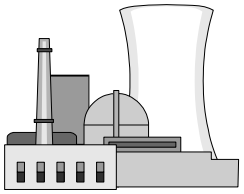
Improving Solar & Load Forecasts: Reducing the Operational Uncertainty behind the Duck Chart

Itron team

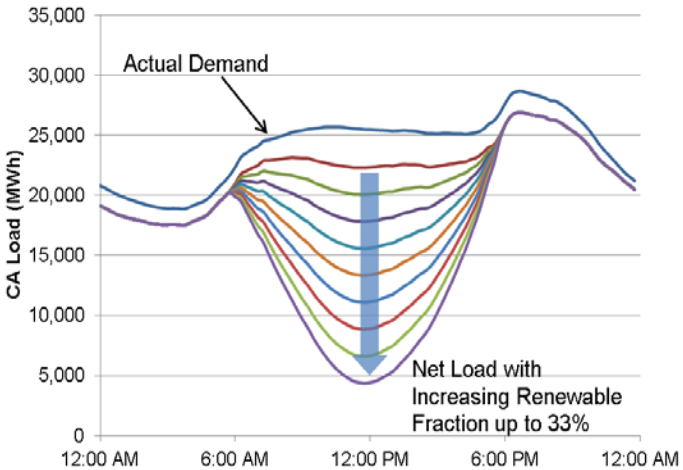
December 3, 2015

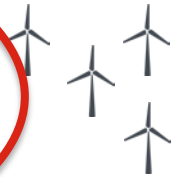
PROJECT

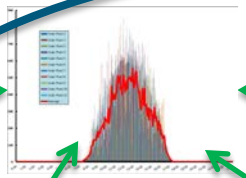
Better Integrate Solar and Net Load



(Demand – BTM)







BTM – Behind the Meter

Improve Solar Simulations & Forecasts

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IMPROVING SOLAR FORECASTS
CLEAN POWER RESEARCH

How much can we improve existing satellite based forecasts

IMPROVING SOLAR FORECASTS

BTM

Grid Connected

» Improve simulation based on real time grid connected irradiance for aerosol optical depth (i.e., dust, smoke, pollution)

» Update installed systems

» Tune simulations based on actual performance

» Use real time data for system availability

SOLAR FORECASTING PROGRESS & ISSUES

Issues

- Reliable Real Time Data for Utility Scale
- Access to good BTM Data over long periods

Progress

- Integrated New BTM Capacities
- Soiling Impacts for BTM

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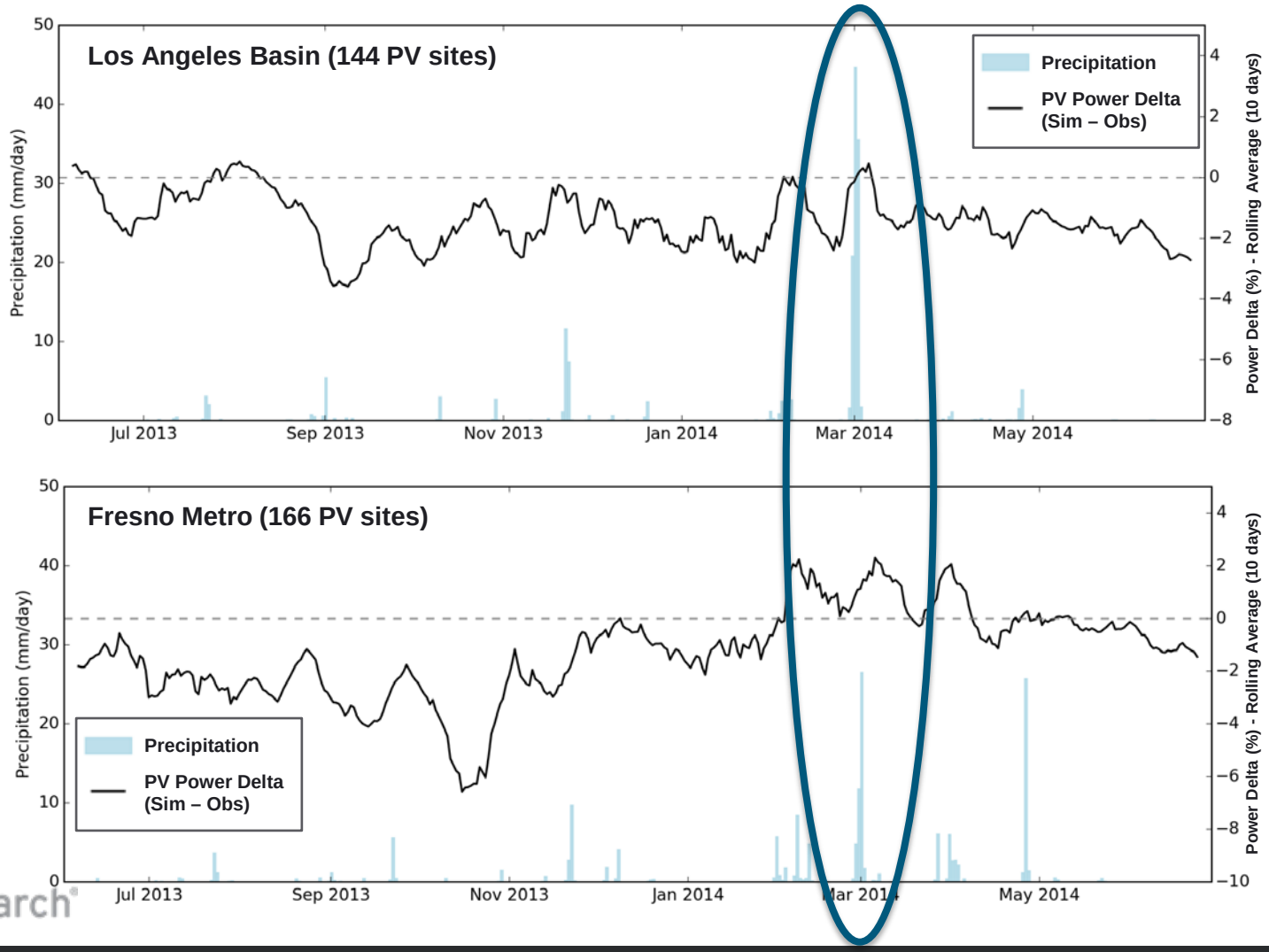
CPR SOILING RESULTS (PRELIMINARY)

