High Penetration PV Initiative

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Overview

- Sacramento Municipal Utility District
- Renewable Energy Drivers
- High Penetration PV Initiative
- Conclusion

Sacramento Municipal Utility District

- Publicly Owned (Sixth Largest in U.S.)
- Service area of 900 square miles, serving 1.4 Million (Sacramento County and parts of Placer)
- Over 578,000 Residential, Commercial and Industrial customers
- Record peak demand-3,299 MW on July 24, 2006
- Aggressive 23.5% Renewable supply by 2010; 37% by 2020
- GHG Reductions by 2050 (10% of 1990 levels, <350,000 metric tonnes/year)

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Renewable Supply

Renewable Energy Program	2009 Supply Goal	2009 Actual	2010 Goal	2020 Goal
RPS	17.0%	18.8%	20%	33%
Greenergy	3.5%	3.5%	3.5%	4%
Totals	20.5%	22.3%	23.5%	37%

SMUD's PV Portfolio

- Consistent Leadership for over 25 years
- Utility designed, owned & operated to incentives
- Currently approximately 20 MW AC, over 1000 installations

  (Residential, Commercial and Utility Scale)

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Concerns:

- Policy Drivers for increasing renewable generation, particularly solar
- How much variable renewable generation can our grid take and still be reliable?
- What kind of mitigation measures are necessary?
- How much will it cost?

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Partnership with HECO

- Common problems on distribution, high penetration and increasing DG PV deployment to meet goals (HI and SMUD)
- Lacking visibility and reliable forecasting capability for solar and DG resources on our systems for effective operations especially during variable weather days and peak loads
- Hawaii already experiencing high penetration levels

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Objective:

Development and testing of hardware and software to evaluate the impact of high penetrations of PV systems on our grid.

Team:

SMUD, HECO, SunPower, NEO Virtus Engineering, BEW Engineering

Project activities:

Feeder and system modeling, baselining, field monitoring and analysis will be conducted on identified case studies that include sites and feeders within SMUD territory and Hawaii. Tools will be developed and piloted.

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Task 2: Baseline Modeling of SMUD and HECO

- Identification of Cases (i.e. high penetration circuits with interesting characteristics)
- High Penetration Circuits Data Collection (Voltage, Loads, Production, Faults)
- Distribution Systems Modeling/Visualization (Synergee modeling integrated with Powerworld identify high value locations for PV, identify problem areas)

Illustration of a Location value map of Oahu showing various distribution circuit penetration levels.

