Guest Speaker Series -2

SMART GRID

by

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HOWARD UNIVERSITY
1867

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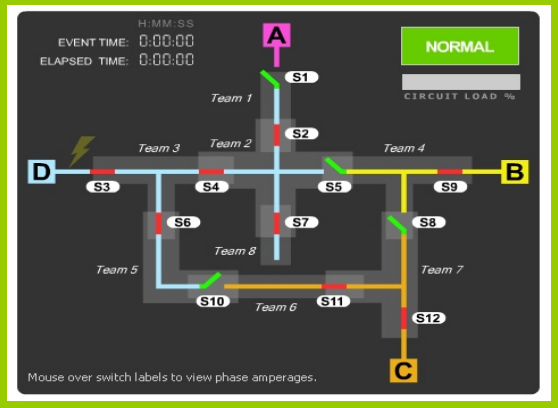
Smart Grid?

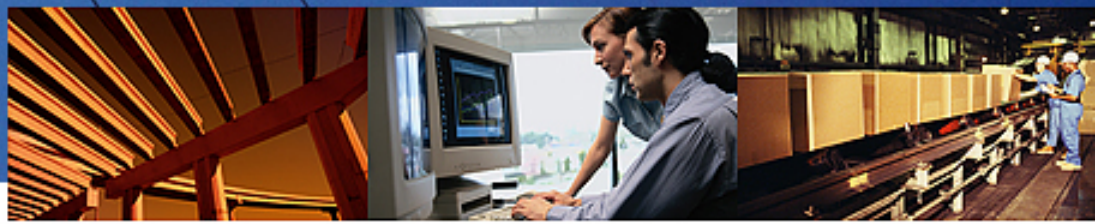
Who Wants a Dumb Grid?

And Who Doesn't Want a

Smart Green Grid℠ ?



Yesterday



- Hand or type written operating orders
- Folders and file cabinets as filing systems
- Mainframe computer system and applications
- No outage management system
- Manual tools and systems

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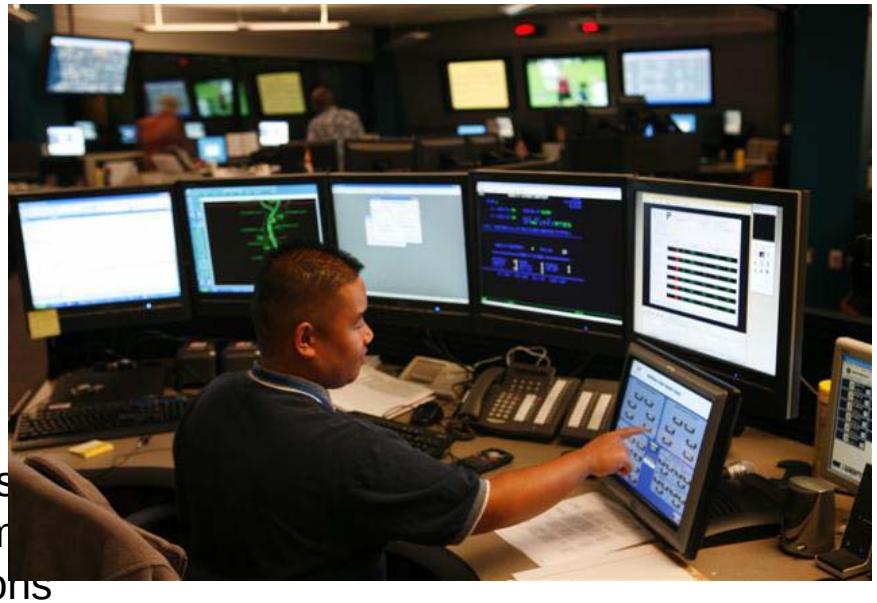
Today

