

# Welcome and Introduction to the Workshop

4<sup>th</sup> PV Performance Modeling  
and Monitoring Workshop  
TÜV Rheinland, Cologne,  
Germany October 22-23, 2015

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**PVPerformance** SAND2015-8571C  
**MODELING COLLABORATIVE**

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# Background

*International Scope*  
*Speakers from 12*  
*countries and 4 continents!*



- Welcome to the 4<sup>th</sup> PVPMC Workshop!
- Aim is to bring together international experts on PV performance modeling and monitoring to discuss new trends and present research results to the community.
  - Focus on technical issues. Information transfer between researchers and industry
  - Support discussion, networking, and partnerships
  - Identify gaps and opportunities for improving models (and technology)



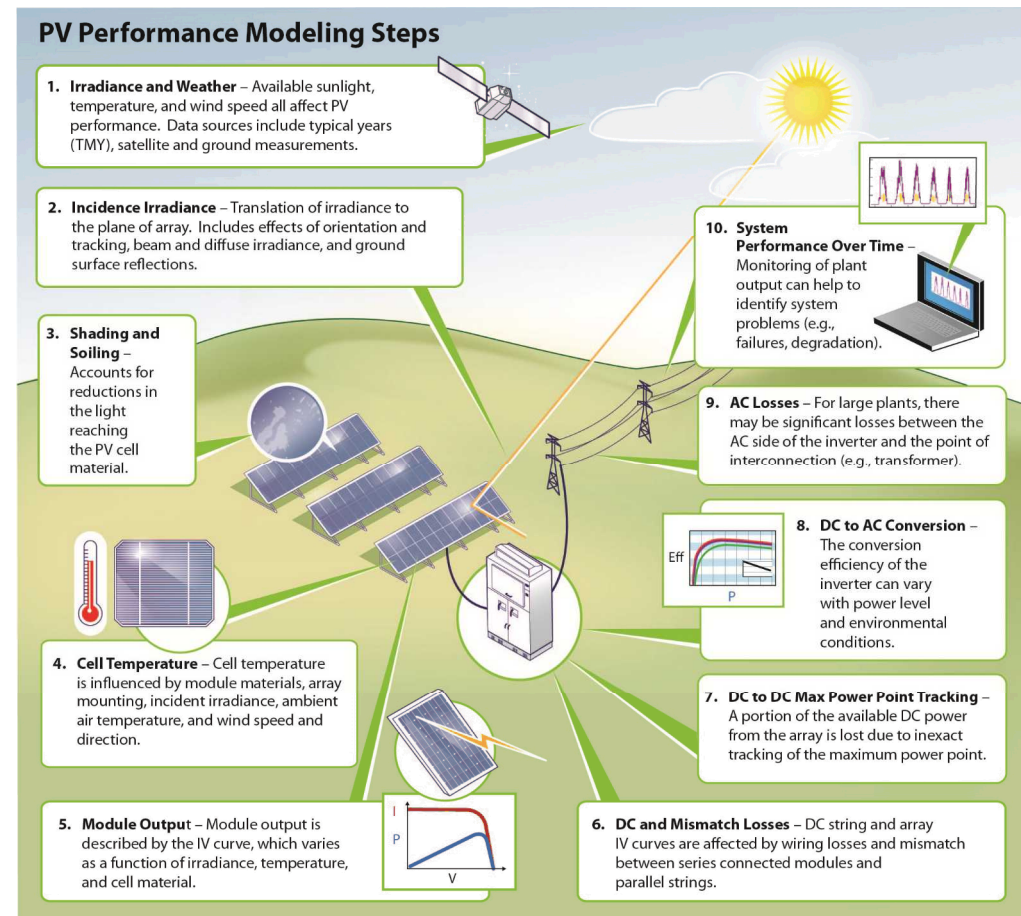
## Previous and Future Workshops

- |    |             |                         |
|----|-------------|-------------------------|
| 1. | 2010        | Albuquerque, NM         |
| 2. | 2013        | Santa Clara, CA         |
| 3. | 2014        | Santa Clara, CA         |
| 4. | <b>2015</b> | <b>Cologne, Germany</b> |
| 5. | 2016 (May)  | Santa Clara, CA         |
| 6. | 2016 (Fall) | Europe???????           |

# PV Performance Modeling and Monitoring Landscape

PV performance is modeled by following the flow of energy from the sun to the meter.

- Each step in the journey is represented with a model.
- Comparison of monitoring data to model predictions helps to detect failures and degradation
- The PVPMC aims to document and improve these models so that best practices are available and used by the solar PV industry.

