Integrating PV into Utility Planning and Operation Tools: Kickoff Meeting

Clean Power Research®

Project Partners

Primary Funders

Power Industry

Copyright © 2011 Clean Power Research

Tasks	
Task 1. Project Management	
Task 2. Produce, Validate, and Extend SolarAnywhere Data	
	2.1. Extend SA Enhanced Resolution (1 km, ½ hour) 2.2. Produce SA High Resolution (1 km, 1 minute) 2.3. Validate SA Enhanced Resolution (CSI and SMUD PV output data) 2.4. Validate SA High Resolution (California ISO and SMUD irradiance data)
Task 3. Validate SolarAnywhere FleetView Methodology	
	3.1. Validate Correlation Models (66 irradiance sensor network from SMUD) 3.2. Validate High Speed PV Fleet Simulation (10 PV systems from California ISO) 3.3. Validate Forecasted PV Fleet Simulation (100 PV systems from PG&E)
Task 4. Integrate SolarAnywhere FleetView into Utility Software Tools	
	4.1. Distribution planning (SMUD) 4.2. Smart grid operation (SMUD) 4.3. Utility load scheduling (PG&E) 4.4. Balancing area planning and operation (California ISO and SMUD)

Task 2. Produce, Validate, and Extend SolarAnywhere Data

2.1. Extend SolarAnywhere Enhanced Resolution

2.2. Produce SolarAnywhere High Resolution

2.3. Validate SA Enhanced Resolution

a. Using 15-minute PV output data from CSI PBI systems

2.4. Validate SA High Resolution

a. Using California ISO irradiance data from 10 locations

b. Using SMUD irradiance data from 66-site network

What Is SolarAnywhere®?

Web-accessible solar irradiance data & analytical tools

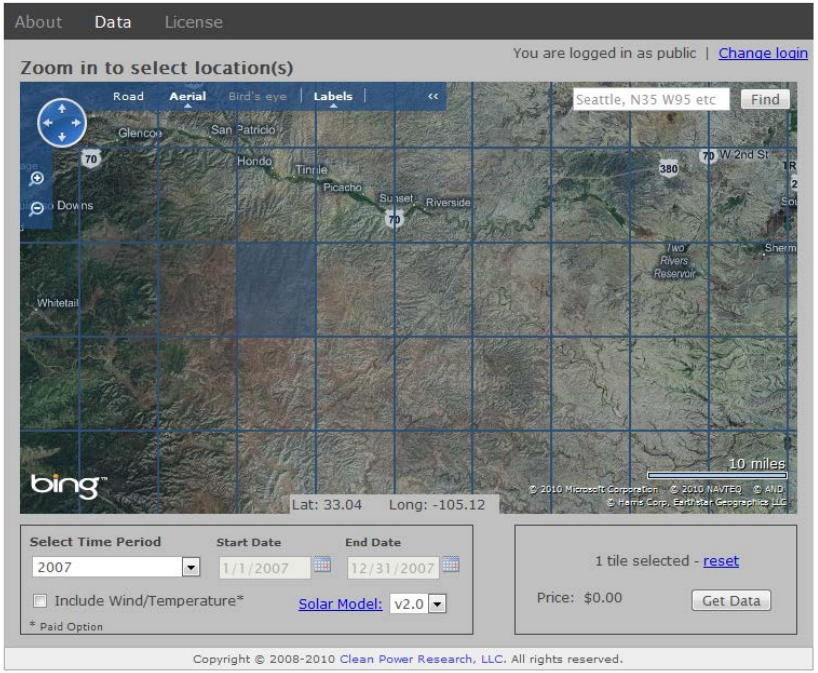
Irradiance data

- Satellite-derived time-series data
- Historical values from 1998 through latest hour
- Forecasts up to 7-days in advance

Analytical tools

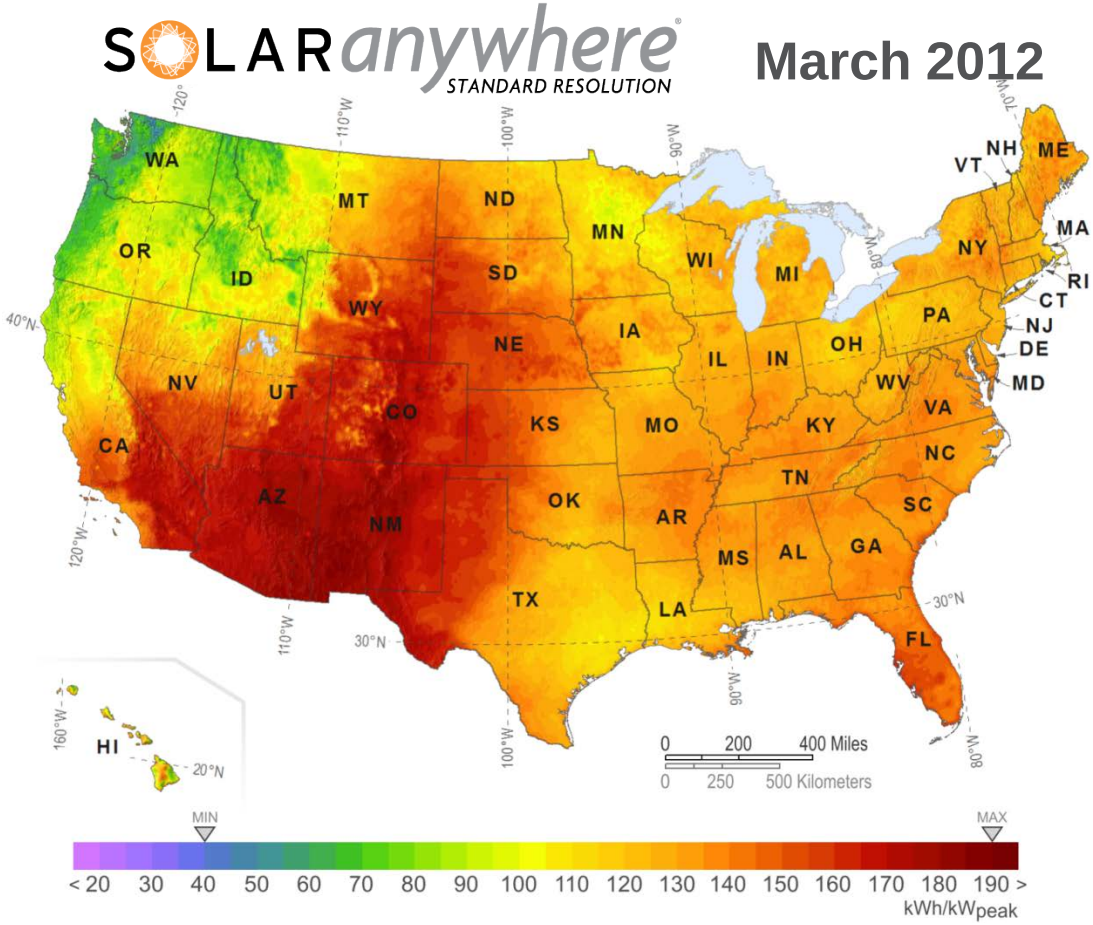
- PV system modeling (FleetView)
- Benchmark to site data (DataGage)
- PV fleet variability

