

# Valuing a Portfolio of PV Investments

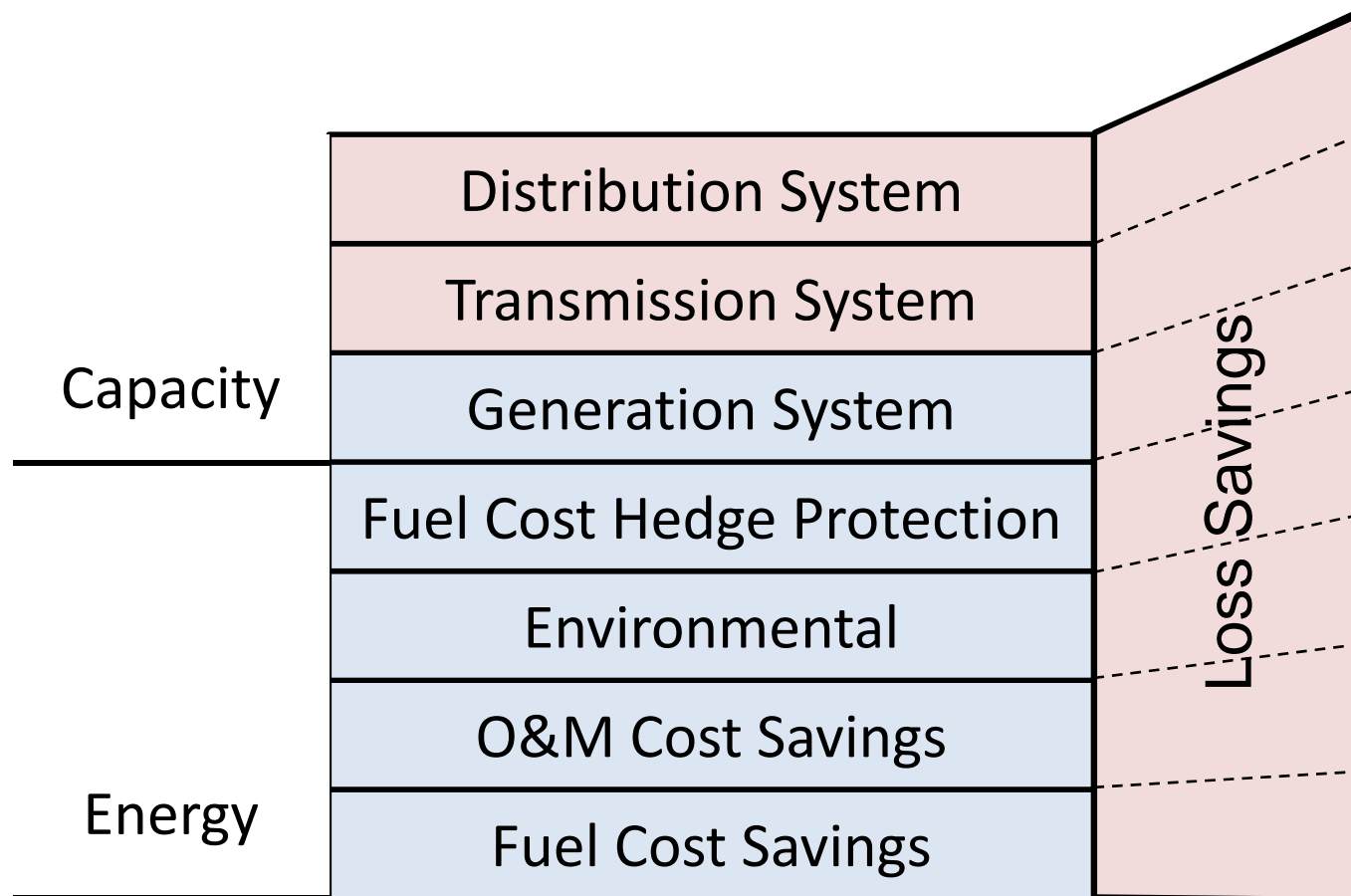
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Clean Power Research  
October 13<sup>th</sup>, 2010  
Solar Power International



# Central station PV value to utility

Capacity	Generation System
Energy	Fuel Cost Hedge Protection
	Environmental
	O&M Cost Savings
	Fuel Cost Savings

