



Center for
Sustainable Energy[®]
CALIFORNIA

Pacific Power California Solar Incentive Program

Shade Analysis & Inspection Protocol

Agenda

- ❑ Conducting a Shade Analysis
 - ❑ Process
 - ❑ Tools
 - ❑ Methodology
- ❑ Determining Tilt and Azimuth
- ❑ Field Inspection Overview
 - ❑ Inspection Tolerances
 - ❑ Change of Incentive, Infractions, Failures
 - ❑ Penalties and Disputes
- ❑ Inspection Scenarios



Shade Analysis Process

Pre-Installation / Design Stage

- Installer performs a detailed shade analysis of the proposed array location and submits the results in the EPBI calculation as part of the Reservation Application package.

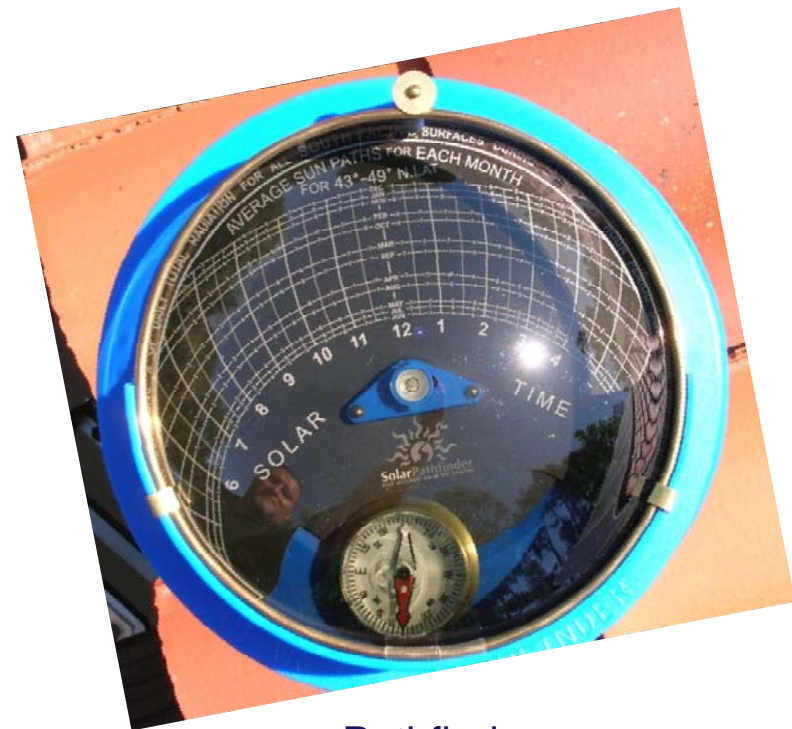
Post Installation / Incentive Claim Stage

- Installer performs a detailed shade analysis post-installation for the actual array location.
- If the information has changed since the reservation, a revised EPBI is submitted showing the actual shade impact.

