CALIFORNIA
ENERGY
COMMISSION

EXPECTED PERFORMANCE BASED INCENTIVE CALCULATION COMPARISON BETWEEN NSHP (EPBI) AND CSI (EPBB) CALCULATORS

STAFF REPORT

December 2007
CEC-300-2007-014

Arnold Schwarzenegger, *Governor*

CALIFORNIA ENERGY COMMISSION

Smita Gupta
Principal Author

Claudia Orlando
Supervisor

Bill Pennington
Manager
Buildings and Appliances Office

Valerie Hall
Deputy Director
Efficiency and Renewables Energy Division

Melissa Jones
Acting Executive Director

Acknowledgements

All charts and figures in this paper have been generated by Energy Commission staff unless otherwise stated. The data for the analysis presented in the charts is contributed by Patrick Saxton, Energy Commission staff.

Abstract

This staff white paper has been prepared in response to the comments from the stakeholders and solar industry related to the expected performance calculation methodology proposed in the Senate Bill 1 Guidelines for statewide solar incentive programs. The two main solar incentive calculation methodologies in California are the ones used by the California Energy Commission's New Solar Homes Partnership (NSHP) termed the expected performance based incentive (EPBI) and the one used by the California Public Utility Commission's (CPUC) California Solar Initiative (CSI) program, termed the expected performance based buy down (EPBB). This paper provides an overview of the main differences in the two methodologies, which result in the difference in incentive amounts paid by each, as a result of the policy and actual calculation that is employed by each.

Background

The two main solar incentive calculation methodologies in California are the ones used by the California Energy Commission's (Energy Commission)New Solar Homes Partnership (NSHP) and the one used by the California Public Utility Commission's (CPUC) California Solar Initiative (CSI) program. The NSHP provides upfront expected performance based incentives based on annual time dependent value weighted production (CECPV calculator[1]) to new residential construction in the three investor owned utilities (IOU) territories of the state, while the CSI provides incentives to all other market categories in the IOU territories. The CSI incentives are either performance based (PBI) payments over 5 years for larger systems or the option of an expected performance based buydown (EPBB[2]) for smaller systems. PBI incentives are required by the CPUC for systems larger than 100kW at this time and the scope of PBI incentives will be increased to all systems greater than 50kW in 2008 and 30kW in 2010.

There are two basic aspects of the incentive calculation methodology under each program. The incentive amounts provided by each methodology in specific instances are a function of these broader aspects.

1. Rule set: These are a function of the policy decisions made under the CSI by CPUC or the NSHP by the Energy Commission. The processing of results through the actual incentive equation and default fixed assumptions in the running of the calculation constitute the rule set.

    - For the NSHP this includes decisions such as: establishing the incentives in terms of $/kWh (TDV weighted); estimating system performance on an hourly basis; the use of 16 climate zone weather data; and for the purposes of converting an incentive level from $/watt to $/kWh, the selection of the reference system and location using a single azimuth.

    - For the CSI this includes decisions such as, establishing the incentives in terms of $/watt adjusted by a design factor; the establishment of a design factor that includes key performance characteristics in both the numerator and denominator; the cap placed on the design factor, the determination of the design factor for the six months of the year that include summer; the determination of the design correction using three different reference azimuths depending on the azimuth of the actual system; and the selection of the reference location and reference tilt for sub-parts of the design factor calculation.

2. Performance estimation engine: These are a function of how the engine used for each program (PVWatts v2 for CSI and CECPV for NSHP), calculates expected performance,

[1] CECPV can be downloaded from [http://www.gosolarcalifornia.ca.gov/nshpcalculator/download_calculator.html].

[2] EPBB calculations are web based and available at [http://www.csi-epbb.com/].

including default assumptions, module and inverter matching, and the modeling of weather and shading implications.

- For the NSHP-EPBI the CECPV engine uses the detailed performance characteristics of the actual module and inverter, compares the output of the modules to the capacity of the inverter on an hourly basis to determine system production, includes the impact of wind as well as solar insolation and ambient temperature on module performance, and calculates the impact of shading on an hourly basis.
- For the CSI-EPBB the PVWatts v2 engine is used for the design factor calculations. It uses default performance characteristics of a nominal crystalline silicon module to represent the performance characteristics of all modules, does not include the impact of wind in the calculations, represents solar insolation for 40 kilometer grids based on factoring the solar insolation data for 10 weather sites using PVWatts1.

The basic math of the two incentive calculations is shown below.

NSHP (EPBI) calculation

Note: The program incentive level is nominally characterized in \$/W (\$2.50/W). A one time calculation is necessary to convert this to $\$/kWh_{TDV}$ using this conversion equation.

$$\$/kWh_{TDV} = \frac{\text{Reference System Watts}_{CEC\text{-}AC} \times \$/\text{Watt (incentive level)}}{\text{Reference System Annual kWh}_{TDV}}$$

Expected performance incentive level

$$\text{Total Incentive } \$ = \text{Applicant System Annual kWh}_{TDV} \times \$/kWh_{TDV}$$

CECPV calculator generates this for each applicant system

CSI (EPBB) calculation

Capacity based incentive level description ($2.50/W)

$$\text{Total Incentive\$} = \text{Applicant System kW}_{\text{CEC - AC}} \times DesignFactor \times \boxed{\$/W}$$

$$DesignFactor = \text{DesignCorrection} \times GeographicCorrection$$

PVWatts used to determine Design factor using performance characteristics of a default system

Actual Azimuth of proposed system

$$DesignCorrection = \frac{Summer\_kWh\_ApplicantSystem}{Summer\_kWh\_ApplicantSystem\ @\ OptimalTilt\ @\ proposedLocation}$$

Actual Azimuth of proposed system if between 180 and 270 else 270 if between 45 and 270 or 180 if between 45 and 180

$$GeographicCorrection = \frac{Annual\_kWh\_ApplicantSystem\ @\ OptimalSummerTilt\ @\ proposedLocation}{Annual\_kWh\_ApplicantSystem\ @\ OptimalSummerTilt\ @\ referenceLocation}$$

South azimuth

Key differences

Addressing peak load

Senate Bill 1 (SB 1) calls for optimal system performance during peak demand periods. In setting policy principles in the *Integrated Energy Policy Report (IEPR)* for statewide implementation of the Governor's *Solar Initiative,* the Energy Commission defined solar systems as a means of meeting peak demand, thereby lowering electricity costs and rates. One of the key differences in the two calculation methodologies is the extent to which each addresses peak demand.

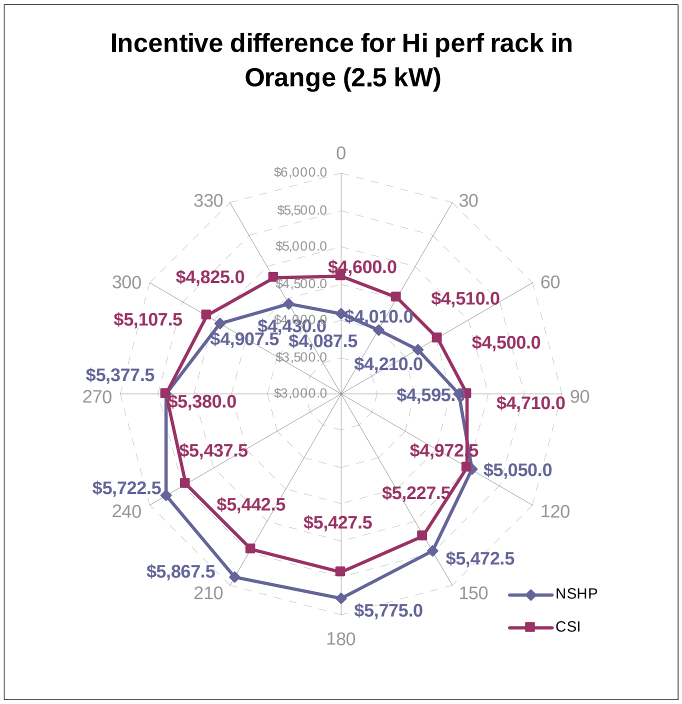
CSI-EPBB results are ***monthly estimates*** of production (using PVWATTS 2) and use ***"summer months"*** (May through October) for computing the design factor for adjusting the system capacity to calculate the incentive. The hours of peak demand in California occur within these six months around summer along with many hours that are outside of the peak demand periods, including off-peak and shoulder periods when the value of production is weighted as being equal to production during peak demand periods.

