NREL
NATIONAL RENEWABLE ENERGY LABORATORY

PV System Energy Evaluation Method

Sarah Kurtz with help from Evan Riley (Black & Veatch), Jeff Newmiller (DNV), Timothy Dierauf (SunPower) Adrianne Kimber (Incident Power), Jacob McKee (GCL Solar Energy), Robert Flottemesch (Constellation), Pramod Krishnani (Belectric), many others

Solar Power International
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Why an Energy Test?

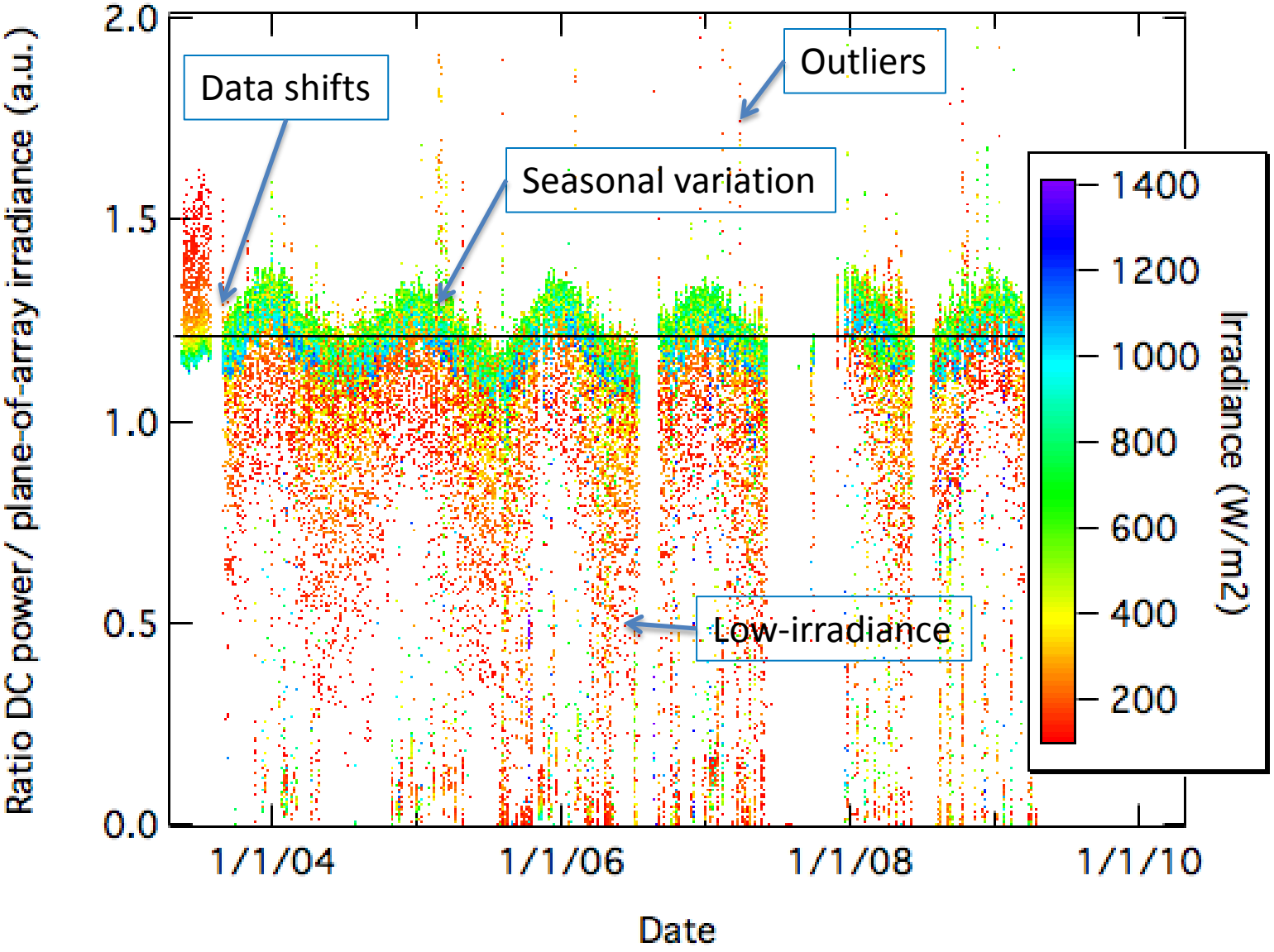
Questions:

