance of export declines dramatically as cloud cover and rain substantially lower PV generation.

With respect to export magnitude at residential sites, the pattern is the same, with larger exports in the second and third quarters. Overall, however, there is less variability in the size of export compared to the probability of export. For example, the high overall average export in the second quarter of 228 kWh is only 159% of the fourth quarter low of 143 kWh. In contrast, the 35.1% chance of export is nearly five times higher than the fourth quarter's 7.2% chance of export.

For the non-residential customer segments, the overall pattern of both export probability and magnitude is similar to the residential sites. However, the heterogeneity of the non-residential sites means that the overall results are unlikely to be representative of any of the individual PAs. Furthermore, the small site counts for some of the cells in the table (see Table 7-11) mean that there are cases where a single site could have excessive influence on the results. As an example, the extremely large exports for CCSE's Government and Non-Profit are based on 15 sites, so it is unwise to ascribe too much importance to any comparisons with the other PAs.

For the annual net export sites, Table 7-16 shows the average probability and size of export by customer segment, quarter, and PA. For residential sites, the patterns are similar to the summary of all sites (Table 7-15), with both export probability and magnitude highest in the first and second quarters. The probability of export for the annual net exporters is, logically, substantially higher in every instance. Overall, the net exporters showed a 55.7% chance of export compared to 17.9% for all sites. Additionally, the probability of export for the annual net exporters does not fall quite as much in the fall and winter months as it does in the summary of all sites. For example, the overall high probability of export of 88.7% in the second quarter goes down to just over 24% for the first quarter. While this is still 3.7 times higher, for all residential sites the second quarter was more than seven times higher than the first quarter.

In terms of average size of export, the second quarter is the largest for the annual net export sites. At 342 kWh, the average monthly export from April through June is more than two times the 158 kWh average from October through December. This is more of a discrepancy than was seen in the overall summary of sites, which had more similarity in export magnitude throughout the year. It is also worth noting that while average monthly exports are higher for the annual net exporters, the difference is not nearly as large as the difference in export probability. This suggests that what makes a site a net exporter has somewhat more to do with the frequency with which it exports than how much electricity is returned to the grid.

Table 7-16: Chance of Export and Average Export Amount by Quarter, Annual Net Exporters

Customer Segment / Quarter		Program Administrator											
		PG&E			SCE			CCSE			Total		
		Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
Residential	Jan - Mar	17.6%	290	162	33.1%	109	185	32.9%	139	154	24.1%	217	169
	Apr - Jun	88.0%	-280	341	88.8%	-282	345	90.9%	-290	343	88.7%	-282	342
	Aug - Sep	77.5%	-187	314	57.4%	18	230	72.8%	-110	257	71.5%	-121	287
	Oct - Dec	36.0%	132	161	38.5%	85	161	37.2%	99	144	36.8%	114	158
	All	55.2%	-16	289	54.6%	-17	258	58.8%	-42	258	55.7%	-20	276
Commercial	Jan - Mar	40.0%	831	1,339	36.3%	267	740	66.7%	-221	773	40.0%	704	1,223
	Apr - Jun	80.6%	-1,325	2,303	89.0%	-880	1,200	94.4%	-1,428	1,627	82.5%	-1,251	2,074
	Aug - Sep	59.1%	24	2,332	61.9%	-17	735	33.3%	-98	865	58.8%	14	2,017
	Oct - Dec	42.0%	2,097	932	35.9%	268	378	33.3%	538	379	40.7%	1,730	837
	All	55.6%	387	1,883	56.2%	-93	866	58.3%	-365	1,138	55.8%	282	1,686
Gov./Non-Profit	Jan - Mar	19.8%	4,139	1,016	36.1%	480	359	4.8%	13,342	22	21.7%	4,389	701
	Apr - Jun	85.9%	-5,220	6,513	83.3%	-963	1,260	96.3%	-15,459	16,272	87.2%	-5,676	6,850
	Aug - Sep	84.7%	-4,311	6,376	52.8%	-71	996	90.0%	-7,542	8,579	77.3%	-3,561	5,689
	Oct - Dec	37.0%	5,575	1,189	25.0%	330	646	56.3%	7,371	3,132	36.1%	4,312	1,356
	All	**56.3%**	**114**	**5,065**	**49.3%**	**-48**	**944**	**64.3%**	**-1,589**	**11,125**	**55.7%**	**-140**	**4,951**

As two final examples of the variation in export probability, Figure 7-9 and Figure 7-10 compare the monthly probability of export for all sites and annual net exporters, first by customer segment for all PAs and then by PA for all customer segments. Consistent with the summary table already presented, the expected difference in export probability for the annual net exporters is clear in both figures. In the comparison of the customer segments, a peak probability of around 90% occurs in the spring for the annual net exporters, compared to much lower peaks of 30% for the non-residential segments and 40% for residential in the all sites group. The government/non-profit segment for all sites has its peak probability around one month later than the other segments. In the comparison of monthly export probability for the PAs, the higher probability of export for CCSE sites is evident among both non-net and annual net exporters.

Figure 7-9: Monthly Export Probability by Customer Segment, All PAs

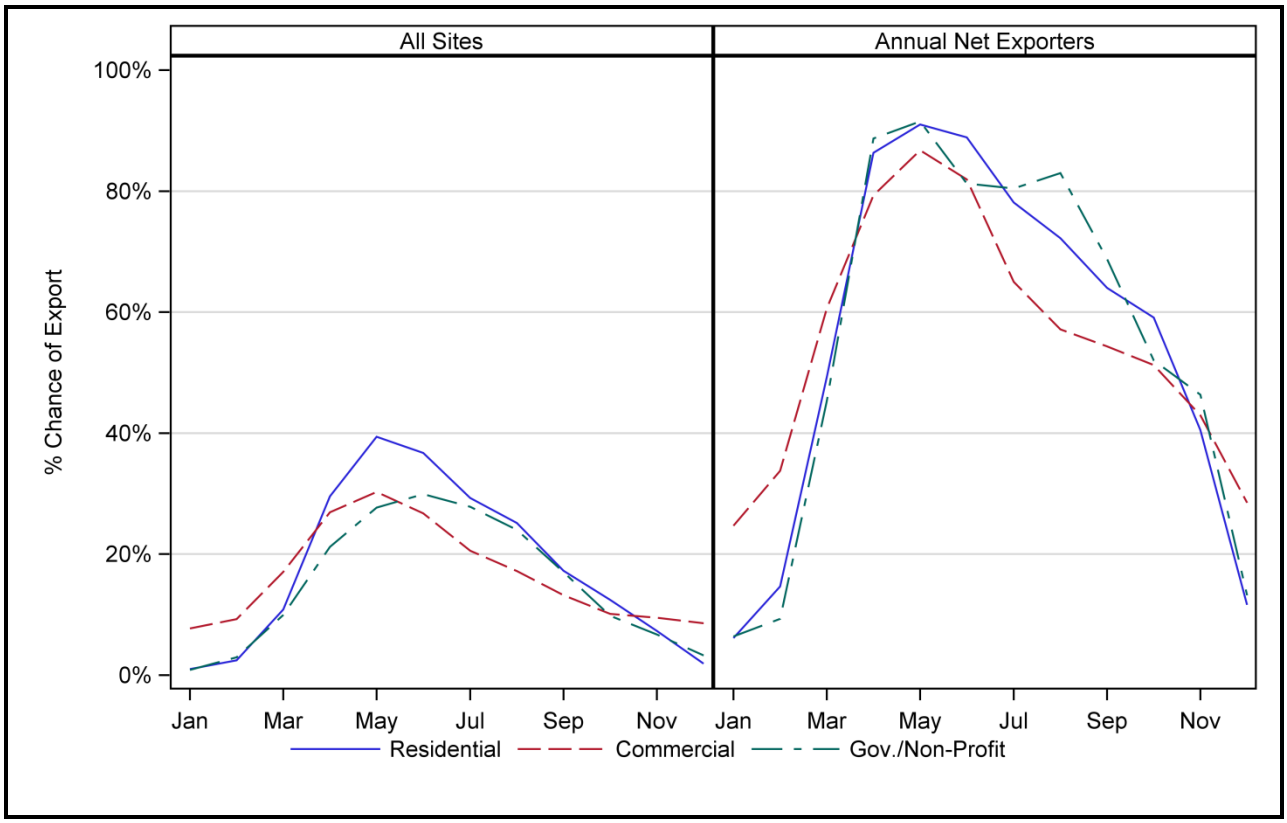
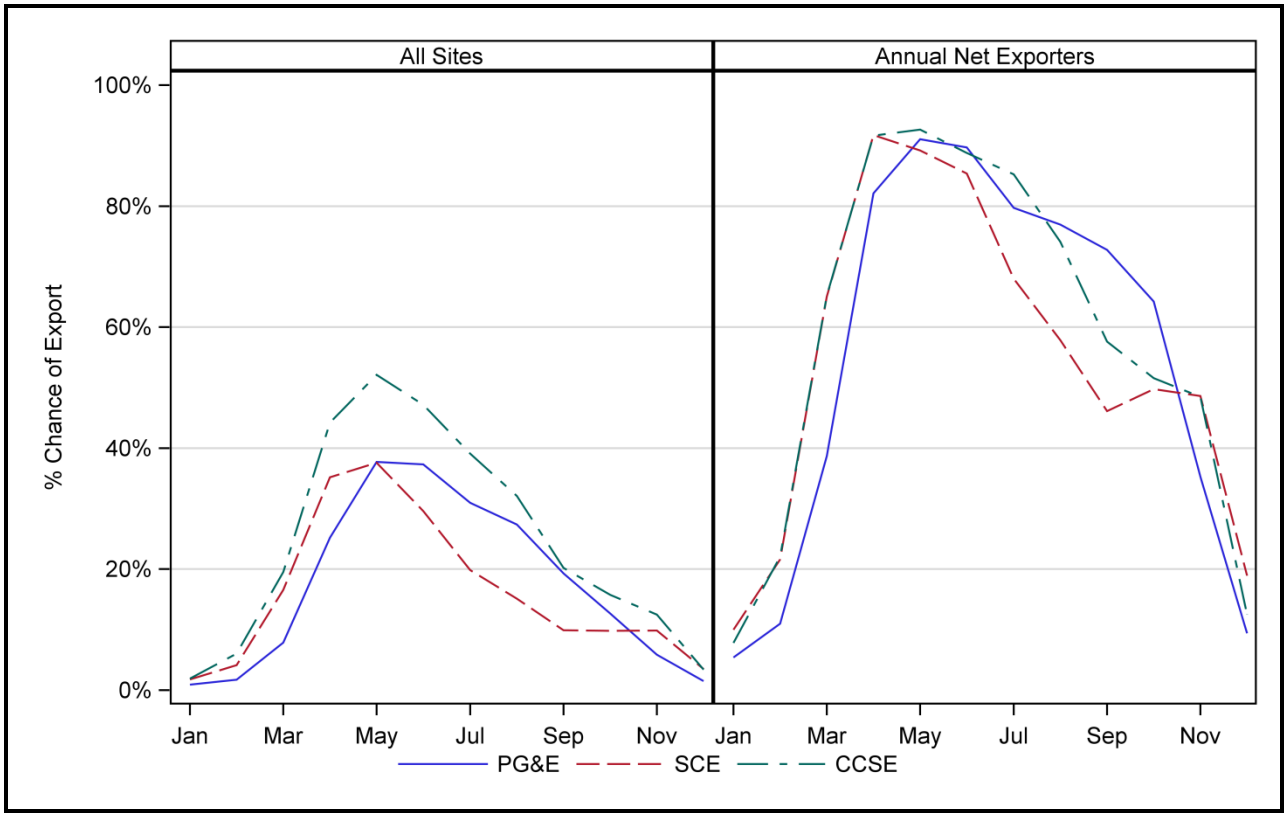


Figure 7-10: Monthly Export Probability by PA, All Customer Segments



7.1.6 Model of Yearly Net Export

The results presented to this point have provided a detailed account of how often the export of PV generation occurs in monthly bills and the size of the exported amounts. The results have also shown how annual net exporters are different from the overall population of CSI GM sites. Annual exporter sites tend to have lower pre-installation consumption relative to the size of the installed systems. The results thus far, however, have been exclusively descriptive and offer few independent answers as to why some sites generate enough excess electricity that they are annual net exporters. As an attempt to identify the independent influence of key factors that affect export behavior and to quantify their degree of influence, this sub-section relies on statistical modeling to determine which site attributes contribute to the likelihood that a site will be an annual net exporter.

Yearly Net Export Modeling Data

The analysis relied on information from three data sources: Power Clerk, utility billing data, and weather data. The billing data were used to determine whether or not a site was an annual net exporter as well as to summarize certain site usage characteristics, such as average pre-installation consumption. The PowerClerk data provided information on the system size and installation date in addition to a site's classification in various strata, including climate zone,

incentive structure (PBI versus EPBB), and whether a system is owned by a third party. Finally, weather data were necessary to control for influence of weather (temperature, cloud cover, etc.) that affect a site's generation, and therefore might enhance or decrease a system's ability to generate excess electricity.

Data Aggregation and Censoring

The first step of the analysis was the cleaning and aggregation of the monthly billing data to the site level. As part of this process, many sites from the initial sample had to be removed due to issues with the data that made them unsuitable for analysis. A summary of the data attrition is presented in Table 7-17, which shows the primary reasons for data attrition and how they affected the number of sites available for analysis. The reasons for removal varied, but all were necessary. Since the annual net exporter status is defined as a site with negative total kWh over any twelve billing periods, sites with less than twelve bills after PV installation were deleted.[2] The modeling approach also needed to consider pre-installation consumption, so any sites with fewer than 300 days of pre-installation billing data were also excluded from the analysis. Finally, there were some sites that were deleted due to other issues that suggested their data were not reliable. For example, bills with negative or zero pre-installation usage were deleted. Also, sites with extremely large PV capacity compared to the pre-installation usage were also deleted from the study.

[2] Note that utility bills with PV installation dates in between the start date and end date of a bill are designated as a dead band period. The dead band does not contribute to either the pre or the post-installation period.

Table 7-17: Data Censoring and Final Net Export Data Set

State of Censoring	Count of Non-Residential Sites	Count of PG&E Residential Sites			Count of SCE Residential Sites			Count of CCSE Residential Sites			Total Count of Sites
		Coastal	Inland	N/A	Coastal	Inland	N/A	Coastal	Inland	N/A	
Raw Data	1,676	11,590	8,839	3	2,433	8,351	2	2,804	2,437	1	38,136
Delete sites that have less than 12 post installation bills	1,134	8,021	5,638	0	1,306	4,290	0	1,678	1,267	0	23,334
Delete the sites with inconsistent bill day information	1,131	8,014	5,633	0	1,306	4,290	0	1,662	1,263	0	23,299
Delete the sites with not enough or invalid pre installation bills	883	7,114	5,123	0	1,171	3,893	0	1,365	1,025	0	20,574
Delete the sites due to other reasons	881	7,113	5,123	0	1,171	3,893	0	1,365	1,024	0	20,570

The starting data set included 38,136 sites and after all problem sites were removed, 20,570 remained for use in the analysis. While this is a substantial reduction, 84% (14,802) of the removed sites were due to having fewer than 12 post-installation bills and 7% (2,725) were removed due to insufficient pre-installation data. This means that less than 10% of the removals were due to issues of problematic data unrelated to the length of pre- or post-installation billing period.

The full sample was separated into many sub-samples. First, non-residential, and residential sites were separated into separate analysis data sets because of inherent differences in the nature of non-residential and residential sites that might impact how different factors influence the likelihood of generating net exports. Following the non-residential and residential analysis, the residential sites were further divided into six sub-samples by PA and location (inland or coastal). Separate models were estimated for the six residential groups for two reasons. First, the probability of net export status might depend on PA influences in program implementation. For example, the PA's interpretation and implementation of sizing requirements might vary by PA. Second, there might be climate effects associated with location that are not adequately captured in any of the weather variables, such as the daily patterns of cloud cover that are lost in the aggregation of daily data to site averages. The count of sites and summary statistics on key analysis variables of the two customer segment sub-samples are presented in Table 7-18. The same information for the six residential sub samples is provided in Table 7-19. As seen in Table 7-18, just over 12% of both the non-residential and the residential sites included in the analysis were annual net exporters. As expected, the system generation capacities for non-residential sites were much larger than for the residential sites with far more variability in size. Comparing capacity to usage, the relative size (PV size divided by average daily usage) for residential sites is (0.15) was very similar to the relative size (0.16) of the non-residential sites, which shows that for both customer segments the systems were sized in a consistent manner.

The statistics of the weather variables are similar for the residential and non-residential sites. For residential sites, the average sky coverage of 3.67 on a scale where zero indicates no clouds and 10 means complete cloud coverage is slightly higher than the 3.58 for non-residential sites. Therefore, the non-residential sites are in slightly less cloudy locations than the residential sites. Consistent with the average cloud coverage, average temperatures are slightly lower for the residential sites than the non-residential sites.

Table 7-18: Summary Statistics for Residential and Non-Residential Samples

	Non-Residential		Residential	
	Mean	**Std Dev**	**Mean**	**Std Dev**
Sample Size	881		19,689	
Number of Post-Install Bills	26.45	7.70	24.53	9.02
Percent Net Exporter	12.3%	0.11	12.4%	0.11
System Size (kW)	134	235	4.68	3.31
Daily Usage (kWh)	5,534	27,419	36.34	63.31
Relative Size (kW/kWh)	0.16	0.39	0.15	0.15
Standard Deviation of Log Daily Usage	0.32	0.35	0.30	0.24
Sky Coverage	3.58	1.42	3.67	1.39
Average Yearly High Temperature	70.94	5.09	70.80	4.70
Third Party Ownership Share of Sites	30.4%	0.21	11.6%	0.10
EPBB Share of Sites	63.5%	0.23	98.7%	0.01
PG&E Share of Sites	65.0%	0.23	62.1%	0.24
SCE Share of Sites	28.8%	0.21	25.7%	0.19
CCSE Share of Sites	6.1%	0.06	12.1%	0.11
Coastal Share of Sites	50.6%	0.25	49.0%	0.25

The distributions of PAs in each customer segment were similar, although the percentage of CCSE sites in the residential customer segment (12.1%) was almost twice the size of its share of non-residential sites (6.1%). For other strata, there were more substantial differences between the two samples. Just over 30% of non-residential systems had third-party owners, compared to 12% for residential sites. In addition, non-residential sites were far more likely (37%) to be based on five-year performance (PBI), than residential sites (1%). Many of the larger non-residential sites were not eligible for EPBB or up front incentives and were restricted to the five-year performance-based incentive.

Table 7-19: Summary Statistics for Residential Sub-Samples

	PG&E Coastal		PG&E Inland		SCE Coastal		SCE Inland		CCSE Coastal		CCSE Inland	
	Mean	**Std Dev**	**Mean**	**Std Dev**	**Mean**	**Std Dev**	**Mean**	**Std Dev**	**Mean**	**Std Dev**	**Mean**	**Std Dev**
Sample Size	7,113		5,123		1,171		3,893		1,365		1,024	
Percent Net Exporter	11%	0.10	8%	0.07	15%	0.13	13%	0.11	22%	0.17	26%	0.19
System Size (kW)	4.29	3.73	5.26	3.04	4.24	2.75	4.94	3.22	3.96	2.27	5.07	2.91
Daily Usage (kWh)	32.17	89.54	41.13	20.85	32.87	26.10	41.64	66.98	28.18	19.62	36.11	20.22
Relative Size (kW/kWh)	0.16	0.14	0.14	0.13	0.16	0.16	0.14	0.17	0.17	0.19	0.15	0.07
Standard Deviation of Log Daily Usage	0.30	0.26	0.34	0.23	0.24	0.24	0.33	0.22	0.22	0.21	0.23	0.18
Sky Coverage	4.63	0.68	2.78	1.24	4.63	0.28	2.23	1.04	4.77	0.08	4.39	0.60
Average Yearly High Temperature	66.93	2.86	73.38	3.05	68.13	0.65	75.93	4.07	68.40	0.81	71.57	1.94
Third Party Ownership	10%	0.09	12%	0.11	13%	0.12	14%	0.12	9%	0.08	11%	0.10
EPBB	99.7%	0.003	99%	0.01	99.7%	0.003	97%	0.03	97%	0.03	98%	0.02
Number of Post-Install Bills	25.96	9.12	25.68	9.13	23.28	8.49	23.37	8.67	20.55	7.65	19.89	7.20

Table 7-19 presents summary statistics for the six residential sub-samples that separate sites by PA and location. The proportion of residential sites which are net exporters is the highest in CCSE or the San Diego area, where 22% of coastal and 26% of inland residential sites are net exporters. In comparison, only 11% of PG&E coastal residential sites and 8% of inland sites are net exporters. For SCE, 15% of coastal residential sites and 13% of inland sites are net exporters. For PG&E and SCE, coastal residential sites are slightly more likely to be net exporters than inland sites. For CCSE, the coastal sites are less likely to be net exporters than inland sites. The coastal clouds and temperate inland climate of San Diego or CCSE's territory likely contributes to the reversal of the normal relationship between location and likelihood of export.

For all three PAs, the average size of residential PV systems is larger for inland sites than for coastal sites. On average, larger PV systems are likely installed inland due to the higher average daily inland electricity usage. In addition, the electricity consumption is higher for both coastal and inland residential sites in PG&E and SCE relative to CCSE. The size of the capacity relative to usage (size divided by daily usage), however, is slightly higher for CCSE, 0.17 for coastal areas and 0.15 for inland areas, than for PG&E and SCE (0.16 and 0.14 for coastal and inland samples, respectively). The slightly higher relative capacity in CCSE may contribute to the higher proportion of CCSE net exporting sites.

Another variable that might contribute to CCSE's higher proportion of net exporters is the standard deviation of the log of daily usage. Lower variation in daily usage, which is likely associated with fewer seasonal loads, might lead to an increased probability of being a net exporter. Likely due to the mild weather in CCSE's area, the means of *SDDailyUsage* for CCSE are 0.22 for coastal area and 0.23 for inland area, much lower than the 0.30 and 0.34 for PG&E, and 0.25 and 0.33 for SCE.

Weather, however, may have confounding effects on the probability of yearly net export for CCSE. The average high temperature for CCSE's area is the lowest among the three PAs. Lower temperatures are associated with higher PV electricity production for a given system size. If the relationship between system size and pre-installation usage were the same across the state, CCSE's temperate climate could lead to higher output for a given system size, increasing the likelihood of net export. The cloud coverage for CCSE, however, is higher than other PAs. The sky coverage is the highest in CCSE's area, 4.8 and 4.4, comparing to the 4.6 and 2.8 in PG&E and 4.6 and 2.2 in SCE's territory. High sky coverage or less sunshine will reduce PV energy production and lower the probability of yearly net export.

The percentage of the systems owned by third parties for residential sites is similar across the three PAs and two climate zones. The percentage of residential sites accepting up front or *EPBB* rebates is also similar across PAs. Finally, residential sites in PG&E's territory were some of the first sites in the state to install solar panels. These sites average 26 post-installation bill months

for both coastal and inland areas. SCE residential sites average 23 post-installation bills, while CCSE residential sites have approximately 20 post-installation bills.

Methodology and Model Specification

The model applied in this analysis is designed to determine the independent impact of site-specific characteristics on the probability of being an annual net exporter. To reiterate, an annual net exporter is defined as a site whose sum of their total billing data over twelve consecutive billing periods is negative. The analysis uses a Logit model to estimate the probability that site will generate annual net export of electricity. The likelihood of a site being a net exporter is hypothesized to be a function of the PV system capacity, the site's electricity consumption, weather, and other site and system specific characteristics. The general form of the model is:

$$Prob(Net\ Export) = f(PV\ Capacity, kWh\ Consumption, Weather, Xi)$$

In this general form, PV capacity represents how much electricity a system can generate, kWh consumption represents how much electricity a site consumes, and Xi represents all of the other factors that might affect whether a site becomes an annual net exporter.

The Logit model was estimated using maximum likelihood method to quantify and test the statistical significance of the independent influence of various site level characteristics on the probability of being a net exporter. For this analysis, each site's data was summarized into a single record. The site's record includes the site's net export status, which is the independent variable has a value of zero or one, where one indicates that the site did have annual net exports. For the independent variables, the record for each site includes the capacity of the PV system, the average pre-installation daily kWh consumption, the standard deviation of pre-installation consumption, yearly average sky coverage, yearly average high temperature, and other site characteristics, such as whether the system was host owned or third party owned, whether the incentive was based on expected performance (EPBB) or five-year performance (Five Year PBI), and etc.

The model specification is shown below.

$$Pr(NetExporter_i) = \frac{1}{1 + e^{-f(x)}}$$

$$\begin{aligned} f(x) = \beta_0 &+ \beta_1 log(size_i) + \beta_2 log(DailyUsage_i) + \beta_3 SDDailyUsage_i + \beta_4 SkyCoverage_i \\ &+ \beta_5 HighTemp_i + \beta_6 HighTemp_i^2 + \beta_7 ThirdParty_i + \beta_8 EPBB_i + \beta_9 n_Bills_i \\ &+ \left\{ \sum_i \beta^i Dummy_i \right\} \end{aligned}$$

Where:

$NetExporter_i$ is a binary variable that equals 1 if site i's total billed kWh amount was negative for any consecutive twelve billing periods, and 0 otherwise,

$log(size_i)$ is the log form of the capacity of site i's PV system in kW,

$log(DailyUsage_i)$ is the log form of the average daily pre-installation kWh for the year prior to the installation of the PV system,[3]

$SDDailyUsage_i$ is the standard deviation of the log form of daily pre-installation kWh for the year before the installation of the PV system,

$SkyCoverage_i$ is the minimum of the average sky coverage index[4] across any consecutive 12 billing periods after the installation of the PV system,

$HighTemp_i$ is the average daily high temperature across all the consecutive 12 billing periods after the installation of the PV system, and $HighTemp_i^2$ is the square of HighTemp,

$ThirdParty_i$ is a binary variable that equals 1 if the site was third-party-owned and 0 otherwise,

$EPBB_i$ is a binary variable that equals 1 if the incentive was calculated based on the expected performance and 0 if the incentive was calculated based on five-year measured performance,

n_Bills_i is the number of bills after the installation of the PV system, and

$Dummy_i$ is a series of binary variables for six areas in $\{PG\&E, SCE, CCSE\} \times \{Coastal, Inland\}$, including: *PGE*, *CCSE*, *Coastal*, *PGE_Coastal*, and *CCSE_Coastal*. The SCE Inland binary variable was taken out to avoid multi-collinearity.[5]

Each coefficient in the model measures the effect of the corresponding independent variable on the cumulative distribution function of *Net Exporter*. While the sign of each coefficient is interpreted similar to a linear ordinary least squares model, the scale of the estimated coefficient

[3] Any sites with less than 300 days of pre installation billing data were deleted to ensure that the average daily usage is not biased due to lack of data.

[4] The Sky Coverage index ranges from 0 to 10, with 0 meaning sunny and 10 meaning totally covered.

[5] Note that these dummy variables were not included in the regression models for the six residential sub-samples.

does not indicate the marginal effect of each independent variable. To estimate the marginal effect of a given change in the independent variable on the probability of net export, the derivative of the Logit function must be analyzed. The results and discussion sub-section will include both the parameter estimates and the score or derivatives.

A principal independent variable in the model is the log form of PV system capacity; $log(size_i)$. A larger PV system is anticipated to increase the probability of net export. Similarly, higher kWh consumption is likely to lower the probability of net export, and hence the sign for β_2 is expected to be negative. The model incorporates a measure of the variation in electricity consumption, the standard deviation of the log of pre-installation electricity consumption. High variability in consumption is likely associated with the presence of seasonal loads such as central air conditioning or electric heating. The seasonal element and the likely sensitivity of consumption to weather may make the sizing of a PV system on a site with a variable load more difficult. If sites size their PV system to meet their average yearly electricity needs, a site with highly variable kWh consumption is more likely to be a monthly net exporter. The system is sized to the yearly electricity requirements; high variability implies that there are very low and very high consumption months. The low consumption periods provide the household with the opportunity to be monthly net exporters. The impact of consumption variability on yearly export may depend on the methodology used to size the system. If system sizing is based solely on the mean of the previous year's consumption, variable loads may reduce the likelihood of yearly net export. Variable loads may be harder to forecast and plan for. Variable loads may change both seasonally and yearly as weather and other factors change the site's electricity usage.

Sky coverage and temperature were included to control for the independent effects of weather on PV performance. The sky or cloud coverage variable is zero for a sky with no cloud coverage and increases as cloud coverage increases. Therefore, as cloud coverage decrease PV kWh production and the probability of net export increases, a negative sign is expected for β_4. The production of electricity from PV panels declines as the panels become hotter. Various temperature variables were tried in the modeling of net export including temperature, HDD, and CDD. The final model incorporated a measure of the site's average post-installation temperature and the square of temperature.

The impact of third-party ownership on net export status may occur through the sizing of the system or the level of maintenance the system receives. If third-party systems are smaller than privately owned systems or they are less well maintained, then the probability of yearly net export for these systems will be lower. Incentive type may also impact the probability of net export. Owners of systems receiving an upfront rebate (EPBB) may have less incentive to clean and maintain their systems than owners of systems receiving a five-year performance-based rebate (PBI). If EPBB rebates lead to less maintenance and cleaning, we may find that EPBB systems have a lower probability of net export than PBI systems.

There is some evidence that the length of post-installation bills may be positively associated with yearly net export simply due to the increased opportunity for a site to be a net exporter (see Table 7-6). At the same time, more post installation bills also means that the sites have older systems, which will see a limited reduction in production with age. Therefore, the effect of n_Bills_i on the probability of yearly net export is ambiguous.

Model Estimates

Table 7-20 presents the coefficients for the independent variables from the analysis of the non-residential and the residential customer segment models. The coefficient standard errors and Chi squared values are also provided. The Logit model, however, is nonlinear and the coefficients do not represent the impact of a one unit change in the independent variable on the probability of net export. The model coefficients can be used to determine the direction of an independent variable's influence on the probability of net export and if the relationship is statistically significant. For example, the non-residential and the residential parameters show that the probability of net export increases with the size of the PV system and decreases with the consumption of the site. Both of these relationships are statistically significant.

Table 7-20: Non-Residential and Residential Net Export Parameter Estimates

Parameter	Non-Residential			Residential		
	Estimate	Standard Error	Pr > Chi^2	Estimate	Standard Error	Pr > Chi^2
Intercept	-19.83	14.88	0.1826	3.26	3.70	0.3787
Log(Size)	1.61	0.23	<.0001	3.91	0.10	<.0001
Log(Daily Usage)	-1.80	0.21	<.0001	-3.97	0.09	<.0001
SD Log Daily Usage	0.28	0.30	0.3586	-1.24	0.11	<.0001
Sky Coverage	-0.27	0.15	0.0665	-0.15	0.03	<.0001
High Temperature	0.57	0.42	0.1710	0.11	0.10	0.3093
High Temperature^2	-0.004	0.00	0.1963	-0.001	0.001	0.2597
Third Party	0.58	0.33	0.0765	-0.21	0.09	0.0195
EPBB	0.68	0.42	0.1085	-0.32	0.18	0.0760
Number Bills	0.005	0.02	0.7829	0.01	0.003	<.0001
PGE	0.18	0.44	0.6838	-0.71	0.09	<.0001
CCSE	2.17	0.71	0.0023	0.82	0.12	<.0001
Coastal	0.89	0.80	0.2652	-0.06	0.15	0.6847
PGE Coastal	-0.28	0.74	0.7066	0.16	0.13	0.2450
CCSE Coastal	-2.84	1.20	0.0180	-0.48	0.17	0.0056

To determine the influence of a one unit increase in an independent variable on the probability of net export, however, the model's marginal effects must be calculated. For example, the influence of sky coverage on the residential probability of net export is estimated to be –0.15. The negative sign on the parameter estimate indicates that when sky coverage or clouds increase, the probability of being a net exporter decreases. In addition, the relationship between the parameter estimate and the standard error or the Chi Squared value can be used to determine that the relationship between sky coverage and net export is statistically significant. The parameter size, however, does not imply that a unit change in sky coverage would decrease the probability of being a net exporter by 0.15 or 15%.

To determine the marginal effect of each independent variable is calculated as $p \times (1 - p) \times \beta$, where p is the probability that the site is a net exporter. Following the example above, if the probability of being a net exporter is 0.2 for a particular site, the marginal effect is calculated to be $0.2 \times 0.8 \times (-0.15) = -0.024$. Therefore, a one-unit increase in sky coverage decreases the probability the site is a net exporter from 0.2 or 20% to 0.176 or 17.6%.

The marginal effects for the non-residential and the residential models are presented in Table 7-21. They measure the change in probability given a one unit change in the corresponding independent variable. The marginal effects are calculated using each site's value for their independent variables. The site level marginal effect is calculated as the difference between the site's actual probability of net export and the probability of net export if the variable of interest is increased by one unit. The sample's marginal effect is the mean of the site level marginal effects. For binary variables, the marginal effect is calculated using a slightly different methodology. It is not possible to increase the value of the binary variable for all sites by one. For example, if a site was already receiving an EPBB rebate, increasing the binary variable from 1 to 2 is out bounds with regards to acceptable variable values. Therefore, the marginal effect is calculated as the difference of the site level predicted probability associated with changing the binary variable from a 0 to a 1 for all sites. For the EPBB example, the predicted probability was first calculated for all sites using the model parameters and setting all site level values for EPBB to 0. Next, the predicted probability was calculated using the model parameters and setting all site level values for EPBB to 1. The marginal effect of being an EPBB site is the difference of these two predicted probabilities.

Table 7-21 also lists the marginal effect of a one unit increase in temperature. The model, however, incorporates two terms for temperature: a level and a squared term. While neither of these terms are statistically significant in the model parameters presented in Table 7-20, both residential and non-residential models find a concave shape with respect to temperatures. For both the residential and the non-residential models, an increase in temperature increases the probability of being a net exporter up to some point, after which increases in temperature reduce the probability of net export. The turning point in the concave function, however, is very different for the residential and non-residential net export models. For the residential model, increases in temperature up to 65 degrees increase the probability of net export, after which increases in temperatures decrease the probability. For the non-residential model, increases in temperature up to 75.6 degrees increase the probability of net export, after which increase in temperature decrease the probability. The average temperature for residential and non-residential sites is approximately 71 degrees (see Table 7-18). Given that the residential model's turning point is below the average temperature, increases in temperature marginally decrease the probability of net export. The commercial model's higher turning point implies that increases in temperature, however, increase the probability of net export.

Table 7-21: Non-Residential and Residential Net Export Marginal Effects

Parameter	Non-Residential	Residential
Sample Probability of Net Export	12.3%	12.4%
Log(size)	0.17	0.43
Log(Daily Usage)	-0.19	-0.43
SD Log Daily Usage	0.03	-0.13
Sky Coverage	-0.03	-0.02
High Temperature	0.004	-0.001
Third Party (0→1)	0.049	-0.016
EPBB (0→1)	0.049	-0.028
Number of Bills	0.0005	0.001
SCE Inland → PG&E Inland	0.01	-0.06
SCE Inland → CCSE Inland	0.22	0.10
SCE Inland → SCE Coastal	0.07	-0.01
SCE Inland → PG&E Coastal	0.06	-0.05
SCE Inland → CCSE Inland	0.01	0.03

Combining the results from Table 7-20 and Table 7-21, a one unit increase in the log of system size is estimated to lead to a statistically significant increase in likelihood of net export while a one unit increase in the log of daily electricity usage leads to a nearly symmetrical decrease in the likelihood of net export. Note that the differences in the size of the residential and non-residential marginal effects were largely due to the size of the systems and of site level

consumption within the non-linear log formulation. A one unit increase in the standard deviation of the log of residential consumption is associated with a statistically significant reduction in the probability of net export. Increases in the variability of consumption within residential sites reduce the probability that the site will be a net exporter. If contractors are attempting to size the systems to the home's expected load, increased variability in demand appears to decrease the likelihood that the systems production exceeds the household's electricity needs.

Third party ownership within the residential customer segment leads to a statistically significant reduction in the likelihood of net export. The marginal effects listed in Table 7-21 show that third-party owners are 1.6 percentage points less likely to be yearly net exporters than private system ownership. While the cause of reduced export with third party ownership needs further research, third-party ownership may be associated with less maintenance and cleaning at residential sites. Changing from a PBI site to an upfront rebate or EPBB site does not statistically significant impact on net export within the non-residential sample and leads to a reduction in the likelihood of net export for the residential sample. Once again, the influence of rebate methodology on net export requires further study, but sites whose rebate is dependent on their production may maintain a more consistent maintenance and cleaning schedule than sites that received their rebate at the time of installation.

The PA and location binary variables were estimated relative to SCE inland. Therefore, the marginal effects for these variables are calculated as if the site were moving from SCE inland to a new location, holding all else constant. The marginal effects are capturing an independent effect of PA and location that are not already captured by the weather, sky coverage, ownership, and rebate variables. Many of the PA and location variables are statistically significant within the residential customer segment. These differences may indicate real differences in the way the program is administered or they may capture weather and geographical sites characteristics that differ by location but are not controlled for within the model.

The large sample size of the residential sample enables us to estimate the residential model by PA and location to determine if the statewide model is obscuring differences in the impact of other independent variables. Table 7-22 lists the parameter estimates, standard errors, and significance values for the Logit models estimating the probability of net export by PA and location for the residential sample. The model is estimated separately for PG&E inland and coastal, SCE inland and coastal, and CCSE inland and coastal.

As with the aggregate residential model, increases in system size increase the probability of net export while increases in household consumption decrease the likelihood of net export. In addition, for all PA and geographical combination, increases in the standard deviation of the log of consumption decreases the likelihood of net export. Increased variability of consumption appears to decrease the probability that a system sized to a household's mean load can cover the entire home's consumption for the year.

The weather variables incorporated into the disaggregated residential model appear to have, at most, a very limited impact on the likelihood of yearly net export. Increases in sky coverage are associated with a statistically significant decrease in net export for residential systems in SCE inland and PG&E coastal. For all other PA and location combinations, sky coverage does have an independent significant impact on the likelihood of being a yearly net export. The lack of a significant relationship may be due to the fact that weather and cloud coverage impact usage and therefore sizing, leaving no independent impact of sky coverage on the probability of net export. Alternatively, the sky coverage variables used in the analysis may be too crude or aggregate to appropriately proxy for the true relationship between sky coverage and the likelihood of net export. In addition, the temperature variables only have a statistically significant impact in PG&E coastal. Again, the lack of relationship may be due to the relationship between temperature, consumption, and sizing or it may be due to using too aggregate a temperature measurement.