# Distributed PV value to utility

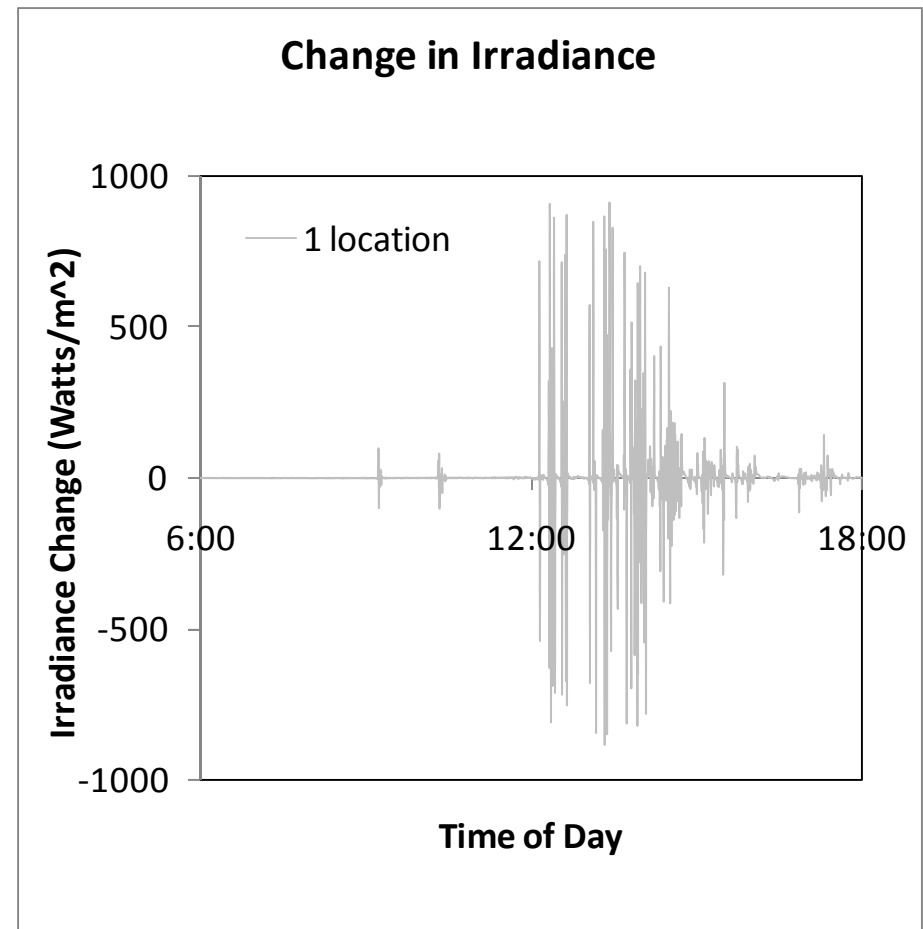
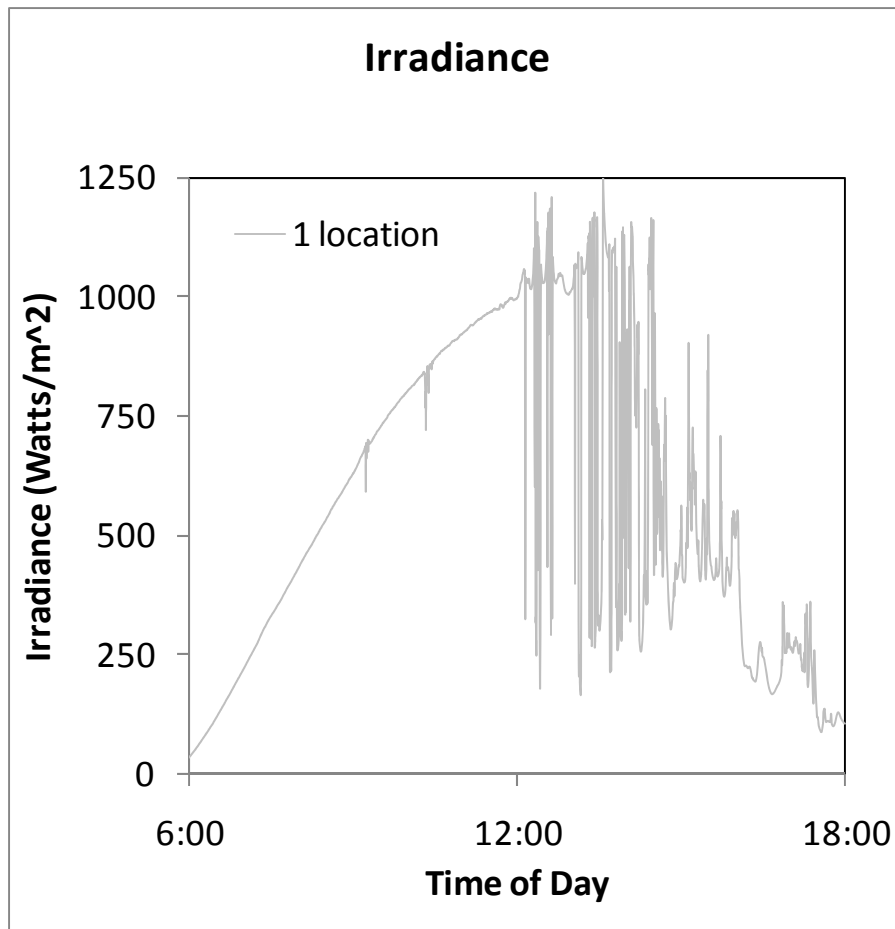