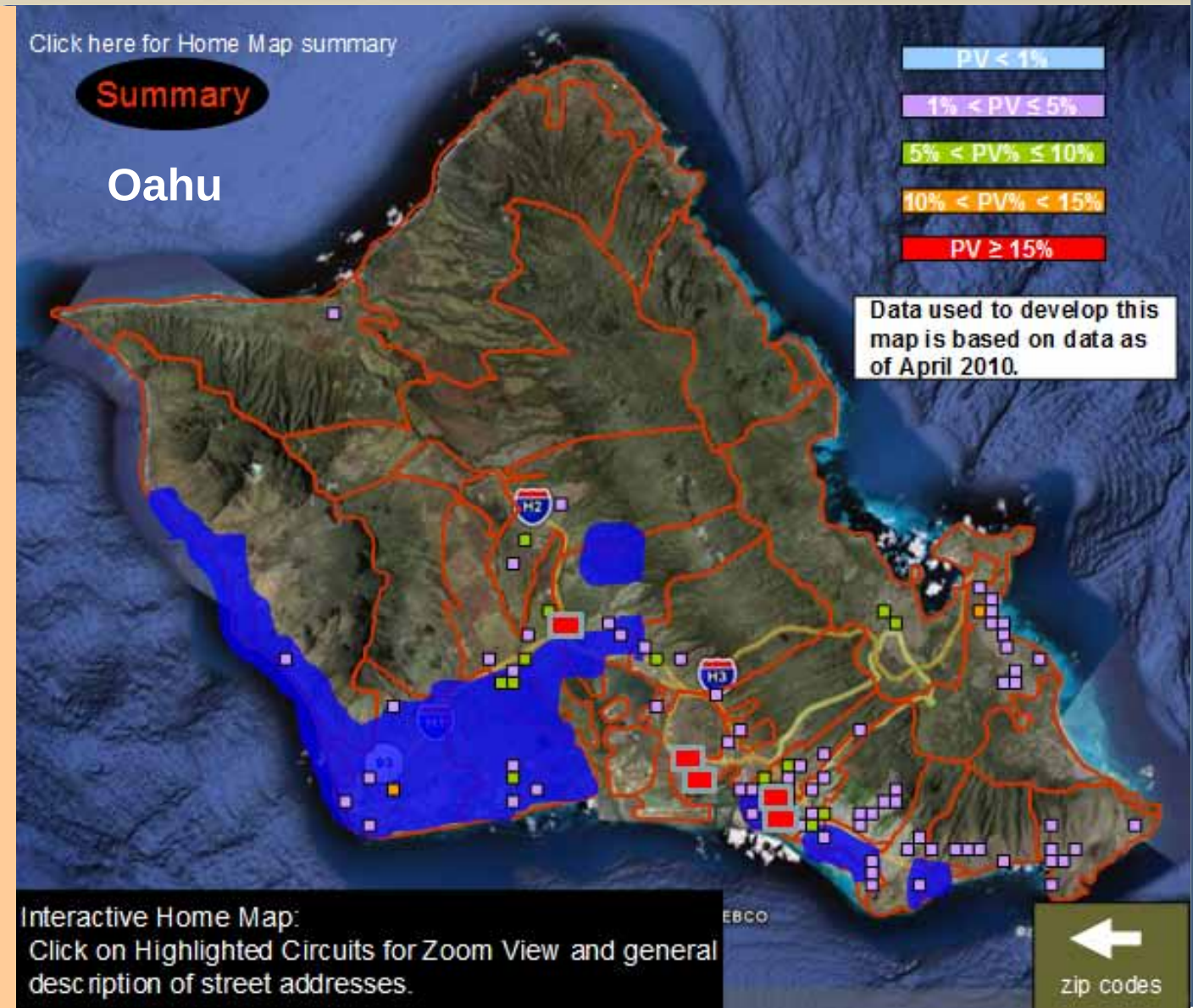
Locational Value Maps (LVM) of High Penetration Circuits

Hawaiian Electric Company, Inc.

Standardized, web-accessible LVM created for HECO/MECO/HELCO to visually track circuit penetrations. Informs developers of high penetration locations which may require study.

Internally, automatic links from GIS, CIS, T&D infrastructure details are being tested. Future links to other database layers including outage mgt, asset mgt. DSM & UFLS circuits

- Areas with highest PV penetration on Oahu:
  - Millilani and Honolulu: Due to customer PV



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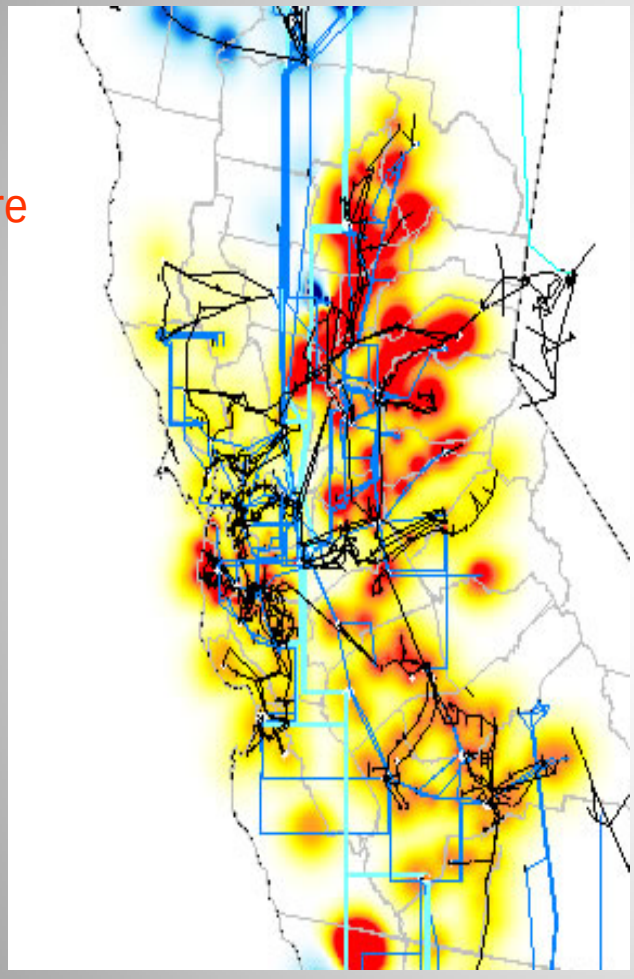
Before