- Does it work under ALL conditions?
- Does it work *as predicted?*

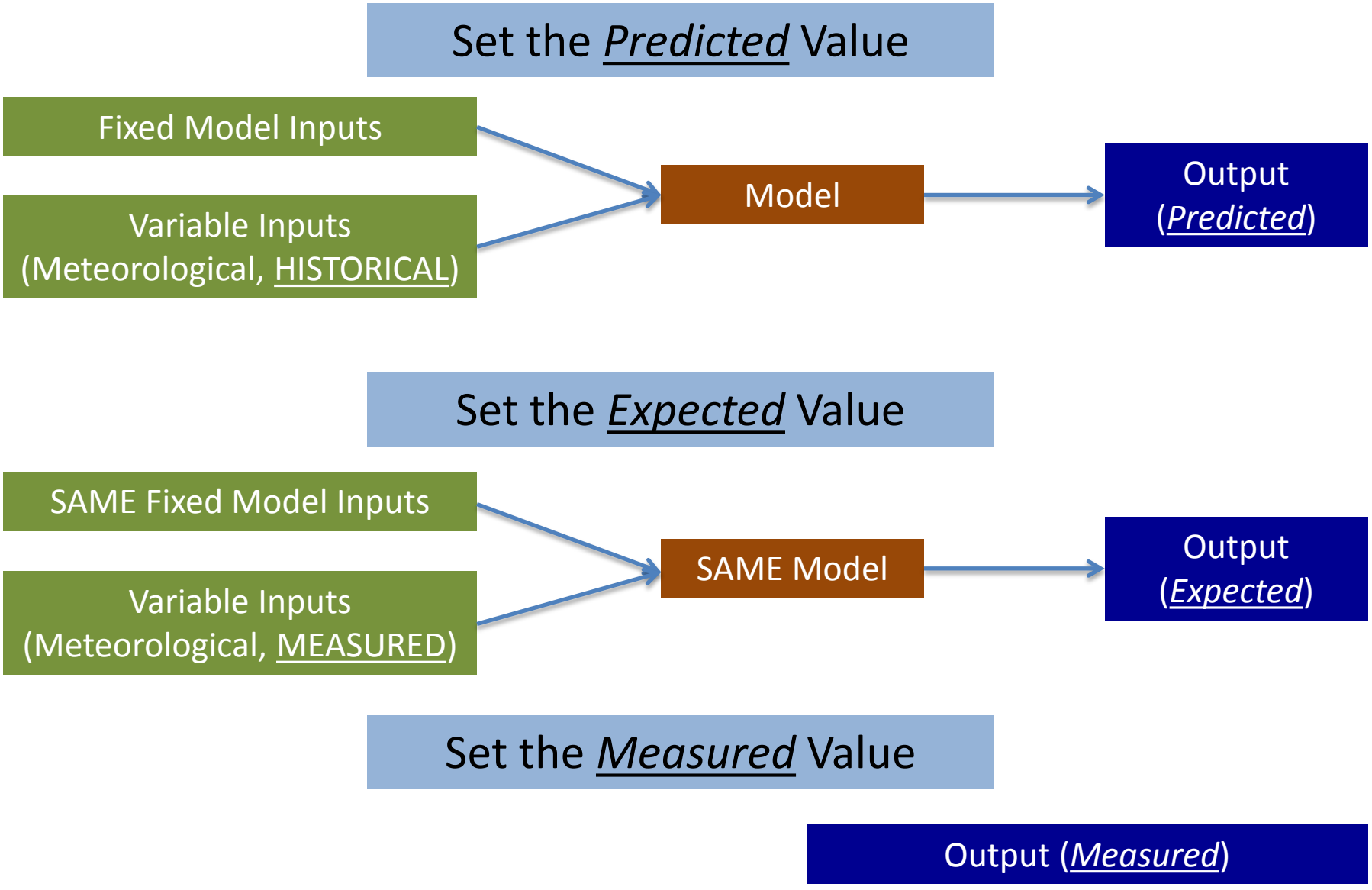
Purposes:

- Calibrate/verify model
- Implement performance guarantee
- Detect system degradation or issue