Shade Tools



Solmetric Sun Eye



Pathfinder

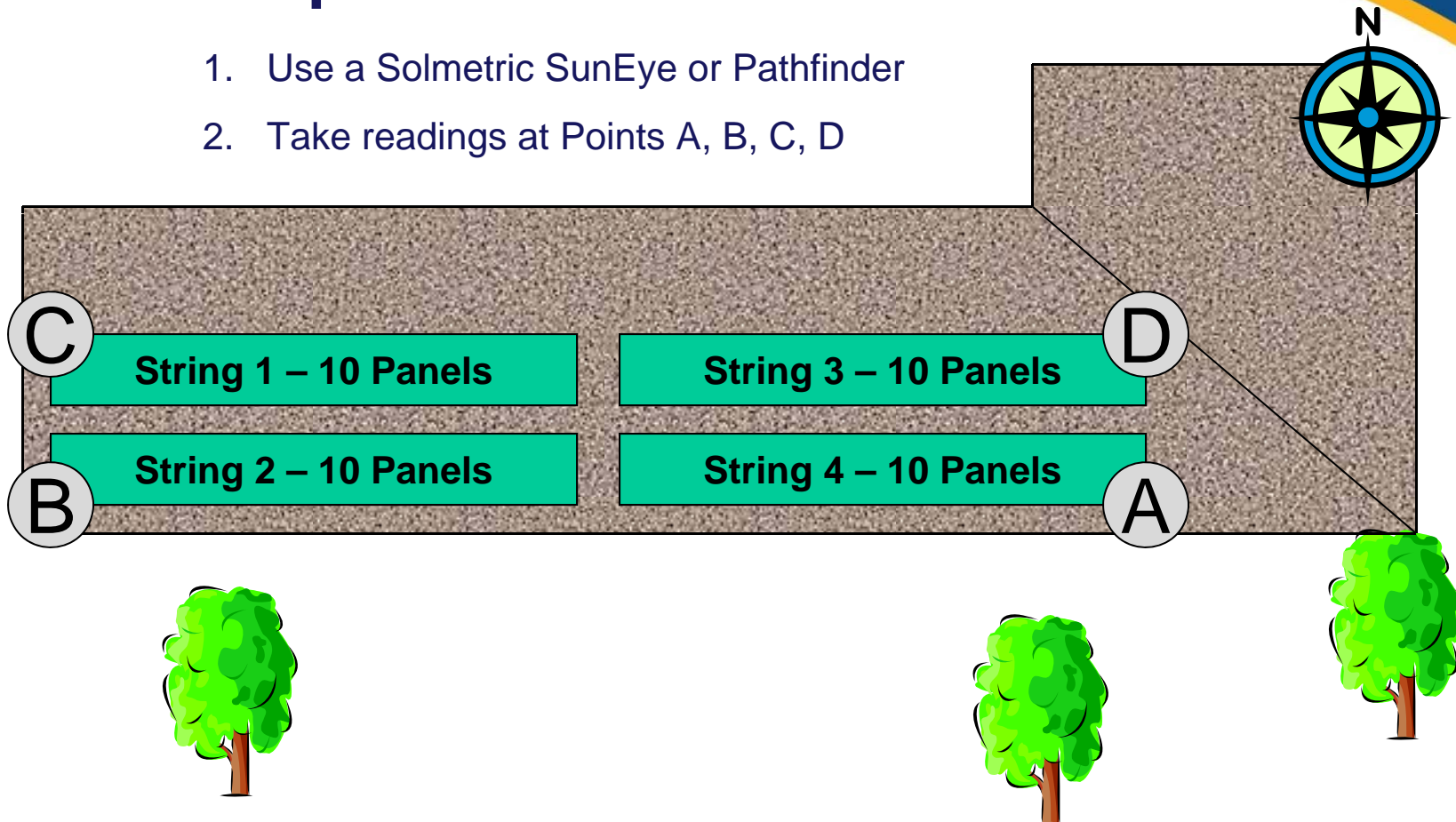
Shade Methodology

1. Take shade readings at the major corners of the PV system.
2. Average the shade readings – this is done automatically by the tools.
3. Enter the January through December percentages on the EPBI Calculator input page.

Sample Scenario

40 Modules 1 Inverter

1. Use a Solmetric SunEye or Pathfinder
2. Take readings at Points A, B, C, D



Compiled Data

% of Solar Availability per month

	(A)	(B)	(C)	(D)	Avg.
• Jan	55	100	100	86	86
• Feb	65	100	100	89	89
• Mar	74	100	100	92	92
• Apr	80	100	100	95	95
• May	83	100	100	95	94
• Jun	93	100	100	97	98
• Jul	98	100	100	100	100
• Aug	98	100	100	100	100
• Sep	80	100	100	99	99
• Oct	73	100	100	91	91
• Nov	60	98	95	82	82
• Dec	50	85	81	70	70

When minimal shading is checked, the EPBI Calculator assumes 100% availability for all months.

Enter the average monthly Shading Derate Factors as shown in your shade tool's output report.

