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PVPerformance MODELING COLLABORATIVE

The 2013 PV Performance Modeling Workshop: Welcome and Purpose

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U.S. DEPARTMENT OF ENERGY NNSA National Nuclear Security Administration

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SunShot Goals and PV Performance

- DOE SunShot Goal: Cost-competitive solar energy by 2020 ($0.06 per kW-hr LCOE)
  - Solar Energy 14% by 2030; 27% by 2050 (Source: SunShot Vision Study
- LCOE depends on cost, performance, reliability, and O&M
- Solar fuel is "free" – most of the cost is up front – financing is very important!
- Accurate PV Performance Modeling is critical for SunShot goals to be achieved.
  - Reduce uncertainty to reduce cost of capital
  - Standard methods for characterizing technology and simulating performance
- Collaborative and inclusive approach

Agenda Topics

- Welcome and Background
- Wed 1-5 PM: Module Models: Generating performance coefficients
- Wed 7-9PM - PV System Performance Models (What's new?)
- Thurs 8-10AM - Solar Resource Data
- Thurs 10AM-2:30 - PM System Losses and Derates
- Thurs 3-4:30PM - Modeling in the Real World
- Thurs 4:30-5 PM - Summary and Next Steps….

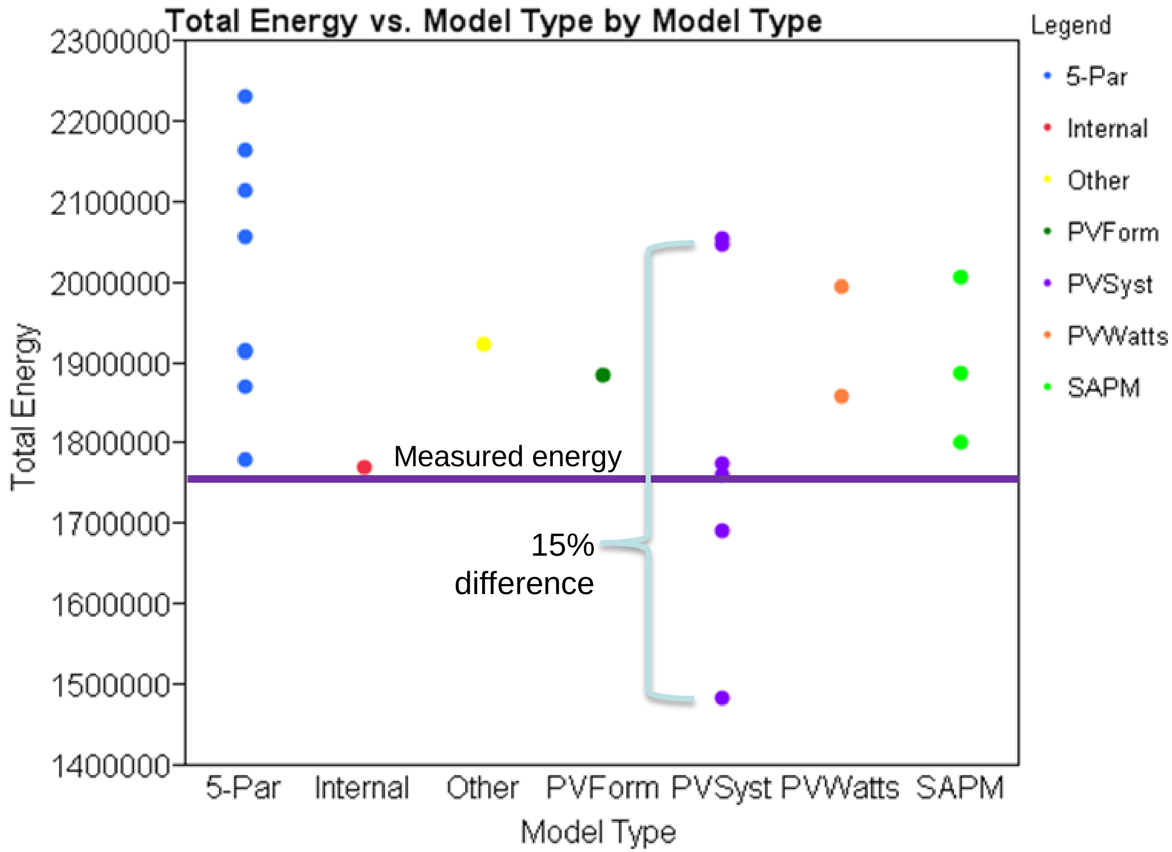
What is PVPMC? – A little history…

- In September 2010, Sandia National Laboratories held a PV Performance Modeling Workshop
  - Invite only (50 participants)
    - Model developers, Independent engineers, integrators, PV manufacturers, financiers, researchers.
  - Pre-workshop "homework" modeling assignment
    - Blind modeling exercise (predict PV system production)
  - Workshop report available at http://pv.sandia.gov (PV Publications)
- Workshop results:
  - Models do not agree (lots of inputs) (uncertainty ignored)
  - Models are quite different (PVWATTS to PVsyst)
  - Few standards or best practices are available
  - Non-standard data sources (module and inverter databases)
  - These factors contribute to significant perceived risk and high cost of capital.

Blind Modeling Study Example

Blind Study Facts

- ~20 participants
- Each given measured weather and irradiance
- Each given 3 PV system designs
- Asked to predict annual energy from systems
- Results compared with measured annual energy
- Most results over-predicted annual energy
- Differences were significant even when same model was used.

