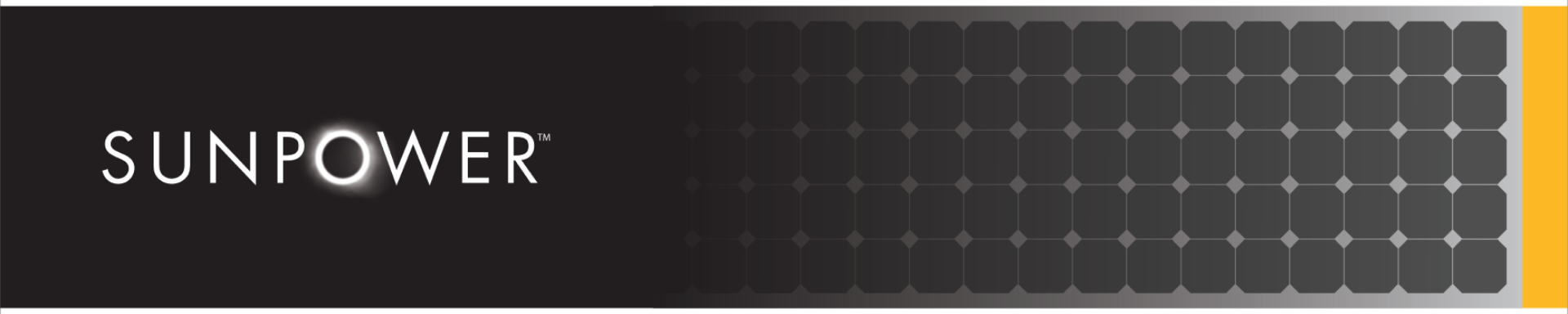
Differentiating Quality PV

Standards & Methodology for Underwriting Certainty

PV Modeling Accuracy & Bankability



Ben Bourne

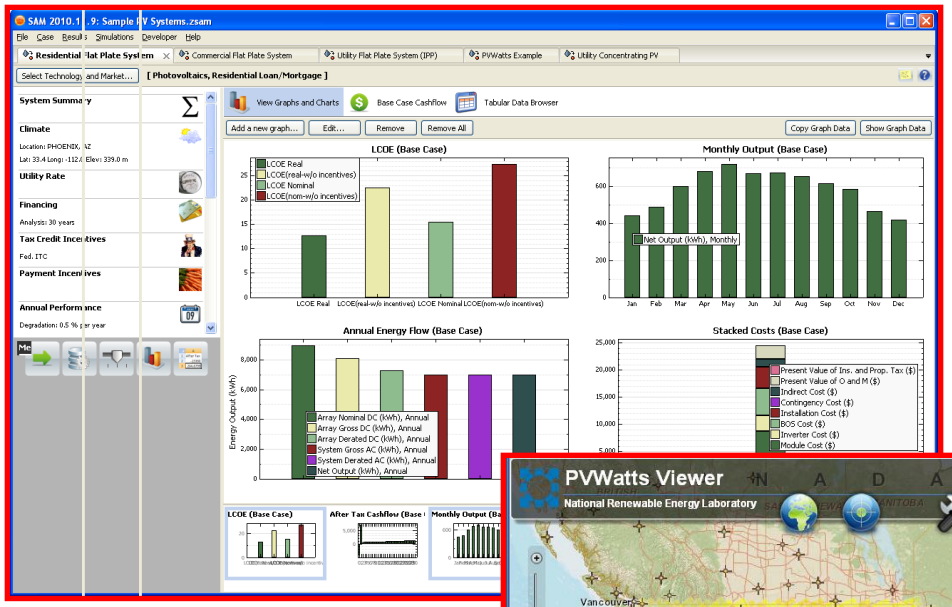
SunPower Corporation

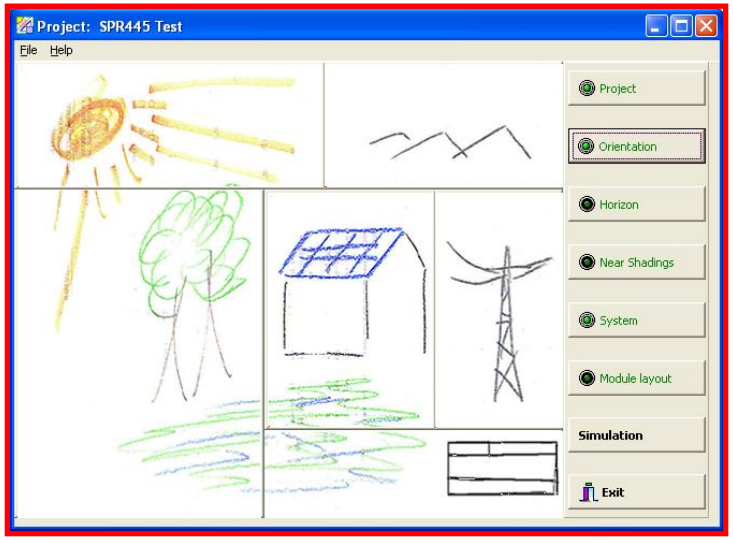
March 6, 2012 - San Francisco, CA

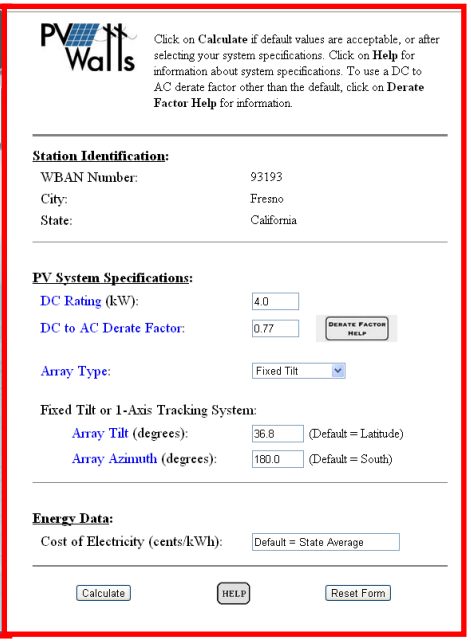
Introduction

- Model accuracy, data quality, and weather variability have direct impact on project bankability and risk:
  - Simulation tool selection (PVSyst, SAM, PVWatts, etc.)
    - How well does the simulation tool predict installed performance?
  - Model selection (CEC/Sandia, Perez/Hay irradiance, etc.)
    - How well do the models match test data?
    - How well do test protocols & data reduction characterize installed performance of PV components?
  - Data quality:
    - How representative is the available weather data
      - How accurate?
      - How variable?
    - What is the accuracy of and uncertainty in the measurements used to predict energy production and assess installed system performance?

