Experience in CA with Behind-the-Meter PV Forecasts

Tom Hoff, Clean Power Research

UVIG Forecasting Workshop, February 26, 2014

Project Partners

UNIVERSITY AT ALBANY
State University of New York

UCSD

SEPA

EPRI

Itron

Primary Funders

pier

Power Industry

SMUD™

California ISO
Your Link to Power

PG&E

Project Lead

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Current Work is Result of Multiple Projects

- **DOE Sunrise**
  - Demonstrate improved net utility load forecast by incorporating behind-the-meter PV forecast for CAISO and all PV in California

- **CSI Phase 3**
  - Address cost-effective strategies for integrating large amounts of PV into distribution systems by integrating PV modeling into utility planning and operation tools

- **CEC Forecasting**
  - Validate ability of satellite-derived solar data to forecast PV fleet output with CAISO and integrate into planning processes

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Highlights

- Behind-the-meter fleet forecasting for all of California has been operational for about a year

- CAISO has initiated testing to determine the benefit derived from forecasts

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Simulate Fleet Output Using SolarAnywhere® FleetView™

SolarAnywhere®

Historical   *Forecast*

PV Specifications From *power***CLERK**® and Other Sources
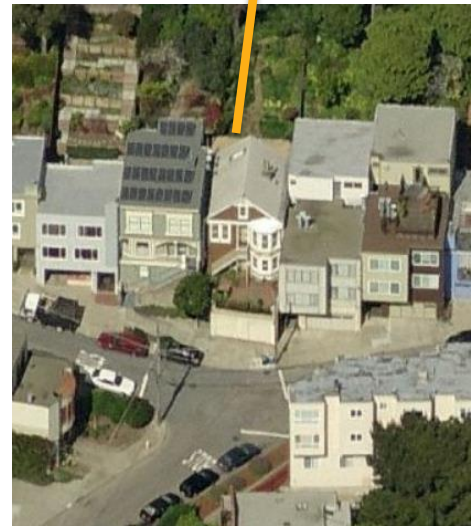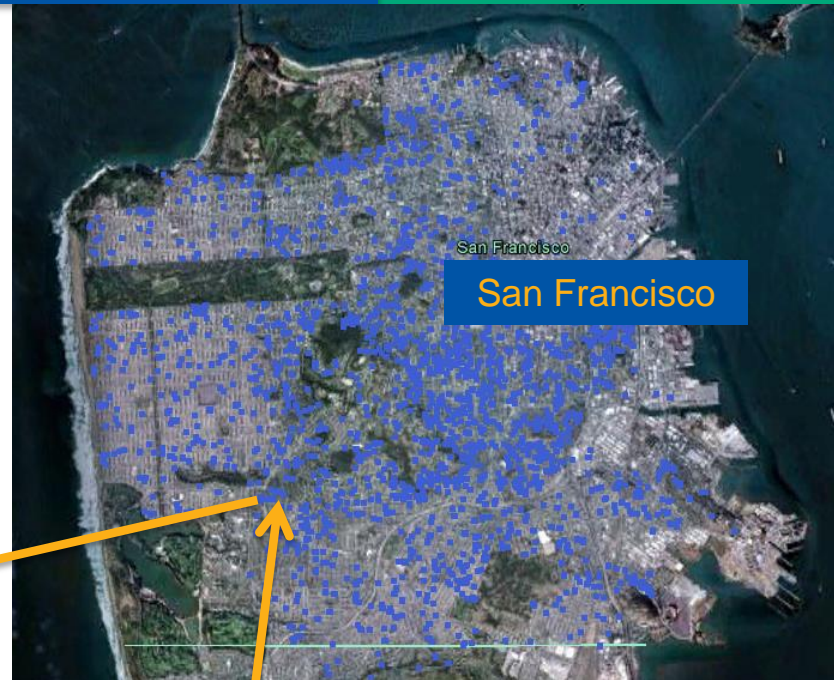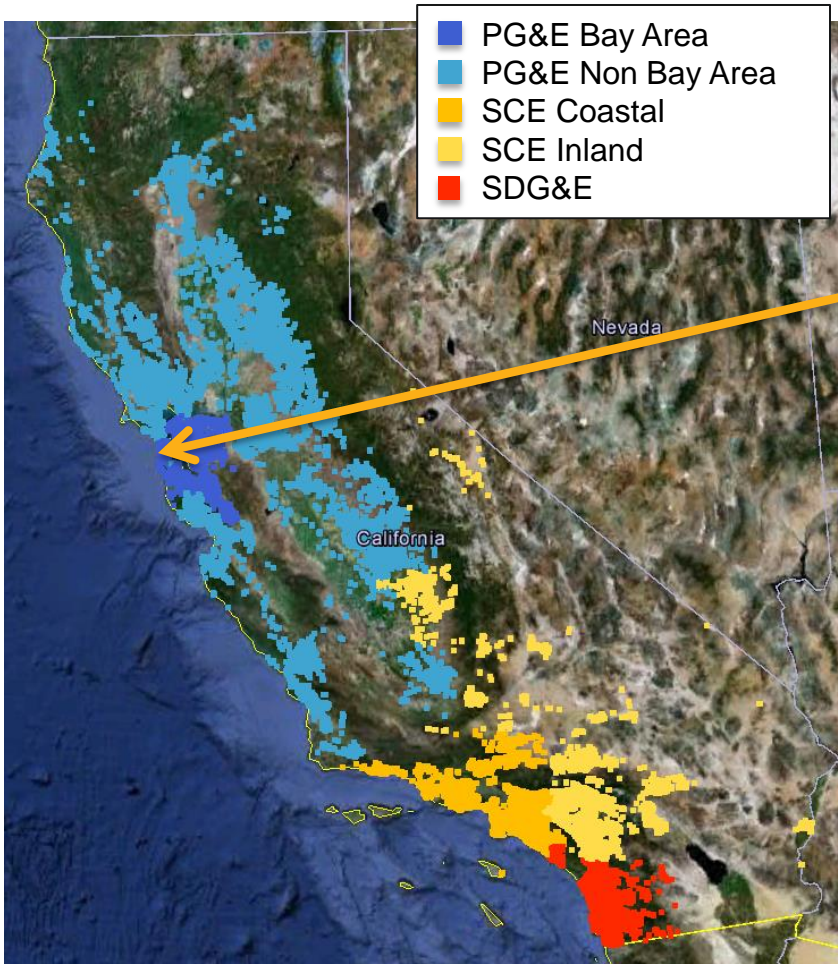
FleetView Simulation Methods