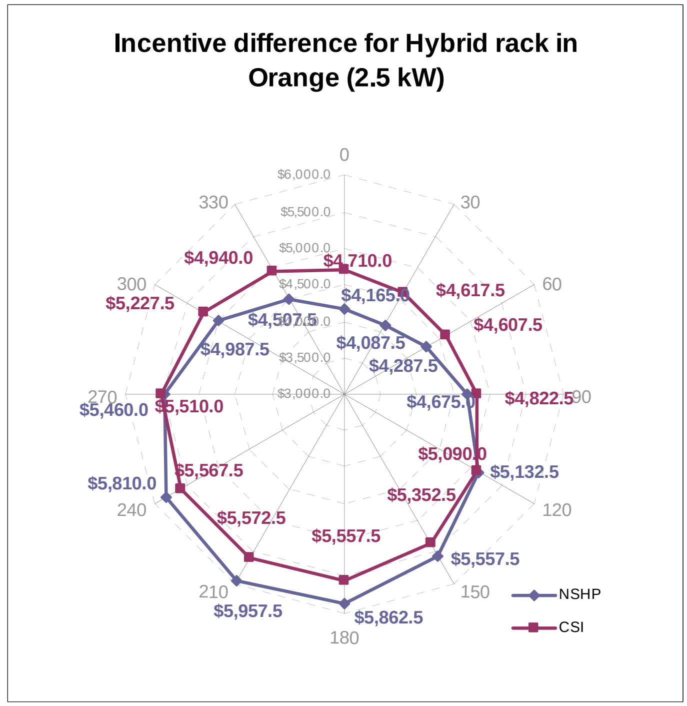
NSHP (CECPV) calculator estimates ***hourly*** system performance and then uses ***time dependent value (TDV)*** factors to weight the production in each hour of the year to incentivize systems oriented to maximize production when peak demand is highest. The TDV factors have been developed for each of the 16 climate zones and are based on the time related generation, distribution and transmission costs of the IOU serving the areas.

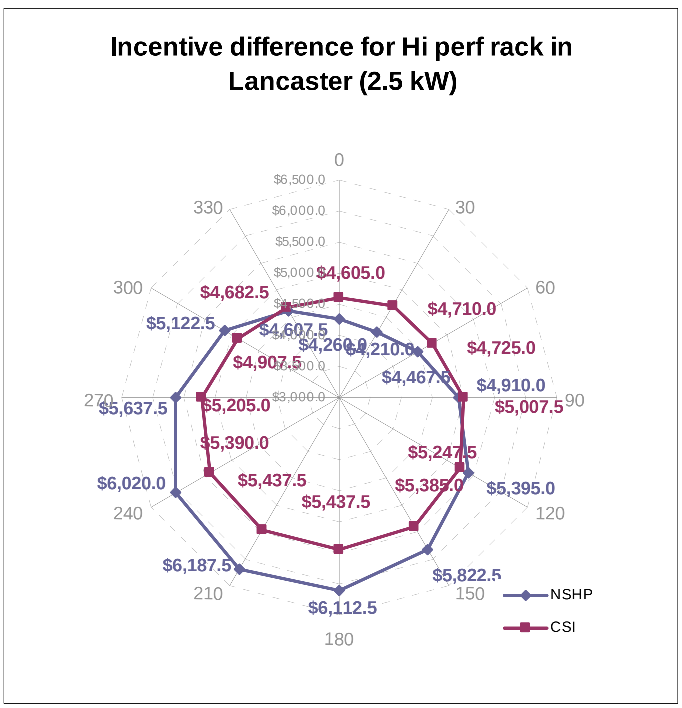
The Energy Commission's proposed SB 1 guidelines require the performance calculations to be hourly and then weighted by TDV in the IOU territories, while giving the flexibility to individual publically owned utilities (POUs) to either use the TDV factors for the climate zones in their service territory or adopt other appropriate time of use weighting factors in the incentive calculation for their service territory.

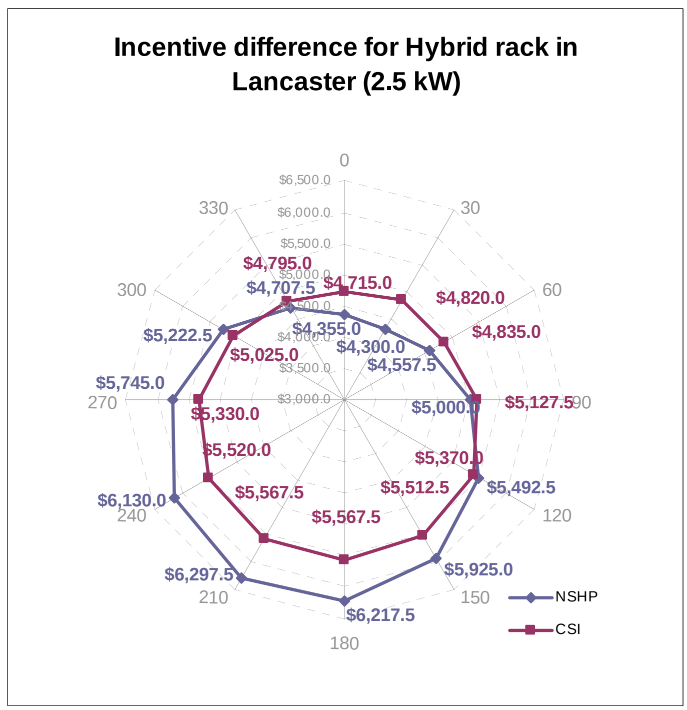
The ability to generate ***hourly results*** is a key requirement of the calculation engine to enable peak demand to be addressed in the solar incentive calculation.

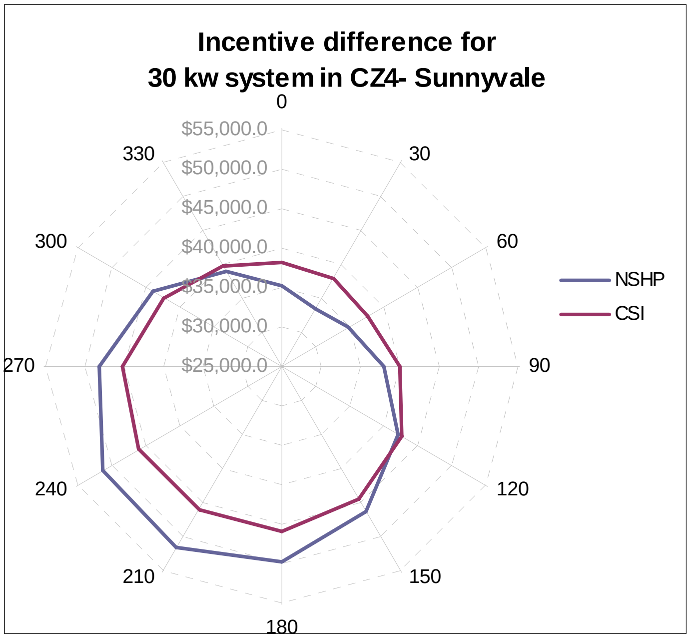
The following charts show the difference of the incentive amount for a given system for the range of azimuths in a given location. The main observable difference is the greater incentives under the NSHP for southwest facing systems. This addresses peak demand more concretely compared to the CSI approach, where incentives are more evenly distributed around the compass. In congruent fashion, the NSHP incentives are significantly lower for those orientations that contribute little peak demand benefit (systems oriented to the east and north). For example, under the CSI approach, a system oriented east and showing most production in morning hours would receive a similar incentive to a system oriented west and showing most production in the peak-demand related afternoon hours. The difference between these orientations with the NSHP calculator is greater, with the east incentive lower than the CSI incentive and the west incentive higher. This result is consistent across the 16 climate zones (found in Appendix A). The results show the combined impact on incentives of both the performance estimation engines (methodology and weather data) and the rulesets of the two programs (particularly the TDV approach versus the six months around summer approach).