Initial soiling study work performed on a year of PV production data from a major installer

Lined up FleetView® PV simulations with gridded precipitation data and observations

Two CA metropolitan region data analysis examples shown



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TASK 4 - IMPROVE NET LOAD FORECAST ACCURACY AND METRICS

How much do better and more integrated solar forecasts help net load forecasts?

MODELING SOLUTIONS

- **Model Directly**. Include BTM Solar Generation as an Explanatory Variable in the existing Short-term Load Forecasting Models. (i.e., put solar forecast on the right side of the equation)

- **Reconstitute the Load Data**. Reconstitute the historical load data with historical estimates of BTM Solar Generation. Then subtract off the BTM Solar Generation forecasts from the resulting load forecast. (i.e., put solar forecast on the left side of the equation and use in the regression)

- **Error Correction**. Start with forecast loads using a model of Net Load. Then adjust the Net Load forecast to account for the BTM Bias based on conditions (sunny, partly cloudy, cloudy, etc.); mimicking what is done by hand now

NET LOAD STEPS

How to Best Integrate Solar with Net Load Forecasting

Model Development

Forecast Simulations

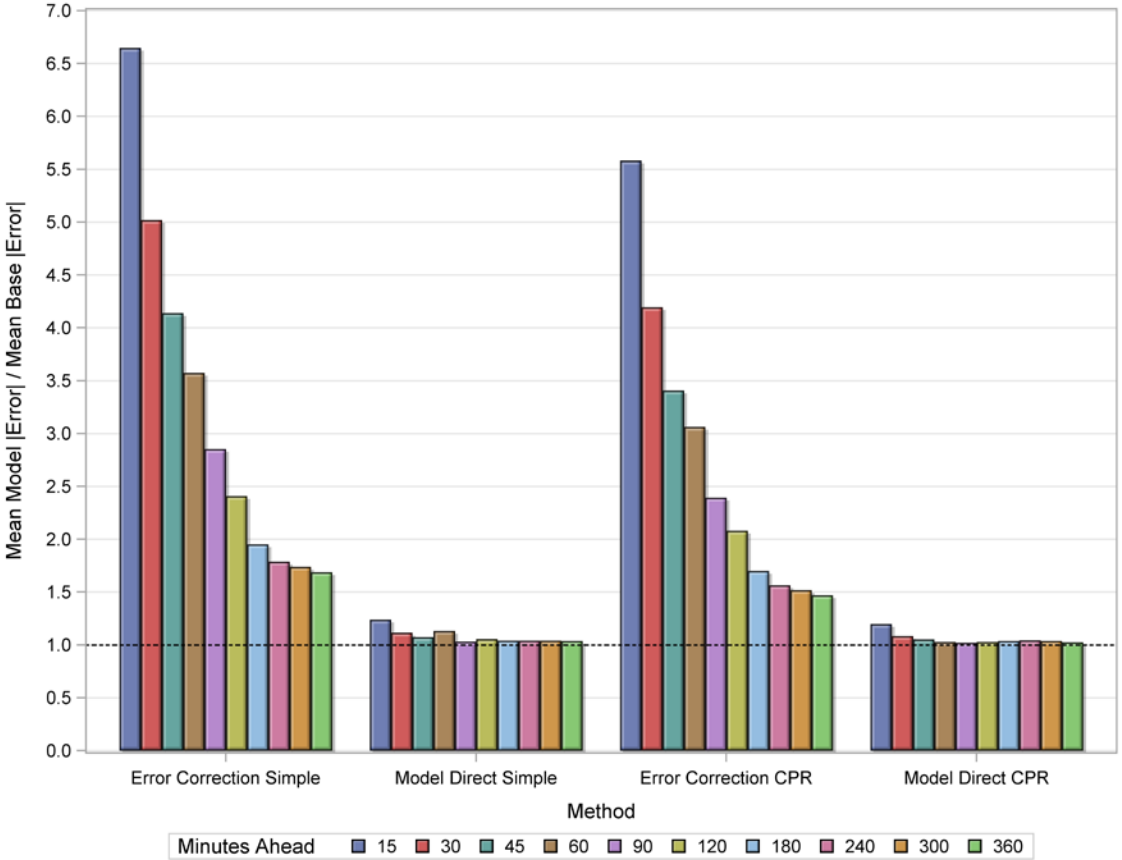
Analyze vs. Actual Data

- Develop Net Load Forecast Performance Metrics
- Construct Forecast Error Distributions