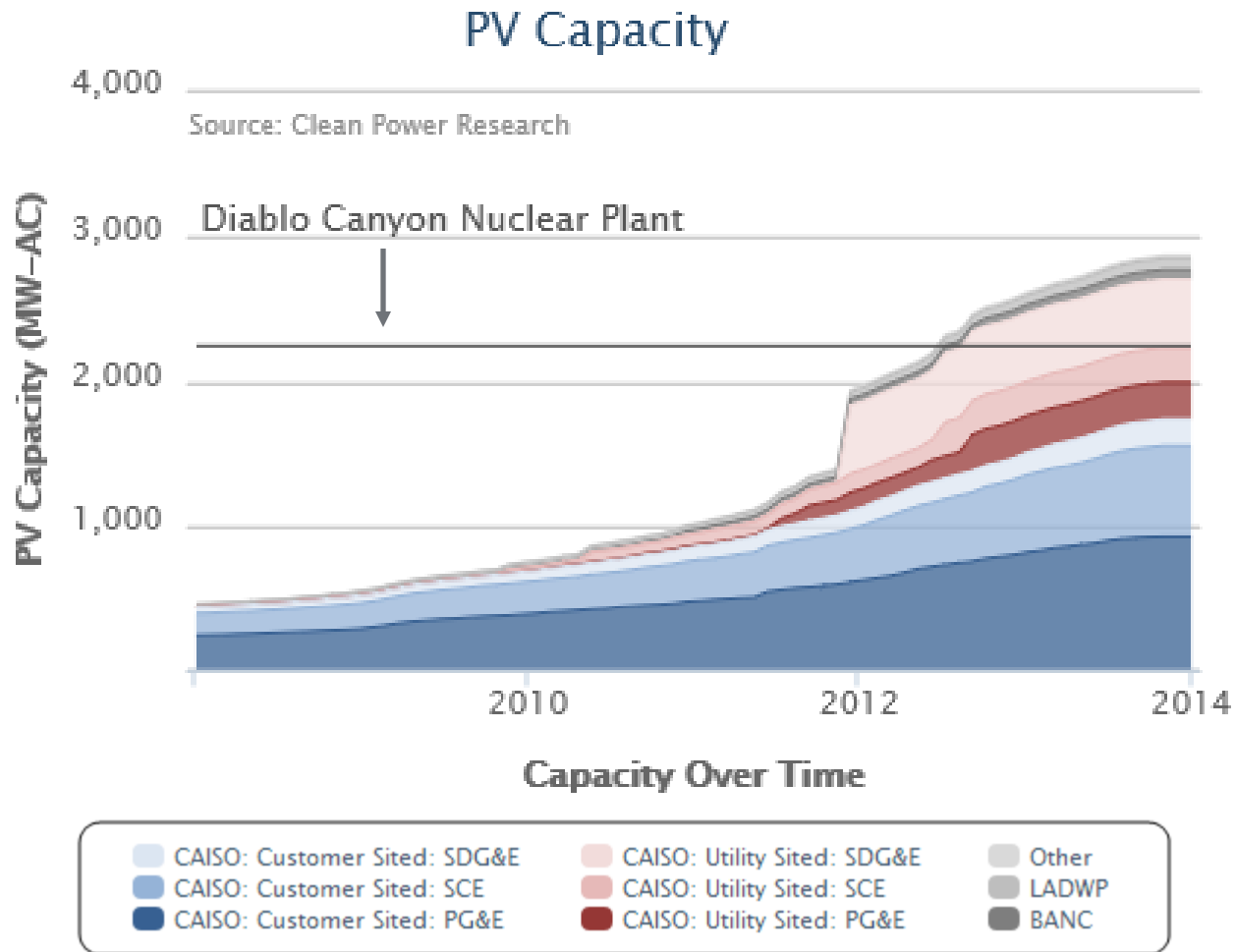Fleet Planning   Fleet Operations

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CA Behind-the-Meter PV Mapping

