



BERKELEY-STANFORD

**CleanTech** Conference Series

# SMART GRID: VISION, OPPORTUNITY AND EFFECTIVENESS



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# Pacific Gas and Electric Company



- Energy services to 15 MM people:
  - 5.1 MM Electric accounts
  - 4.2 MM Natural Gas accounts
- 70,000 square miles with diverse topography
- 123,054 circuit miles electric distribution lines and 18,610 circuit miles of interconnected transmission lines
- Peak load: 22,554 MW on July 25, 2006
- A regulated investor-owned utility

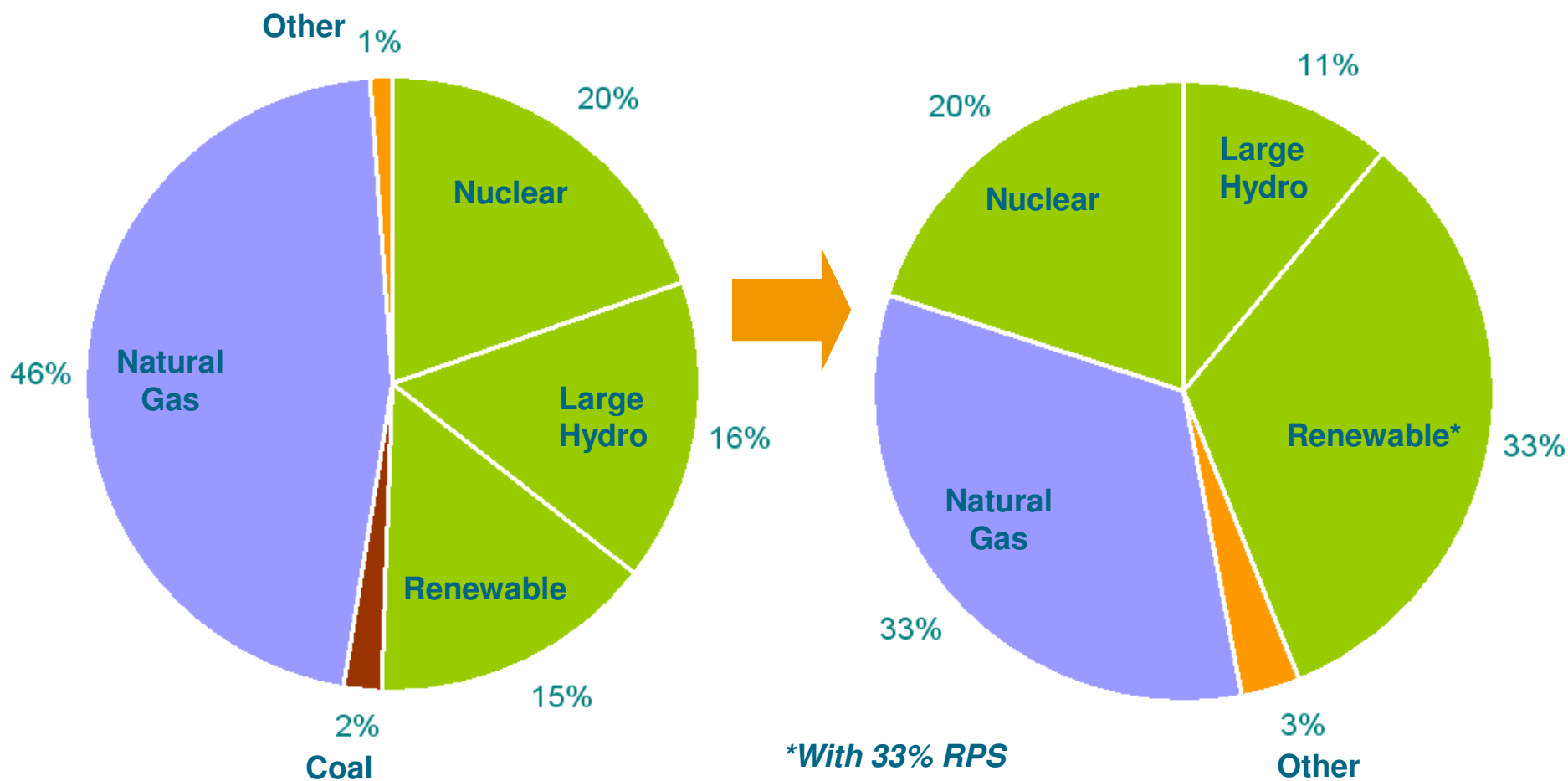


**Ranked the greenest utility in the United States**

# PG&E Projected Power Mix

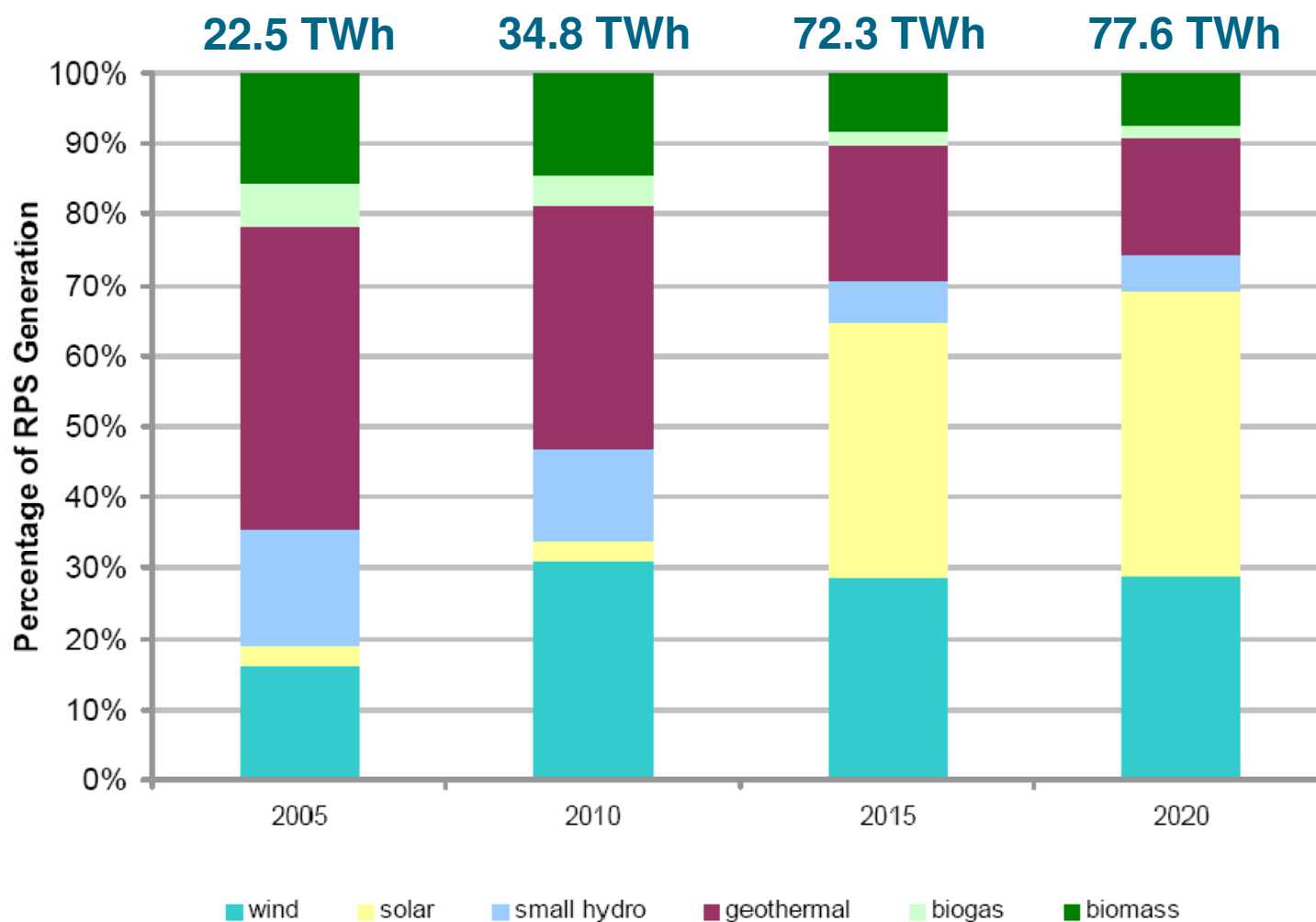
## 2009

## 2020





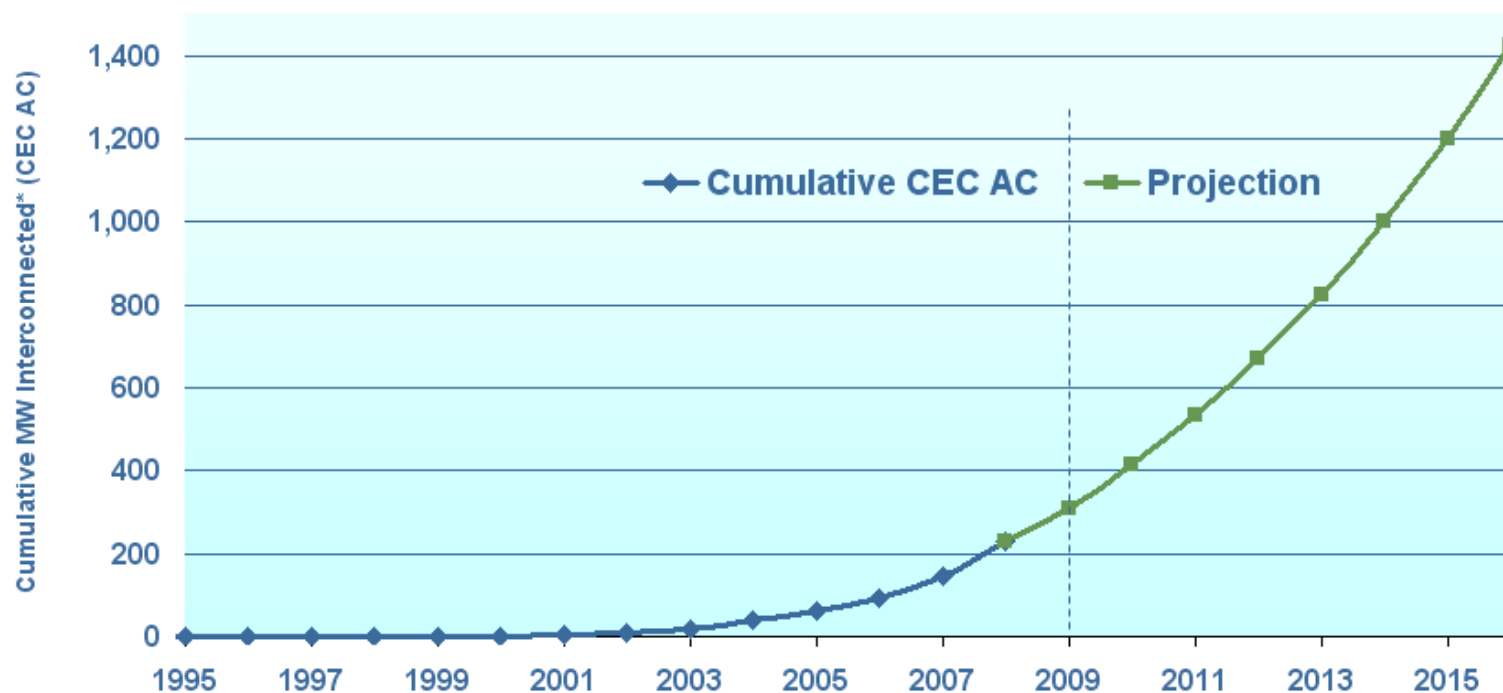