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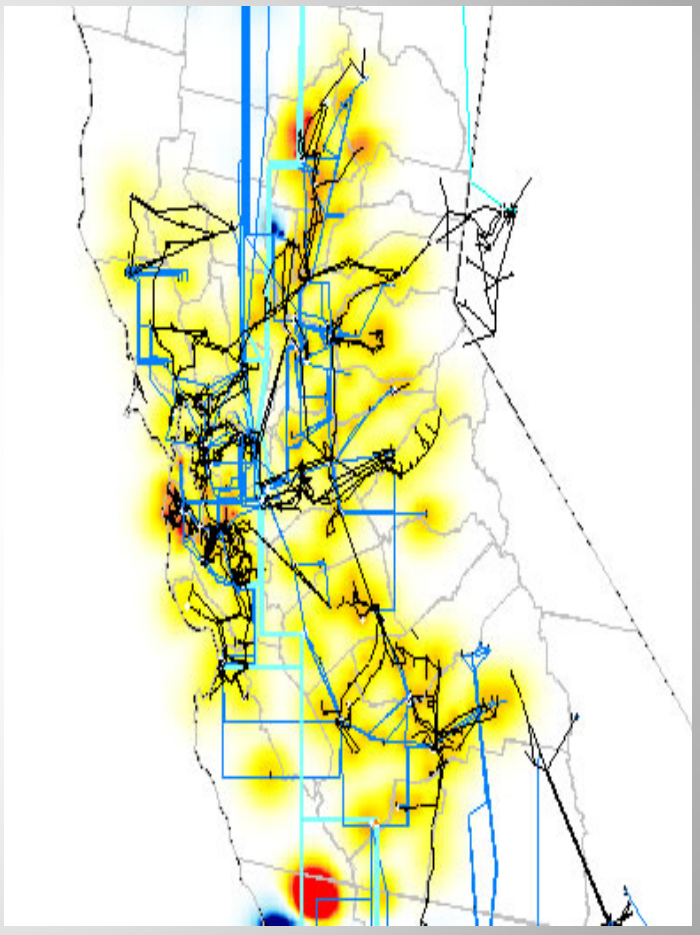

Example of Locational Value Map

Transmission Case with 1,000 MW of DG

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Task 3: Field Monitoring and Analysis

- Monitoring Equipment Installation
- Data Collection /Modeling Validation
- Simulation, testing and validation efforts to address grid impacts using Synergee and PowerWorld (e.g. voltage regulation, VAR Control, fault contribution, reverse power flows, etc)

Synergee model of Anatolia Subdivision

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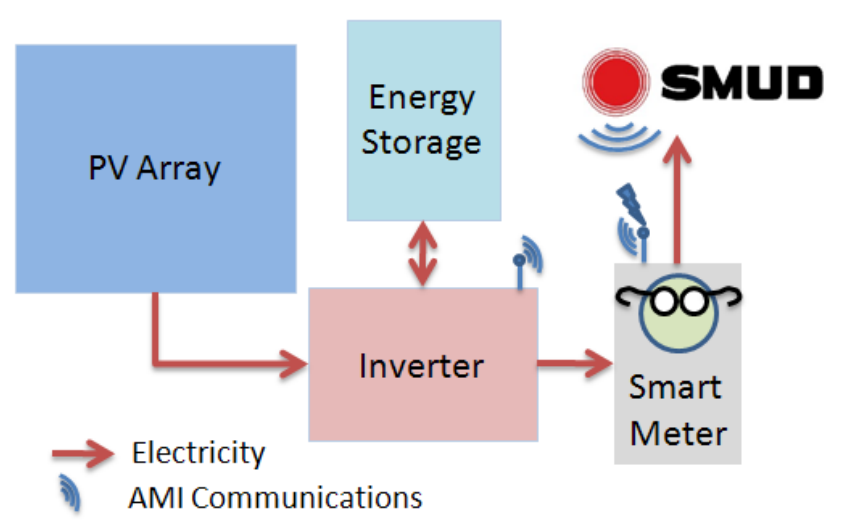
Task 3.3 Inverter Communications

