

# Elevating our Transmission Operations

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i-PCGRID Workshop

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# Rapidly changing network structure requires more transmission and complicates regulatory choices.





# Emerging Trends & Drivers

## Improved Reliability

- Weather related outages alone cost the economy between \$18 and \$33 billion annually.
- DOE estimates all outages cost up to \$125 billion

## Renewables Integration

- Interconnecting generation facilities timely
- California's 33% renewables by 2020

## Micro-Grids

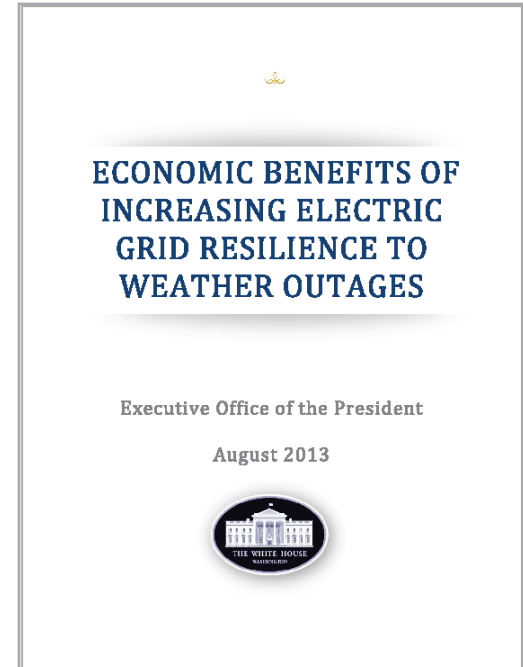
- Adding operational & integration complexity

## New Technologies

- Storage and other technological solutions require new approaches to integration

## FERC Order 1000

- Creates a competitive process for system improvements
- Requires an open planning process





# Emerging Trends & Drivers

## Grid Resiliency

- Cost of Major Outages
- Public Safety & Security
- Critical Cyber Asset Protection
- Geomagnetic Disturbances