# Changing Mix of Renewable Resources



Source: California Public Utilities Commission, July 2009

# Distributed Generation Is Growing Rapidly

Cumulative Capacity of NEM (MW, CEC AC)  
Interconnected with PG&E Grid\*

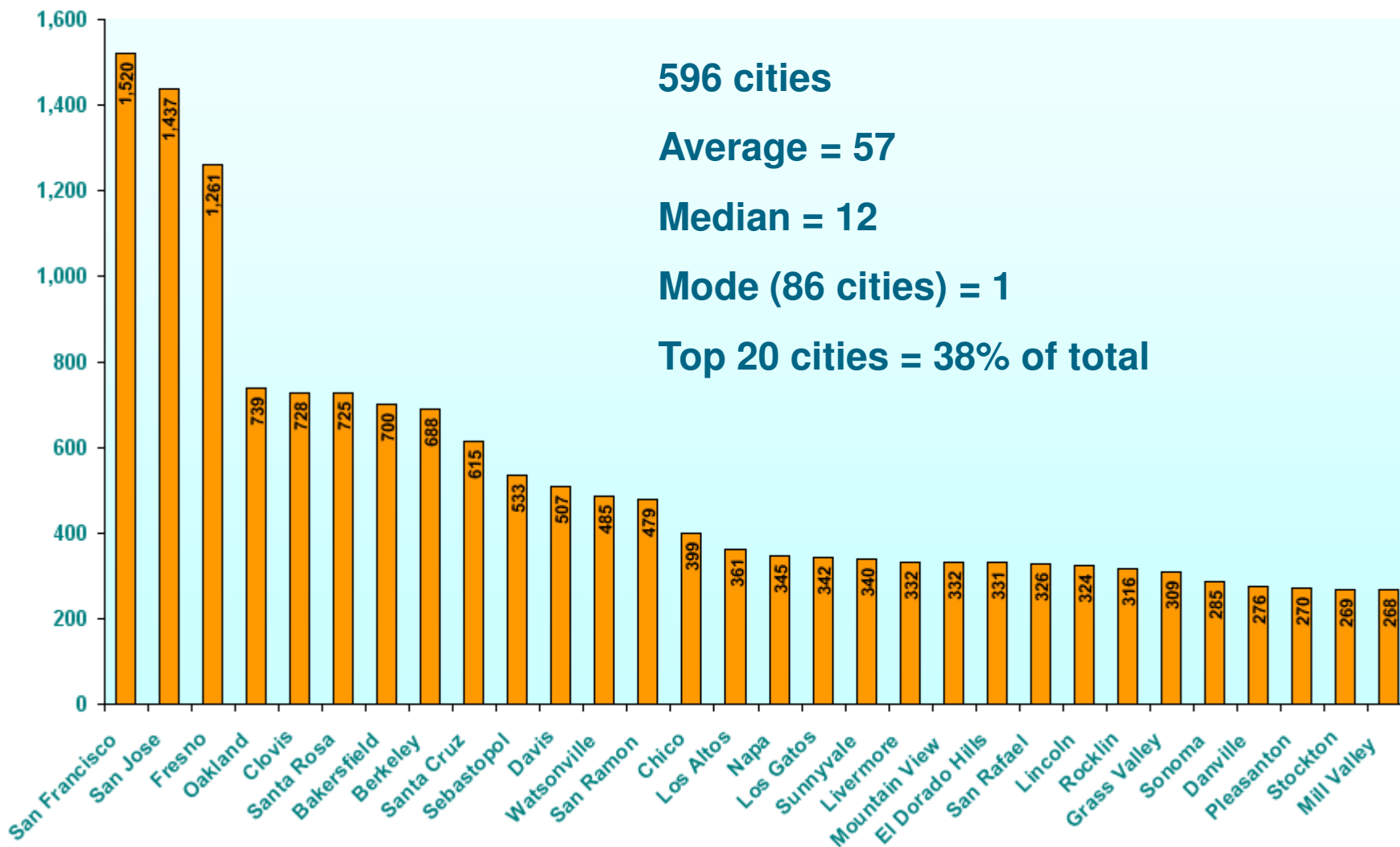


\* Includes all NEM projects (PV, W, MT); excludes Non-Export projects

40% of US solar PV interconnections are in PG&E's service territory