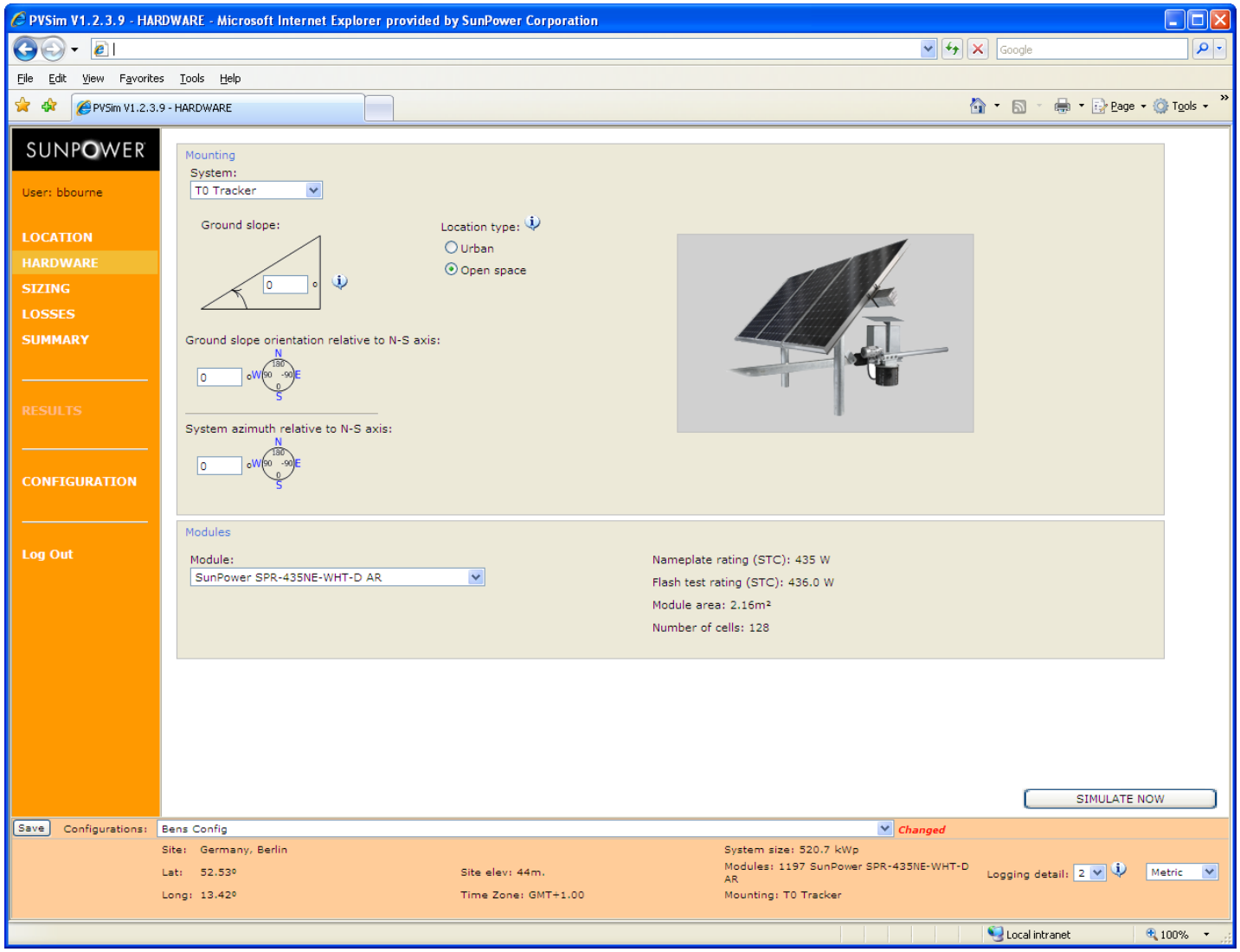
Modeling Tool Selection



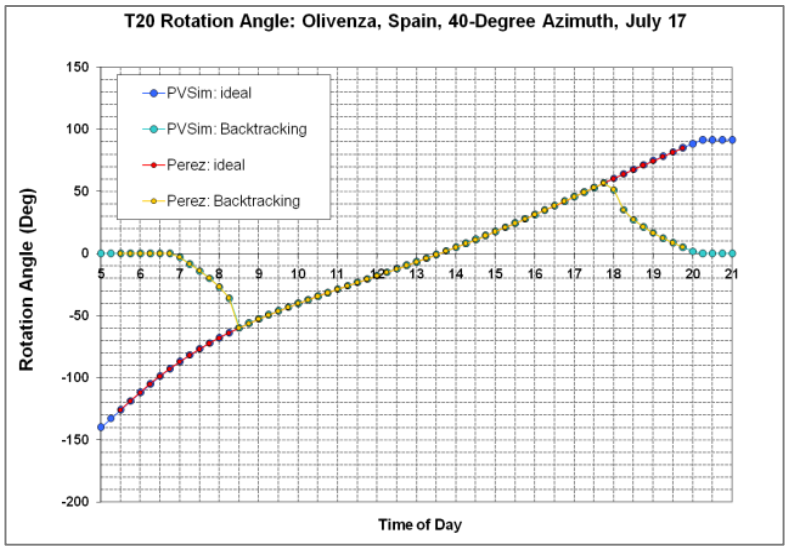


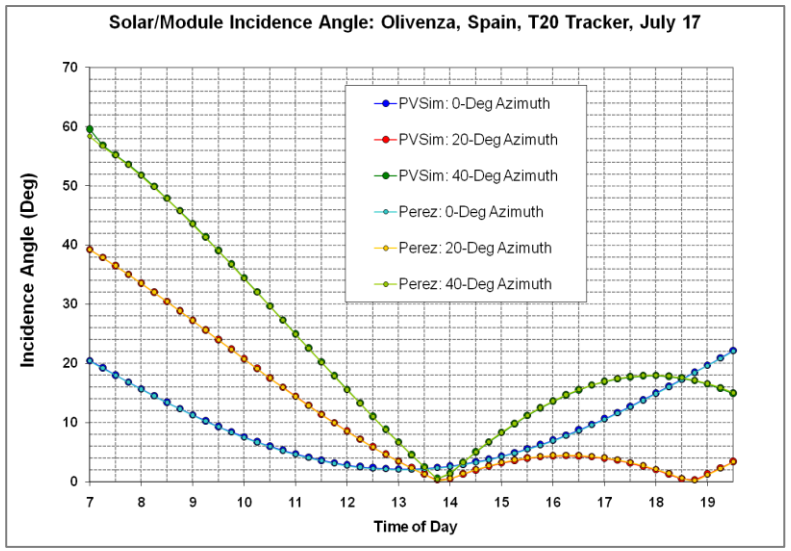