SOLARanywhere®



Clean Power Research®

SolarAnywhere's PV Power Map



Clean Power Research®

www.cleanpower.com/about-us/resources/pv-power-maps

Three SolarAnywhere Resolutions

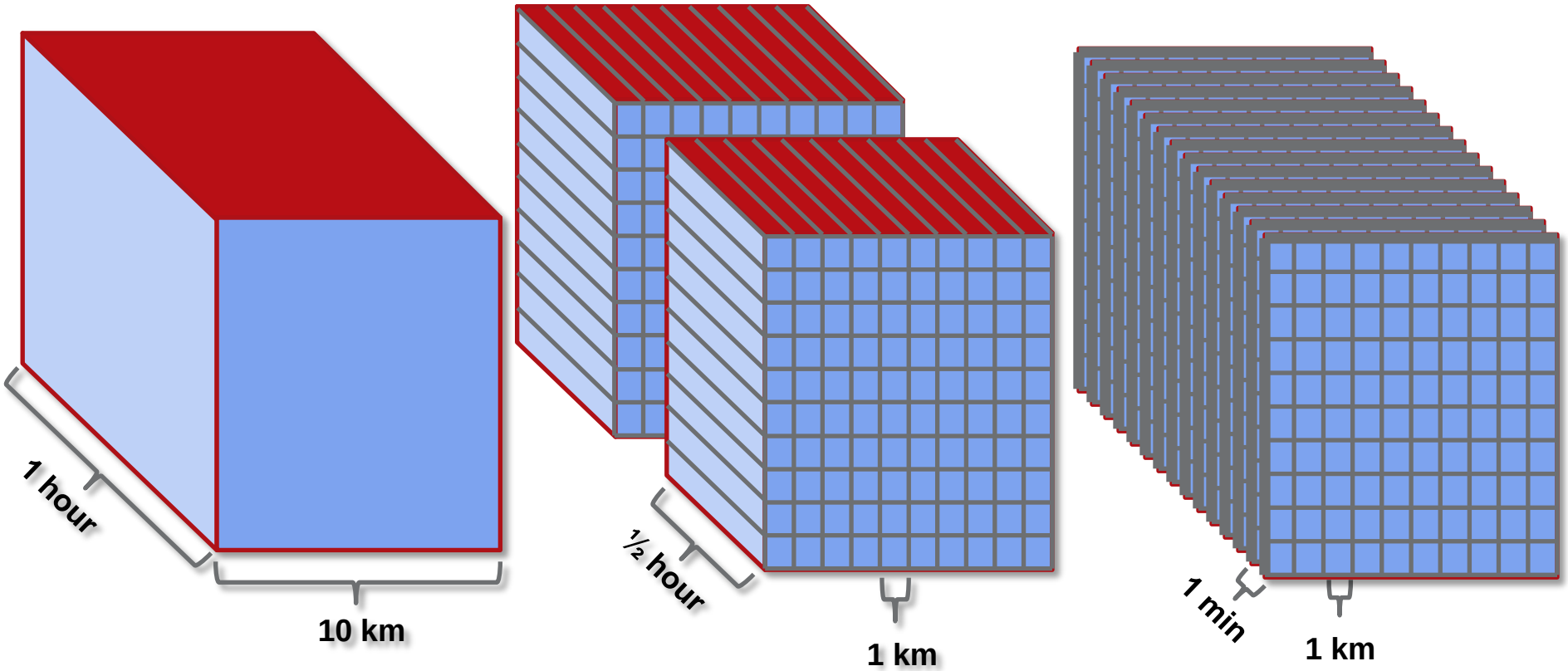
Standard Resolution
10 km, 1 hour

→

Enhanced Resolution
1 km, ½ hour

→

High Resolution
1 km, 1 minute



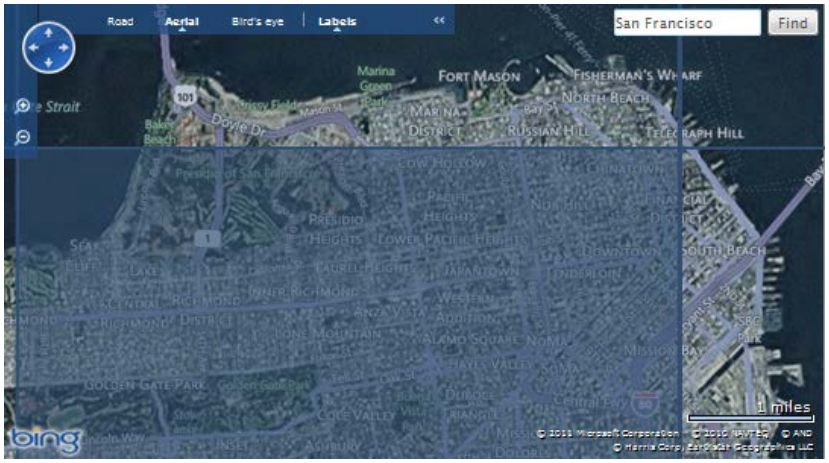
2.1. Extend SolarAnywhere

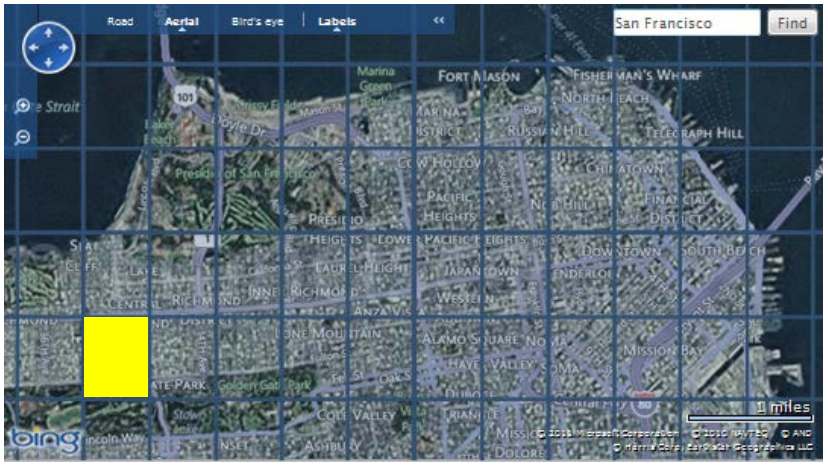