# Output variability

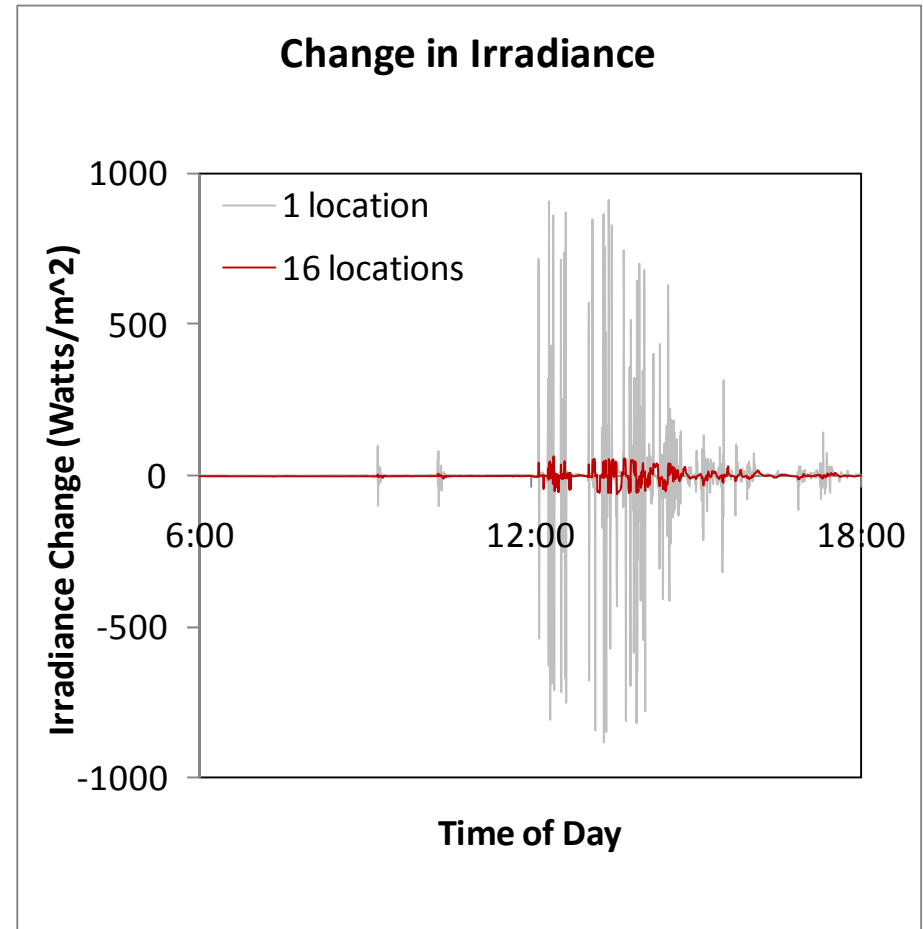
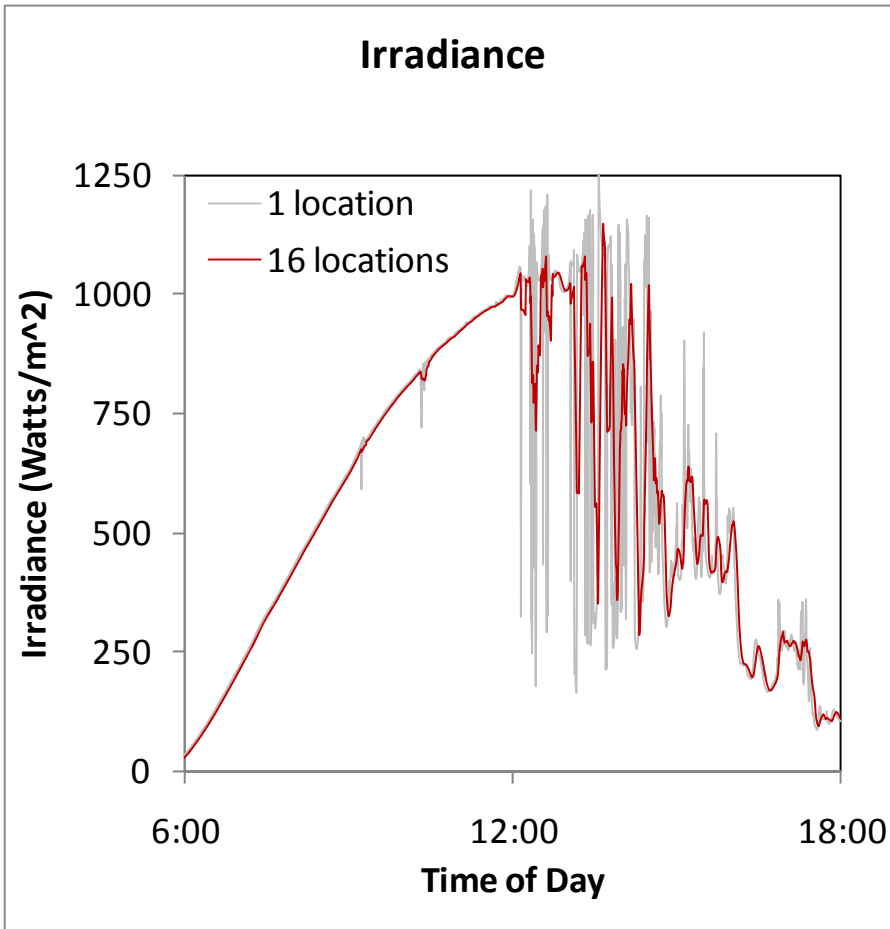


