



Guidelines for California's Solar Electric Incentive Programs pursuant to SB1 (Staff Draft)

Component and Installation Standards

Smita Gupta

Buildings and Appliances Office

Renewables Committee Workshop

October 04, 2007



Chapter 3

Component Standards

Modules

Inverters

Meters

**compliance no later than
1 January 2009**



PV Modules

no change

- Modules shall be certified to [UL 1703](#) by a Nationally Recognized Testing Laboratory (NRTL) to ensure safety and reliability
- Detailed performance data
 - [IEC 61215](#) or [61646](#) (subsections relevant to performance)
 - [International Laboratory Accreditation Cooperation \(ILAC\)](#) accredited laboratory
- The [NOCT for roof integrated BIPV](#) products shall be determined using the specification as described in the [Guidelines Appendix 1](#)

Appendix 1



Non PV technologies

updated

Manufacturers of non-PV solar energy systems are directed to work with the Energy Commission staff to define comparably rigorous and appropriate component standards for such systems.



Inverters

no change

- Inverters shall be certified to [UL 1741](#) safety standards by a Nationally Recognized Testing Laboratory (NRTL).
- Performance data tested in accordance with "[Performance Test Protocol for Evaluating Inverters Used in Grid-Connected Photovoltaic Systems](#)" by a NRTL
 - Maximum Continuous Output Power
 - Conversion Efficiency at various voltage and power conditions
 - Tare Losses

Appendix 1



Meters

no change

- ± 2 percent accuracy for all PBI
 - ANSI C-12 testing protocols by independent test laboratories
- ± 5 percent accuracy meters (primarily inverter integrated) allowed for expected performance incentive applicants (test protocol under development)
- Communication port for performance monitoring and reporting service (PMRS)
- Display and storing of instantaneous and cumulative performance data

Appendix 1



Chapter 4

Installation Standards

Performance Based Incentives
Expected Performance Calculation
Field Verification
Installer
PMRS and Maintenance

**compliance no later than
1 January 2009**



Performance Based Incentives (PBI) *revised*

- Required for system size over 50 kW (2008) and 30 kW (2010)
- Paid over 5 year minimum term (could be longer)
- Based on \$/kWh actually produced



Expected Performance Based Incentive (EPBI)

Used for systems that are below the PBI size threshold and that do not voluntarily use the PBI approach



Photovoltaic performance calculation requirements

updated

1. Model fixed flat plate collector technologies at a minimum
(include single/dual axis and concentrating if allowed in the EPBI)
2. California 16 Climate Zone weather data
(hourly solar radiation, temperature and wind speed)
3. Account for azimuth and tilt of installation
(to determine incident solar radiation)
4. Use detailed performance characteristics of PV Modules
(from data certified to the CEC - listed in Appendix 1 Table 1)
5. Determine operating system voltage
(based on circuit design – series and parallel strings and inverter match up)
6. Account for mounting type and offset
(BIPV or rack mounted – offset distance for operating temperature difference)
7. Account for height above ground
(wind speed adjustment)



Photovoltaic performance calculation requirements (contd.)

8. Use detailed performance curve data for inverters
(from data certified to the Energy Commission)
9. Limit production based on size of array and inverter capacity
10. Hourly PV production results for entire year
11. Determine solar altitude and azimuth for each hour
(for shading impact)
12. Determine shading impact on each string
(based on obstructing solar access in a given hour)
13. Apply TDV to the hourly production results
(after shading impact)
14. Generate performance verification table
(for field verification of performance)
15. Generate Certificate of Compliance
(application and field verification – echo input & performance verification table)



Peak Load

revised

- Weighting of hourly results to encourage systems that perform higher on peak
- TDV weighting factors for every hour in a climate zone

POU program administrators may use either the TDV factors determined for the 16 climate zones or use hourly time of use weighting factors applicable for their service territories.