Legend:
- PG&E Bay Area
- PG&E Non Bay Area
- SCE Coastal
- SCE Inland
- SDG&E

San Francisco

- 4.49 kW-AC
- SunPower Inverter (SPR-5000X, 240V)
- 27 Modules (SunPower 210 W, SPR-210-WHT)
- 37.76281º N, 122.44313º W
- Commissioned April 2008

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California PV Capacity by ISO Areas

Note: Utility-sited systems include intertie systems in NV and AZ
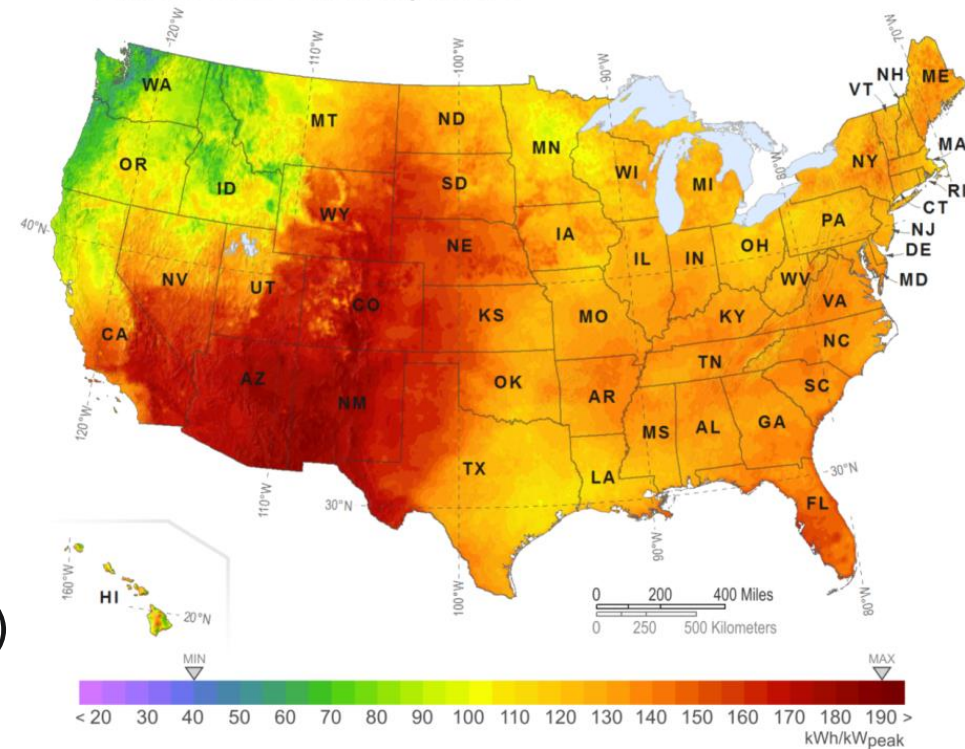
SolarAnywhere – 1 km data