Incentive difference for Hi perf rack in Orange (2.5 kW)
NSHP
CSI
$4,600.0
$4,510.0
$4,500.0
$4,710.0
$4,972.5
$5,227.5
$5,427.5
$5,442.5
$5,437.5
$5,380.0
$5,107.5
$4,825.0
$4,010.0
$4,087.5
$4,210.0
$4,595.0
$5,050.0
$5,472.5
$5,775.0
$5,867.5
$5,722.5
$5,377.5
$4,907.5
$4,430.0

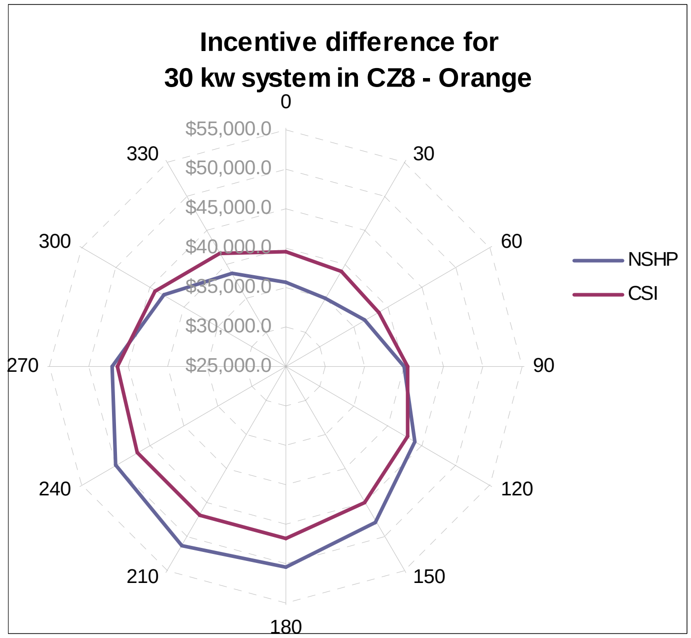

Incentive difference for Hybrid rack in Orange (2.5 kW)
NSHP
CSI
$4,710.0
$4,617.5
$4,607.5
$4,822.5
$5,090.0
$5,352.5
$5,557.5
$5,572.5
$5,567.5
$5,510.0
$5,227.5
$4,940.0
$4,165.0
$4,087.5
$4,287.5
$4,675.0
$5,132.5
$5,557.5
$5,862.5
$5,957.5
$5,810.0
$5,460.0
$4,987.5
$4,507.5


Incentive difference for Hi perf rack in Lancaster (2.5 kW)
NSHP
CSI
$4,605.0
$4,710.0
$4,725.0
$5,007.5
$5,247.5
$5,385.0
$5,437.5
$5,437.5
$5,390.0
$5,205.0
$4,907.5
$4,682.5
$4,260.0
$4,210.0
$4,467.5
$4,910.0
$5,395.0
$5,822.5
$6,112.5
$6,187.5
$6,020.0
$5,637.5
$5,122.5
$4,607.5


Incentive difference for Hybrid rack in Lancaster (2.5 kW)
NSHP
CSI
$4,715.0
$4,820.0
$4,835.0
$5,127.5
$5,370.0
$5,512.5
$5,567.5
$5,567.5
$5,520.0
$5,330.0
$5,025.0
$4,795.0
$4,355.0
$4,300.0
$4,557.5
$5,000.0
$5,492.5
$5,925.0
$6,217.5
$6,297.5
$6,130.0
$5,745.0
$5,222.5
$4,707.5



Incentive difference for
30 kw system in CZ4- Sunnyvale
0
30
60
90
120
150
180
210
240
270
300
330
$55,000.0
$50,000.0
$45,000.0
$40,000.0
$35,000.0
$30,000.0
$25,000.0
NSHP
CSI



Incentive difference for
30 kw system in CZ8 - Orange
0
30
60
90
120
150
180
210
240
270
300
330
$55,000.0
$50,000.0
$45,000.0
$40,000.0
$35,000.0
$30,000.0
$25,000.0
NSHP
CSI

Incentivizing higher performing equipment, systems and locations

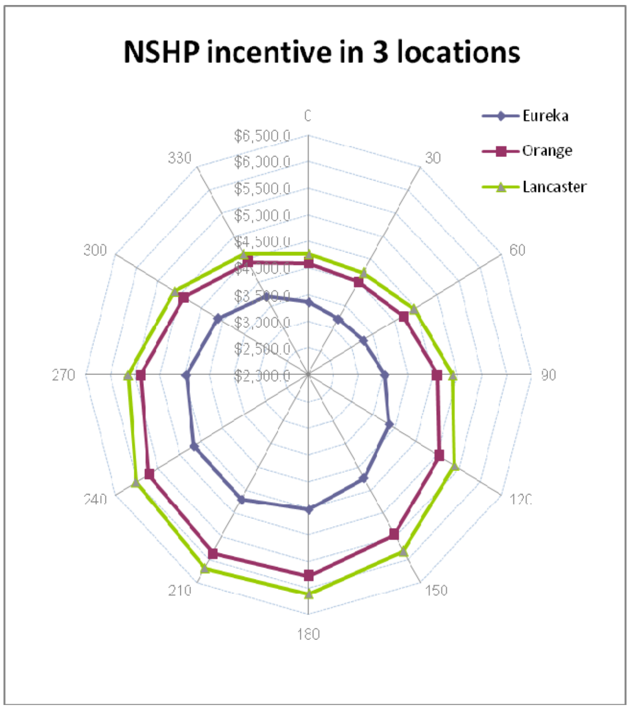
The CSI calculation methodology uses the same equipment performance characteristics in both the numerator and denominator of the design factor calculations neutralizing the impact of those performance characteristics on the calculation (note that the performance characteristics are not those of the actual module but rather the performance characteristics of the default crystalline silicon modules used by PVWATTS2). The NSHP calculation methodology, on the other hand, calculates the incentive directly using the performance characteristics of the actual modules (using the $/kWh $_{TDV}$ for each incentives step).

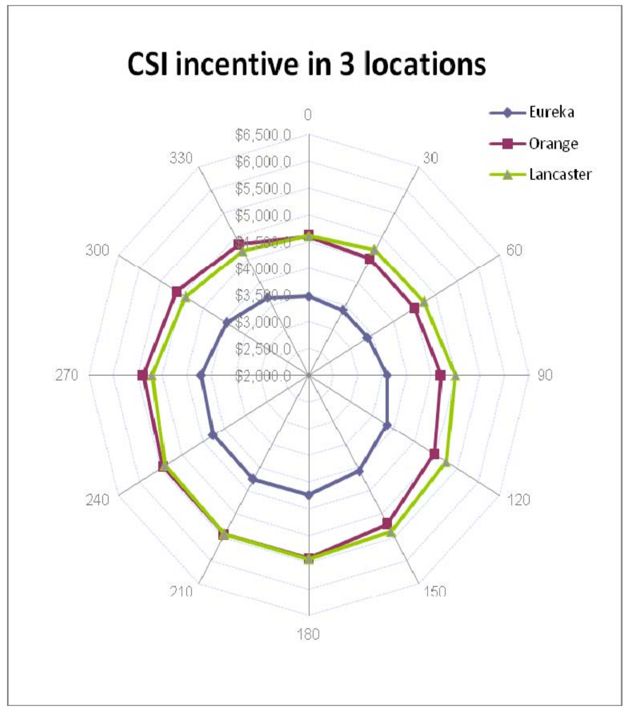
This results in no incentive encouragement for higher efficiency equipment, because the same default equipment performance characteristics are used both in the numerator and the denominator of the CSI calculation. In contrast, the NSHP calculation explicitly encourages more efficient equipment. Therefore the NSHP approach will provide an advantage to higher performing equipment characteristics today and will promote more innovation and technological improvement related to improving system efficiencies in the future. This difference derives from three factors:

- **Treatment of Module Performance Characteristics.** NSHP uses detailed component characteristics in the performance estimation engine. Hourly modeling of individual system performance, using the detailed characteristics of each component, enables differentiation of efficiency characteristics. The NSHP calculation engine uses the 5 parameter model, customized for California through enhancements to include gamma, the power temperature coefficient. The calculation utilizes the detailed I-V curve properties along with temperature coefficients and the NOCT of the module in its installed condition. The CSI performance estimation engine uses default crystalline silicon module performance characteristics with the only consideration for the actual equipment being the capacity of the specific proposed system.
- **Comparison of the Reference System to the Proposed System**. The NSHP calculations use a single reference system, azimuth and tilt and location merely to establish the $/kWh (TDV weighted) incentive level through a one time, sidebar conversion of the nominal $/W incentive level of the program. The reference system has no other impact on the incentive calculation. After that any proposed system is paid incentives on the annual kWh $_{TDV}$ it produces. In contrast, the CSI rule-set uses the reference system (which has many of the same module performance characteristics as the proposed system as discussed above) in the denominator of the calculation, and varies the azimuth and tilt of the reference system in a complicated manner in the sub-parts of the design factor, depending on the azimuth, tilt and location of the proposed system.
- **The Cap.** The CSI rule-set establishes an incentive cap that prevents systems located where performance can be expected to be greater than the reference location from receiving an incentive commensurate with resulting improvements in the expected performance. The CPUC rule-set, including a cap on the design factor for the CSI calculation, leads to truncating the incentive for higher performing equipment that are better than the selected reference as well as installations in locations with better

insolation than the reference location. Under the NSHP rule-set, there is no cap on the incentive for a high performing system, which encourages the installation of high performing systems in high solar resource locations.