Inverter: 333 kW 480 Vac Three Phase Utility Interactive Inverter

Number of Inverters:

Shading: Minimal Shading

Shading Derate Factors (%)

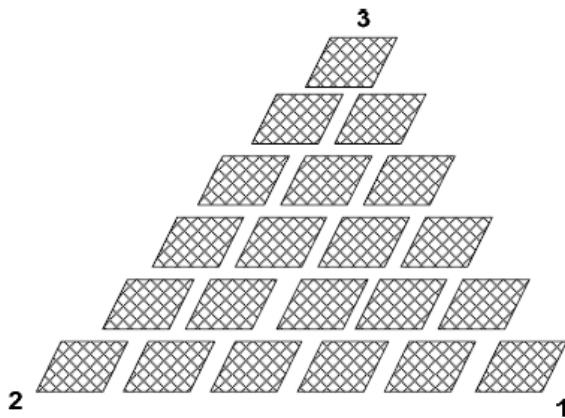
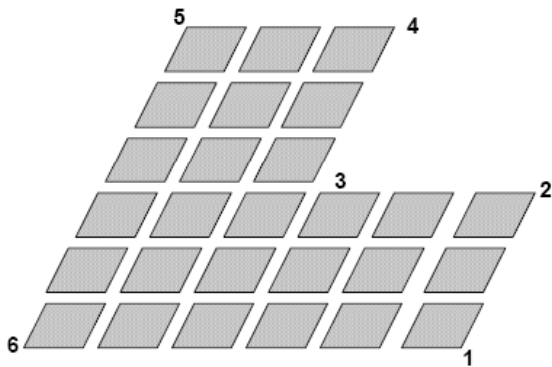
January	<input type="text" value="86"/>
February	<input type="text" value="89"/>
March	<input type="text" value="92"/>
April	<input type="text" value="95"/>
May	<input type="text" value="94"/>
June	<input type="text" value="98"/>
July	<input type="text" value="100"/>
August	<input type="text" value="100"/>
September	<input type="text" value="99"/>
October	<input type="text" value="91"/>
November	<input type="text" value="82"/>
December	<input type="text" value="70"/>

Array Tilt (degrees):

Array Azimuth (degrees):