Challenge: Efficiency changes constantly



Three-Step Process



Some Common Issues/Questions

Differences between historical and measured weather:

- Time step: One hour versus one minute data
- Global horizontal (direct + diffuse) vs plane of array

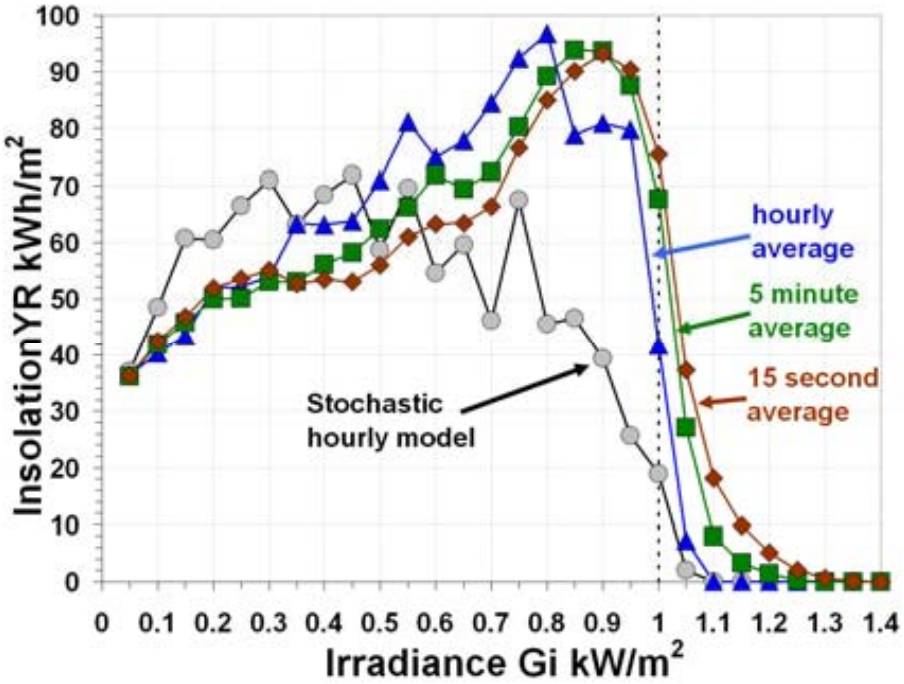
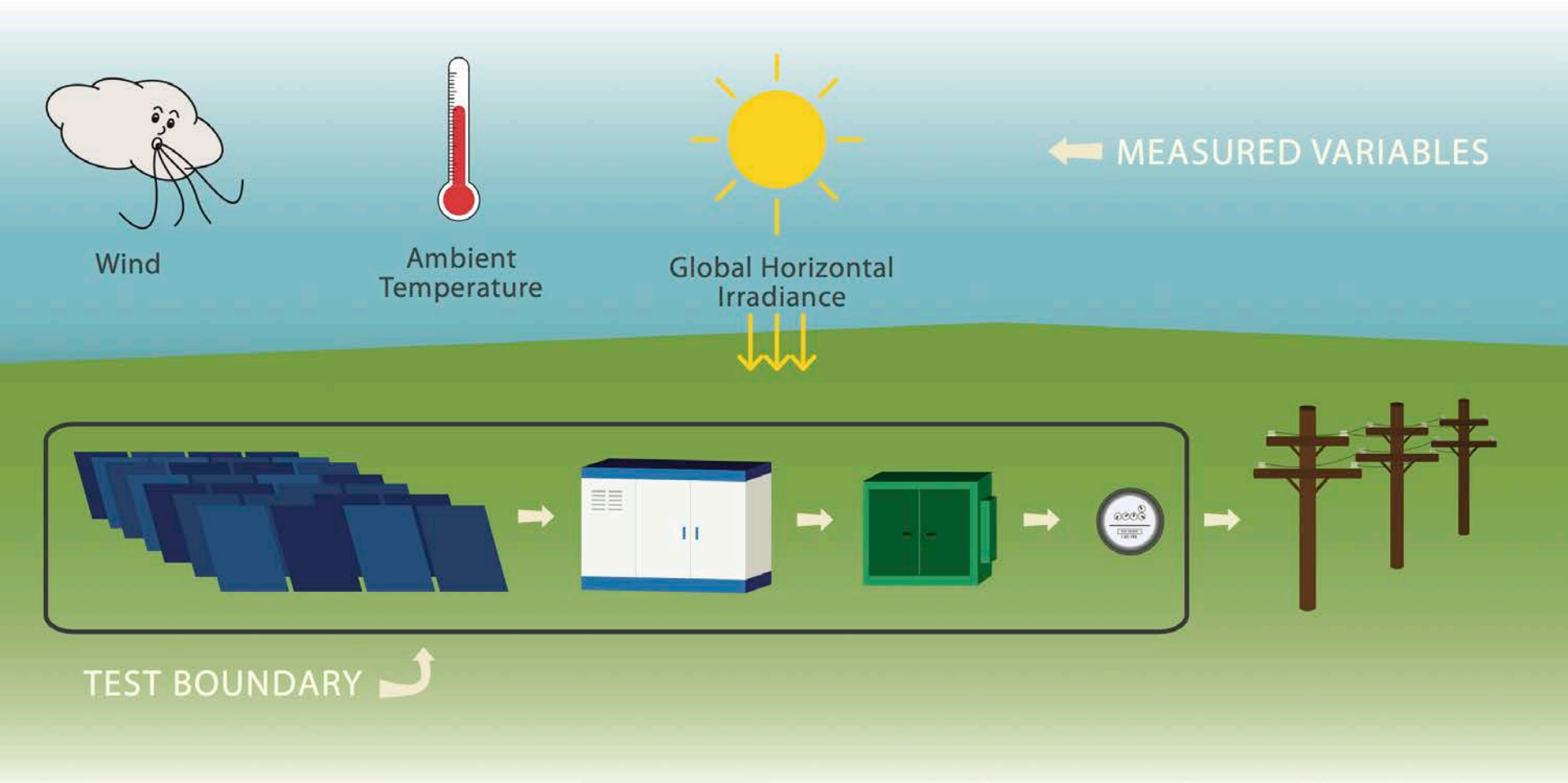