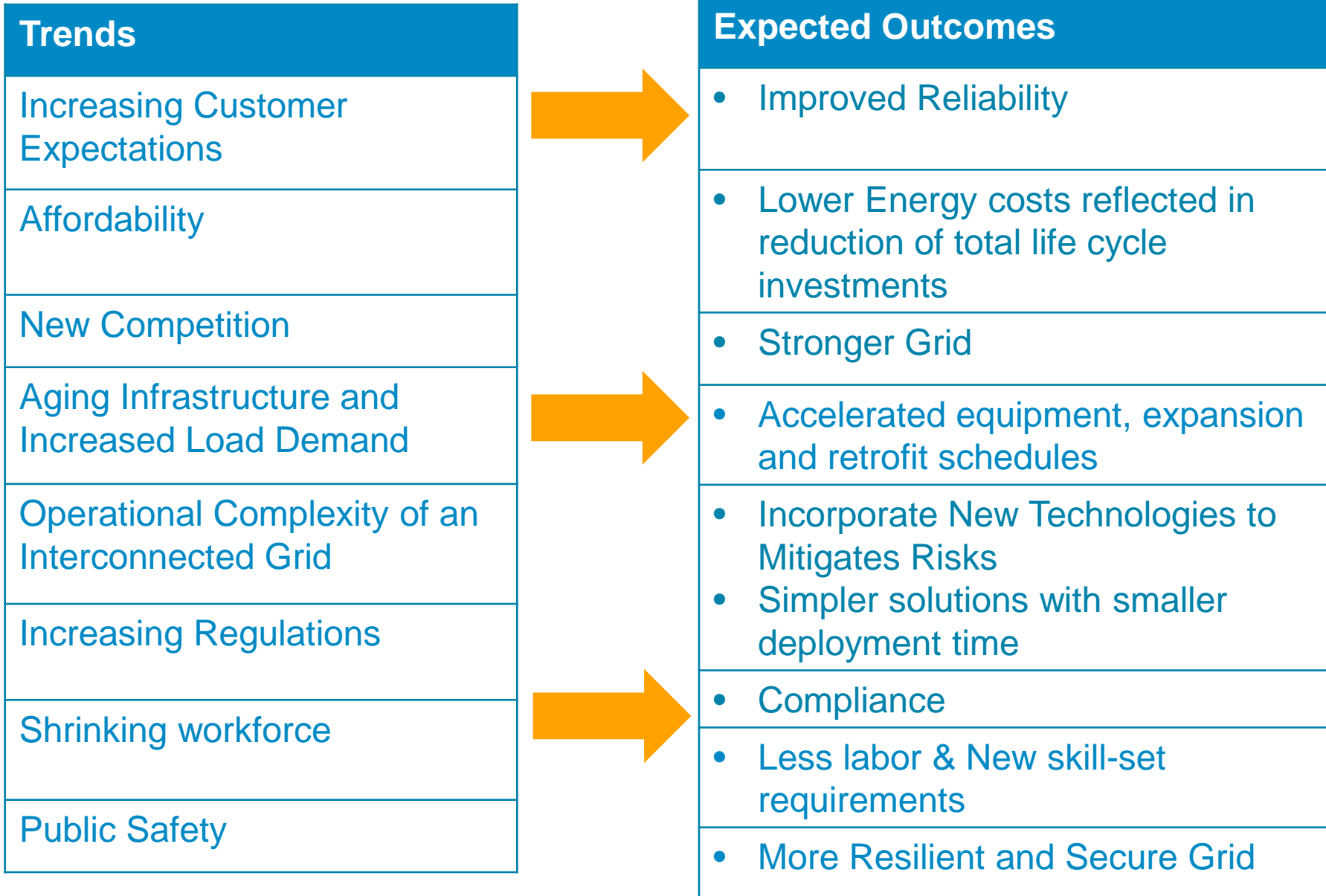
## Physical Vulnerability

- Security Assessment
- System Assessment
  - Selecting critical substations
- NERC Standard





# Trends & Expectations







# How PG&E is Meeting Customer Expectations

## Risk Based Asset Management

- Public Safety
- Risk based Investment
- Real-time asset management

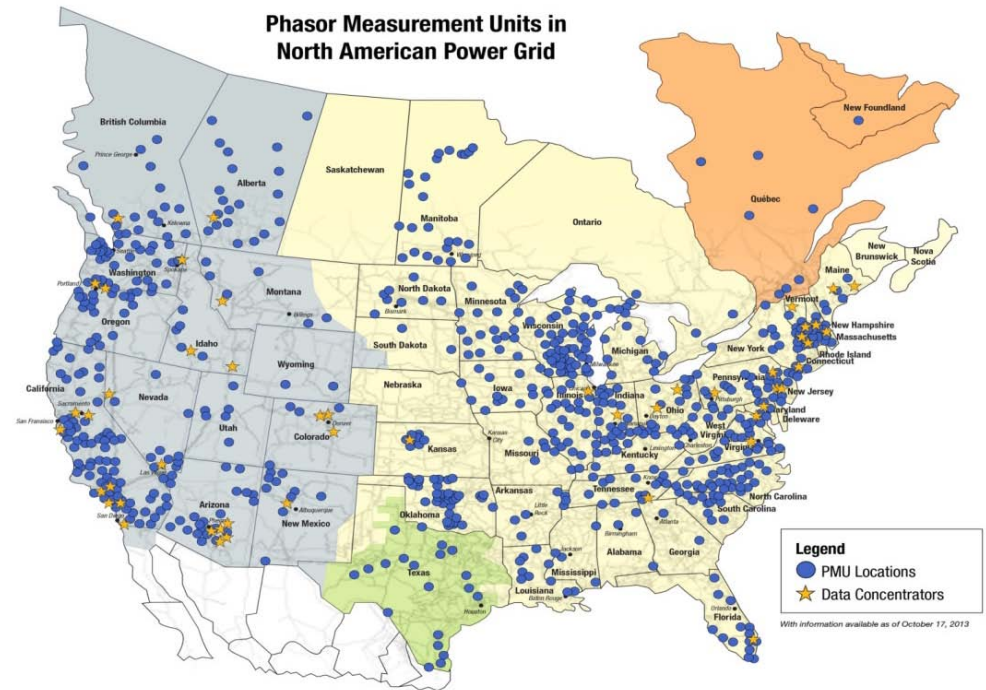
## Grid Modernization

## Disaster Recovery

- Remedial Action Schemes
- System Integrity Protection Systems (SIPS)