Performance calculator compliance

updated

The NSHP Energy Commission PV calculator (completely or partially) can be used directly or as a reference program to demonstrate compliance with these requirements



Incentive calculation

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



Incentive calculation

Expected performance incentive level

$$\$/kWh_{TDV}$$

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

Capacity based incentive level
(\$2.80/W for POUs)

$$\$/\text{Watt (incentive level)}$$



Reference System

- **Location of the system**
(weather data and corresponding applicable TDV factors)
- **Size of a system**
(median in the applicable utility program)
- **Module**
(from the Energy Commission's Eligible Equipment List)
- **Inverter**
(from the Energy Commission's Eligible Equipment List)
- **Installation characteristics**
(including, but not limited to)
 - Azimuth
 - Tilt
 - Mounting offset (BIPV or rack with specific height above substrate)
 - Height above ground (one story or higher)
 - Electrical circuit design (modules in series and parallel)
 - Shading conditions (minimal shading)
 - Other system losses (such as dirt, dust and wiring losses)



Incentive calculation

Expected performance incentive level

$$\$/kWh_{TDV}$$

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

Capacity based incentive level
(\$2.80/W for POUs)

Performance calculator used to generate this for the reference system



Incentive calculation

Expected performance incentive level

Capacity based incentive level
(\$2.80/W for POUs)

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

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



Incentive calculation

Expected performance incentive level

Capacity based incentive level
(\$2.80/W for POUs)

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

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



Incentive calculation

Expected performance incentive level

Capacity based incentive level (\$2.80/W for POUs)

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

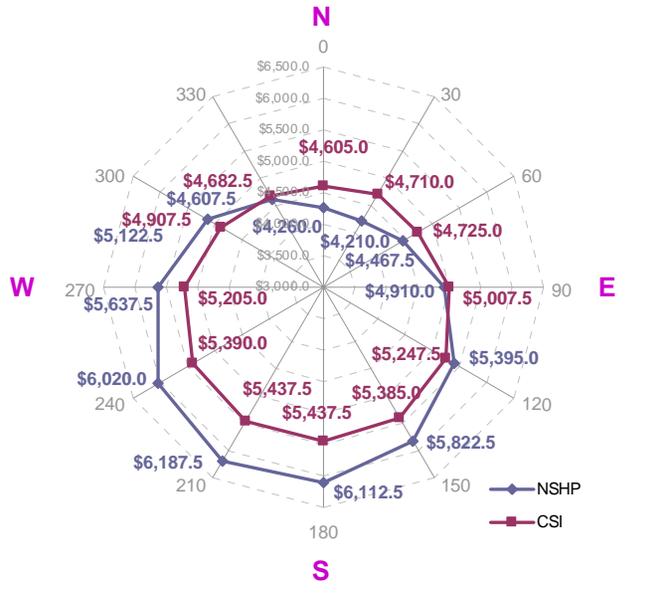
$$\text{Total Incentive \$} = \text{Applicant System Annual kWh}_{TDV} \times \$/kWh_{TDV}$$

Performance calculator generates this for each applicant system

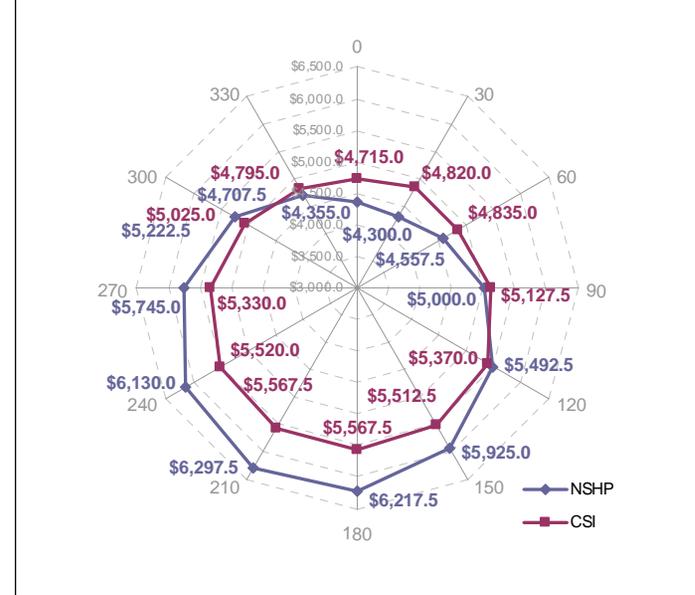


CSI NSHP incentive comparison

Incentive difference for Hi perf rack in Lancaster (2.5 kW)