10 km, 1 hour

SOLARanywhere STANDARD RESOLUTION

1 km, ½ hour

SOLARanywhere ENHANCED RESOLUTION





Example: San Francisco, CA

Clean Power Research

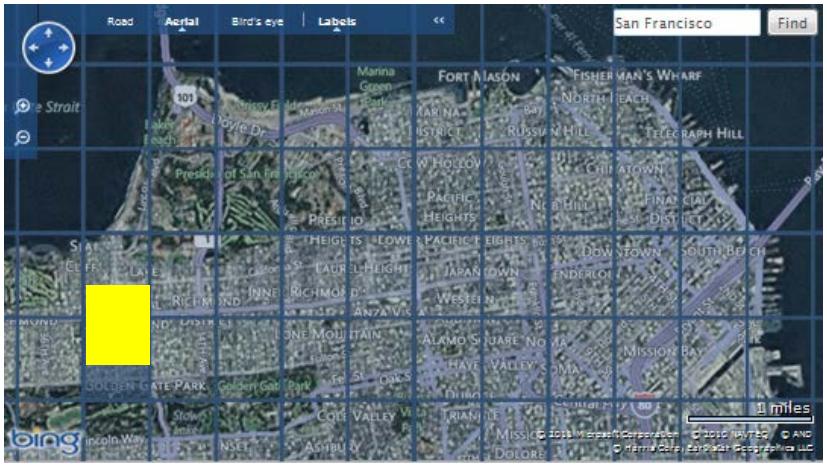
GO solar CALIFORNIA

PUBLIC UTILITIES COMMISSION · EUREKA · STATE OF CALIFORNIA

2.2. Produce SolarAnywhere High Resolution

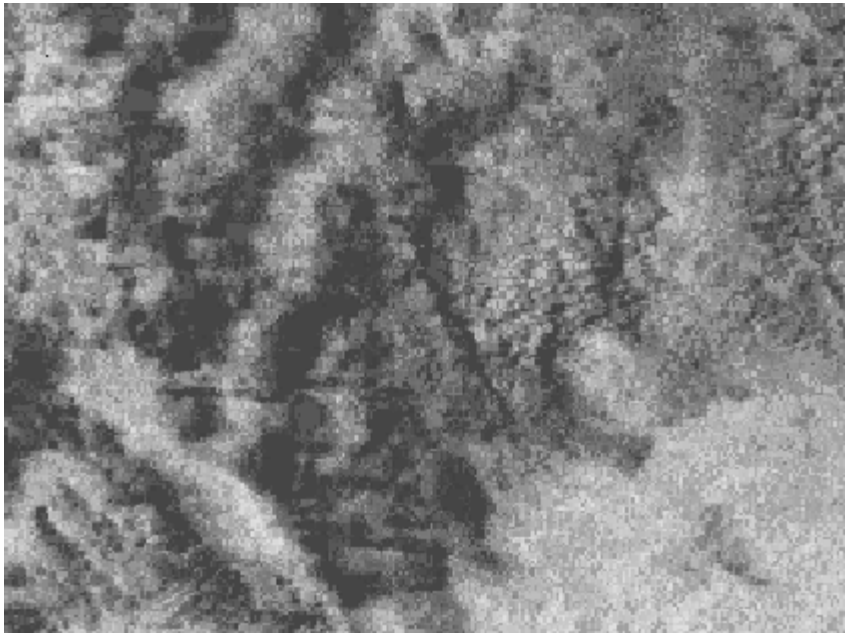
1 km, ½ hour

SOLARanywhere ENHANCED RESOLUTION



1 km, 1 minute

