

BUILDING A WORLD OF DIFFERENCE

SOLAR PHOTOVOLTAICS – INDUSTRY INPUT

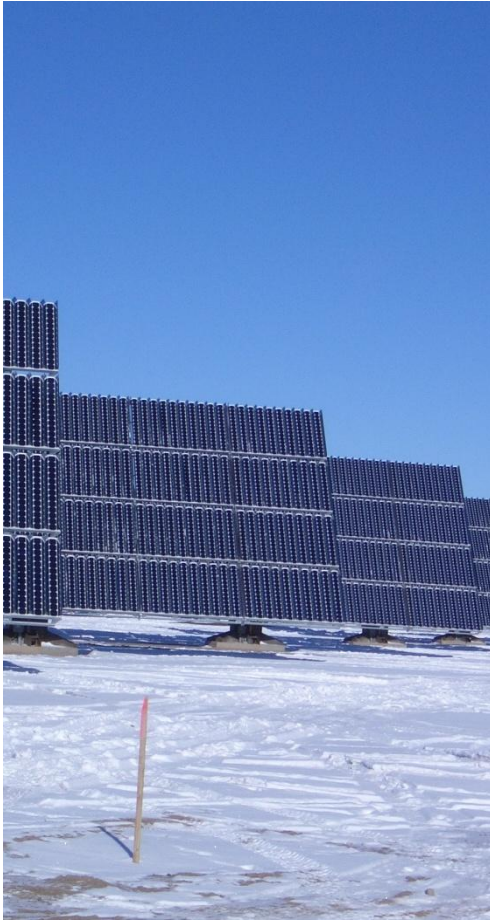
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7 March 2012



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Building a world of difference.



Low Concentration System at Alamosa, CO

HOW NATIONAL LABS AND ACADEMIA CAN ASSIST THE SOLAR INDUSTRY

- Solar Resource Validation
- Performance Test Standards
- Module Reliability Test Standards

Just three today...there are more!

Energy Production Uncertainty and Variability

Sources of uncertainty and typical values

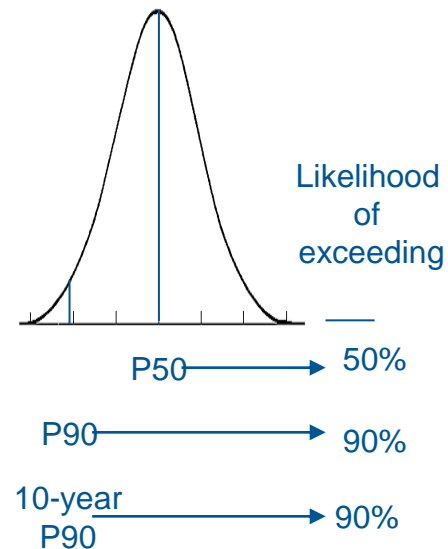
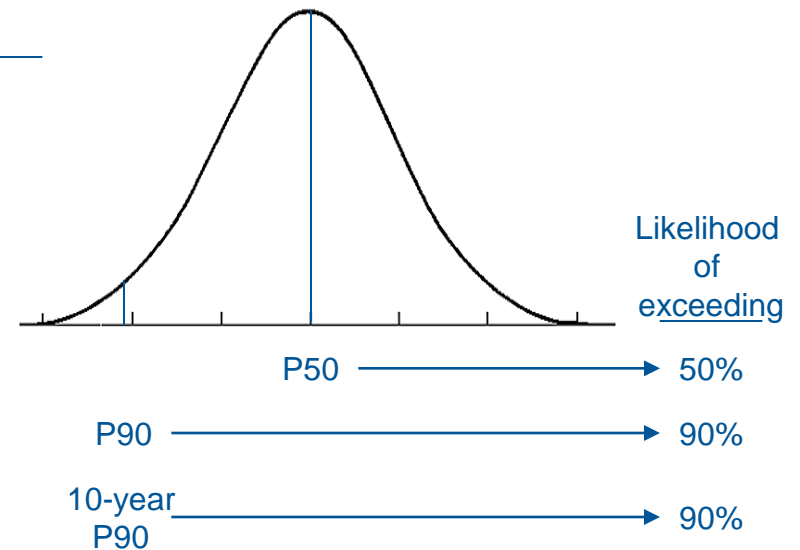
Radiation measurement uncertainty	5-15%	σ_b
Radiation inter-annual variability	2-6%	σ_Y
Production model	3.5%	σ_M

Typical standard deviation

~ 6-7%

Improved standard deviation by
reduction in resource uncertainty

~ 3-5%





Alamosa Pyranometer

SOLAR RESOURCE NEEDS

- **NSRDB 2 and 3**
 - Provides a long term historical record
 - Standard file formats
 - Extremely useful!
- **Where we need help:**
 - Define annual uncertainty
 - Validation of Satellite models
 - Continue work – NSRDB v4?
- **Current divergence – are solar resource databases public or private?**

Lower resource uncertainty = lower financing costs = lower LCOE



Carissa Plains PV system

UNDERSTANDING DEGRADATION: PV RELIABILITY TESTING

- Long-term performance impacts
 - Project Finance
 - Energy Production
 - O&M
- Can manufacturers show reasonable testing to back warranty/performance claims?
- Current Industry Standards don't address long-term performance
 - IEC 61215/61646: Module performance (screen for infant mortality)
 - UL 1703/IEC 61730: Safety

Industry needs a longer long-term performance standard



APPROACHES TO PV RELIABILITY TESTS

- **Manufacturers**
 - Combined Stress/Combined Cycle testing
 - 2x IEC standards
 - Methodology not consistent between manufacturers
- **Do these correlate with failure mechanisms and activation energies in the field, for each technology type?**
- **Third Party “recipes”**
 - TUV Long-term Sequential Testing
 - Fraunhofer Durability Initiative
 - RETC Thresher Test
 - PVEL Reliability Demonstration Test
 - Atlas Long Term Durability Test

Standardized industry approach to reliability testing that correlates environmental test conditions to technology-specific long-term failure mechanisms





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