Figure 1: Plane of array insolation vs irradiance at ISET, 2003 comparing a stochastic hourly model to measured data and averages. Steve Ransome, Barcelona, 2005

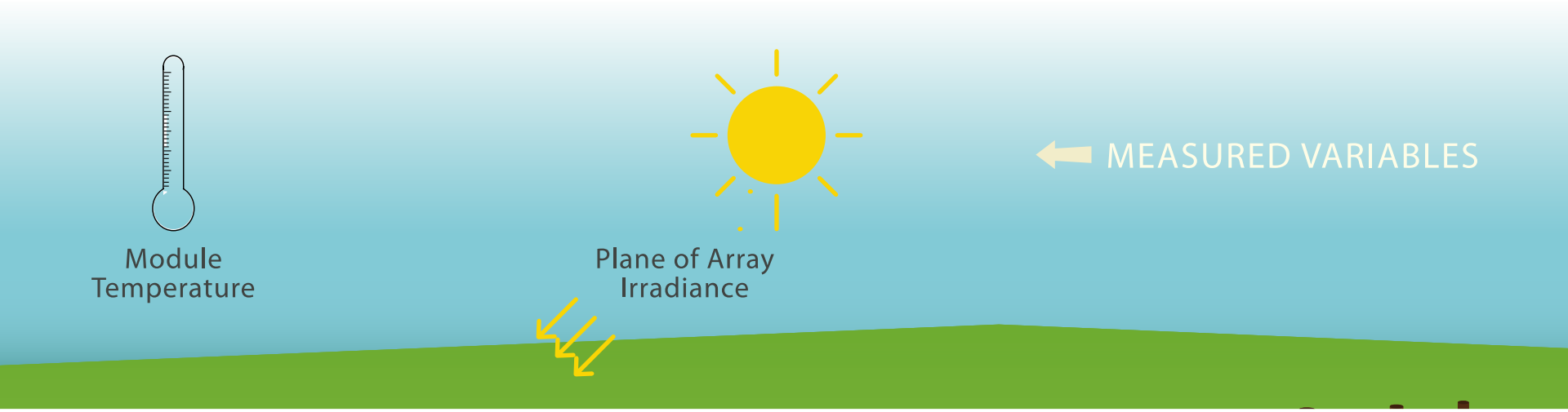
If the efficiency depends on irradiance the predicted performance may depend on how the irradiance is averaged