SOLARanywhere HIGH RESOLUTION

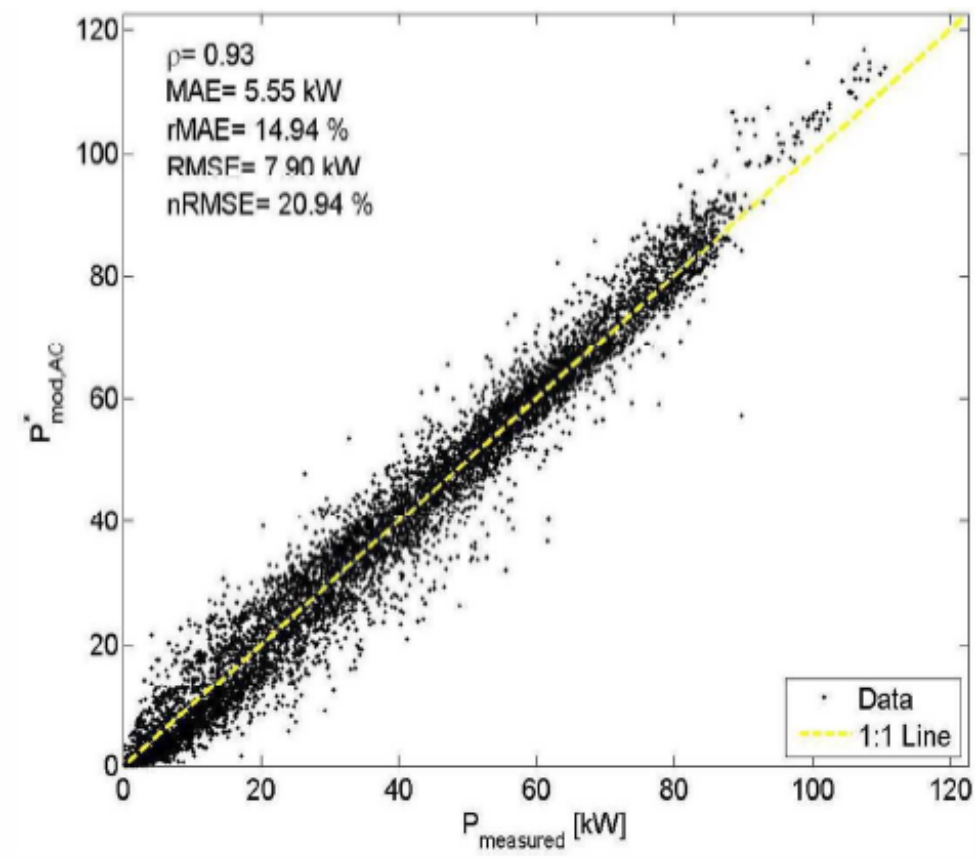


Clean Power Research®

0 10 20 30

Minutes

2.3. Validate SolarAnywhere Enhanced Resolution: Using 2010 and 2011 CSI Data (Sample Results Shown)



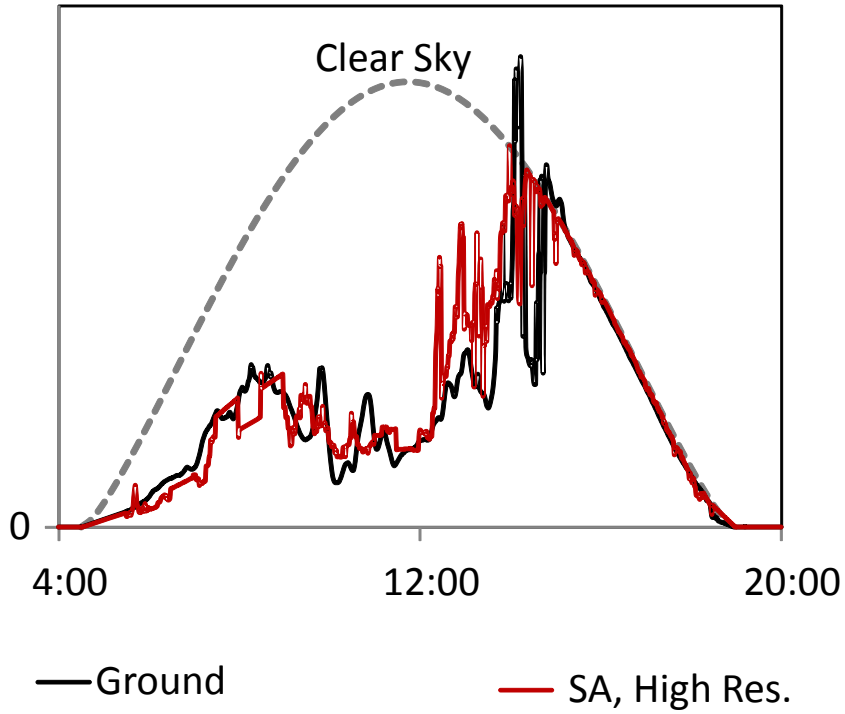
Calibrated SolarAnywhere performance, with 30-min time step, versus CSI measured output (averaged over two 15-min time steps), for 86 PV sites in 2009 in San Diego, CA