Web-accessible solar irradiance data & analytical tools

Irradiance data

- Historical satellite-derived time-series data from 1998 through latest hour
- Forecasts up to 7-days in advance by combining cloud motion vector and NWP approaches
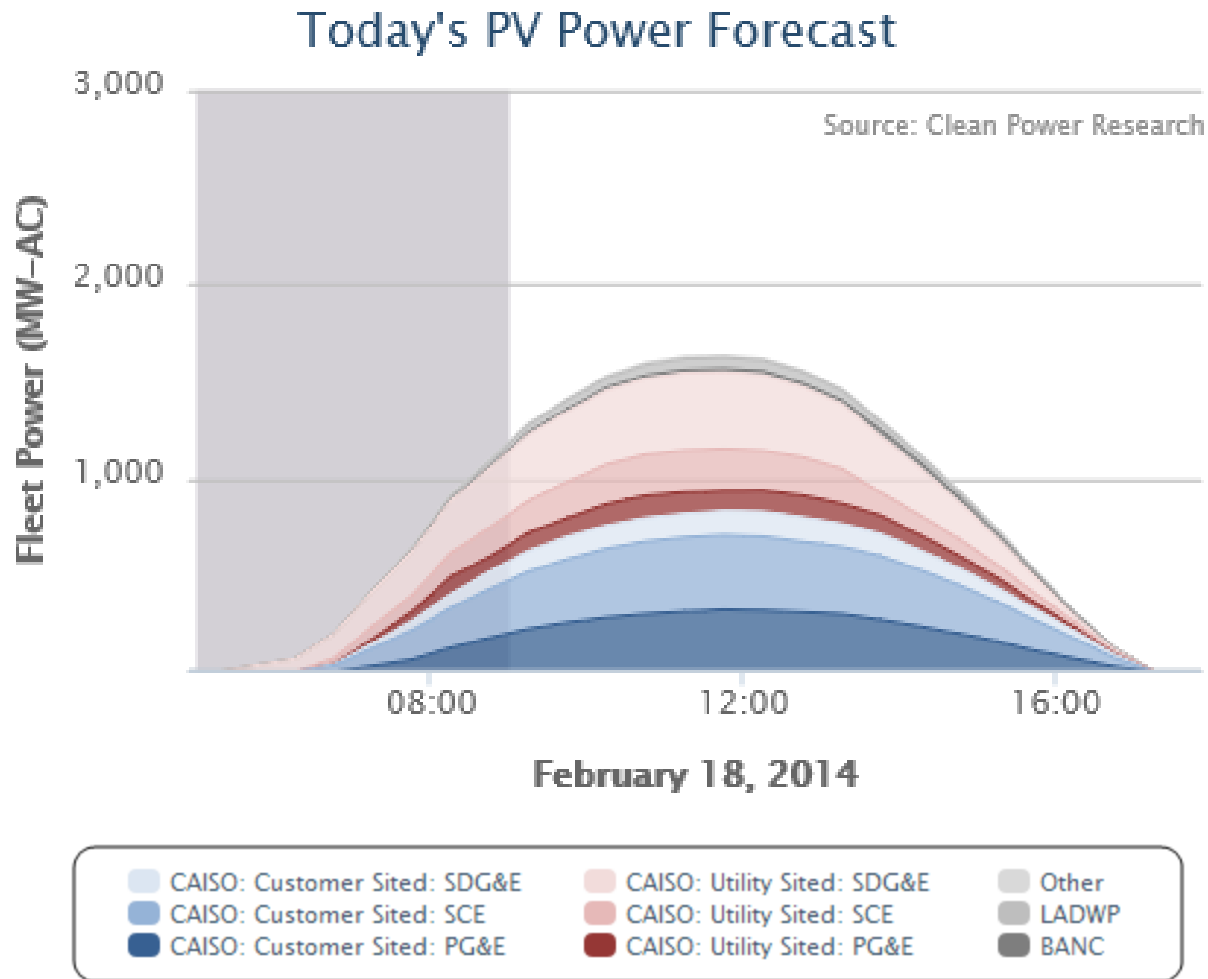
Analytical tools

- PV system modeling (FleetView)
- PV benchmarking (DataCheck)
- PV fleet variability

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Using FleetView for Net Load Forecasting

Note: Utility Sited systems include intertie systems in NV and AZ

Current Development Efforts

- Move from static to dynamic accuracy validation

- Implement improved techniques to reduce forecast error

- Implement and test rapid fleet simulation method

- Incorporate uncertainty and ramp rate forecasting

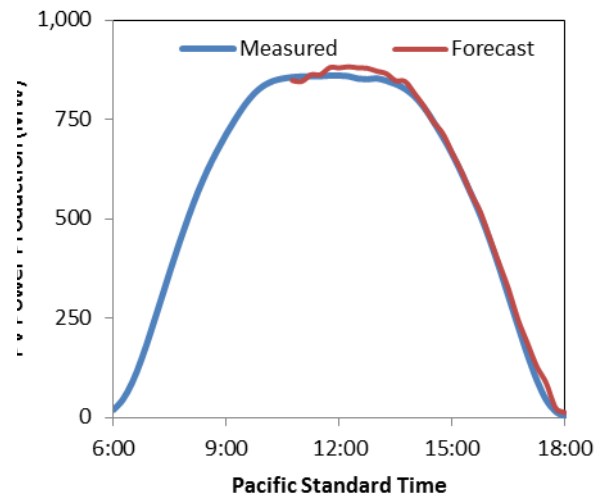- Maintain ongoing collection of PV system specifications

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Transition From Static To Dynamic Validation