- This impact of capping the design factor is seen in the graphs below. In the CSI chart, one can see that systems installed south and southwest in Lancaster do not receive a higher incentive than in Orange (the CSI reference location), despite receiving higher insolation and being expected to produce more electricity. A system facing east in Lancaster would receive a higher incentive than a similarly facing system in Orange because the incentive is not above the incentive for the south facing reference system located in Orange.





CSI caps the design factor at 1 which limits the incentive for systems located in higher solar resource locations than the reference in Orange. NSHP rewards systems based on the performance of the system and does not limit the incentive for systems that produce higher than the reference system (located in San Jose).

Other points of comparison

Generating performance verification table

The performance verification table is an important aspect of the field verification, which is used to ensure that the installed systems actually perform as expected by the expected performance incentive calculation.

The NSHP CECPV calculator generates a look-up table that computes expected performance of a given system at the range of site conditions of incident solar radiation and ambient temperature. By measuring the incident solar radiation and ambient air temperature at the time of field verification, the expected AC output can be found in the table and can be easily verified on the display of a performance meter to be at least as much as the look up value in the performance verification table uniquely generated for the system by the calculator. There are adequate tolerances built into the calculation which take into account default losses and difference in measurement accuracy, but would detect any performance flaws in the system such as missing connections or modules.

The CSI calculation structure and field verification approach do not include such a performance verification mechanism. Consequently, while the CSI field verification can determine that the systems installed are as expected through visual inspection, and can determine that the system installed is generating electricity within broad expectations, it does not enable the field verifier to determine whether the specifically installed system is generating expected output given the ambient temperature and solar irradiance conditions at the time of the inspection. Under the NSHP structure, the field verifier is enabled to determine that the specific system output meets the expected performance for the specific site conditions at the time of the inspection, using the calculator-generated look-up table and based on two easy-to-perform, ground-level measurements (solar irradiance and ambient temperature).

Ambient air temperature in deg F

(W/m^2)	T=15	T=20	T=25	T=30	T=35	T=40	T=45	T=50	T=55	T=60	T=65	T=70	T=75	T=80
300	614	606	599	591	584	576	568	560	553	544	536	528	520	512
325	665	657	648	640	632	623	615	607	598	590	581	572	564	555
350	716	707	698	689	680	671	662	653	643	634	625	616	606	597
375	766	757	747	738	728	718	708	699	689	679	669	659	649	639
400	817	807	797	786	776	765	755	745	734	723	713	702	691	681
425	868	857	846	835	824	813	802	790	779	768	757	745	734	722
450	918	907	895	883	872	860	848	836	824	812	800	788	776	764
475	967	955	943	931	919	907	894	882	869	856	843	831	818	805
500	1016	1004	991	978	966	953	940	927	913	900	887	873	860	846
525	1065	1052	1038	1025	1012	998	984	971	957	943	929	915	901	887
550	1113	1099	1085	1071	1057	1043	1029	1014	1000	986	971	956	942	927
575	1161	1147	1132	1117	1102	1088	1073	1058	1043	1027	1012	997	982	966
600	1209	1194	1178	1163	1147	1132	1116	1100	1085	1069	1053	1037	1021	1005
625	1256	1240	1224	1208	1192	1176	1159	1143	1126	1110	1093	1077	1060	1043
650	1302	1286	1269	1252	1236	1219	1202	1185	1168	1150	1133	1116	1098	1081
675	1348	1331	1314	1296	1279	1261	1244	1226	1208	1190	1172	1154	1136	1118
700	1394	1376	1358	1340	1322	1304	1285	1267	1248	1230	1211	1192	1174	1155

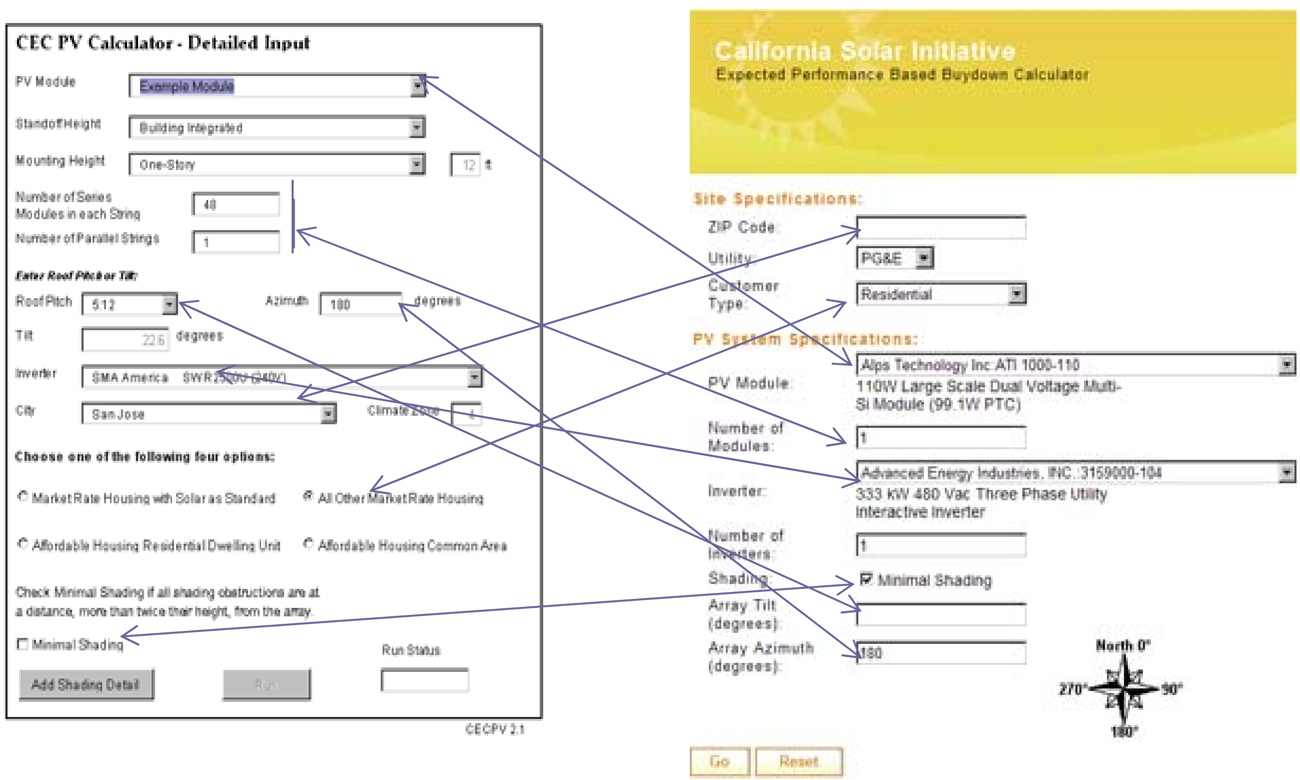
NSHP – Performance verification table example (truncated table)

Number of inputs

Even though the NSHP calculations internally use more rigorous component and system details to perform hourly simulations, to the end user the number of inputs to drive the model are not any greater or burdensome. This is because the detailed equipment performance characteristics are entered by the Energy Commission in the library of modules and inverters, and those detailed performance characteristics are called up for the calculation by a simple selection of the equipment model numbers from drop-down menus.

During the application process, the CSI calculator interface requires ***8 basic inputs along with a check box for minimal shading*** and selection of customer type, residential or commercial, to set the incentive level. When the minimal shading criterion is not met, there are 12 additional monthly solar availability inputs.

The NSHP CECPV interface requires ***9 basic inputs*** along with a ***check box for minimal shading*** and boxes that relate to selection of differential incentive levels for different applications, such as affordable housing installations. When the minimal shading criterion is not met, additional inputs are required for each shading obstruction. In many cases, there will be fewer obstruction inputs using the NSHP CECPV than the 12 additional shading inputs using the CSI EPBB calculator.