Test Boundary for Clean System Definition



Global horizontal irradiance and ambient temperature are unaffected by the system, but the model must transpose these

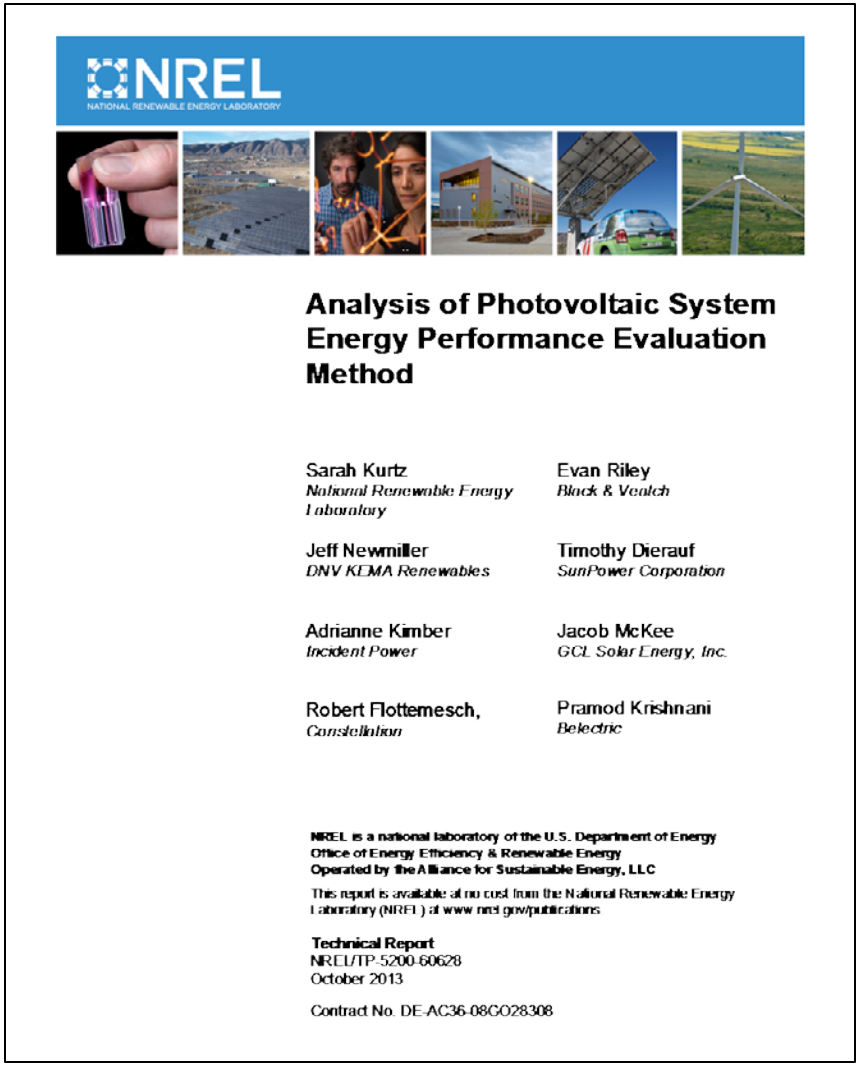
Test Boundary for Precise Measurement



TEST BOUNDARY

Plane-of-array irradiance and module temperature are directly related to system performance, but may depend on system installation

Turn Method into Standard



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Analysis of Photovoltaic System Energy Performance Evaluation Method

Sarah Kurtz
National Renewable Energy Laboratory

Evan Riley
Black & Veatch

Jeff Newmiller
DNV KEMA Renewables

Timothy Dierauf
SunPower Corporation

Adrianne Kimber
Incident Power

Jacob McKee
GCL Solar Energy, Inc.

Robert Flottemesch,
Constellation

Pramod Krishnani
Belectric

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- Report summarizes method and unresolved questions
- Will be submitted to IEC for consideration as international standard

Summary

Energy Evaluation is useful toward:

- Verifying accuracy of model or system performance
- Evaluation of performance guarantee

Energy Evaluation is more complicated than it might seem:

- Alignment of historical and measured weather data
- Definition of test boundary

Standard in progress:

- Report will be posted this week
- Will be considered by IEC as international standard