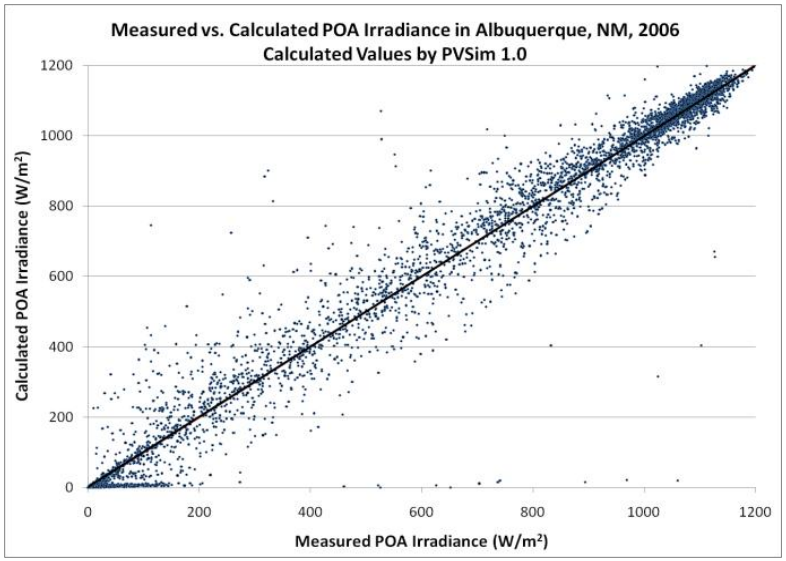
Modeling Tool Selection

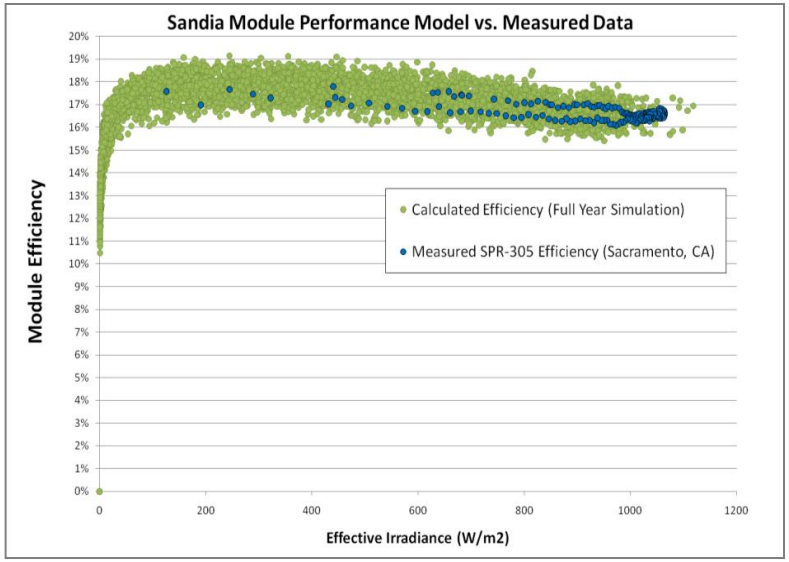


PVSim: Validation Practices









© 2010 SunPower Corp.