- One factor excluded from a typical value analysis is power output variability
- Output variability, and thus integration cost, is based on the structure of the PV portfolio (e.g., distributed vs. centralized)

# What is meant by variability?



# Portfolio configuration can reduce variability



# Power output variability is driven by a few factors

For a **single** PV system, changes in short-term output are driven by:

1. Clearness of the sky
2. Sun position

For a **portfolio** of PV systems, changes in output are driven by the same forces as those of a single system but also include fleet configuration

# CSI RD&D project



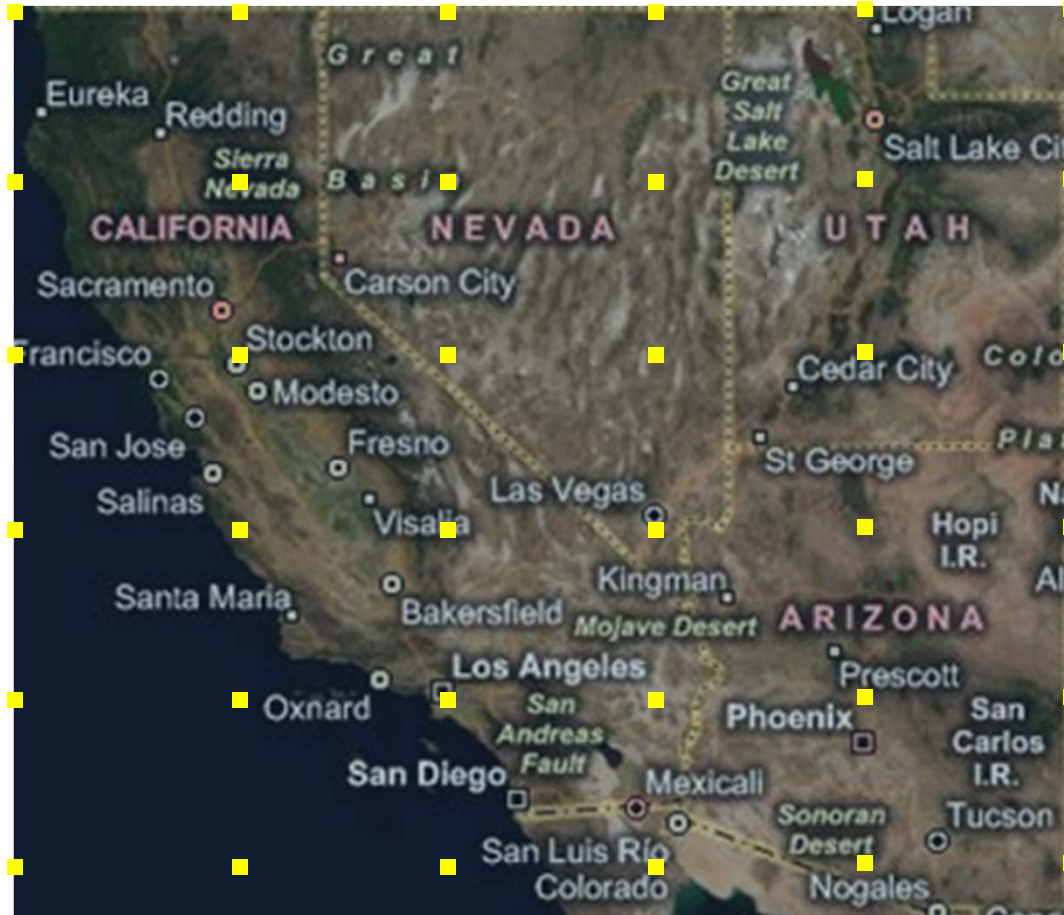
- Enhance spatial and temporal resolution of SolarAnywhere<sup>®</sup>
- Integrate output variability into PV simulation tools
- Integrate PV into distribution modeling tools
- Create tool to calculate economic value of a PV fleet



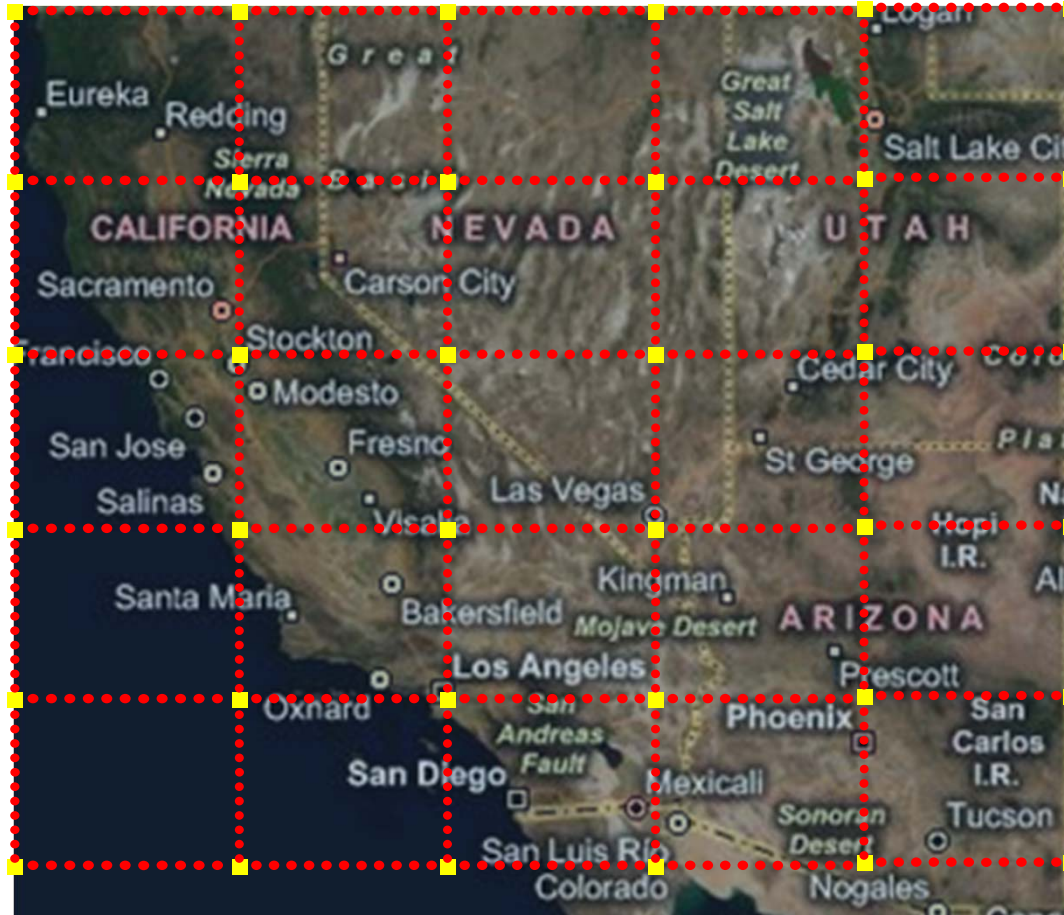
# Use SolarAnywhere to assess variability