Table 7-22: Residential Regression Parameters by PA and Location

Parameters		PG&E			SCE			CCSE		
		Estimate	**Std Err**	**Pr>Chi^2**	**Estimate**	**Std Err**	**Pr>Chi^2**	**Estimate**	**Std Err**	**Pr>Chi^2**
Inland	Intercept	-39.17	22.09	0.0762	-6.77	15.07	0.6533	-104.90	60.96	0.0852
	Log (Size)	4.30	0.23	<.0001	4.26	0.23	<.0001	6.24	0.50	<.0001
	Log (Daily Usage)	-4.31	0.22	<.0001	-4.19	0.21	<.0001	-6.19	0.48	<.0001
	SD Log Daily Usage	-0.55	0.24	0.0206	-0.63	0.23	0.0057	-1.64	0.49	0.0008
	Sky Coverage	-0.02	0.07	0.7566	-0.30	0.07	<.0001	0.32	0.30	0.2922
	High Temp	1.25	0.64	0.0491	0.38	0.39	0.3191	2.88	1.67	0.0858
	High Temp^2	-0.01	0.00	0.0541	-0.003	0.00	0.2693	-0.02	0.01	0.1218
	Third-Party Ownership	-0.08	0.21	0.719	-0.15	0.17	0.3836	-0.61	0.31	0.0486
	EPBB	1.02	0.75	0.1724	0.14	0.31	0.6542	-1.02	0.51	0.0438
	Number of Bills	0.01	0.01	0.4008	0.001	0.01	0.8861	-0.01	0.01	0.5042
Coastal	Intercept	-37.69	18.57	0.0424	-344.80	705.30	0.6249	-681.30	516.70	0.1873
	Log (Size)	3.26	0.15	<.0001	3.20	0.37	<.0001	4.91	0.38	<.0001
	Log (Daily Usage)	-3.42	0.13	<.0001	-3.52	0.32	<.0001	-4.88	0.34	<.0001
	SD Log Daily Usage	-1.10	0.17	<.0001	-2.82	0.54	<.0001	-3.56	0.49	<.0001
	Sky Coverage	-0.25	0.07	0.0001	-0.61	0.44	0.1676	-0.38	1.60	0.8122
	High Temp	1.36	0.56	0.0156	9.65	13.23	0.4657	20.06	14.92	0.1787
	High Temp^2	-0.01	0.00	0.0127	-0.07	0.09	0.4718	-0.15	0.11	0.1736
	Third Party Ownership	0.03	0.16	0.8643	-0.28	0.28	0.3271	-1.01	0.39	0.0097
	EPBB	-0.45	0.66	0.4958	12.85	534.80	0.9808	-0.83	0.42	0.0482
	Number of Bills	0.01	0.01	0.0065	-0.01	0.02	0.668	0.04	0.02	0.0477

Table 7-23 presents the marginal effects associated with the model parameters presented in Table 7-22. As with the aggregated model described above, the impact of a one unit increase in the log of system size is very similar, though opposite in effect, to a one unit increase in the log of household consumption. For example, assuming a 0.1 unit increase in the log of system size for CCSE inland (on average increasing the log of system size from the sample average from 0.705 to 0.805 or the level from 5.07 kW to 6.38 kW) increases the probability of net export from the sample average of 26% to 37.9%. Alternatively, a 0.1 unit decrease in the log of average daily consumption for a site in CCSE inland (on average decreasing the log of average daily consumption from the sample average of 1.557 to 1.457 or the level from 36.11 kWh to 28.64 kWh) increases the probability of net export from the sample average of 26% to 37.8%.

Table 7-23: Residential Marginal Effects by PA and Location

Parameters	PG&E Inland Marginal Effect	PG&E Coastal Marginal Effect	SCE Inland Marginal Effect	SCE Coastal Marginal Effect	CCSE Inland Marginal Effect	CCSE Coastal Marginal Effect
Probability of Net Export	8%	11%	13%	15%	26%	22%
Log(Size)	0.31*	0.32*	0.48*	0.41*	1.19*	0.85*
Log(Daily Usage)	-0.31*	-0.34*	-0.48*	-0.45*	-1.18*	-0.84*
SD Log Daily Usage	-0.04*	-0.11*	-0.07*	-0.36*	-0.31*	-0.61*
Sky Coverage	-0.002	-0.03*	-0.03*	-0.08	0.06	-0.07
Third Party (0 → 1)	-0.01	0.003	-0.02	-0.04	-0.12*	-0.18*
EPBB (0 → 1)	0.07	-0.04	0.02	1.63	-0.19*	-0.14*
Number of Bills	0.001	0.001*	0.0001	-0.001	-0.002	0.01
High Temperature	-0.004*	-0.007*	-0.003	0.046	0.068	0.025
Average Temperature	73.4	66,9	75.9	68.1	71.6	68.4
Temperature Turn Point	70.2	63.7	70.8	70.8	81.7	68.9

* Indicates marginal effects where the model parameter estimates were statistically significant at the 10% level or better.

The marginal effect of third party ownership and incentive type is only statistically significant within CCSE's program. Within CCSE, however, the marginal effects are large and precisely estimated. For CCSE inland, changing from private home ownership of the PV system to a third-party ownership reduces the expected likelihood of net export from the sample average of 26% to 14%. Similarly, for CCSE coastal, third-party ownership reduces the likelihood of net export from 22% to 4%. Additional research, and review of program methodology, is needed to better explain why third party ownership is having such a pronounced effect on net export within CCSE.

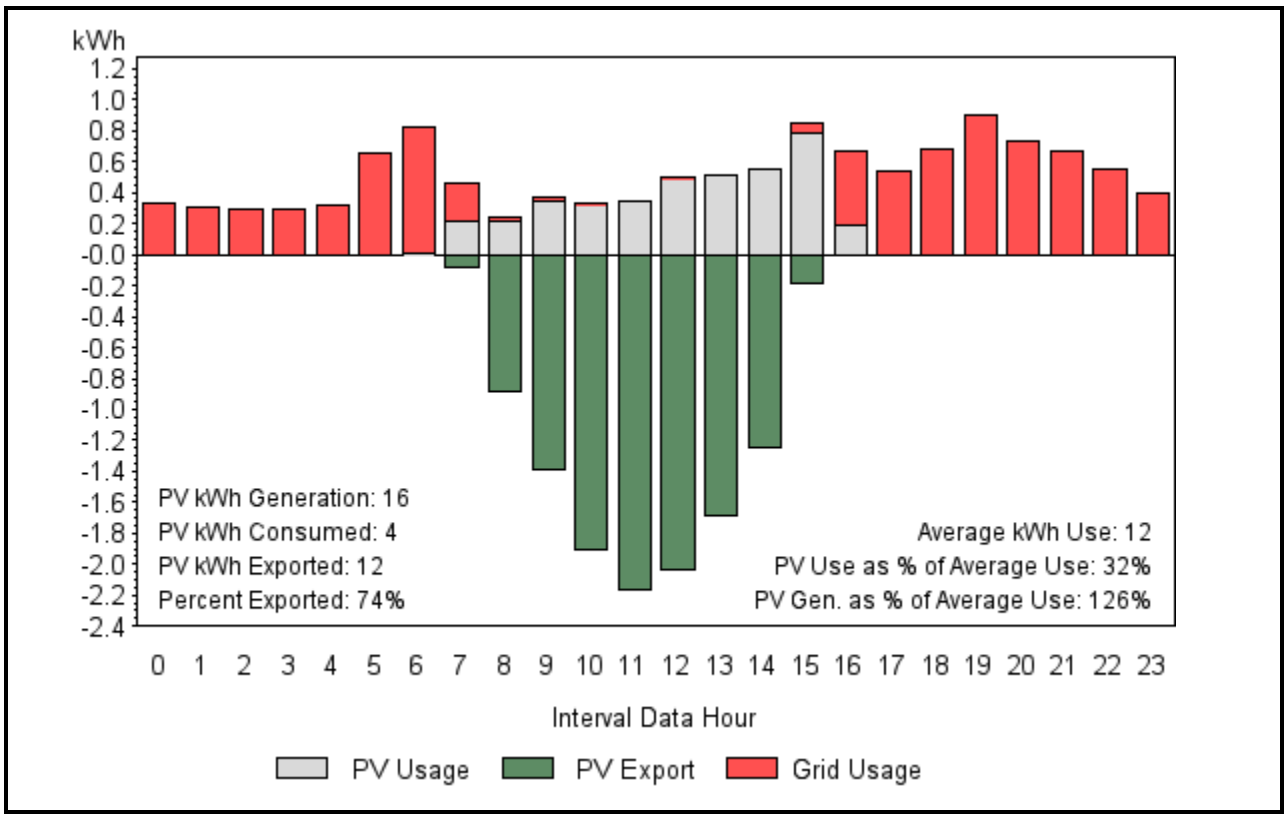
7.2 Interval Data Analysis

This section presents the results of analysis based on a small subset of sites for SCE and CCSE for which hourly interval demand data were available. Given their relatively small numbers and the fact that interval meters are typically associated with certain customer types, the sites represent a convenience sample. The results that follow therefore are unlikely to be representative of the population of CSI GM participants. In spite of this, the results presented here suggest that there are many more rich research topics that could be investigated with an expanded and more representative sample of interval data for CSI GM host customer sites.

7.2.1 Comparison of Interval and Billing Data

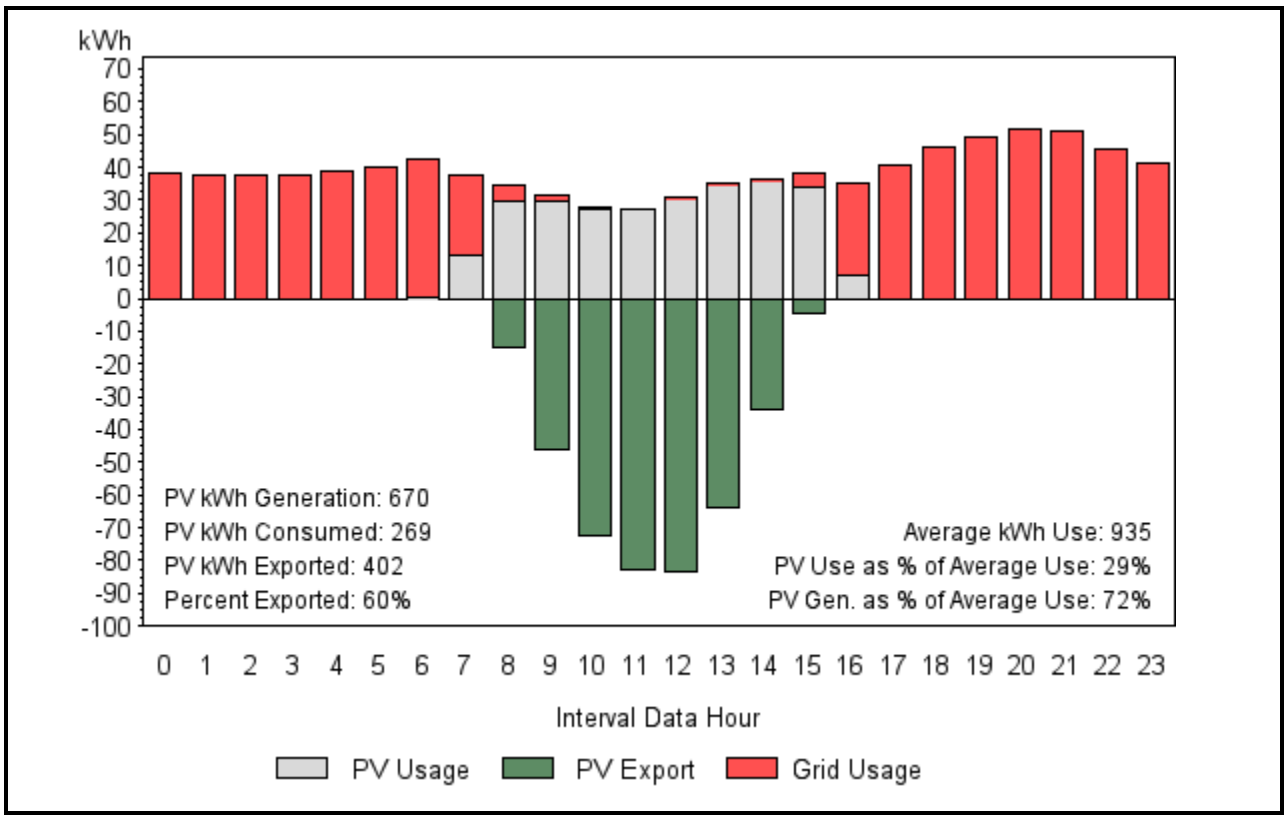
This section is crucial to better understand the actual timing and quantity of electricity exports. The previous sub-sections of this chapter have focused on monthly billing data but the monthly data only show when the PV generation exceeded demand for a given billing period (or series of billing periods). The absence of exported PV in billing records—as indicated by a negative kWh bill—does not necessarily mean that a site consumed all of the electricity generated by its PV system at the time the electricity was generated. While that could be the case, the absence of export only means that site's consumption off the grid was in excess of the amount of PV generation. To illustrate this point, Figure 7-11 and Figure 7-12 show the average hourly load profiles for the interval data for a single billing period for two different sites. In the case of Figure 7-11, the data show a billing period in which there was a net export of PV generation. The red segments of the bars show the average amount of electricity consumed off the grid in each hour during the billing period, while the gray and green segments of the bars show PV generation, either consumed or exported, respectively. Summary statistics are annotated in the bottom corners of the plot area. On average over the billing period, the PV system generated 16 kWh per day, exceeding the site's needs of 12 kWh per day and resulting in a net export of electricity. Overall, 74% of the PV generation was not consumed at the site, but was instead exported.

Figure 7-11: Average Hourly Load Profiles for a Billing Period with Net Export



In contrast to the previous illustration, Figure 7-12 shows the load profiles for a site that did not have a net excess of PV generation over the billing period. The site, however, has several hours over the day and the month with export. While the hours of export are clearly not as large in relative magnitude when compared to the site with a net negative bill, they still amount to a substantial amount of generation that is not used at the site (60%, in fact) at the time of generation. The site's electricity requirements in the non-daylight hours are more than large enough to offset the exported generation. It is important to note that the billing period represented in Figure 7-12 would not have been flagged as an export in the analysis of the monthly billing data even though a large amount of export took place.

Figure 7-12: Average Hourly Load Profiles for a Billing Period without Net Export



7.2.2 Utility Interval Data

The raw data provided by SCE and CCSE consisted of interval kWh readings for more than 1,500 SCE and more than 300 CCSE and CSI GM host customer sites. To eliminate any bias due to the influence of seasonality, however, any sites with less than one full year of interval data were removed from the analysis. Table 7-24 presents the count of sites for which there was at least one full year of interval data by PA, customer segment and the export group. The export group indicates whether the site represents an annual net exporter. The two non-residential customer segments are overrepresented relative to the overall CSI GM population, with 256, or 21%, of the 1,212 sites for both PAs. The large share of non-residential sites is due to the higher penetration of interval meters among non-residential customers. The residential customers, however, still comprise the largest share of the sample. The share of sites with interval data that showed an annual net export of electricity is similar to that of the much larger sample summarized earlier in this section.

Table 7-24: Counts for Interval Data Sites with Full Year of Data

Customer Segment/Export Group		Program Administrator						Total		
		SCE			CCSE					
		Sites	Export Group Percent	PA Percent	Sites	Export Group Percent	PA Percent	Sites	Export Group Percent	PA Percent
Residential	Non-Net Exporters	713	93.2%	82.9%	147	77.0%	17.1%	860	90.0%	100.0%
	Annual Net Exporters	52	6.8%	54.2%	44	23.0%	45.8%	96	10.0%	100.0%
	Total	765	100.0%	80.0%	191	100.0%	20.0%	956	100.0%	100.0%
Commercial	Non-Net Exporters	125	88.0%	73.1%	46	95.8%	26.9%	171	90.0%	100.0%
	Annual Net Exporters	17	12.0%	89.5%	2	4.2%	10.5%	19	10.0%	100.0%
	Total	142	100.0%	74.7%	48	100.0%	25.3%	190	100.0%	100.0%
Gov./Non-Profit	Non-Net Exporters	43	91.5%	74.1%	15	78.9%	25.9%	58	87.9%	100.0%
	Annual Net Exporters	4	8.5%	50.0%	4	21.1%	50.0%	8	12.1%	100.0%
	Total	47	100.0%	71.2%	19	100.0%	28.8%	66	100.0%	100.0%
Total	Non-Net Exporters	881	92.3%	80.9%	208	80.6%	19.1%	1,089	89.9%	100.0%
	Annual Net Exporters	73	7.7%	59.3%	50	19.4%	40.7%	123	10.1%	100.0%
	Total	**954**	**100.0%**	**78.7%**	**258**	**100.0%**	**21.3%**	**1,212**	**100.0%**	**100.0%**

The analysis of the interval data presented here looks at two characteristics of the export of PV generation. First, it characterizes the timing of hourly exports by summarizing the probability of exported generation in each hour. Second, it summarizes the hourly interval kWh values to show the influence of PV generation on hourly load profiles.

As an initial exploration into the timing of hourly PV exports Figure 7-13, Figure 7-14, and Figure 7-15 present the average hourly probability of export for residential, commercial, and government/non-profit customer segments, respectively. To examine differences in seasonality, the figures show separate series for each quarter of year. The data are also presented separately for each PA so they can be compared side by side.

There are several interesting features in Figure 7-13. For one, there is clear seasonality visible, with the highest hourly export probability coming in the spring (April-June) for both PAs. Furthermore, the likely influence of shorter days is visible in the narrower series for the fall and winter quarters (October-December and January-March). There are also differences between the two PAs. For SCE, the export probability drops substantially from the spring to summer, from a noon peak probability of well over 80% in April to June to around 75% in July to September. This decline in the summer for SCE is also higher in the afternoon hours. For CCSE, the decline is far slighter, with the noon peak probability of export staying over 90%. Furthermore, for CCSE the probability stays higher until later in the day. A possible explanation for this difference is the higher AC loads associated with SCE's hotter and more inland service territory.

Figure 7-13: Residential Hourly Export Probability by PA

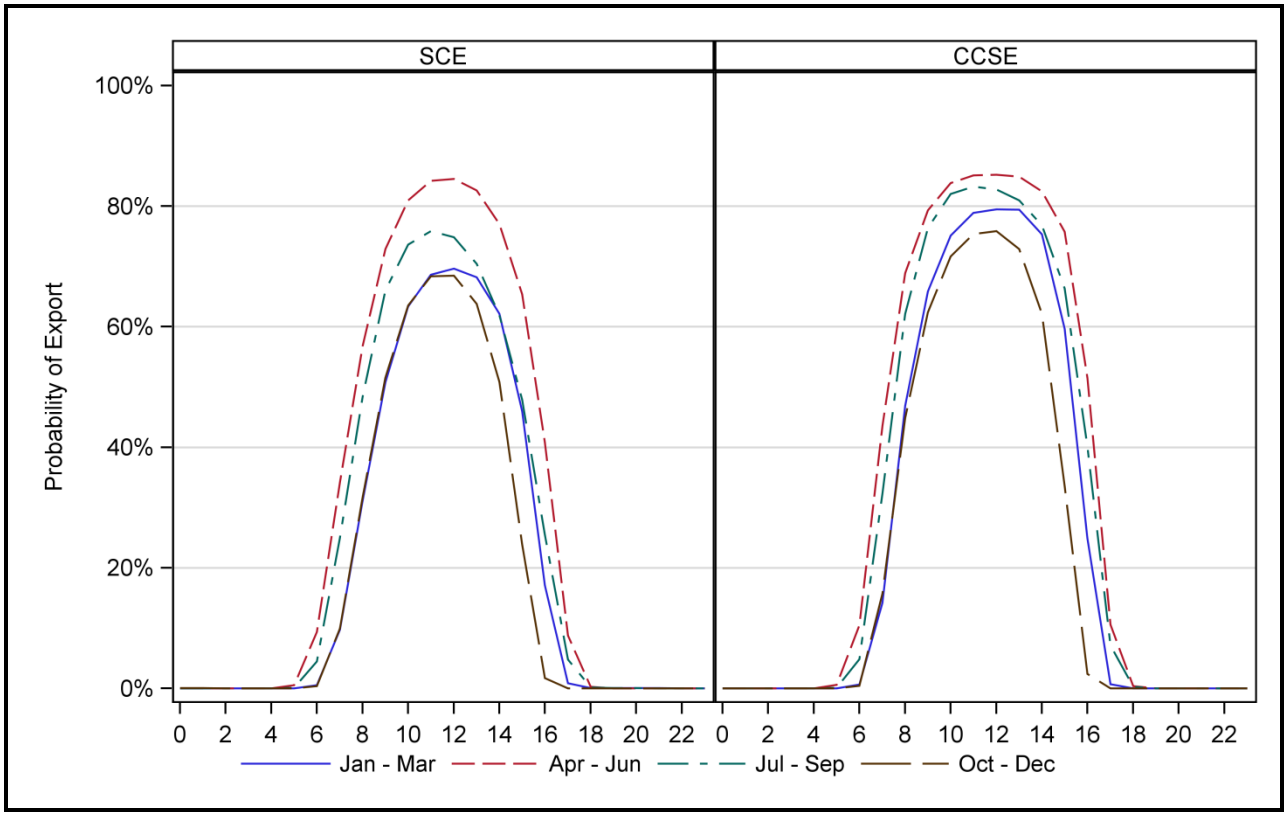


Figure 7-14 and Figure 7-15 show the hourly probability of export for the two non-residential customer segments. The small number of sites included in the sample means that one should apply caution in drawing any conclusions, but there are still several noteworthy features in the plots. For commercial sites, the probability of export is far lower than for residential sites. For both PAs, the highest probability of export also occurs in the spring, but is approximately 30 percentage points lower than the high for the residential sites in Figure 7-13. It is also interesting that the season with the second highest probability is in the winter from January to March. For SCE, the summer months from July to September represent the quarter with the lowest probability of export. Given that this quarter is typically associated with higher levels of generation, this is more evidence for the importance of AC loads in lowering the likelihood of exported PV generation.

Figure 7-14: Commercial Hourly Export Probability by PA

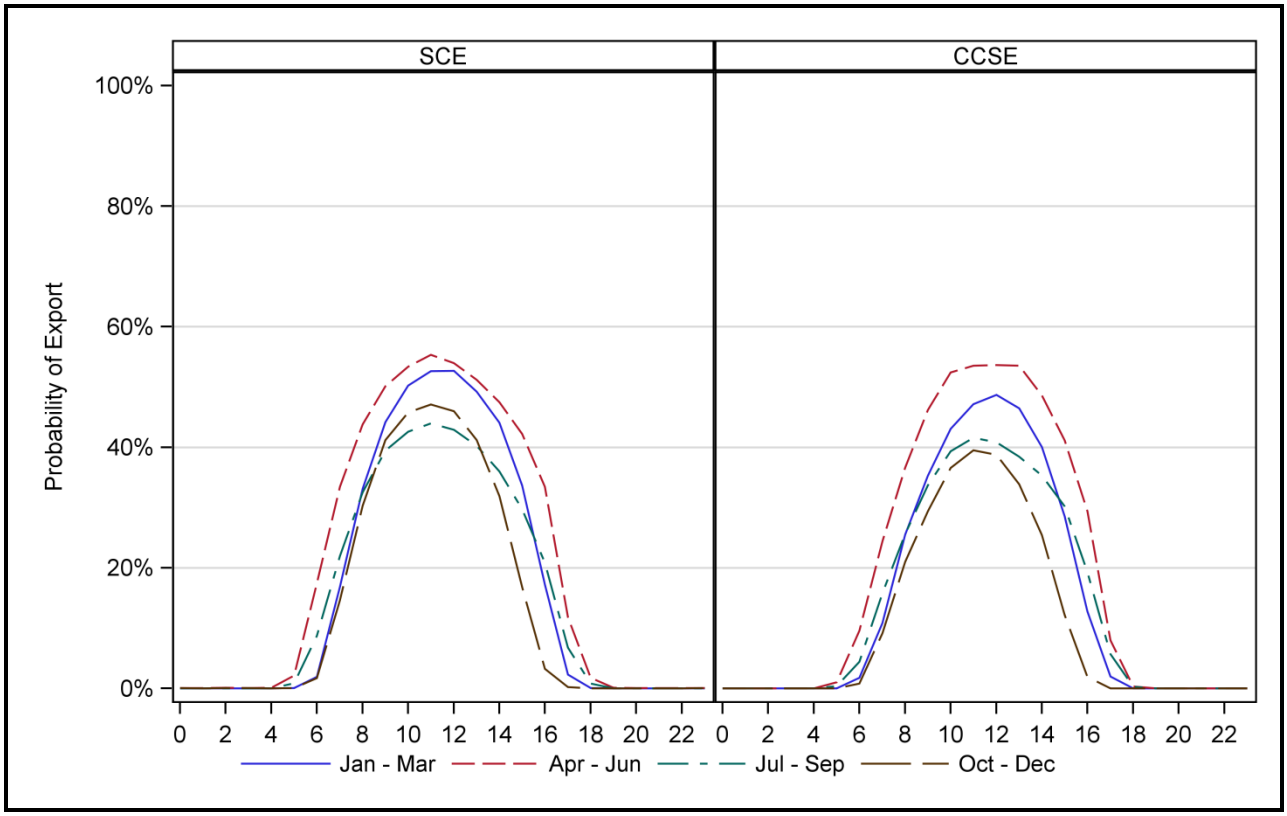
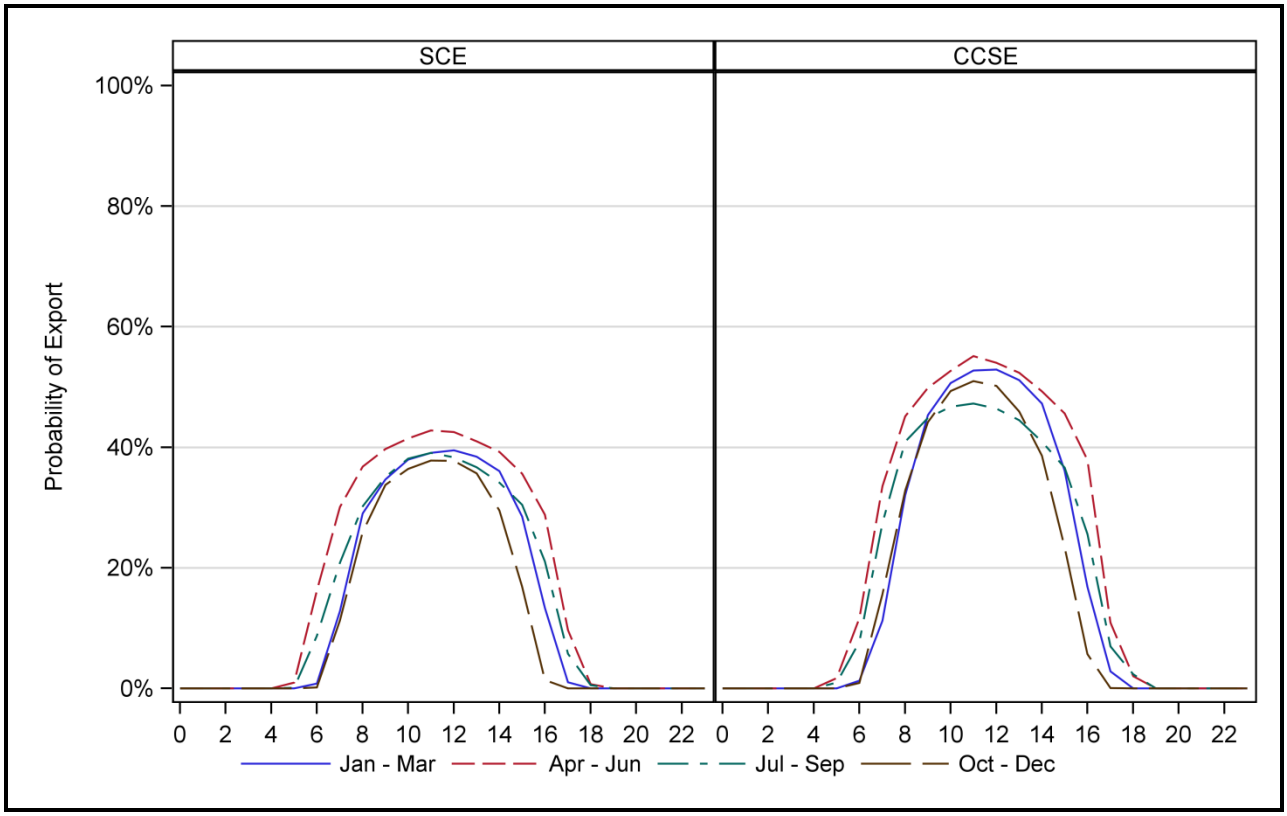


Figure 7-15: Government/Non-Profit Hourly Export Probability by PA



For government/non-profit sites (Figure 7-15), the results are similar to those for the commercial sites. The most salient attribute is the difference between the two PAs in terms of overall export probability. For CCSE, peak probability around noon in the spring is around 12 percentage points higher than for SCE. The third quarter from July to September, which has the lowest export probability for CCSE, is higher than SCE highest export probability. These summaries are based on a combined 66 sites, but these results still raise the question of whether the export differences are due to differences in the types of customers that comprise this customer segments for the two PAs or are simply an artifact of weather and air conditioning loads

The plots of export probability in Figure 7-13 though Figure 7-15 are based on all available sites. To compare the non-net exporter sites with the annual net exporters in the residential customer segment, Figure 7-16 and Figure 7-17 compare the hourly export probability for the two groups by quarter for SCE and CCSE. For both PAs, there is a similar season influence on export probability, but what is interesting is that while both groups show the highest probability of export in the second quarter, the decline in the likelihood of export for the annual net exporters in the other quarters is far less evident than for the non-net export sites. The non-net export group has a peak probability of hourly export of less than 80% in all but the second quarter, whereas the peak probability of hourly export for annual net exporters is always above 80%.

Figure 7-16: SCE Hourly Residential Export Probability by Export Group

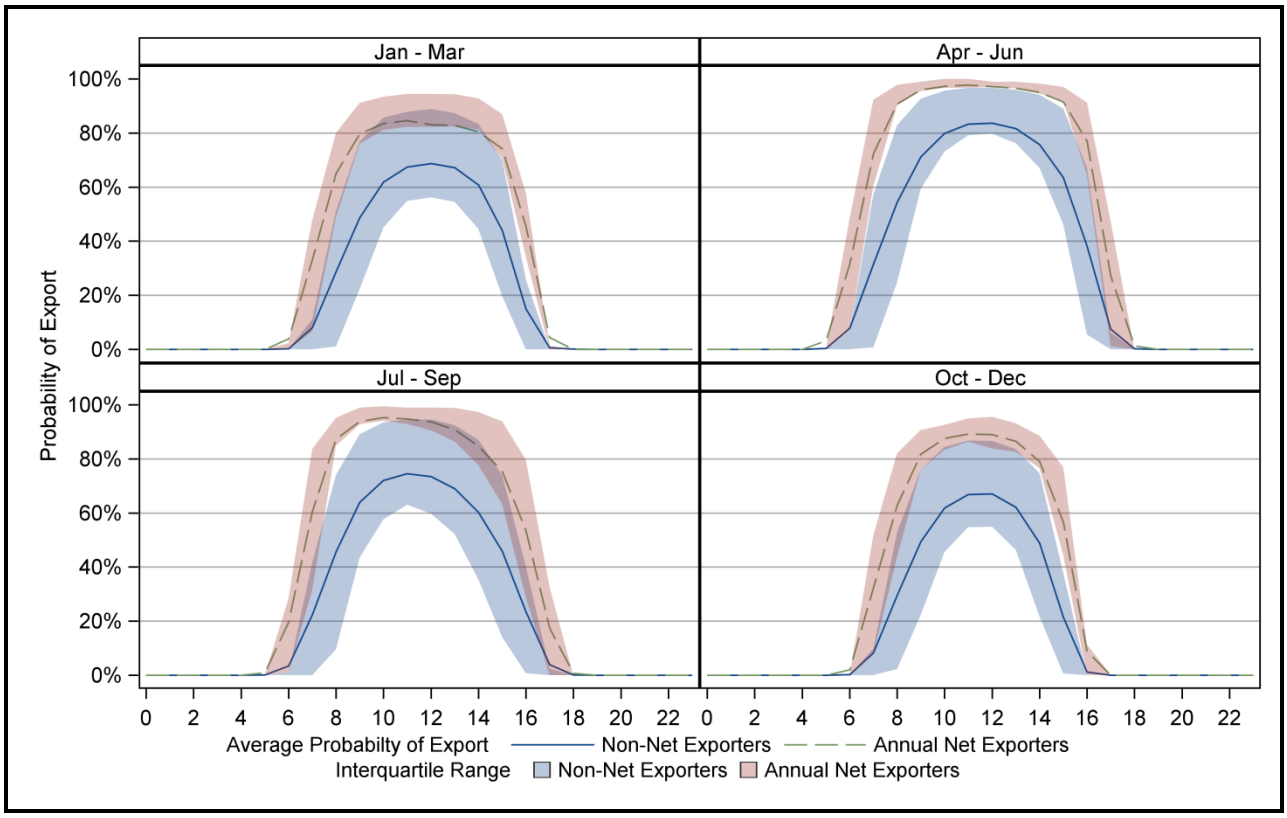
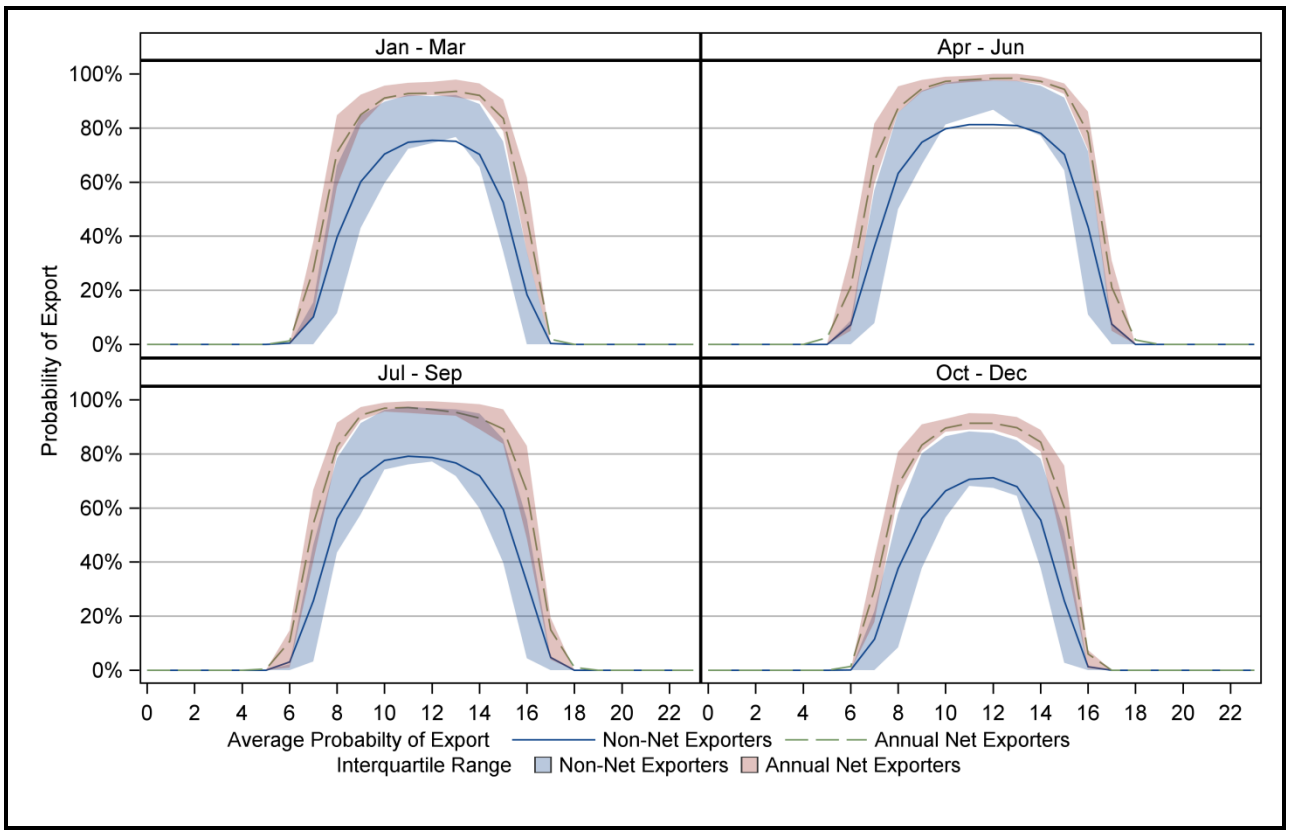


Figure 7-17: CCSE Hourly Residential Export Probability by Export Group



The plots presented above show that there is a very high probability that PV generation will be exported to the grid for the mid hours of the day. The analysis of the monthly bills as well as the interval data however, indicate that only a fraction of sites will actually show an annual net export of electricity. This implies that, for most sites, there is a substantial amount of consumption off the grid during non-generation hours, making up for the exported PV electricity. The next set of analysis uses interval data to look at daily load profiles for residential sites to see when the grid consumption is taking place and why grid consumption offsets exports for some sites and not for others.