Source: Jan Kleissl, UCSD

Clean Power Research®

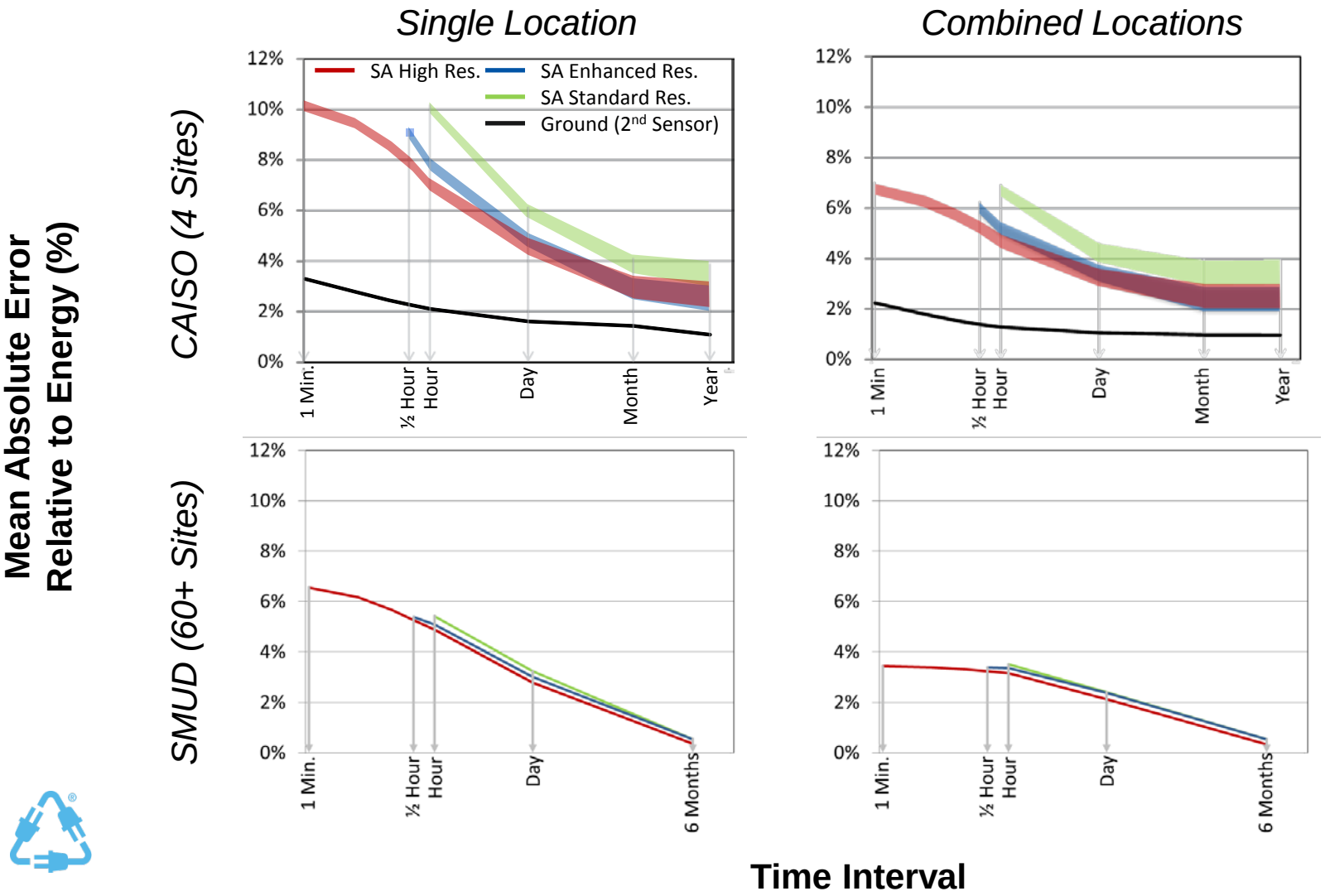
2.4. Validate One-Minute Irradiance Data

July 4, 2011, CAISO Site A



Clean Power Research®

2.4. Validate SolarAnywhere High Resolution: Preliminary Results. Repeat Using More Data.



Task 3. Validate SolarAnywhere FleetView

3.1. Validate Models

- Correlation using 66 irradiance network from SMUD
- Hourly PV output data from SMUD's 3,000+ systems

3.2. Validate High Speed PV Fleet Simulation

- Use 10 PV systems from California ISO

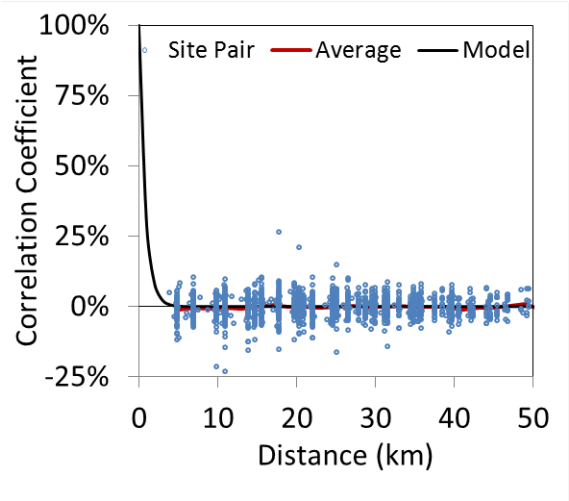
3.3. Validate Forecasted Hourly PV Fleet Simulation

- Use 100 PV systems from PG&E

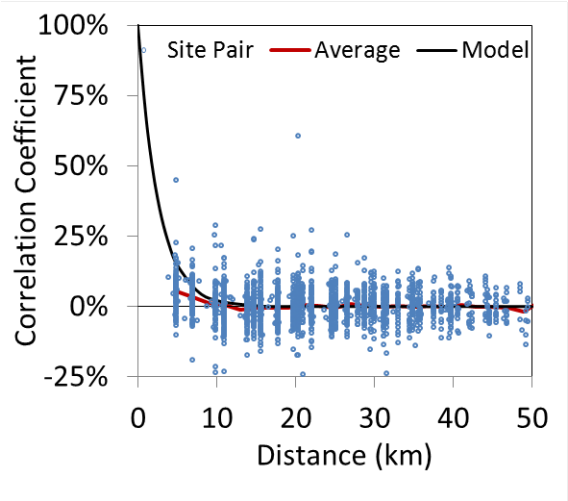
3.1. Validate Correlation Models: Preliminary Results. Repeat Using More Data