# Select 1<sup>st</sup> station every 200 km in the southwest



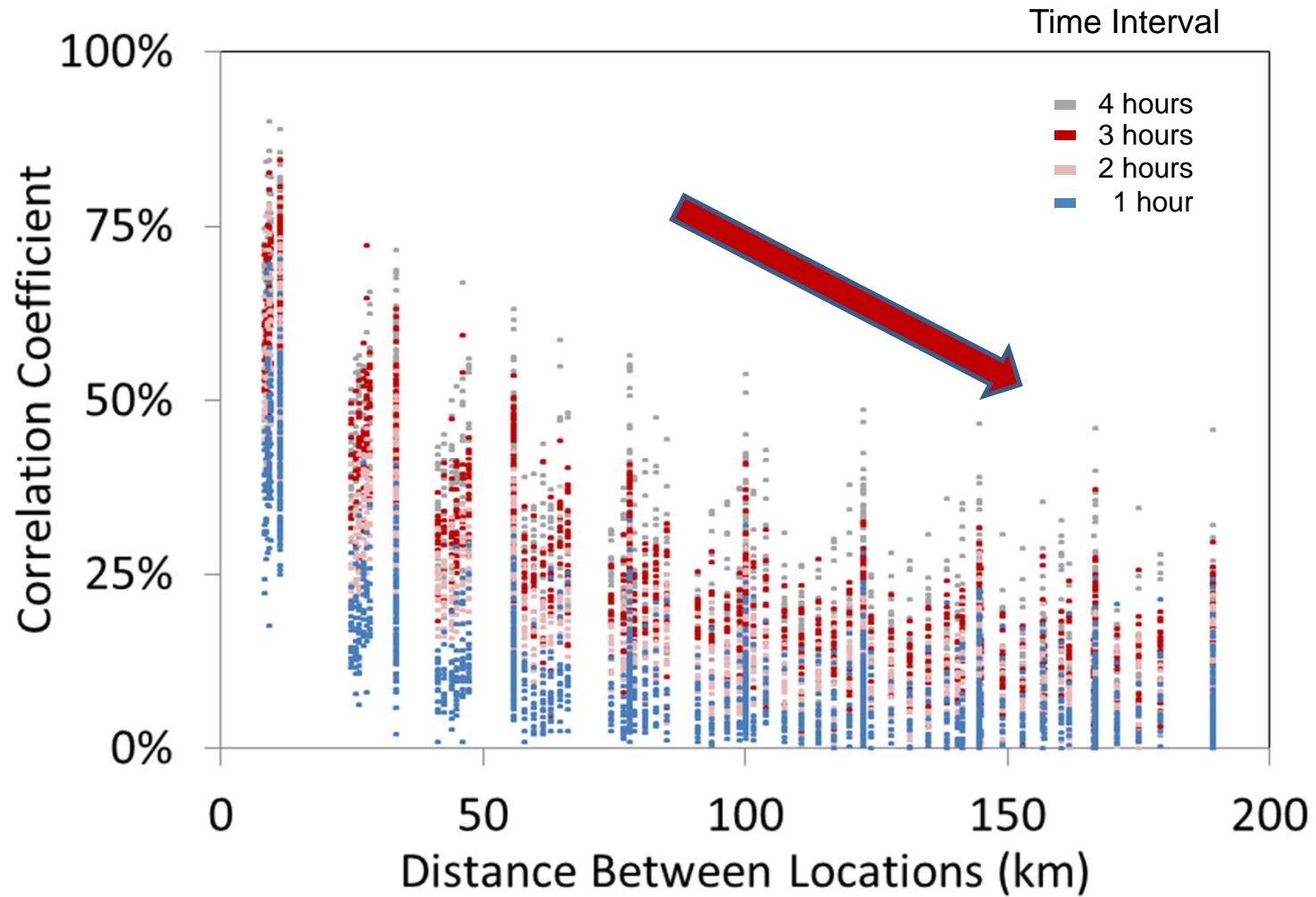
Add a station pair 10, 30, ... 190 km from 1<sup>st</sup> station