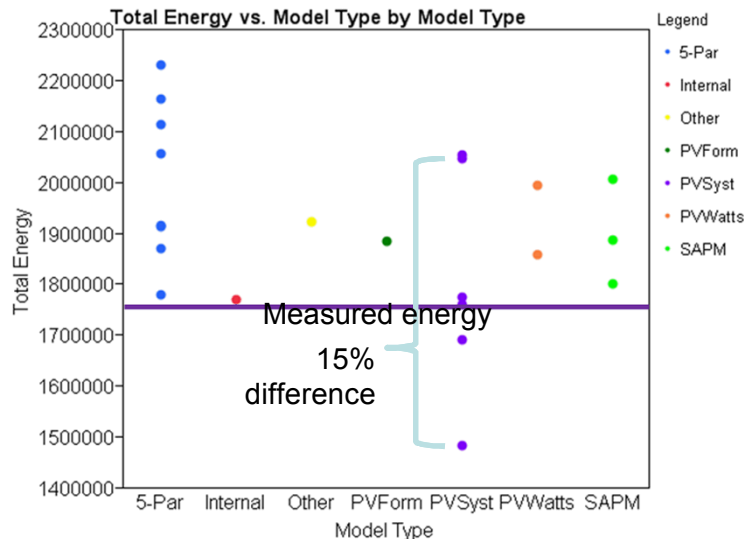


Stein, J. S. and B. H. King (2013). Modeling for PV plant optimization. *Photovoltaics International*, Solar Media Ltd. 19th: 101-109.

# 2010 and 2015 Blind Modeling Studies

## 2010 Blind Study Facts

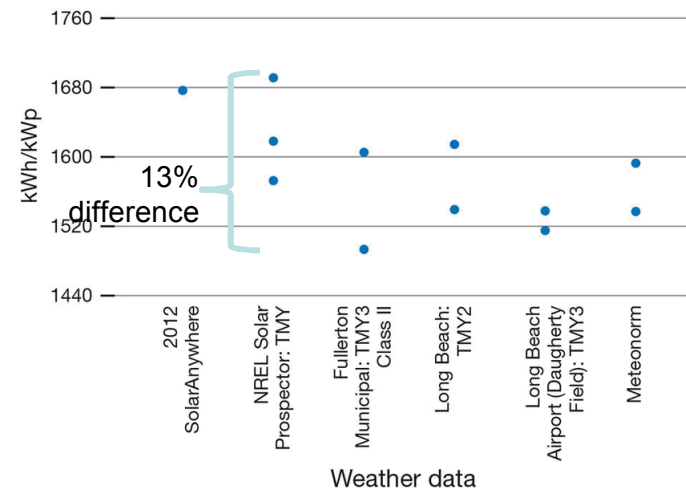
- 20 participants given measured weather and irradiance and 3 PV system designs
- Asked to predict annual energy from systems
- Results compared with measured annual energy



Cameron, C., J. Stein and C. Tasca (2011). PV Performance Modeling Workshop Summary Report. Albuquerque, NM, Sandia National Laboratories.

## 2015 Blind Study Facts

- 12 participants given 1 PV system design and location.
- Asked to predict annual energy from system
- Participants had to find their own weather data.



Andrews and Yates, SolarPro Magazine Sept/Oct 2015

Lesson Learned: Greater consistency and transparency in modeling is still needed. 4

# Topics for this workshop

## 1. Solar Resource Data

- One of the largest source of uncertainties
- Need for low-cost, accurate data everywhere

## 2. Spectral Corrections

- Recognized as important but not standardized in existing software
- PV cell technology specific
- Need for new, universal methods and data

## 3. Soiling

- Major source of energy loss
- Lack of standard methods to measure and predict.

## 4. Bifacial PV

- Disruptive technology?
- Quantify advantages and challenges.

## 5. Modeling Applications

- Updates from model developers

## 6. Monitoring and Validation

- Best practices for monitoring.
- What data is needed for model validation?
- Recent results from validation studies.



# Protocols

## ■ Speakers

- Time limits will be enforced!
- Ensure presentations are uploaded well before your scheduled session.
- We would like to be able to post/share presentation materials after the workshop. If there are restrictions, please notify organizers.

## ■ Audience

- Silence cell phones
- Return from breaks on time
- Ask questions
- Participate in discussion sessions
- Meet colleagues and network during breaks



# Workshop Report

- We will be preparing a workshop report as part of the IEA PVPS task 13 Activity 2.4 “PV Performance Modeling Collaborative”
  - It will include:
    - Overview of the PV performance modeling process
    - Summaries of workshop presentations (Orals and Posters)
  - It will be published by the IEA PVPS and be available online in late 2016 or early 2017.
- I will be reaching out to presenters after the workshop to review summaries that I will prepare.
- This is a collaborative effort and any other contributions to this report will be considered and are welcome.
  - Please contact me (Joshua Stein) if you would like to contribute.

# Thank You and Enjoy the Workshop!



Joshua S. Stein

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