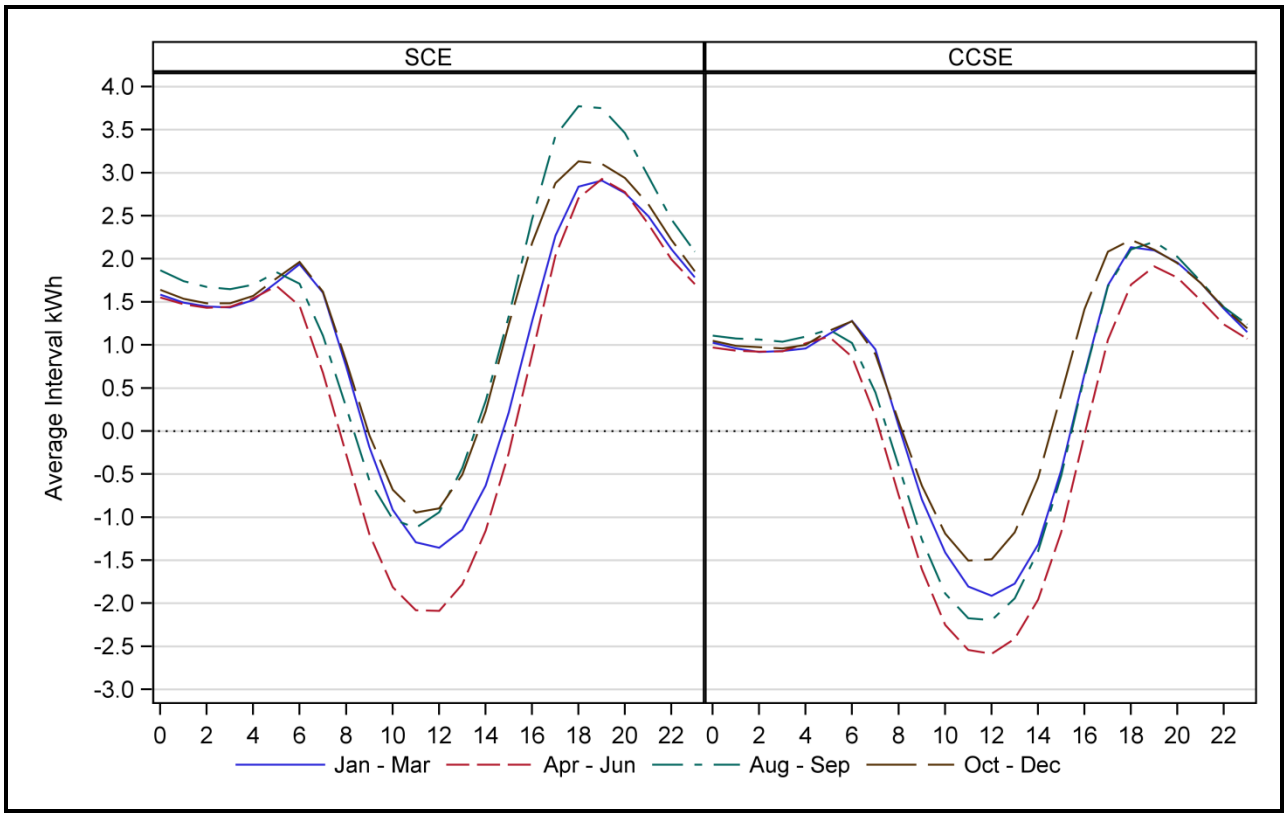
7.2.3 Interval Export and Consumption

Figure 7-18 shows the hourly average residential load profiles for SCE and CCSE by quarter. These figures provide some immediate, though perhaps not unexpected, insight into why the substantial hourly PV exports don't result in a larger number of annual exporters. For residential sites, the primary periods of electricity demand are in the morning and evening, and not during the day when many occupants are away at work. If all residential interval sites are incorporated into the analysis, the sum of the area below zero, which represents exported PV generation, is not greater than the area above zero, which is why these sites on average do not show net exports. There is not, unfortunately, a sufficient quantity of pre-installation interval data to compare of

the pre- and post-installation load profiles, nor is there complete generation data for these sites to show the level of actual consumption during the PV generation hours.

Residential load profiles however, are understood well enough to know that there is generally a substantial dip in consumption during the middle of the day. The PV generation of electricity substantially increases the size of the dip in the customers net load profile, driving the average PV customer to export during middle of the day. The PV generation/consumption profile indicates that these houses require, on average, no utility electricity during the period from approximately 8 AM to 2-3 PM. At the likely time of the daily peak (after 2-3 PM), these households are likely consuming electricity from the grid, though substantially less electricity than without PV generation.

Figure 7-18: Comparison of Residential Average Hourly kWh



Since much of the focus of this section has been on the annual net exporter, Figure 7-19 and Figure 7-20 compare the average hourly load profiles of the two exports groups by quarter for SCE and CSSE, respectively. Much of what the two figures show is the expected differences between the two groups. For example, annual net exporters have more hours with exported generation and the amount of the exports is larger. What stands out most in the two figures is that for CCSE, there is a greater similarity between the annual net exporters and the non-net exporters. For the SCE residential sites, the non-net export group does have an average negative bill during generation hours, but compared to the net exporters the kWh values drop only slightly below zero. The non-net export sits for CCSE still have smaller exported values, but they are much closer in magnitude to the annual net export group. Additional evidence for this phenomenon is that for the SCE sites in Figure 7-19, the bands that show the interquartile range for net and non-net exporters rarely overlap and there is almost always a visible white gap between the series for the two groups. For the CCSE sites in Figure 7-20, the net and non-net export series overlap in nearly every instance.

Figure 7-19: SCE Hourly Average kWh by Export Group

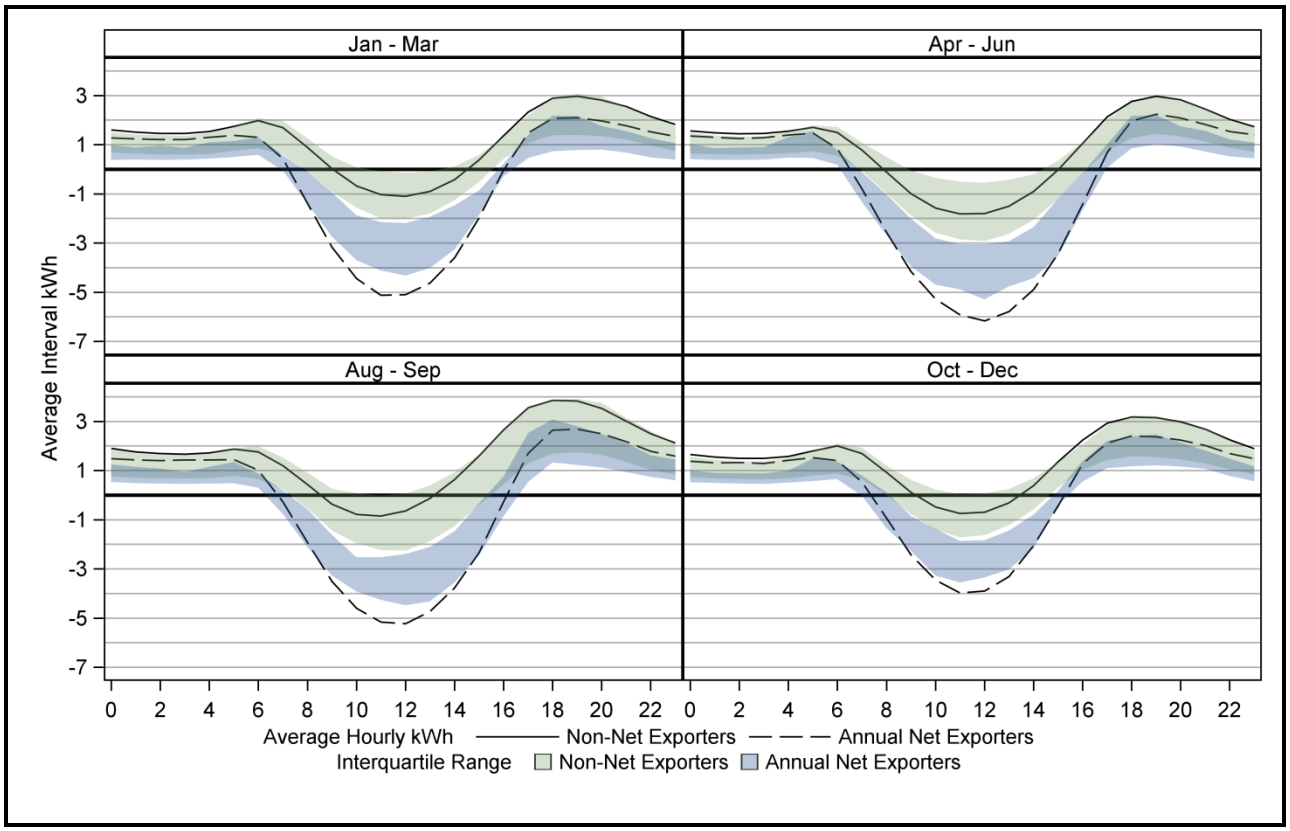
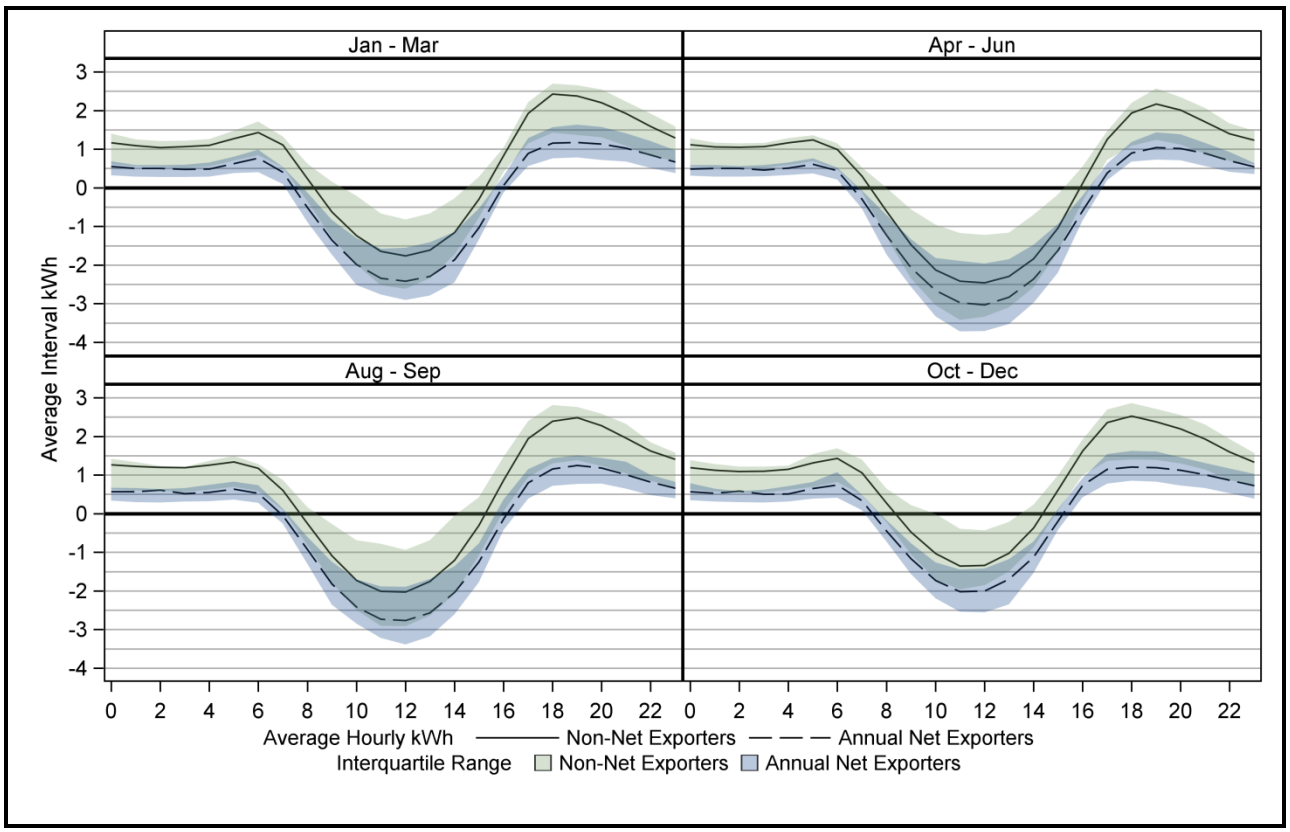


Figure 7-20: CCSE Hourly Average kWh by Export Group



As a conclusion to this section, the following analysis examines an even smaller subset of interval data sites for which there was a full year of validated hourly PV generation. The analysis of interval data presented prior to this point examined electricity as either consumed from or exported to the grid. The inclusion of PV generation data allows the exploration of two additional areas. First, the inclusion of PV generation enables the calculation of total consumption, which allows for a more complete picture of hourly consumption and export profiles. Second, metered PV system data allow for analysis that shows what the exported electricity represents as a percentage of total PV generation.

The counts of sites for this analysis are presented in Table 7-25. With only 105 residential sites and even fewer for the other customer segments, the available sample calls for even stronger caveats on drawing conclusions from the numbers presented here. Furthermore, small cells render some comparisons irrelevant, such as the presence of just one annual net exporter among SCE's residential sites. Nevertheless, there is still value in the analysis for some high-level characterizations of PV export behavior.

Table 7-25: Sites with Full-Year Interval and PV Generation Data

Customer Segment/Export Group		Program Administrator						Total		
		SCE			CCSE					
		Sites	Export Group Percent	PA Percent	Sites	Export Group Percent	PA Percent	Sites	Export Group Percent	PA Percent
Residential	Non-Net Exporters	44	97.8%	50.0%	44	73.3%	50.0%	88	83.8%	100.0%
	Annual Net Exporters	1	2.2%	5.9%	16	26.7%	94.1%	17	16.2%	100.0%
	Total	45	100.0%	42.9%	60	100.0%	57.1%	105	100.0%	100.0%
Commercial	Non-Net Exporters	42	91.3%	71.2%	17	100.0%	28.8%	59	93.7%	100.0%
	Annual Net Exporters	4	8.7%	100.0%	-	-	-	4	6.3%	100.0%
	Total	46	100.0%	73.0%	17	100.0%	27.0%	63	100.0%	100.0%
Gov./Non-Profit	Non-Net Exporters	8	88.9%	66.7%	4	57.1%	33.3%	12	75.0%	100.0%
	Annual Net Exporters	1	11.1%	25.0%	3	42.9%	75.0%	4	25.0%	100.0%
	Total	9	100.0%	56.3%	7	100.0%	43.8%	16	100.0%	100.0%
Total	Non-Net Exporters	94	94.0%	59.1%	65	77.4%	40.9%	159	86.4%	100.0%
	Annual Net Exporters	6	6.0%	24.0%	19	22.6%	76.0%	25	13.6%	100.0%
	Total	**100**	**100.0%**	**54.3%**	**84**	**100.0%**	**45.7%**	**184**	**100.0%**	**100.0%**

The first set of results presented in Table 7-26 is a summary of hourly averages for several metrics. Included in the table are the average hourly values for grid consumption and PV export, both of which come directly from the utility interval data, and the average hourly generation, which comes directly from the meter on the PV system. From these three fields come the amount of PV generation consumed, the total consumption, and the exported generation as a percent of total generation. Results are included for the two non-residential segments, but given the small sample sizes the focus of the discussion is exclusively on the residential sites.

The lack of equivalence in the samples for the PAs—the presence of only one annual net exporter for SCE, for example—means that their results should not be compared to each other. There are, however, interesting patterns in each PA that are worthy of note. For SCE residential sites, there was a larger increase on total site consumption in the third quarter, which corresponded to large drop in the share of PV generation that was exported. Granted, a decline in PV generation also contributed to this result, but the average hourly generation only declined from 1.52 kWh in the second quarter to 1.41 in the third, so its contribution was far smaller. For

CCSE, the season pattern is similar, but the changes in both total consumption and percentage of exported generation are both smaller in degree. These results are consistent with differences in the typical climate associated with both PA's territories.

In the summaries in Table 7-26, net exports for any time period would be indicated by a total PV generation value that exceeded the total kWh used, which only occurs in one instance. For the second quarter for CCSE residential sites, the average hourly generation of 1.37 kWh is greater than the 1.29 kWh used, which means that those sites for that one quarter were net exporters. This is clearly influenced by the nearly 27% of sites that were annual net exporters included in the group, but the results are consistent with previous findings regarding the timing of exports that show the greatest likelihood and magnitude occurring in the spring.

Table 7-26: Average Hourly Usage, Generation, and Exports by Customer Segment, PA, and Quarter

Customer Segment/Quarter		SCE						CCSE					
		Grid kWh Used	PV kWh Exported	Total PV kWh Generation	PV kWh Used	Total kWh Used	Percent of PV kWh Exported	Grid kWh Used	PV kWh Exported	Total PV kWh Generation	PV kWh Used	Total kWh Used	Percent of PV kWh Exported
Residential	Jan - Mar	1.19	0.43	0.95	0.53	1.72	44.8%	0.87	0.52	1.01	0.49	1.37	51.2%
	Apr - Jun	1.07	0.70	1.52	0.82	1.88	46.1%	0.70	0.78	1.37	0.59	1.29	56.7%
	Jul - Sep	1.48	0.45	1.41	0.96	2.44	32.0%	0.89	0.61	1.32	0.71	1.60	46.3%
	Oct - Dec	1.31	0.30	0.84	0.54	1.85	35.9%	0.95	0.37	0.84	0.47	1.42	44.4%
	All	1.26	0.47	1.18	0.71	1.97	39.8%	0.86	0.57	1.14	0.57	1.42	50.2%
Commercial	Jan - Mar	346.6	11.1	48.9	37.8	384.4	22.8%	203.5	1.16	53.4	52.2	255.7	2.2%
	Apr - Jun	320.3	12.3	67.9	55.6	375.9	18.1%	202.8	2.90	76.1	73.2	276.0	3.8%
	Jul - Sep	349.2	9.86	62.8	53.0	402.2	15.7%	225.5	0.91	69.7	68.8	294.3	1.3%
	Oct - Dec	343.0	9.43	41.3	31.9	374.9	22.8%	239.8	0.40	44.9	44.5	284.3	0.9%
	All	339.8	10.7	55.2	44.6	384.3	19.3%	217.9	1.34	61.0	59.7	277.6	2.2%
Gov./Non-Profit	Jan - Mar	303.1	1.32	24.9	23.6	326.7	5.3%	93.3	17.6	54.4	36.9	130.2	32.3%
	Apr - Jun	362.2	1.66	38.8	37.1	399.3	4.3%	125.6	27.9	84.7	56.8	182.5	32.9%
	Jul - Sep	391.2	1.09	37.2	36.1	427.3	2.9%	126.7	20.5	83.8	63.4	190.1	24.4%
	Oct - Dec	350.0	0.74	21.7	20.9	370.9	3.4%	101.6	18.0	48.6	30.6	132.1	37.1%
	All	**351.6**	**1.20**	**30.6**	**29.4**	**381.1**	**3.9%**	**111.8**	**21.0**	**67.9**	**46.9**	**158.7**	**30.9%**

Alternative graphical representations of the data presented for residential sites in Table 7-26 are provided in Figure 7-21 and Figure 7-22. The graphs show how the average usage and export values in hourly profiles. Figure 7-21 shows the data for SCE residential sites and Figure 7-22 shows their CCSE counterparts. Overall, the figures do not lead to any alternative conclusions, but they do provide a better idea of how seasonal consumption patterns are related to PV exports. For example, for SCE sites in the third quarter, starting around hour 14 (2:00 PM.), the declining generation is inadequate to meet site needs and the share of consumption of electricity off the grid increases. In contrast, the afternoon loads in April through June are lower and a substantial share of the PV generation is exported for another hour or so longer. For CCSE residential sites, the July to September total consumption is not as markedly different from the other quarters.

Figure 7-21: SCE Average Hourly Load Profiles for Residential Sites by Quarter

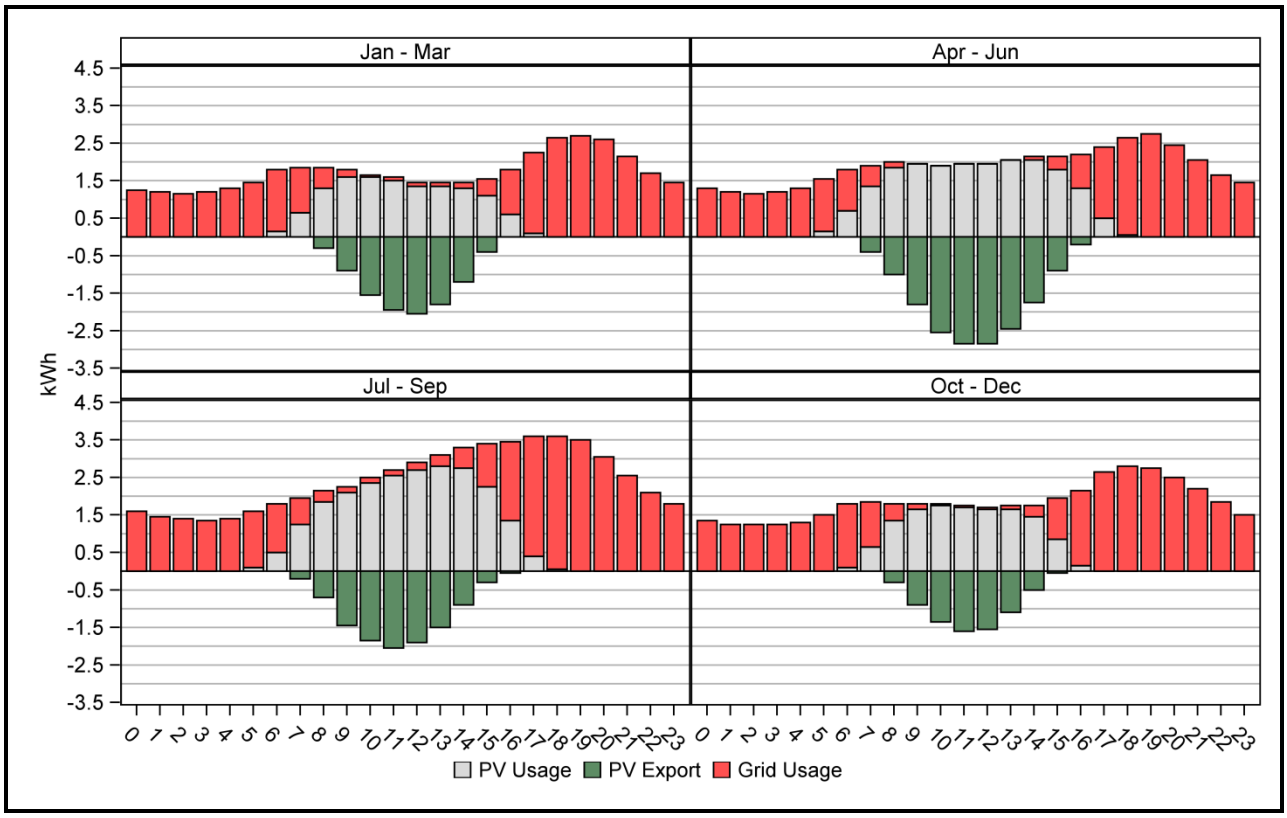
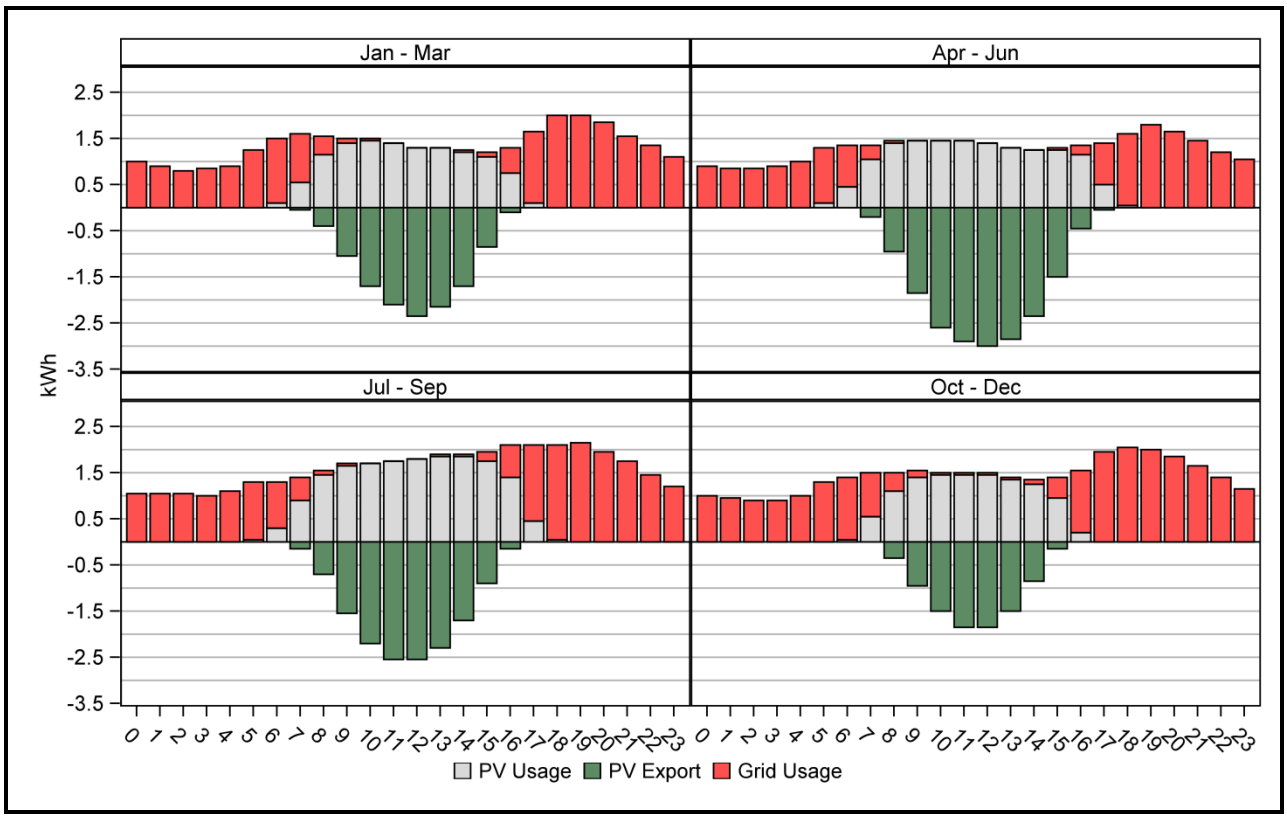
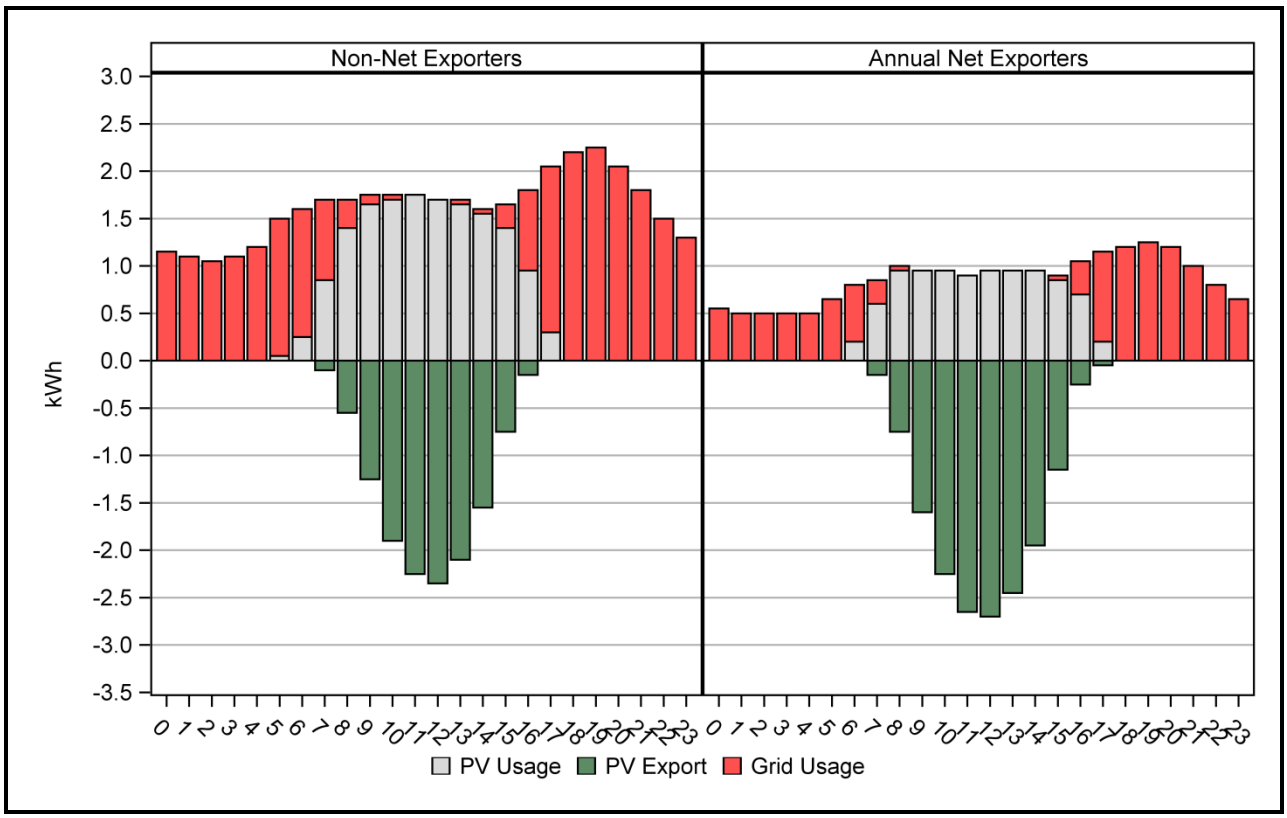


Figure 7-22: CCSE Average Hourly Load Profiles for Residential Sites by Quarter



As a final figure in this section, Figure 7-23 compares the annual hourly usage and export profiles for CCSE's residential sites, comparing non-net exporter to annual net exporters. The difference between the two groups is stark, but what stands out most is not a higher quantity of exported generation for the annual net exporters, but the much lower level of consumption throughout the day. The amount of total generation for the sites, which is based on the sum of the gray and green segments, is only slightly higher for the non-net export group. Given that a site's PV unit should be sized based on historical consumption, the amount of total generation for the two groups should not be so similar. Nevertheless, these images illustrate that what really drives net exports for the small subset of sites in this analysis is the overall low levels of site consumption.

Figure 7-23: CCSE Average Hourly Load Profiles for Residential Sites by Export Type



7.3 Summary

The different types of analysis in this section provide a number of takeaways depending on one's particular interests. The most simple assessment showed that a high percentage of host sites had at least one billing period with net exports (more than half of residential sites and more than one-third of non-residential sites), which suggests an interaction between correctly sized systems and the seasonal variability in generation. Unless a site's pattern of monthly demand is highly similar to the pattern of PV generation, it makes sense that there will be at least a couple of months during the year when generation exceeds electric needs, and the results strongly support this conclusion.

Of greater interest than the instances of single-bill exports are those sites that showed net exports over an entire year. Nearly 14% of residential sites had annual net exports compared to 16.7% for commercial and 12.9% for government/non-profit sites, respectively. Because these sites had system generation that exceeded demand frequently enough or in such large amounts to create an annual surplus of generation, they were the focus of much of the remaining analysis. Comparisons of export likelihood and quantity by month show that most of the annual net excess comes from generation during the spring and early summer, before AC loads reach high levels. For a subset of sites with sufficient pre-installation billing data, analysis showed that lower levels of overall consumption are also a key factor in determining whether a site will have annual net exports.

Finally, although based on a much smaller non-representative sample, an analysis of hourly interval data showed that net exports in the bill conceal the fact that much of PV generation throughout the day is exported to the grid, but that consumption in later hours makes up for the exports and the net consumption at a site stays positive. For sites where the total PV generation was known, around 40% and 50% of PV generation was exported for SCE and CCSE residential sites, respectively. The share of exported PV was substantially smaller for non-residential sites, which have lower demand during the day compared to commercial sites that are typically open for business during the periods of peak PV generation, but was substantial enough to make the hourly export of generation a topic for further research with an expanded sample.

Appendix A

Additional Tables Detailing PV Performance over Time

This appendix presents more detailed comparisons and information for the statistical comparisons presented in Section 5.

A.1 ANOVA Analysis

To analyze how variables interact, the statistical technique of ANOVA is used to test for significance between the differences of means of variables. The strength behind ANOVA is its ability to distinguish four types of variation – main, interacting, hierarchical, and slicing factors. A significance threshold of 10% is used throughout this analysis.

A.1.1 Types of ANOVA Analysis

Main effect tests for the variation of the dependent variable explained by one independent variable. The crossed effect tests for the independent and multiplicative effects of independent variables to the dependent variable. The nested or hierarchical effect tests for significant when one variable in contained within another variable. The slice of a crossed effects tests for the variation of each level of a variable to that of another variable.

1. Main effect – what individual variables explain capacity factor?
2. Crossed effect – what combination of variables explain capacity factor?
3. Nested effect – does customer type perform better within location?
4. Slice of crossed effect – what levels of the variable incentive affect a particular program?

Each type of effect is employed across and within variables in order to determine significant differences between the means.

A.1.2 Results and Model

Results mentioned in Section 5 are those that exhibited a significant difference between the means. The model used for testing in this analysis is as follows:

$$CF = Year\ of\ Operation\ X_i + Location\ X_i + PA\ X_i + Incentive\ X_i + Customer\ Type\ X_i + Ownership\ X_i + Module\ Type\ X_i + e$$

where the variables are weighted capacity factor, year of operation, location, program administrator, incentive type, customer type, ownership, module type and error.

Through an ANOVA analysis of location to other variables, only two variables crossed with location, program administrator and incentive type, are significant in explaining weighted capacity factor. The tables below show the means and significance relationship of location to program administrator and location to incentive type.

Table A-1: Location by Program Administrator – Least Squares Means

Program Administrator	Location	Least Squares Means of CF
CCSE	Coastal	0.182
CCSE	Inland	0.205
PG&E	Coastal	0.179
PG&E	Inland	0.189
SCE	Coastal	0.181
SCE	Inland	0.184

Table A-2 below shows either significant (S) or not significant (NS) differences between the means of comparison. For example, there exists a significant difference between CCSE Inland (0.205) and SCE Inland (0.184).

Table A-2: Location by Program Administrator – Significance Matrix

Program Administrator and Location	CCSE Coastal	CCSE Inland	PG&E Coastal	PG&E Inland	SCE Coastal	SCE Inland
CCSE Coastal		S	NS	S	NS	NS
CCSE Inland	S		S	S	S	S
PG&E Coastal	NS	S		S	NS	S
PG&E Inland	S	S	S		S	S
SCE Coastal	NS	S	NS	S		NS
SCE Inland	NS	S	S	S	NS	

S = Significant, NS = Not Significant

Table A-3: Location by Incentive – Least Squares Means

Incentive	Location	Least Squares Means of CF
EPBB	Coastal	0.191
EPBB	Inland	0.197
PBI	Coastal	0.198
PBI	Inland	0.203
SGIP	Coastal	0.161
SGIP	Inland	0.170

Table A-4 shown below shows either significant (S) or not significant (NS) differences between the means of comparison. For example, there exists a significant difference between EPBB Coastal (0.191) and EPBB Inland (0.197).

Table A-4: Location by Incentive – Significance Matrix

Incentive and Location	EPBB Coastal	EPBB Inland	PBI Coastal	PBI Inland	SGIP Coastal	SGIP Inland
EPBB Coastal		S	S	S	S	S
EPBB Inland	S		NS	S	S	S
PBI Coastal	S	NS		NS	S	S
PBI Inland	S	S	NS		S	S
SGIP Coastal	S	S	S	S		S
SGIP Inland	S	S	S	S	S	

S = Significant, NS = Not Significant

Table A-5: Program Administrator by Incentive – Least Squares Means

Program Administrator	Incentive	Least Squares Means of CF
CCSE	EPBB	0.208
CCSE	PBI	0.213
CCSE	SGIP	0.175
PG&E	EPBB	0.190
PG&E	PBI	0.195
PG&E	SGIP	0.163
SCE	EPBB	0.193
SCE	PBI	0.204
SCE	SGIP	0.146

Table A-6 shows either significant (S) or not significant (NS) differences between the means of comparison. For example, there is no significant difference between CCSE EPBB (0.208) and CCSE PBI (0.213).

Table A-6: Program Administrator (PA) by Incentive – Significance Matrix

PA and Incentive	CCSE EPBB	CCSE PBI	CCSE SGIP	PG&E EPBB	PG&E PBI	PG&E SGIP	SCE EPBB	SCE PBI	SCE SGIP
CCSE EPBB		NS	S	S	S	S	S	NS	S
CCSE PBI	NS		S	S	S	S	S	S	S
CCSE SGIP	S	S		S	S	S	S	S	S
PG&E EPBB	S	S	NS		NS	S	NS	S	S
PG&E PBI	S	S	S	NS		S	NS	S	S
PG&E SGIP	S	S	S	S	S		S	S	S
SCE EPBB	S	S	S	NS	NS	S		S	S
SCE PBI	NS	NS	S	S	S	S	S		S
SCE SGIP	S	S	S	S	S	S	S	S	

S = Significant, NS = Not Significant

Table A-7: Incentive Type by Customer Group – Least Squares Means

Incentive	Customer Group	Least Squares Means of CF
EPBB	Large Commercial	0.184
EPBB	Residential	0.195
PBI	Large Commercial	0.200
PBI	Residential	0.204
SGIP Incentive	SGIP	0.165

Table A-8 shows either significant (S) or not significant (NS) differences between the means of comparison. For example, there exists a significant difference between EPBB Large Commercial (0.184) and EPBB Residential (0.195).

Table A-8: Incentive Type by Customer Group – Significance Matrix

Incentive and Customer Group	EPBB Large Commercial	EPBB Residential	PBI Large Commercial	PBI Residential	SGIP Incentive
EPBB Large Commercial		S	S	S	S
EPBB Residential	S		S	S	S
PBI Large Commercial	S	S		NS	S
PBI Residential	S	S	NS		S
SGIP Incentive	S	S	S	S	

S = Significant, NS = Not Significant

Table A-9: Incentive Type by Third Party Ownership – Least Squares Means

Incentive	Third Party Ownership	Least Squares Means of CF
EPBB	Customer Owned	0.191
EPBB	Third Party Owned	0.196
PBI	Customer Owned	0.200
PBI	Third Party Owned	0.202
SGIP	NA	0.165

Table A-10 shows either significant (S) or not significant (NS) differences between the means of comparison. For example, there exists a significant difference between EPBB Customer Owned (0.191) and EPBB Third Party Owned (0.196).