Time Interval

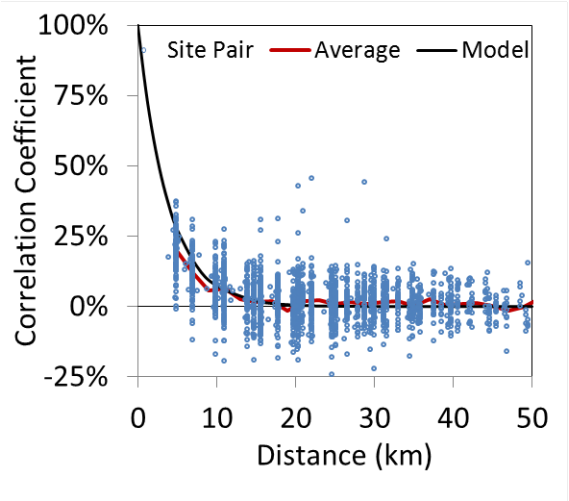
1 Minute



5 Minutes



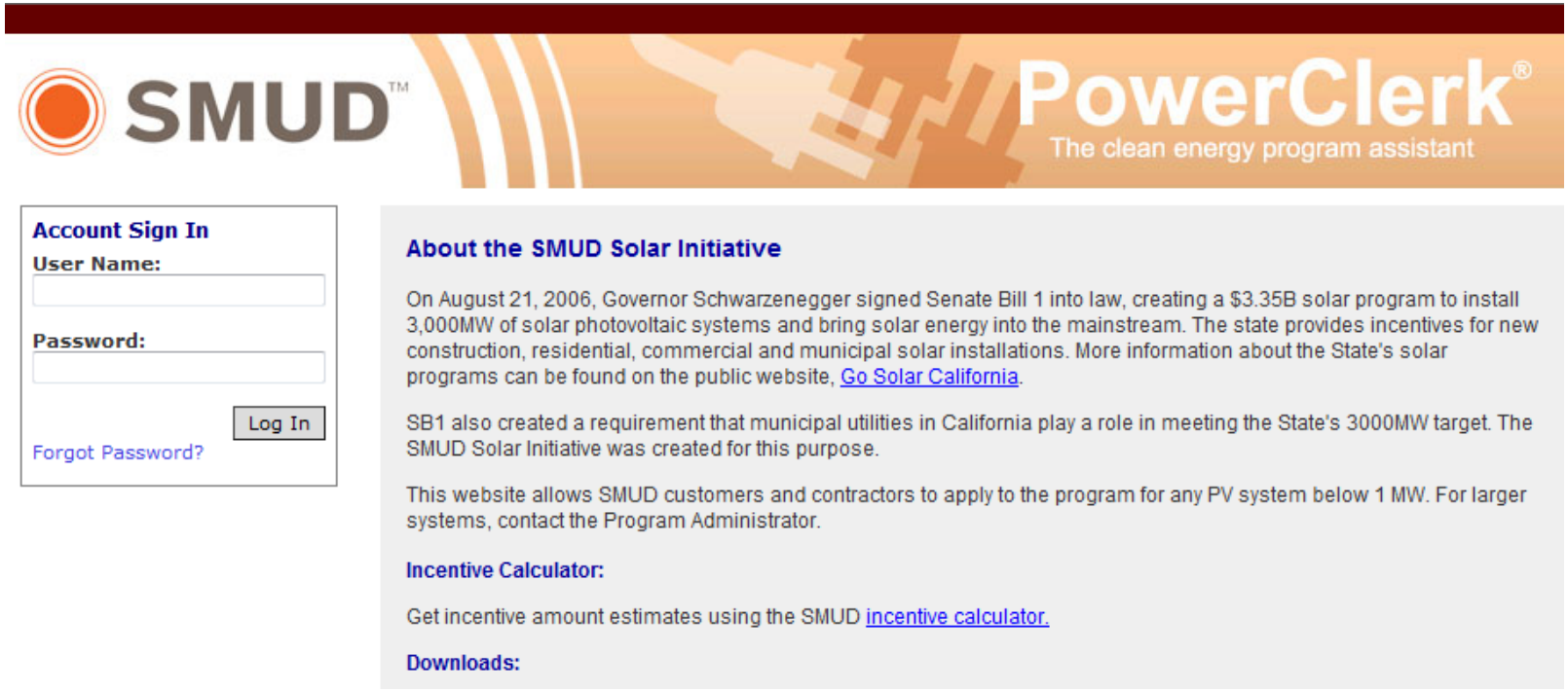
10 Minutes



Results based on most variable days in SMUD's network from July 1, 2011 to December 31, 2011

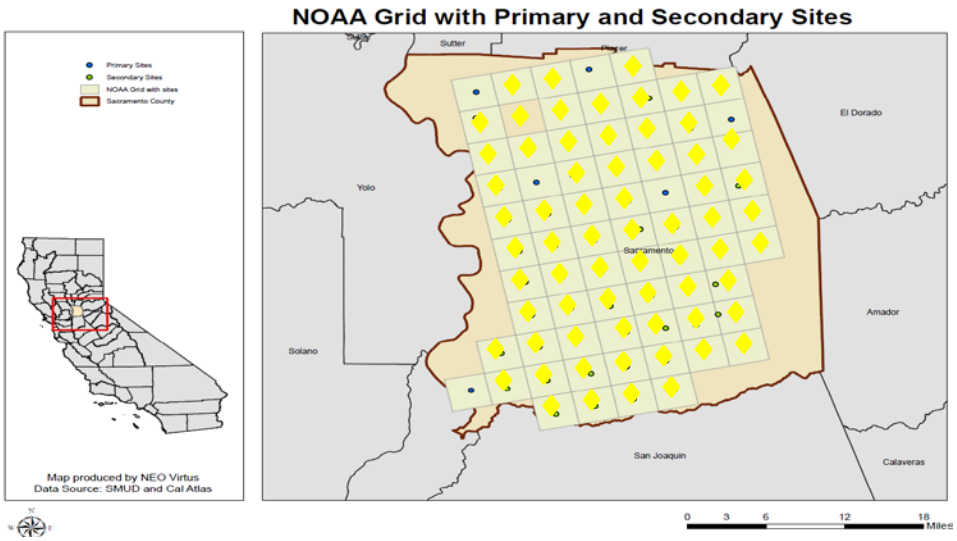
Clean Power Research®

3.1. Validate SolarAnywhere Enhanced Resolution: Using SMUD Data From 3,000+ PV Systems



Clean Power Research®

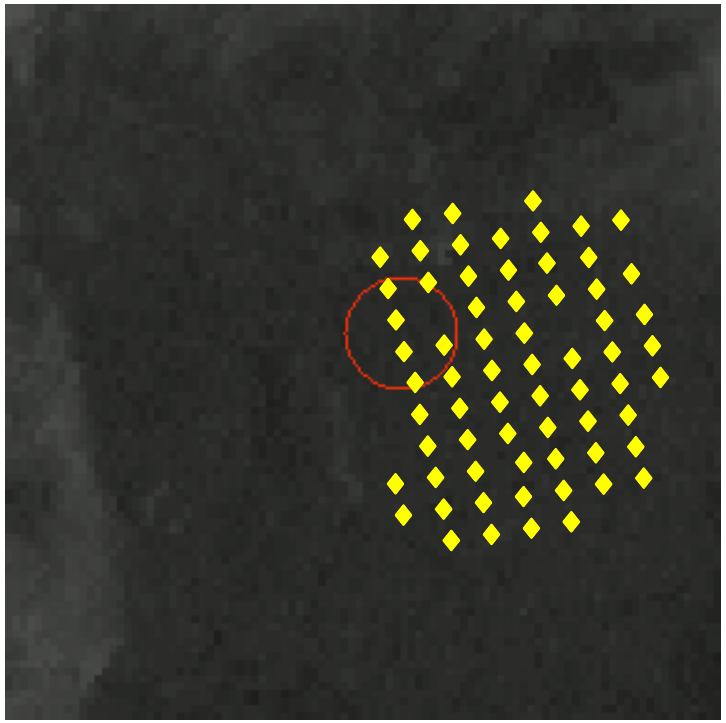
3.2. Validate High Speed PV Fleet Simulation Preliminary Results for SMUD. Repeat for CAISO