- Advancing the modern grid
  - Outage management system
  - Field Force Automation
  - Discrete data warehouses
  - Automation
    - T&D SCADA
- Leading the modern grid efforts
  - STATCOM
  - Advanced conductor R&D
  - Real-time ratings R&D
  - DER incorporation in the planning proces
  - Advanced metering infrastructure implem
  - Broadband over power line demonstrations
  - Feeder automation switching trials
  - OPEX 20/20
  - Microgrid R&D
- IBM Nomination for “Outstanding Leadership in Advancement of a Smart Grid“
- Lobbying for DOE Smart Grid regional demonstration area



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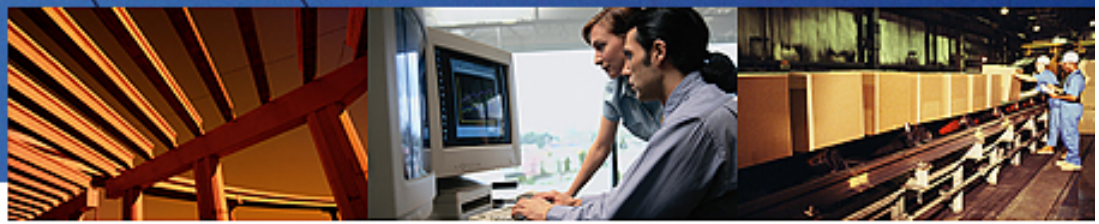
Vision



- Electric grid evolves to incorporate advances in information technology, communication systems and new technologies
  - Ubiquitous communications backbone
    - Distributed sensors
    - New and/or automated control methodologies
    - Real-time ratings
  - New technologies
    - Alternative system designs
    - Distributed Energy Resources
    - Predictive and condition based maintenance
  - Information technology
    - Asset optimization
    - Operational excellence
    - Customer participation

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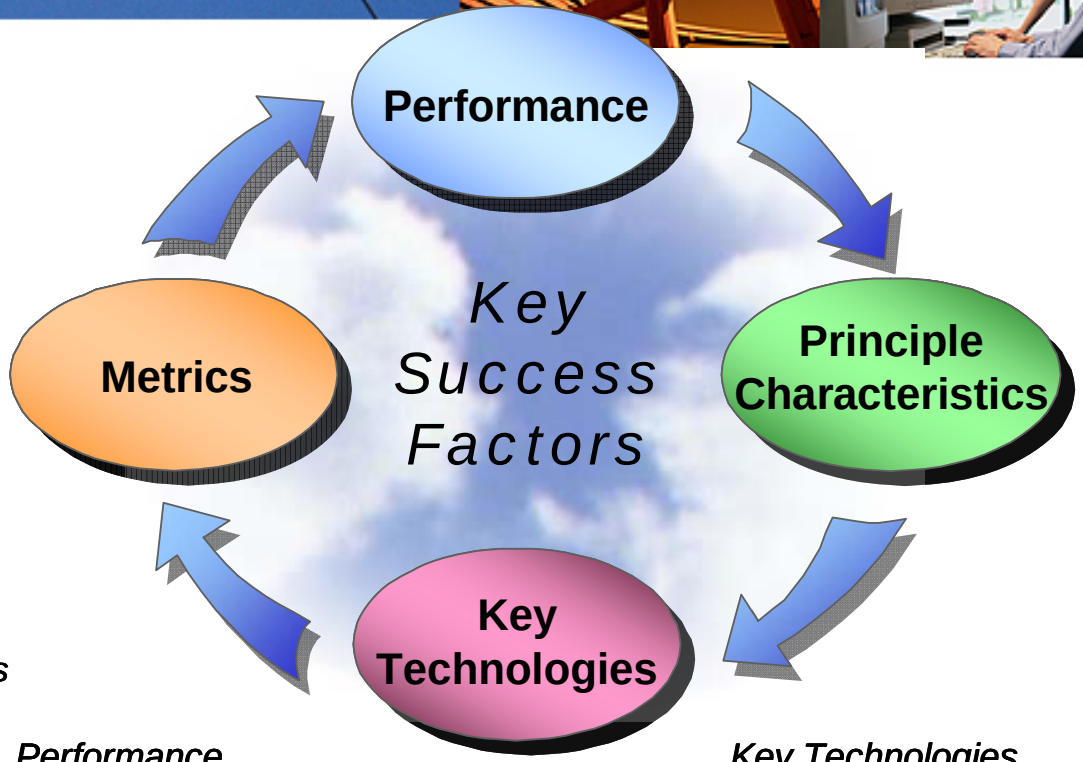
Modern Grid Initiative