North 0°
270° 90°
180°

Non-Standard Shapes

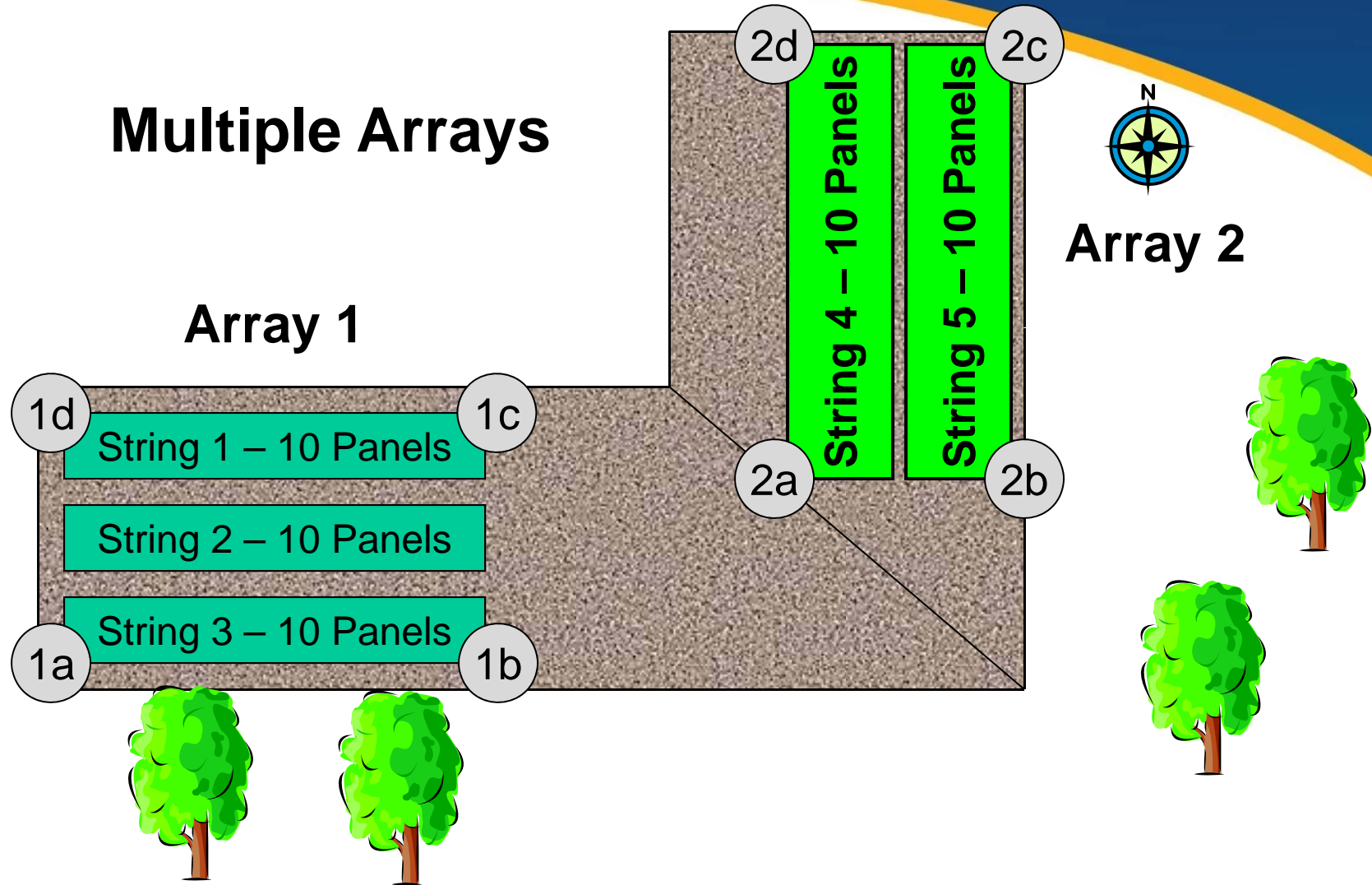


- 1) Take the readings at the corners
- 2) Average the readings
- 3) Enter the results in the EPBI Calculator
- 4) Let the PA know where you took your measurements. This can be a hand drawing, 1 line diagram, or a photo with notes. If the array is oddly shaped and the project is selected for inspection, the inspector will be able to take the same readings to get a similar result.

Multiple Arrays

- ❑ Multiple arrays require multiple EPBI calculations
- ❑ How do you know if there are multiple arrays?
 - ❑ Different inverters = multiple array
 - ❑ Different panel types = multiple array
 - ❑ Panels feeding into a single inverter have a different azimuth or tilt = multiple array

Multiple Arrays



Calculate Average

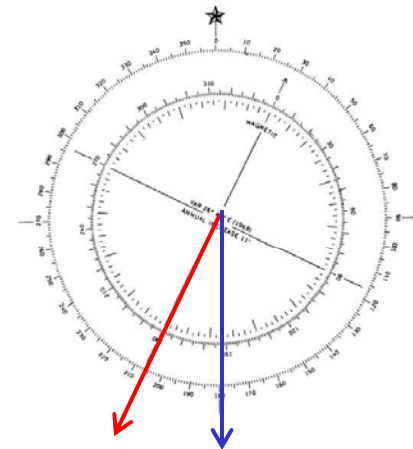
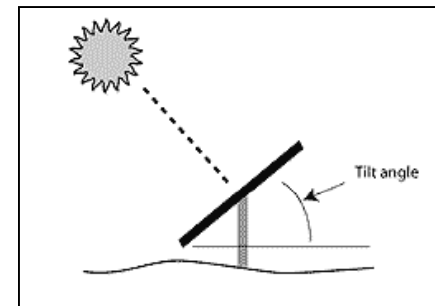
<p>Array 1</p> <p>Readings 1a - 1d</p>	Jan	89	Jan	90	<p>Array 2</p> <p>Readings 2a – 2d</p>
	Feb	90	Feb	91	
	Mar	92	Mar	92	
	Apr	93	Apr	93	
	May	94	May	94	
	June	95	June	95	
	July	97	July	96	
	Aug	96	Aug	96	
	Sept	94	Sept	95	
	Oct	92	Oct	93	
	Nov	91	Nov	92	
	Dec	89	Dec	91	