## Wide Area Monitoring, Protection, and Control

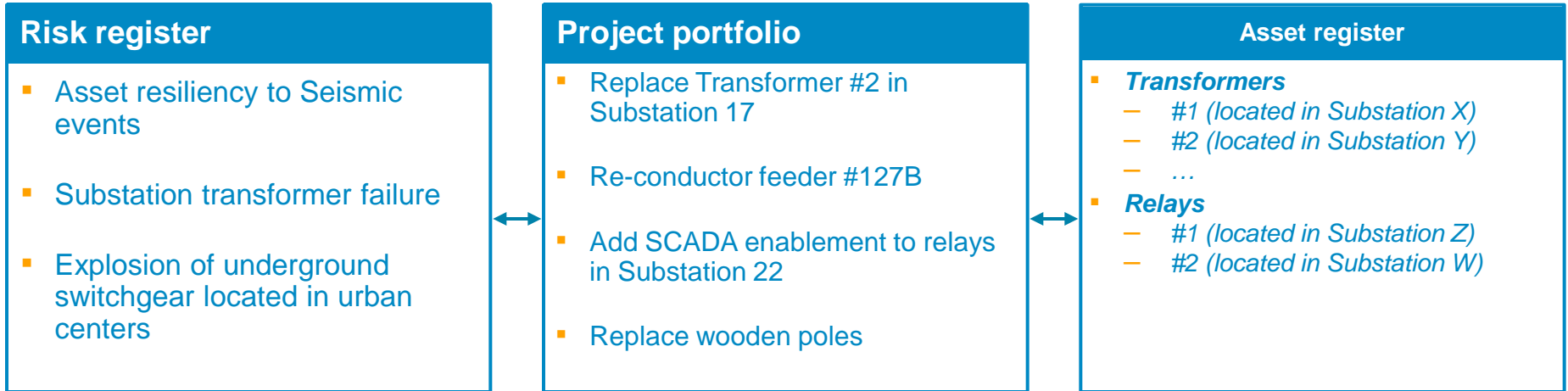
- Synchrophasor Technology
- Geomagnetic Disturbances