Note: In the near future, the CSI EPBB input screen is proposed to expand to include mounting height of the modules and required shading related solar availability for all 12 months by removing the minimal shading checkbox. There has been a proposal that the CSI EPBB calculation account for operating temperature (NOCT) and power temperature coefficient property of the specific module. However, given that the design factor calculation uses the same module characteristics in both the numerator and denominator the inclusion of these additional details in modeling approach will be neutralized to a large extent.

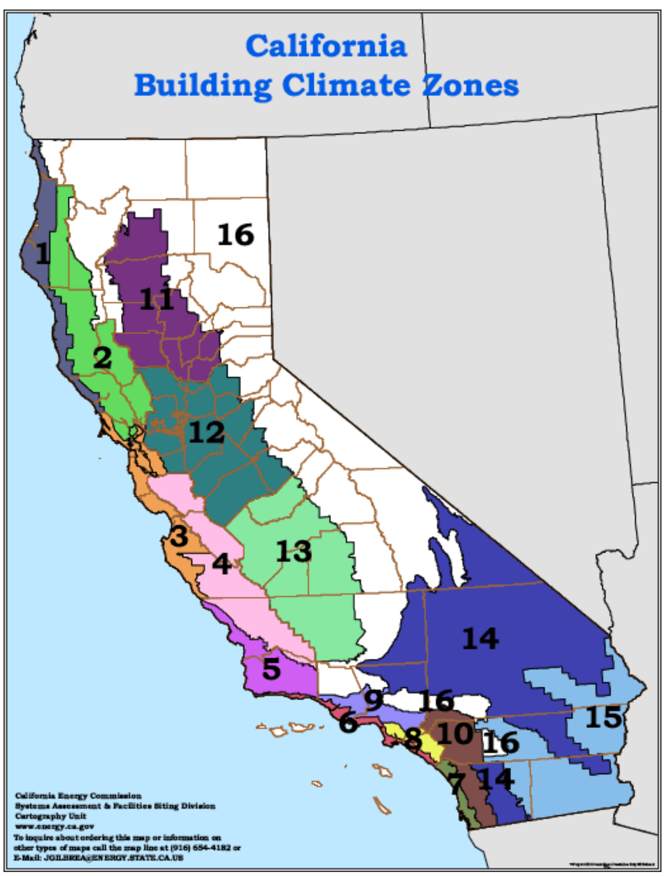
Source: CSI-EPBB website screen capture

Weather data

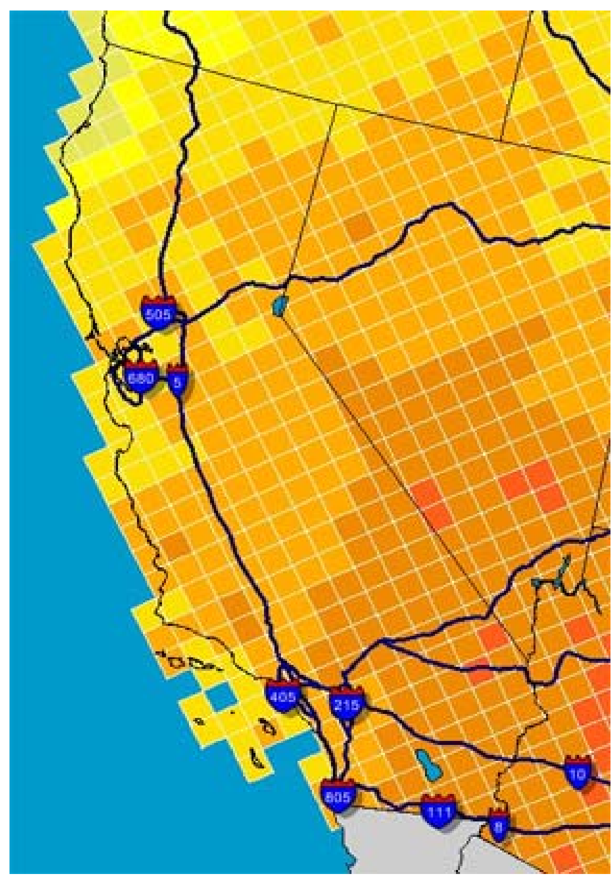
NSHP CECPV calculations use ***hourly*** weather data for the ***16 climate zones*** in California that is the same solar radiation, ambient temperature and wind data used by the building energy efficiency standards for performance based compliance. The weather data for the 16 climate zones is based on a reference city in each zone and the weather data available for that location.

CSI EPBB calculations rely on the PVWatts2 methodology of using the actual weather data for ***10 TMY2 weather locations*** in the state to run the hourly performance simulation, adjusting the output on a ***monthly*** basis for a ***40 km grid cell***. The 40 km grid cells are assigned solar insolation data for one of 10 locations in California or the southwest that is mapped as most similar to the expected solar insolation in the 40 km grid cell where the actual solar installation is located. The CSI EPBB calculator uses this solar insolation data to determine a baseline expected hourly production from the PV system. The total baseline production on a monthly basis is then multiplied by a factor to adjust it to reflect data on cloud cover in the 40 km grid.

There are basic differences in the underlying weather data used by the two programs. An advantage of the CSI calculation is that it provides an estimate of solar insolation data with a finer geographical resolution than the 16 climate zone locations used by the NSHP calculation. The disadvantage of the CSI calculation is that this resolution is only intended for the determination of total monthly production rather than the hourly production that the NSHP calculation is designed to provide.



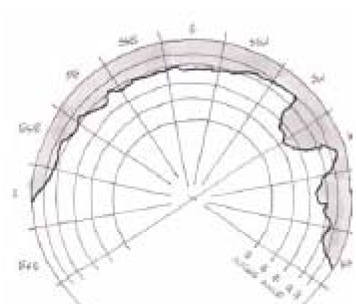
16 climate zone map used in the NSHP EPBI calculations



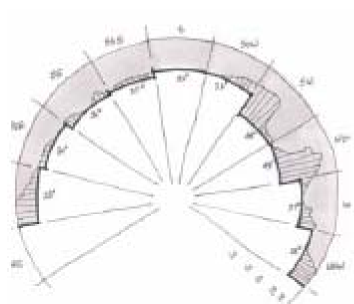
40 km grid cells used in the CSI EPBB (PVWatts 2) calculations
Source: NREL PVWatts website screen capture
http://mapserve2.nrel.gov/website/PVWATTSLITE/viewer.htm

Shading methodology

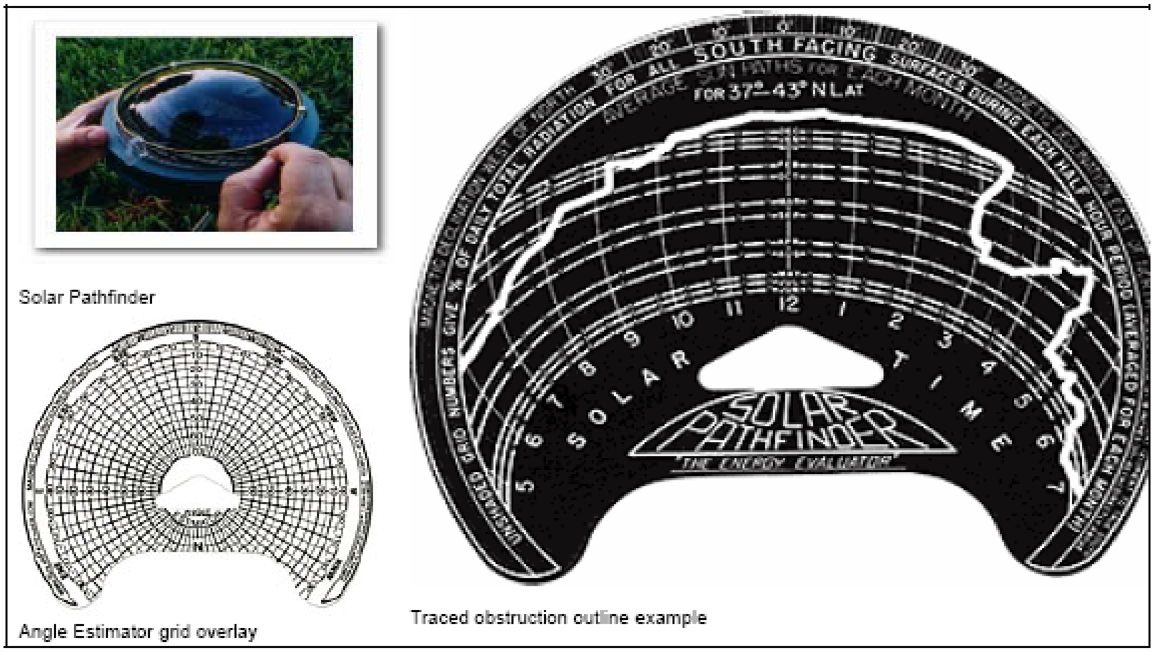
The NSHP shading methodology accounts for shading, when present above minimal amounts, on an hourly basis within the calculation engine. Specifically, the calculator assumes no production from a specific string in the hour(s) that string is shaded by an obstruction. This is determined by comparing the measured obstruction height and distance from the array which is shaded, to the solar position (altitude and azimuth) in the sky at that particular location and point in time. No shading calculation tool is required by the methodology, merely the height and distance measurements of possible obstructions (only obstructions within generally southernly azimuths must be considered). If all of the obstructions meet the minimal shading 2:1 ratio, no additional shading details are required. The minimal shading 2:1 ratio provides an easy estimation methodology, which translates to blocking a solar altitude of 26.5 deg above the horizon. The production associated with this solar altitude happens outside the high production hours for a system (approximately 9 a.m. to 3 p.m. in winter and 7 a.m. to 7 p.m. in summer), and thus the system can be said to be 'minimally shaded' during these most significant hours of production. In most cases, these measurements can be reliably determined from the ground, removing the necessity for salespersons or estimators to access the roofs. As an option there is capability to use the obstruction altitude information traced by solar analysis instruments such as Solarpathfinder in the NSHP structure.