- Demonstrate Inverter Monitoring via AMI communication from smart meter to inverter
- Demonstrate receiving data, querying for faults, sending control signals
- Utilized as actively controlled contributors versus passive devices on the grid



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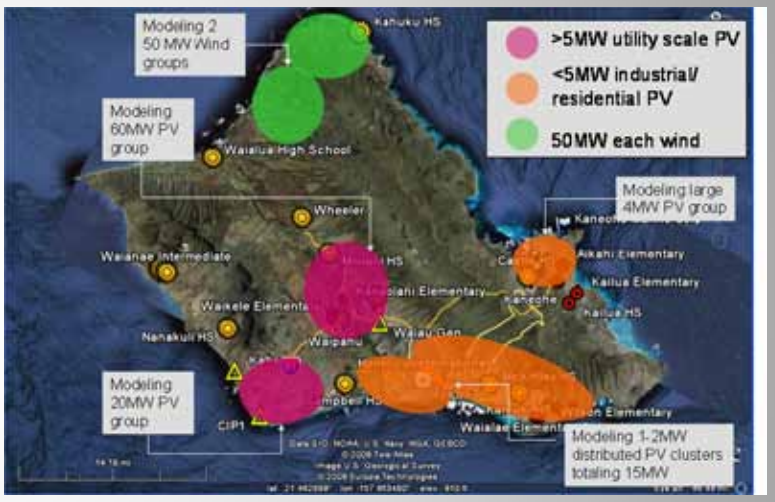
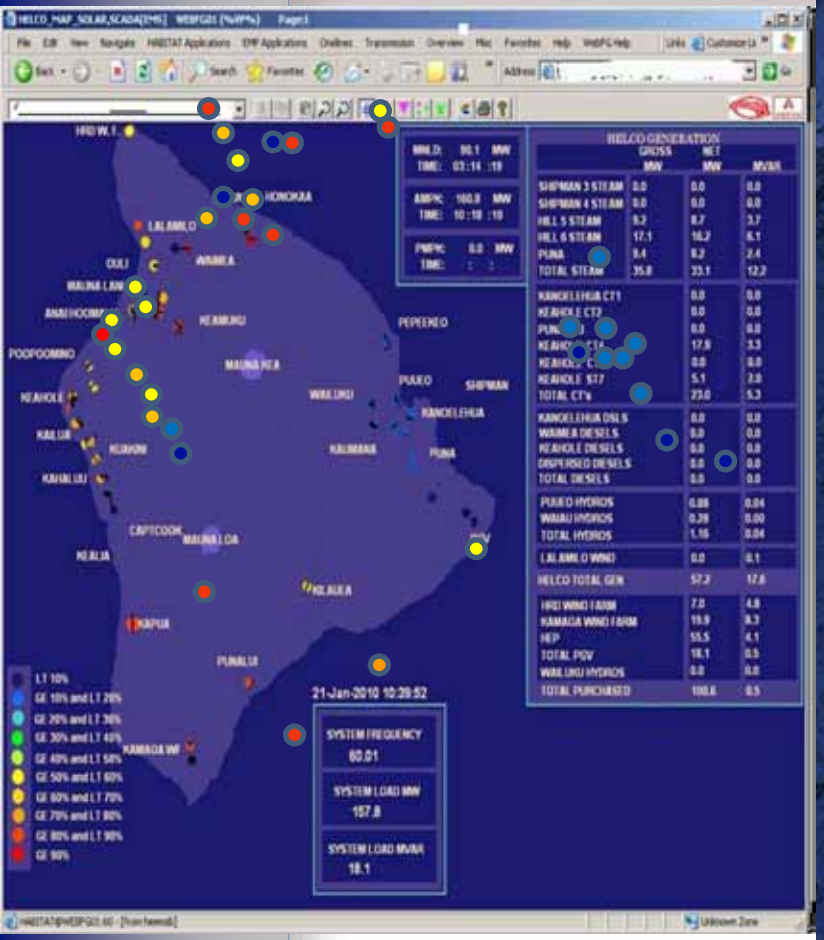
Task 4: High Penetration Solar/Wind Display Concept