Where We Are for 2 methods

PRELIMINARY RESULTS - STATEWIDE

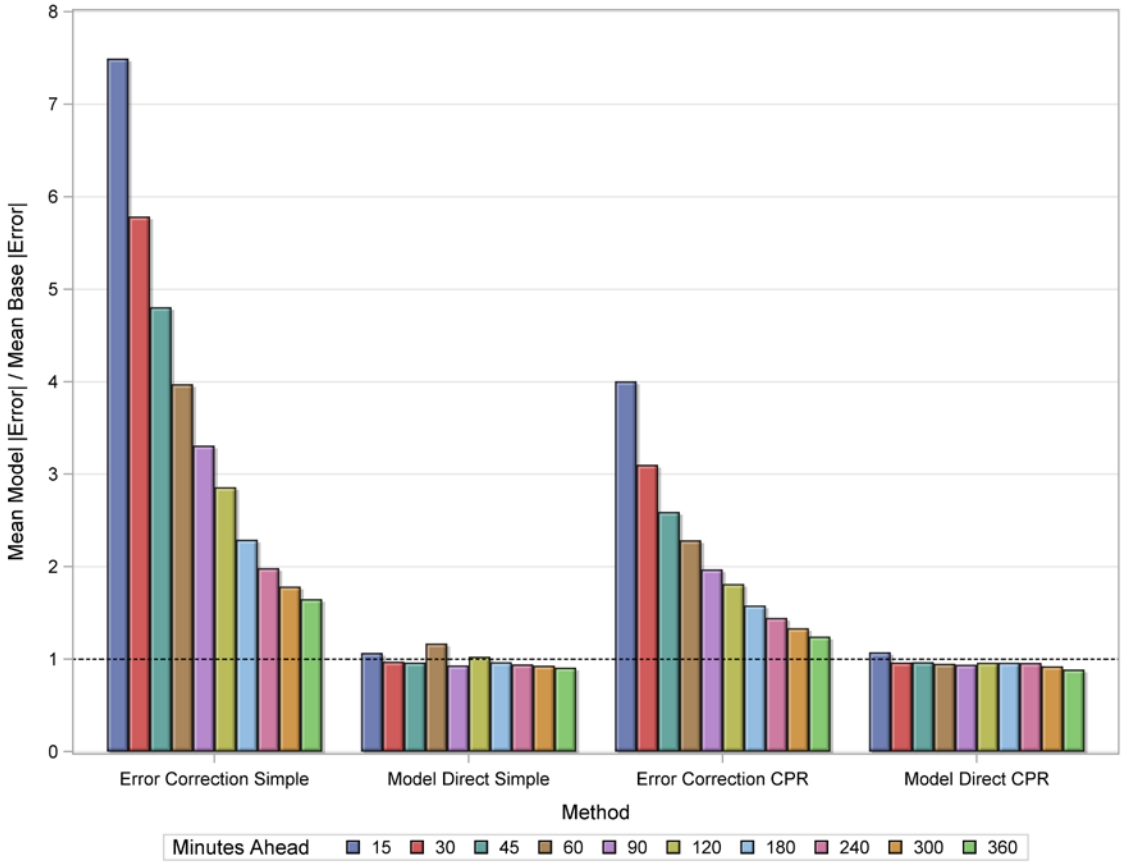
Statewide Average 2012-2015



- Not quite beating baseline
- Error correction based on average last three years; working on other normalization techniques

PRELIMINARY RESULTS – SDG&E

2015 Partial Year; PV Penetration ~ 3.8% aggregate (NEM), ~10% coincident



- » Starting to see the advantages of integrating PV modeling for smaller areas with higher penetrations of PV
- » Further out forecasts have less impact from historical load