(a) This diagram shows the 22.5 ° compass segments used by the PV Calculator and the altitude angles.



(b) Within each compass segment, the highest altitude is selected and used for that entire segment. This data is input into the PV Calculator.



The CSI shading methodology is based on estimating the percentage of solar access on a monthly basis using shade analysis tools. The recommendations of the CSI Shading subcommittee are related to this mechanism and the problems that were identified with the use of the minimal shading criteria of 2:1 when determining the monthly solar access. The 2:1 ratio of siting obstructions is not easily captured in the monthly solar availability metric, hence the problem. The minimal shading criterion is simple to measure in the field, easy to input into the CECPV calculator and facilitates the calculation of hourly estimates of production. However, the minimal shading criteria is not easily captured in the monthly estimation of shade methodology that is used by the CSI EPBB calculator, which does not endeavor to arrive at hourly estimates of production.

Orientation	Obstruction Type	Altitude Angle to Shading Obstruction	Distance to Height Ratio	Minimum Distance to Small Tree	Minimum Distance to Medium Tree	M Dis La
ENE (55 – 79)	NA	Minimal Shading	2.00	16	46	
E (79 -101)	NA	Minimal Shading	2.00	16	46	
ESE (101 – 124)	Neighboring structure	45 degrees	1.00			
SE (124 – 146)		Minimal Shading	2.00	16	46	
SSE (146 – 169)	On roof obstruction	50 degrees	0.84			
S (169 – 191)	Tree (existing-mature)	70 degrees	0.36			
SSW (191 – 214)		Minimal Shading	2.00	16	46	
SW (214 – 236)	Tree (existing-not mature)	30 degrees	1.5			
WSW (236 – 259)		Minimal Shading	2.00	16	46	
W (259 – 281)		Minimal Shading	2.00	16	46	
WNW (281 – 305)	Tree (planned)	65 degrees	0.49			

NSHP EPBI shading table

Shading: ☐ Minimal Shading

Shading Derate Factors (%)

January	100
February	100
March	100
April	100
May	100
June	100
July	100
August	100
September	100
October	100
November	100
December	100

CSI EPBB shading input

Source: CSI-EPBB web page screen capture

Appendix A

Systems used for creating the charts

Hi-perf rack system

Manufacturer	*Model #*	*Type*	*Total modules*	*Series*	*Parallel*	*STC*	*PTC*	*Total STC W*	*Total PTC W*
SunPower Corp	SPR-205-BLK-U	Rack	16	8	2	205	189	3280	3024
Manufacturer	*Model #*	*Wtd Eff*							
Xantrex Tech	GT3.0-NA-DS-240-POS	94.5							

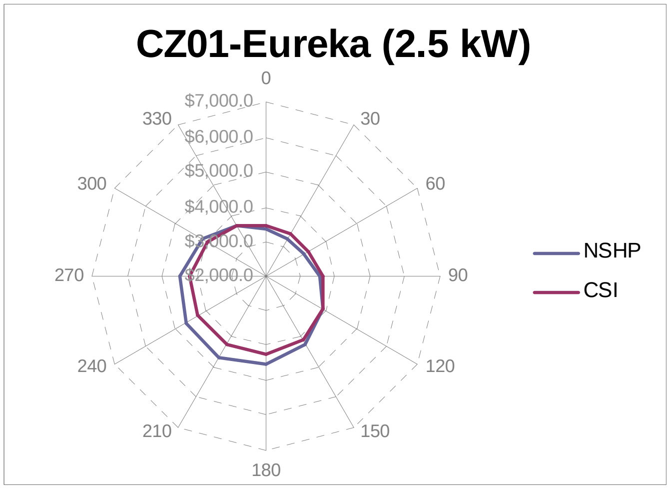
Hybrid rack system

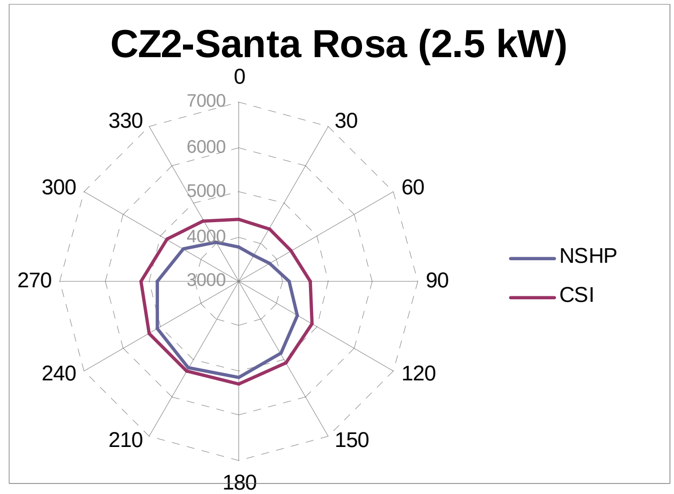
Manufacturer	*Model #*	*Type*	*Total modules*	*Series*	*Parallel*	*STC*	*PTC*	*Total STC W*	*Total PTC W*
Sanyo Electric	HIP-205BA3	Rack	16	8	2	205	193.5	3280	3096
Manufacturer	*Model #*	*Wtd Eff*							
Xantrex Tech	GT3.0-NA-DS-240-POS	94.5							

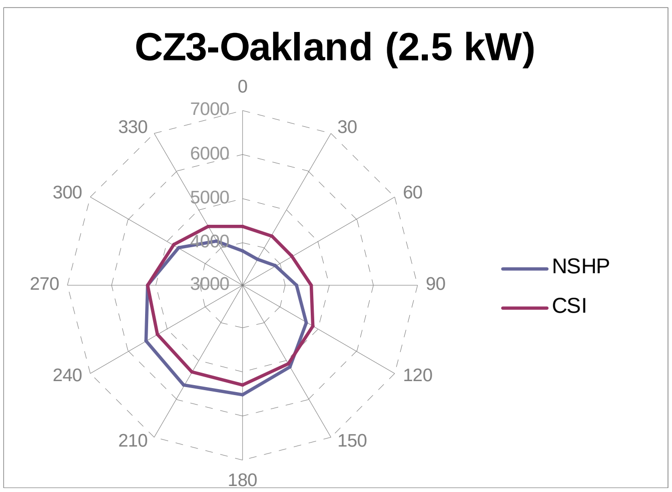
Larger system (30kW)