Time Horizon (Relative to Forecast Delivery)
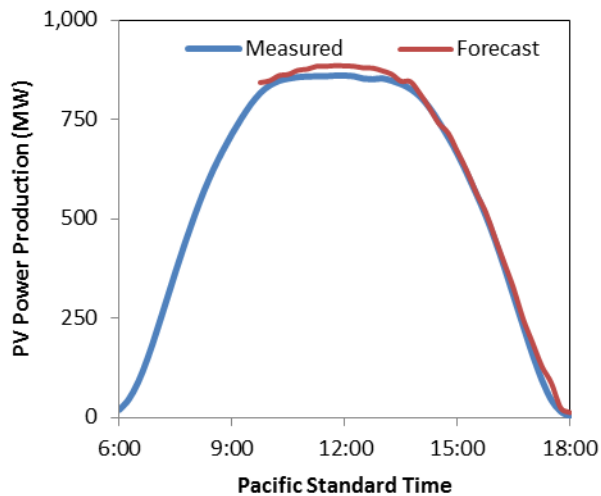
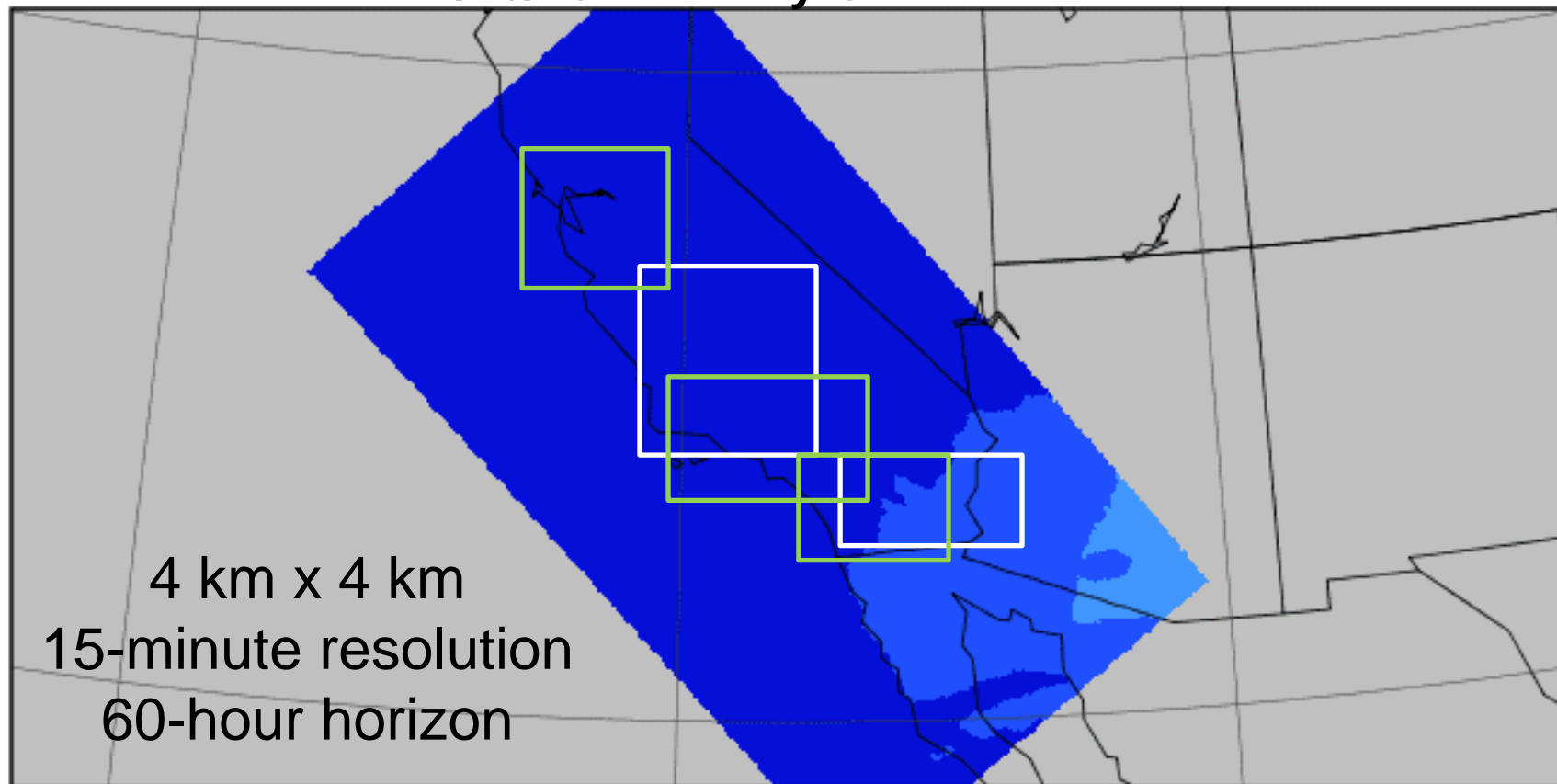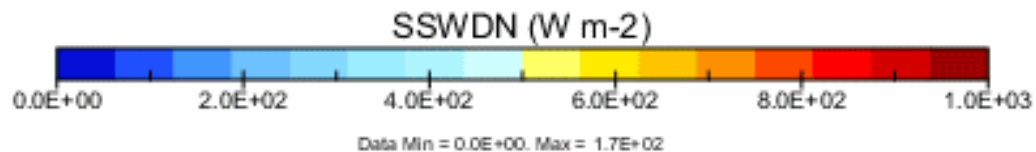### 0 – ¼ Hours   1 – 1¼ Hours   2 – 2¼ Hours