ONGOING AND FUTURE WORK

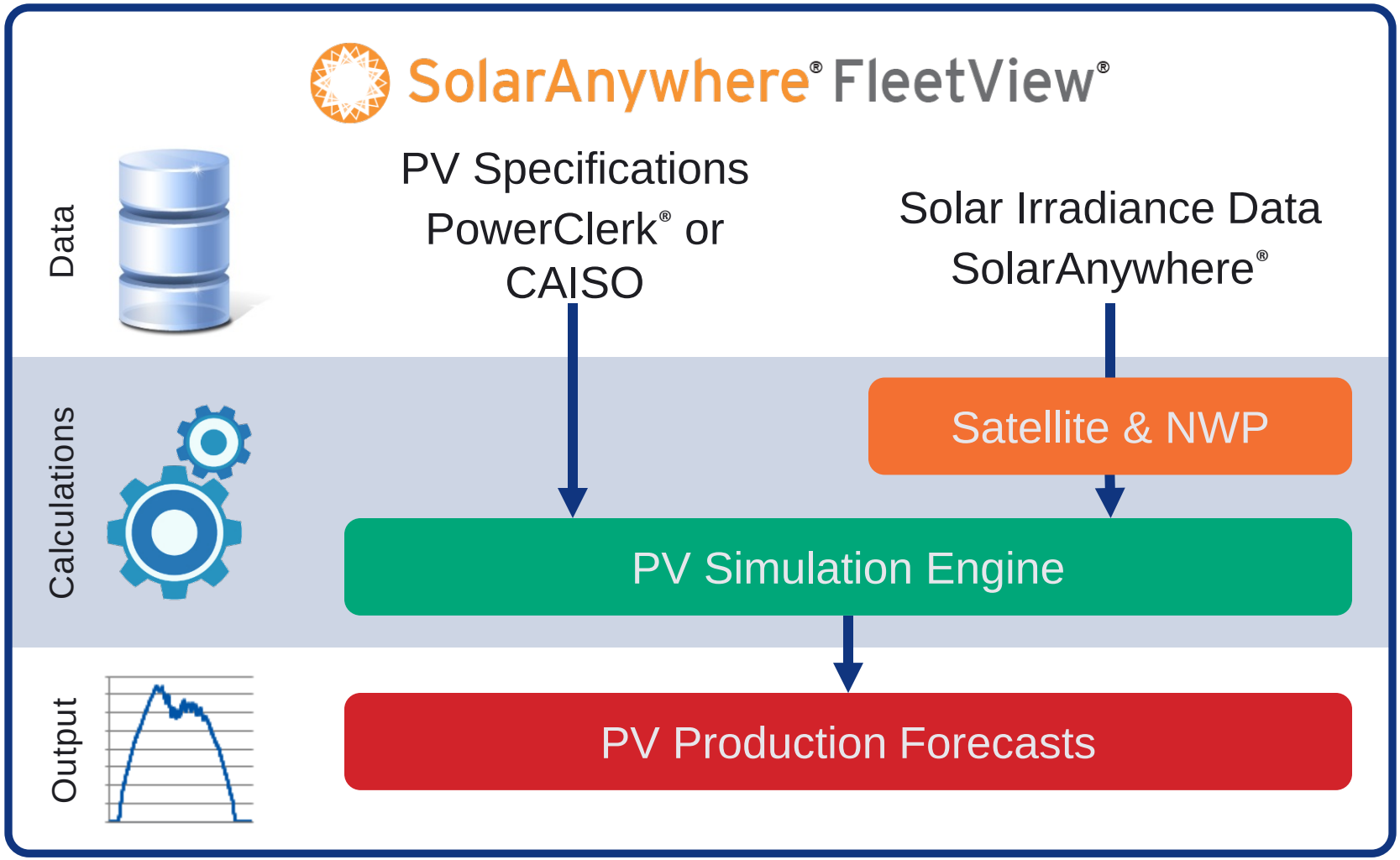
Or how much does it save

APPLYING WHAT WE LEARN

- Apply the best models to
  - Develop lessons learned
  - Improve operations
  - Quantify benefits including use of production cost models
- Improve the models CAISO is using today
  - Will roll in the improved forecasts to help with grid operations
  - Lower needed spinning reserves