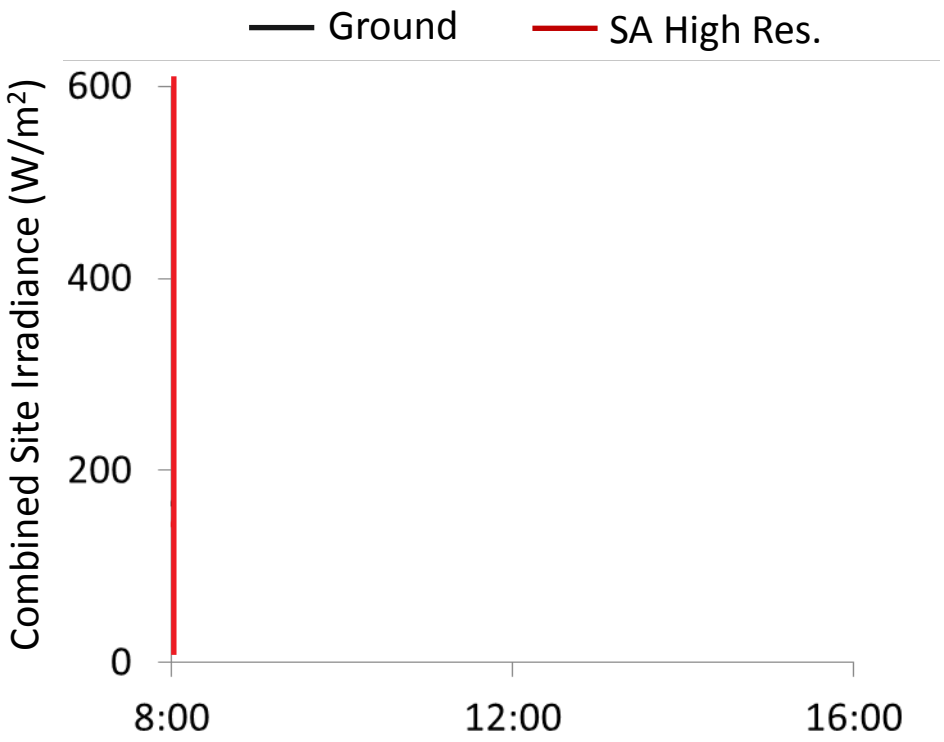


Clean Power Research®

3.2. Validate High Speed PV Fleet Simulation Preliminary Results for SMUD. Repeat for CAISO

Preliminary results using SMUD's 66 sensor solar data network on highly variable day (Nov. 18, 2011) vs. 0 to 30 minute forecast





Clean Power Research®

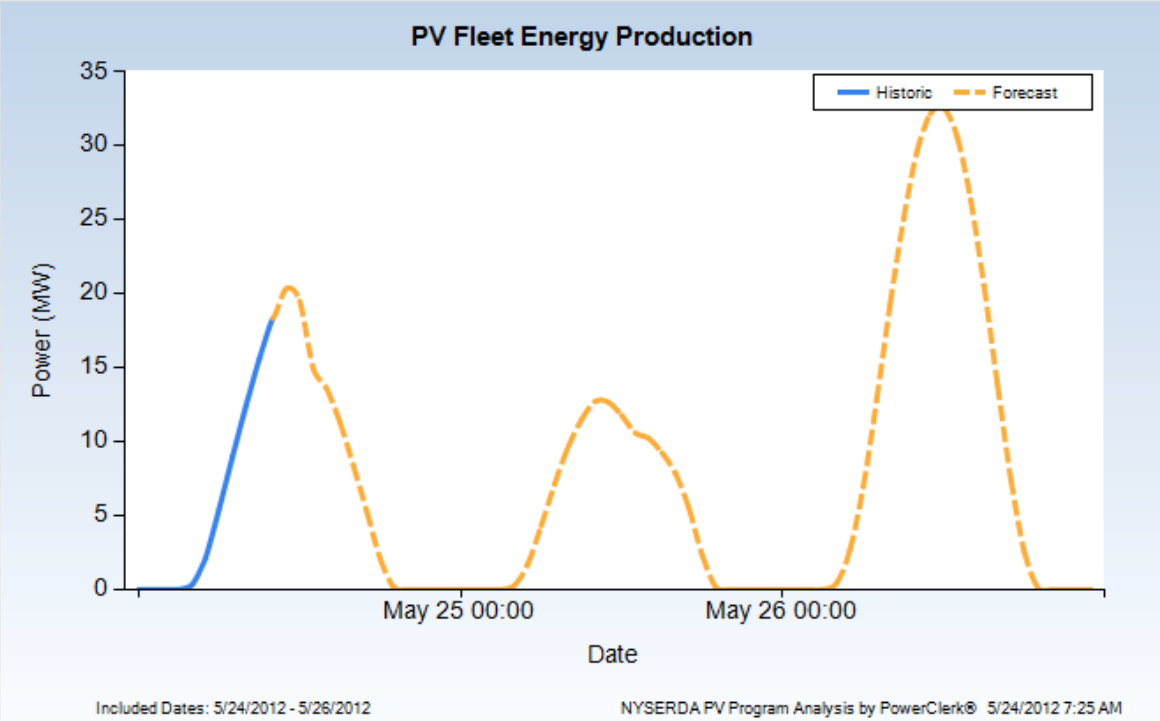
3.3. Validate Forecasted Hourly PV Fleet Simulation: Sample Results for New York. Repeat for PG&E.