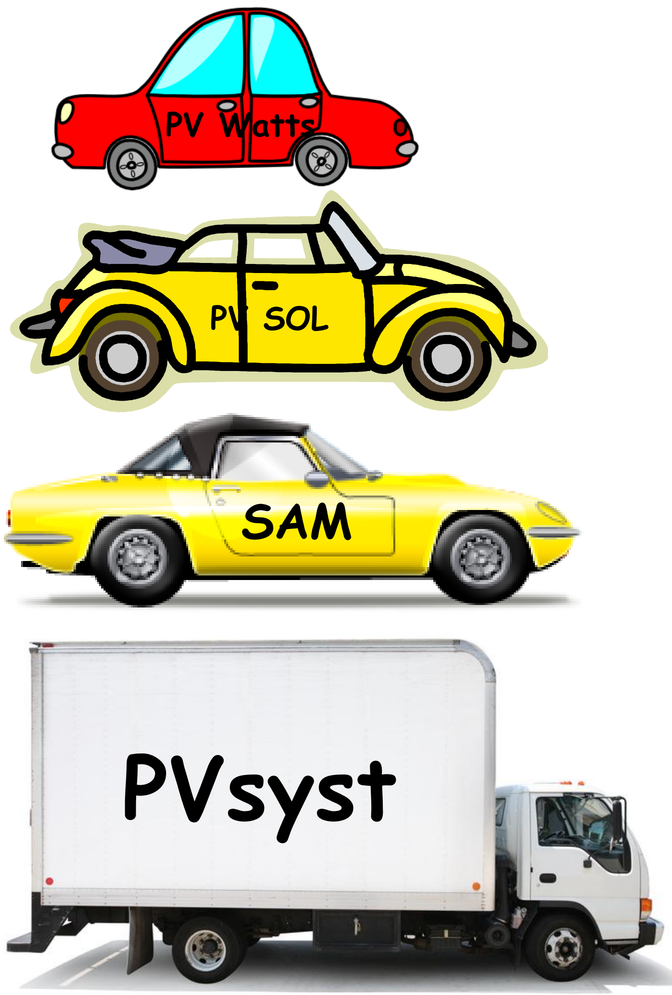


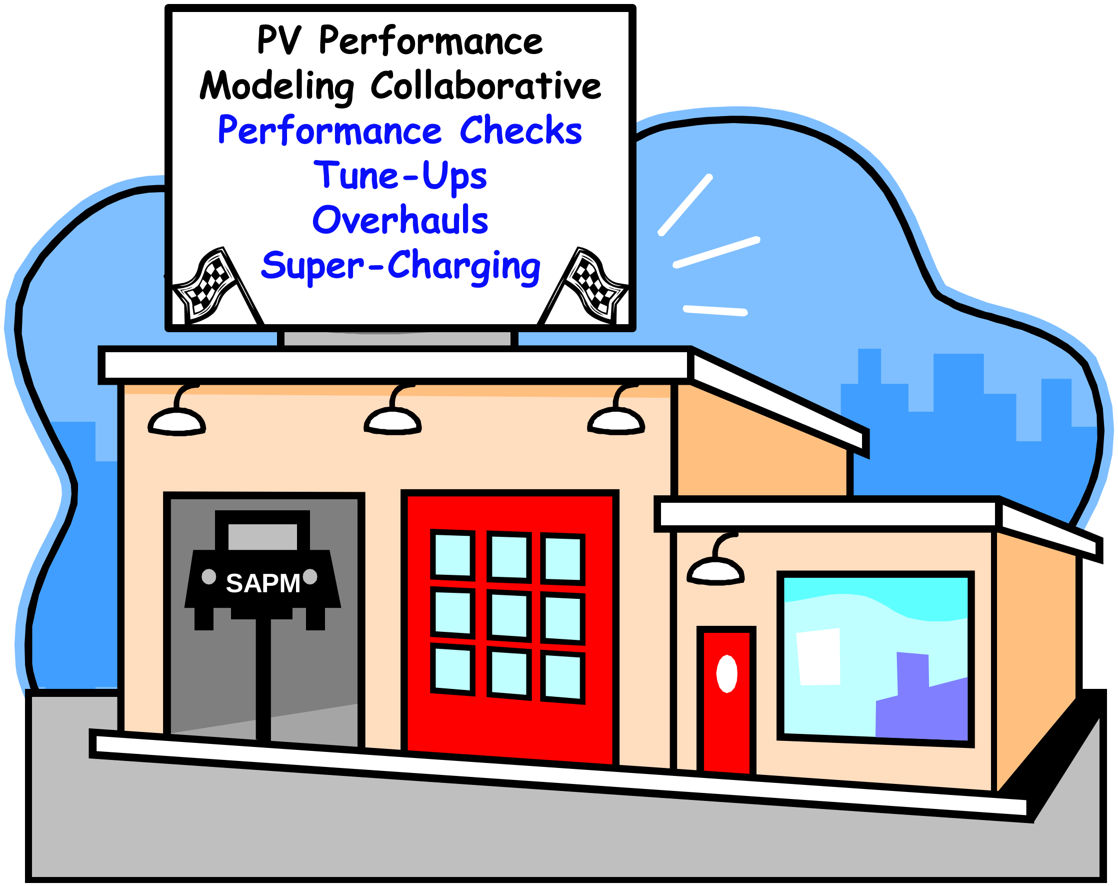
Lesson Learned: Greater consistency and transparency in modeling is needed.

PV Performance Modeling Collaborative

- PV modelers working together to increase confidence in the predictability of PV system performance.
- Transparent science, algorithms, validation, process
- Collect and organize accurate information
- Provide access to advanced algorithms and submodels
- Organize periodic meetings, webinars, conference sessions, workshops.
- Start industry working groups to create standards and best practices for PV performance modeling.
  - Model results generated with validated models, presented in a consistent format, uncertainty is quantified.
  - Increased confidence in model predictions = more money for investment in PV.