BACKUPS

CPR PV SIMULATION METHODOLOGY



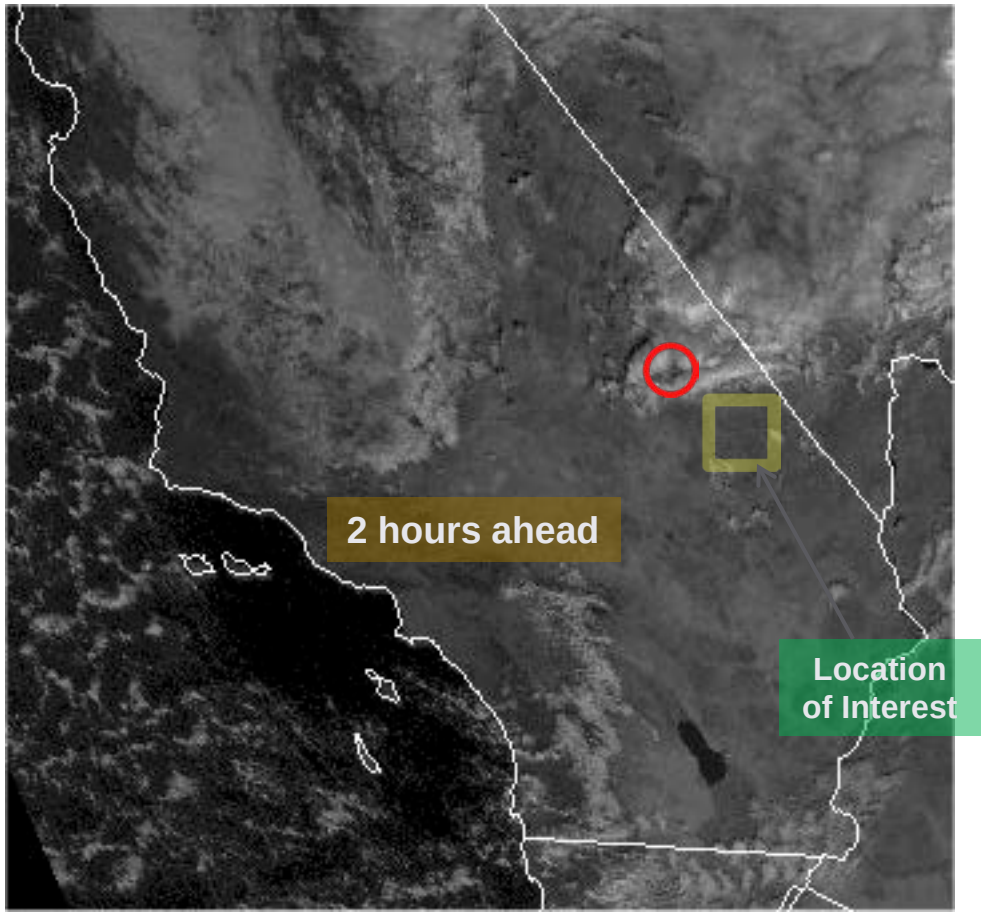
CPR SOLAR FORECASTING METHODOLOGY

Satellite-derived cloud motion vectors (CMV) derived from consecutive satellite images

Sub-hourly forecasts up to 5 hours ahead

Visible and Infrared satellite image-based for continuous CMV forecast coverage

Satellite CMV forecasts are blended into NWP forecasts at longer time horizons (> 5 hrs)



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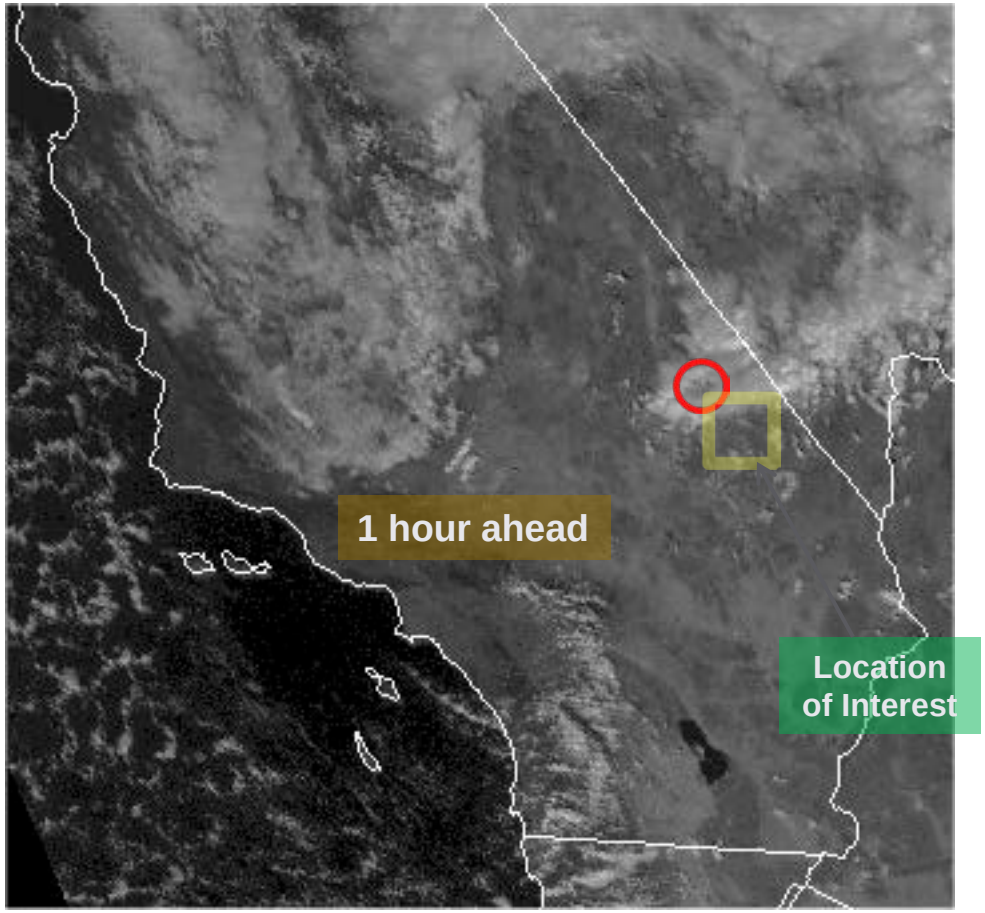