# Calculate change in clearness index correlation

- Select 12 years of solar data for a portfolio of two locations between 10 and 200 km apart
- Calculate correlation coefficient for the change in the clearness index
- Repeat this 40,000 times
  - 1,000 portfolios – pairs of locations
  - Time increments of 1, 2, 3, or 4 hours
  - 10 irradiance bins

# Variability decreases as plants are spread out

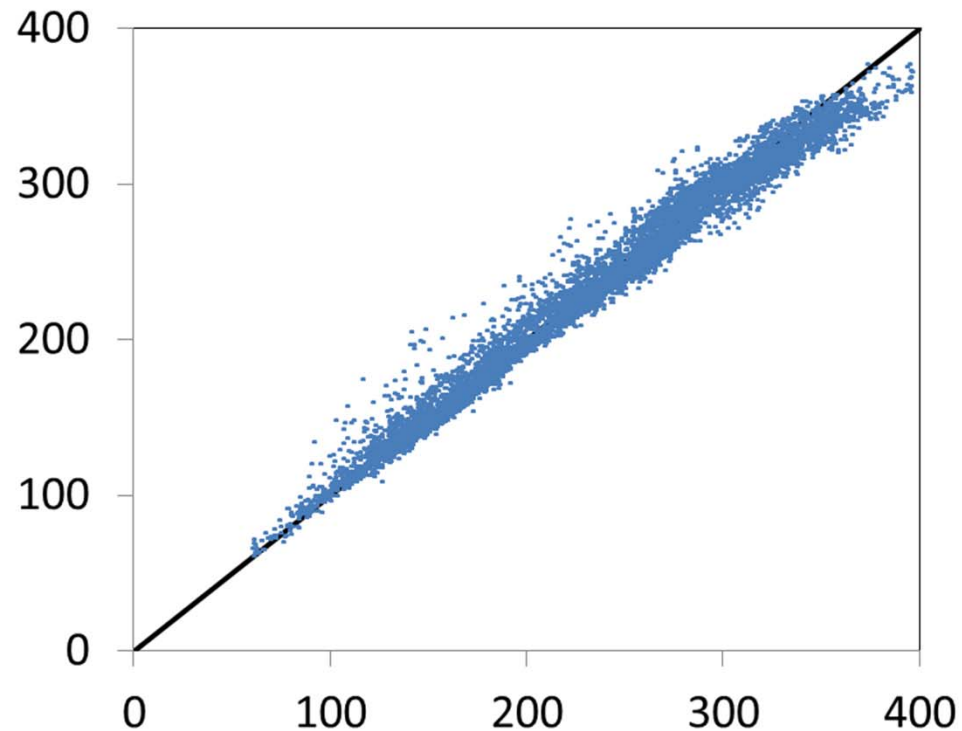


# Output variability for a portfolio of PV is predictable

***Standard deviation ( $W/m^2$ ) in output variability  
between two locations for 40,000 scenarios***