Key Success Factors

Reliability
Security
Economics
Power quality
Efficiency and environmental quality
Safety

Performance

Emergency
Restoration
Routine Operations
Optimization
Systems
Planning

Principle Characteristics

Self-healing
Empowers and incorporates the consumer
Tolerates security attack
Provides 21st century power quality
Accommodates a wide variety of generation options
Fully enables electricity markets
Optimizes asset use; minimizes O&M expenses

Key Technologies

Integrated communications
Advanced control methodologies
Sensing, metering, and measurement
Advanced grid components
Decision support and human interfaces

Metrics

Congestion costs
Blackout probability
SAIFI
Restoration time
CAIDI
Peak-to-average load ratio
Capacity utilization

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The Smart Green Grid Overview

Business Concept

- To modernize the grid that will:
  - Anticipate & respond to system disturbances (self-heal)
  - Accommodate all generation and storage options including renewables
  - Enable active participation by consumers
  - Enable new products, services and markets
  - Optimize asset utilization and operate efficiently

Smart Green Grid℠

Sources of Value / Utility Fit / Aspirations Served

- Improvements in grid reliability by reducing the frequency and duration of power outages
- Allow for more efficient consumer response to prices
- Provide opportunity to create and offer new products and services that give consumers greater choice and flexibility in energy consumption and to create value for end users
- Environmental stewardship by allowing customers to purchase cleaner, lower-carbon-emitting generation
- Help Grid Operators to optimize the use of grid assets and avoid new capital expenditures

Business and Regulatory Model Activities

- CEC, CPUC regulatory activity
- DOE Smart Grid task force support
- GridWise Alliance participation

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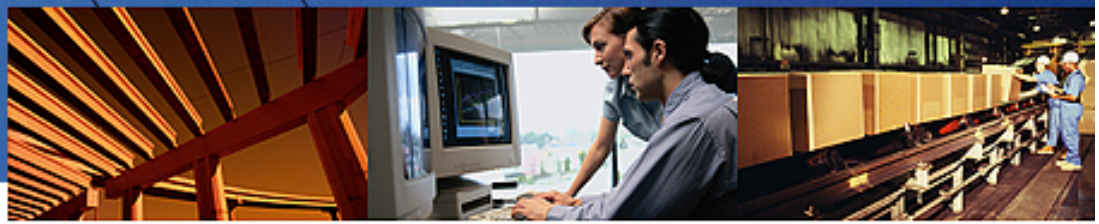
Smart Green Grid Scope enables new behaviors that drive value



Scope

- Electric grid evolves to incorporate advances in communication systems, operational technologies and information technologies
  - **Ubiquitous communications backbone**
    - Distributed sensors
    - New and/or automated control methodologies
    - Real-time ratings
  - **Operational technologies**
    - Alternative system designs
    - Distributed Energy Resources
    - Predictive and condition based maintenance
  - **Information technologies**
    - Asset optimization
    - Operational excellence
    - Customer participation

Behavior

- Detect emerging problems and fix them before they seriously impact quality of service.
- Incorporate extensive measurements, rapid communications, advanced diagnostics, and feedback control to return the system stability
- Reroutes power flows, change load patterns, improve voltage profiles, and take other corrective steps, within seconds of detecting a problem.
- Enable consumers and utilities to adjust loads and distributed resources to integrate with operations.
- Use modern tools to improve design and operation with reliability, security, efficiency, and safety as fundamental values

Value

- **To utility**
  - ✓ Operations, asset management, distributed generation
- **To consumer**
  - ✓ Real-time access: information, choices
- **To society**
  - ✓ Renewables, jobs, market opportunities
- **To regulators**
  - ✓ Aging assets, competition, modern economy, environment, reduced dependence on petro
- **To environment**
  - ✓ Peak shifting, peak shaving, reduced emissions

