DOCKETED

Docket Number:	16-BSTD-03
Project Title:	Updates to the 2016 Residential Alternative Calculation Method Reference Manual and Software
TN #:	210964
Document Title:	CBECC-Res Photovoltaic Calculation Presentation
Description:	N/A
Filer:	Hilary Fiese
Organization:	Bruce Wilcox P.E.
Submitter Role:	Public
Submission Date:	4/6/2016 2:25:48 PM
Docketed Date:	4/6/2016

CBECC-Res Photovoltaic Calculation

Bruce Wilcox P.E.,

CBECC-Res consultant team project manager

March 29, 2016

1

PV Calculation Consultant Team

- – Chip Barnaby
- – Neal Kruis, Big Ladder Software

CBECC-Res Photovoltaic Calculation Agenda

- Overview
- Background
- PVWatts
- CBECC-Res PV Inputs
- PVWatts Compared to CECPV

PV Calculator Overview

- Integrated with CBECC-Res 2016
  - hourly,
  - TDV
  - uses PVWatts algorithms

- Solely for Energy Design Ratings (EDR)
  - not for compliance
  - not intended for PV system design

- User input options
  - simple using California Flexible Installation (CFI)
  - detailed for multiple arrays, orientations, components

Background

- New Solar Homes Partnership since 2008
  - Uses Commission created software CECPV
  - Developed set of rules including field verification

- 2013 PV Compliance Credit
  - Very simple input
  - Limited credit based on fixed PV production by climate zone
  -

- 2016 PV Compliance Credit similar to 2013

- New PV Calculator for Energy Design Ratings and above code programs such as Calgreen ZNE.

PVWatts

Simple hourly simulation

- Compatible with CA compliance weather files
- Works with TDV
- Maintained by NREL

Implemented in new code in the CSE simulator

- Using public documentation of the algorithms
- Gives results identical to NREL PVWatts
    - Except for Daylight Savings Time etc.
- Meets our Open Source requirement

CBECC-Res Simple PV Input

California Flexible Installation (CFI)

- From New Solar Home Partnership (NSHP)

- Allows for PV credit for systems where full design details are not known at time of calculations

- Azimuth from 150 to 270 degrees

- Tilts at same slope as roof between 0:12 and 7:12

Revised Value - Original slide showed 4/12 which did not match the NSHP Guidebook.

- Must meet minimal shading criteria to limit obstructions

Minimal Shading Criteria

- Applies to vent, chimney, architectural feature, mechanical equipment, neighboring terrain, trees, etc.

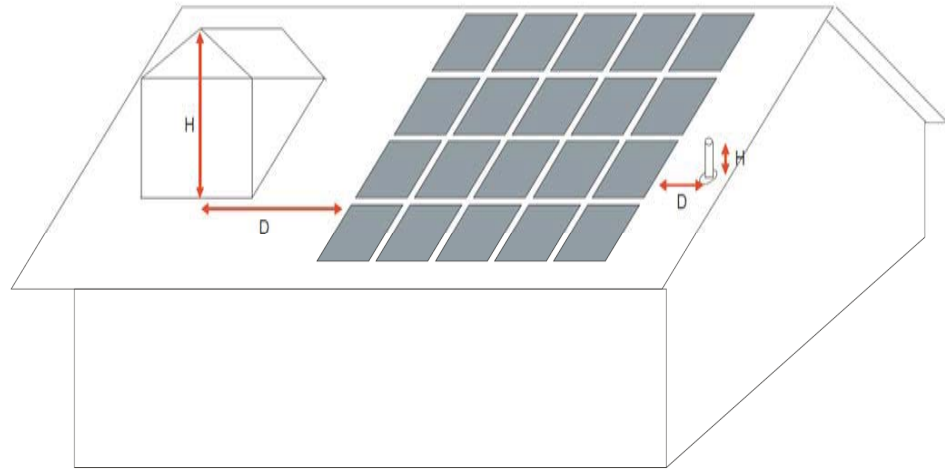- Distance "D" must be at least two times greater than the distance "H"

Figure 5 – The Minimal Shading Criterion - Artistic Depiction of "H" and "D"

CBECC-Res PV Calculation

9

CBECC-Res Detailed PV Input

Complicated PV System Input

PV System CF1R Report

ENERGY DESIGN RATING PV SYSTEM INPUTS - DETAILED							
DC System Size (kW)	Module Type	CFI	Azimuth (deg)	Tilt Input	Array Angle (deg)	Tilt: (x in 12)	Inverter Eff. (%)
1	Standard	☐	190	pitch	26.6	6.0	96
1	Standard	☐	170	deg	22.6	5.0	96
2	Standard	☒	NA	NA	NA	NA	96
3	Premium	☐	200	pitch	30.3	7.0	90
4	Thin Film	☐	290	deg	35.0	8.4	96