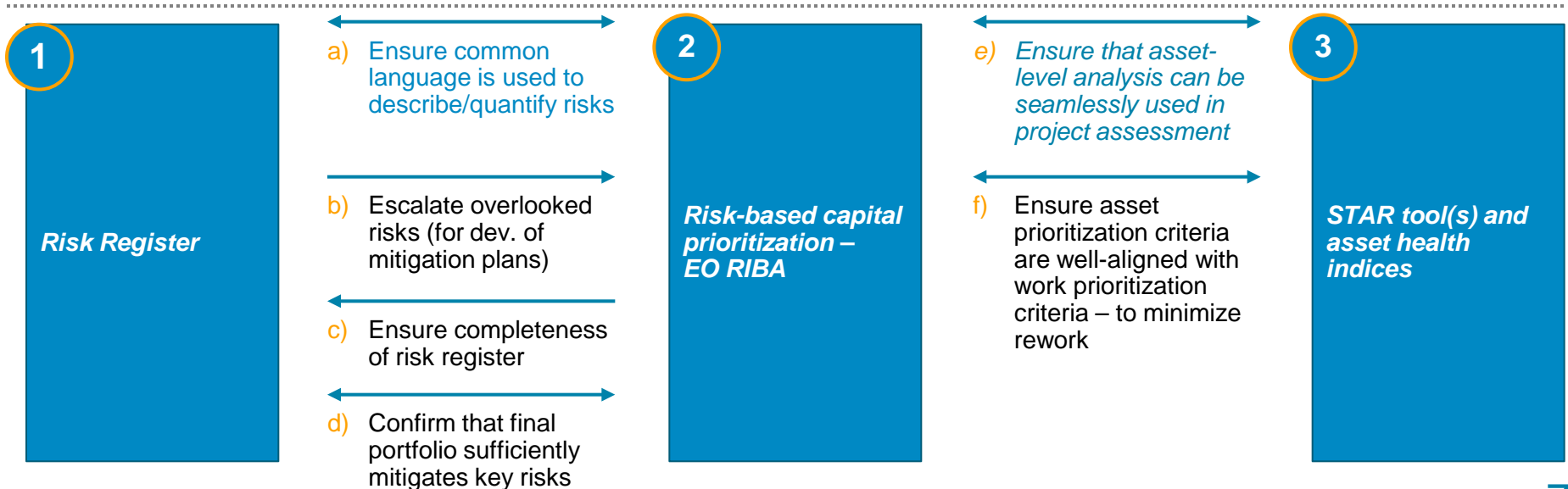
# Risk and Asset Management

■ Risk initiatives  
↔ Coordination points



Session D

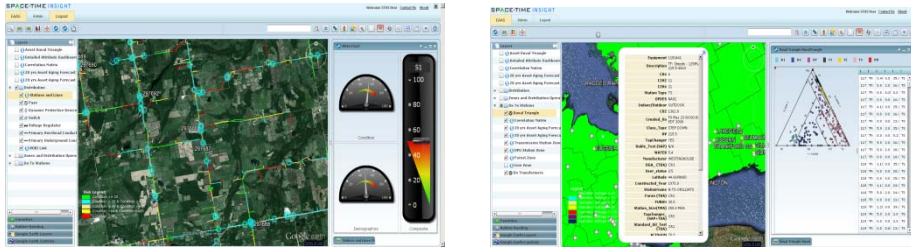
S1/S2





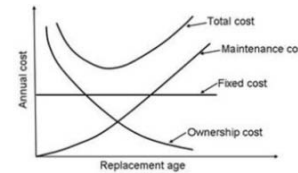
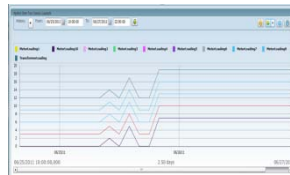
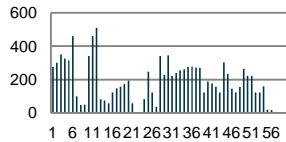
# Risk Mgmt. Conceptual Architecture

Analytics is comprised of multiple layers of data sources, calculations, reports, and visualization layers to serve up information in a meaningful way



Visualization, Analytics, and Dashboards

Circuit Breaker Demographics



Reports, and Data Delivery Environment

$$x^T \beta = \beta_0 + x_1 \beta_1 + \dots + x_n \beta_n$$
$$x^T \beta = \beta_0 + x_1 \beta_1 + x_1^2 \beta_{11} + x_1 x_2 \beta_{12} \dots + x_n \beta_n + x_n^2 \beta_{n1}$$

Category	Value	Color
Category 1	1,000	Red
Category 2	2,000	Red
Category 3	3,000	Red
Category 4	4,000	Red
Category 5	5,000	Red
Category 6	6,000	Red
Category 7	7,000	Red
Category 8	8,000	Red
Category 9	9,000	Red
Category 10	10,000	Red
Category 11	11,000	Red
Category 12	12,000	Red
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Category 43	43,000	Red
Category 44	44,000	Red
Category 45	45,000	Red
Category 46	46,000	Red
Category 47	47,000	Red
Category 48	48,000	Red
Category 49	49,000	Red
Category 50	50,000	Red