Table A-10: Incentive Type by Third Party Ownership – Significance Matrix

Incentive and Ownership	EPBB Customer Owned	EPBB Third Party Owned	PBI Customer Owned	PBI Third Party Owned	SGIP
EPBB Customer Owned		S	S	S	S
EPBB Third Party Owned	S		NS	S	S
PBI Customer Owned	S	NS		NS	S
PBI Third Party Owned	S	S	NS		S
SGIP NA	S	S	S	S	

S = Significant, NS = Not Significant

A.2 Summary Charts by Variable

In this section are more detailed tables that present mean, confidence intervals, and sample size for the graphical figures in section 5.

Table A-11: Performance by Vintage over Time by Weighted Mean Yearly Capacity

Year Of Operation		1	2	3	4	5	6	7	8
2002-2004	n	51	96	96	101	105	113	66	12
	Lower CI	0.163	0.166	0.161	0.165	0.163	0.152	0.153	0.126
	Mean	0.169	0.170	0.165	0.170	0.169	0.158	0.161	0.143
	Upper CI	0.174	0.174	0.168	0.175	0.174	0.164	0.170	0.160
2005-2007	n	108	268	269	113	93	10		
	Lower CI	0.182	0.191	0.183	0.170	0.154	0.101		
	Mean	0.186	0.194	0.185	0.175	0.161	0.142		
	Upper CI	0.189	0.197	0.188	0.181	0.168	0.183		
2008-2010	n	971	655	36					
	Lower CI	0.204	0.199	0.196					
	Mean	0.206	0.201	0.201					
	Upper CI	0.208	0.203	0.205					

Table A-12: Performance by Location over Time by Weighted Mean Capacity

Year Of Operation			1	2	3	4	5	6	7	8
CSI	Coastal	n	483	392	87					
		Lower CI	0.194	0.194	0.192					
		Mean	0.197	0.196	0.196					
		Upper CI	0.200	0.198	0.200					
	Inland	n	521	384	73					
		Lower CI	0.209	0.202	0.196					
		Mean	0.212	0.205	0.199					
		Upper CI	0.214	0.207	0.203					
SGIP	Coastal	n	76	145	153	133	117	68	38	5
		Lower CI	0.170	0.175	0.169	0.165	0.151	0.141	0.141	0.084
		Mean	0.175	0.178	0.172	0.169	0.157	0.147	0.148	0.119
		Upper CI	0.179	0.181	0.175	0.172	0.162	0.154	0.154	0.155
	Inland	n	50	98	88	81	81	55	28	7
		Lower CI	0.176	0.192	0.182	0.172	0.170	0.160	0.164	0.140
		Mean	0.182	0.198	0.188	0.180	0.177	0.170	0.181	0.157
		Upper CI	0.187	0.204	0.193	0.188	0.184	0.181	0.197	0.174

Table A-13: Performance by Program Administrator over Time by Weighted Mean Capacity Factor

Year Of Operation			1	2	3	4	5	6	7	8
CSI	CCSE	n	247	89	11					
		Lower CI	0.216	0.202	0.205					
		Mean	0.218	0.206	0.212					
		Upper CI	0.220	0.210	0.219					
	PG&E	n	509	444	114					
		Lower CI	0.203	0.197	0.181					
		Mean	0.206	0.199	0.183					
		Upper CI	0.210	0.201	0.186					
	SCE	n	248	243	35					
		Lower CI	0.199	0.199	0.200					
		Mean	0.202	0.203	0.205					
		Upper CI	0.205	0.206	0.210					
SGIP	CCSE	n	79	96	93	85	65	30	16	3
		Lower CI	0.172	0.179	0.176	0.163	0.149	0.134	0.141	-0.041
		Mean	0.177	0.184	0.180	0.168	0.158	0.148	0.153	0.120
		Upper CI	0.181	0.188	0.185	0.174	0.167	0.162	0.165	0.281
	PG&E	n	39	116	112	88	72	51	27	6
		Lower CI	0.177	0.184	0.172	0.165	0.160	0.151	0.139	0.127
		Mean	0.183	0.188	0.176	0.171	0.165	0.157	0.147	0.147
		Upper CI	0.188	0.193	0.180	0.177	0.170	0.163	0.156	0.167
	SCE	n	8	31	36	41	61	42	23	3
		Lower CI	0.132	0.173	0.172	0.177	0.164	0.150	0.164	0.113
		Mean	0.154	0.185	0.184	0.188	0.174	0.165	0.183	0.142
		Upper CI	0.175	0.197	0.195	0.198	0.184	0.180	0.202	0.172

Table A-14: Performance by Incentive Type over Time by Weighted Mean Capacity Factor

Year Of Operation			1	2	3	4	5	6	7	8
CSI	EPBB	n	673	420	89					
		Lower CI	0.179	0.182	0.176					
		Mean	0.181	0.183	0.180					
		Upper CI	0.183	0.185	0.184					
	Five Year PBI	n	331	356	71					
		Lower CI	0.207	0.202	0.200					
		Mean	0.210	0.204	0.203					
		Upper CI	0.213	0.207	0.206					
SGIP	Incentive	n	126	243	241	214	198	123	66	12
		Lower CI	0.174	0.184	0.175	0.170	0.161	0.151	0.153	0.126
		Mean	0.178	0.187	0.178	0.174	0.165	0.157	0.161	0.143
		Upper CI	0.181	0.190	0.181	0.178	0.169	0.164	0.170	0.160

Table A-15: Performance by Customer Type over Time by Weighted Mean Capacity Factor

Year Of Operation			1	2	3	4	5	6	7	8
CSI	Large Commercial	n	273	273	42					
		Lower CI	0.203	0.199	0.194					
		Mean	0.207	0.201	0.199					
		Upper CI	0.210	0.204	0.204					
	Residential	n	731	503	118					
		Lower CI	0.201	0.191	0.184					
		Mean	0.202	0.194	0.189					
		Upper CI	0.204	0.196	0.193					
SGIP	SGIP	n	126	243	241	214	198	123	66	12
		Lower CI	0.174	0.184	0.175	0.170	0.161	0.151	0.153	0.126
		Mean	0.178	0.187	0.178	0.174	0.165	0.157	0.161	0.143
		Upper CI	0.181	0.190	0.181	0.178	0.169	0.164	0.170	0.160

Table A-16: Performance by Ownership over Time by Weighted Capacity Factor

Year Of Operation			1	2	3	4	5	6	7	8
CSI	Customer Owned	n	490	427	125					
		Lower CI	0.200	0.199	0.187					
		Mean	0.203	0.201	0.190					
		Upper CI	0.205	0.203	0.192					
	Third Party Owned	n	515	350	35					
		Lower CI	0.207	0.198	0.198					
		Mean	0.210	0.201	0.204					
		Upper CI	0.212	0.204	0.209					
SGIP	NA	n	126	243	241	214	198	123	66	12
		Lower CI	0.174	0.184	0.175	0.170	0.161	0.151	0.153	0.126
		Mean	0.178	0.187	0.178	0.174	0.165	0.157	0.161	0.143
		Upper CI	0.181	0.190	0.181	0.178	0.169	0.164	0.170	0.160

Table A-17: Performance by Module Type over Time by Weighted Capacity Factor

Year Of Operation		1	2	3	4	5	6	7	8
HIT-Si	n	82	84	47	24	18	11	9	
	Lower CI	0.183	0.192	0.172	0.160	0.133	0.130	0.126	
	Mean	0.188	0.197	0.179	0.171	0.149	0.147	0.143	
	Upper CI	0.194	0.201	0.186	0.182	0.166	0.164	0.160	
Mono-c-Si	n	231	232	99	64	59	41	28	5
	Lower CI	0.204	0.188	0.169	0.159	0.160	0.141	0.137	0.116
	Mean	0.208	0.191	0.172	0.166	0.166	0.149	0.144	0.136
	Upper CI	0.211	0.194	0.176	0.173	0.171	0.156	0.150	0.156
Multi-c-Si	n	691	608	190	85	67	44	27	6
	Lower CI	0.203	0.199	0.189	0.178	0.165	0.153	0.169	0.117
	Mean	0.205	0.201	0.192	0.185	0.174	0.167	0.184	0.151
	Upper CI	0.207	0.203	0.196	0.191	0.184	0.181	0.200	0.185
Thin Film	n	74	38	38	30	24	15	1	1
	Lower CI	0.178	0.171	0.159	0.148	0.136	0.108		
	Mean	0.182	0.178	0.166	0.157	0.148	0.127	0.156	0.117
	Upper CI	0.186	0.184	0.172	0.167	0.161	0.147		

Appendix B

Methodologies

The data sources for the Impact Evaluation Report were described in Section 3. Program impact estimates and the uncertainty in those estimates were presented in Section 6. This appendix describes data analysis methodology, including the bases of the impact estimates and uncertainty characterizations.

B.1 Data Processing Methods

This section discusses the data processing and validation methodology for photovoltaic (PV) systems.

To process raw PV data received from data providers, a SAS code template has been developed which reads, processes, and highlights suspect data. When necessary, the code adjusts for daylight savings time, accounts for inverter losses, and corrects a data stream which contains more than one site, as well as many other site-specific and data provider-specific issues. Validation of PV data utilizes irradiance, temperature, and rainfall data downloaded from the California Irrigation Management Information System (CIMIS). Each PV site is assigned a nearby CIMIS site. Data are flagged as suspect when there is low daily output, low hourly output, high daily output, or high hourly output compared to the available irradiation. The suspect data are reviewed internally and either validated or invalidated. An example of a suspect case that can be validated internally is a bad weather event that results in low daily output. An example of a suspect case that can be invalidated internally is consistently high daily output that greatly exceeds the system capacity and likely means that significant capacity was added to the system.

B.2 Estimating Impacts of Unmetered Systems

Data from metered systems were used to estimate impacts for unmetered systems, as described in sections 6.1 and 6.8.1. To summarize, estimates for each unmetered system were calculated from the system's rated capacity and the performance of metered systems with similar characteristics, or strata. As stated in section 6.1, the characteristics used to define strata are:

1. Program Administrator
2. Configuration (Near Flat, Tilted, Tracking)
3. Locale (Inland, Coastal)
4. Program and Incentive Type (CSI GM Residential and Small Commercial (<10kW) EPBB, CSI GM Residential and Small Commercial (<10kW) PBI, CSI GM Large Commercial (≥ 10 kW) EPBB, CSI GM Large Commercial (≥ 10 kW) PBI, SGIP > 300 kW, SGIP ≤ 300 kW)
5. Installation Year Group [1](2002-2004, 2005-2007, 2008-2010); and
6. Installation Year.

The strata characteristics were chosen based on there ability to represent factors that are likely to influence system performance and based on what information was available Using *Program Administrator* (PA) as a strata characteristics provides high-level matching for several factors that can influence operational performance. These PA-related factors include local economic climate, available tariffs, and, to some degree, the local meteorological climate. The *configuration* characteristic groups systems by their mounting type and tilt range. The *locale* characteristic addresses some climate based performance differences between coastal and inland regions. Performance differences between program classes and, to some degree, system size; or incentive types are captured with the *program* characteristic. Degradation in generation due to system age is captured by the *installation vintage* and *year of installation* characteristics. *Installation Year Group* is simply a secondary age characteristic for cases where there were not enough system with the exact same *year of installation*, as described below.

All estimated hourly impacts were based on no fewer than two metered observations of similar systems, often in the same strata. For some unmetered systems, there were hours with fewer than two metered observations within the same strata. To estimate impacts for these, metered data from other strata were included until there were at least two metered observations for the same hour. For example, metered data from SCE, near flat, coastal, CSI Large Commercial PBI systems installed between 2008-2010 could be used to estimate impacts for unmetered SCE, near flat, coastal, CSI Large Commercial PBI systems installed during 2009 when too few metered observations existed from 2009 systems alone. If there still were fewer than two metered observations, then data from all SCE, near flat, coastal, Large Commercial PBI systems were allowed to be used. The amount of generation estimated at each of the strata levels is detailed in Table 6.1 for CSI and SGIP programs, and the introductory paragraphs of Section 6.8 for other programs.

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[1] "Installation Year Group" refers to a grouping of systems by three successive years of installation, as opposed to "Installation Year" which is when the system was actually installed.

It is important to note that data from metered systems that are *off* (i.e. not generating) due to maintenance, decommissioning, or other reason are still included in estimates. Therefore, the ratio of generation that is *off* in the metered sample will be extrapolated to the systems receiving estimates. The validity of this extrapolation is based on the metered data sample described in section 3.

A ratio representing average power output per unit of rebated system capacity was calculated using at least two metered observations for each system hour needing an impact estimate. The product of this ratio and the system's rebated capacity was the system's estimated hourly average power output. Estimates of power output were calculated as:

$$\hat{ENGO}_{sdh} = \left(Ca_{sdh}\right) \times \left(\frac{\sum ENGO_{isdh}}{\sum C_{isdh}} \right)_{Metered}$$

Where:

$\hat{ENGO}_{sdh}$ = Predicted net generator output for alls projects in strata[2] *s* on date *d* during hour *h*

Units: kWh

Source: Calculated

Ca_{sdh} = Capacity for *all* projects in strata *s*

Units: kW

Source: PowerClerk Database

C_{isdh} = Capacity for each metered projects in strata *s*

Units: kW

Source: PowerClerk Database

$ENGO_{isdh}$ = Metered net generator output for each project in strata *s* on date *d* during hour *h*

Units: kWh

[2] Strata are always defined by like systems in the same area for the same hour.

Source: Net Generator Output Meters

B.3 Assessing Uncertainty of Impacts Estimates

Metered data available for a subset of PV systems were used in a ratio analysis to estimate impacts of unmetered systems as described above. Due to sampling error the calculated impacts totals will be subject to some uncertainty. The magnitude of this uncertainty was estimated to enable actual performance and expected performance to be compared.

The variance of the ratio estimator is calculated for each strata, day, and hour as:

$$\dot{s}_{sdh}^2 = \frac{1}{n_{sdh}-1}\sum_{i=1}^{n_{sdh}}\left(ENGO_{isdh} - \left(\frac{\sum ENGO_{isdh}}{\sum C_{isdh}}\right)_{Metered} C_{isdh}\right)^2$$

Where:

$\dot{s}_{sdh}^2$ = The variance of the ratio estimator in strata *s* on date *d* during hour *h*

Units: kWh

Source: Calculated

n_{sdh} = The number of metered systems in strata *s* on date *d* during hour *h*

The variance of the estimate of total impacts is approximated as:

$$s_{sdh}^2 = \left(Ca_{sdh}\right)^2\left(\frac{1}{\overline{C}_{sdh}^2}\right)^2 \frac{\dot{s}_{sdh}^2}{n_{sdh}}$$

Where:

$\overline{C}_{sdh}^2$ = The square of the average capacity for metered systems in strata *s* on date *d* during hour *h*

Units: kW

Source: PowerClerk

The standard error of the estimate of total impacts is:

$$SE_{sdh} = \sqrt{s_{sdh}^2}$$

The error bound for an approximate 90 percent confidence interval for the estimate of total impacts is:

$$EB_{sdh} = t_{n_{sdh}} SE_{sdh}$$

An approximate 90 percent confidence interval for the estimate of total impacts is:

$$\hat{\tau}_{sdh} \pm EB_{sdh}$$

The ratio analysis was conducted at the hourly level for individual strata. In numerous instances, these hourly results were combined to calculate values of other performance metrics. In some cases, results for individual strata were aggregated (e.g., total impacts for particular PAs for individual hours). In other cases, summary results were calculated for combinations of hours (e.g., all of 2009). Use of uncertainty analysis results for individual hours to estimate uncertainty in summary results is described below.

B.3.1 Error Bound for Totals Calculated across Hours

Confidence intervals for individual-hour power output results were described above. Total annual energy production—the sum of hourly power output values—is another critical performance parameter. Estimation of confidence intervals for energy production is complicated by the fact that performance of metered systems from hour-to-hour is correlated. The calculation of variance for the sum of the correlated variables must account for this correlation. The general relationship between covariance and total variance is illustrated below:

$$\begin{aligned} s_s^2\Big|_{energy} = \sum_{dh} s_{sdh}^2 + 2Cov(H1, H2) + 2Cov(H1, H3) + \ .....2Cov(H1, H_N) + \\ 2Cov(H2, H3) + 2Cov(H2, H4) + ...2Cov(H2, H_N) + \\ .....2Cov(H_{N-1}, H_N) \end{aligned}$$

Metered data sets available for PBI and large PV systems were sufficiently complete to support direct implementation of the above relationship. The methodology whereby estimated variance for energy production was translated into error bounds mirrored the approach described above for hourly impacts.

B.3.2 Error Bound for Totals Calculated across Strata

Calculation of total impacts estimates requires summing impacts for individual strata. The sampling errors influencing estimated impacts calculated for different strata are assumed to be mutually independent of each other. For some strata, the metered sample will result in overestimation of impacts; for others underestimation. In cases such as this, where the errors being combined are mutually independent of each other and free of bias, the error bound associated with the estimated total is calculated as the square root of the sum of the squared error bounds of each of the strata:

$$EB = \sqrt{\sum EB_s^2}$$

Appendix C

Impacts for All Programs

This appendix complements Section 6, presenting contributions from each program within each IOU service territory and a statewide total for *All* territories. The primary unique content in this appendix is the data presented in tabular format. Some content originally presented in Section 6 is repeated here to make the tables complete and comprehensive. Refer to Section 6 for analysis methodology and further explanations of the data. Similar to the tables in Section 6-8, subtotals are provided for the CSI programs (General Market, MASH, and SASH) and non-CSI programs (SGIP, ERP, NSHP).

Table C-1 presents annual generation and capacity factor for each program within individual IOU service territories. Also shown is the total number of systems and rated capacity.

Table C-1: Annual Energy Generation and Capacities

IOU Service Territory	Program	PV Systems (n)	Rated Capacity (MW)	Generation (MWh)*	Annual Capacity Factor (kWh/kW rebated)
PG&E	CSI - General Market	24,461	252	347,728	0.19
	CSI - MASH	34	1.5	952	0.18
	CSI - SASH	197	0.5	510	0.19
	Subtotal - All CSI	*24,692*	*254*	*349,191*	*0.19*
	SGIP	494	81	111,490	0.16
	ERP	17,700	79	107,997	0.16
	NSHP	2,431	6	9,959	0.19
	Subtotal - Non-CSI	*20,625*	*167*	*229,446*	*0.16*
	All	**45,317**	**420**	**578,637**	**0.18**
SCE	CSI - General Market	11,498	140	204,880	0.20
	CSI - MASH	9	0.7	931	0.20
	CSI - SASH	105	0.3	247	0.20
	Subtotal - All CSI	*11,612*	*141*	*206,058*	*0.20*
	SGIP	291	41	62,591	0.18
	ERP	6,201	29	40,832	0.16
	NSHP	516	1.3	2,072	0.20
	Subtotal - Non-CSI	*7,008*	*71*	*105,494*	*0.17*
	All	**18,620**	**212**	**311,552**	**0.19**
SDG&E	CSI - General Market	5,704	46	69,422	0.21
	CSI - MASH	6	0.2	42	0.15
	CSI - SASH	70	0.1	150	0.20
	Subtotal - All CSI	*5,780*	*47*	*69,614*	*0.21*
	SGIP	105	14	17,431	0.14
	ERP	4,132	15	19,751	0.15
	NSHP	335	1.4	2,361	0.21
	Subtotal - Non-CSI	*4,572*	*30*	*39,543*	*0.15*
	All	**10,352**	**77**	**109,158**	**0.18**
All	CSI - General Market	41,663	438	622,031	0.20
	CSI - MASH	49	2.3	1,925	0.19
	CSI - SASH	372	1.0	907	0.19
	Subtotal - All CSI	*42,084*	*441*	*624,863*	*0.20*
	SGIP	890	136	191,512	0.16
	ERP	28,033	123	168,580	0.16
	NSHP	3,282	8.9	14,392	0.19
	Subtotal - Non-CSI	*32,205*	*268*	*374,483*	*0.16*
	All	**74,289**	**709**	**999,347**	**0.18**

* The uncertainty on all of these estimates is better than 90/10 confidence.

Table C-2 presents each program impact during the 2010 CAISO peak hour, with results separated for individual IOU service territories. The total number of systems and rated capacity numbers include systems that were completed by the peak hour.

Table C-2: Estimated Demand Impact Coincident with CAISO System Peak Hour

IOU Service Territory	Program	PV Systems (n)	Rated Capacity (MW)	Generation (MWh)	Peak Hourly Capacity Factor (kWh peak hour/kW rebated)
PG&E	CSI - General Market	21,368	219	145	0.66
	CSI - MASH	19	0.9	0.7	0.73
	CSI - SASH	138	0.4	0.3	0.68
	Subtotal - All CSI	*21,525*	*220*	*146*	*0.66*
	SGIP	494	81	44	0.55
	ERP	17,700	79	44	0.55
	NSHP	2,421	6.2	4.1	0.66
	Subtotal - Non-CSI	*20,615*	*166*	*92*	*0.55*
	All	**42,140**	**386**	**238**	**0.62**
SCE	CSI - General Market	9,398	121	59	0.48
	CSI - MASH	7	0.7	0.3	0.42
	CSI - SASH	74	0.2	0.1	0.47
	Subtotal - All CSI	*9,479*	*122*	*59*	*0.48*
	SGIP	291	41	16 †	0.40
	ERP	6,201	29	12 †	0.40
	NSHP	514	1.3	0.6	0.50
	Subtotal - Non-CSI	*7,006*	*71*	*29*	*0.40*
	All	**16,485**	**193**	**88**	**0.45**
SDG&E	CSI - General Market	4,967	42	22	0.53
	CSI - MASH	1	0.0	0.0	0.59
	CSI - SASH	53	0.1	0.1	0.57
	Subtotal - All CSI	*5,021*	*42*	*22*	*0.53*
	SGIP	105	14	4.7	0.33
	ERP	4,132	15	5.2 †	0.36
	NSHP	333	1.4	0.7	0.53
	Subtotal - Non-CSI	*4,570*	*30*	*11*	*0.35*
	All	**9,591**	**72**	**33**	**0.46**
All	CSI - General Market	35,733	382	226	0.59
	CSI - MASH	27	1.6	1.0	0.60
	CSI - SASH	265	0.7	0.4	0.61
	Subtotal - All CSI	*36,025*	*384*	*227*	*0.59*
	SGIP	890	136	65	0.48
	ERP	28,033	123	60	0.49
	NSHP	3,268	8.8	5.4	0.62
	Subtotal - Non-CSI	*32,191*	*268*	*131*	*0.49*
	All	**68,216**	**652**	**359**	**0.55**

† indicates confidence is better than 70/30. No symbol indicates confidence is better than 90/10.

The impact from each program on the individual IOU peak demand hours is presented in Table C-3.

Table C-3: Estimated PA-Specific IOU Peak Impacts

IOU Service Territory	Program	Peak Date and Time (PDT)	PV Systems (n)	Rated Capacity (MW)	Generation (MWh)	Peak Hourly Capacity Factor (kWh peak hour/kW rebated)
PG&E	CSI - General Market	August 25, 4:00 to 5:00 PM	21,368	219	119	0.55
	CSI - MASH		19	0.92	0.52	0.56
	CSI - SASH		138	0.39	0.20	0.52
	Subtotal - All CSI		*21,525*	*220*	*120*	*0.55*
	SGIP		494	81	37	0.46
	ERP		17,700	79	35 †	0.45
	NSHP		2,421	6.2	3.1	0.50
	Subtotal - Non-CSI		*20,615*	*166*	*76*	*0.45*
	All		**42,140**	**386**	**196**	**0.51**
SCE	CSI - General Market	September 27, 2:00 to 3:00 PM	10,015	130	80	0.62
	CSI - MASH		7	0.68	0.43	0.63
	CSI - SASH		76	0.20	0.13	0.65
	Subtotal - All CSI		*10,098*	*131*	*81*	*0.62*
	SGIP		291	41	22	0.54
	ERP		6,201	29	14	0.49
	NSHP		515	1.3	0.8	0.62
	Subtotal - Non-CSI		*7,007*	*71*	*37*	*0.52*
	All		**17,105**	**202**	**118**	**0.58**
SDG&E	CSI - General Market	September 27, 2:00 to 3:00 PM	5,152	43	29	0.68
	CSI - MASH		2	0.04	0.03	0.71
	CSI - SASH		57	0.11	0.08	0.71
	Subtotal - All CSI		*5,211*	*43*	*30*	*0.68*
	SGIP		105	14	5.9	0.42
	ERP		4,132	15	6.8 †	0.46
	NSHP		335	1.4	0.95	0.69
	Subtotal - Non-CSI		*4,572*	*30*	*14*	*0.45*
	All		**9,783**	**74**	**43**	**0.59**

† indicates confidence is better than 70/30. No symbol indicates confidence is better than 90/10.

Table C-4 presents the avoided emissions data with contributions from each program allocated to the individual IOU service territories.

Table C-4: Estimated Avoided Emissions

IOU Service Territory	Program	CO2 Emissions Avoided (Tons)	Generation (MWh)	CO2Eq Factor (Tons/ MWh)	PM10 Emssions Avoided (lbs)	Nox Emssions Avoided (lbs)
PG&E	CSI - General Market	171,372	347,728	0.493	22,760	40,409
	CSI - MASH	480	952	0.504	63	116
	CSI - SASH	254	510	0.498	34	61
	Subtotal - All CSI	*172,106*	*349,191*	*0.493*	*22,857*	*40,586*
	SGIP	54,816	111,490	0.492	7,284	12,893
	ERP	53,215	107,997	0.493	7,068	12,546
	NSHP	4,906	9,959	0.493	652	1,156
	Subtotal - Non-CSI	*112,936*	*229,446*	*0.492*	*15,003*	*26,595*
	All	**285,042**	**578,637**	**0.493**	**37,860**	**67,181**
SCE	CSI - General Market	98,210	204,880	0.479	13,130	22,468
	CSI - MASH	454	931	0.488	60	106
	CSI - SASH	120	247	0.488	16	28
	Subtotal - All CSI	*98,785*	*206,058*	*0.479*	*13,207*	*22,602*
	SGIP	29,898	62,591	0.478	4,001	6,813
	ERP	19,556	40,832	0.479	2,615	4,470
	NSHP	995	2,072	0.481	133	228
	Subtotal - Non-CSI	*50,450*	*105,494*	*0.478*	*6,749*	*11,511*
	All	**149,235**	**311,552**	**0.479**	**19,955**	**34,113**
SDG&E	CSI - General Market	33,380	69,422	0.481	4,459	7,663
	CSI - MASH	20	42	0.475	3	5
	CSI - SASH	73	150	0.485	10	17
	Subtotal - All CSI	*33,473*	*69,614*	*0.481*	*4,472*	*7,684*
	SGIP	8,315	17,431	0.477	1,113	1,892
	ERP	9,413	19,751	0.477	1,260	2,140
	NSHP	1,133	2,361	0.480	151	260
	Subtotal - Non-CSI	*18,862*	*39,543*	*0.477*	*2,525*	*4,291*
	All	**52,334**	**109,158**	**0.479**	**6,996**	**11,975**
All	CSI - General Market	302,961	622,031	0.487	40,349	70,540
	CSI - MASH	954	1,925	0.496	127	226
	CSI - SASH	447	907	0.493	59	106
	Subtotal - All CSI	*304,363*	*624,863*	*0.487*	*40,535*	*70,872*
	SGIP	93,029	191,512	0.486	12,398	21,598
	ERP	82,185	168,580	0.488	10,943	19,155
	NSHP	7,034	14,392	0.489	936	1,644
	Subtotal - Non-CSI	*182,248*	*374,483*	*0.487*	*24,277*	*42,397*
	All	**486,611**	**999,347**	**0.487**	**64,812**	**113,268**

Appendix D

Detailed Tables on Export Frequency

This appendix complements Section 7 by providing additional cross tabulations of three different summaries of export frequency. The additional cross tabulations include the system size, incentive type, location, and third-party ownership. The three types of summaries include frequency of any single bill net export, the maximum number exporters in any 12-bill (one-year) period, and the frequency of sites with annual net exports in any 12-bill period.

Table D-1: Residential Frequency of Sites with at Least One Single Bill Export by Incentive Type, Location, and PA

Incentive Type / Location		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
EPBB	Coastal	10,961	6,394	58.3%	2,157	1,006	46.6%	2,571	1,444	56.2%	15,689	8,844	56.4%
	Inland	8,394	4,301	51.2%	7,541	3,319	44.0%	2,272	1,362	59.9%	18,207	8,982	49.3%
	Total	19,355	10,695	55.3%	9,698	4,325	44.6%	4,843	2,806	57.9%	33,896	17,826	52.6%
FiveYearPBI	Coastal	22	17	77.3%	8	6	75.0%	68	57	83.8%	98	80	81.6%
	Inland	54	38	70.4%	167	105	62.9%	51	39	76.5%	272	182	66.9%
	Total	76	55	72.4%	175	111	63.4%	119	96	80.7%	370	262	70.8%
Total	Coastal	10,983	6,411	58.4%	2,165	1,012	46.7%	2,639	1,501	56.9%	15,787	8,924	56.5%
	Inland	8,448	4,339	51.4%	7,708	3,424	44.4%	2,323	1,401	60.3%	18,479	9,164	49.6%
	Total	19,431	10,750	55.3%	9,873	4,436	44.9%	4,962	2,902	58.5%	34,266	18,088	52.8%

Table D-2: Commercial Frequency of Sites with at Least One Single Bill Export by Incentive Type, Location, and PA

Incentive Type / Location		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
EPBB	**Coastal**	268	150	56.0%	32	9	28.1%	32	10	31.3%	332	169	50.9%
	Inland	183	108	59.0%	140	61	43.6%	17	14	82.4%	340	183	53.8%
	Total	451	258	57.2%	172	70	40.7%	49	24	49.0%	672	352	52.4%
FiveYearPBI	**Coastal**	69	28	40.6%	22	0	0.0%	16	3	18.8%	107	31	29.0%
	Inland	89	44	49.4%	156	17	10.9%	10	2	20.0%	255	63	24.7%
	Total	158	72	45.6%	178	17	9.6%	26	5	19.2%	362	94	26.0%
Total	**Coastal**	337	178	52.8%	54	9	16.7%	48	13	27.1%	439	200	45.6%
	Inland	272	152	55.9%	296	78	26.4%	27	16	59.3%	595	246	41.3%
	Total	609	330	54.2%	350	87	24.9%	75	29	38.7%	1,034	446	43.1%

Table D-3: Gov./Non-Profit Frequency of Sites with at Least One Single Bill Export by Incentive Type, Location, and PA

Incentive Type / Location		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
EPBB	**Coastal**	164	64	39.0%	31	9	29.0%	11	5	45.5%	206	78	37.9%
	Inland	51	14	27.5%	51	15	29.4%	10	6	60.0%	112	35	31.3%
	Total	215	78	36.3%	82	24	29.3%	21	11	52.4%	318	113	35.5%
FiveYearPBI	**Coastal**	53	26	49.1%	8	1	12.5%	5	0	0.0%	66	27	40.9%
	Inland	26	12	46.2%	30	3	10.0%	4	4	100.0%	60	19	31.7%
	Total	79	38	48.1%	38	4	10.5%	9	4	44.4%	126	46	36.5%
Total	**Coastal**	217	90	41.5%	39	10	25.6%	16	5	31.3%	272	105	38.6%
	Inland	77	26	33.8%	81	18	22.2%	14	10	71.4%	172	54	31.4%
	Total	294	116	39.5%	120	28	23.3%	30	15	50.0%	444	159	35.8%

Table D-4: Residential Frequency of Sites with at Least One Single Bill Export by Incentive Type, Third-Party Ownership, and PA

Incentive Type / Third-Party Ownership		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
EPBB	**Host Owned**	16,379	9,349	57.1%	7,830	3,568	45.6%	4,283	2,528	59.0%	28,492	15,445	54.2%
	Third Party Owned	2,976	1,346	45.2%	1,868	757	40.5%	560	278	49.6%	5,404	2,381	44.1%
	Total	19,355	10,695	55.3%	9,698	4,325	44.6%	4,843	2,806	57.9%	33,896	17,826	52.6%
FiveYearPBI	**Host Owned**	74	53	71.6%	171	107	62.6%	119	96	80.7%	364	256	70.3%
	Third Party Owned	2	2	100.0%	4	4	100.0%	.	.	.	6	6	100.0%
	Total	76	55	72.4%	175	111	63.4%	119	96	80.7%	370	262	70.8%
Total	**Host Owned**	16,453	9,402	57.1%	8,001	3,675	45.9%	4,402	2,624	59.6%	28,856	15,701	54.4%
	Third Party Owned	2,978	1,348	45.3%	1,872	761	40.7%	560	278	49.6%	5,410	2,387	44.1%
	Total	19,431	10,750	55.3%	9,873	4,436	44.9%	4,962	2,902	58.5%	34,266	18,088	52.8%

Table D-5: Commercial Frequency of Sites with at Least One Single Bill Export by Incentive Type, Third-Party Ownership, and PA

Incentive Type / Third-Party Ownership		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
EPBB	**Host Owned**	386	224	58.0%	158	62	39.2%	44	23	52.3%	588	309	52.6%
	Third Party Owned	65	34	52.3%	14	8	57.1%	5	1	20.0%	84	43	51.2%
	Total	451	258	57.2%	172	70	40.7%	49	24	49.0%	672	352	52.4%
FiveYearPBI	**Host Owned**	84	46	54.8%	66	6	9.1%	14	4	28.6%	164	56	34.1%
	Third Party Owned	74	26	35.1%	112	11	9.8%	12	1	8.3%	198	38	19.2%
	Total	158	72	45.6%	178	17	9.6%	26	5	19.2%	362	94	26.0%
Total	**Host Owned**	470	270	57.4%	224	68	30.4%	58	27	46.6%	752	365	48.5%
	Third Party Owned	139	60	43.2%	126	19	15.1%	17	2	11.8%	282	81	28.7%
	Total	609	330	54.2%	350	87	24.9%	75	29	38.7%	1,034	446	43.1%

Table D-6: Gov./Non-Profit Frequency of Sites with at Least One Single Bill Export by Incentive Type, Third-Party Ownership, and PA

Incentive Type / Third-Party Ownership		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
EPBB	**Host Owned**	193	68	35.2%	78	23	29.5%	21	11	52.4%	292	102	34.9%
	Third Party Owned	22	10	45.5%	4	1	25.0%	.	.	.	26	11	42.3%
	Total	215	78	36.3%	82	24	29.3%	21	11	52.4%	318	113	35.5%
FiveYearPBI	**Host Owned**	46	14	30.4%	26	2	7.7%	3	0	0.0%	75	16	21.3%
	Third Party Owned	33	24	72.7%	12	2	16.7%	6	4	66.7%	51	30	58.8%
	Total	79	38	48.1%	38	4	10.5%	9	4	44.4%	126	46	36.5%
Total	**Host Owned**	239	82	34.3%	104	25	24.0%	24	11	45.8%	367	118	32.2%
	Third Party Owned	55	34	61.8%	16	3	18.8%	6	4	66.7%	77	41	53.2%
	Total	294	116	39.5%	120	28	23.3%	30	15	50.0%	444	159	35.8%

Table D-7: Residential Frequency of Sites with at Least One Single Bill Export by Incentive Type, System Size, and PA

Incentive Type / System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
EPBB	**0-2.5 kW**	3,156	1,465	46.4%	1,823	396	21.7%	952	317	33.3%	5,931	2,178	36.7%
	2.5-4 kW	6,114	3,273	53.5%	2,865	1,174	41.0%	1,493	863	57.8%	10,472	5,310	50.7%
	4-7.5 kW	7,843	4,436	56.6%	3,932	2,122	54.0%	1,961	1,307	66.6%	13,736	7,865	57.3%
	7.5+ kW	2,242	1,521	67.8%	1,078	633	58.7%	437	319	73.0%	3,757	2,473	65.8%
	Total	19,355	10,695	55.3%	9,698	4,325	44.6%	4,843	2,806	57.9%	33,896	17,826	52.6%
FiveYearPBI	**0-2.5 kW**	3	1	33.3%	5	3	60.0%	10	9	90.0%	18	13	72.2%
	2.5-4 kW	18	10	55.6%	25	17	68.0%	35	26	74.3%	78	53	67.9%
	4-7.5 kW	33	28	84.8%	92	57	62.0%	56	48	85.7%	181	133	73.5%
	7.5+ kW	22	16	72.7%	53	34	64.2%	18	13	72.2%	93	63	67.7%
	Total	76	55	72.4%	175	111	63.4%	119	96	80.7%	370	262	70.8%
Total	**0-2.5 kW**	3,159	1,466	46.4%	1,828	399	21.8%	962	326	33.9%	5,949	2,191	36.8%
	2.5-4 kW	6,132	3,283	53.5%	2,890	1,191	41.2%	1,528	889	58.2%	10,550	5,363	50.8%
	4-7.5 kW	7,876	4,464	56.7%	4,024	2,179	54.2%	2,017	1,355	67.2%	13,917	7,998	57.5%
	7.5+ kW	2,264	1,537	67.9%	1,131	667	59.0%	455	332	73.0%	3,850	2,536	65.9%
	Total	19,431	10,750	55.3%	9,873	4,436	44.9%	4,962	2,902	58.5%	34,266	18,088	52.8%

Table D-8: Commercial Frequency of Sites with at Least One Single Bill Export by Incentive Type, System Size, and PA

Incentive Type / System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
EPBB	**0-5 kW**	118	61	51.7%	43	16	37.2%	18	7	38.9%	179	84	46.9%
	5-10 kW	112	68	60.7%	42	13	31.0%	6	2	33.3%	160	83	51.9%
	10-25 kW	112	71	63.4%	52	29	55.8%	15	10	66.7%	179	110	61.5%
	25+ kW	109	58	53.2%	35	12	34.3%	10	5	50.0%	154	75	48.7%
	Total	451	258	57.2%	172	70	40.7%	49	24	49.0%	672	352	52.4%
FiveYearPBI	**0-5 kW**	1	1	100.0%	1	0	0.0%	.	.	.	2	1	50.0%
	5-10 kW	1	1	100.0%	4	1	25.0%	.	.	.	5	2	40.0%
	10-25 kW	12	9	75.0%	6	4	66.7%	2	1	50.0%	20	14	70.0%
	25+ kW	144	61	42.4%	167	12	7.2%	24	4	16.7%	335	77	23.0%
	Total	158	72	45.6%	178	17	9.6%	26	5	19.2%	362	94	26.0%
Total	**0-5 kW**	119	62	52.1%	44	16	36.4%	18	7	38.9%	181	85	47.0%
	5-10 kW	113	69	61.1%	46	14	30.4%	6	2	33.3%	165	85	51.5%
	10-25 kW	124	80	64.5%	58	33	56.9%	17	11	64.7%	199	124	62.3%
	25+ kW	253	119	47.0%	202	24	11.9%	34	9	26.5%	489	152	31.1%
	Total	609	330	54.2%	350	87	24.9%	75	29	38.7%	1,034	446	43.1%

