SAND#2010-8092P

Welcome to the PV Performance Modeling Workshop

Note – access to tomorrow's tour will be by bus only.
We will leave from the conference center at 1 pm and return at ~3:30 to the conference center and the Courtyard Marriot.
Any special needs, please see Coryne.

If you signed up for the tour but are now unable to attend, please tell Coryne.

Thanks for Coming!

Manufacturers
Abound Solar
BP Solar
First Solar
Miasole
SoloPower
SunPower
Uni-Solar
Yingli

Integrators
American Capital Energy
Borrego Solar
Sun Edison

Independent Engineers
BEW Engineering
Black and Veatch
Luminate

Consultants/Analysts/Other
Steve Ransome
Navigant
SolarTech

Modelers
CEC-UW
Clean Power
King Solar Works
PVDesign Pro - Hoes Engineering
PV*Sol
PVSyst

Universities
U of Arizona
U of Colorado
U of New Mexico
U of Wisconsin

Labs/Government
National Institute of Standards and Technology

National Renewable Energy Laboratory

Sandia National Laboratories

US DOE

Modeling Activities within Systems Integration

The mission of the Modeling Team is

- **to provide manufacturers, system integrators, project developers, and the financial community with validated tools to calculate key metrics, such as expected system performance and Levelized Cost of Energy, including the contributions of component and system lifetime, durability, and availability, and, as a result,**

- **to help *reduce cost and hasten market development* by reducing uncertainty in expected performance and Levelized Cost of Energy, thereby reducing risk and the cost associated with that risk (cost of and time to obtain financing, cost of warranties and service agreements, etc.)**

The Market Transformation Team performs additional modeling and analysis

DOE Solar Modeling Activities
Sandia's Role

- **Evaluate and validate PV performance models**
  - **Includes DOE and non-DOE models**
  - **Attempting to characterize accuracy and uncertainty**
  - **Key supporting activity is collecting high-quality weather, solar resource, and system performance data for use in model evaluation**
  - **Option: *We can analyze results from proprietary models run by others***
- **Identify opportunities for model improvement**
  - **Share with model developers and assist with implementation**
- **Perform modeling for DOE program**
  - **For example, in support of stage gate evaluations**

DOE Solar Modeling Activities
Sandia Performance Models

- Sandia has developed models and has made them available to others for implementation in higher level models
- Performance models developed by Sandia include:
  - PV Form
    - used in PVWatts
  - Sandia PV Array Performance Model
    - Used in Solar Advisor Model and PV Design Pro, etc.
    - An empirical model for which Sandia provides module performance coefficients
      - Module characterization being transferred to TUV-PTL
  - Sandia Inverter Model
    - Used in Solar Advisor Model
    - Model coefficients developed from CEC-published test data
- The modeling team is not beholden to Sandia models
  - Our goal is to identify the most appropriate tradeoff between accuracy, complexity, and required input data

Why Did We Organize This Meeting?

- **Models Do Not Agree**
  - **Even the same model, applied by different users may produce different answers**
- **Model accuracy and uncertainty, in general, have not been independently verified**
  - **Uncertainty (x y) generally not stated**
  - **No accepted validation process**
- **Potential impacts include**
  - **Choosing a technology because the model associated with an incentive treats it favorably**
  - **Choosing a technology based on performance that is not a better value when uncertainty is considered.**
  - **High market hurdles for new technologies lacking extensive field performance data to justify tweaking models**
  - **A decrease in investor confidence, leading to higher financing costs**

What Are Our Objectives for the Meeting?

- Assess the state of performance modeling
- Educate each other about needs, concerns, and possible paths forward
- Prioritize work to best meet the needs of the PV community
  - What must be done to improve module performance modeling?
  - How to ensuring quality in model inputs?
  - Should uncertainty be included in model outputs?
  - Validating models and inputs - are new standards needed?
  - Prioritization of future efforts, roles, and responsibilities

Meeting Structure

Day One

- Overview and Needs Assessment from Integrators, Manufacturers, and Independent Engineers
- Analysis of Model Accuracy
  - Results of pre-work
- Modeling the Module
  - Module models
  - Modeling module temperature
  - Discussion of needs, priorities, and paths forward

Day Two

- Beyond the module – systems modeling
  - System losses
  - Shading and MPPT
  - Large systems
  - Discussion
- Impact of uncertainty
- Discussion on ensuring quality, need for standards, model validation
- Action items and next steps
- Tours