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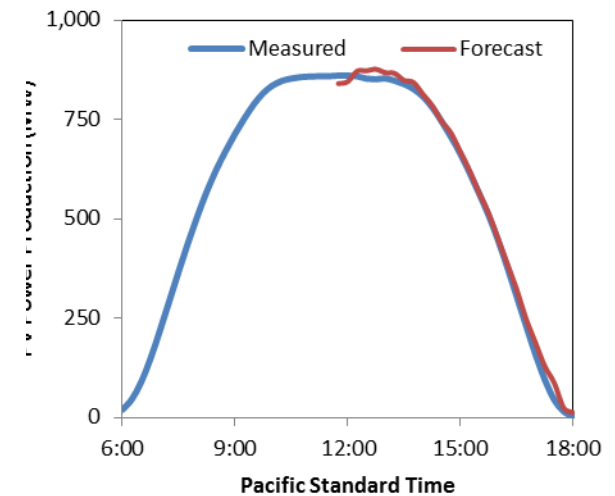
Improve Forecasts Using WRF Modeling (Dr. Kleissl - UCSD)

2/15/2014 Hourly GHI Animation

4 km x 4 km
15-minute resolution
60-hour horizon

SSWDN (W m-2)

0.0E+00   2.0E+02   4.0E+02   6.0E+02   8.0E+02   1.0E+03

Data Min = 0.0E+00. Max = 1.7E+02