Table D-9: Gov./Non-Profit Frequency of Sites with at Least One Single Bill Export by Incentive Type, System Size, and PA

Incentive Type / System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
EPBB	**0-5 kW**	75	21	28.0%	19	5	26.3%	9	6	66.7%	103	32	31.1%
	5-10 kW	40	16	40.0%	17	5	29.4%	3	0	0.0%	60	21	35.0%
	10-25 kW	52	23	44.2%	29	10	34.5%	6	3	50.0%	87	36	41.4%
	25+ kW	48	18	37.5%	17	4	23.5%	3	2	66.7%	68	24	35.3%
	Total	215	78	36.3%	82	24	29.3%	21	11	52.4%	318	113	35.5%
FiveYearPBI	**5-10 kW**	1	0	0.0%	.	.	.	.	.	.	1	0	0.0%
	10-25 kW	4	3	75.0%	2	1	50.0%	.	.	.	6	4	66.7%
	25+ kW	74	35	47.3%	36	3	8.3%	9	4	44.4%	119	42	35.3%
	Total	79	38	48.1%	38	4	10.5%	9	4	44.4%	126	46	36.5%
Total	**0-5 kW**	75	21	28.0%	19	5	26.3%	9	6	66.7%	103	32	31.1%
	5-10 kW	41	16	39.0%	17	5	29.4%	3	0	0.0%	61	21	34.4%
	10-25 kW	56	26	46.4%	31	11	35.5%	6	3	50.0%	93	40	43.0%
	25+ kW	122	53	43.4%	53	7	13.2%	12	6	50.0%	187	66	35.3%
	Total	294	116	39.5%	120	28	23.3%	30	15	50.0%	444	159	35.8%

Table D-10: Residential Frequency of Sites with at Least One Single Bill Export by Location, Third-Party Ownership, and PA

Location / Third-Party Ownership		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
Coastal	Host Owned	9,513	5,797	60.9%	1,825	859	47.1%	2,365	1,373	58.1%	13,703	8,029	58.6%
	Third Party Owned	1,470	614	41.8%	340	153	45.0%	274	128	46.7%	2,084	895	42.9%
	Total	10,983	6,411	58.4%	2,165	1,012	46.7%	2,639	1,501	56.9%	15,787	8,924	56.5%
Inland	Host Owned	6,940	3,605	51.9%	6,176	2,816	45.6%	2,037	1,251	61.4%	15,153	7,672	50.6%
	Third Party Owned	1,508	734	48.7%	1,532	608	39.7%	286	150	52.4%	3,326	1,492	44.9%
	Total	8,448	4,339	51.4%	7,708	3,424	44.4%	2,323	1,401	60.3%	18,479	9,164	49.6%
Total	Host Owned	16,453	9,402	57.1%	8,001	3,675	45.9%	4,402	2,624	59.6%	28,856	15,701	54.4%
	Third Party Owned	2,978	1,348	45.3%	1,872	761	40.7%	560	278	49.6%	5,410	2,387	44.1%
	Total	19,431	10,750	55.3%	9,873	4,436	44.9%	4,962	2,902	58.5%	34,266	18,088	52.8%

Table D-11: Commercial Frequency of Sites with at Least One Single Bill Export by Location, Third-Party Ownership, and PA

Location / Third-Party Ownership		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
Coastal	**Host Owned**	267	147	55.1%	39	8	20.5%	39	13	33.3%	345	168	48.7%
	Third Party Owned	70	31	44.3%	15	1	6.7%	9	0	0.0%	94	32	34.0%
	Total	337	178	52.8%	54	9	16.7%	48	13	27.1%	439	200	45.6%
Inland	**Host Owned**	203	123	60.6%	185	60	32.4%	19	14	73.7%	407	197	48.4%
	Third Party Owned	69	29	42.0%	111	18	16.2%	8	2	25.0%	188	49	26.1%
	Total	272	152	55.9%	296	78	26.4%	27	16	59.3%	595	246	41.3%
Total	**Host Owned**	470	270	57.4%	224	68	30.4%	58	27	46.6%	752	365	48.5%
	Third Party Owned	139	60	43.2%	126	19	15.1%	17	2	11.8%	282	81	28.7%
	Total	609	330	54.2%	350	87	24.9%	75	29	38.7%	1,034	446	43.1%

Table D-12: Gov./Non-Profit Frequency of Sites with at Least One Single Bill Export by Location, Third-Party Ownership, and PA

Location / Third-Party Ownership		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
Coastal	Host Owned	175	65	37.1%	34	10	29.4%	14	5	35.7%	223	80	35.9%
	Third Party Owned	42	25	59.5%	5	0	0.0%	2	0	0.0%	49	25	51.0%
	Total	217	90	41.5%	39	10	25.6%	16	5	31.3%	272	105	38.6%
Inland	Host Owned	64	17	26.6%	70	15	21.4%	10	6	60.0%	144	38	26.4%
	Third Party Owned	13	9	69.2%	11	3	27.3%	4	4	100.0%	28	16	57.1%
	Total	77	26	33.8%	81	18	22.2%	14	10	71.4%	172	54	31.4%
Total	Host Owned	239	82	34.3%	104	25	24.0%	24	11	45.8%	367	118	32.2%
	Third Party Owned	55	34	61.8%	16	3	18.8%	6	4	66.7%	77	41	53.2%
	Total	294	116	39.5%	120	28	23.3%	30	15	50.0%	444	159	35.8%

Table D-13: Residential Frequency of Sites with at Least One Single Bill Export by Location, System Size, and PA

Location / System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
Coastal	**0-2.5 kW**	2,362	1,224	51.8%	504	150	29.8%	641	235	36.7%	3,507	1,609	45.9%
	2.5-4 kW	3,915	2,295	58.6%	743	362	48.7%	921	568	61.7%	5,579	3,225	57.8%
	4-7.5 kW	3,794	2,271	59.9%	753	424	56.3%	934	608	65.1%	5,481	3,303	60.3%
	7.5+ kW	912	621	68.1%	165	76	46.1%	143	90	62.9%	1,220	787	64.5%
	Total	10,983	6,411	58.4%	2,165	1,012	46.7%	2,639	1,501	56.9%	15,787	8,924	56.5%
Inland	**0-2.5 kW**	797	242	30.4%	1,324	249	18.8%	321	91	28.3%	2,442	582	23.8%
	2.5-4 kW	2,217	988	44.6%	2,147	829	38.6%	607	321	52.9%	4,971	2,138	43.0%
	4-7.5 kW	4,082	2,193	53.7%	3,271	1,755	53.7%	1,083	747	69.0%	8,436	4,695	55.7%
	7.5+ kW	1,352	916	67.8%	966	591	61.2%	312	242	77.6%	2,630	1,749	66.5%
	Total	8,448	4,339	51.4%	7,708	3,424	44.4%	2,323	1,401	60.3%	18,479	9,164	49.6%
Total	**0-2.5 kW**	3,159	1,466	46.4%	1,828	399	21.8%	962	326	33.9%	5,949	2,191	36.8%
	2.5-4 kW	6,132	3,283	53.5%	2,890	1,191	41.2%	1,528	889	58.2%	10,550	5,363	50.8%
	4-7.5 kW	7,876	4,464	56.7%	4,024	2,179	54.2%	2,017	1,355	67.2%	13,917	7,998	57.5%
	7.5+ kW	2,264	1,537	67.9%	1,131	667	59.0%	455	332	73.0%	3,850	2,536	65.9%
	Total	19,431	10,750	55.3%	9,873	4,436	44.9%	4,962	2,902	58.5%	34,266	18,088	52.8%

Table D-14: Commercial Frequency of Sites with at Least One Single Bill Export by Location, System Size, and PA

Location / System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
Coastal	**0-5 kW**	71	37	52.1%	7	1	14.3%	15	5	33.3%	93	43	46.2%
	5-10 kW	58	33	56.9%	14	4	28.6%	3	0	0.0%	75	37	49.3%
	10-25 kW	74	45	60.8%	9	4	44.4%	9	3	33.3%	92	52	56.5%
	25+ kW	134	63	47.0%	24	0	0.0%	21	5	23.8%	179	68	38.0%
	Total	337	178	52.8%	54	9	16.7%	48	13	27.1%	439	200	45.6%
Inland	**0-5 kW**	48	25	52.1%	37	15	40.5%	3	2	66.7%	88	42	47.7%
	5-10 kW	55	36	65.5%	32	10	31.3%	3	2	66.7%	90	48	53.3%
	10-25 kW	50	35	70.0%	49	29	59.2%	8	8	100.0%	107	72	67.3%
	25+ kW	119	56	47.1%	178	24	13.5%	13	4	30.8%	310	84	27.1%
	Total	272	152	55.9%	296	78	26.4%	27	16	59.3%	595	246	41.3%
Total	**0-5 kW**	119	62	52.1%	44	16	36.4%	18	7	38.9%	181	85	47.0%
	5-10 kW	113	69	61.1%	46	14	30.4%	6	2	33.3%	165	85	51.5%
	10-25 kW	124	80	64.5%	58	33	56.9%	17	11	64.7%	199	124	62.3%
	25+ kW	253	119	47.0%	202	24	11.9%	34	9	26.5%	489	152	31.1%
	Total	609	330	54.2%	350	87	24.9%	75	29	38.7%	1,034	446	43.1%

Table D-15: Gov./Non-Profit Frequency of Sites with at Least One Single Bill Export by Location, System Size, and PA

Location / System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
Coastal	**0-5 kW**	54	19	35.2%	6	2	33.3%	3	3	100.0%	63	24	38.1%
	5-10 kW	32	12	37.5%	8	3	37.5%	2	0	0.0%	42	15	35.7%
	10-25 kW	45	22	48.9%	9	1	11.1%	4	1	25.0%	58	24	41.4%
	25+ kW	86	37	43.0%	16	4	25.0%	7	1	14.3%	109	42	38.5%
	Total	217	90	41.5%	39	10	25.6%	16	5	31.3%	272	105	38.6%
Inland	**0-5 kW**	21	2	9.5%	13	3	23.1%	6	3	50.0%	40	8	20.0%
	5-10 kW	9	4	44.4%	9	2	22.2%	1	0	0.0%	19	6	31.6%
	10-25 kW	11	4	36.4%	22	10	45.5%	2	2	100.0%	35	16	45.7%
	25+ kW	36	16	44.4%	37	3	8.1%	5	5	100.0%	78	24	30.8%
	Total	77	26	33.8%	81	18	22.2%	14	10	71.4%	172	54	31.4%
Total	**0-5 kW**	75	21	28.0%	19	5	26.3%	9	6	66.7%	103	32	31.1%
	5-10 kW	41	16	39.0%	17	5	29.4%	3	0	0.0%	61	21	34.4%
	10-25 kW	56	26	46.4%	31	11	35.5%	6	3	50.0%	93	40	43.0%
	25+ kW	122	53	43.4%	53	7	13.2%	12	6	50.0%	187	66	35.3%
	Total	294	116	39.5%	120	28	23.3%	30	15	50.0%	444	159	35.8%

Table D-16: Residential Frequency of Sites with at Least One Single Bill Export by Third-Party Ownership, System Size, and PA

Third-Party Ownership / System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
Host Owned	**0-2.5 kW**	2,786	1,336	48.0%	1,649	363	22.0%	895	308	34.4%	5,330	2,007	37.7%
	2.5-4 kW	5,244	2,963	56.5%	2,331	1,012	43.4%	1,338	818	61.1%	8,913	4,793	53.8%
	4-7.5 kW	6,516	3,783	58.1%	3,114	1,748	56.1%	1,758	1,198	68.1%	11,388	6,729	59.1%
	7.5+ kW	1,907	1,320	69.2%	907	552	60.9%	411	300	73.0%	3,225	2,172	67.3%
	Total	16,453	9,402	57.1%	8,001	3,675	45.9%	4,402	2,624	59.6%	28,856	15,701	54.4%
Third Party Owned	**0-2.5 kW**	373	130	34.9%	179	36	20.1%	67	18	26.9%	619	184	29.7%
	2.5-4 kW	888	320	36.0%	559	179	32.0%	190	71	37.4%	1,637	570	34.8%
	4-7.5 kW	1,360	681	50.1%	910	431	47.4%	259	157	60.6%	2,529	1,269	50.2%
	7.5+ kW	357	217	60.8%	224	115	51.3%	44	32	72.7%	625	364	58.2%
	Total	2,978	1,348	45.3%	1,872	761	40.7%	560	278	49.6%	5,410	2,387	44.1%
Total	**0-2.5 kW**	3,159	1,466	46.4%	1,828	399	21.8%	962	326	33.9%	5,949	2,191	36.8%
	2.5-4 kW	6,132	3,283	53.5%	2,890	1,191	41.2%	1,528	889	58.2%	10,550	5,363	50.8%
	4-7.5 kW	7,876	4,464	56.7%	4,024	2,179	54.2%	2,017	1,355	67.2%	13,917	7,998	57.5%
	7.5+ kW	2,264	1,537	67.9%	1,131	667	59.0%	455	332	73.0%	3,850	2,536	65.9%
	Total	19,431	10,750	55.3%	9,873	4,436	44.9%	4,962	2,902	58.5%	34,266	18,088	52.8%

Table D-17: Commercial Frequency of Sites with at Least One Single Bill Export by Third-Party Ownership, System Size, and PA

Third-Party Ownership / System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
Host Owned	**0-5 kW**	109	58	53.2%	40	15	37.5%	18	7	38.9%	167	80	47.9%
	5-10 kW	103	62	60.2%	42	12	28.6%	4	2	50.0%	149	76	51.0%
	10-25 kW	104	68	65.4%	52	27	51.9%	14	10	71.4%	170	105	61.8%
	25+ kW	154	82	53.2%	90	14	15.6%	22	8	36.4%	266	104	39.1%
	Total	470	270	57.4%	224	68	30.4%	58	27	46.6%	752	365	48.5%
Third Party Owned	**0-5 kW**	10	4	40.0%	4	1	25.0%	.	.	.	14	5	35.7%
	5-10 kW	10	7	70.0%	4	2	50.0%	2	0	0.0%	16	9	56.3%
	10-25 kW	20	12	60.0%	6	6	100.0%	3	1	33.3%	29	19	65.5%
	25+ kW	99	37	37.4%	112	10	8.9%	12	1	8.3%	223	48	21.5%
	Total	139	60	43.2%	126	19	15.1%	17	2	11.8%	282	81	28.7%
Total	**0-5 kW**	119	62	52.1%	44	16	36.4%	18	7	38.9%	181	85	47.0%
	5-10 kW	113	69	61.1%	46	14	30.4%	6	2	33.3%	165	85	51.5%
	10-25 kW	124	80	64.5%	58	33	56.9%	17	11	64.7%	199	124	62.3%
	25+ kW	253	119	47.0%	202	24	11.9%	34	9	26.5%	489	152	31.1%
	Total	609	330	54.2%	350	87	24.9%	75	29	38.7%	1,034	446	43.1%

Table D-18: Gov./Non-Profit Frequency of Sites with at Least One Single Bill Export by Third-Party Ownership, System Size, and PA

Third-Party Ownership / System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
Host Owned	**0-5 kW**	68	18	26.5%	18	5	27.8%	9	6	66.7%	95	29	30.5%
	5-10 kW	39	15	38.5%	17	5	29.4%	3	0	0.0%	59	20	33.9%
	10-25 kW	51	24	47.1%	29	10	34.5%	6	3	50.0%	86	37	43.0%
	25+ kW	81	25	30.9%	40	5	12.5%	6	2	33.3%	127	32	25.2%
	Total	239	82	34.3%	104	25	24.0%	24	11	45.8%	367	118	32.2%
Third Party Owned	**0-5 kW**	7	3	42.9%	1	0	0.0%	.	.	.	8	3	37.5%
	5-10 kW	2	1	50.0%	.	.	.	.	.	.	2	1	50.0%
	10-25 kW	5	2	40.0%	2	1	50.0%	.	.	.	7	3	42.9%
	25+ kW	41	28	68.3%	13	2	15.4%	6	4	66.7%	60	34	56.7%
	Total	55	34	61.8%	16	3	18.8%	6	4	66.7%	77	41	53.2%
Total	**0-5 kW**	75	21	28.0%	19	5	26.3%	9	6	66.7%	103	32	31.1%
	5-10 kW	41	16	39.0%	17	5	29.4%	3	0	0.0%	61	21	34.4%
	10-25 kW	56	26	46.4%	31	11	35.5%	6	3	50.0%	93	40	43.0%
	25+ kW	122	53	43.4%	53	7	13.2%	12	6	50.0%	187	66	35.3%
	Total	294	116	39.5%	120	28	23.3%	30	15	50.0%	444	159	35.8%

Table D-19: Residential Highest Number of Exports over any 12-Bill Period by Incentive Type and PA

Incentive Type / Maximum Number of Exports over 12-Billing-Period Interval		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent
EPBB	**1-3**	4,177	43.8%	67.9%	1,346	42.6%	21.9%	629	30.4%	10.2%	6,152	41.7%	100.0%
	4-6	3,342	35.1%	65.0%	1,066	33.7%	20.7%	731	35.3%	14.2%	5,139	34.8%	100.0%
	7-9	1,755	18.4%	60.1%	630	19.9%	21.6%	535	25.9%	18.3%	2,920	19.8%	100.0%
	10-12	258	2.7%	46.8%	120	3.8%	21.8%	173	8.4%	31.4%	551	3.7%	100.0%
FiveYearPBI	**1-3**	22	41.5%	27.5%	50	49.5%	62.5%	8	10.1%	10.0%	80	34.3%	100.0%
	4-6	21	39.6%	26.9%	34	33.7%	43.6%	23	29.1%	29.5%	78	33.5%	100.0%
	7-9	9	17.0%	18.4%	16	15.8%	32.7%	24	30.4%	49.0%	49	21.0%	100.0%
	10-12	1	1.9%	3.8%	1	1.0%	3.8%	24	30.4%	92.3%	26	11.2%	100.0%
Total	**1-3**	4,199	43.8%	67.4%	1,396	42.8%	22.4%	637	29.7%	10.2%	6,232	41.6%	100.0%
	4-6	3,363	35.1%	64.5%	1,100	33.7%	21.1%	754	35.1%	14.5%	5,217	34.8%	100.0%
	7-9	1,764	18.4%	59.4%	646	19.8%	21.8%	559	26.0%	18.8%	2,969	19.8%	100.0%
	10-12	259	2.7%	44.9%	121	3.7%	21.0%	197	9.2%	34.1%	577	3.8%	100.0%
	Total	9,585	100.0%	63.9%	3,263	100.0%	21.8%	2,147	100.0%	14.3%	14,995	100.0%	100.0%

Table D-20: Commercial Highest Number of Exports over any 12-Bill Period by Incentive Type and PA

Incentive Type / Maximum Number of Exports over 12-Billing-Period Interval		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent
EPBB	**1-3**	62	27.9%	83.8%	10	20.0%	13.5%	2	9.5%	2.7%	74	25.3%	100.0%
	4-6	69	31.1%	71.1%	20	40.0%	20.6%	8	38.1%	8.2%	97	33.1%	100.0%
	7-9	73	32.9%	80.2%	12	24.0%	13.2%	6	28.6%	6.6%	91	31.1%	100.0%
	10-12	18	8.1%	58.1%	8	16.0%	25.8%	5	23.8%	16.1%	31	10.6%	100.0%
FiveYearPBI	**1-3**	15	22.7%	78.9%	3	23.1%	15.8%	1	33.3%	5.3%	19	23.2%	100.0%
	4-6	34	51.5%	82.9%	5	38.5%	12.2%	2	66.7%	4.9%	41	50.0%	100.0%
	7-9	13	19.7%	81.3%	3	23.1%	18.8%	.	.	.	16	19.5%	100.0%
	10-12	4	6.1%	66.7%	2	15.4%	33.3%	.	.	.	6	7.3%	100.0%
Total	**1-3**	77	26.7%	82.8%	13	20.6%	14.0%	3	12.5%	3.2%	93	24.8%	100.0%
	4-6	103	35.8%	74.6%	25	39.7%	18.1%	10	41.7%	7.2%	138	36.8%	100.0%
	7-9	86	29.9%	80.4%	15	23.8%	14.0%	6	25.0%	5.6%	107	28.5%	100.0%
	10-12	22	7.6%	59.5%	10	15.9%	27.0%	5	20.8%	13.5%	37	9.9%	100.0%
	Total	288	100.0%	76.8%	63	100.0%	16.8%	24	100.0%	6.4%	375	100.0%	100.0%

Table D-21: Gov./Non-Profit Highest Number of Exports over any 12-Bill Period by Incentive Type and PA

Incentive Type / Maximum Number of Exports over 12-Billing-Period Interval		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent
EPBB	**1-3**	19	27.1%	76.0%	2	10.5%	8.0%	4	50.0%	16.0%	25	25.8%	100.0%
	4-6	24	34.3%	66.7%	9	47.4%	25.0%	3	37.5%	8.3%	36	37.1%	100.0%
	7-9	21	30.0%	84.0%	4	21.1%	16.0%	.	.	.	25	25.8%	100.0%
	10-12	6	8.6%	54.5%	4	21.1%	36.4%	1	12.5%	9.1%	11	11.3%	100.0%
FiveYearPBI	**1-3**	13	37.1%	100.0%	.	.	.	.	.	.	13	30.2%	100.0%
	4-6	16	45.7%	84.2%	2	50.0%	10.5%	1	25.0%	5.3%	19	44.2%	100.0%
	7-9	6	17.1%	75.0%	2	50.0%	25.0%	.	.	.	8	18.6%	100.0%
	10-12	.	.	.	.	.	.	3	75.0%	100.0%	3	7.0%	100.0%
Total	**1-3**	32	30.5%	84.2%	2	8.7%	5.3%	4	33.3%	10.5%	38	27.1%	100.0%
	4-6	40	38.1%	72.7%	11	47.8%	20.0%	4	33.3%	7.3%	55	39.3%	100.0%
	7-9	27	25.7%	81.8%	6	26.1%	18.2%	.	.	.	33	23.6%	100.0%
	10-12	6	5.7%	42.9%	4	17.4%	28.6%	4	33.3%	28.6%	14	10.0%	100.0%
	Total	105	100.0%	75.0%	23	100.0%	16.4%	12	100.0%	8.6%	140	100.0%	100.0%

Table D-22: Residential Highest Number of Exports over any 12-Bill Period by Location and PA

Location / Maximum Number of Exports over 12-Billing-Period Interval		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent
Coastal	**1-3**	2,145	37.5%	77.2%	290	38.1%	10.4%	345	29.8%	12.4%	2,780	36.4%	100.0%
	4-6	2,175	38.0%	77.5%	241	31.7%	8.6%	390	33.6%	13.9%	2,806	36.7%	100.0%
	7-9	1,225	21.4%	70.5%	195	25.6%	11.2%	318	27.4%	18.3%	1,738	22.8%	100.0%
	10-12	172	3.0%	55.0%	35	4.6%	11.2%	106	9.1%	33.9%	313	4.1%	100.0%
Inland	**1-3**	2,054	53.1%	59.5%	1,106	44.2%	32.0%	292	29.6%	8.5%	3,452	46.9%	100.0%
	4-6	1,188	30.7%	49.3%	859	34.3%	35.6%	364	36.8%	15.1%	2,411	32.8%	100.0%
	7-9	539	13.9%	43.8%	451	18.0%	36.6%	241	24.4%	19.6%	1,231	16.7%	100.0%
	10-12	87	2.2%	33.0%	86	3.4%	32.6%	91	9.2%	34.5%	264	3.6%	100.0%
Total	**1-3**	4,199	43.8%	67.4%	1,396	42.8%	22.4%	637	29.7%	10.2%	6,232	41.6%	100.0%
	4-6	3,363	35.1%	64.5%	1,100	33.7%	21.1%	754	35.1%	14.5%	5,217	34.8%	100.0%
	7-9	1,764	18.4%	59.4%	646	19.8%	21.8%	559	26.0%	18.8%	2,969	19.8%	100.0%
	10-12	259	2.7%	44.9%	121	3.7%	21.0%	197	9.2%	34.1%	577	3.8%	100.0%
	Total	9,585	100.0%	63.9%	3,263	100.0%	21.8%	2,147	100.0%	14.3%	14,995	100.0%	100.0%

Table D-23: Commercial Highest Number of Exports over any 12-Bill Period by Location and PA

Location / Maximum Number of Exports over 12-Billing-Period Interval		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent
Coastal	**1-3**	42	26.6%	93.3%	2	25.0%	4.4%	1	9.1%	2.2%	45	25.4%	100.0%
	4-6	58	36.7%	92.1%	3	37.5%	4.8%	2	18.2%	3.2%	63	35.6%	100.0%
	7-9	45	28.5%	86.5%	2	25.0%	3.8%	5	45.5%	9.6%	52	29.4%	100.0%
	10-12	13	8.2%	76.5%	1	12.5%	5.9%	3	27.3%	17.6%	17	9.6%	100.0%
Inland	**1-3**	35	26.9%	72.9%	11	20.0%	22.9%	2	15.4%	4.2%	48	24.2%	100.0%
	4-6	45	34.6%	60.0%	22	40.0%	29.3%	8	61.5%	10.7%	75	37.9%	100.0%
	7-9	41	31.5%	74.5%	13	23.6%	23.6%	1	7.7%	1.8%	55	27.8%	100.0%
	10-12	9	6.9%	45.0%	9	16.4%	45.0%	2	15.4%	10.0%	20	10.1%	100.0%
Total	**1-3**	77	26.7%	82.8%	13	20.6%	14.0%	3	12.5%	3.2%	93	24.8%	100.0%
	4-6	103	35.8%	74.6%	25	39.7%	18.1%	10	41.7%	7.2%	138	36.8%	100.0%
	7-9	86	29.9%	80.4%	15	23.8%	14.0%	6	25.0%	5.6%	107	28.5%	100.0%
	10-12	22	7.6%	59.5%	10	15.9%	27.0%	5	20.8%	13.5%	37	9.9%	100.0%
	Total	288	100.0%	76.8%	63	100.0%	16.8%	24	100.0%	6.4%	375	100.0%	100.0%

Table D-24: Gov./Non-Profit Highest Number of Exports over any 12-Bill Period by Location and PA

Location / Maximum Number of Exports over 12-Billing-Period Interval		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent
Coastal	**1-3**	27	32.5%	90.0%	1	12.5%	3.3%	2	50.0%	6.7%	30	31.6%	100.0%
	4-6	31	37.3%	91.2%	1	12.5%	2.9%	2	50.0%	5.9%	34	35.8%	100.0%
	7-9	20	24.1%	83.3%	4	50.0%	16.7%	.	.	.	24	25.3%	100.0%
	10-12	5	6.0%	71.4%	2	25.0%	28.6%	.	.	.	7	7.4%	100.0%
Inland	**1-3**	5	22.7%	62.5%	1	6.7%	12.5%	2	25.0%	25.0%	8	17.8%	100.0%
	4-6	9	40.9%	42.9%	10	66.7%	47.6%	2	25.0%	9.5%	21	46.7%	100.0%
	7-9	7	31.8%	77.8%	2	13.3%	22.2%	.	.	.	9	20.0%	100.0%
	10-12	1	4.5%	14.3%	2	13.3%	28.6%	4	50.0%	57.1%	7	15.6%	100.0%
Total	**1-3**	32	30.5%	84.2%	2	8.7%	5.3%	4	33.3%	10.5%	38	27.1%	100.0%
	4-6	40	38.1%	72.7%	11	47.8%	20.0%	4	33.3%	7.3%	55	39.3%	100.0%
	7-9	27	25.7%	81.8%	6	26.1%	18.2%	.	.	.	33	23.6%	100.0%
	10-12	6	5.7%	42.9%	4	17.4%	28.6%	4	33.3%	28.6%	14	10.0%	100.0%
	Total	105	100.0%	75.0%	23	100.0%	16.4%	12	100.0%	8.6%	140	100.0%	100.0%

Table D-25: Residential Highest Number of Exports over any 12-Bill Period by Third-Party Ownership and PA

Third-Party Ownership / Maximum Number of Exports over 12-Billing-Period Interval		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent
Host Owned	**1-3**	3,598	42.3%	67.3%	1,180	42.1%	22.1%	567	28.6%	10.6%	5,345	40.3%	100.0%
	4-6	3,027	35.6%	64.8%	949	33.9%	20.3%	692	34.9%	14.8%	4,668	35.2%	100.0%
	7-9	1,634	19.2%	59.9%	567	20.2%	20.8%	529	26.7%	19.4%	2,730	20.6%	100.0%
	10-12	237	2.8%	44.2%	107	3.8%	20.0%	192	9.7%	35.8%	536	4.0%	100.0%
Third Party Owned	**1-3**	601	55.2%	67.8%	216	47.0%	24.4%	70	41.9%	7.9%	887	51.7%	100.0%
	4-6	336	30.9%	61.2%	151	32.8%	27.5%	62	37.1%	11.3%	549	32.0%	100.0%
	7-9	130	11.9%	54.4%	79	17.2%	33.1%	30	18.0%	12.6%	239	13.9%	100.0%
	10-12	22	2.0%	53.7%	14	3.0%	34.1%	5	3.0%	12.2%	41	2.4%	100.0%
Total	**1-3**	4,199	43.8%	67.4%	1,396	42.8%	22.4%	637	29.7%	10.2%	6,232	41.6%	100.0%
	4-6	3,363	35.1%	64.5%	1,100	33.7%	21.1%	754	35.1%	14.5%	5,217	34.8%	100.0%
	7-9	1,764	18.4%	59.4%	646	19.8%	21.8%	559	26.0%	18.8%	2,969	19.8%	100.0%
	10-12	259	2.7%	44.9%	121	3.7%	21.0%	197	9.2%	34.1%	577	3.8%	100.0%
	Total	9,585	100.0%	63.9%	3,263	100.0%	21.8%	2,147	100.0%	14.3%	14,995	100.0%	100.0%

Table D-26: Commercial Highest Number of Exports over any 12-Bill Period by Third-Party Ownership and PA

Third-Party Ownership / Maximum Number of Exports over 12-Billing-Period Interval		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent
Host Owned	**1-3**	62	26.6%	80.5%	12	24.5%	15.6%	3	13.6%	3.9%	77	25.3%	100.0%
	4-6	79	33.9%	75.2%	17	34.7%	16.2%	9	40.9%	8.6%	105	34.5%	100.0%
	7-9	72	30.9%	80.9%	12	24.5%	13.5%	5	22.7%	5.6%	89	29.3%	100.0%
	10-12	20	8.6%	60.6%	8	16.3%	24.2%	5	22.7%	15.2%	33	10.9%	100.0%
Third Party Owned	**1-3**	15	27.3%	93.8%	1	7.1%	6.3%	.	.	.	16	22.5%	100.0%
	4-6	24	43.6%	72.7%	8	57.1%	24.2%	1	50.0%	3.0%	33	46.5%	100.0%
	7-9	14	25.5%	77.8%	3	21.4%	16.7%	1	50.0%	5.6%	18	25.4%	100.0%
	10-12	2	3.6%	50.0%	2	14.3%	50.0%	.	.	.	4	5.6%	100.0%
Total	**1-3**	77	26.7%	82.8%	13	20.6%	14.0%	3	12.5%	3.2%	93	24.8%	100.0%
	4-6	103	35.8%	74.6%	25	39.7%	18.1%	10	41.7%	7.2%	138	36.8%	100.0%
	7-9	86	29.9%	80.4%	15	23.8%	14.0%	6	25.0%	5.6%	107	28.5%	100.0%
	10-12	22	7.6%	59.5%	10	15.9%	27.0%	5	20.8%	13.5%	37	9.9%	100.0%
	Total	288	100.0%	76.8%	63	100.0%	16.8%	24	100.0%	6.4%	375	100.0%	100.0%

Table D-27: Gov./Non-Profit Highest Number of Exports over any 12-Bill Period by Third-Party Ownership and PA

Third-Party Ownership / Maximum Number of Exports over 12-Billing-Period Interval		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent
Host Owned	**1-3**	19	26.0%	76.0%	2	10.0%	8.0%	4	50.0%	16.0%	25	24.8%	100.0%
	4-6	27	37.0%	69.2%	9	45.0%	23.1%	3	37.5%	7.7%	39	38.6%	100.0%
	7-9	21	28.8%	80.8%	5	25.0%	19.2%	.	.	.	26	25.7%	100.0%
	10-12	6	8.2%	54.5%	4	20.0%	36.4%	1	12.5%	9.1%	11	10.9%	100.0%
Third Party Owned	**1-3**	13	40.6%	100.0%	.	.	.	.	.	.	13	33.3%	100.0%
	4-6	13	40.6%	81.3%	2	66.7%	12.5%	1	25.0%	6.3%	16	41.0%	100.0%
	7-9	6	18.8%	85.7%	1	33.3%	14.3%	.	.	.	7	17.9%	100.0%
	10-12	.	.	.	.	.	.	3	75.0%	100.0%	3	7.7%	100.0%
Total	**1-3**	32	30.5%	84.2%	2	8.7%	5.3%	4	33.3%	10.5%	38	27.1%	100.0%
	4-6	40	38.1%	72.7%	11	47.8%	20.0%	4	33.3%	7.3%	55	39.3%	100.0%
	7-9	27	25.7%	81.8%	6	26.1%	18.2%	.	.	.	33	23.6%	100.0%
	10-12	6	5.7%	42.9%	4	17.4%	28.6%	4	33.3%	28.6%	14	10.0%	100.0%
	Total	105	100.0%	75.0%	23	100.0%	16.4%	12	100.0%	8.6%	140	100.0%	100.0%

Table D-28: Residential Highest Number of Exports over any 12-Bill Period by System Size and PA

System Size / Maximum Number of Exports over 12-Billing-Period Interval		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent
0-2.5 kW	**1-3**	520	38.0%	70.7%	115	39.8%	15.6%	100	36.6%	13.6%	735	38.0%	100.0%
	4-6	462	33.7%	73.8%	80	27.7%	12.8%	84	30.8%	13.4%	626	32.4%	100.0%
	7-9	338	24.7%	71.8%	76	26.3%	16.1%	57	20.9%	12.1%	471	24.4%	100.0%
	10-12	50	3.6%	50.0%	18	6.2%	18.0%	32	11.7%	32.0%	100	5.2%	100.0%
2.5-4 kW	**1-3**	1,333	44.0%	68.5%	406	44.2%	20.9%	206	30.2%	10.6%	1,945	42.0%	100.0%
	4-6	1,032	34.0%	66.9%	292	31.8%	18.9%	219	32.1%	14.2%	1,543	33.3%	100.0%
	7-9	581	19.2%	61.0%	182	19.8%	19.1%	189	27.7%	19.9%	952	20.6%	100.0%
	10-12	85	2.8%	44.5%	38	4.1%	19.9%	68	10.0%	35.6%	191	4.1%	100.0%
4-7.5 kW	**1-3**	1,829	47.3%	65.8%	669	42.5%	24.1%	282	28.9%	10.1%	2,780	43.3%	100.0%
	4-6	1,348	34.9%	59.2%	562	35.7%	24.7%	368	37.7%	16.2%	2,278	35.5%	100.0%
	7-9	598	15.5%	52.5%	289	18.4%	25.4%	251	25.7%	22.1%	1,138	17.7%	100.0%
	10-12	91	2.4%	41.6%	54	3.4%	24.7%	74	7.6%	33.8%	219	3.4%	100.0%
7.5+ kW	**1-3**	517	39.2%	67.0%	206	42.7%	26.7%	49	22.6%	6.3%	772	38.3%	100.0%
	4-6	521	39.5%	67.7%	166	34.4%	21.6%	83	38.2%	10.8%	770	38.2%	100.0%
	7-9	247	18.7%	60.5%	99	20.5%	24.3%	62	28.6%	15.2%	408	20.2%	100.0%
	10-12	33	2.5%	49.3%	11	2.3%	16.4%	23	10.6%	34.3%	67	3.3%	100.0%
Total	**1-3**	4,199	43.8%	67.4%	1,396	42.8%	22.4%	637	29.7%	10.2%	6,232	41.6%	100.0%
	4-6	3,363	35.1%	64.5%	1,100	33.7%	21.1%	754	35.1%	14.5%	5,217	34.8%	100.0%
	7-9	1,764	18.4%	59.4%	646	19.8%	21.8%	559	26.0%	18.8%	2,969	19.8%	100.0%
	10-12	259	2.7%	44.9%	121	3.7%	21.0%	197	9.2%	34.1%	577	3.8%	100.0%
	Total	9,585	100.0%	63.9%	3,263	100.0%	21.8%	2,147	100.0%	14.3%	14,995	100.0%	100.0%

Table D-29: Commercial Highest Number of Exports over any 12-Bill Period by System Size and PA