Our Approach:
Open the Hood and Work Together



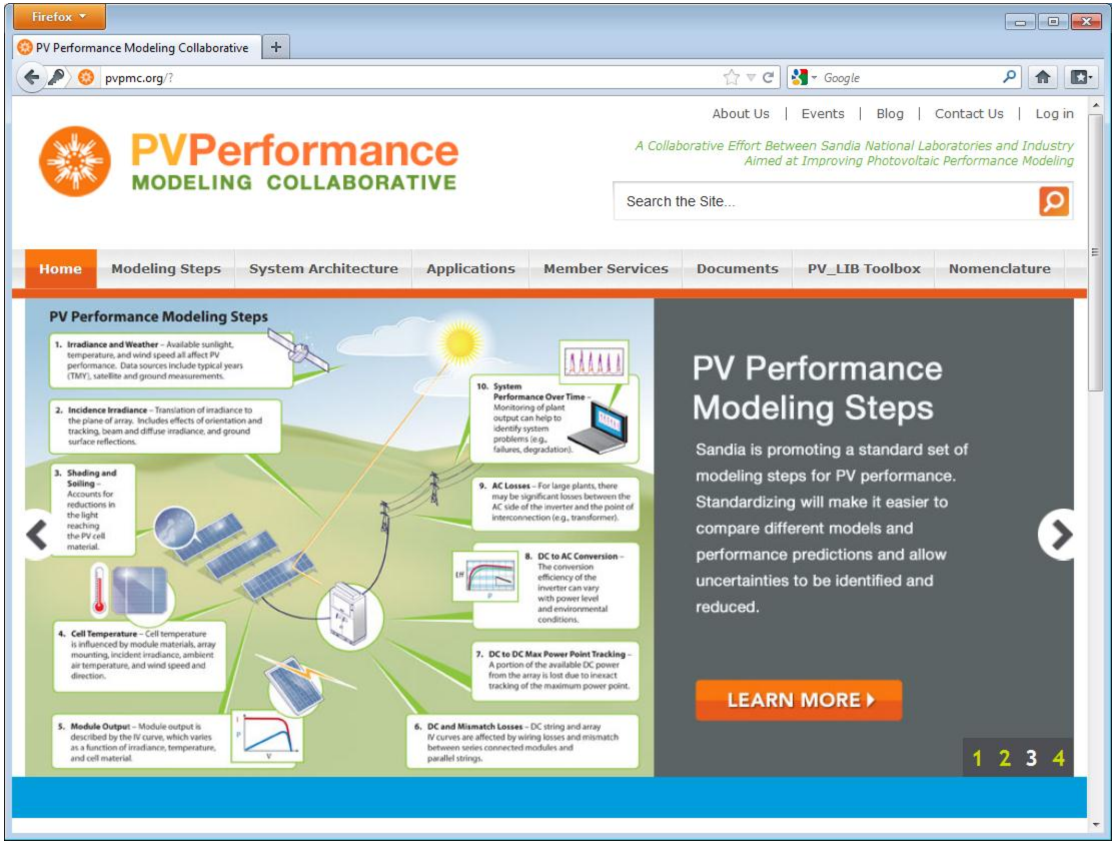


The Challenge:

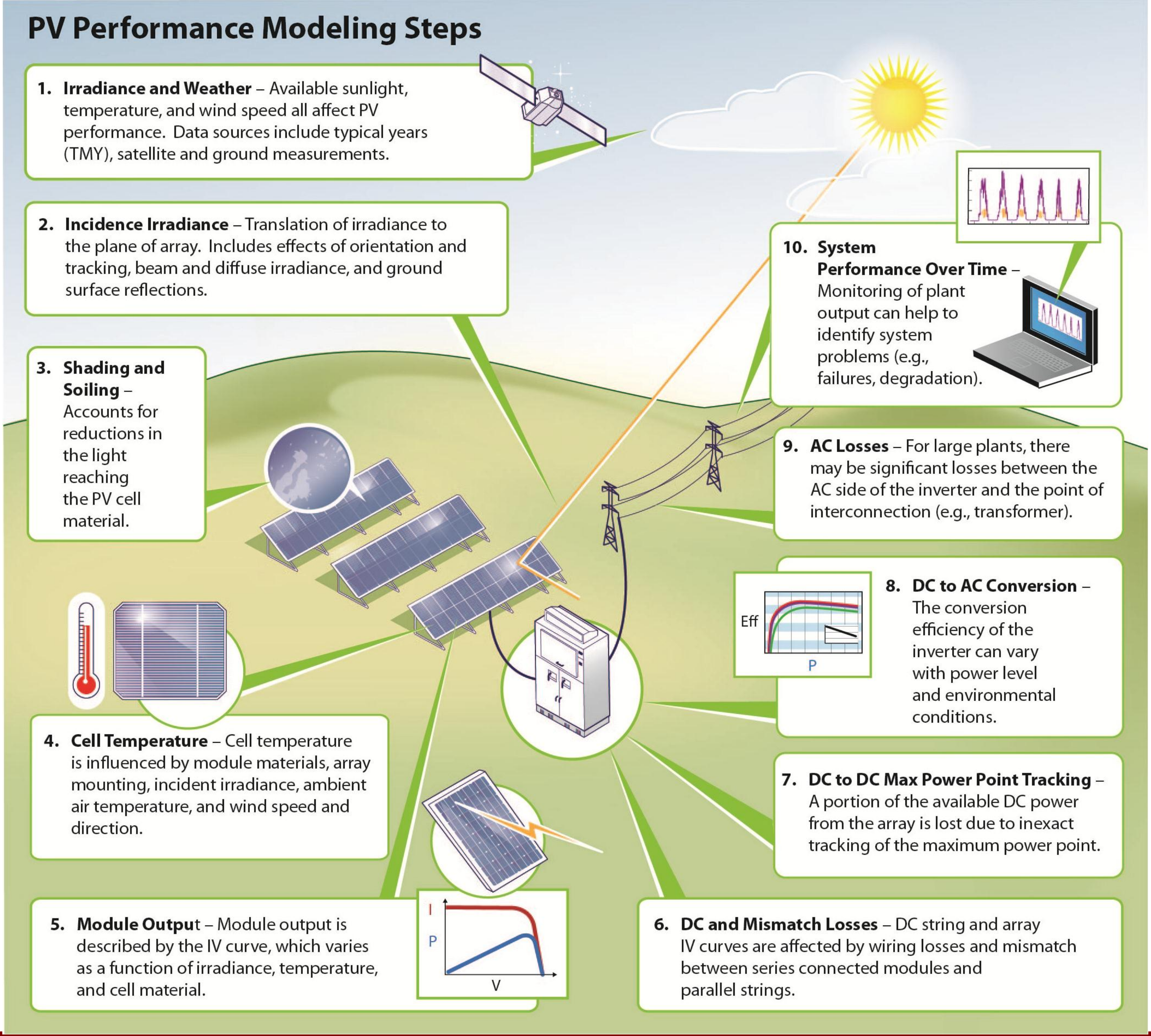
Model Users Don't Know What is Under the Hood and
Model Developers Don't Know How the Model Will Be Operated