# PV Solar Is Concentrated

PV Interconnections by City

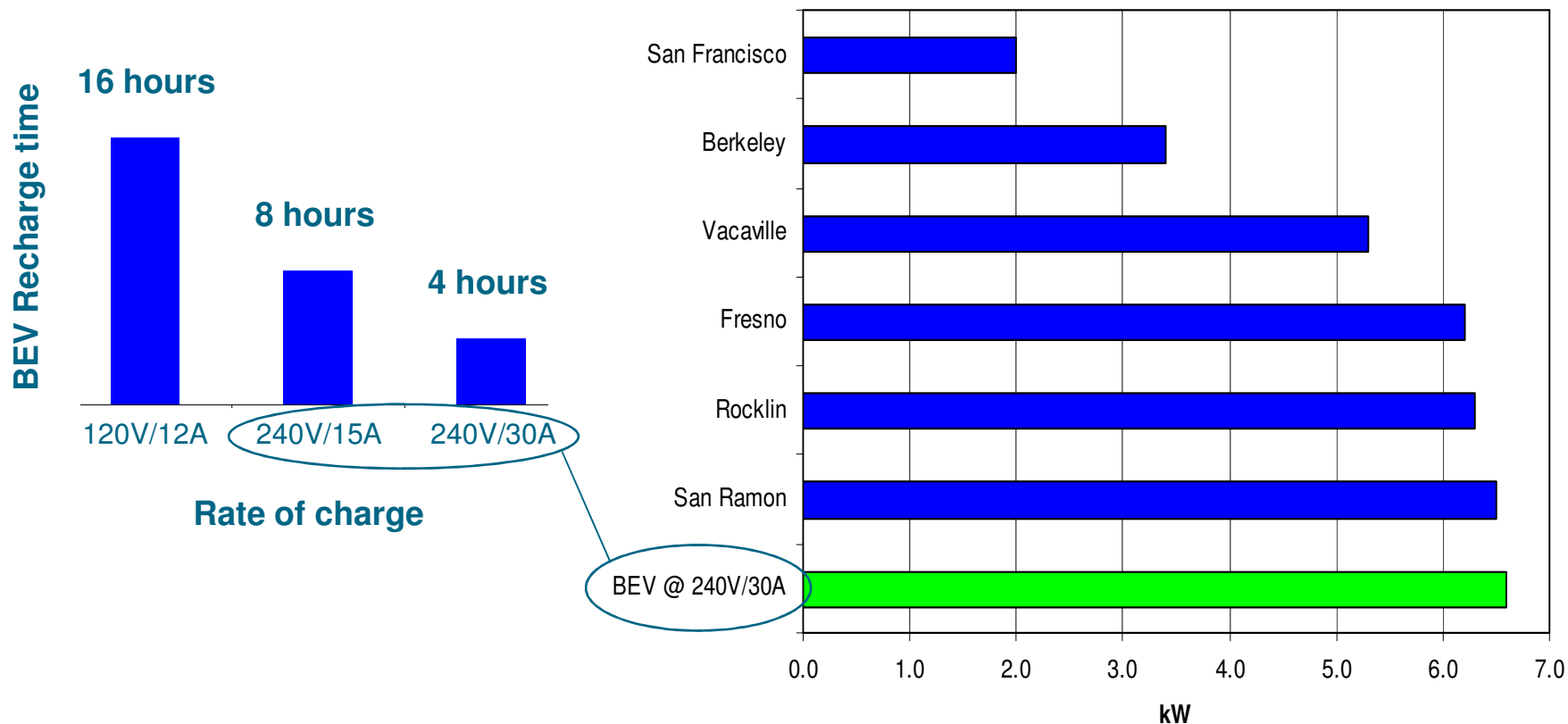


# PEV Charging Creates A Significant Increase In Load

Customers will prefer a 240V charge to shorten recharge times

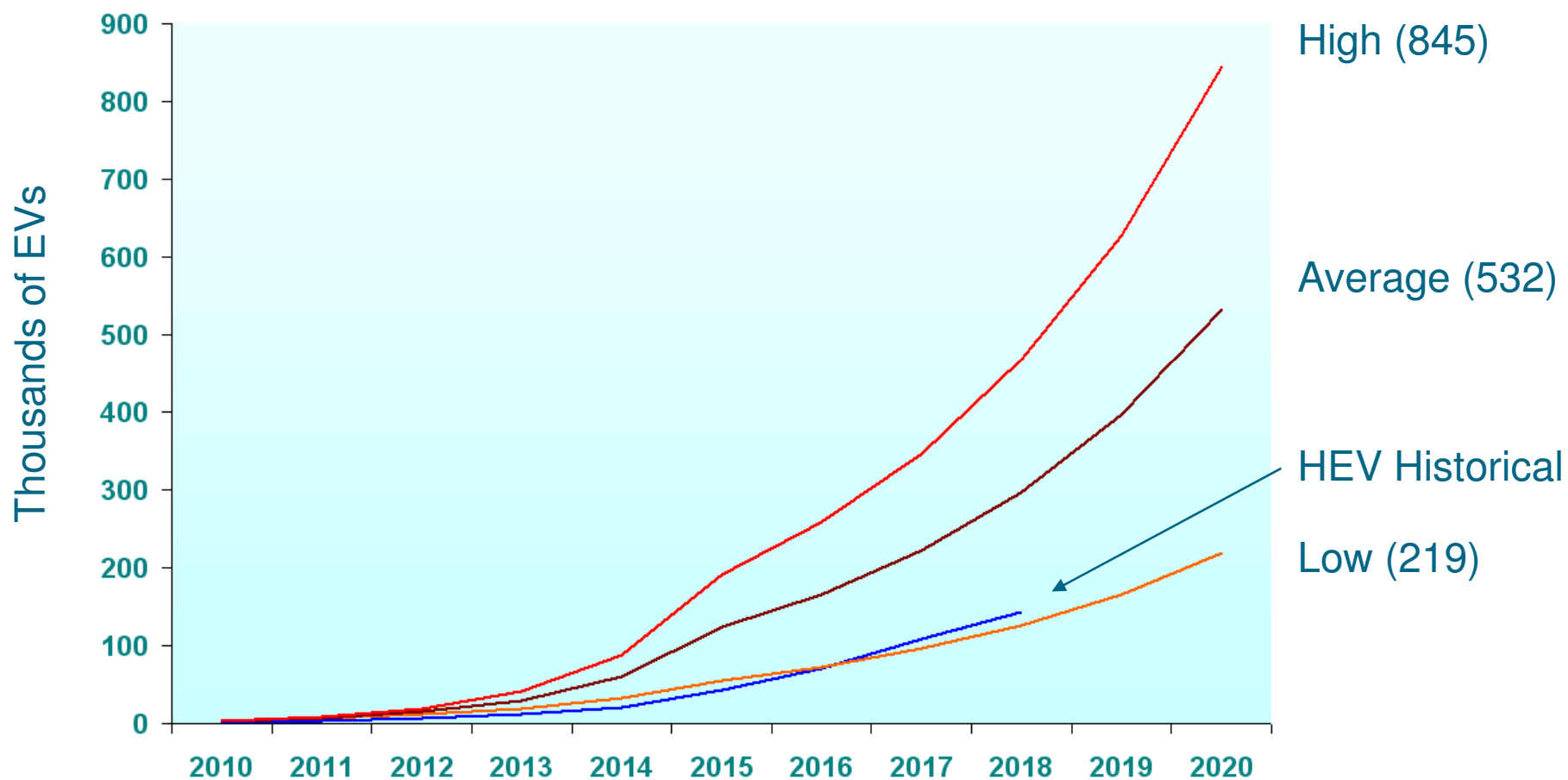


PEV charging is a large load for PG&E customers, comparable to average peak summer load of a single home