PVSim: Calculated Losses & Adjustments

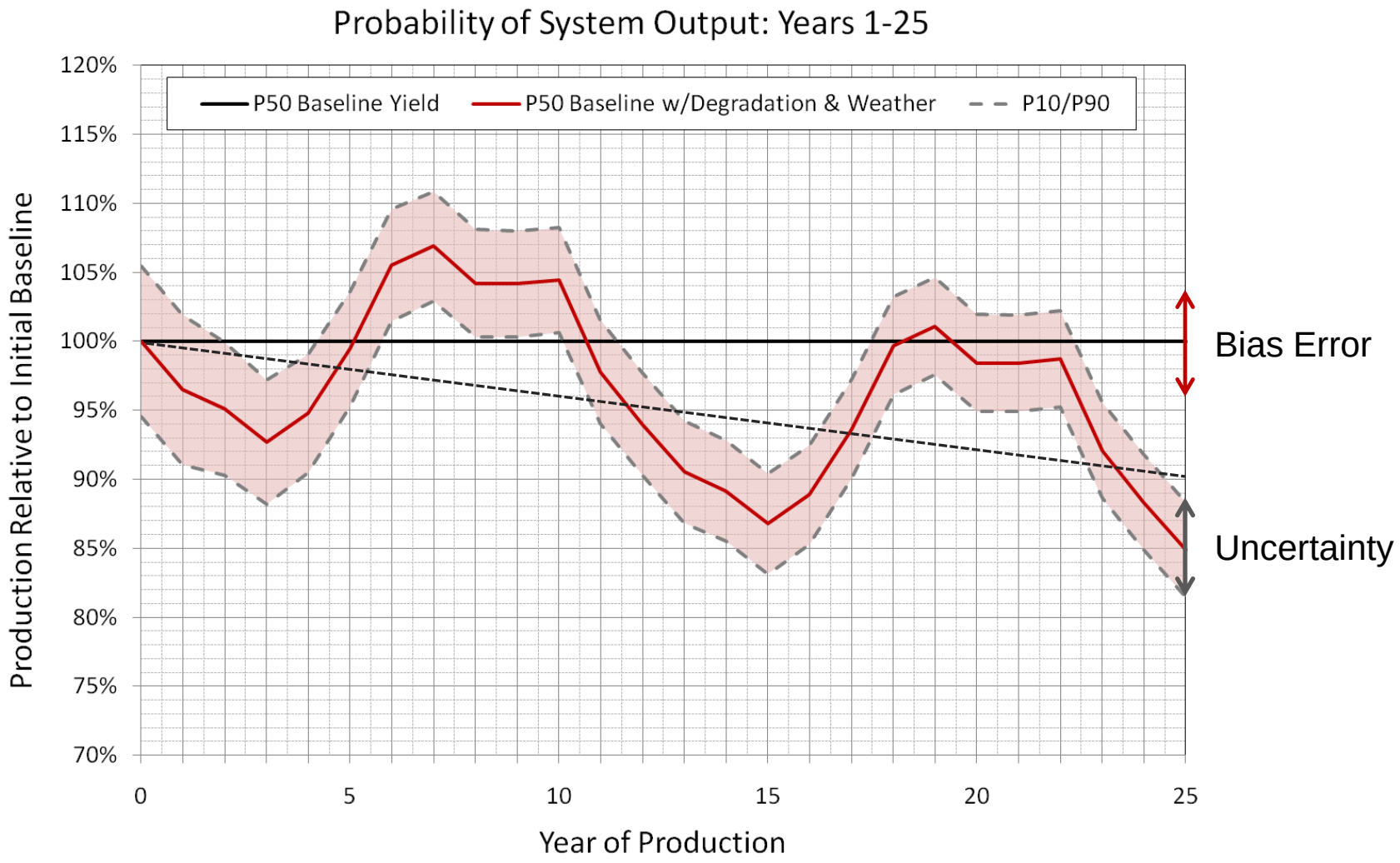
- Energy Out = Solar Energy In + System Inefficiencies + Bias/Uncertainty

Time Range	Gh (kWh/m^2/day)	Ipoa (kWh/m^2/day)	AC Energy (kWh)
Jan	1.94	2.61	330
Feb	2.92	3.77	424
Mar	4.32	5.09	598
Apr	5.80	6.33	692
May	7.38	7.49	828
Jun	7.83	7.66	816
Jul	7.83	7.77	852
Aug	7.02	7.45	820
Sep	5.86	6.89	741
Oct	3.97	5.14	615
Nov	2.53	3.55	433
Dec	1.76	2.53	327
Year 1	**4.94**	**5.53**	**7,477**