System Size / Maximum Number of Exports over 12-Billing-Period Interval		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent
0-5 kW	**1-3**	13	22.4%	92.9%	1	8.3%	7.1%	.	.	.	14	18.4%	100.0%
	4-6	15	25.9%	71.4%	4	33.3%	19.0%	2	33.3%	9.5%	21	27.6%	100.0%
	7-9	20	34.5%	80.0%	4	33.3%	16.0%	1	16.7%	4.0%	25	32.9%	100.0%
	10-12	10	17.2%	62.5%	3	25.0%	18.8%	3	50.0%	18.8%	16	21.1%	100.0%
5-10 kW	**1-3**	14	23.7%	70.0%	5	50.0%	25.0%	1	50.0%	5.0%	20	28.2%	100.0%
	4-6	19	32.2%	79.2%	4	40.0%	16.7%	1	50.0%	4.2%	24	33.8%	100.0%
	7-9	22	37.3%	95.7%	1	10.0%	4.3%	.	.	.	23	32.4%	100.0%
	10-12	4	6.8%	100.0%	.	.	.	.	.	.	4	5.6%	100.0%
10-25 kW	**1-3**	25	42.4%	89.3%	2	10.0%	7.1%	1	10.0%	3.6%	28	31.5%	100.0%
	4-6	12	20.3%	46.2%	10	50.0%	38.5%	4	40.0%	15.4%	26	29.2%	100.0%
	7-9	19	32.2%	65.5%	7	35.0%	24.1%	3	30.0%	10.3%	29	32.6%	100.0%
	10-12	3	5.1%	50.0%	1	5.0%	16.7%	2	20.0%	33.3%	6	6.7%	100.0%
25+ kW	**1-3**	25	22.3%	80.6%	5	23.8%	16.1%	1	16.7%	3.2%	31	22.3%	100.0%
	4-6	57	50.9%	85.1%	7	33.3%	10.4%	3	50.0%	4.5%	67	48.2%	100.0%
	7-9	25	22.3%	83.3%	3	14.3%	10.0%	2	33.3%	6.7%	30	21.6%	100.0%
	10-12	5	4.5%	45.5%	6	28.6%	54.5%	.	.	.	11	7.9%	100.0%
Total	**1-3**	77	26.7%	82.8%	13	20.6%	14.0%	3	12.5%	3.2%	93	24.8%	100.0%
	4-6	103	35.8%	74.6%	25	39.7%	18.1%	10	41.7%	7.2%	138	36.8%	100.0%
	7-9	86	29.9%	80.4%	15	23.8%	14.0%	6	25.0%	5.6%	107	28.5%	100.0%
	10-12	22	7.6%	59.5%	10	15.9%	27.0%	5	20.8%	13.5%	37	9.9%	100.0%
	Total	288	100.0%	76.8%	63	100.0%	16.8%	24	100.0%	6.4%	375	100.0%	100.0%

Table D-30: Gov./Non-Profit Highest Number of Exports over any 12-Bill Period by System Size and PA

System Size / Maximum Number of Exports over 12-Billing-Period Interval		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent	Sites	Export Months Percent	PA Percent
0-5 kW	**1-3**	2	10.5%	50.0%	.	.	.	2	50.0%	50.0%	4	14.3%	100.0%
	4-6	6	31.6%	66.7%	2	40.0%	22.2%	1	25.0%	11.1%	9	32.1%	100.0%
	7-9	6	31.6%	85.7%	1	20.0%	14.3%	.	.	.	7	25.0%	100.0%
	10-12	5	26.3%	62.5%	2	40.0%	25.0%	1	25.0%	12.5%	8	28.6%	100.0%
5-10 kW	**1-3**	7	46.7%	87.5%	1	33.3%	12.5%	.	.	.	8	44.4%	100.0%
	4-6	3	20.0%	75.0%	1	33.3%	25.0%	.	.	.	4	22.2%	100.0%
	7-9	5	33.3%	83.3%	1	33.3%	16.7%	.	.	.	6	33.3%	100.0%
10-25 kW	**1-3**	5	22.7%	71.4%	1	10.0%	14.3%	1	50.0%	14.3%	7	20.6%	100.0%
	4-6	9	40.9%	56.3%	6	60.0%	37.5%	1	50.0%	6.3%	16	47.1%	100.0%
	7-9	7	31.8%	77.8%	2	20.0%	22.2%	.	.	.	9	26.5%	100.0%
	10-12	1	4.5%	50.0%	1	10.0%	50.0%	.	.	.	2	5.9%	100.0%
25+ kW	**1-3**	18	36.7%	94.7%	.	.	.	1	16.7%	5.3%	19	31.7%	100.0%
	4-6	22	44.9%	84.6%	2	40.0%	7.7%	2	33.3%	7.7%	26	43.3%	100.0%
	7-9	9	18.4%	81.8%	2	40.0%	18.2%	.	.	.	11	18.3%	100.0%
	10-12	.	.	.	1	20.0%	25.0%	3	50.0%	75.0%	4	6.7%	100.0%
Total	**1-3**	32	30.5%	84.2%	2	8.7%	5.3%	4	33.3%	10.5%	38	27.1%	100.0%
	4-6	40	38.1%	72.7%	11	47.8%	20.0%	4	33.3%	7.3%	55	39.3%	100.0%
	7-9	27	25.7%	81.8%	6	26.1%	18.2%	.	.	.	33	23.6%	100.0%
	10-12	6	5.7%	42.9%	4	17.4%	28.6%	4	33.3%	28.6%	14	10.0%	100.0%
	Total	105	100.0%	75.0%	23	100.0%	16.4%	12	100.0%	8.6%	140	100.0%	100.0%

Table D-31: Residential Frequency of Sites with Annual Net Export by Incentive Type, Location, and PA

Incentive Type / Location		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
EPBB	**Coastal**	10,961	1,163	10.6%	2,157	199	9.2%	2,571	388	15.1%	15,689	1,750	11.2%
	Inland	8,394	575	6.9%	7,541	557	7.4%	2,272	349	15.4%	18,207	1,481	8.1%
	Total	19,355	1,738	9.0%	9,698	756	7.8%	4,843	737	15.2%	33,896	3,231	9.5%
FiveYearPBI	**Coastal**	22	3	13.6%	8	0	0.0%	68	31	45.6%	98	34	34.7%
	Inland	54	3	5.6%	167	15	9.0%	51	19	37.3%	272	37	13.6%
	Total	76	6	7.9%	175	15	8.6%	119	50	42.0%	370	71	19.2%
Total	**Coastal**	10,983	1,166	10.6%	2,165	199	9.2%	2,639	419	15.9%	15,787	1,784	11.3%
	Inland	8,448	578	6.8%	7,708	572	7.4%	2,323	368	15.8%	18,479	1,518	8.2%
	Total	19,431	1,744	9.0%	9,873	771	7.8%	4,962	787	15.9%	34,266	3,302	9.6%

Table D-32: Commercial Frequency of Sites with Annual Net Export by Incentive Type, Location, and PA

Incentive Type / Location		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
EPBB	**Coastal**	268	46	17.2%	32	4	12.5%	32	7	21.9%	332	57	17.2%
	Inland	183	33	18.0%	140	20	14.3%	17	5	29.4%	340	58	17.1%
	Total	451	79	17.5%	172	24	14.0%	49	12	24.5%	672	115	17.1%
FiveYearPBI	**Coastal**	69	12	17.4%	22	0	0.0%	16	0	0.0%	107	12	11.2%
	Inland	89	5	5.6%	156	4	2.6%	10	0	0.0%	255	9	3.5%
	Total	158	17	10.8%	178	4	2.2%	26	0	0.0%	362	21	5.8%
Total	**Coastal**	337	58	17.2%	54	4	7.4%	48	7	14.6%	439	69	15.7%
	Inland	272	38	14.0%	296	24	8.1%	27	5	18.5%	595	67	11.3%
	Total	609	96	15.8%	350	28	8.0%	75	12	16.0%	1,034	136	13.2%

Table D-33: Gov./Non-Profit Frequency of Sites with Annual Net Export by Incentive Type, Location, and PA

Incentive Type / Location		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
EPBB	**Coastal**	164	15	9.1%	31	6	19.4%	11	0	0.0%	206	21	10.2%
	Inland	51	5	9.8%	51	6	11.8%	10	1	10.0%	112	12	10.7%
	Total	215	20	9.3%	82	12	14.6%	21	1	4.8%	318	33	10.4%
FiveYearPBI	**Coastal**	53	3	5.7%	8	1	12.5%	5	0	0.0%	66	4	6.1%
	Inland	26	3	11.5%	30	1	3.3%	4	3	75.0%	60	7	11.7%
	Total	79	6	7.6%	38	2	5.3%	9	3	33.3%	126	11	8.7%
Total	**Coastal**	217	18	8.3%	39	7	17.9%	16	0	0.0%	272	25	9.2%
	Inland	77	8	10.4%	81	7	8.6%	14	4	28.6%	172	19	11.0%
	Total	294	26	8.8%	120	14	11.7%	30	4	13.3%	444	44	9.9%

Table D-34: Residential Frequency of Sites with Annual Net Export by Incentive Type, Third-Party Ownership, and PA

Incentive Type / Third-Party Ownership		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
EPBB	**Host Owned**	16,379	1,610	9.8%	7,830	667	8.5%	4,283	701	16.4%	28,492	2,978	10.5%
	Third Party Owned	2,976	128	4.3%	1,868	89	4.8%	560	36	6.4%	5,404	253	4.7%
	Total	19,355	1,738	9.0%	9,698	756	7.8%	4,843	737	15.2%	33,896	3,231	9.5%
FiveYearPBI	**Host Owned**	74	6	8.1%	171	15	8.8%	119	50	42.0%	364	71	19.5%
	Third Party Owned	2	0	0.0%	4	0	0.0%	.	.	.	6	0	0.0%
	Total	76	6	7.9%	175	15	8.6%	119	50	42.0%	370	71	19.2%
Total	**Host Owned**	16,453	1,616	9.8%	8,001	682	8.5%	4,402	751	17.1%	28,856	3,049	10.6%
	Third Party Owned	2,978	128	4.3%	1,872	89	4.8%	560	36	6.4%	5,410	253	4.7%
	Total	19,431	1,744	9.0%	9,873	771	7.8%	4,962	787	15.9%	34,266	3,302	9.6%

Table D-35: Commercial Frequency of Sites with Annual Net Export by Incentive Type, Third-Party Ownership, and PA

Incentive Type / Third-Party Ownership		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
EPBB	**Host Owned**	386	68	17.6%	158	23	14.6%	44	11	25.0%	588	102	17.3%
	Third Party Owned	65	11	16.9%	14	1	7.1%	5	1	20.0%	84	13	15.5%
	Total	451	79	17.5%	172	24	14.0%	49	12	24.5%	672	115	17.1%
FiveYearPBI	**Host Owned**	84	9	10.7%	66	1	1.5%	14	0	0.0%	164	10	6.1%
	Third Party Owned	74	8	10.8%	112	3	2.7%	12	0	0.0%	198	11	5.6%
	Total	158	17	10.8%	178	4	2.2%	26	0	0.0%	362	21	5.8%
Total	**Host Owned**	470	77	16.4%	224	24	10.7%	58	11	19.0%	752	112	14.9%
	Third Party Owned	139	19	13.7%	126	4	3.2%	17	1	5.9%	282	24	8.5%
	Total	609	96	15.8%	350	28	8.0%	75	12	16.0%	1,034	136	13.2%

Table D-36: Gov./Non-Profit Frequency of Sites with Annual Net Export by Incentive Type, Third-Party Ownership, and PA

Incentive Type / Third-Party Ownership		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
EPBB	**Host Owned**	193	19	9.8%	78	11	14.1%	21	1	4.8%	292	31	10.6%
	Third Party Owned	22	1	4.5%	4	1	25.0%	.	.	.	26	2	7.7%
	Total	215	20	9.3%	82	12	14.6%	21	1	4.8%	318	33	10.4%
FiveYearPBI	**Host Owned**	46	0	0.0%	26	1	3.8%	3	0	0.0%	75	1	1.3%
	Third Party Owned	33	6	18.2%	12	1	8.3%	6	3	50.0%	51	10	19.6%
	Total	79	6	7.6%	38	2	5.3%	9	3	33.3%	126	11	8.7%
Total	**Host Owned**	239	19	7.9%	104	12	11.5%	24	1	4.2%	367	32	8.7%
	Third Party Owned	55	7	12.7%	16	2	12.5%	6	3	50.0%	77	12	15.6%
	Total	294	26	8.8%	120	14	11.7%	30	4	13.3%	444	44	9.9%

Table D-37: Residential Frequency of Sites with Annual Net Export by Incentive Type, System Size, and PA

Incentive Type / System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
EPBB	**0-2.5 kW**	3,156	332	10.5%	1,823	92	5.0%	952	77	8.1%	5,931	501	8.4%
	2.5-4 kW	6,114	546	8.9%	2,865	211	7.4%	1,493	233	15.6%	10,472	990	9.5%
	4-7.5 kW	7,843	595	7.6%	3,932	345	8.8%	1,961	333	17.0%	13,736	1,273	9.3%
	7.5+ kW	2,242	265	11.8%	1,078	108	10.0%	437	94	21.5%	3,757	467	12.4%
	Total	19,355	1,738	9.0%	9,698	756	7.8%	4,843	737	15.2%	33,896	3,231	9.5%
FiveYearPBI	**0-2.5 kW**	3	0	0.0%	5	0	0.0%	10	6	60.0%	18	6	33.3%
	2.5-4 kW	18	1	5.6%	25	3	12.0%	35	14	40.0%	78	18	23.1%
	4-7.5 kW	33	3	9.1%	92	8	8.7%	56	23	41.1%	181	34	18.8%
	7.5+ kW	22	2	9.1%	53	4	7.5%	18	7	38.9%	93	13	14.0%
	Total	76	6	7.9%	175	15	8.6%	119	50	42.0%	370	71	19.2%
Total	**0-2.5 kW**	3,159	332	10.5%	1,828	92	5.0%	962	83	8.6%	5,949	507	8.5%
	2.5-4 kW	6,132	547	8.9%	2,890	214	7.4%	1,528	247	16.2%	10,550	1,008	9.6%
	4-7.5 kW	7,876	598	7.6%	4,024	353	8.8%	2,017	356	17.6%	13,917	1,307	9.4%
	7.5+ kW	2,264	267	11.8%	1,131	112	9.9%	455	101	22.2%	3,850	480	12.5%
	Total	19,431	1,744	9.0%	9,873	771	7.8%	4,962	787	15.9%	34,266	3,302	9.6%

Table D-38: Commercial Frequency of Sites with Annual Net Export by Incentive Type, System Size, and PA

Incentive Type / System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
EPBB	**0-5 kW**	118	23	19.5%	43	7	16.3%	18	5	27.8%	179	35	19.6%
	5-10 kW	112	21	18.8%	42	2	4.8%	6	0	0.0%	160	23	14.4%
	10-25 kW	112	20	17.9%	52	11	21.2%	15	5	33.3%	179	36	20.1%
	25+ kW	109	15	13.8%	35	4	11.4%	10	2	20.0%	154	21	13.6%
	Total	451	79	17.5%	172	24	14.0%	49	12	24.5%	672	115	17.1%
FiveYearPBI	**0-5 kW**	1	1	100.0%	1	0	0.0%	.	.	.	2	1	50.0%
	5-10 kW	1	0	0.0%	4	0	0.0%	.	.	.	5	0	0.0%
	10-25 kW	12	2	16.7%	6	0	0.0%	2	0	0.0%	20	2	10.0%
	25+ kW	144	14	9.7%	167	4	2.4%	24	0	0.0%	335	18	5.4%
	Total	158	17	10.8%	178	4	2.2%	26	0	0.0%	362	21	5.8%
Total	**0-5 kW**	119	24	20.2%	44	7	15.9%	18	5	27.8%	181	36	19.9%
	5-10 kW	113	21	18.6%	46	2	4.3%	6	0	0.0%	165	23	13.9%
	10-25 kW	124	22	17.7%	58	11	19.0%	17	5	29.4%	199	38	19.1%
	25+ kW	253	29	11.5%	202	8	4.0%	34	2	5.9%	489	39	8.0%
	Total	609	96	15.8%	350	28	8.0%	75	12	16.0%	1,034	136	13.2%

Table D-39: Gov./Non-Profit Frequency of Sites with Annual Net Export by Incentive Type, System Size, and PA

Incentive Type / System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
EPBB	**0-5 kW**	75	10	13.3%	19	3	15.8%	9	1	11.1%	103	14	13.6%
	5-10 kW	40	3	7.5%	17	2	11.8%	3	0	0.0%	60	5	8.3%
	10-25 kW	52	7	13.5%	29	5	17.2%	6	0	0.0%	87	12	13.8%
	25+ kW	48	0	0.0%	17	2	11.8%	3	0	0.0%	68	2	2.9%
	Total	215	20	9.3%	82	12	14.6%	21	1	4.8%	318	33	10.4%
FiveYearPBI	**5-10 kW**	1	0	0.0%	.	.	.	.	.	.	1	0	0.0%
	10-25 kW	4	0	0.0%	2	0	0.0%	.	.	.	6	0	0.0%
	25+ kW	74	6	8.1%	36	2	5.6%	9	3	33.3%	119	11	9.2%
	Total	79	6	7.6%	38	2	5.3%	9	3	33.3%	126	11	8.7%
Total	**0-5 kW**	75	10	13.3%	19	3	15.8%	9	1	11.1%	103	14	13.6%
	5-10 kW	41	3	7.3%	17	2	11.8%	3	0	0.0%	61	5	8.2%
	10-25 kW	56	7	12.5%	31	5	16.1%	6	0	0.0%	93	12	12.9%
	25+ kW	122	6	4.9%	53	4	7.5%	12	3	25.0%	187	13	7.0%
	Total	294	26	8.8%	120	14	11.7%	30	4	13.3%	444	44	9.9%

Table D-40: Residential Frequency of Sites with Annual Net Export by Location, Third-Party Ownership, and PA

Location / Third-Party Ownership		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
Coastal	**Host Owned**	9,513	1,095	11.5%	1,825	178	9.8%	2,365	405	17.1%	13,703	1,678	12.2%
	Third Party Owned	1,470	71	4.8%	340	21	6.2%	274	14	5.1%	2,084	106	5.1%
	Total	10,983	1,166	10.6%	2,165	199	9.2%	2,639	419	15.9%	15,787	1,784	11.3%
Inland	**Host Owned**	6,940	521	7.5%	6,176	504	8.2%	2,037	346	17.0%	15,153	1,371	9.0%
	Third Party Owned	1,508	57	3.8%	1,532	68	4.4%	286	22	7.7%	3,326	147	4.4%
	Total	8,448	578	6.8%	7,708	572	7.4%	2,323	368	15.8%	18,479	1,518	8.2%
Total	**Host Owned**	16,453	1,616	9.8%	8,001	682	8.5%	4,402	751	17.1%	28,856	3,049	10.6%
	Third Party Owned	2,978	128	4.3%	1,872	89	4.8%	560	36	6.4%	5,410	253	4.7%
	Total	19,431	1,744	9.0%	9,873	771	7.8%	4,962	787	15.9%	34,266	3,302	9.6%

Table D-41: Commercial Frequency of Sites with Annual Net Export by Location, Third-Party Ownership, and PA

Location / Third-Party Ownership		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
Coastal	**Host Owned**	267	47	17.6%	39	4	10.3%	39	7	17.9%	345	58	16.8%
	Third Party Owned	70	11	15.7%	15	0	0.0%	9	0	0.0%	94	11	11.7%
	Total	337	58	17.2%	54	4	7.4%	48	7	14.6%	439	69	15.7%
Inland	**Host Owned**	203	30	14.8%	185	20	10.8%	19	4	21.1%	407	54	13.3%
	Third Party Owned	69	8	11.6%	111	4	3.6%	8	1	12.5%	188	13	6.9%
	Total	272	38	14.0%	296	24	8.1%	27	5	18.5%	595	67	11.3%
Total	**Host Owned**	470	77	16.4%	224	24	10.7%	58	11	19.0%	752	112	14.9%
	Third Party Owned	139	19	13.7%	126	4	3.2%	17	1	5.9%	282	24	8.5%
	Total	609	96	15.8%	350	28	8.0%	75	12	16.0%	1,034	136	13.2%

Table D-42: Gov./Non-Profit Frequency of Sites with Annual Net Export by Location, Third-Party Ownership, and PA

Location / Third-Party Ownership		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
Coastal	Host Owned	175	14	8.0%	34	7	20.6%	14	0	0.0%	223	21	9.4%
	Third Party Owned	42	4	9.5%	5	0	0.0%	2	0	0.0%	49	4	8.2%
	Total	217	18	8.3%	39	7	17.9%	16	0	0.0%	272	25	9.2%
Inland	Host Owned	64	5	7.8%	70	5	7.1%	10	1	10.0%	144	11	7.6%
	Third Party Owned	13	3	23.1%	11	2	18.2%	4	3	75.0%	28	8	28.6%
	Total	77	8	10.4%	81	7	8.6%	14	4	28.6%	172	19	11.0%
Total	Host Owned	239	19	7.9%	104	12	11.5%	24	1	4.2%	367	32	8.7%
	Third Party Owned	55	7	12.7%	16	2	12.5%	6	3	50.0%	77	12	15.6%
	Total	294	26	8.8%	120	14	11.7%	30	4	13.3%	444	44	9.9%

Table D-43: Residential Frequency of Sites with Annual Net Export by Location, System Size, and PA

Location / System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
Coastal	**0-2.5 kW**	2,362	285	12.1%	504	34	6.7%	641	66	10.3%	3,507	385	11.0%
	2.5-4 kW	3,915	429	11.0%	743	79	10.6%	921	169	18.3%	5,579	677	12.1%
	4-7.5 kW	3,794	322	8.5%	753	77	10.2%	934	161	17.2%	5,481	560	10.2%
	7.5+ kW	912	130	14.3%	165	9	5.5%	143	23	16.1%	1,220	162	13.3%
	Total	10,983	1,166	10.6%	2,165	199	9.2%	2,639	419	15.9%	15,787	1,784	11.3%
Inland	**0-2.5 kW**	797	47	5.9%	1,324	58	4.4%	321	17	5.3%	2,442	122	5.0%
	2.5-4 kW	2,217	118	5.3%	2,147	135	6.3%	607	78	12.9%	4,971	331	6.7%
	4-7.5 kW	4,082	276	6.8%	3,271	276	8.4%	1,083	195	18.0%	8,436	747	8.9%
	7.5+ kW	1,352	137	10.1%	966	103	10.7%	312	78	25.0%	2,630	318	12.1%
	Total	8,448	578	6.8%	7,708	572	7.4%	2,323	368	15.8%	18,479	1,518	8.2%
Total	**0-2.5 kW**	3,159	332	10.5%	1,828	92	5.0%	962	83	8.6%	5,949	507	8.5%
	2.5-4 kW	6,132	547	8.9%	2,890	214	7.4%	1,528	247	16.2%	10,550	1,008	9.6%
	4-7.5 kW	7,876	598	7.6%	4,024	353	8.8%	2,017	356	17.6%	13,917	1,307	9.4%
	7.5+ kW	2,264	267	11.8%	1,131	112	9.9%	455	101	22.2%	3,850	480	12.5%
	Total	19,431	1,744	9.0%	9,873	771	7.8%	4,962	787	15.9%	34,266	3,302	9.6%

Table D-44: Commercial Frequency of Sites with Annual Net Export by Location, System Size, and PA

Location / System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
Coastal	**0-5 kW**	71	15	21.1%	7	1	14.3%	15	4	26.7%	93	20	21.5%
	5-10 kW	58	10	17.2%	14	1	7.1%	3	0	0.0%	75	11	14.7%
	10-25 kW	74	14	18.9%	9	2	22.2%	9	1	11.1%	92	17	18.5%
	25+ kW	134	19	14.2%	24	0	0.0%	21	2	9.5%	179	21	11.7%
	Total	337	58	17.2%	54	4	7.4%	48	7	14.6%	439	69	15.7%
Inland	**0-5 kW**	48	9	18.8%	37	6	16.2%	3	1	33.3%	88	16	18.2%
	5-10 kW	55	11	20.0%	32	1	3.1%	3	0	0.0%	90	12	13.3%
	10-25 kW	50	8	16.0%	49	9	18.4%	8	4	50.0%	107	21	19.6%
	25+ kW	119	10	8.4%	178	8	4.5%	13	0	0.0%	310	18	5.8%
	Total	272	38	14.0%	296	24	8.1%	27	5	18.5%	595	67	11.3%
Total	**0-5 kW**	119	24	20.2%	44	7	15.9%	18	5	27.8%	181	36	19.9%
	5-10 kW	113	21	18.6%	46	2	4.3%	6	0	0.0%	165	23	13.9%
	10-25 kW	124	22	17.7%	58	11	19.0%	17	5	29.4%	199	38	19.1%
	25+ kW	253	29	11.5%	202	8	4.0%	34	2	5.9%	489	39	8.0%
	Total	609	96	15.8%	350	28	8.0%	75	12	16.0%	1,034	136	13.2%

Table D-45: Gov./Non-Profit Frequency of Sites with Annual Net Export by Location, System Size, and PA

Location / System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
Coastal	**0-5 kW**	54	10	18.5%	6	2	33.3%	3	0	0.0%	63	12	19.0%
	5-10 kW	32	2	6.3%	8	2	25.0%	2	0	0.0%	42	4	9.5%
	10-25 kW	45	3	6.7%	9	1	11.1%	4	0	0.0%	58	4	6.9%
	25+ kW	86	3	3.5%	16	2	12.5%	7	0	0.0%	109	5	4.6%
	Total	217	18	8.3%	39	7	17.9%	16	0	0.0%	272	25	9.2%
Inland	**0-5 kW**	21	0	0.0%	13	1	7.7%	6	1	16.7%	40	2	5.0%
	5-10 kW	9	1	11.1%	9	0	0.0%	1	0	0.0%	19	1	5.3%
	10-25 kW	11	4	36.4%	22	4	18.2%	2	0	0.0%	35	8	22.9%
	25+ kW	36	3	8.3%	37	2	5.4%	5	3	60.0%	78	8	10.3%
	Total	77	8	10.4%	81	7	8.6%	14	4	28.6%	172	19	11.0%
Total	**0-5 kW**	75	10	13.3%	19	3	15.8%	9	1	11.1%	103	14	13.6%
	5-10 kW	41	3	7.3%	17	2	11.8%	3	0	0.0%	61	5	8.2%
	10-25 kW	56	7	12.5%	31	5	16.1%	6	0	0.0%	93	12	12.9%
	25+ kW	122	6	4.9%	53	4	7.5%	12	3	25.0%	187	13	7.0%
	Total	294	26	8.8%	120	14	11.7%	30	4	13.3%	444	44	9.9%

Table D-46: Residential Frequency of Sites with Annual Net Export by Third-Party Ownership, System Size, and PA

Third-Party Ownership / System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
Host Owned	**0-2.5 kW**	2,786	309	11.1%	1,649	87	5.3%	895	79	8.8%	5,330	475	8.9%
	2.5-4 kW	5,244	516	9.8%	2,331	197	8.5%	1,338	238	17.8%	8,913	951	10.7%
	4-7.5 kW	6,516	552	8.5%	3,114	307	9.9%	1,758	340	19.3%	11,388	1,199	10.5%
	7.5+ kW	1,907	239	12.5%	907	91	10.0%	411	94	22.9%	3,225	424	13.1%
	Total	16,453	1,616	9.8%	8,001	682	8.5%	4,402	751	17.1%	28,856	3,049	10.6%
Third Party Owned	**0-2.5 kW**	373	23	6.2%	179	5	2.8%	67	4	6.0%	619	32	5.2%
	2.5-4 kW	888	31	3.5%	559	17	3.0%	190	9	4.7%	1,637	57	3.5%
	4-7.5 kW	1,360	46	3.4%	910	46	5.1%	259	16	6.2%	2,529	108	4.3%
	7.5+ kW	357	28	7.8%	224	21	9.4%	44	7	15.9%	625	56	9.0%
	Total	2,978	128	4.3%	1,872	89	4.8%	560	36	6.4%	5,410	253	4.7%
Total	**0-2.5 kW**	3,159	332	10.5%	1,828	92	5.0%	962	83	8.6%	5,949	507	8.5%
	2.5-4 kW	6,132	547	8.9%	2,890	214	7.4%	1,528	247	16.2%	10,550	1,008	9.6%
	4-7.5 kW	7,876	598	7.6%	4,024	353	8.8%	2,017	356	17.6%	13,917	1,307	9.4%
	7.5+ kW	2,264	267	11.8%	1,131	112	9.9%	455	101	22.2%	3,850	480	12.5%
	Total	19,431	1,744	9.0%	9,873	771	7.8%	4,962	787	15.9%	34,266	3,302	9.6%

Table D-47: Commercial Frequency of Sites with Annual Net Export by Third-Party Ownership, System Size, and PA

Third-Party Ownership / System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
Host Owned	**0-5 kW**	109	23	21.1%	40	7	17.5%	18	5	27.8%	167	35	21.0%
	5-10 kW	103	19	18.4%	42	2	4.8%	4	0	0.0%	149	21	14.1%
	10-25 kW	104	18	17.3%	52	10	19.2%	14	4	28.6%	170	32	18.8%
	25+ kW	154	17	11.0%	90	5	5.6%	22	2	9.1%	266	24	9.0%
	Total	470	77	16.4%	224	24	10.7%	58	11	19.0%	752	112	14.9%
Third Party Owned	**0-5 kW**	10	1	10.0%	4	0	0.0%	.	.	.	14	1	7.1%
	5-10 kW	10	2	20.0%	4	0	0.0%	2	0	0.0%	16	2	12.5%
	10-25 kW	20	4	20.0%	6	1	16.7%	3	1	33.3%	29	6	20.7%
	25+ kW	99	12	12.1%	112	3	2.7%	12	0	0.0%	223	15	6.7%
	Total	139	19	13.7%	126	4	3.2%	17	1	5.9%	282	24	8.5%
Total	**0-5 kW**	119	24	20.2%	44	7	15.9%	18	5	27.8%	181	36	19.9%
	5-10 kW	113	21	18.6%	46	2	4.3%	6	0	0.0%	165	23	13.9%
	10-25 kW	124	22	17.7%	58	11	19.0%	17	5	29.4%	199	38	19.1%
	25+ kW	253	29	11.5%	202	8	4.0%	34	2	5.9%	489	39	8.0%
	Total	609	96	15.8%	350	28	8.0%	75	12	16.0%	1,034	136	13.2%

Table D-48: Gov./Non-Profit Frequency of Sites with Annual Net Export by Third-Party Ownership, System Size, and PA

Third-Party Ownership / System Size		Program Administrator									Total		
		PG&E			SCE			CCSE					
		Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export	Total Sites	Sites with Any Bill Export	Percent with Any Bill Export
Host Owned	**0-5 kW**	68	9	13.2%	18	3	16.7%	9	1	11.1%	95	13	13.7%
	5-10 kW	39	3	7.7%	17	2	11.8%	3	0	0.0%	59	5	8.5%
	10-25 kW	51	7	13.7%	29	4	13.8%	6	0	0.0%	86	11	12.8%
	25+ kW	81	0	0.0%	40	3	7.5%	6	0	0.0%	127	3	2.4%
	Total	239	19	7.9%	104	12	11.5%	24	1	4.2%	367	32	8.7%
Third Party Owned	**0-5 kW**	7	1	14.3%	1	0	0.0%	.	.	.	8	1	12.5%
	5-10 kW	2	0	0.0%	.	.	.	.	.	.	2	0	0.0%
	10-25 kW	5	0	0.0%	2	1	50.0%	.	.	.	7	1	14.3%
	25+ kW	41	6	14.6%	13	1	7.7%	6	3	50.0%	60	10	16.7%
	Total	55	7	12.7%	16	2	12.5%	6	3	50.0%	77	12	15.6%
Total	**0-5 kW**	75	10	13.3%	19	3	15.8%	9	1	11.1%	103	14	13.6%
	5-10 kW	41	3	7.3%	17	2	11.8%	3	0	0.0%	61	5	8.2%
	10-25 kW	56	7	12.5%	31	5	16.1%	6	0	0.0%	93	12	12.9%
	25+ kW	122	6	4.9%	53	4	7.5%	12	3	25.0%	187	13	7.0%
	Total	294	26	8.8%	120	14	11.7%	30	4	13.3%	444	44	9.9%

Appendix E

Detailed Tables on Export Magnitude and Timing

This appendix complements Section 7 by providing additional cross tabulations of summaries of export timing and magnitude. The additional cross tabulations include the incentive type, location, and third-party ownership. The first set of summaries shows the average bill export amount along with 10th and 90th percentiles. The second set of summaries shows the quarterly export probability, average post-installation bill, and average export amount.

Table E-1: Residential, All Sites Average Amount of Bill Exports by Incentive Type, Location, and PA

Incentive Type / Location		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
EPBB	Coastal	44,368	21	184	395	6,392	21	173	374	10,084	21	165	352
	Inland	23,868	25	222	490	18,145	26	228	501	8,718	30	241	527
	All	68,236	22	197	430	24,537	25	214	467	18,802	25	201	431
FiveYearPBI	Coastal	151	57	548	1,039	56	15	119	250	705	21	161	335
	Inland	234	26	257	635	573	30	265	560	396	30	247	518
	All	385	30	371	756	629	28	252	547	1,101	24	192	386
All	Coastal	44,519	21	185	395	6,448	21	173	373	10,789	21	165	350
	Inland	24,102	25	223	493	18,718	26	229	503	9,114	30	242	526
	All	68,621	22	198	431	25,166	25	215	470	19,903	25	200	428

Table E-2: Residential, Annual Net Exporters Average Amount of Bill Exports by Incentive Type, Location, and PA

Incentive Type / Location		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
EPBB	**Coastal**	16,554	40	254	511	2,720	36	198	406	5,473	31	194	388
	Inland	7,888	44	313	669	7,193	38	272	567	4,456	40	288	603
	All	24,442	41	273	566	9,913	37	252	526	9,929	34	236	488
FiveYearPBI	**Coastal**	44	75	389	1,039	.	.	.	.	549	28	165	340
	Inland	39	63	361	897	178	26	282	609	308	42	276	540
	All	83	66	376	897	178	26	282	609	857	31	205	390
All	**Coastal**	16,598	40	254	513	2,720	36	198	406	6,022	31	191	382
	Inland	7,927	44	313	669	7,371	37	272	568	4,764	40	288	600
	All	24,525	41	273	567	10,091	37	252	529	10,786	34	234	480

Table E-3: Commercial, All Sites Average Amount of Bill Exports by Incentive Type, Location, and PA

Incentive Type / Location		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
EPBB	**Coastal**	1,322	71	931	2,160	92	64	537	1,237	111	43	395	763
	Inland	1,002	75	1,081	1,919	472	44	797	2,175	95	44	1,178	3,236
	All	2,324	72	996	2,040	564	44	755	1,932	206	43	756	1,788
FiveYearPBI	**Coastal**	239	296	10,142	32,198	.	.	.	.	8	16	4,893	10,019
	Inland	334	320	15,858	40,457	135	260	27,107	96,953	11	335	9,779	24,375
	All	573	320	13,474	35,085	135	260	27,107	96,953	19	47	7,722	24,375
All	**Coastal**	1,561	80	2,342	3,920	92	64	537	1,237	119	41	697	1,905
	Inland	1,336	96	4,775	8,160	607	54	6,649	5,604	106	47	2,071	5,474
	All	2,897	83	3,464	5,560	699	55	5,844	4,306	225	44	1,344	2,463

Table E-4: Commercial, Annual Net Exporters Average Amount of Bill Exports by Incentive Type, Location, and PA

Incentive Type / Location		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
EPBB	**Coastal**	736	88	905	2,400	76	64	591	1,344	82	56	451	1,434
	Inland	486	86	720	1,635	281	63	1,004	2,652	46	52	767	1,758
	All	1,222	87	832	2,040	357	63	916	2,385	128	52	565	1,565
FiveYearPBI	**Coastal**	150	271	8,515	32,800	.	.	.	.	.	.	.	.
	Inland	68	189	8,624	23,760	71	1,072	47,630	123,460	.	.	.	.
	All	218	229	8,549	26,820	71	1,072	47,630	123,460	.	.	.	.
All	**Coastal**	886	105	2,194	3,900	76	64	591	1,344	82	56	451	1,434
	Inland	554	93	1,690	2,640	352	73	10,409	20,841	46	52	767	1,758
	All	1,440	103	2,000	3,317	428	72	8,666	7,280	128	52	565	1,565

Table E-5: Gov./Non-Profit, All Sites Average Amount of Bill Exports by Incentive Type, Location, and PA

Incentive Type / Location		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
EPBB	**Coastal**	570	30	682	1,600	114	57	843	2,755	38	56	377	879
	Inland	132	57	708	1,890	131	61	661	1,494	33	70	338	840
	All	702	31	687	1,600	245	59	746	2,120	71	58	359	840
FiveYearPBI	**Coastal**	156	195	6,937	21,000	7	4,909	7,565	9,969	.	.	.	.
	Inland	84	1,600	9,109	20,891	17	123	4,140	8,806	69	1,326	12,379	33,261
	All	240	380	7,697	20,946	24	243	5,139	9,384	69	1,326	12,379	33,261
All	**Coastal**	726	34	2,026	3,600	121	59	1,232	3,279	38	56	377	879
	Inland	216	88	3,975	9,760	148	61	1,061	2,160	102	116	8,483	20,412
	All	942	45	2,473	6,600	269	59	1,138	2,812	140	93	6,283	18,482

Table E-6: Gov./Non-Profit, Annual Net Exporters Average Amount of Bill Exports by Incentive Type, Location, and PA

Incentive Type / Location		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
EPBB	**Coastal**	265	21	305	962	102	57	866	2,812	.	.	.	.
	Inland	79	103	775	1,890	78	77	823	2,082	17	70	233	411
	All	344	27	413	1,280	180	64	847	2,322	17	70	233	411
FiveYearPBI	**Coastal**	38	2,280	18,159	43,413	7	4,909	7,565	9,969	.	.	.	.
	Inland	42	1,440	5,048	9,760	8	1,090	4,371	8,125	62	1,326	9,050	20,412
	All	80	1,640	11,276	27,060	15	1,378	5,861	9,556	62	1,326	9,050	20,412
All	**Coastal**	303	25	2,545	4,920	109	57	1,296	3,437	.	.	.	.
	Inland	121	138	2,258	7,680	86	109	1,153	2,195	79	157	7,152	20,067
	All	424	31	2,463	6,755	195	70	1,233	3,019	79	157	7,152	20,067

Table E-7: Residential, All Sites Average Amount of Bill Exports by Incentive Type, Third-Party Ownership, and PA

Incentive Type / Third-Party Ownership		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
EPBB	**Host Owned**	62,031	22	198	429	20,838	25	212	459	17,564	25	201	431
	Third Party Owned	6,205	21	196	440	3,699	24	223	518	1,238	28	196	415
	All	68,236	22	197	430	24,537	25	214	467	18,802	25	201	431
FiveYearPBI	**Host Owned**	380	30	312	731	592	26	245	537	1,101	24	192	386
	Third Party Owned	5	640	4,848	18,720	37	83	359	788	.	.	.	.
	All	385	30	371	756	629	28	252	547	1,101	24	192	386
All	**Host Owned**	62,411	22	198	430	21,430	25	213	461	18,665	25	200	429
	Third Party Owned	6,210	21	200	441	3,736	24	224	520	1,238	28	196	415
	All	68,621	22	198	431	25,166	25	215	470	19,903	25	200	428