# Projected Electric Vehicle Growth

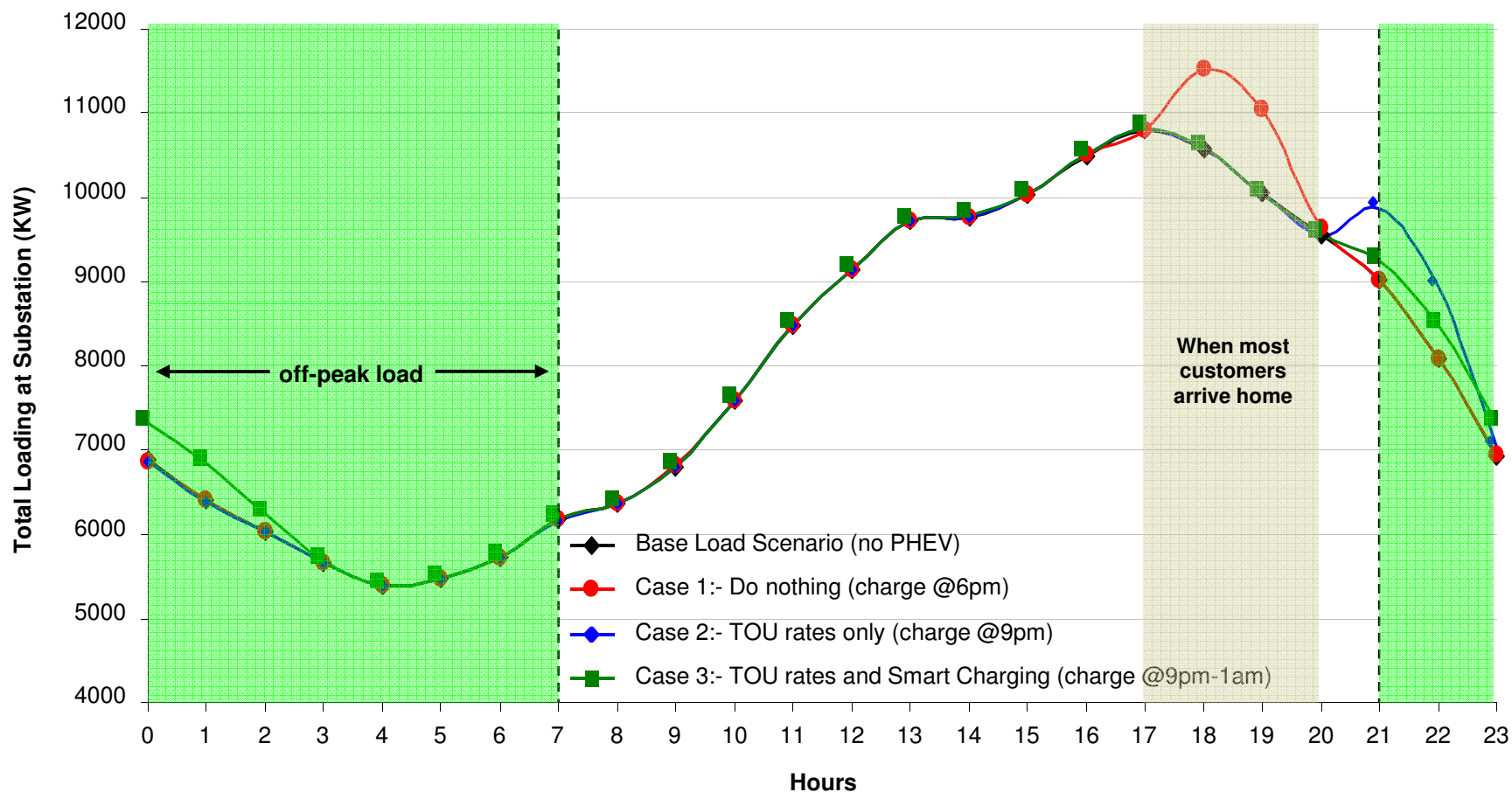


**Cumulative PG&E Service Territory PEV Market Adoption Scenarios**

\* Shifted 10 years forward

# Left Unmanaged, PEV load will add to peak electric demand

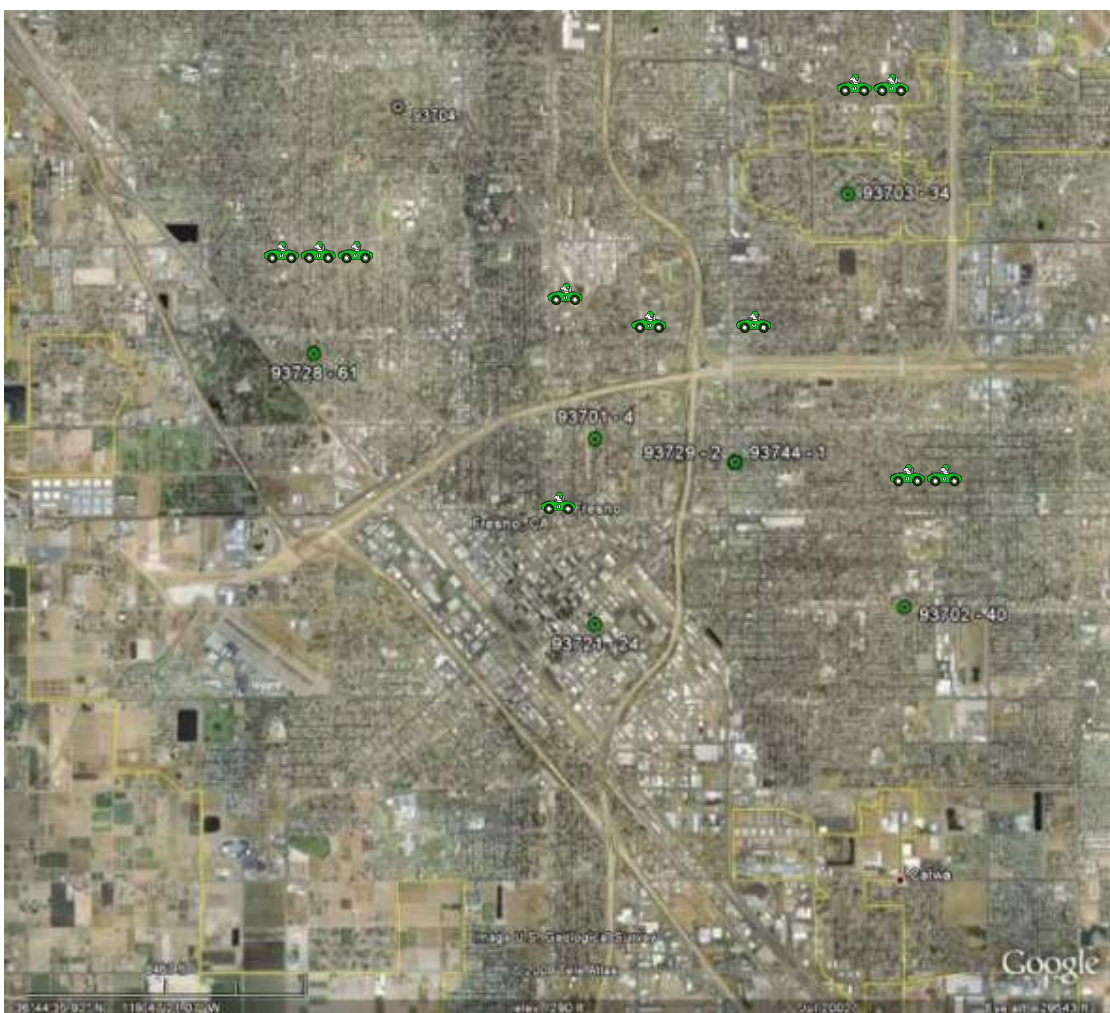
24 Hour Total Loading of Single Feeder - July 27, 2007



Source: EPRI.


Note: Feeder of Northeastern utility feeder during urban summer peak with 2,778 residential customers. PEV penetration = 10%. Case 1 – 3 charge @ 240V, 12A