Website: http://pvpmc.org

Initial login = sandia



When you join you will set up a username and password



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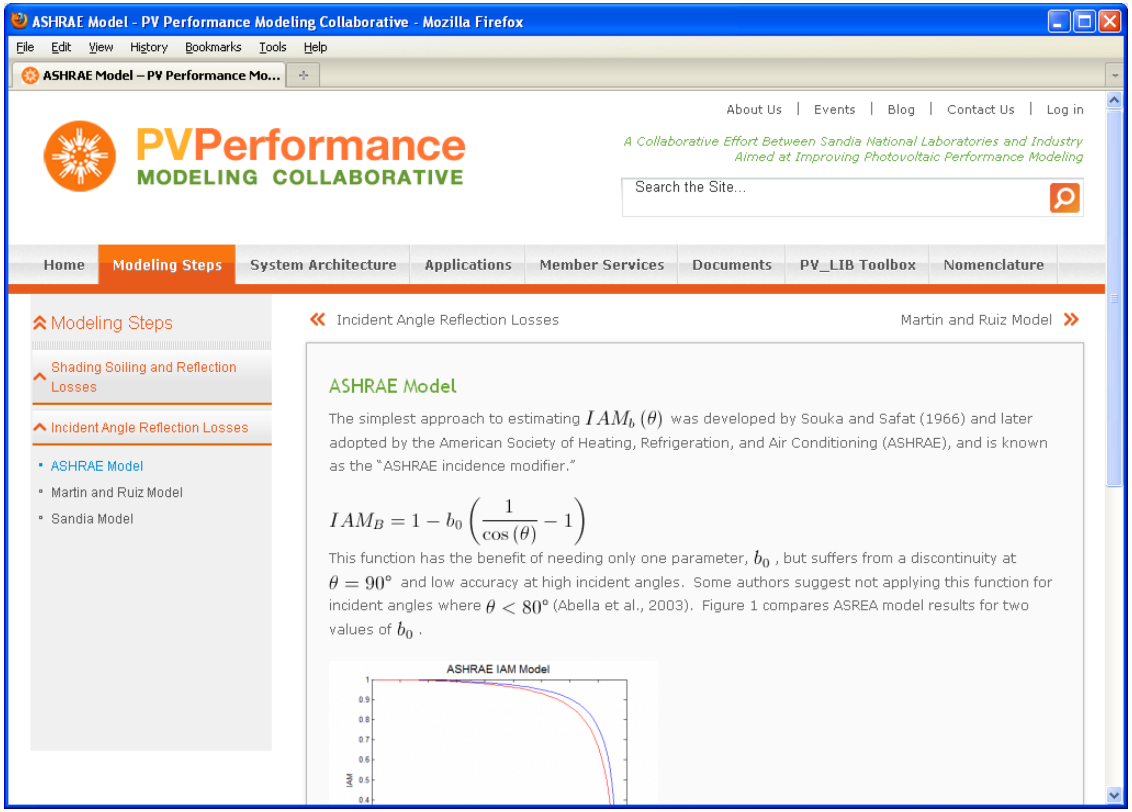
Modeling Steps

- Detailed outline covering the 10 Steps to Modeling a PV System.