Table E-8: Residential, Annual Net Exporters Average Amount of Bill Exports by Incentive Type, Third-Party Ownership, and PA

Incentive Type / Third-Party Ownership		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
EPBB	**Host Owned**	22,794	41	271	561	8,717	37	247	514	9,559	34	236	485
	Third Party Owned	1,648	43	293	661	1,196	39	285	629	370	43	249	514
	All	24,442	41	273	566	9,913	37	252	526	9,929	34	236	488
FiveYearPBI	**Host Owned**	83	66	376	897	178	26	282	609	857	31	205	390
	All	83	66	376	897	178	26	282	609	857	31	205	390
All	**Host Owned**	22,877	41	272	562	8,895	37	248	517	10,416	33	233	478
	Third Party Owned	1,648	43	293	661	1,196	39	285	629	370	43	249	514
	All	24,525	41	273	567	10,091	37	252	529	10,786	34	234	480

Table E-9: Commercial, All Sites Average Amount of Bill Exports by Incentive Type, Third-Party Ownership, and PA

Incentive Type / Third-Party Ownership		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
EPBB	**Host Owned**	2,065	68	802	1,689	511	44	762	1,970	199	41	751	1,798
	Third Party Owned	259	118	2,544	4,160	53	85	682	1,571	7	286	896	1,312
	All	2,324	72	996	2,040	564	44	755	1,932	206	43	756	1,788
FiveYearPBI	**Host Owned**	372	286	9,871	21,777	27	218	2,756	6,866	14	47	2,996	9,762
	Third Party Owned	201	560	20,141	54,899	108	386	33,195	111,590	5	900	20,956	46,888
	All	573	320	13,474	35,085	135	260	27,107	96,953	19	47	7,722	24,375
All	**Host Owned**	2,437	78	2,186	3,517	538	44	862	2,350	213	43	898	2,147
	Third Party Owned	460	160	10,233	31,124	161	161	22,492	92,312	12	764	9,255	24,375
	All	2,897	83	3,464	5,560	699	55	5,844	4,306	225	44	1,344	2,463

Table E-10: Commercial, Annual Net Exporters Average Amount of Bill Exports by Incentive Type, Third-Party Ownership, and PA

Incentive Type / Third-Party Ownership		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
EPBB	**Host Owned**	1,089	81	723	1,600	337	63	918	2,463	121	52	546	1,565
	Third Party Owned	133	160	1,718	4,440	20	191	887	1,566	7	286	896	1,312
	All	1,222	87	832	2,040	357	63	916	2,385	128	52	565	1,565
FiveYearPBI	**Host Owned**	130	152	2,779	9,520	15	839	3,984	7,280	.	.	.	.
	Third Party Owned	88	1,600	17,072	41,200	56	1,072	59,321	128,303	.	.	.	.
	All	218	229	8,549	26,820	71	1,072	47,630	123,460	.	.	.	.
All	**Host Owned**	1,219	91	943	1,873	352	63	1,049	2,765	121	52	546	1,565
	Third Party Owned	221	253	7,831	26,400	76	580	43,944	123,460	7	286	896	1,312
	All	1,440	103	2,000	3,317	428	72	8,666	7,280	128	52	565	1,565

Table E-11: Gov./Non-Profit, All Sites Average Amount of Bill Exports by Incentive Type, Third-Party Ownership, and PA

Incentive Type / Third-Party Ownership		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
EPBB	**Host Owned**	644	40	583	1,520	239	59	743	2,127	71	58	359	840
	Third Party Owned	58	8	1,836	2,240	6	200	857	1,460	.	.	.	.
	All	702	31	687	1,600	245	59	746	2,120	71	58	359	840
FiveYearPBI	**Host Owned**	77	160	6,507	20,891	12	123	4,615	9,556	.	.	.	.
	Third Party Owned	163	880	8,259	21,000	12	1,378	5,663	8,806	69	1,326	12,379	33,261
	All	240	380	7,697	20,946	24	243	5,139	9,384	69	1,326	12,379	33,261
All	**Host Owned**	721	47	1,216	2,080	251	59	928	2,316	71	58	359	840
	Third Party Owned	221	31	6,573	18,000	18	440	4,061	8,806	69	1,326	12,379	33,261
	All	942	45	2,473	6,600	269	59	1,138	2,812	140	93	6,283	18,482

Table E-12: Gov./Non-Profit, Annual Net Exporters Average Amount of Bill Exports by Incentive Type, Third-Party Ownership, and PA

Incentive Type / Third-Party Ownership		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
EPBB	**Host Owned**	320	32	440	1,285	174	62	847	2,328	17	70	233	411
	Third Party Owned	24	12	54	97	6	200	857	1,460	.	.	.	.
	All	344	27	413	1,280	180	64	847	2,322	17	70	233	411
FiveYearPBI	**Host Owned**	.	.	.	.	7	4,909	7,565	9,969	.	.	.	.
	Third Party Owned	80	1,640	11,276	27,060	8	1,090	4,371	8,125	62	1,326	9,050	20,412
	All	80	1,640	11,276	27,060	15	1,378	5,861	9,556	62	1,326	9,050	20,412
All	**Host Owned**	320	32	440	1,285	181	65	1,107	2,755	17	70	233	411
	Third Party Owned	104	31	8,686	23,040	14	440	2,865	6,152	62	1,326	9,050	20,412
	All	424	31	2,463	6,755	195	70	1,233	3,019	79	157	7,152	20,067

Table E-13: Residential, All Sites Average Amount of Bill Exports by Incentive Type, Unit Size Category, and PA

Incentive Type / Unit Size Category		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
EPBB	**0-2.5 kW**	10,910	13	93	198	2,578	14	95	196	2,245	13	89	189
	2.5-4 kW	22,209	19	135	288	6,716	19	132	274	6,338	21	135	278
	4-7.5 kW	25,809	27	206	443	11,606	29	216	457	8,208	31	217	450
	7.5+ kW	9,308	52	446	950	3,637	55	440	941	2,011	62	464	998
	All	68,236	22	197	430	24,537	25	214	467	18,802	25	201	431
FiveYearPBI	**0-2.5 kW**	2	29	43	57	8	4	22	33	147	20	109	211
	2.5-4 kW	75	17	114	267	114	21	140	276	363	19	140	290
	4-7.5 kW	200	27	218	424	310	31	223	479	452	29	207	414
	7.5+ kW	108	64	840	1,560	197	41	372	829	139	31	365	879
	All	385	30	371	756	629	28	252	547	1,101	24	192	386
All	**0-2.5 kW**	10,912	13	93	198	2,586	14	94	195	2,392	13	91	190
	2.5-4 kW	22,284	19	135	287	6,830	19	133	274	6,701	21	136	279
	4-7.5 kW	26,009	27	206	443	11,916	29	217	458	8,660	31	216	448
	7.5+ kW	9,416	53	451	958	3,834	54	436	934	2,150	60	458	990
	All	68,621	22	198	431	25,166	25	215	470	19,903	25	200	428

Table E-14: Residential, Annual Net Exporters Average Amount of Bill Exports by Incentive Type, Unit Size Category, and PA

Incentive Type / Unit Size Category		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
EPBB	**0-2.5 kW**	4,800	24	122	229	1,366	24	113	213	1,189	23	109	207
	2.5-4 kW	8,206	39	188	354	2,852	34	160	303	3,511	30	158	301
	4-7.5 kW	8,078	56	300	592	4,363	41	268	529	4,134	40	256	509
	7.5+ kW	3,358	88	631	1,283	1,332	76	536	1,113	1,095	85	553	1,132
	All	24,442	41	273	566	9,913	37	252	526	9,929	34	236	488
FiveYearPBI	**0-2.5 kW**	.	.	.	.	.	.	.	.	116	20	112	231
	2.5-4 kW	13	40	197	424	34	37	182	340	301	28	151	304
	4-7.5 kW	40	63	290	591	89	34	266	537	343	41	215	414
	7.5+ kW	30	146	568	1,066	55	23	370	814	97	52	449	1,038
	All	83	66	376	897	178	26	282	609	857	31	205	390
All	**0-2.5 kW**	4,800	24	122	229	1,366	24	113	213	1,305	23	109	208
	2.5-4 kW	8,219	39	188	354	2,886	34	161	304	3,812	30	157	302
	4-7.5 kW	8,118	56	300	592	4,452	41	268	529	4,477	40	253	501
	7.5+ kW	3,388	88	630	1,282	1,387	72	529	1,096	1,192	82	545	1,125
	All	24,525	41	273	567	10,091	37	252	529	10,786	34	234	480

Table E-15: Commercial, All Sites Average Amount of Bill Exports by Incentive Type, Unit Size Category, and PA

Incentive Type / Unit Size Category		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
EPBB	**0-5 kW**	629	37	250	580	190	28	176	373	67	32	163	338
	5-10 kW	623	72	426	846	49	32	303	691	20	12	192	376
	10-25 kW	503	134	779	1,585	215	98	681	1,429	86	44	571	1,247
	25+ kW	569	200	2,635	5,120	110	172	2,100	4,496	33	421	2,785	6,934
	All	2,324	72	996	2,040	564	44	755	1,932	206	43	756	1,788
FiveYearPBI	**0-5 kW**	11	129	291	399	.	.	.	.	.	.	.	.
	5-10 kW	4	152	242	458	6	93	452	830	.	.	.	.
	10-25 kW	86	125	682	1,453	18	95	512	1,288	6	47	465	1,031
	25+ kW	472	914	16,224	41,200	111	910	32,861	109,358	13	325	11,071	24,375
	All	573	320	13,474	35,085	135	260	27,107	96,953	19	47	7,722	24,375
All	**0-5 kW**	640	39	251	577	190	28	176	373	67	32	163	338
	5-10 kW	627	72	425	846	55	36	319	719	20	12	192	376
	10-25 kW	589	125	765	1,581	233	98	667	1,390	92	47	564	1,193
	25+ kW	1,041	320	8,796	22,240	221	364	17,550	73,667	46	325	5,127	9,828
	All	2,897	83	3,464	5,560	699	55	5,844	4,306	225	44	1,344	2,463

Table E-16: Commercial, Annual Net Exporters Average Amount of Bill Exports by Incentive Type, Unit Size Category, and PA

Incentive Type / Unit Size Category		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
EPBB	**0-5 kW**	387	49	291	670	128	32	199	401	59	33	176	348
	5-10 kW	309	103	476	869	16	194	441	771	.	.	.	.
	10-25 kW	279	216	849	1,635	145	145	761	1,493	53	57	708	1,716
	25+ kW	247	212	2,104	4,560	68	382	2,709	5,844	16	298	1,525	3,253
	All	1,222	87	832	2,040	357	63	916	2,385	128	52	565	1,565
FiveYearPBI	**0-5 kW**	11	129	291	399	.	.	.	.	.	.	.	.
	10-25 kW	45	116	579	1,162	.	.	.	.	.	.	.	.
	25+ kW	162	720	11,323	30,887	71	1,072	47,630	123,460	.	.	.	.
	All	218	229	8,549	26,820	71	1,072	47,630	123,460	.	.	.	.
All	**0-5 kW**	398	51	291	666	128	32	199	401	59	33	176	348
	5-10 kW	309	103	476	869	16	194	441	771	.	.	.	.
	10-25 kW	324	169	811	1,581	145	145	761	1,493	53	57	708	1,716
	25+ kW	409	284	5,755	18,240	139	756	25,654	96,953	16	298	1,525	3,253
	All	1,440	103	2,000	3,317	428	72	8,666	7,280	128	52	565	1,565

Table E-17: Gov./Non-Profit, All Sites Average Amount of Bill Exports by Incentive Type, Unit Size Category, and PA

Incentive Type / Unit Size Category		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
EPBB	**0-5 kW**	260	13	106	211	61	25	175	369	51	56	191	393
	5-10 kW	118	48	364	781	47	32	238	469	.	.	.	.
	10-25 kW	224	112	780	1,890	93	187	780	1,494	12	109	529	1,040
	25+ kW	100	80	2,371	4,040	44	682	2,007	3,290	8	48	1,176	4,554
	All	702	31	687	1,600	245	59	746	2,120	71	58	359	840
FiveYearPBI	**10-25 kW**	13	68	704	1,374	5	28	484	1,164	.	.	.	.
	25+ kW	227	640	8,098	21,026	19	1,378	6,364	9,556	69	1,326	12,379	33,261
	All	240	380	7,697	20,946	24	243	5,139	9,384	69	1,326	12,379	33,261
All	**0-5 kW**	260	13	106	211	61	25	175	369	51	56	191	393
	5-10 kW	118	48	364	781	47	32	238	469	.	.	.	.
	10-25 kW	237	103	776	1,840	98	137	765	1,494	12	109	529	1,040
	25+ kW	327	240	6,346	17,927	63	849	3,321	7,818	77	840	11,215	25,667
	All	942	45	2,473	6,600	269	59	1,138	2,812	140	93	6,283	18,482

Table E-18: Gov./Non-Profit, Annual Net Exporters Average Amount of Bill Exports by Incentive Type, Unit Size Category, and PA

Incentive Type / Unit Size Category		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
EPBB	**0-5 kW**	201	15	91	161	47	54	181	369	17	70	233	411
	5-10 kW	34	87	418	953	34	27	221	419	.	.	.	.
	10-25 kW	109	155	1,007	2,160	59	187	912	2,035	.	.	.	.
	25+ kW	.	.	.	.	40	610	2,067	3,364	.	.	.	.
	All	344	27	413	1,280	180	64	847	2,322	17	70	233	411
FiveYearPBI	**25+ kW**	80	1,640	11,276	27,060	15	1,378	5,861	9,556	62	1,326	9,050	20,412
	All	80	1,640	11,276	27,060	15	1,378	5,861	9,556	62	1,326	9,050	20,412
All	**0-5 kW**	201	15	91	161	47	54	181	369	17	70	233	411
	5-10 kW	34	87	418	953	34	27	221	419	.	.	.	.
	10-25 kW	109	155	1,007	2,160	59	187	912	2,035	.	.	.	.
	25+ kW	80	1,640	11,276	27,060	55	758	3,102	7,231	62	1,326	9,050	20,412
	All	424	31	2,463	6,755	195	70	1,233	3,019	79	157	7,152	20,067

Table E-19: Residential, All Sites Average Amount of Bill Exports by Location, Third-Party Ownership, and PA

Location / Third-Party Ownership		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
Coastal	**Host Owned**	41,221	21	185	396	5,555	21	175	373	10,217	21	164	348
	Third Party Owned	3,298	19	184	376	893	18	160	370	572	22	178	399
	All	44,519	21	185	395	6,448	21	173	373	10,789	21	165	350
Inland	**Host Owned**	21,190	25	223	491	15,875	27	226	492	8,448	29	244	531
	Third Party Owned	2,912	25	218	500	2,843	26	244	559	666	34	211	431
	All	24,102	25	223	493	18,718	26	229	503	9,114	30	242	526
All	**Host Owned**	62,411	22	198	430	21,430	25	213	461	18,665	25	200	429
	Third Party Owned	6,210	21	200	441	3,736	24	224	520	1,238	28	196	415
	All	68,621	22	198	431	25,166	25	215	470	19,903	25	200	428

Table E-20: Residential, Annual Net Exporters Average Amount of Bill Exports by Location, Third-Party Ownership, and PA

Location / Third-Party Ownership		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
Coastal	Host Owned	15,646	40	253	509	2,419	36	197	406	5,857	30	190	381
	Third Party Owned	952	38	278	597	301	35	207	406	165	35	216	481
	All	16,598	40	254	513	2,720	36	198	406	6,022	31	191	382
Inland	Host Owned	7,231	44	313	664	6,476	37	267	554	4,559	39	288	603
	Third Party Owned	696	50	313	710	895	40	312	682	205	47	276	530
	All	7,927	44	313	669	7,371	37	272	568	4,764	40	288	600
All	Host Owned	22,877	41	272	562	8,895	37	248	517	10,416	33	233	478
	Third Party Owned	1,648	43	293	661	1,196	39	285	629	370	43	249	514
	All	24,525	41	273	567	10,091	37	252	529	10,786	34	234	480

Table E-21: Commercial, All Sites Average Amount of Bill Exports by Location, Third-Party Ownership, and PA

Location / Third-Party Ownership		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
Coastal	**Host Owned**	1,362	76	1,359	2,415	86	63	550	1,263	119	41	697	1,905
	Third Party Owned	199	160	9,064	28,160	6	85	349	516	.	.	.	.
	All	1,561	80	2,342	3,920	92	64	537	1,237	119	41	697	1,905
Inland	**Host Owned**	1,075	80	3,234	5,394	452	44	922	2,609	94	44	1,153	3,236
	Third Party Owned	261	160	11,124	32,911	155	161	23,349	94,740	12	764	9,255	24,375
	All	1,336	96	4,775	8,160	607	54	6,649	5,604	106	47	2,071	5,474
All	**Host Owned**	2,437	78	2,186	3,517	538	44	862	2,350	213	43	898	2,147
	Third Party Owned	460	160	10,233	31,124	161	161	22,492	92,312	12	764	9,255	24,375
	All	2,897	83	3,464	5,560	699	55	5,844	4,306	225	44	1,344	2,463

Table E-22: Commercial, Annual Net Exporters Average Amount of Bill Exports by Location, Third-Party Ownership, and PA

Location / Third-Party Ownership		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
Coastal	Host Owned	765	93	843	2,040	76	64	591	1,344	82	56	451	1,434
	Third Party Owned	121	382	10,732	35,892	.	.	.	.	.	.	.	.
	All	886	105	2,194	3,900	76	64	591	1,344	82	56	451	1,434
Inland	Host Owned	454	87	1,110	1,560	276	63	1,175	3,334	39	44	744	1,788
	Third Party Owned	100	150	4,322	18,588	76	580	43,944	123,460	7	286	896	1,312
	All	554	93	1,690	2,640	352	73	10,409	20,841	46	52	767	1,758
All	Host Owned	1,219	91	943	1,873	352	63	1,049	2,765	121	52	546	1,565
	Third Party Owned	221	253	7,831	26,400	76	580	43,944	123,460	7	286	896	1,312
	All	1,440	103	2,000	3,317	428	72	8,666	7,280	128	52	565	1,565

Table E-23: Gov./Non-Profit, All Sites Average Amount of Bill Exports by Location, Third-Party Ownership, and PA

Location / Third-Party Ownership		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
Coastal	**Host Owned**	564	39	602	1,600	121	59	1,232	3,279	38	56	377	879
	Third Party Owned	162	25	6,983	21,026	.	.	.	.	.	.	.	.
	All	726	34	2,026	3,600	121	59	1,232	3,279	38	56	377	879
Inland	**Host Owned**	157	80	3,421	9,677	130	59	645	1,522	33	70	338	840
	Third Party Owned	59	880	5,448	10,400	18	440	4,061	8,806	69	1,326	12,379	33,261
	All	216	88	3,975	9,760	148	61	1,061	2,160	102	116	8,483	20,412
All	**Host Owned**	721	47	1,216	2,080	251	59	928	2,316	71	58	359	840
	Third Party Owned	221	31	6,573	18,000	18	440	4,061	8,806	69	1,326	12,379	33,261
	All	942	45	2,473	6,600	269	59	1,138	2,812	140	93	6,283	18,482

Table E-24: Gov./Non-Profit, Annual Net Exporters Average Amount of Bill Exports by Location, Third-Party Ownership, and PA

Location / Third-Party Ownership		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
Coastal	Host Owned	241	26	331	1,080	109	57	1,296	3,437	.	.	.	.
	Third Party Owned	62	22	11,151	31,910	.	.	.	.	.	.	.	.
	All	303	25	2,545	4,920	109	57	1,296	3,437	.	.	.	.
Inland	Host Owned	79	103	775	1,890	72	77	821	2,082	17	70	233	411
	Third Party Owned	42	1,440	5,048	9,760	14	440	2,865	6,152	62	1,326	9,050	20,412
	All	121	138	2,258	7,680	86	109	1,153	2,195	79	157	7,152	20,067
All	Host Owned	320	32	440	1,285	181	65	1,107	2,755	17	70	233	411
	Third Party Owned	104	31	8,686	23,040	14	440	2,865	6,152	62	1,326	9,050	20,412
	All	424	31	2,463	6,755	195	70	1,233	3,019	79	157	7,152	20,067

Table E-25: Residential, All Sites Average Amount of Bill Exports by Location, Unit Size Category, and PA

Location / Unit Size Category		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
Coastal	**0-2.5 kW**	9,328	13	91	194	1,032	15	91	186	1,799	12	90	191
	2.5-4 kW	16,708	19	135	288	2,437	17	127	262	4,432	20	132	273
	4-7.5 kW	14,360	29	210	452	2,578	26	206	434	4,024	30	207	423
	7.5+ kW	4,123	60	514	1,043	401	52	449	1,014	534	50	385	789
	All	44,519	21	185	395	6,448	21	173	373	10,789	21	165	350
Inland	**0-2.5 kW**	1,584	14	102	219	1,554	13	97	204	593	15	93	189
	2.5-4 kW	5,576	17	133	286	4,393	20	136	280	2,269	21	143	294
	4-7.5 kW	11,649	26	201	433	9,338	30	220	464	4,636	32	225	468
	7.5+ kW	5,293	50	401	874	3,433	55	435	929	1,616	64	482	1,038
	All	24,102	25	223	493	18,718	26	229	503	9,114	30	242	526
All	**0-2.5 kW**	10,912	13	93	198	2,586	14	94	195	2,392	13	91	190
	2.5-4 kW	22,284	19	135	287	6,830	19	133	274	6,701	21	136	279
	4-7.5 kW	26,009	27	206	443	11,916	29	217	458	8,660	31	216	448
	7.5+ kW	9,416	53	451	958	3,834	54	436	934	2,150	60	458	990
	All	68,621	22	198	431	25,166	25	215	470	19,903	25	200	428

Table E-26: Residential, Annual Net Exporters Average Amount of Bill Exports by Location, Unit Size Category, and PA

Location / Unit Size Category		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
Coastal	**0-2.5 kW**	4,116	24	121	226	518	29	108	196	1,009	22	109	210
	2.5-4 kW	6,467	41	187	350	1,134	36	160	295	2,563	28	151	292
	4-7.5 kW	4,386	63	314	609	960	44	263	502	2,174	40	244	474
	7.5+ kW	1,629	92	700	1,385	108	67	458	1,062	276	70	449	840
	All	16,598	40	254	513	2,720	36	198	406	6,022	31	191	382
Inland	**0-2.5 kW**	684	27	131	252	848	22	117	223	296	23	109	199
	2.5-4 kW	1,752	34	193	375	1,752	32	161	308	1,249	33	169	327
	4-7.5 kW	3,732	49	284	569	3,492	40	269	533	2,303	40	261	523
	7.5+ kW	1,759	83	565	1,182	1,279	75	535	1,112	916	86	573	1,170
	All	7,927	44	313	669	7,371	37	272	568	4,764	40	288	600
All	**0-2.5 kW**	4,800	24	122	229	1,366	24	113	213	1,305	23	109	208
	2.5-4 kW	8,219	39	188	354	2,886	34	161	304	3,812	30	157	302
	4-7.5 kW	8,118	56	300	592	4,452	41	268	529	4,477	40	253	501
	7.5+ kW	3,388	88	630	1,282	1,387	72	529	1,096	1,192	82	545	1,125
	All	24,525	41	273	567	10,091	37	252	529	10,786	34	234	480

Table E-27: Commercial, All Sites Average Amount of Bill Exports by Location, Unit Size Category, and PA

Location / Unit Size Category		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
Coastal	**0-5 kW**	389	36	244	542	24	33	226	392	58	32	161	309
	5-10 kW	277	64	418	870	14	60	298	507	.	.	.	.
	10-25 kW	331	124	706	1,380	54	197	737	1,517	37	38	272	535
	25+ kW	564	280	5,693	13,500	.	.	.	.	24	298	2,648	6,812
	All	1,561	80	2,342	3,920	92	64	537	1,237	119	41	697	1,905
Inland	**0-5 kW**	251	42	262	601	166	26	169	367	9	11	172	444
	5-10 kW	350	79	430	841	41	36	326	771	20	12	192	376
	10-25 kW	258	148	841	1,638	179	79	647	1,385	55	52	760	1,716
	25+ kW	477	346	12,466	30,631	221	364	17,550	73,667	22	865	7,831	22,789
	All	1,336	96	4,775	8,160	607	54	6,649	5,604	106	47	2,071	5,474
All	**0-5 kW**	640	39	251	577	190	28	176	373	67	32	163	338
	5-10 kW	627	72	425	846	55	36	319	719	20	12	192	376
	10-25 kW	589	125	765	1,581	233	98	667	1,390	92	47	564	1,193
	25+ kW	1,041	320	8,796	22,240	221	364	17,550	73,667	46	325	5,127	9,828
	All	2,897	83	3,464	5,560	699	55	5,844	4,306	225	44	1,344	2,463

Table E-28: Commercial, Annual Net Exporters Average Amount of Bill Exports by Location, Unit Size Category, and PA

Location / Unit Size Category		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
Coastal	**0-5 kW**	260	52	292	677	24	33	226	392	52	43	172	309
	5-10 kW	152	107	448	772	9	244	384	519	.	.	.	.
	10-25 kW	209	160	783	1,440	43	197	838	1,553	14	38	263	579
	25+ kW	265	320	6,174	17,040	.	.	.	.	16	298	1,525	3,253
	All	886	105	2,194	3,900	76	64	591	1,344	82	56	451	1,434
Inland	**0-5 kW**	138	41	290	641	104	32	193	401	7	33	205	444
	5-10 kW	157	103	503	961	7	179	515	1,001	.	.	.	.
	10-25 kW	115	195	863	1,635	102	145	728	1,455	39	61	868	1,788
	25+ kW	144	219	4,986	18,320	139	756	25,654	96,953	.	.	.	.
	All	554	93	1,690	2,640	352	73	10,409	20,841	46	52	767	1,758
All	**0-5 kW**	398	51	291	666	128	32	199	401	59	33	176	348
	5-10 kW	309	103	476	869	16	194	441	771	.	.	.	.
	10-25 kW	324	169	811	1,581	145	145	761	1,493	53	57	708	1,716
	25+ kW	409	284	5,755	18,240	139	756	25,654	96,953	16	298	1,525	3,253
	All	1,440	103	2,000	3,317	428	72	8,666	7,280	128	52	565	1,565

Table E-29: Gov./Non-Profit, All Sites Average Amount of Bill Exports by Location, Unit Size Category, and PA

Location / Unit Size Category		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
Coastal	**0-5 kW**	256	13	105	206	32	54	214	394	29	56	172	318
	5-10 kW	75	121	422	800	42	32	231	469	.	.	.	.
	10-25 kW	168	80	752	1,800	7	303	1,229	2,041	8	178	595	1,040
	25+ kW	227	160	5,666	17,520	40	803	3,098	7,320	1	4,554	4,554	4,554
	All	726	34	2,026	3,600	121	59	1,232	3,279	38	56	377	879
Inland	**0-5 kW**	4	17	176	389	29	14	132	287	22	70	215	399
	5-10 kW	43	29	263	680	5	134	299	441	.	.	.	.
	10-25 kW	69	138	833	1,970	91	137	729	1,440	4	89	396	1,262
	25+ kW	100	809	7,891	18,604	23	878	3,709	8,125	76	840	11,302	25,667
	All	216	88	3,975	9,760	148	61	1,061	2,160	102	116	8,483	20,412
All	**0-5 kW**	260	13	106	211	61	25	175	369	51	56	191	393
	5-10 kW	118	48	364	781	47	32	238	469	.	.	.	.
	10-25 kW	237	103	776	1,840	98	137	765	1,494	12	109	529	1,040
	25+ kW	327	240	6,346	17,927	63	849	3,321	7,818	77	840	11,215	25,667
	All	942	45	2,473	6,600	269	59	1,138	2,812	140	93	6,283	18,482

Table E-30: Gov./Non-Profit, Annual Net Exporters Average Amount of Bill Exports by Location, Unit Size Category, and PA

Location / Unit Size Category		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
Coastal	**0-5 kW**	201	15	91	161	32	54	214	394	.	.	.	.
	5-10 kW	24	169	437	778	34	27	221	419	.	.	.	.
	10-25 kW	40	380	1,306	2,480	7	303	1,229	2,041	.	.	.	.
	25+ kW	38	2,280	18,159	43,413	36	758	3,286	7,409	.	.	.	.
	All	303	25	2,545	4,920	109	57	1,296	3,437	.	.	.	.
Inland	**0-5 kW**	.	.	.	.	15	59	111	160	17	70	233	411
	5-10 kW	10	30	373	1,007	.	.	.	.	.	.	.	.
	10-25 kW	69	138	833	1,970	52	187	869	1,931	.	.	.	.
	25+ kW	42	1,440	5,048	9,760	19	287	2,753	6,152	62	1,326	9,050	20,412
	All	121	138	2,258	7,680	86	109	1,153	2,195	79	157	7,152	20,067
All	**0-5 kW**	201	15	91	161	47	54	181	369	17	70	233	411
	5-10 kW	34	87	418	953	34	27	221	419	.	.	.	.
	10-25 kW	109	155	1,007	2,160	59	187	912	2,035	.	.	.	.
	25+ kW	80	1,640	11,276	27,060	55	758	3,102	7,231	62	1,326	9,050	20,412
	All	424	31	2,463	6,755	195	70	1,233	3,019	79	157	7,152	20,067

Table E-31: Residential, All Sites Average Amount of Bill Exports by Third-Party Ownership, Unit Size Category, and PA

Third-Party Ownership / Unit Size Category		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
Host Owned	**0-2.5 kW**	10,073	13	93	198	2,411	14	93	192	2,289	13	91	191
	2.5-4 kW	20,771	19	134	287	5,985	19	134	278	6,363	21	135	277
	4-7.5 kW	23,158	28	208	447	9,915	31	218	458	7,997	31	217	451
	7.5+ kW	8,409	53	456	969	3,119	54	440	951	2,016	59	465	1,002
	All	62,411	22	198	430	21,430	25	213	461	18,665	25	200	429
Third Party Owned	**0-2.5 kW**	839	13	93	194	175	12	113	274	103	20	89	172
	2.5-4 kW	1,513	17	139	301	845	19	119	253	338	20	149	321
	4-7.5 kW	2,851	25	189	413	2,001	23	209	458	663	31	205	406
	7.5+ kW	1,007	48	410	772	715	56	418	856	134	66	350	780
	All	6,210	21	200	441	3,736	24	224	520	1,238	28	196	415
All	**0-2.5 kW**	10,912	13	93	198	2,586	14	94	195	2,392	13	91	190
	2.5-4 kW	22,284	19	135	287	6,830	19	133	274	6,701	21	136	279
	4-7.5 kW	26,009	27	206	443	11,916	29	217	458	8,660	31	216	448
	7.5+ kW	9,416	53	451	958	3,834	54	436	934	2,150	60	458	990
	All	68,621	22	198	431	25,166	25	215	470	19,903	25	200	428

Table E-32: Residential, Annual Net Exporters Average Amount of Bill Exports by Third-Party Ownership, Unit Size Category, and PA

Third-Party Ownership / Unit Size Category		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
Host Owned	**0-2.5 kW**	4,488	24	122	229	1,276	23	111	204	1,258	23	110	210
	2.5-4 kW	7,753	39	186	353	2,646	34	162	305	3,712	29	156	301
	4-7.5 kW	7,544	56	300	590	3,854	42	268	529	4,311	40	253	503
	7.5+ kW	3,092	88	635	1,303	1,119	70	538	1,113	1,135	82	548	1,128
	All	22,877	41	272	562	8,895	37	248	517	10,416	33	233	478
Third Party Owned	**0-2.5 kW**	312	31	129	229	90	36	153	317	47	26	84	141
	2.5-4 kW	466	39	216	401	240	24	148	284	100	49	200	339
	4-7.5 kW	574	49	295	651	598	36	267	542	166	41	245	487
	7.5+ kW	296	85	583	959	268	78	494	1,026	57	75	486	1,105
	All	1,648	43	293	661	1,196	39	285	629	370	43	249	514
All	**0-2.5 kW**	4,800	24	122	229	1,366	24	113	213	1,305	23	109	208
	2.5-4 kW	8,219	39	188	354	2,886	34	161	304	3,812	30	157	302
	4-7.5 kW	8,118	56	300	592	4,452	41	268	529	4,477	40	253	501
	7.5+ kW	3,388	88	630	1,282	1,387	72	529	1,096	1,192	82	545	1,125
	All	24,525	41	273	567	10,091	37	252	529	10,786	34	234	480

Table E-33: Commercial, All Sites Average Amount of Bill Exports by Third-Party Ownership, Unit Size Category, and PA

Third-Party Ownership / Unit Size Category		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
Host Owned	**0-5 kW**	609	37	255	585	182	28	176	376	67	32	163	338
	5-10 kW	578	72	435	863	48	32	294	646	20	12	192	376
	10-25 kW	502	124	754	1,522	186	98	674	1,390	85	44	536	1,193
	25+ kW	748	280	6,073	13,500	122	303	2,395	5,604	41	325	3,196	7,071
	All	2,437	78	2,186	3,517	538	44	862	2,350	213	43	898	2,147
Third Party Owned	**0-5 kW**	31	41	183	358	8	30	172	336	.	.	.	.
	5-10 kW	49	80	310	640	7	93	490	830	.	.	.	.
	10-25 kW	87	160	830	1,684	47	85	640	1,400	7	286	896	1,312
	25+ kW	293	560	15,748	44,746	99	580	36,226	120,200	5	900	20,956	46,888
	All	460	160	10,233	31,124	161	161	22,492	92,312	12	764	9,255	24,375
All	**0-5 kW**	640	39	251	577	190	28	176	373	67	32	163	338
	5-10 kW	627	72	425	846	55	36	319	719	20	12	192	376
	10-25 kW	589	125	765	1,581	233	98	667	1,390	92	47	564	1,193
	25+ kW	1,041	320	8,796	22,240	221	364	17,550	73,667	46	325	5,127	9,828
	All	2,897	83	3,464	5,560	699	55	5,844	4,306	225	44	1,344	2,463

Table E-34: Commercial, Annual Net Exporters Average Amount of Bill Exports by Third-Party Ownership, Unit Size Category, and PA

Third-Party Ownership / Unit Size Category		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
Host Owned	**0-5 kW**	384	52	295	670	128	32	199	401	59	33	176	348
	5-10 kW	286	95	487	889	16	194	441	771	.	.	.	.
	10-25 kW	290	165	775	1,435	125	145	741	1,464	46	52	680	1,758
	25+ kW	259	200	2,594	5,120	83	515	2,939	6,633	16	298	1,525	3,253
	All	1,219	91	943	1,873	352	63	1,049	2,765	121	52	546	1,565
Third Party Owned	**0-5 kW**	14	41	203	438	.	.	.	.	.	.	.	.
	5-10 kW	23	119	335	566	.	.	.	.	.	.	.	.
	10-25 kW	34	309	1,123	2,283	20	191	887	1,566	7	286	896	1,312
	25+ kW	150	760	11,213	32,800	56	1,072	59,321	128,303	.	.	.	.
	All	221	253	7,831	26,400	76	580	43,944	123,460	7	286	896	1,312
All	**0-5 kW**	398	51	291	666	128	32	199	401	59	33	176	348
	5-10 kW	309	103	476	869	16	194	441	771	.	.	.	.
	10-25 kW	324	169	811	1,581	145	145	761	1,493	53	57	708	1,716
	25+ kW	409	284	5,755	18,240	139	756	25,654	96,953	16	298	1,525	3,253
	All	1,440	103	2,000	3,317	428	72	8,666	7,280	128	52	565	1,565

Table E-35: Gov./Non-Profit, All Sites Average Amount of Bill Exports by Third-Party Ownership, Unit Size Category, and PA

Third-Party Ownership / Unit Size Category		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
Host Owned	**0-5 kW**	226	15	115	232	61	25	175	369	51	56	191	393
	5-10 kW	117	48	366	781	47	32	238	469	.	.	.	.
	10-25 kW	224	103	753	1,600	92	137	759	1,494	12	109	529	1,040
	25+ kW	154	160	4,151	9,677	51	758	2,770	6,064	8	48	1,176	4,554
	All	721	47	1,216	2,080	251	59	928	2,316	71	58	359	840
Third Party Owned	**0-5 kW**	34	10	44	96	.	.	.	.	.	.	.	.
	5-10 kW	1	160	160	160	.	.	.	.	.	.	.	.
	10-25 kW	13	160	1,157	1,920	6	200	857	1,460	.	.	.	.
	25+ kW	173	800	8,301	21,026	12	1,378	5,663	8,806	69	1,326	12,379	33,261
	All	221	31	6,573	18,000	18	440	4,061	8,806	69	1,326	12,379	33,261
All	**0-5 kW**	260	13	106	211	61	25	175	369	51	56	191	393
	5-10 kW	118	48	364	781	47	32	238	469	.	.	.	.
	10-25 kW	237	103	776	1,840	98	137	765	1,494	12	109	529	1,040
	25+ kW	327	240	6,346	17,927	63	849	3,321	7,818	77	840	11,215	25,667
	All	942	45	2,473	6,600	269	59	1,138	2,812	140	93	6,283	18,482

Table E-36: Gov./Non-Profit, Annual Net Exporters Average Amount of Bill Exports by Third-Party Ownership, Unit Size Category, and PA

Third-Party Ownership / Unit Size Category		Program Administrator											
		PG&E				SCE				CCSE			
		Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)	Total Bills in Summary	10th Percentile (kWh)	Average Monthly Export (kWh)	90th Percentile (kWh)
Host Owned	**0-5 kW**	177	15	96	165	47	54	181	369	17	70	233	411
	5-10 kW	34	87	418	953	34	27	221	419	.	.	.	.
	10-25 kW	109	155	1,007	2,160	53	187	918	2,035	.	.	.	.
	25+ kW	.	.	.	.	47	682	2,886	7,231	.	.	.	.
	All	320	32	440	1,285	181	65	1,107	2,755	17	70	233	411
Third Party Owned	**0-5 kW**	24	12	54	97	.	.	.	.	.	.	.	.
	10-25 kW	.	.	.	.	6	200	857	1,460	.	.	.	.
	25+ kW	80	1,640	11,276	27,060	8	1,090	4,371	8,125	62	1,326	9,050	20,412
	All	104	31	8,686	23,040	14	440	2,865	6,152	62	1,326	9,050	20,412
All	**0-5 kW**	201	15	91	161	47	54	181	369	17	70	233	411
	5-10 kW	34	87	418	953	34	27	221	419	.	.	.	.
	10-25 kW	109	155	1,007	2,160	59	187	912	2,035	.	.	.	.
	25+ kW	80	1,640	11,276	27,060	55	758	3,102	7,231	62	1,326	9,050	20,412
	All	424	31	2,463	6,755	195	70	1,233	3,019	79	157	7,152	20,067