Determining Tilt and Azimuth



Design Terminology

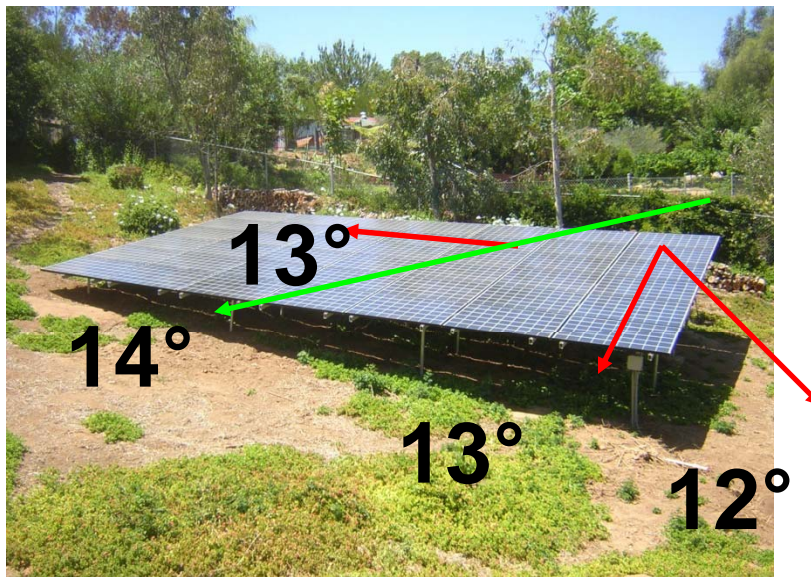
- ❑ Tilt
 - ❑ Degree of pitch
 - ❑ Measured with inclinometer or SunEye
- ❑ Azimuth
 - ❑ Direction of orientation
 - ❑ True reading, not magnetic
 - ❑ If you are using a magnetic compass within PacifiCorp's CA service territory, add 15 degrees to the magnetic reading to obtain the true reading.
- Magnetic Compass = 180.....True = 195



What is Optimal Tilt?

- ❑ The PPCSIP is designed to give the highest rebate for optimal production during the summer months (May-Oct). Therefore, the best tilt for the rebate may not be the best for net metering.
- ❑ You will need to discuss this with your customer: Do you maximize the rebate amount or net metering benefits?

How to Measure Tilt and Azimuth



1. Find the line of maximum tilt. This is as easy as rotating the inclinometer until it reaches the highest measurement.
For example: 14° tilt
2. Measure the azimuth of this line.
For example: 225°
3. If necessary, adjust for declination to get the true azimuth.
For example: $225^\circ + 15^\circ = 240^\circ$ true azimuth.

Difficult Tilt/Azimuth



Not the azimuth

Correct Azimuth

Not the azimuth

Field Inspection Overview

If your project is selected for a field inspection, the inspector will:

- Conduct a shading analysis using a Solmetric SunEye
- Determine tilt and azimuth of each array
- Inspect and verify system components
- Take photographs of major system components
- Record system output (kW)
- Measure environmental conditions (sky cover, temperature)
- Review the inspection findings and compare to the submitted EPBI

Inspection Tolerances

- Tilt = +/- 3 degrees
- Azimuth = +/- 5 degrees
- Shading = +/- 5%

Example: If June Shading = 93% on the EPBI submitted and the inspector finds 88-98%, there is no change.

Month	Original EPBI	Inspection Results	Revised EPBI
June	93%	88%	93%
July	100%	96%	100%
August	100%	92%	92%

Change of Incentive, Infractions and Failures

A new EPBI Calculation will be run and the project incentive modified accordingly if:

- The onsite field inspection results are outside any of the tolerances, or
- The onsite field inspection reveals other discrepancies between key project components.

If the result shows a change of incentive from the original EPBI, the rebate is adjusted accordingly and all parties are notified via email along with a copy the inspection results. Additionally, an infraction or failure will be issued to the appropriate party if the incentive amount is at least 5% greater or below the incentive identified on the Incentive Claim Form.

Change of Incentive, Infractions and Failures

Change of Incentive (no penalty issued):

- Difference of less than 5% of the incentive amount

Infraction:

- Difference of 5-10% of incentive amount

Failure:

- Difference of more than 10% of incentive amount
- System is found non-operational
- PV modules, inverters, and/or performance meters not on the CEC's list of approved equipment
- Re-inspections (due to contested result) found to have adjustments made to match the original submission following the initial inspection
- Re-inspections (due to contested results) found to have the same results as the inspection
- 3 Infractions

Penalties & Disputes

Any Applicant, Solar Contractor, System Owner, Seller and/or Host Customer that receives two failures in a rolling 12 month period will be on probation for a period of 12 months, during which time all of its projects will be inspected.