nyserda Energy. Innovation. Solutions.

powerCLERK powered by Clean Power Research

Available Reports

- Map
- PV Fleet Energy Production
- Program Summary
- Installation Status
- Applications by Status
- Cumulative Production
- Cumulative Capacity
- Capacity by Manufacturer
- Price by County
- Price Deviation by County
- Price by Component
- Price Distribution
- Capacity Distribution
- Incentive Distribution



Clean Power Research®

Task 4. Integrate FleetView into Utility Software Tools

4.1. Distribution planning (SMUD)

4.2. Smart grid operation (SMUD)

4.3. Utility load scheduling (PG&E)

4.4. Balancing area planning and operation (California ISO and SMUD)

Clean Power Research®

4.1. Integrate FleetView into Distribution Planning Tool

- Objective
  - SMUD distribution planning engineers will use SynerGEE to demonstrate how to determine the magnitude of line voltage fluctuations caused by past or anticipated cloud transients and optimize spacing of commercial PV systems relative to residential systems to mitigate this effect
- SMUD Tasks
  - Inform SynerGEE SMUD wants capability of modeling PV exposed in SynerGEE
  - Provide definitions of study PV systems
  - Use SynerGEE to perform studies
- CPR Tasks
  - Expose FleetView to SynerGEE
  - Update FleetView to include variability algorithms
- SynerGEE Tasks
  - Access FleetView software service via CPR's API

4.2. Integrate FleetView into Smart Grid Operation

- Objective
  - Evaluate usefulness of PV forecasts in dispatching storage in distribution system
- CPR Tasks
  - Provide forecasted output using FleetView for distribution feeder
- SMUD Tasks
  - Provide definition of PV systems on feeder
  - Use forecasted PV output to perform studies

4.3. Integrate FleetView into Utility Load Scheduling

- Objective
  - Provide hourly forecasted PV output (hour ahead to day ahead) for distributed PV systems installed under CSI to modify load forecasts submitted to California ISO
- CPR Tasks
  - Obtain PV system specifications from PowerClerk
  - Provide FleetView forecast of PV fleet output
- PG&E Tasks
  - Integrate PV fleet forecast into load forecasting system

4.4. Integrate FleetView into Balancing Area Planning (California ISO)

- Objective
  - Provide historical PV fleet output for all PV systems incentivized under CSI program
- CPR tasks
  - Obtain permission from CSI program administrators to have access to specs of all CSI PV systems in PowerClerk
  - Simulate ½ hour PV fleet output from January 1, 2008 through the current date, taking into account date that systems became operational

Clean Power Research®

4.4. Integrate FleetView into Balancing Area Planning (California ISO)

- Objective
  - Provide 1 minute PV fleet output for arbitrary PV fleet configuration for use in planning studies
- California ISO tasks
  - Provide definition of PV fleet (i.e., PV size, orientation, location) and selected time period
  - Perform planning studies
- CPR tasks
  - Simulate 1-minute PV fleet output
  - Add uncertainty calculations to provide 30-min average, standard deviation, and standard deviation of rate of change

4.4. Integrate FleetView into Balancing Area Planning (SMUD)

- Objective
  - Provide 1 minute PV fleet output for arbitrary PV fleet configuration for use in planning studies
- SMUD tasks
  - Provide definition of PV fleet (i.e., PV size, orientation, location) and selected time period
  - Perform planning studies
- CPR tasks
  - Simulate 1-minute PV fleet output
  - Add uncertainty calculations to provide 30-min average, standard deviation, and standard deviation of rate of change

4.4. Integrate FleetView into Balancing Area Operation (California ISO)

- Objective
  - Forecast output for all “behind-the-meter” PV systems incentivized under the CSI program broken down by 5 regions (2 for PG&E, 2 for SCE, 1 for SDG&E)
- California ISO tasks
  - Define counties that divide CA into 5 regions, each of which will constitute a PV fleet (Rebecca Laferriere will provide list of counties)
  - Define desired time intervals, method of delivery, etc. (Jim Blatchford will provide), including next day (as of 9 am) and next hour.
- CPR tasks
  - Obtain PV system specs from PowerClerk and group by 5 regions
  - Forecast PV output
  - Provide results to California ISO

Other Projects

Clean Power Research®

CEC (CPR) Project: Validate methodology

- Task 2. Build state-wide PV database
- Task 3. Create SolarAnywhere High Resolution data for specified locations
- Task 4. Simulate time series PV output data from SolarAnywhere High Resolution data, PV system specifications, and algorithms
- Task 5. Validate simulated PV production data using measured PV production data from California ISO
- Note: Overlaps with CSI tasks 2.2, 2.4 and 3.2

Clean Power Research®

CEC (AWS) Project

- Prepare and provide high-resolution (~1km) and medium resolution (10km) cloud motion forecasts for the areas surrounding the selected project location(s) throughout the project's evaluation period. The forecast will go from a few minutes ahead up to 5 hours ahead.
- Evaluate how cloud motion forecasts can be improved by using real time irradiance feedback from the project sites.
- Participate in optimization of a fusion operational product including satellite–derived forecasts and combining cloud imager based very short term forecasts at one end and longer term NWP forecasts at the other.

Clean Power Research®

Thank you

Questions?
Tom Hoff
tomhoff@cleanpower.com
cleanpower.com

Clean Power Research®

The information herein is for informational purposes only and represents the current view of Clean Power Research, L.L.C. as of the date of this presentation. Because Clean Power Research must respond to changing market conditions, it should not be interpreted to be a commitment on the part of Clean Power Research, and Clean Power Research cannot guarantee the accuracy of any information provided after the date of this presentation. CLEAN POWER RESEARCH, L.L.C. MAKES NO WARRANTIES, EXPRESS, IMPLIED OR STATUTORY, AS TO THE INFORMATION IN THIS PRESENTATION.