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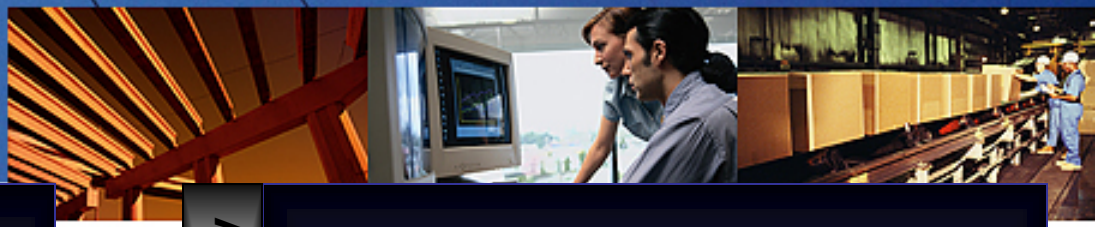
Attributes of the Smart Green Grid



Functional

- Self-healing
  - ✓ A grid able to rapidly detect, analyze, respond and restore from perturbations.
- Empower and incorporate the consumer
  - ✓ The ability to incorporate consumer equipment and behavior in the design and operation of the grid.
- Tolerant of attack
  - ✓ A grid that mitigates and stands resilient to physical and cyber security attacks.
- Provides power quality needed by 21st century users
  - ✓ A grid that provides a quality of power consistent with consumer and industry needs.
- Accommodates a wide variety of generation options
  - ✓ A grid that accommodates a wide variety of local and regional generation technologies (including green power).
- Fully enables maturing electricity markets
  - ✓ Allows competitive markets for those who want them.
- Optimizes assets
  - ✓ A grid that uses IT and monitoring to continually optimize its capital assets while minimizing operations and maintenance costs.

Technology

- Grid-wide integrated communications
  - ✓ Internet for the power grid
- Sensing, metering, measurement
  - ✓ Digital two-way communication devices
  - ✓ Enable generation connect and disconnect
  - ✓ Enhance operator information
- Advanced control capabilities
  - ✓ Computer based grid monitoring
  - ✓ Enables dispatch of distributed resource
- Advance grid components
  - ✓ Energy storage
  - ✓ Distributed generation
- Decision Support
  - ✓ Analytics to guide grid operators
  - ✓ Semi-autonomous agent software

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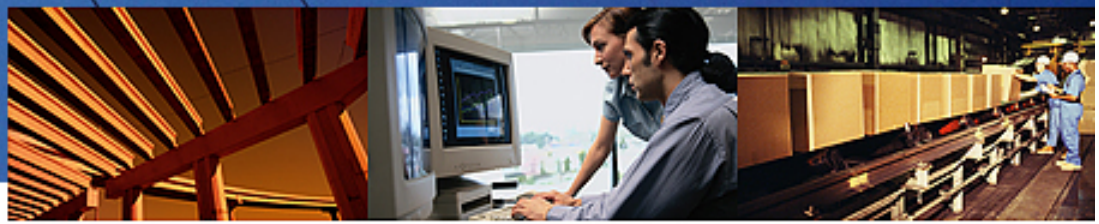
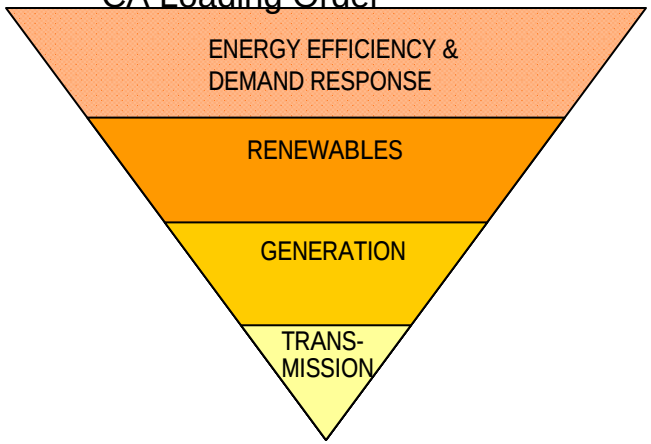
Why A Smart Green Grid?