# HEV density 2004 – 2008: A Tale of Two Cities



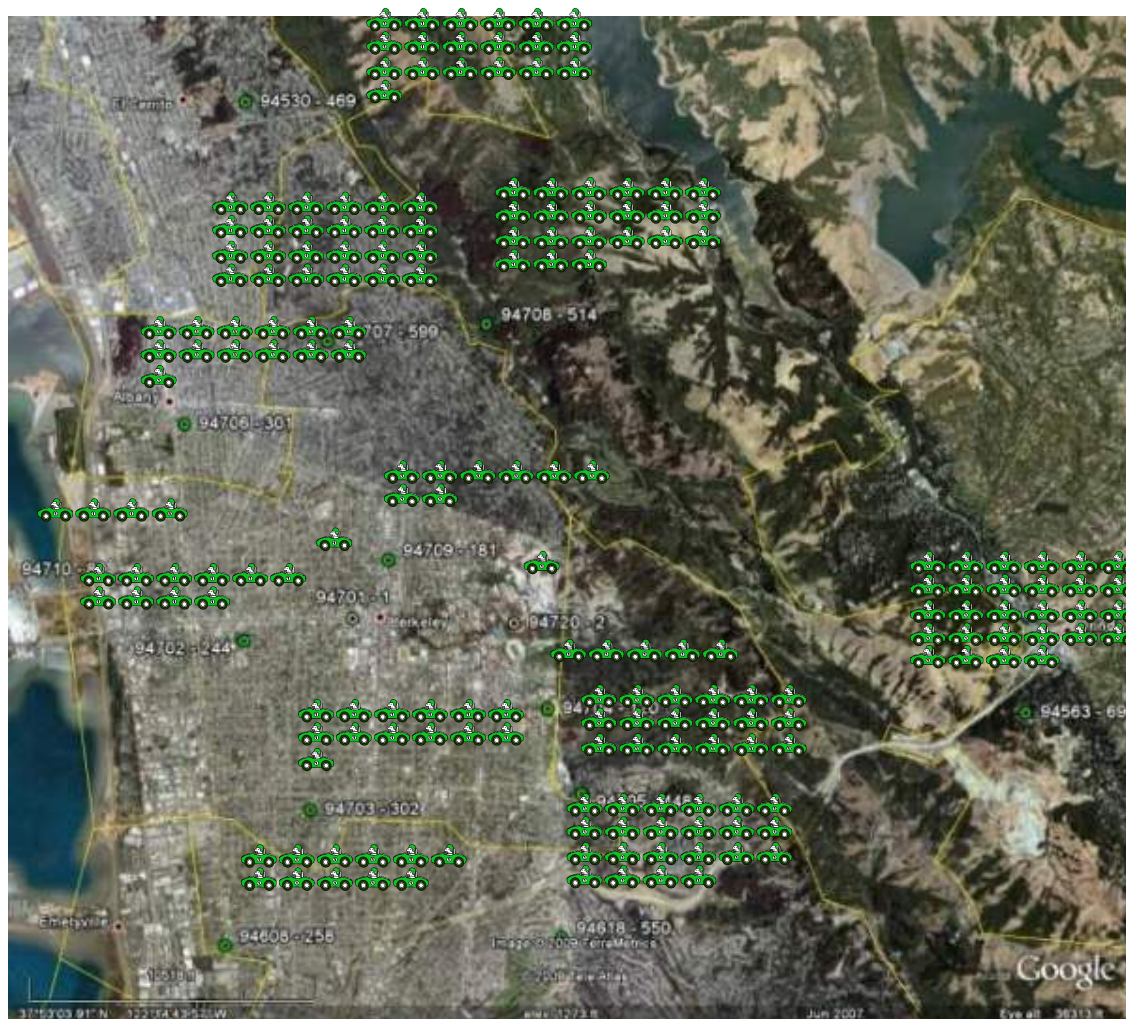
## Fresno CA:

- New registrations: 83K
- HEV registrations: 2K
- 2.4% new registrations HEVs
- HEV zip code median: 11

 = 25 HEVs

Source: Polk & Company, DMV new car registrations.

# Load Management Critical To Handle Secondary Distribution Impacts



## Berkeley CA:

- New registrations: 14K
- HEV registrations: 2.5K
- 18% new registrations HEVs
- HEV zip code median: 212

= 25 HEVs

Source: Polk & Company, DMV new car registrations.



# A Smart Grid

Overlay with intelligence and automation

**Sense**



**Communicate**



**Compute**



**Control**



**Power  
Plants**



**Transmission  
Networks**



**Substations**



**Distribution  
Networks**



**Consumers**

# Advanced SmartMeter™ Electric Meter

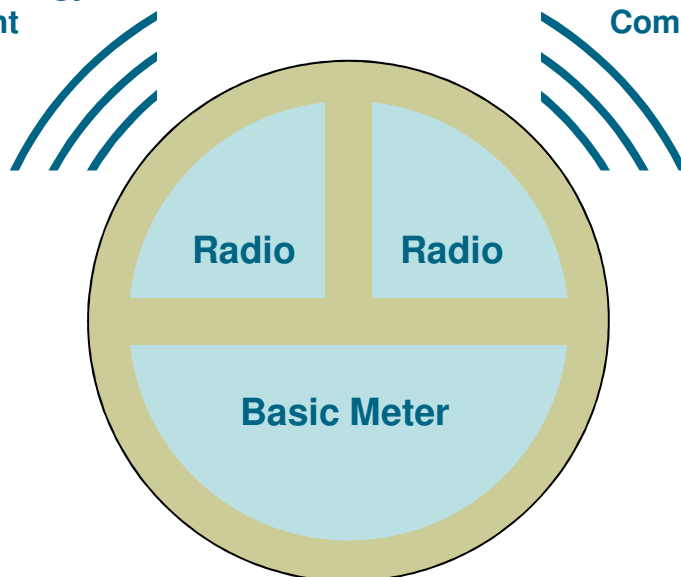


- Automated meter reading for all customers
- Frequent meter reads
- Platform for future innovations



Customer Energy Management Network

SmartMeter™ Communications Network



- Solid-state technology
- Integrated remote connect / disconnect, load-limiting switch
- Home Area Network (HAN) gateway

# Customer Benefits Today

## Online Energy Use Data

- Displays hourly electric use by day
- View data by billing cycle, month, or week
- Customer service reps can view graphs