PVWatts Results Similar to CECPV

|	Panel Pitch			
Azimuth	2 in 12	4 in 12	6 in 12	8 in 12
090	4%	4%	4%	4%
110	3%	3%	3%	3%
125	3%	3%	3%	3%
145	3%	2%	2%	2%
170	2%	2%	1%	1%
180	2%	1%	1%	0%
190	2%	1%	0%	0%
210	1%	0%	-1%	-2%
230	1%	-1%	-1%	-2%
250	1%	-1%	-2%	-3%
270	1%	-1%	-2%	-3%

(CECPV - PVWatts)/CECPV

For standard panel, fixed (open rack), 94% inverter

From "Recommended PV Evaluation Method for CALGreen ZNE Tier for Inclusion in 2016 CBECC-Res Software" by DEG, Nov 30, 2015 calculated using CECPV

CBECC-Res PV Calculation

13

Panel Type Variables for Temperature and Reflectance
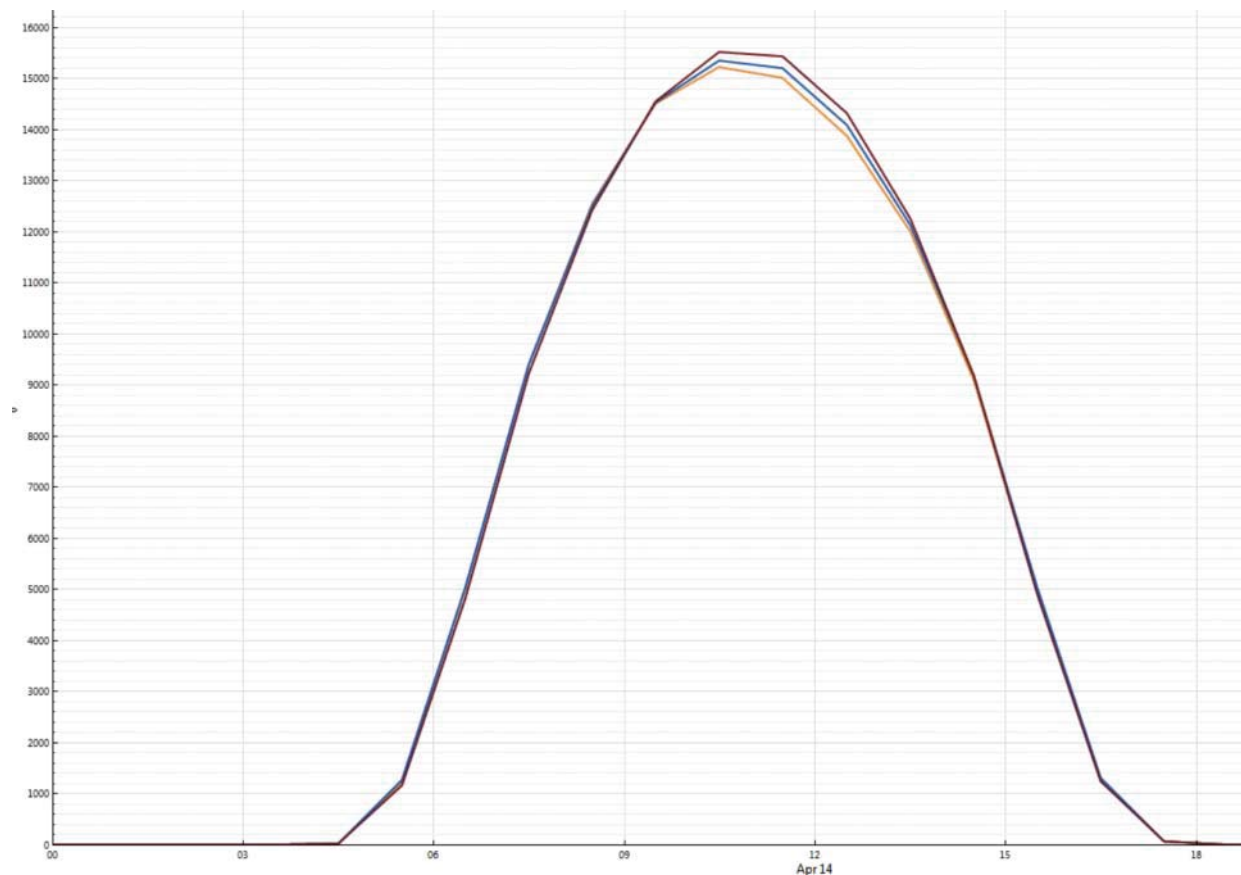
Orange =   Standard

Blue =   Premium +1% Annual TDV

Maroon = Thin film   +2% Annual TDV

CBECC-Res PV Calculation

14