Table E-37: Residential, All Sites Chance of Export and Average Export Amount by Quarter, Incentive Type, and PA

Sector / Quarter		Program Administrator											
		PG&E				SCE				CCSE			
		Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
EPBB	**Jan - Mar**	1,777	3.3%	723	153	1,510	7.9%	588	172	665	9.2%	441	152
	Apr - Jun	19,007	33.3%	196	220	6,872	34.9%	228	241	3,530	47.1%	58	240
	Jul - Sep	14,870	26.0%	376	207	3,068	15.5%	639	185	2,246	30.2%	250	197
	Oct - Dec	3,726	6.5%	578	140	1,488	7.7%	594	154	749	10.0%	420	134
	All	39,380	17.4%	466	205	12,938	16.6%	512	209	7,190	24.3%	292	207
FiveYearPBI	**Jan - Mar**	10	3.8%	1,085	228	60	11.9%	499	234	48	23.3%	382	107
	Apr - Jun	114	41.5%	156	306	225	43.9%	146	284	193	72.6%	-138	289
	Jul - Sep	63	22.7%	543	636	62	12.1%	1,009	214	145	55.6%	-9	270
	Oct - Dec	20	7.2%	917	187	50	9.8%	575	155	66	26.3%	280	122
	All	207	19.0%	669	393	397	19.5%	557	249	452	45.9%	115	238

Table E-38: Residential, Annual Net Exporters Chance of Export and Average Export Amount by Quarter, Incentive Type, and PA

Sector / Quarter		Program Administrator											
		PG&E				SCE				CCSE			
		Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
EPBB	**Jan - Mar**	1,065	17.6%	289	162	888	33.1%	108	186	518	32.7%	129	157
	Apr - Jun	5,621	88.0%	-279	340	2,429	88.8%	-282	345	1,498	91.1%	-291	342
	Jul - Sep	4,914	77.4%	-187	314	1,580	57.5%	18	230	1,183	72.3%	-104	253
	Oct - Dec	2,289	36.0%	131	161	1,039	38.6%	85	161	599	36.8%	97	146
	All	13,889	55.2%	-16	288	5,936	54.7%	-18	258	3,798	58.5%	-42	258
FiveYearPBI	**Jan - Mar**	4	15.4%	688	200	22	36.1%	176	137	42	35.9%	281	115
	Apr - Jun	26	92.9%	-534	548	58	89.2%	-293	372	136	88.9%	-280	355
	Jul - Sep	22	81.5%	-264	362	30	49.2%	35	201	115	77.7%	-182	304
	Oct - Dec	9	33.3%	210	260	24	36.9%	88	155	61	41.8%	128	127
	All	61	56.5%	11	416	134	53.2%	-1	255	354	62.8%	-29	268

Table E-39: Commercial, All Sites Chance of Export and Average Export Amount by Quarter, Incentive Type, and PA

Sector / Quarter		Program Administrator											
		PG&E				SCE				CCSE			
		Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
EPBB	**Jan - Mar**	211	15.8%	4,615	697	33	9.5%	19,556	707	11	18.6%	3,375	1,767
	Apr - Jun	524	37.8%	3,518	943	111	31.1%	18,847	869	21	30.9%	3,104	1,396
	Jul - Sep	344	24.7%	4,694	824	58	16.2%	21,792	577	9	12.9%	3,648	1,478
	Oct - Dec	206	14.9%	4,896	555	26	7.4%	20,934	351	6	9.0%	4,343	615
	All	1,285	23.4%	4,429	808	228	16.1%	20,289	712	47	17.8%	3,619	1,429
FiveYearPBI	**Jan - Mar**	59	12.7%	62,271	8,870	13	2.1%	224,797	6,726	2	4.8%	344,582	35,603
	Apr - Jun	137	29.0%	46,305	14,914	28	4.4%	219,448	3,533	7	14.3%	274,068	7,440
	Jul - Sep	83	17.8%	62,828	12,798	12	1.9%	260,837	1,590	2	3.3%	372,580	262
	Oct - Dec	26	5.6%	82,185	5,138	11	1.8%	244,852	6,860	0	0.0%	510,620	.
	All	305	16.3%	63,037	12,375	64	2.6%	237,570	4,383	11	5.7%	371,065	12,717

Table E-40: Commercial, Annual Net Exporters Chance of Export and Average Export Amount by Quarter, Incentive Type, and PA

Sector / Quarter		Program Administrator											
		PG&E				SCE				CCSE			
		Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
EPBB	**Jan - Mar**	131	42.0%	238	601	27	36.5%	196	722	8	66.7%	-221	773
	Apr - Jun	255	79.9%	-631	988	67	88.2%	-691	1,014	17	94.4%	-1,428	1,627
	Jul - Sep	191	59.9%	-146	865	46	59.0%	102	627	5	33.3%	-98	865
	Oct - Dec	143	46.1%	167	526	25	34.7%	252	363	5	33.3%	538	379
	All	720	57.1%	-98	793	165	55.0%	-37	759	35	58.3%	-365	1,138
FiveYearPBI	**Jan - Mar**	21	30.9%	3,512	5,763	2	33.3%	1,134	996	.	.	.	.
	Apr - Jun	56	83.6%	-4,598	8,308	6	100.0%	-3,283	3,283	.	.	.	.
	Jul - Sep	36	55.4%	893	10,377	6	100.0%	-1,549	1,549	.	.	.	.
	Oct - Dec	14	21.9%	11,849	5,261	3	50.0%	455	501	.	.	.	.
	All	127	48.1%	2,735	8,122	17	70.8%	-797	1,904	.	.	.	.

Table E-41: Gov./Non-Profit, All Sites Chance of Export and Average Export Amount by Quarter, Incentive Type, and PA

Sector / Quarter		Program Administrator											
		PG&E				SCE				CCSE			
		Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
EPBB	**Jan - Mar**	18	3.1%	13,957	320	19	10.6%	677,805	336	2	6.9%	22,381	123
	Apr - Jun	130	20.9%	10,944	761	46	25.6%	677,057	636	9	30.0%	26,468	459
	Jul - Sep	144	23.5%	9,998	946	20	11.0%	763,949	246	1	3.2%	33,686	109
	Oct - Dec	42	6.6%	12,298	283	8	4.4%	709,335	166	3	10.0%	30,429	149
	All	334	13.6%	11,784	759	93	12.9%	707,224	449	15	12.5%	28,285	318
FiveYearPBI	**Jan - Mar**	10	5.2%	71,885	2,399	1	1.4%	539,397	29	3	10.0%	29,368	61,796
	Apr - Jun	82	40.8%	45,978	7,431	9	11.5%	564,896	4,725	25	64.1%	31,168	20,840
	Jul - Sep	76	37.6%	38,111	8,271	3	3.9%	699,868	7,483	17	48.6%	69,293	9,257
	Oct - Dec	11	5.3%	58,143	3,017	3	4.1%	643,702	1,641	8	28.6%	56,512	14,914
	All	179	22.3%	53,400	7,254	16	5.3%	612,760	4,368	53	40.2%	45,880	19,324

Table E-42: Gov./Non-Profit, Annual Net Exporters Chance of Export and Average Export Amount by Quarter, Incentive Type, and PA

Sector / Quarter		Program Administrator											
		PG&E				SCE				CCSE			
		Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
EPBB	**Jan - Mar**	12	23.1%	667	411	13	39.4%	198	359	1	33.3%	50	22
	Apr - Jun	40	81.6%	-526	779	27	81.8%	-575	816	3	100.0%	-370	370
	Jul - Sep	41	83.7%	-734	965	17	51.5%	326	276	1	33.3%	-5	109
	Oct - Dec	24	44.4%	335	306	6	18.2%	513	134	3	100.0%	-149	149
	All	117	57.4%	-39	706	63	47.7%	121	509	8	66.7%	-118	208
FiveYearPBI	**Jan - Mar**	5	14.7%	9,412	2,393	0	0.0%	3,618	.	0	0.0%	15,988	.
	Apr - Jun	33	91.7%	-11,627	13,498	3	100.0%	-5,315	5,315	23	95.8%	-17,973	19,071
	Jul - Sep	31	86.1%	-8,773	12,982	2	66.7%	-4,492	7,056	17	100.0%	-9,257	9,257
	Oct - Dec	10	26.3%	12,956	3,263	3	100.0%	-1,641	1,641	6	46.2%	9,667	5,451
	All	79	54.9%	324	11,295	8	66.7%	-1,920	4,320	46	63.9%	-1,904	13,733

Table E-43: Residential, All Sites Chance of Export and Average Export Amount by Quarter, Location, and PA

Sector / Quarter		Program Administrator											
		PG&E				SCE				CCSE			
		Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
Coastal	**Jan - Mar**	876	2.7%	711	143	251	5.3%	610	122	403	9.8%	413	124
	Apr - Jun	10,936	32.6%	205	197	1,623	33.8%	228	175	1,976	46.1%	78	194
	Jul - Sep	11,562	34.5%	211	206	1,348	27.9%	312	159	1,378	32.0%	212	167
	Oct - Dec	2,274	6.8%	563	132	346	7.3%	545	117	435	10.1%	394	113
	All	25,648	19.3%	419	193	3,568	18.7%	424	160	4,192	24.7%	274	170
Inland	**Jan - Mar**	911	4.0%	745	164	1,319	8.8%	578	184	310	9.3%	471	181
	Apr - Jun	8,185	34.4%	183	251	5,474	35.6%	225	262	1,747	50.3%	20	298
	Jul - Sep	3,371	14.1%	612	220	1,782	11.6%	754	206	1,013	29.8%	281	247
	Oct - Dec	1,472	6.2%	603	154	1,192	7.9%	608	165	380	11.1%	443	157
	All	13,939	14.8%	533	228	9,767	16.0%	542	229	3,450	25.3%	304	256

Table E-44: Residential, Annual Net Exporters Chance of Export and Average Export Amount by Quarter, Location, and PA

Sector / Quarter		Program Administrator											
		PG&E				SCE				CCSE			
		Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
Coastal	**Jan - Mar**	641	15.8%	278	150	196	25.8%	131	128	312	34.7%	112	136
	Apr - Jun	3,742	87.4%	-243	301	690	89.8%	-199	237	851	90.3%	-223	268
	Jul - Sep	3,631	85.4%	-243	315	591	76.6%	-102	199	737	77.5%	-108	213
	Oct - Dec	1,453	34.1%	135	148	273	35.9%	87	117	350	37.2%	83	122
	All	9,467	56.2%	-23	273	1,750	57.2%	-20	193	2,250	60.3%	-35	209
Inland	**Jan - Mar**	428	21.1%	315	181	714	36.0%	101	200	248	30.9%	169	176
	Apr - Jun	1,905	89.2%	-355	419	1,797	88.4%	-313	387	783	91.6%	-367	427
	Jul - Sep	1,305	61.6%	-74	312	1,019	50.1%	64	248	561	67.3%	-112	313
	Oct - Dec	845	39.7%	124	182	790	39.5%	84	176	310	37.2%	116	169
	All	4,483	53.3%	-1	321	4,320	53.7%	-16	284	1,902	57.2%	-49	317

Table E-45: Commercial, All Sites Chance of Export and Average Export Amount by Quarter, Location, and PA

Sector / Quarter		Program Administrator											
		PG&E				SCE				CCSE			
		Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
Coastal	**Jan - Mar**	112	11.3%	20,860	1,047	5	3.2%	87,439	755	1	1.6%	57,069	310
	Apr - Jun	347	33.6%	16,090	2,709	21	13.1%	82,626	655	5	6.9%	63,309	1,126
	Jul - Sep	283	27.6%	17,585	2,104	18	11.2%	94,327	731	5	6.7%	76,128	421
	Oct - Dec	102	9.9%	21,940	990	6	3.8%	93,365	505	0	0.0%	65,150	.
	All	844	20.7%	19,074	2,078	50	7.9%	89,475	674	11	4.0%	65,624	733
Inland	**Jan - Mar**	158	19.6%	18,091	3,480	41	5.1%	162,531	2,622	12	30.8%	274,544	7,693
	Apr - Jun	314	37.9%	12,705	5,091	118	14.3%	159,338	1,537	23	51.1%	192,605	3,151
	Jul - Sep	144	17.3%	21,876	5,155	52	6.3%	189,596	758	6	10.7%	289,329	2,136
	Oct - Dec	130	15.8%	26,134	1,078	31	3.8%	177,442	2,542	6	15.0%	408,935	615
	All	746	22.7%	19,687	4,067	242	7.4%	172,295	1,685	47	26.1%	289,134	4,067

Table E-46: Commercial, Annual Net Exporters Chance of Export and Average Export Amount by Quarter, Location, and PA

Sector / Quarter		Program Administrator											
		PG&E				SCE				CCSE			
		Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
Coastal	**Jan - Mar**	77	36.5%	1,462	852	4	26.7%	139	915	1	33.3%	829	310
	Apr - Jun	175	81.0%	-1,873	2,530	15	100.0%	-748	748	3	100.0%	-1,792	1,792
	Jul - Sep	146	67.6%	-716	2,052	14	93.3%	-790	857	2	100.0%	-630	630
	Oct - Dec	82	39.2%	2,072	933	6	40.0%	-11	505	0	0.0%	1,334	.
	All	480	56.3%	199	1,841	39	65.0%	-351	767	6	50.0%	-28	1,163
Inland	**Jan - Mar**	75	44.4%	40	1,842	25	38.5%	296	713	7	77.8%	-568	842
	Apr - Jun	136	80.0%	-623	2,006	58	86.6%	-910	1,318	14	93.3%	-1,336	1,582
	Jul - Sep	81	48.2%	979	2,832	38	55.1%	153	688	3	23.1%	1	1,022
	Oct - Dec	75	45.5%	2,128	931	22	34.9%	333	344	5	45.5%	270	379
	All	367	54.6%	626	1,939	143	54.2%	-35	893	29	60.4%	-456	1,132

Table E-47: Gov./Non-Profit, All Sites Chance of Export and Average Export Amount by Quarter, Location, and PA

Sector / Quarter		Program Administrator											
		PG&E				SCE				CCSE			
		Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
Coastal	**Jan - Mar**	13	2.1%	30,204	885	9	9.5%	604,610	159	1	4.3%	53,786	237
	Apr - Jun	153	24.1%	21,546	3,367	15	15.6%	597,700	304	4	16.0%	59,815	590
	Jul - Sep	182	28.8%	18,235	3,266	10	10.5%	613,839	204	0	0.0%	81,044	.
	Oct - Dec	27	4.2%	25,451	483	4	4.1%	629,955	68	0	0.0%	67,104	.
	All	375	14.9%	23,818	3,033	38	9.9%	611,694	218	5	4.6%	66,424	522
Inland	**Jan - Mar**	15	8.5%	22,126	1,164	11	7.1%	659,257	458	4	11.1%	7,947	45,222
	Apr - Jun	59	31.2%	13,173	3,286	40	24.7%	670,086	1,672	30	68.2%	8,878	17,179
	Jul - Sep	38	20.8%	12,455	4,651	13	8.0%	821,620	1,968	18	51.4%	22,337	8,579
	Oct - Dec	26	13.3%	16,029	1,275	7	4.5%	728,533	871	11	37.9%	14,436	9,221
	All	138	18.5%	15,870	3,057	71	11.2%	720,656	1,460	63	43.8%	12,925	15,719

Table E-48: Gov./Non-Profit, Annual Net Exporters Chance of Export and Average Export Amount by Quarter, Location, and PA

Sector / Quarter		Program Administrator											
		PG&E				SCE				CCSE			
		Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
Coastal	Jan - Mar	8	16.0%	6,162	1,144	8	53.3%	-15	150	.	.	.	.
	Apr - Jun	42	85.7%	-7,046	8,841	13	86.7%	-233	291	.	.	.	.
	Jul - Sep	43	86.0%	-5,490	8,201	10	66.7%	-23	204	.	.	.	.
	Oct - Dec	14	25.5%	9,195	655	4	26.7%	67	68	.	.	.	.
	All	107	52.5%	859	6,950	35	58.3%	-50	208	.	.	.	.
Inland	Jan - Mar	9	25.0%	1,344	911	5	23.8%	832	704	1	4.8%	13,342	22
	Apr - Jun	31	86.1%	-2,728	3,351	17	81.0%	-1,489	2,005	26	96.3%	-15,459	16,272
	Jul - Sep	29	82.9%	-2,626	3,631	9	42.9%	-106	1,863	18	90.0%	-7,542	8,579
	Oct - Dec	20	54.1%	167	1,576	5	23.8%	519	1,105	9	56.3%	7,371	3,132
	All	89	61.8%	-943	2,790	36	42.9%	-47	1,662	54	64.3%	-1,589	11,125

Table E-49: Residential, All Sites Chance of Export and Average Export Amount by Quarter, Third-Party Ownership, and PA

Sector / Quarter		Program Administrator											
		PG&E				SCE				CCSE			
		Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
Host Owned	**Jan - Mar**	1,585	3.3%	722	154	1,358	8.0%	582	171	671	10.1%	434	152
	Apr - Jun	16,997	33.8%	194	220	6,166	35.3%	219	241	3,392	48.8%	49	245
	Jul - Sep	13,718	27.2%	364	209	2,753	15.7%	636	184	2,209	32.0%	237	201
	Oct - Dec	3,447	6.8%	574	140	1,359	7.9%	583	152	774	11.2%	411	135
	All	35,747	17.9%	461	205	11,636	16.8%	505	209	7,046	25.7%	282	210
Third Party Owned	**Jan - Mar**	202	3.0%	747	146	212	8.0%	613	193	42	5.4%	483	100
	Apr - Jun	2,124	30.3%	209	224	931	34.4%	267	251	331	41.3%	78	215
	Jul - Sep	1,215	17.4%	471	209	377	13.9%	730	201	182	22.9%	294	199
	Oct - Dec	299	4.2%	622	142	179	6.8%	659	174	41	5.1%	455	104
	All	3,840	13.8%	509	209	1,699	15.9%	568	224	596	18.7%	328	194

Table E-50: Residential, Annual Net Exporters Chance of Export and Average Export Amount by Quarter, Third-Party Ownership, and PA

Sector / Quarter		Program Administrator											
		PG&E				SCE				CCSE			
		Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
Host Owned	**Jan - Mar**	971	17.3%	287	162	802	32.8%	111	180	536	33.5%	133	157
	Apr - Jun	5,222	88.0%	-277	337	2,221	89.0%	-277	337	1,545	91.1%	-294	345
	Jul - Sep	4,629	78.7%	-195	314	1,433	57.3%	21	224	1,236	73.4%	-110	254
	Oct - Dec	2,142	36.3%	126	160	965	39.2%	78	159	633	37.7%	95	146
	All	12,964	55.6%	-20	287	5,421	54.8%	-17	252	3,950	59.3%	-45	259
Third Party Owned	**Jan - Mar**	98	20.9%	332	161	108	35.6%	93	219	24	24.5%	227	86
	Apr - Jun	425	87.6%	-315	384	266	87.2%	-320	412	89	88.1%	-235	311
	Jul - Sep	307	63.0%	-85	309	177	57.8%	-8	278	62	62.6%	-108	306
	Oct - Dec	156	31.8%	203	176	98	32.9%	139	180	27	27.6%	162	108
	All	986	51.0%	31	306	649	53.5%	-24	308	202	51.0%	11	255

Table E-51: Commercial, All Sites Chance of Export and Average Export Amount by Quarter, Third-Party Ownership, and PA

Sector / Quarter		Program Administrator											
		PG&E				SCE				CCSE			
		Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
Host Owned	**Jan - Mar**	239	16.9%	12,788	2,223	29	6.3%	147,892	698	11	12.8%	149,330	1,767
	Apr - Jun	534	36.4%	10,073	2,380	100	20.9%	150,205	863	25	25.5%	123,341	1,311
	Jul - Sep	336	22.8%	12,975	1,715	56	11.6%	171,936	585	11	9.6%	174,158	1,308
	Oct - Dec	206	14.1%	15,540	915	25	5.3%	157,776	353	6	6.2%	199,402	615
	All	1,315	22.6%	12,835	1,951	210	11.1%	157,053	705	53	13.4%	162,144	1,351
Third Party Owned	**Jan - Mar**	31	8.0%	44,620	4,455	17	3.4%	152,427	5,363	2	13.3%	46,108	35,603
	Apr - Jun	127	32.3%	31,301	9,888	39	7.7%	143,933	2,797	3	15.8%	34,624	17,348
	Jul - Sep	91	23.8%	44,240	8,479	14	2.8%	176,273	1,414	0	0.0%	81,771	.
	Oct - Dec	26	6.8%	56,074	2,019	12	2.4%	169,168	6,280	0	0.0%	65,795	.
	All	275	17.8%	43,859	8,086	82	4.1%	160,473	3,597	5	8.3%	55,921	26,323

Table E-52: Commercial, Annual Net Exporters Chance of Export and Average Export Amount by Quarter, Third-Party Ownership, and PA

Sector / Quarter		Program Administrator											
		PG&E				SCE				CCSE			
		Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
Host Owned	**Jan - Mar**	134	43.8%	-122	1,206	26	36.6%	156	725	8	66.7%	-221	773
	Apr - Jun	248	79.5%	-232	1,066	64	87.7%	-664	998	17	94.4%	-1,428	1,627
	Jul - Sep	180	57.3%	757	788	46	61.3%	81	627	5	33.3%	-98	865
	Oct - Dec	139	45.7%	148	704	24	34.8%	262	366	5	33.3%	538	379
	All	701	56.7%	142	949	160	55.6%	-44	752	35	58.3%	-365	1,138
Third Party Owned	**Jan - Mar**	18	24.3%	4,804	2,334	3	33.3%	1,140	869	.	.	.	.
	Apr - Jun	63	85.1%	-5,824	7,147	9	100.0%	-2,632	2,632	.	.	.	.
	Jul - Sep	47	67.1%	-3,207	8,298	6	66.7%	-823	1,549	.	.	.	.
	Oct - Dec	18	25.7%	10,801	2,702	4	44.4%	309	451	.	.	.	.
	All	146	50.7%	1,437	6,381	22	61.1%	-492	1,692	.	.	.	.

Table E-53: Gov./Non-Profit, All Sites Chance of Export and Average Export Amount by Quarter, Third-Party Ownership, and PA

Sector / Quarter		Program Administrator											
		PG&E				SCE				CCSE			
		Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
Host Owned	**Jan - Mar**	21	3.4%	24,323	690	19	9.3%	662,478	314	2	5.7%	34,567	123
	Apr - Jun	133	20.7%	18,458	1,106	46	22.1%	659,729	601	9	23.7%	39,992	459
	Jul - Sep	146	22.7%	15,934	995	18	8.6%	745,195	220	1	2.3%	57,194	109
	Oct - Dec	43	6.5%	19,263	286	8	3.9%	697,081	166	3	7.7%	49,790	149
	All	343	13.4%	19,443	934	91	11.0%	691,352	426	15	9.6%	45,906	318
Third Party Owned	**Jan - Mar**	7	4.0%	42,419	2,011	1	2.2%	529,317	457	3	12.5%	11,893	61,796
	Apr - Jun	79	44.1%	23,719	7,109	9	18.0%	574,154	4,923	25	80.6%	13,005	20,840
	Jul - Sep	74	42.8%	20,633	8,274	5	10.2%	743,840	4,707	17	77.3%	36,678	9,257
	Oct - Dec	10	5.5%	38,633	3,263	3	6.3%	661,018	1,641	8	42.1%	23,073	14,914
	All	170	24.0%	31,306	7,183	18	9.4%	628,176	4,051	53	55.2%	19,931	19,324

Table E-54: Gov./Non-Profit, Annual Net Exporters Chance of Export and Average Export Amount by Quarter, Third-Party Ownership, and PA

Sector / Quarter		Program Administrator											
		PG&E				SCE				CCSE			
		Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh	Total Export Bills in Summary	Chance of Export	Average Monthly Post-Install kWh	Average Monthly Export kWh
Host Owned	**Jan - Mar**	12	23.1%	667	411	12	40.0%	188	352	1	33.3%	50	22
	Apr - Jun	40	81.6%	-526	779	24	80.0%	-507	761	3	100.0%	-370	370
	Jul - Sep	41	83.7%	-734	965	15	50.0%	385	249	1	33.3%	-5	109
	Oct - Dec	24	44.4%	335	306	6	20.0%	419	134	3	100.0%	-149	149
	All	117	57.4%	-39	706	57	47.5%	126	472	8	66.7%	-118	208
Third Party Owned	**Jan - Mar**	5	14.7%	9,412	2,393	1	16.7%	1,947	457	0	0.0%	15,988	.
	Apr - Jun	33	91.7%	-11,627	13,498	6	100.0%	-3,261	3,261	23	95.8%	-17,973	19,071
	Jul - Sep	31	86.1%	-8,773	12,982	4	66.7%	-2,363	3,765	17	100.0%	-9,257	9,257
	Oct - Dec	10	26.3%	12,956	3,263	3	50.0%	-115	1,641	6	46.2%	9,667	5,451
	All	79	54.9%	324	11,295	14	58.3%	-925	2,852	46	63.9%	-1,904	13,733

Appendix F

Additional Tables for Program Status

Table F-1: CSI GM Systems—Trend in Third-Party Ownership by Incentive Type for PG&E

Year	EPBB				PBI			
	Installed Systems –All EPBB	Installed Systems –Third-Party-Owned (% of EPBB)	Installed Capacity –All EPBB (MW)	Installed Capacity –Third-Party-Owned (% of EPBB)	Installed Systems –All PBIs	Installed Systems –Third-Party-Owned (% of PBI)	Installed Capacity –All PBI (MW)	Installed Capacity –Third-Party-Owned (% of PBI)
2007	2,442	6%	13	11%	40	13%	3	53%
2008	5,388	9%	34	21%	139	49%	27	66%
2009	7,408	12%	40	17%	167	34%	47	46%
2010	8,738	22%	47	22%	137	33%	41	42%
Total	**23,976**	**15%**	**134**	**19%**	**483**	**36%**	**118**	**49%**

Table F-2: CSI GM Systems—Trend in Third-Party Ownership by Incentive Type for SCE

Year	EPBB				PBI			
	Installed Systems –All EPBB	Installed Systems –Third-Party-Owned (% of EPBB)	Installed Capacity –All EPBB (MW)	Installed Capacity –Third-Party-Owned (% of EPBB)	Installed Systems –All PBIs	Installed Systems –Third-Party-Owned (% of PBI)	Installed Capacity –All PBI (MW)	Installed Capacity –Third-Party-Owned (% of PBI)
2007	615	31%	4	29%	23	43%	4	77%
2008	2,016	8%	16	22%	134	39%	24	67%
2009	3,280	13%	18	17%	138	32%	27	78%
2010	5,171	24%	25	26%	122	20%	23	40%
Total	**11,082**	**18%**	**63**	**22%**	**417**	**31%**	**77**	**63%**

Table F-3: CSI GM Systems—Trend in Third-Party Ownership by Incentive Type for CCSE

Year	EPBB				PBI			
	Installed Systems –All EPBB	Installed Systems –Third-Party-Owned (% of EPBB)	Installed Capacity –All EPBB (MW)	Installed Capacity –Third-Party-Owned (% of EPBB)	Installed Systems –All PBIs	Installed Systems –Third-Party-Owned (% of PBI)	Installed Capacity –All PBI (MW)	Installed Capacity –Third-Party-Owned (% of PBI)
2007	308	1%	1	3%	12	8%	1	51%
2008	700	7%	3	7%	58	28%	8	52%
2009	1,996	11%	9	11%	55	33%	4	77%
2010	2,490	13%	12	13%	86	16%	7	51%
Total	**5,494**	**11%**	**26**	**11%**	**211**	**23%**	**20**	**57%**

Table F-4: CSI GM PV Systems—Trend in Median Size of Residential and Non-Residential Installations by PA

Quarter and Year	Residential			Non-Residential		
	PG&E	SCE	CCSE	PG&E	SCE	CCSE
Q1_2007	3.46	4.46		99	30	201
Q2_2007	3.86	5.01	4.30	50		
Q3_2007	3.82	4.98	3.87	33	90	
Q4_2007	3.75	4.38	3.36	52	200	69
Q1_2008	3.68	4.36	3.67	39	126	232
Q2_2008	3.98	4.45	3.56	41	198	53
Q3_2008	3.98	3.80	3.71	81	117	93
Q4_2008	3.61	3.85	3.52	97	102	99
Q1_2009	3.92	4.09	4.07	43	179	102
Q2_2009	3.85	4.17	3.66	33	215	22
Q3_2009	4.08	4.21	4.15	48	40	42
Q4_2009	4.29	3.93	3.90	64	46	32
Q1_2010	4.37	3.74	4.06	38	51	65
Q2_2010	4.49	4.26	4.05	28	88	75
Q3_2010	4.65	4.10	4.11	37	94	89
Q4_2010	4.45	4.02	4.18	30	28	28

Table F-5: California IOU Public Purpose Program PV Systems*—Trend in Annual Installed Capacity and Number of Installations by PA

Year	PG&E		SCE		CCSE	
	Installed Capacity (MW)	Installed Systems	Installed Capacity (MW)	Installed Systems	Installed Capacity (MW)	Installed Systems
1998	0	27	0	14		
1999	0	127	0	47	0	6
2000	0	125	0	59	0	31
2001	2	650	1	311	1	275
2002	7	1,331	3	596	2	337
2003	13	1,741	10	763	3	466
2004	22	3,069	10	1,041	4	622
2005	25	2,673	11	790	6	621
2006	35	3,970	18	1,263	7	1,026
2007	60	6,351	19	2,069	7	1,055
2008	72	6,121	44	2,442	12	930
2009	89	8,134	47	3,676	15	2,297
2010	90	9,225	49	5,516	19	2,678
Total	**416**	**43,544**	**212**	**18,587**	**77**	**10,344**

* CSI GM, SGIP, MASH, and ERP.

Table F-6: California IOU Public Purpose Program PV Systems*—Trend in Annual Installed Capacity and Number of Installations by Customer Class for PG&E

Year	Residential		Non-Residential	
	Installed Capacity (MW)	Installed Systems	Installed Capacity (MW)	Installed Systems
1998	0.1	27		
1999	0.3	125	0.1	2
2000	0.3	122	0.1	3
2001	1.9	647	0.2	3
2002	4.1	1,301	3.1	30
2003	6.3	1,675	6.3	66
2004	10.9	2,931	11.3	138
2005	10.0	2,512	15.2	161
2006	16.1	3,753	18.6	217
2007	26.3	6,039	33.3	312
2008	25.6	5,794	46.7	327
2009	37.0	7,890	51.8	244
2010	46.8	8,962	43.6	263
Total	**185.7**	**41,778**	**230.4**	**1,766**

* CSI GM, SGIP, MASH, and ERP.

Table F-7: California IOU Public Purpose Program PV Systems*—Trend in Annual Installed Capacity and Number of Installations by Customer Class for SCE

Year	Residential		Non-Residential	
	Installed Capacity (MW)	Installed Systems	Installed Capacity (MW)	Installed Systems
1998	0.0	12	0.1	2
1999	0.1	45	0.1	2
2000	0.1	58	0.0	1
2001	0.9	309	0.2	2
2002	1.9	580	0.8	16
2003	2.9	699	7.5	64
2004	4.3	968	5.5	73
2005	3.1	691	7.5	99
2006	5.5	1,176	12.5	87
2007	9.4	1,986	10.1	83
2008	10.6	2,292	33.1	150
2009	16.8	3,561	29.7	115
2010	24.9	5,378	24.3	138
Total	**80.4**	**17,755**	**131.4**	**832**

* CSI GM, SGIP, MASH, and ERP.

Table F-8: California IOU Public Purpose Program PV Systems*—Trend in Annual Installed Capacity and Number of Installations by Customer Class for CCSE

Year	Residential		Non-Residential	
	Installed Capacity (MW)	Installed Systems	Installed Capacity (MW)	Installed Systems
1998				
1999	0.0	6		
2000	0.1	30	0.0	1
2001	0.7	274	0.1	1
2002	1.0	330	1.0	7
2003	1.6	452	1.6	14
2004	2.2	598	1.5	24
2005	1.9	575	4.6	46
2006	2.9	988	3.9	38
2007	4.0	1,018	3.4	37
2008	3.5	882	8.6	48
2009	9.8	2,252	5.0	45
2010	12.3	2,626	7.2	52
Total	**39.9**	**10,031**	**36.7**	**313**

* CSI GM, SGIP, MASH, and ERP.

Table F-9: California IOU Public Purpose Program PV Systems*—Trend in Costs by Customer Class and PA

Year	PG&E		SCE		CCSE	
	Residential	Non-Residential	Residential	Non-Residential	Residential	Non-Residential
1998	13.4		16.8	11.2		
1999	13.0	21.2	20.6	11.2	11.7	
2000	12.4	9.7	12.6	6.8	12.7	9.5
2001	13.0	10.4	12.2	7.8	11.9	7.4
2002	12.6	10.0	12.5	11.6	12.0	11.7
2003	11.4	9.1	11.1	9.9	10.7	7.0
2004	10.4	9.7	10.1	10.0	9.7	9.1
2005	9.7	8.8	9.6	9.7	9.4	9.6
2006	9.8	8.8	9.7	9.2	9.4	8.8
2007	10.0	11.7	9.9	9.1	9.5	8.2
2008	9.6	8.8	9.5	7.9	9.5	8.5
2009	9.1	8.9	9.5	8.5	9.0	8.8
2010	7.7	6.9	8.5	6.7	7.8	7.5

* CSI GM, SGIP, MASH, and ERP

Table F-10: California IOU Public Purpose Program PV Systems*—Cost of Residential Systems by Size and PA

System Size (kW)	PG&E	SCE	CCSE
0-0.5	17.3	15.4	16.4
0.5-1	13.6	14.0	11.2
1-1.5	11.9	13.4	12.6
1.5-2	11.0	12.4	10.5
2-2.5	10.5	10.9	10.2
2.5-3	9.9	10.1	9.6
3-3.5	9.7	10.0	9.3
3.5-4	9.5	9.7	9.2
4-4.5	9.3	9.3	8.8
4.5-5	9.3	9.4	9.0
5-5.5	9.1	9.2	8.4
5.5-6	9.0	9.0	8.5
6-6.5	9.0	9.0	8.5
6.5-7	8.7	8.7	8.2
7-7.5	8.9	9.0	8.6
7.5-8	8.8	8.8	8.4
8-8.5	8.9	8.8	8.6
8.5-9	8.8	8.7	8.3
9-9.5	9.1	9.2	8.2
9.5-10	9.6	9.7	9.3
10+	8.8	9.0	8.2

* CSI GM, MASH, SGIP, and ERP. Costs as of December 31, 2010.

Table F-11: California IOU Public Purpose Program PV Systems*—Cost of Non-Residential Systems by Size and PA

System Size (kW)	PG&E	SCE	CCSE
0-30	9.11	9.19	8.77
30-50	9.35	9.57	9.46
50-100	9.22	9.77	8.85
100-200	9.47	9.48	8.87
200-300	8.80	8.66	8.35
300-400	8.37	7.50	8.53
400-500	8.58	7.64	9.03
500+	8.93	8.03	8.07

* CSI GM, SGIP, and ERP. Costs are as of December 31, 2010.

Table F-12: California IOU Public Purpose Program PV Systems*—Trend in Annual Installed Capacity and Number of Installations for Residential Customers by Size and PA

System Size (kW)	PG&E		SCE		CCSE	
	Installed Capacity (MW)	Installed Systems	Installed Capacity (MW)	Installed Systems	Installed Capacity (MW)	Installed Systems
0-0.5	0.02	54	0.01	33	0.01	22
0.5-1	0.37	428	0.11	135	0.46	521
1-1.5	2.54	2061	0.86	694	1.01	828
1.5-2	5.28	2982	3.00	1698	1.62	907
2-2.5	11.96	5236	4.33	1902	3.12	1392
2.5-3	12.93	4758	4.87	1796	2.37	867
3-3.5	12.20	3750	4.70	1453	2.27	700
3.5-4	13.68	3664	5.92	1582	3.00	803
4-4.5	13.04	3080	5.51	1301	2.90	687
4.5-5	14.96	3120	6.67	1392	3.11	649
5-5.5	14.54	2798	6.67	1282	2.97	572
5.5-6	9.14	1585	4.14	718	2.25	391
6-6.5	8.23	1324	4.02	647	1.90	306
6.5-7	8.41	1249	3.86	575	1.72	255
7-7.5	9.22	1274	3.99	549	2.32	321
7.5-8	5.35	695	2.85	369	1.14	148
8-8.5	4.65	565	2.03	247	0.62	76
8.5-9	3.61	412	1.73	198	0.64	73
9-9.5	3.41	369	1.30	141	0.56	60
9.5-10	5.24	535	2.25	230	1.03	105
10+	26.89	1839	11.58	813	4.94	348

* CSI GM, ERP, SASH, MASH, and NSHP

Table F-13: California IOU Public Purpose Program PV Systems*—Trend in Annual Installed Capacity and Number of Installations for Non-Residential Customers by Size and PA

System Size (kW)	PG&E		SCE		CCSE	
	Installed Capacity (MW)	Installed Systems	Installed Capacity (MW)	Installed Systems	Installed Capacity (MW)	Installed Systems
0-30	15.5	739	4.9	251	2.2	104
30-50	11.7	310	6.9	182	2.4	62
50-100	15.6	209	7.0	98	3.6	50
100-200	27.8	195	12.8	91	6.1	46
200-300	19.8	84	15.4	65	5.3	23
300-400	23.2	68	13.9	41	2.3	7
400-500	19.8	44	15.3	33	2.2	5
500+	97.0	117	55.1	71	12.6	16

* CSI GM, ERP, and SGIP