Algorithms, calculations, and asset risk factor development



Structured and Unstructured Data Sources






# Risk Based Model – STAR Tool (System Tool for Asset Risk)


## Indicators/Score for Selected Asset

**Probability of Failure = XX**  
**Failure Indicators**



Condition      Demographics

**Severity = XX**  
**Severity Indicators**



Public Safety      Reliability      Environmental

**Risk Score =**  
**XX**



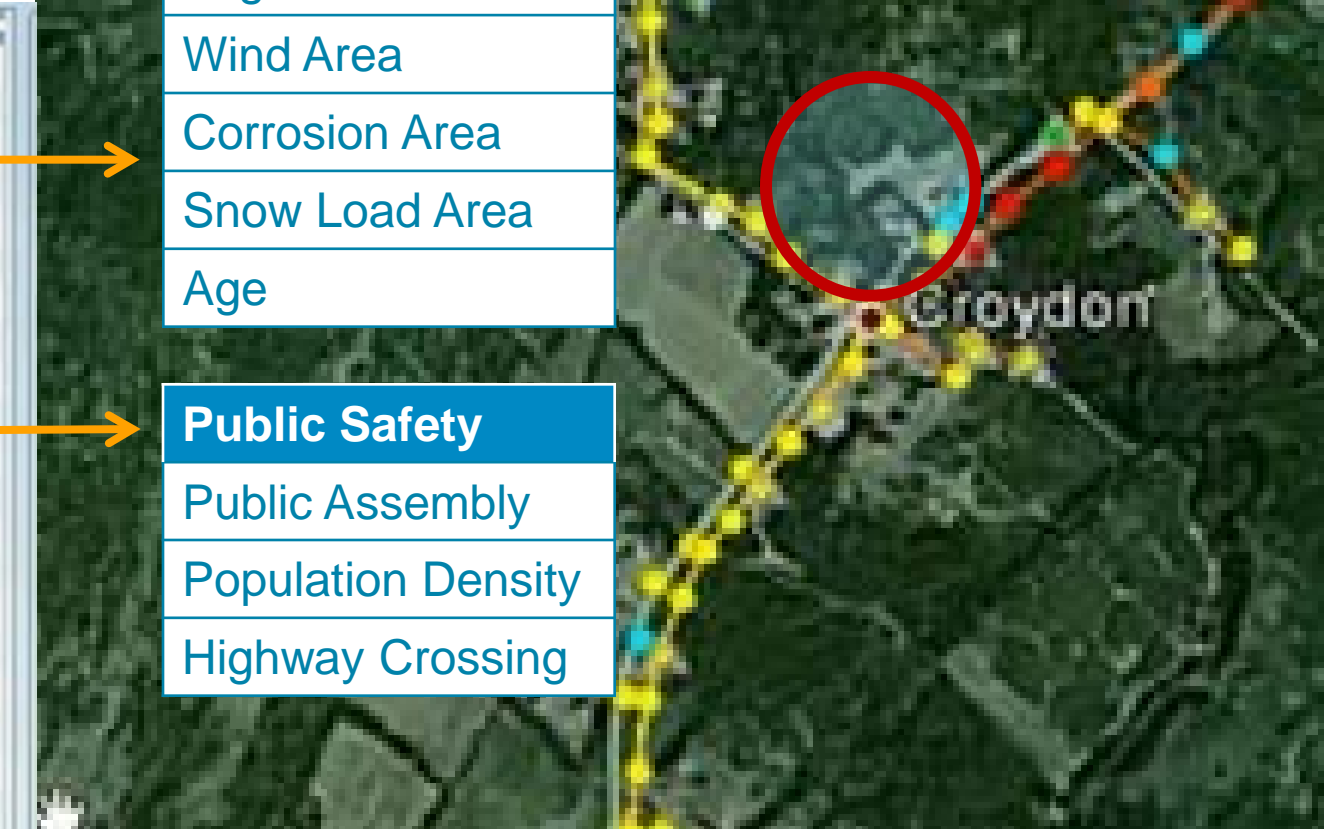
Composite

### Demographics

- Vegetation Area
- Wind Area
- Corrosion Area
- Snow Load Area
- Age

### Public Safety

- Public Assembly
- Population Density
- Highway Crossing





# GRID Modernization Roadmap

## Action Plan

- Goals & Benchmarks
- Knowledge of Complexities of Grid System Reliability Goals
- Life-cycle management, asset utilization, & interoperability Considerations
- Sustainability Program
- Risk-based Investment Model

## Success Stories

- Strategic Industry Partnerships
- Multiple dimension Testing and Modeling
- Modular Protection Automation Buildings
- EMS Upgrade
- PMU Program
- Effective Training Programs
- Development of Industry Standards
- Infrastructure Revitalization

## Result: A Superior Grid

- Energy Flow Management
- Control Centers w/ Premier Technical Visualization Tools
- Automated Fault Detection, Islanding & Self Healing for Reliability in Grid Network System

## FOUNDATION

- Leadership Strategies and Action Plan
- Standardization in Design to ensure compliance
- Disaster Recovery Programs
- Innovative Programs – Develop Prototypes, Testing & System Modeling
- Industry Partnerships & Teamwork