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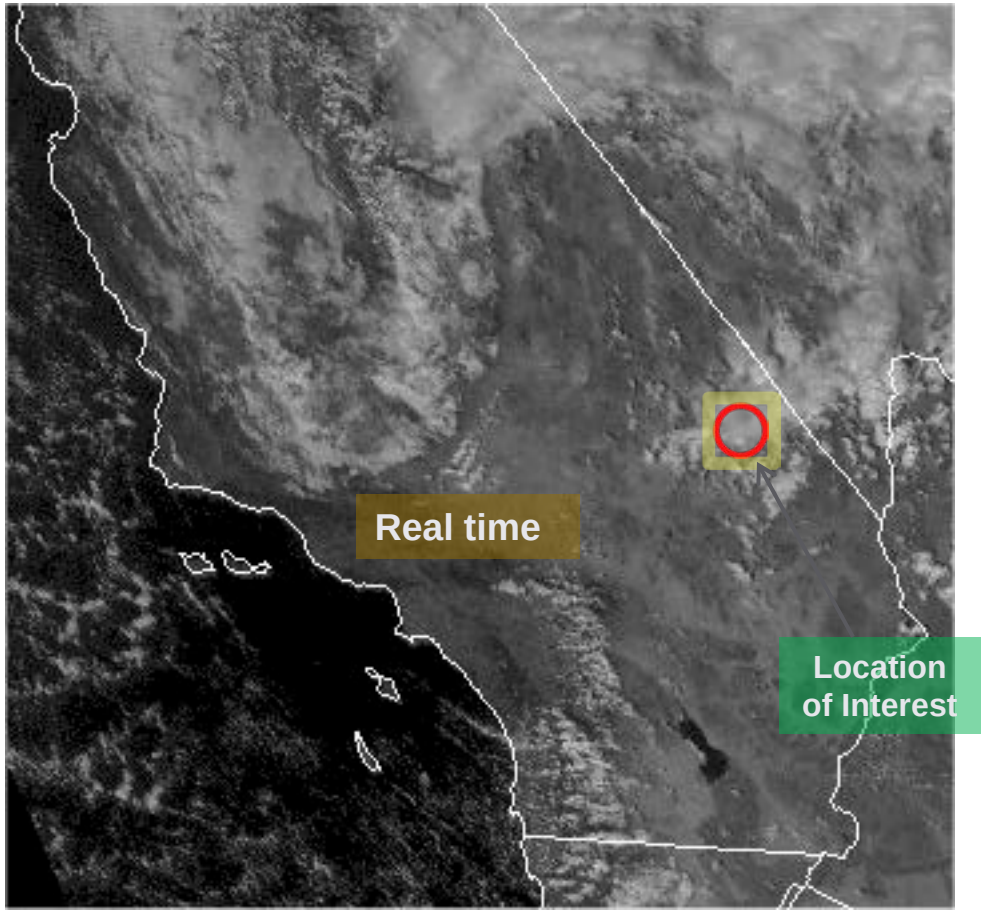

THE TEAM

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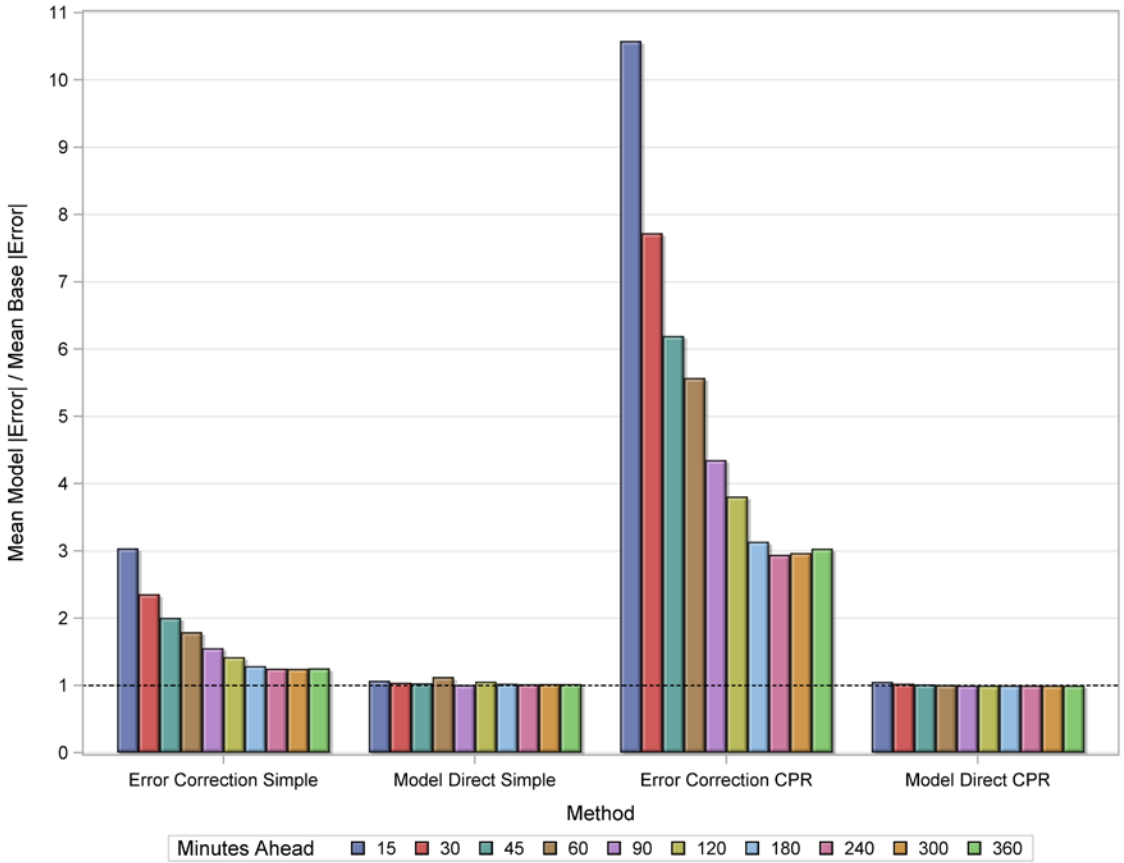
PRELIMINARY RESULTS – SDG&E