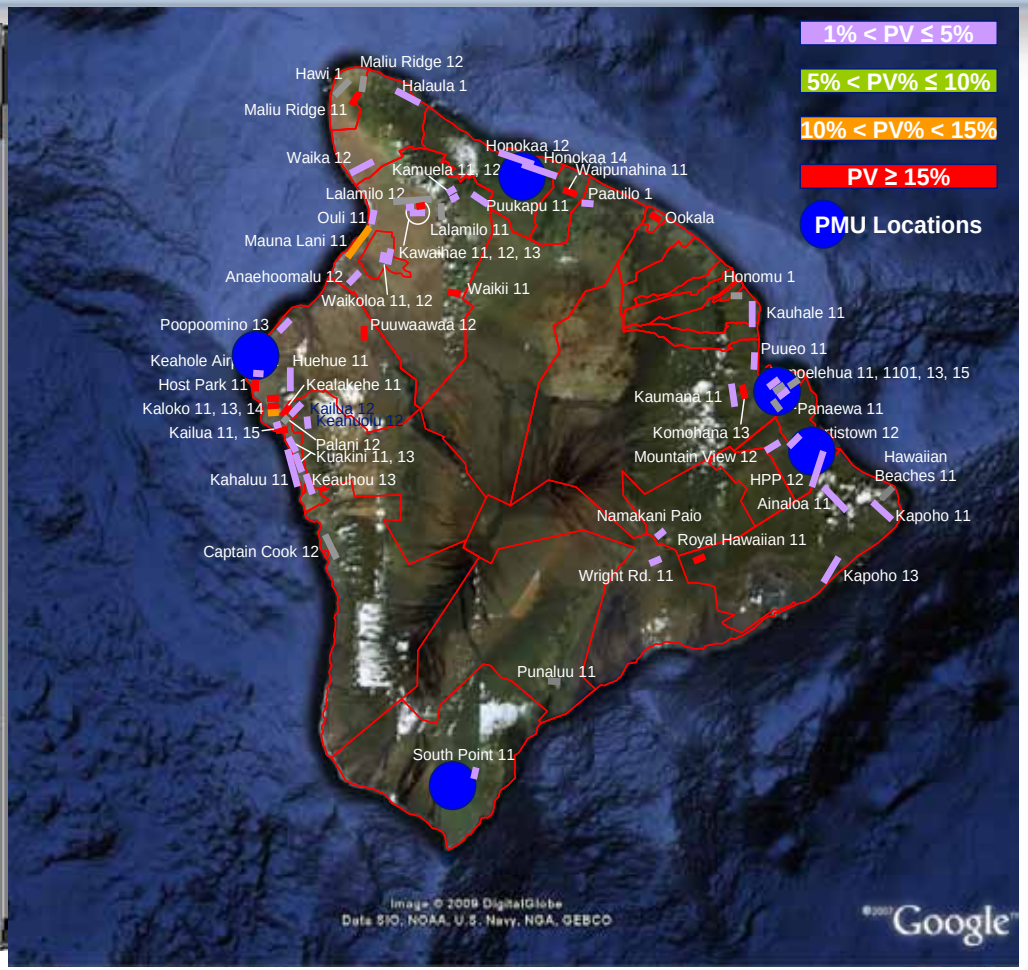
- Distribution System Modeling/Visualization (Synergee modeling integrated with Powerworld)
- Display Large Solar/Wind Generation
- Develop and pilot an operational display tool for grid operations



Hawaiian Electric Company, Inc.