## SmartRate pricing plan

- 10,000 voluntary participants in 2008; 30,000 in 2009
- **2008:** Across 9 called events, the average residential customer achieved a reduction of **16.6%**
- **2009:** 15 called events, 86% highly satisfied, 97% intend to continue on plan



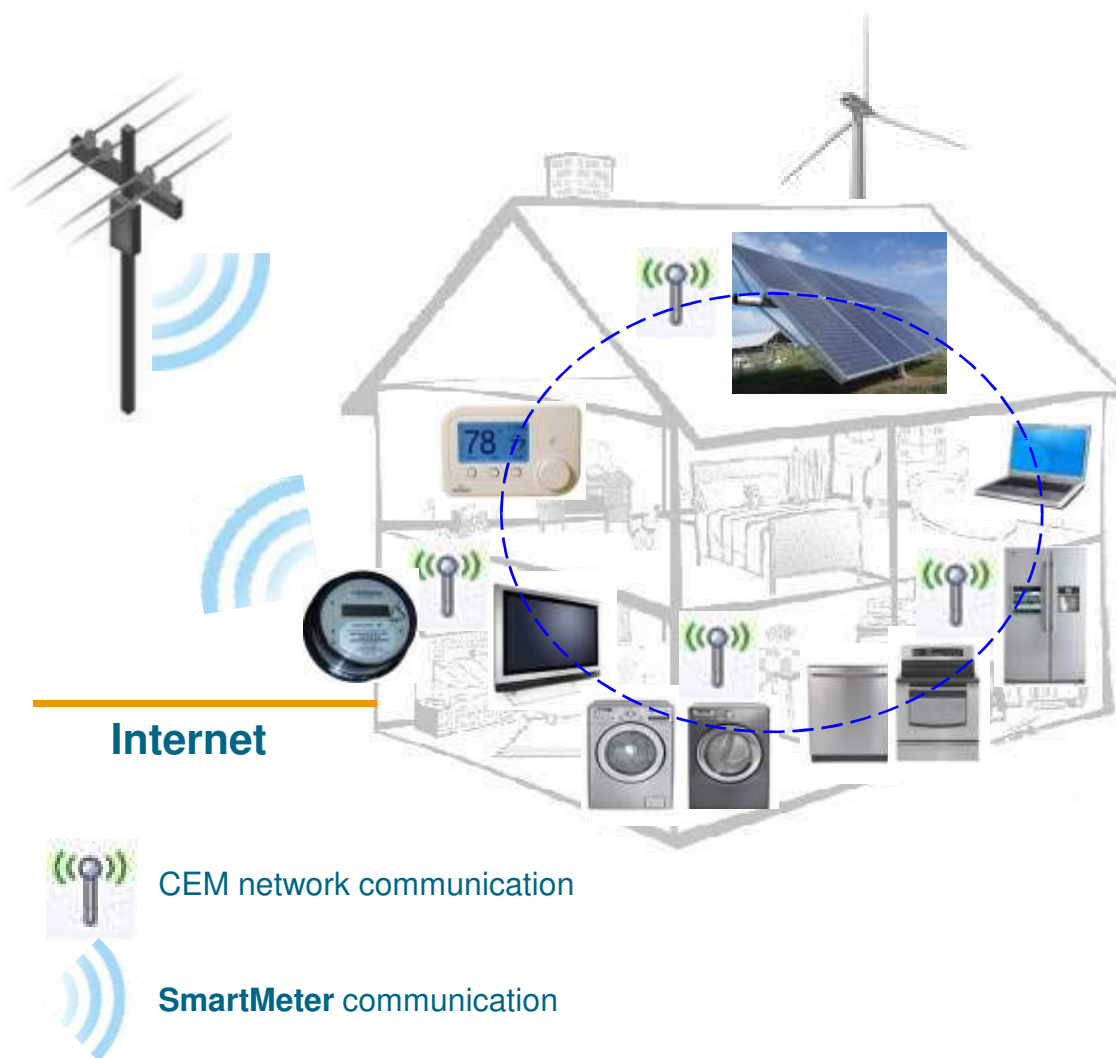
# Next Step: Customer Energy Management Pilot

## From meter to the home:

- Timely price signals
- Appliance / energy management control signals

## From meter to utility:

- Customer electric use
- Customer energy generation (e.g. solar)
- Appliance response to energy management control signals



# Serving New Loads: PG&E's Smart Charging Pilot

- **Test technical integration** of smart meter, HAN, smart port and electric vehicle
- **Validate ability to manage peak loads** using smart charging with plug-in electric vehicles
- **Explore customer behavior** using smart ports with time-of-use pricing, demand response and renewable generation



# Integrating Renewables: PG&E's Utility-scale Battery Pilot



The NAS battery installation at Tokyo Electric Power Co.'s Ohito Substation is rated at 6 MW/48 MWh

- 4 MW / 32 MWh sodium sulfur (NaS) battery
- Goal to improve reliability and power quality
- Test ability to provide ancillary services
  - Load-following
  - Frequency regulation
- Test ability to cost-effectively integrate intermittent renewable resources

# Leading Industry Work on Smart Grid Standards

- Required by Energy Independence and Security Act (EISA) of 2007
- Seeks a standard architecture to enable “plug and play” capability
- Create markets
- Industry-led effort coordinated by NIST and supported by EEI



**NIST**



**EDISON ELECTRIC  
INSTITUTE**

*The Association of Shareholder-Owned Electric Companies*

# Challenges On The Horizon

- Policy
- Technology
- Consumer Adoption

# At PG&E, We Are Committed To Sustainability