2012; PV Penetration ~ 1.7% aggregate (NEM), 5% coincident



» Not quite beating baseline

CLEAN POWER RESEARCH TECHNICAL TASKS

- **TASK 2: Improve Data Acquisition Capabilities, Reliability, and Cost Effectiveness of Ground-mounted Solar Instrumentation**
  - Goals: Integrate CAISO data to improve AOD and cloud albedo aspects of FleetView forecasts
  - (Utility scale) Incorporate real-time metered PV generation data to fine-tune fleet forecasts (capacity tracking)
- **TASK 3: Develop & Refine Solar Forecasting Tools**
  - Goals:
    - (BTM) Incorporate adjustments for real-world fleet behavior
    - Implement regional PV fleet forecasting model improvements

PUTTING $$'S TO BENEFITS

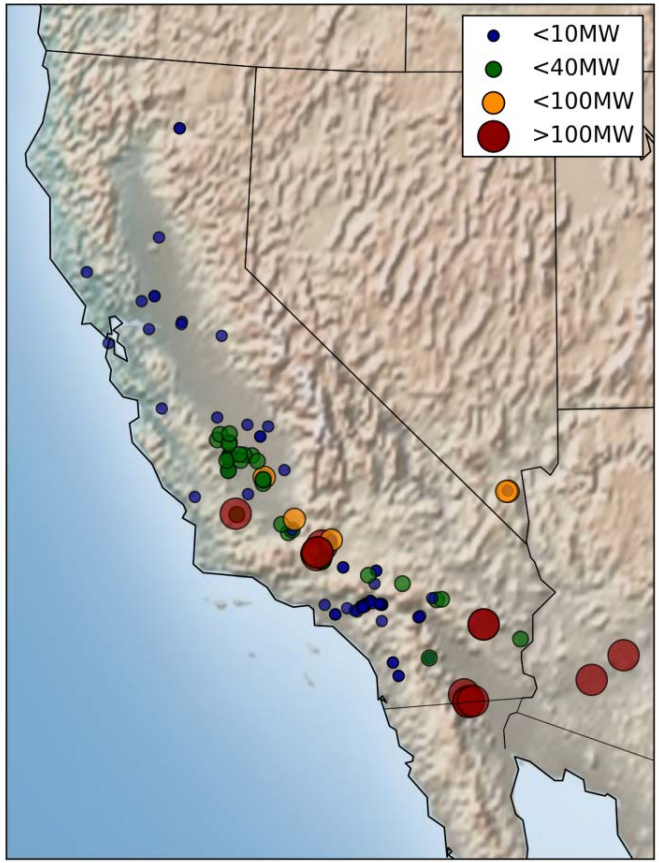
Part two by SMUD using Production Cost Models

- Use Production Cost Models to identify to quantify cost of carrying reserves and impact of different levels of accuracy including:
  - Estimation of the monetary value of the forecasts for dispatching traditional generating units and minimizing the need for excessive reserves based on the production cost modeling; and
  - Identification of the possible approaches that can be used to help optimize the dispatch of generating units needed to firm the intermittency associated with solar PV production.

GOALS AND OBJECTIVES

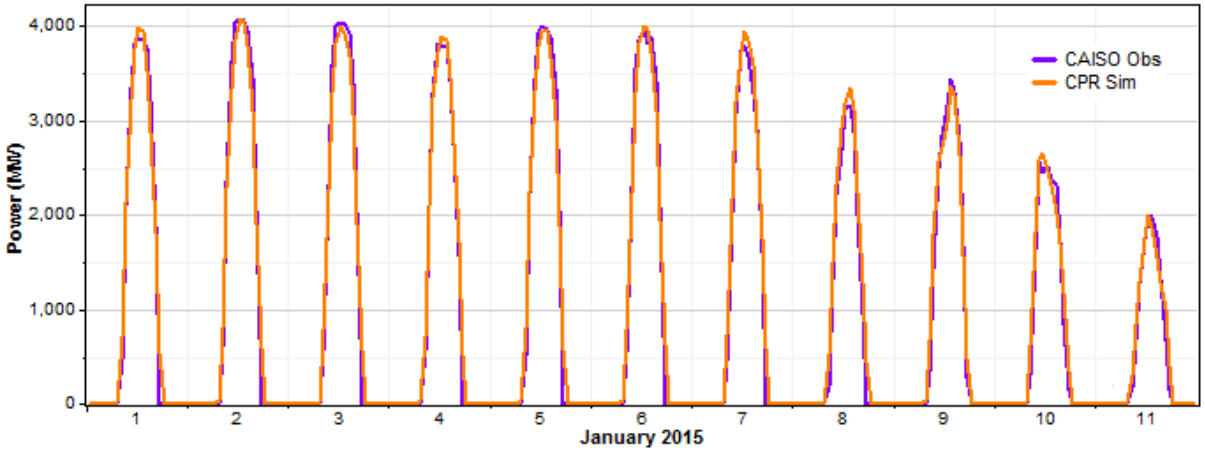
- Goal
  - Improve the accuracy of solar and net load forecasting to better integrate more PV.
- Objectives:
  - Improve solar forecasts
    - Utility scale
    - Behind the meter
  - Integrate the improved solar forecasts and improve the accuracy and metrics of net load forecasts.
  - Apply research work to demonstrate improved solar forecasting and integration and quantify the value