Itemized Annual Energy Losses	%
Shading Loss	0.00
Soiling Loss	-5.00
Angle-of-Incidence Loss	-3.62
Air Mass Adjustment	0.24
Operating Temperature Adjustment	-4.78
Efficiency vs. Irradiance Adjustment	-1.31
Module Flash Adjustment	0.65
Module Mismatch Loss	-2.00
DC Wiring Loss	-1.00
Inverter DC Limit Loss	0.00
Inverter Efficiency Adjustment	-4.75
Inverter AC-Capacity Clipping Loss	-4.21
Transformer Efficiency Loss (Day)	0.00
Transformer Efficiency Loss (Night)	0.00
AC Wiring Loss	-0.20
Site Shading Loss	0.00
Auxiliary Load Loss	0.00
Annual Availability	**98.00**

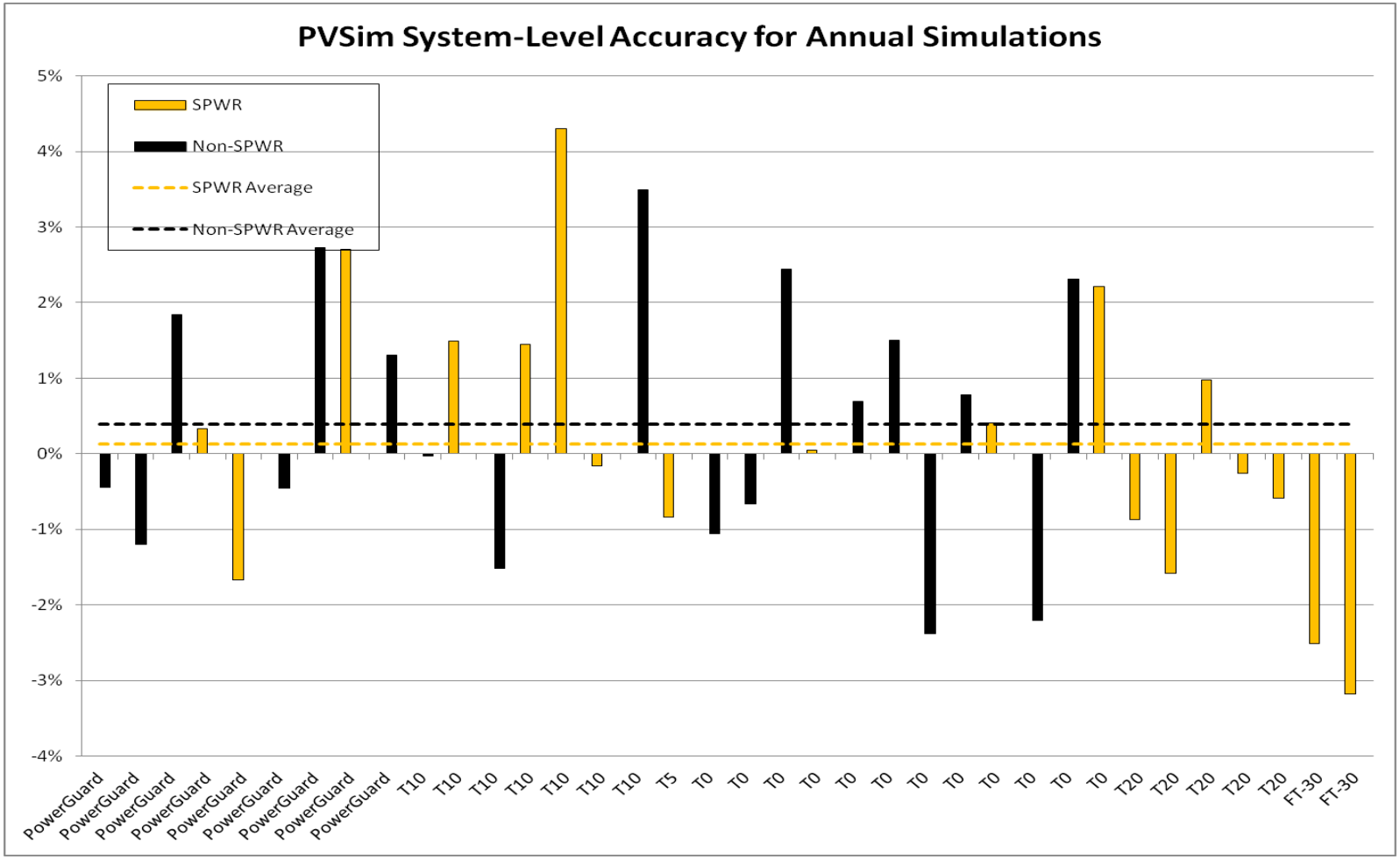
© 2010 SunPower Corp.