**Simulated Results**

Based on a few  
input parameters



**Measured Results**

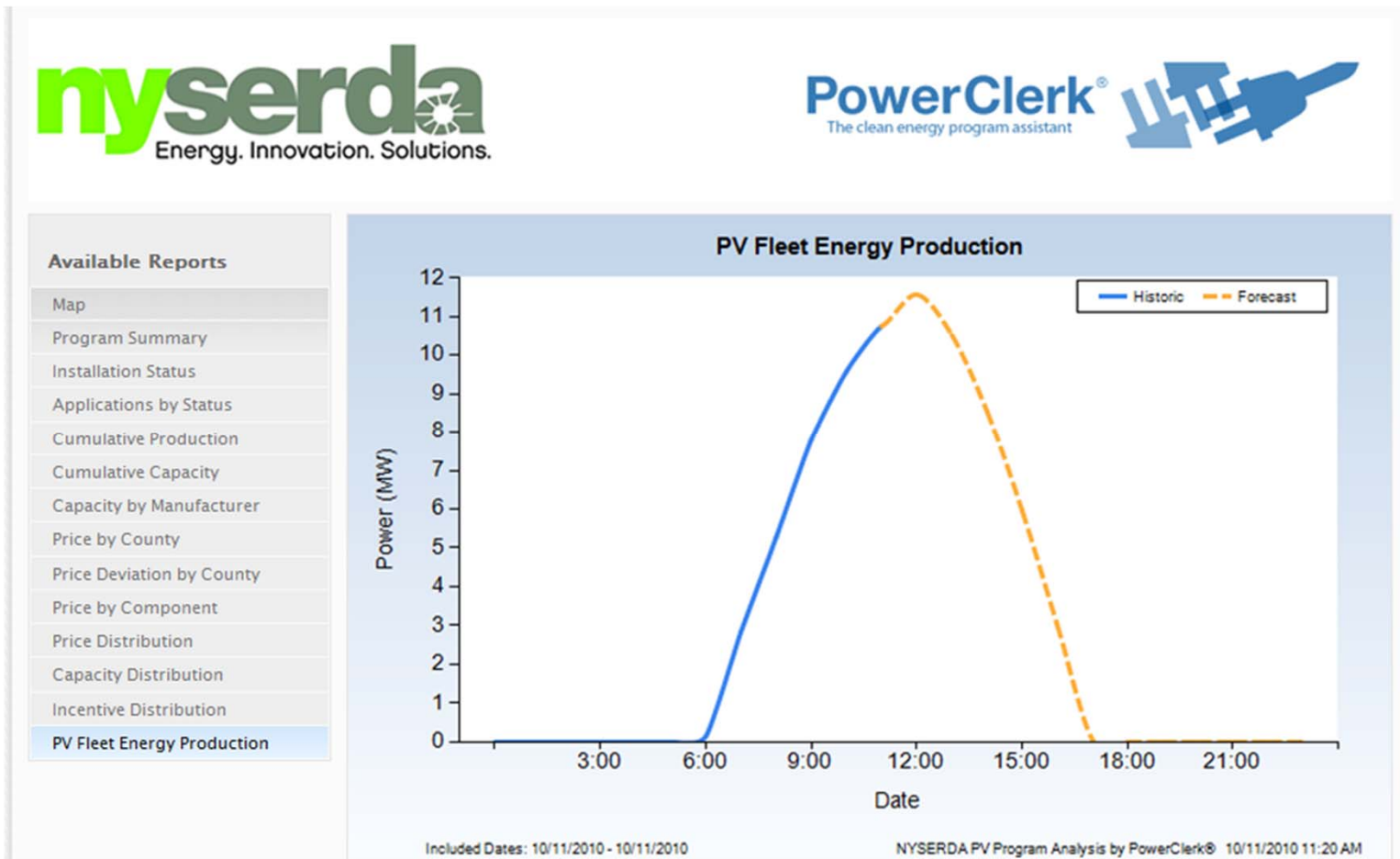
Based on 12 years of solar data

# Summary



- Output variability for a portfolio of PV is predictable for longer time increments
- Results appear to scale to shorter time increments
- Verification of results is in process
  - Virtual networks (Perez)
  - Higher resolution SolarAnywhere data
  - Short-term data collection
- Verified results will be integrated into value analysis and planning tools

# Next steps: PV fleet variability forecasting?



DRAFT





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