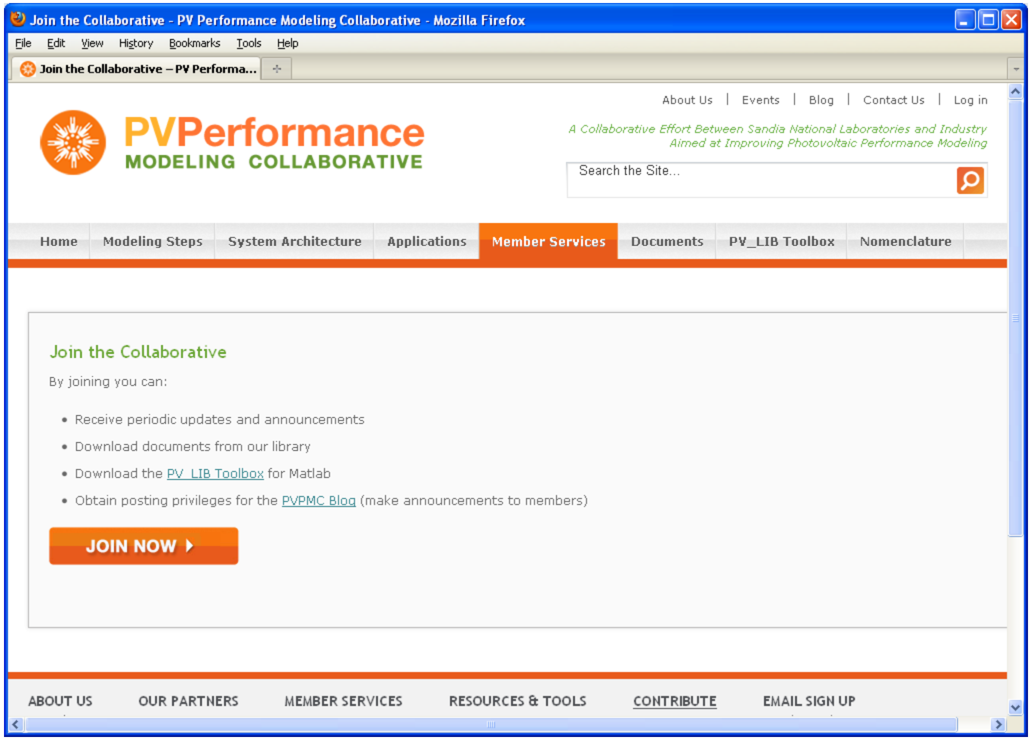
This section will eventually become an online, multimedia textbook on PV performance modeling theory and practice.

Contributors will be acknowledged at base of page.



Join for More Access

- Some features and resources are only available if you Join.
  - Documents
  - PV_LIB Toolbox
  - List of members?
- Need to provide name, email, affiliation, etc.
- Receive periodic email announcements