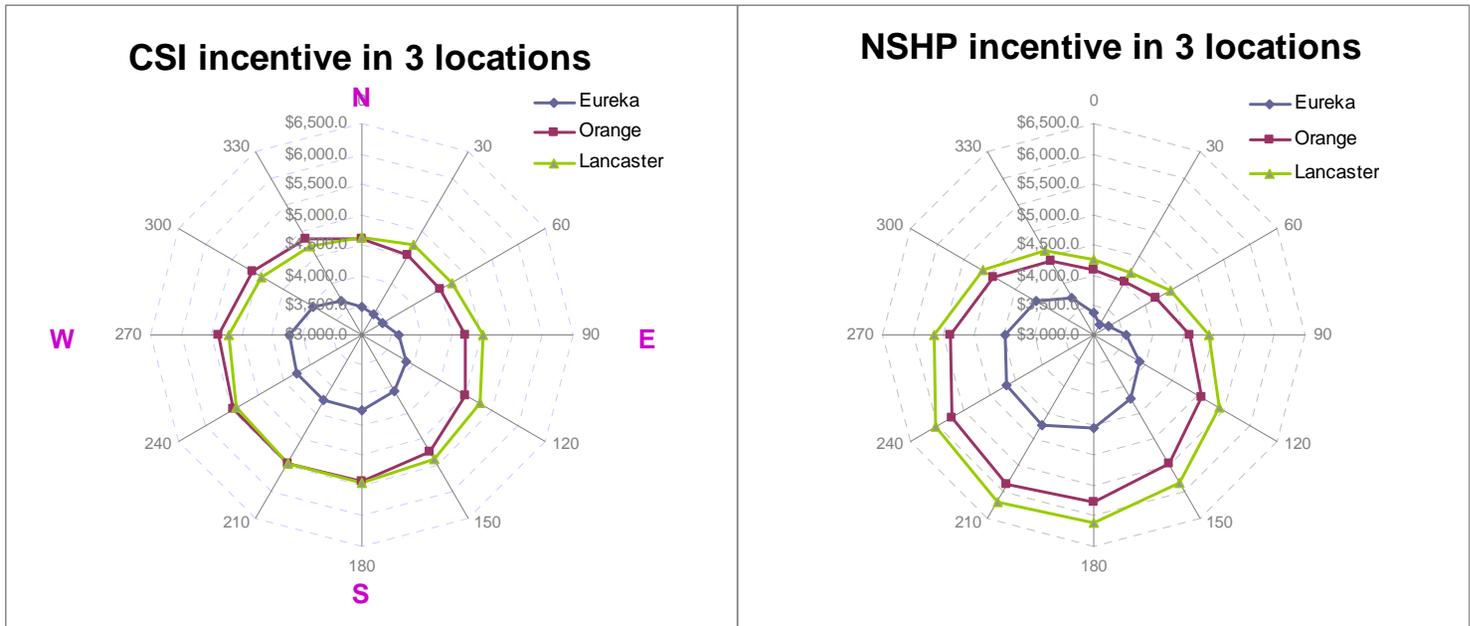


Incentive difference for Hybrid rack in Lancaster (2.5 kW)





CSI NSHP incentive comparison





revised

Field Verification

- Third party
Home Energy Rating System (HERS) rater or by the program administrator (or their designated qualified contractor)
- Protocol to include:
 - Equipment verification
 - Installation characteristics verification
 - Performance verification
 - Shading verification
- Sampling (1 in 7 minimum sample size)
- Tolerance in measurements

Appendix 2



Shading

no change

- Emphasis on avoiding shade
 - Minimal shade criteria – 2:1 distance to height ratio
- Simple methodology to determine unavoidable shading
 - Height and distance measurement
 - Optional elevation angle measurement (use of instrumentation)
- Account for existing and future potential shade
 - Trees (mature height for species)
 - Other (known/planned) structures on roof or neighboring
- Measurement and verification methodology specified with tolerance

Appendix 2



Installer

no change

- Qualified installers
 - valid A, B, C-10 or C-46 contractor license
- Installer certification of installation
 - Components
 - Installation characteristics
 - Performance
 - Shading analysis
- NABCEP certification encouraged though not required



Performance Monitoring and Reporting Service (PMRS)

- PMRS contract for minimum of 5 years
- PMRS requirement for all PBI and EPBI (with cost cap)

	5% accuracy meters	2% accuracy meters	PMRS
EPBI < 30kW	Required	Optional	Cost cap – 1% of entire system
EPBI 30kW and greater	Required	Optional	Cost cap – 0.5% of entire system
PBI	N/A	Required	Required



Maintenance

Maintenance plan required by installer for systems larger than 10 kW

Including but not limited to:

- Cleaning schedule for the array to remove dirt and dust build up
- Periodic checking of electrical connections for corrosion
- Checking the inverter for instantaneous power, long term energy output and diagnosing and taking corrective action if production is significantly lower than expected.
- Checking for tree/plant growth or other obstructions that are causing shading on the array and advise on how to eliminate that shading.



Thank You