After being placed on probation, the entity will be removed from probation if no additional failures occur within 12 months from the second failure. If a third failure occurs before the end of the probationary period, the entity will be disqualified from participating in the program for a minimum of one year.

If the program issues an infraction or failure for a project that is later re-inspected because the results are contested and the failure was due to inspector error, the failure will be removed from the records.

Inspection Results Scenario # 1

Results are within tolerances:

Tilt $\pm 3^\circ$

Azimuth $\pm 5^\circ$

Shading $\pm 5\%$ of summer shading

Equipment matches

PA accepts submitted claim and pays project as normal

JOHN DOE OR JANE DOE 123 MAIN STREET ANYTOWN, TN 01234 PHONE 555-1212	2670 87-823/641
Pay to the Order of	19 \$
<i>Bank of Yourtown</i> YOURTOWN, TN	Dollars  Security details 6-73
For	MP
⑆0 1 2345678⑆	⑆98765432⑆

Inspection Results Scenario # 2

Results are outside the tolerances but within 5% of incentive amount:

- Recalculate Incentive - Notify all parties of the new incentive amount and field inspection results
- Applicant accepts the change of incentive or disputes with PA for resolution
- No infraction or failure issued

- 4kW CEC System:

Tilt from Horizontal	10 °		22 °		Change	12 °
Azimuth	180 °	true	165 °	true	Change	-15 °
Design Factor	98.689%		97.795%		OK	0.906%

Original EPBI:

- PPCSIP Rating: 3.946 kW
- Incentive Rate: \$1.13/watt
- Incentive Amount: **\$4,459**

Revised EPBI:

- PPCSIP Rating: 3.912 kW
- Incentive Rate: \$1.13/watt
- Incentive Amount: **\$4,421**

Difference = -\$38
~(0.9%)

Inspection Results Scenario # 3

Results are outside the tolerances and incentive between 5% and 10% of incentive amount:

- Recalculate Incentive - Notify Applicant of a new incentive amount and field inspection results
- PA issues infraction
- Applicant accepts the incentive amount change or disputes with PA for resolution

- 4kW CEC System:

Total Module Output		kW	Total Module Output	0.000	kW	Differences:	
Azimuth	210	° true	Azimuth	180	° true		30.0 °
Tilt from Horizontal	20	°	Tilt from Horizontal	5	°		15.0 °



Original EPBI:

- PPCSIP Rating: 3.700 kW
- Incentive Rate: \$1.13/watt
- Incentive Amount: **\$4,181**

Revised EPBI:

- PPCSIP Rating: 3.920 kW
- Incentive Rate: \$1.13/watt
- Incentive Amount: **\$4,430**

Difference = +\$249
6% = Infraction

Inspection Results Scenario # 4

Results are outside the tolerances and outside 10% of incentive amount:

- Recalculate Incentive - Notify Applicant of a new incentive amount and inspection results
- PA issues failure
- Applicant accepts the incentive amount change or disputes with PA for resolution

- 4kW CEC System:

Total Module Output	0.000	kW	Total Module Output	0.000	kW	Differences:	
Azimuth	180	° true	Azimuth	180	° true		0.0 °
Tilt from Horizontal	17	°	Tilt from Horizontal	50	°		-33.0 °



Original EPBI:

- PPCSIP Rating: 3.841 kW
- Incentive Rate: \$1.13/watt
- Incentive Amount: **\$4,340**

Revised EPBI:

- PPCSIP Rating: 3.417 kW
- Incentive Rate: \$1.13/watt
- Incentive Amount: **\$3,861**

Difference = -\$479
11% = Failure

Inspection Results Scenario # 5

Equipment is Different:

- The PTC rating of modules and the efficiency of the installed inverters will affect the CEC-AC rating of the system, which is used to calculate the PPCSIP rating and the incentive amount.
- Recalculate Incentive - Notify Applicant of a new incentive amount
- The penalty is determined by the % difference from original incentive.
- Applicant accepts the incentive amount change or disputes with PA for resolution

Thank you!

If you have questions or concerns regarding the shading analysis, determining tilt and azimuth or the inspection process, please contact the Program Administrator at PPCSIP@energycenter.org, or call 858-244-1177.



For a complete guide to the rules and requirements of the Pacific Power California Solar Incentive Program, please download the latest version of the PPCSIP Handbook found at www.pacificpowercasolar.com