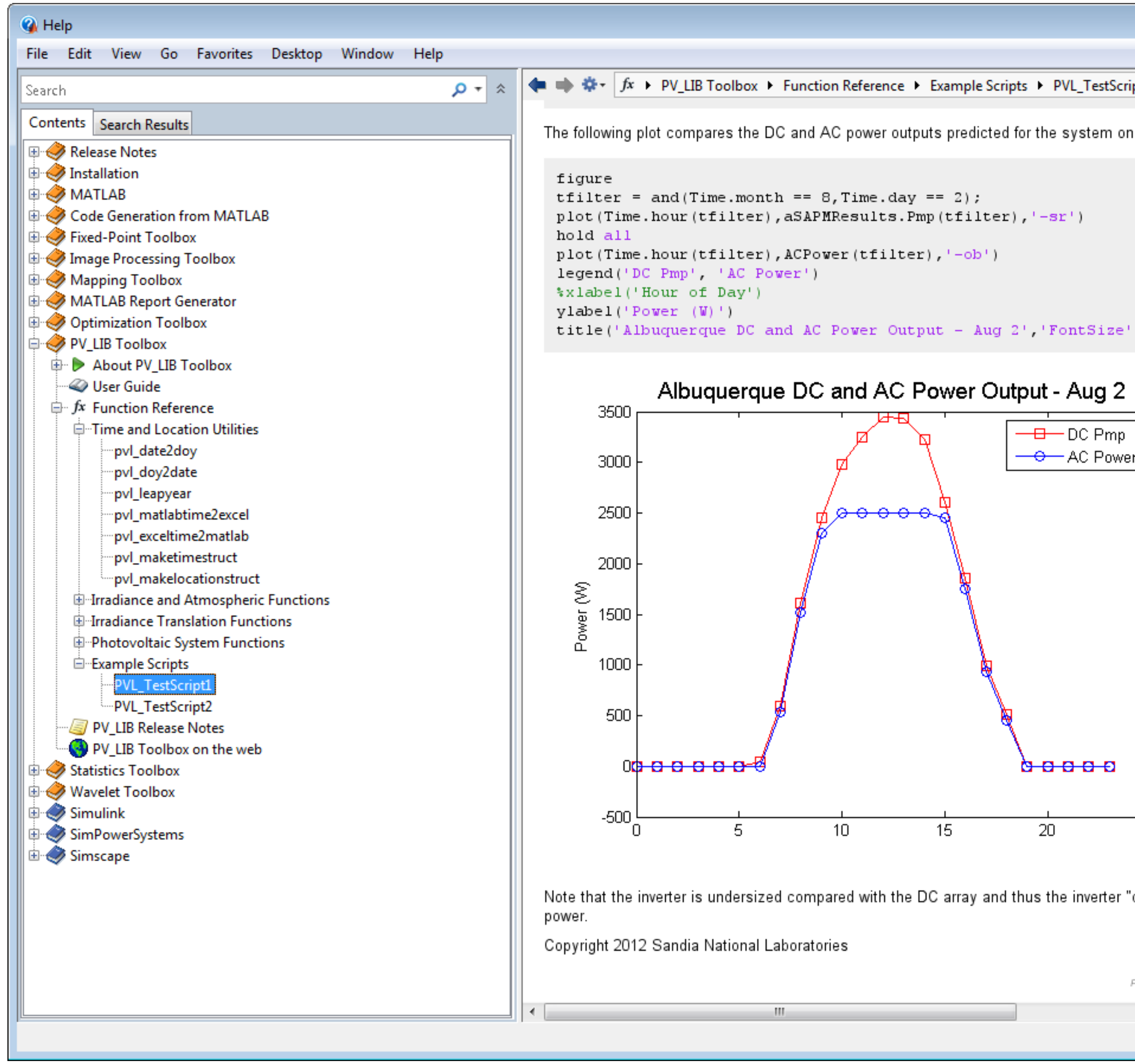


Documents, Nomenclature, Blog

- Document library
  - Documents, reports, and papers (no copyright violations)
  - Presentations
  - Datasets (databases, performance, testing, etc)
- Nomenclature
  - A to Z Listing of technical terms
- PVPMC Blog and Events (in development)
  - PV Modeling News and Events (reviews, conferences, etc)
  - Send announcements for me to post
  - Significant contributors can request posting privileges

PV_LIB Toolbox for Matlab

- Over 30 functions
  - Example scripts
  - Time and Location Utilities
  - Irradiance and atmospheric functions
  - Irradiance translation functions
  - Photovoltaic system functions
- Education, model validation, transparency
- License agreement



Summary

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- Performance modeling is a key component of PV project bankability.
- Currently models are opaque. Uncertainty is significant.
- Solution: "Open the Hood", develop and promote best practices, work across the PV field

- PV Performance Modeling Collaborative provides a venue to
  - "Write the book" on PV performance modeling methods and practice.
  - Communicate to a wide PV performance modeling community
  - Share methods and tools needed for model validation
  - Establish PV performance modeling as a "discipline"
- Join, Contribute, and Help Increase Confidence in PV System Performance!

Thank You!

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http://solar.sandia.gov

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