HECO/HELCO/MECO Visualization & Data Monitoring





Ability to anticipate production on the system by linking solar resource information with installed capacity around the island

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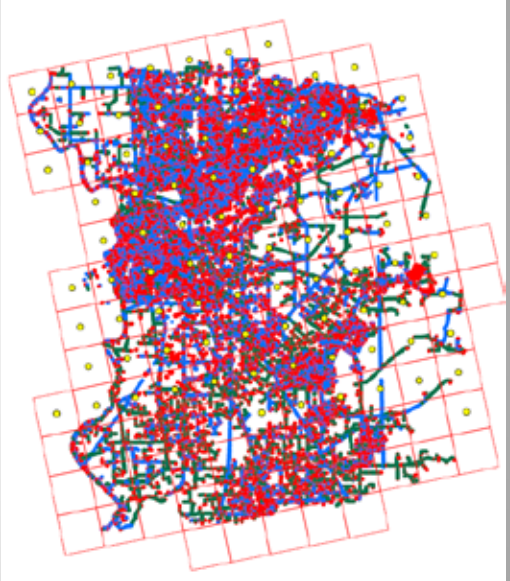
Task 5: Solar Resource Data Collection and Forecasting

- Deployment of Network of 70 Solar Irradiance monitors, cell modem data collection, 1 minute data
- Modeling/solar forecasting using NOAA weather forecasts, validated using ground network
- Assessment of resource variability across much of the service territory over the year
- Development of a forecasting tool for solar characterization and cloud impacts on system



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Progress to Date:

- SMUD selected as Grant Recipient
- March 11th, CPUC Resolution approved entering into grant agreements with grant recipient
- May 6th, SMUD Board Authorize on the General Manager to execute a funding agreement with the California Public Utilities Commission/Itron (CPUC) to implement the High Penetration PV Initiative Project
- June 10, 2010, effective date of the funding agreement
- Identifying cases (i.e. feeders, locations, characteristics etc.)
- Currently developing sub-agreements to implement project

Conclusion

- SMUD's Renewable portfolio is growing
- Understanding the impacts of variable renewable is necessary in order to sustain reliability
- Utilities need tools to understand the variability and uncertainties
- SMUD is searching for solutions

Thank You!

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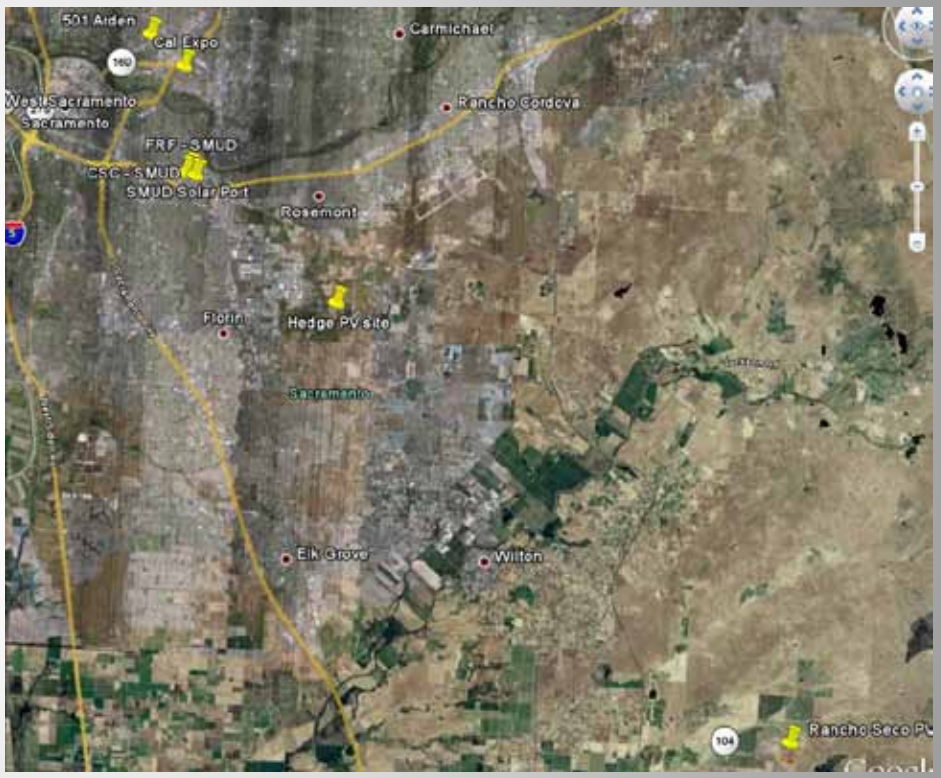

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