CALIFORNIA GRID CONNECTED METERED PV SYSTEM SIMULATIONS



- Accurate utility-scale PV simulations require detailed site specifications (PV modules, inverters, orientation, row spacing, etc.).
- Same methodology as pre-construction PV energy simulations (PVsyst, SAM, etc.)

Aggregated CAISO Fleet PV production



120+ Metered Utility-Scale PV Systems in the CAISO region

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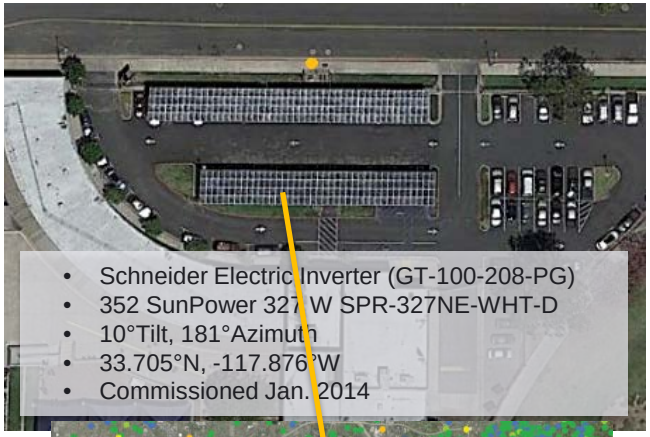
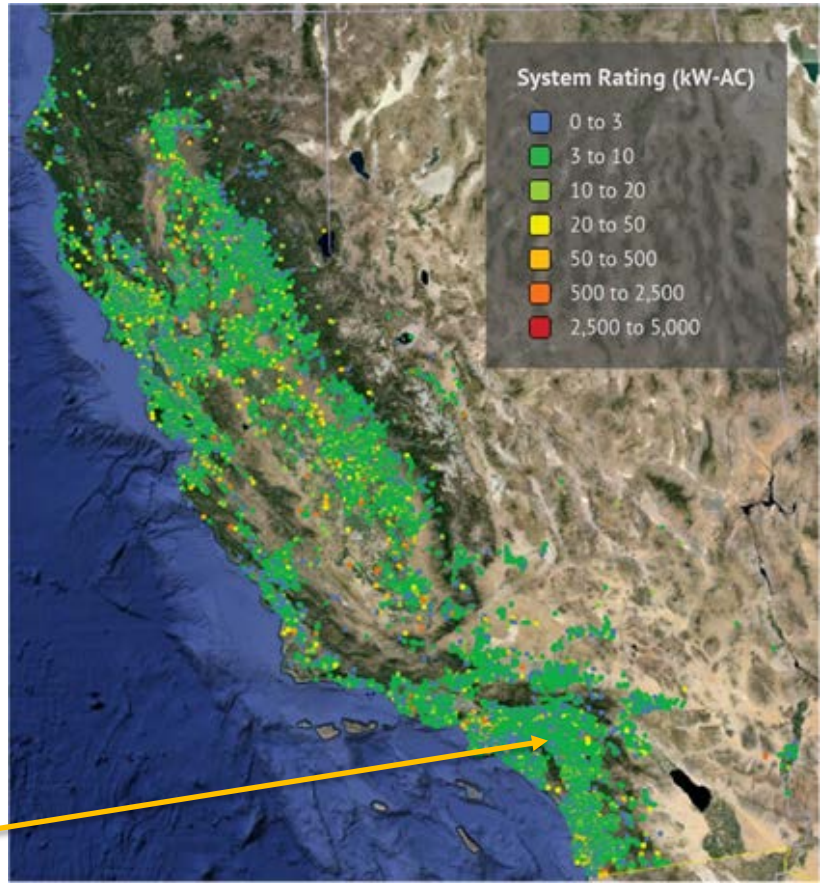
CAPTURES BTM FLEET LOCATIONS AND DIVERSITY

- PowerClerk® links administration to fleet simulation
- Use same methodology as employed with utility-scale PV simulations





Regional and system-wide BTM simulation capabilities

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