Improve Forecasts Using Ensemble Methods (Dr. Perez - SUNY)
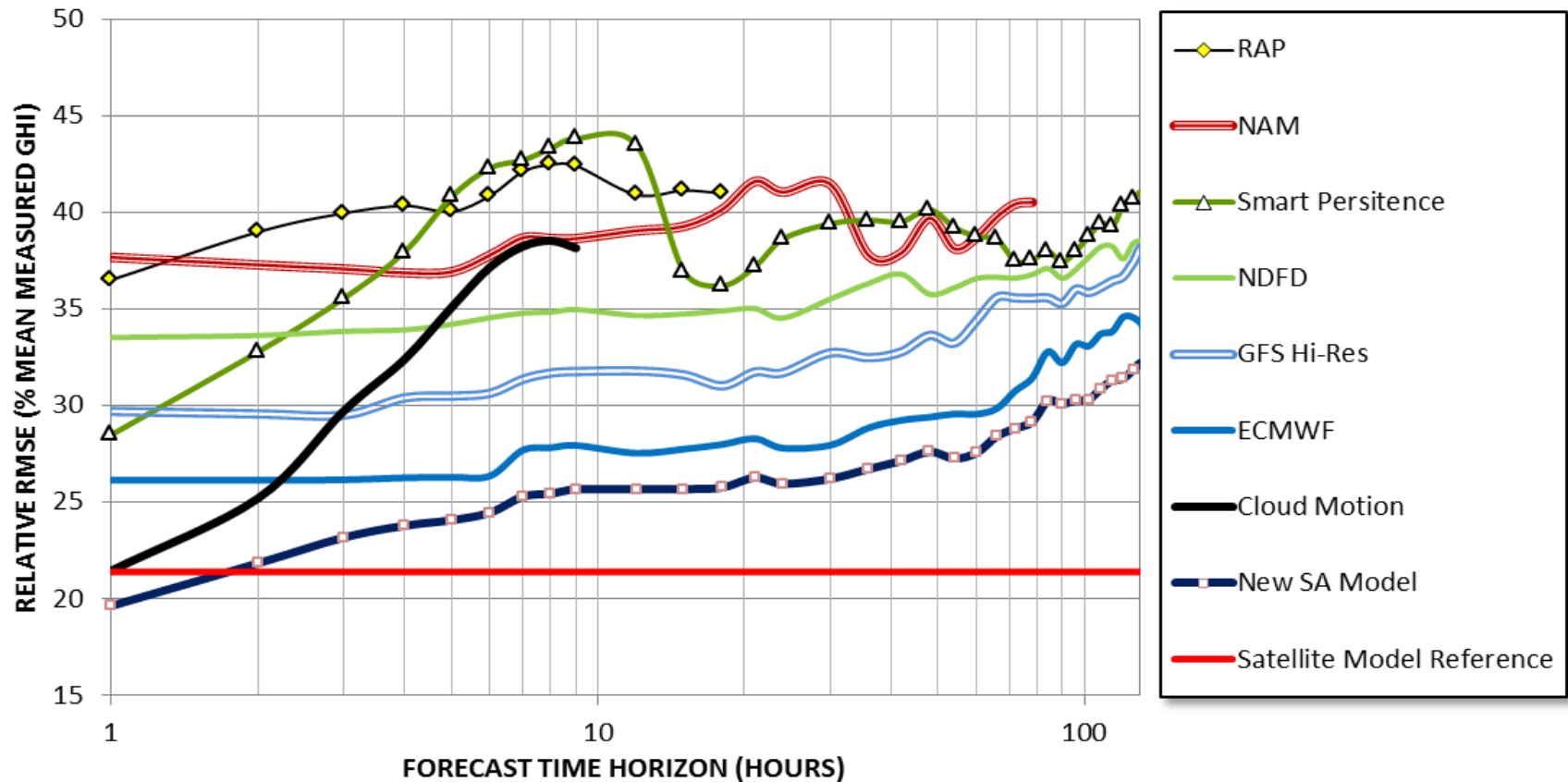
Improve Forecasts Using Machine Learning (Dr. Coimbra - UCSD)
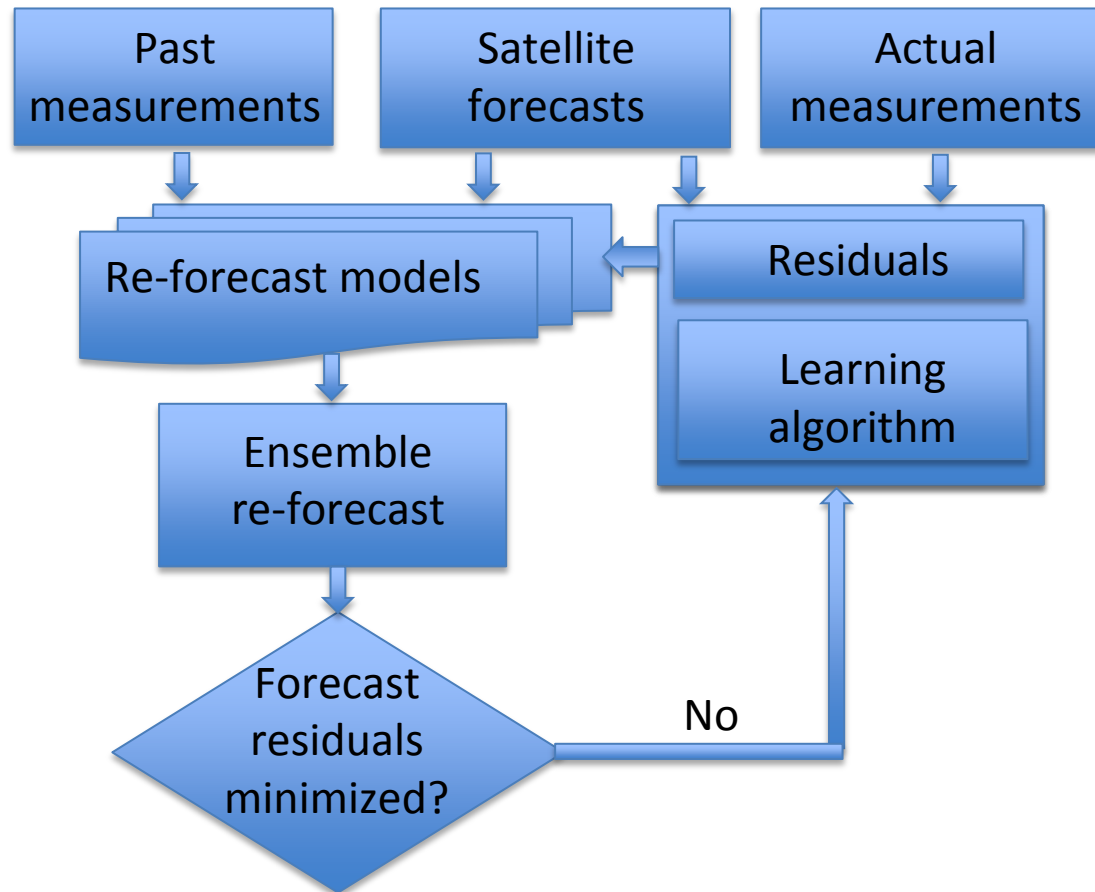
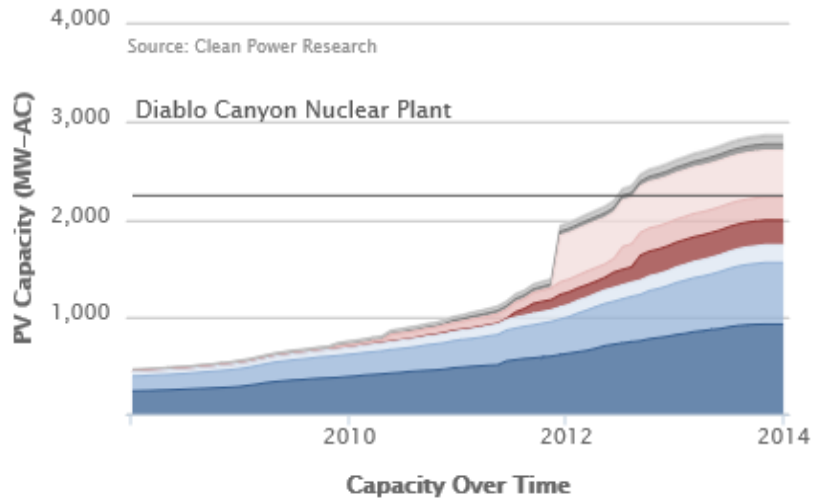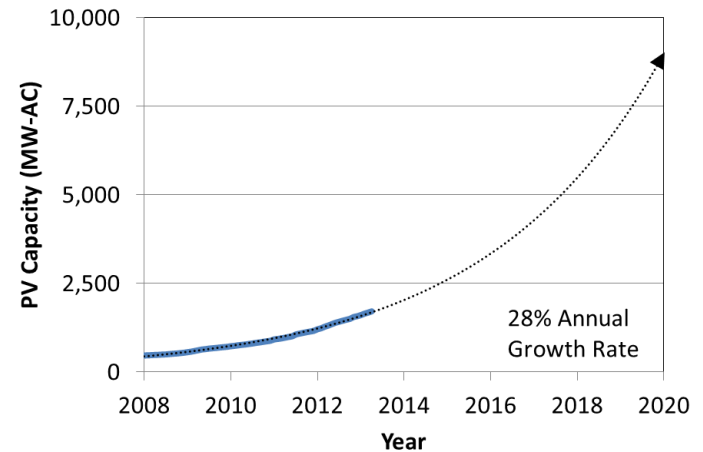**Real-Time Smart Re-forecasting**