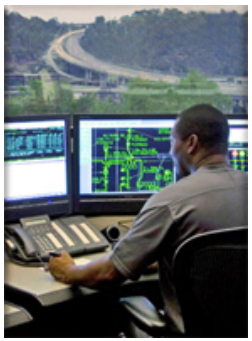
- **Policy Drivers**
- Aging Infrastructure
  - Significant investment in T&D system likely in coming years
- Help Achieve / Integrate policy goals
  - Renewable Portfolio Standards
  - Greenhouse Gas Reductions
  - CA Loading Order



- **Business Drivers**
- Exceptional customer service is a priority of SDG&E as it seeks to provide superior electric reliability to the region at reasonable rates.
- SDG&E has been proactive in incorporating new technologies.
- Maturing workforce.
- SDG&E needs to create a power grid that meets the growing and changing needs of customers.
- Advance State policy initiatives by incorporating green renewable resources.
- Advancements in IT and communication systems are accelerating and provide opportunities to achieve operational efficiencies, streamline processes, and incorporate new technologies.
- SDG&E plans to incorporate modern grid technologies and building blocks when available and cost effective.

Current Commitments and Potential Investments

- Smart Meter roll-out underway
- Op-Ex 20/20: investing in operational excellence
- General Rate Case requests
- Transmission investments
- Distribution system improvements
- Green Initiatives



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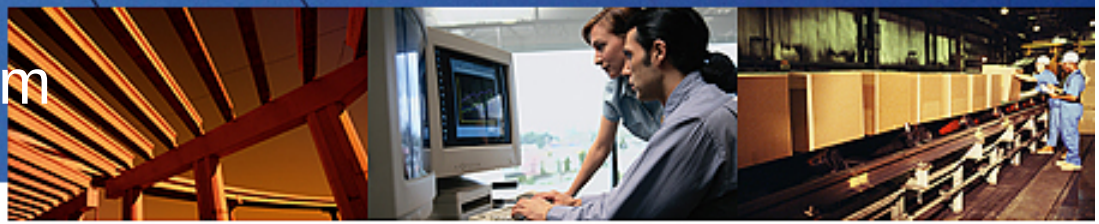
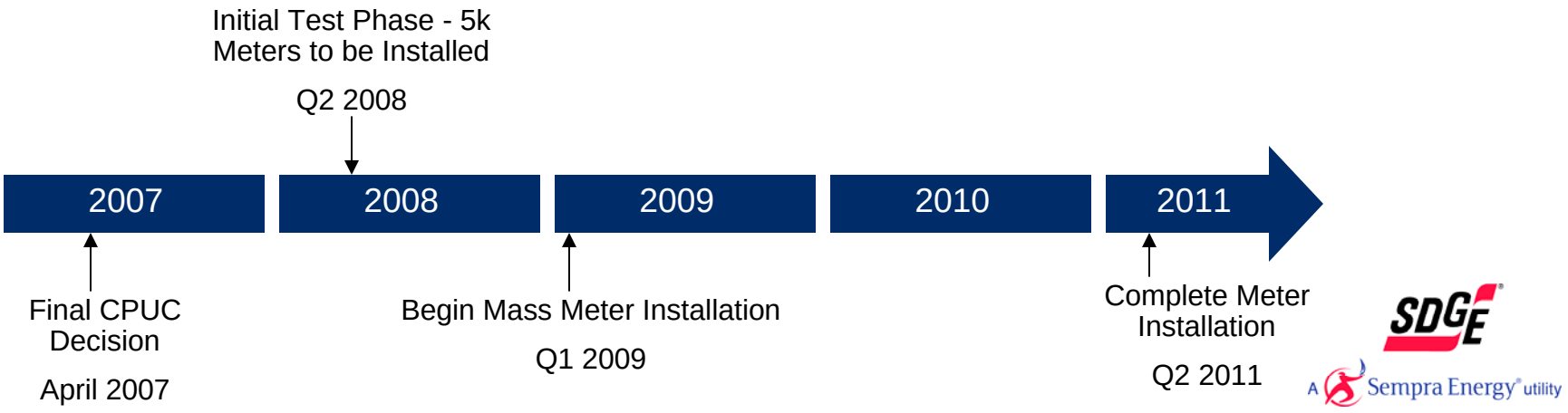
SDG&E Smart Meter Program