Understanding Weather Variability & Risk



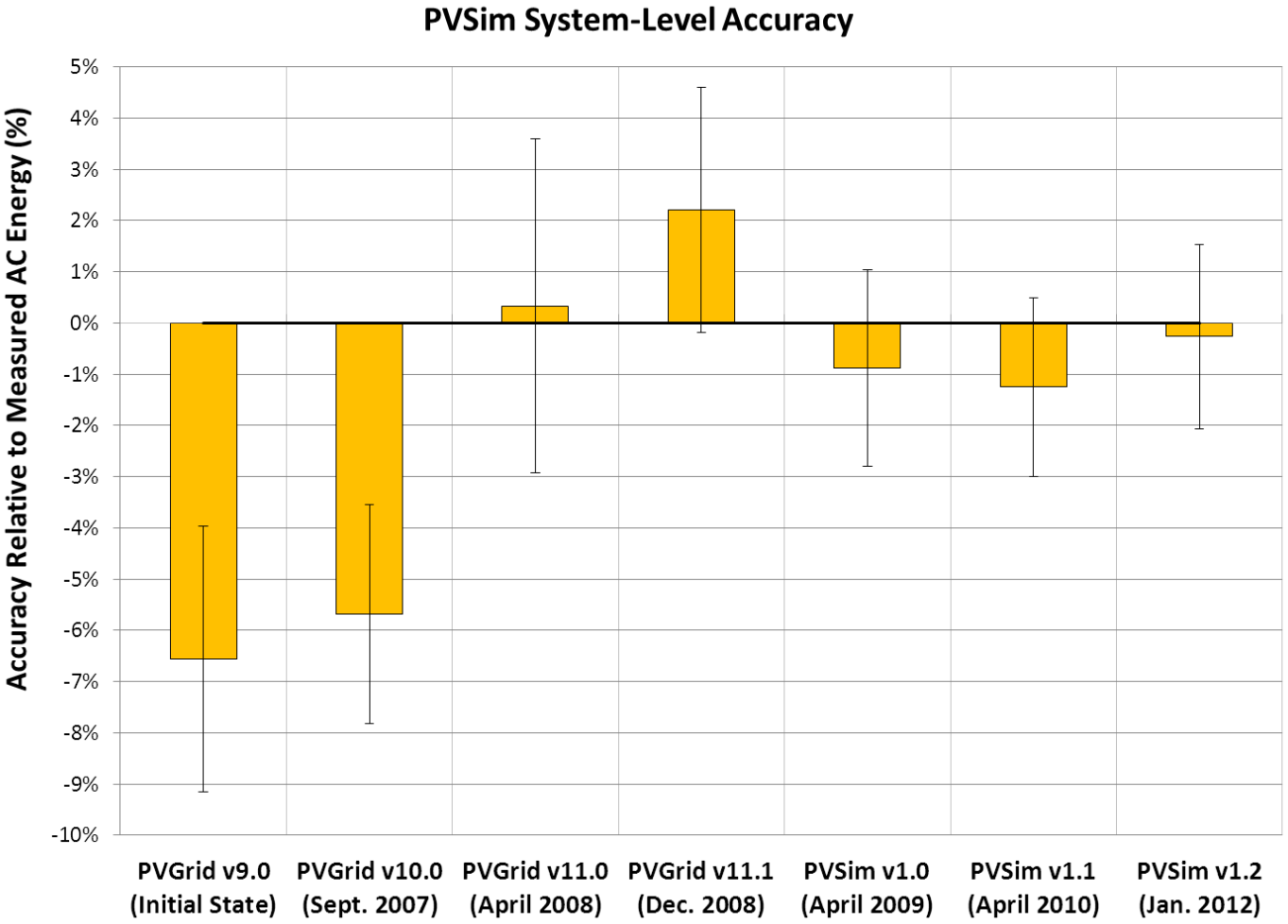
System Level Validation

- SunPower's current simulation accuracy: -0.86% ± 1.58%



Improving PV Models and Accuracy

- SunPower is constantly working to improve our modeling accuracy



Thanks!