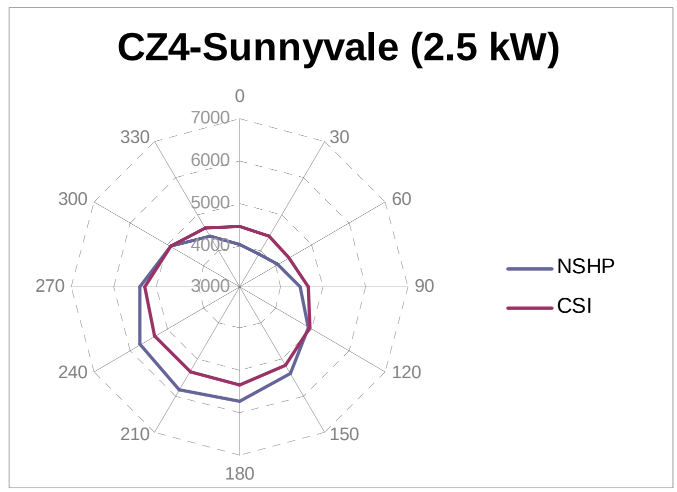
Manufacturer	*Model #*	*Type*	*Total modules*	*Series*	*Parallel*	*STC*	*PTC*	*Total STC W*	*Total PTC W*
BP Solar	BP4175B	Rack	192	12	16	175	155.2	33600	29798.4
Manufacturer	*Model #*	*Wtd Eff*							
SatCon AE	30	60							

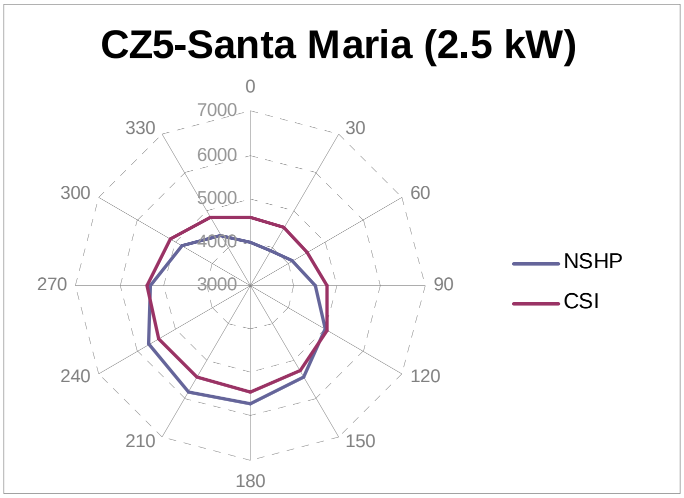
The following charts show the incentive amounts under each of the two calculation approaches in 30 deg increments around the compass for azimuth and at 5:12 (22 deg) tilt for a hi-perf rack system. The results for these systems were normalized to reflect the incentive for a 2.5 kW (STC) system to create the charts. And the locations in each climate zone were picked to correspond with the climate zone (CZ) reference city or a location that is represented in the CSI EPBB calculations.

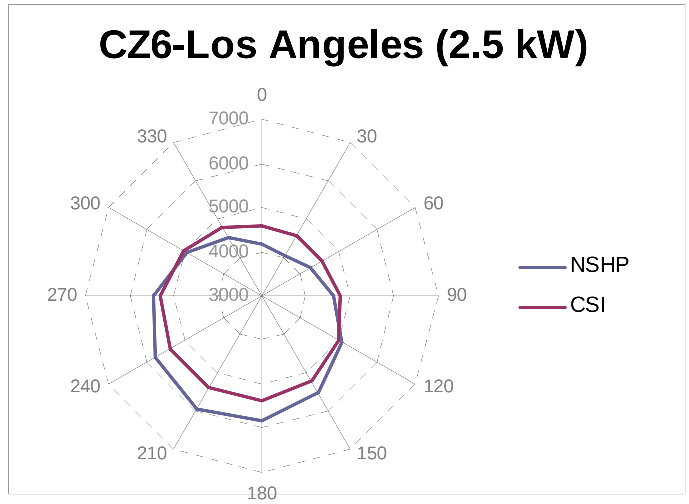


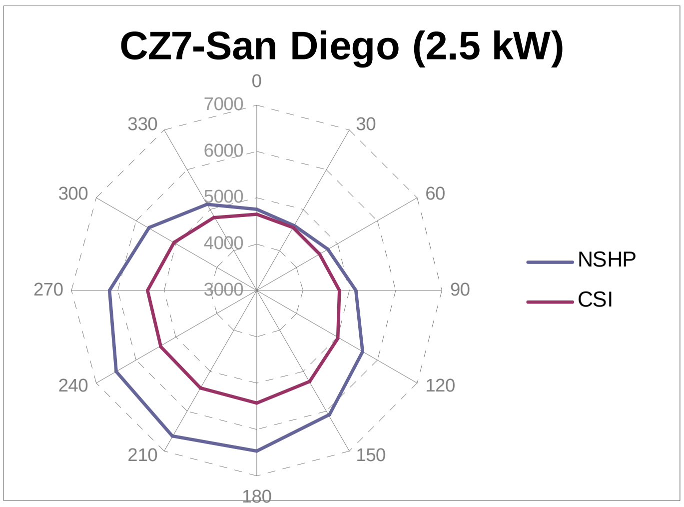


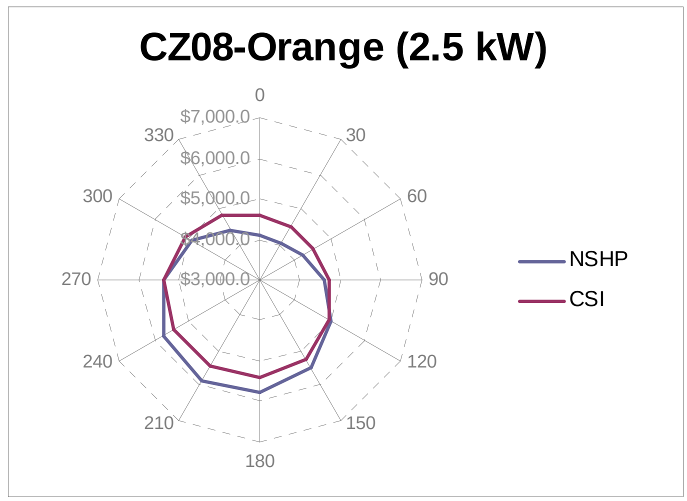


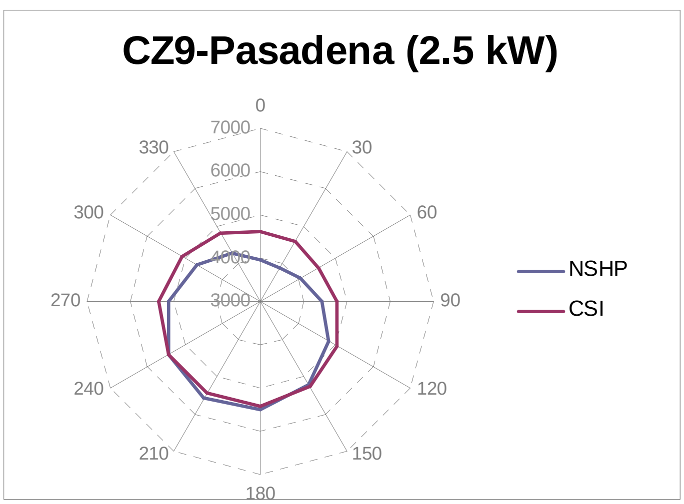


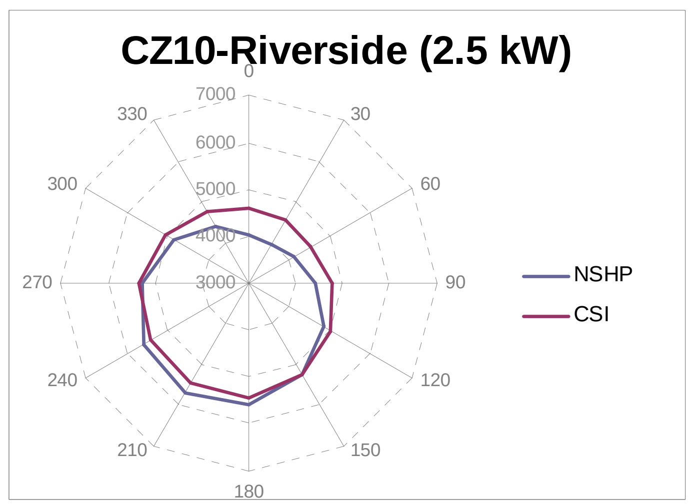

CZ5-Santa Maria (2.5 kW)
0
30
60
90
120
150
180
210
240
270
300
330
7000
6000
5000
4000
3000
NSHP
CSI