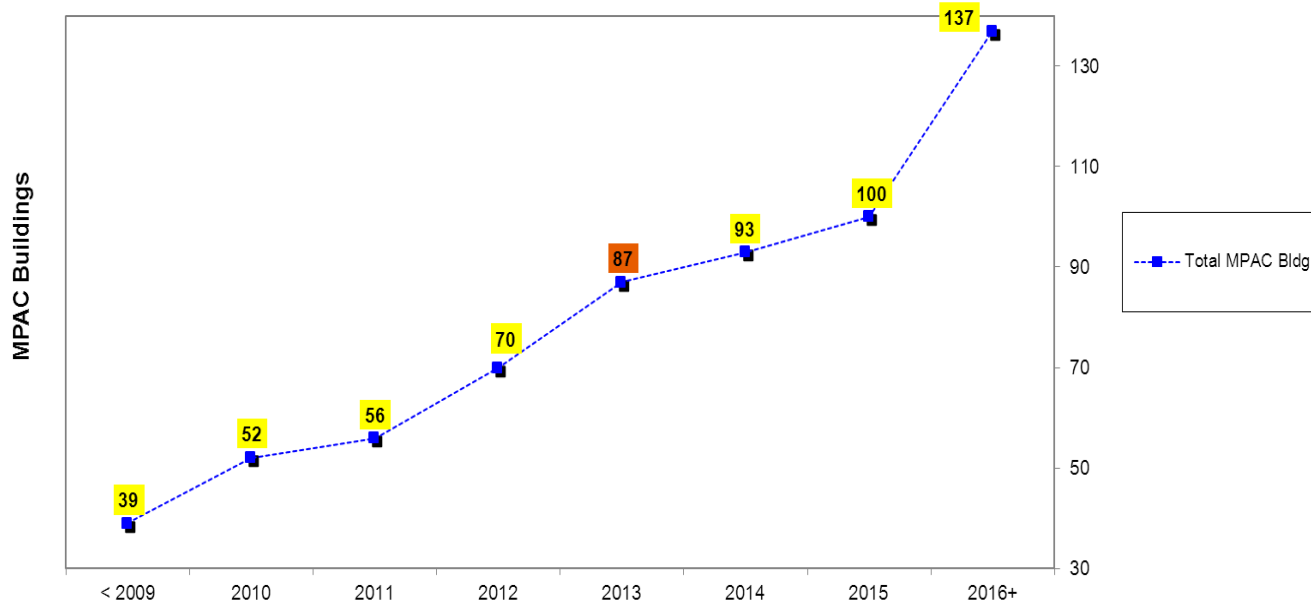




# Standards & Modernization Modular Protection & Automation Buildings

MPAC Buildings Completed & Forecast

Data: Mar 2014

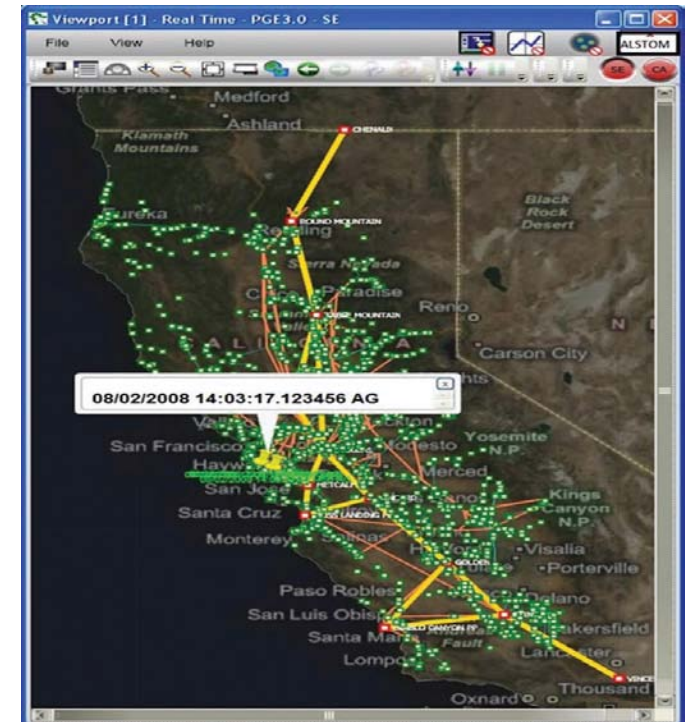


- 1) EOY 2013: 87 MPAC buildings have been placed in service at PG&E. (64% of total installed MPAC buildings)
- 2) 2014-2016+: Forecasted to place 50 MPAC buildings in service at PG&E.



# Industry Leadership - Synchrophasors

- Situational Awareness, Visualization, and Alarming
- System restoration
- Enhanced EMS
- Real-time Voltage Instability Management
- Linear and Distributed State Estimation
- Post-Disturbance Event Analysis for Planners and Engineers
- Operator and Engineering Training, Dispatch Training Simulator
- Proof of Concept (POC) Facility



# Q&A





# Thank You

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