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Need for New Method to Collect Specs

Current Capacity

Source: Clean Power Research

Diablo Canyon Nuclear Plant

PV Capacity (MW–AC): 4,000 / 3,000 / 2,000 / 1,000

2010 2012 2014

Capacity Over Time

Projected Behind-the-Meter Capacity

PV Capacity (MW–AC): 10,000 / 7,500 / 5,000 / 2,500 / 0

28% Annual Growth Rate

2008 2010 2012 2014 2016 2018 2020

Year

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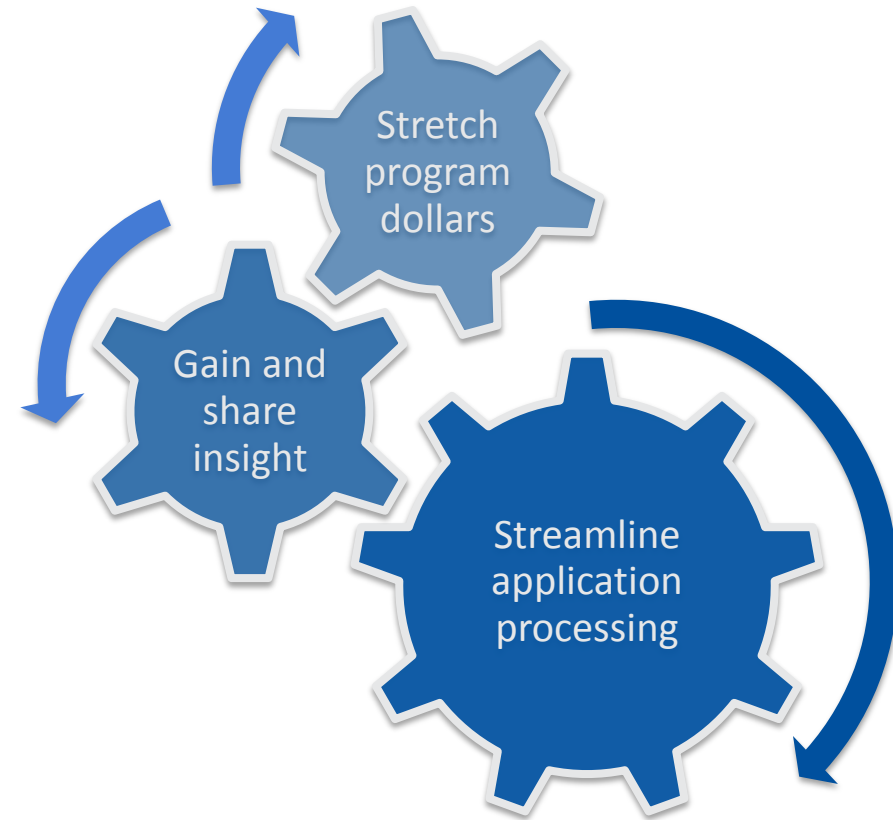
14

PowerClerk for Interconnection

- CPR background was incentive and program *design*

- Customer pain point was prog. *operations*

- Customers asked us to build PowerClerk Incentives

- SunShot Incubator award: commercialization of next PowerClerk platform – interconnection, incentives …

Stretch program dollars

Gain and share insight

Streamline application processing

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Conclusion

- Behind-the-meter fleet forecasting for all of California is operational and has been for almost a year

- CAISO has initiated testing to determine the benefit derived from forecasts

- Active research/product improvement is progressing well

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Thank you

Please feel free to contact us for any details or clarification related to presentation

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