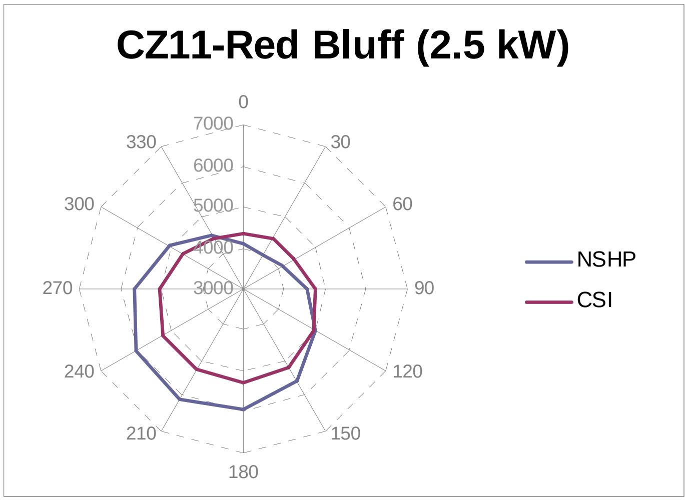

CZ6-Los Angeles (2.5 kW)
0
30
60
90
120
150
180
210
240
270
300
330
7000
6000
5000
4000
3000
NSHP
CSI

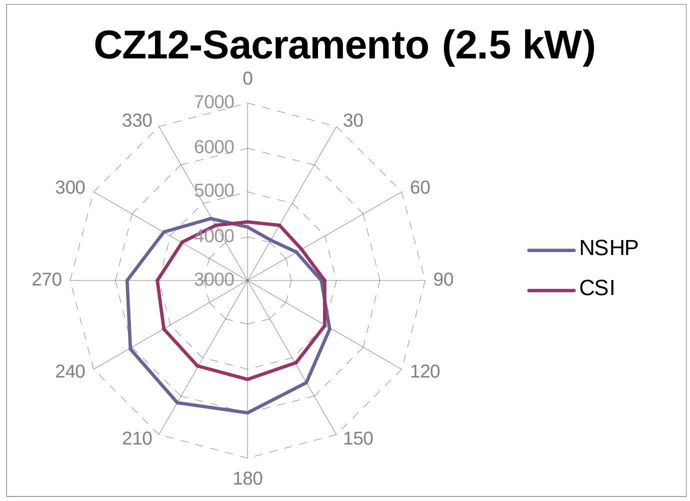

CZ7-San Diego (2.5 kW)
0
30
60
90
120
150
180
210
240
270
300
330
7000
6000
5000
4000
3000
NSHP
CSI

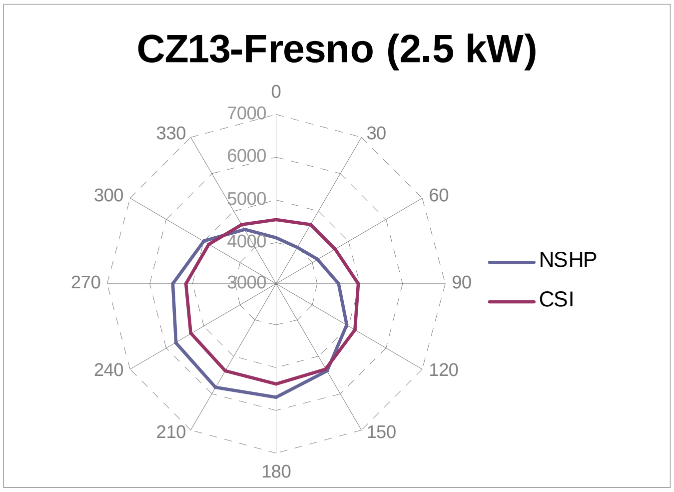

CZ08-Orange (2.5 kW)
0
30
60
90
120
150
180
210
240
270
300
330
$7,000.0
$6,000.0
$5,000.0
$4,000.0
$3,000.0
NSHP
CSI

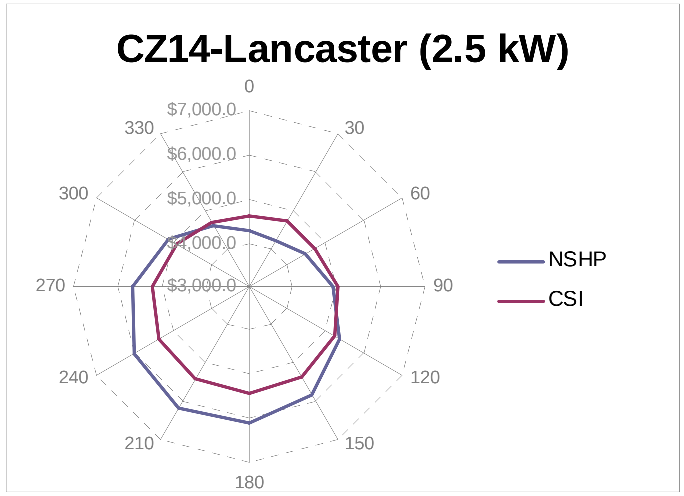

CZ9-Pasadena (2.5 kW)
0
30
60
90
120
150
180
210
240
270
300
330
7000
6000
5000
4000
3000
NSHP
CSI

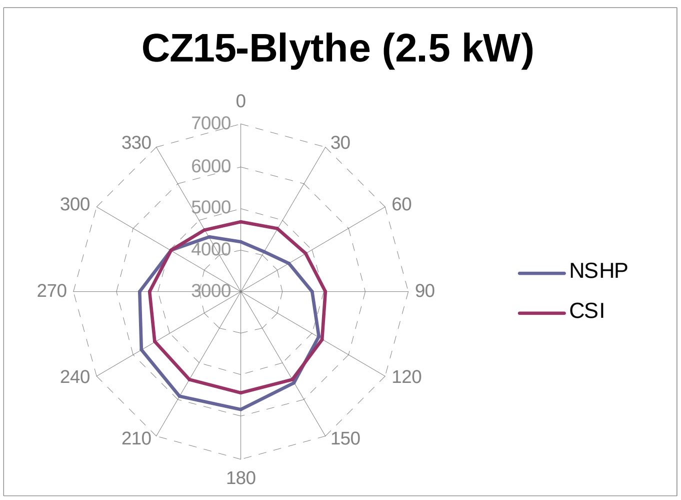

CZ10-Riverside (2.5 kW)
0
30
60
90
120
150
180
210
240
270
300
330
7000
6000
5000
4000
3000
NSHP
CSI

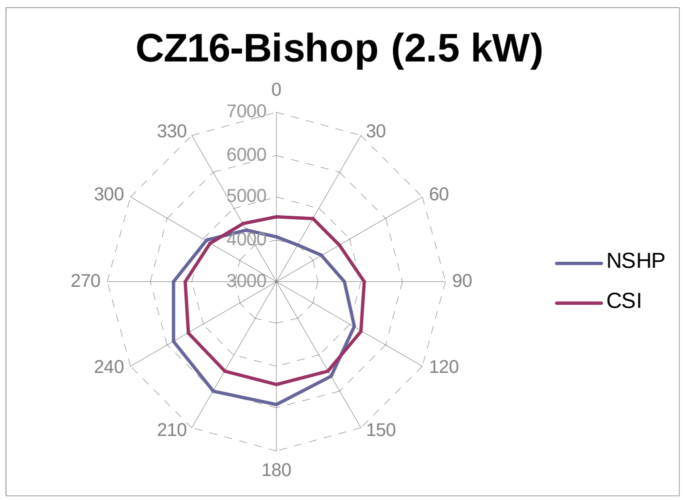

CZ11-Red Bluff (2.5 kW)
0
30
60
90
120
150
180
210
240
270
300
330
7000
6000
5000
4000
3000
NSHP
CSI


CZ12-Sacramento (2.5 kW)
0
30
60
90
120
150
180
210
240
270
300
330
7000
6000
5000
4000
3000
NSHP
CSI


CZ13-Fresno (2.5 kW)
0
30
60
90
120
150
180
210
240
270
300
330
7000
6000
5000
4000
3000
NSHP
CSI


CZ14-Lancaster (2.5 kW)
0
30
60
90
120
150
180
210
240
270
300
330
$7,000.0
$6,000.0
$5,000.0
$4,000.0
$3,000.0
NSHP
CSI


CZ15-Blythe (2.5 kW)
0
30
60
90
120
150
180
210
240
270
300
330
7000
6000
5000
4000
3000
NSHP
CSI


CZ16-Bishop (2.5 kW)
0
30
60
90
120
150
180
210
240
270
300
330
7000
6000
5000
4000
3000
NSHP
CSI