- $572 million capital project installing 1.4 million electric and 900,000 gas meters in service territory by Q2 2011
  - Two-way communication meters
  - Remote disconnect and Home Area Network capability
  - Opportunity for real-time pricing and in-home services



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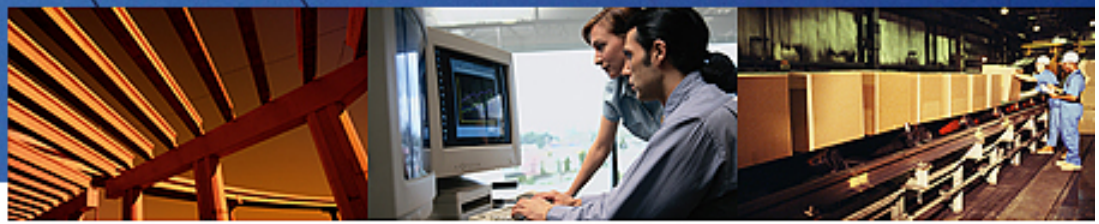
Smart Meter allows for …



- Two-way communication
- More control over energy use/savings
- Remote measuring of energy
- Enables automated load control devices (i.e., smart thermostats)
- Better customer service
- Lower operating costs
- Improved reliability, outage management
- Provides foundation for improved utility services for customer in the future

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Operational Benefits That Will Benefit Customers

- Improved accuracy and timelines of meter reads, decreasing errors and ruling the volume of billing adjustments.
- Move-in/Move-out services requiring final or initial read of the meter can be performed remotely without delay for scheduling and dispatching a field visit
- Decline in safety incidents associated with diminution in meter reading and customer services field personnel.
- Allowing SDG&E to detect energy theft and tampering, meters stuck without movement and meters registering consumption use when in “off” position.
- Reducing the need for on-going demand response programs and avoided transmission and distribution capital expenditures.
- Ability for SDG&E to schedule preventive system maintenance; more accurately plan local energy infrastructure upgrades; and dispatch staff more efficiently.

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OpEx 20/20: Reinventing Key Systems

Our Field Processes

Our Assets

Technology Foundations

Work Mgmt System
Forecasting/Scheduling
Real-time Routing
Dispatching

Geographic Info System (GIS)
Asset Investment Support
Outage/Dist Mgmt System
Condition Based Maintenance

Our Customers

Operational Insight Analytics
Web and IVR
Enhanced Self-Service Options

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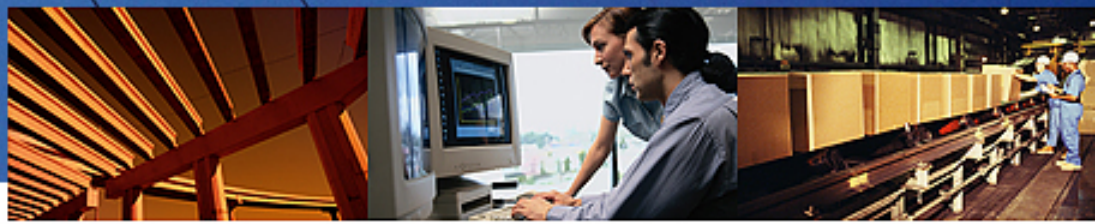
OpEx 20/20



- Timing for the OpEx 20/20 initiatives are:
  - GIS - 2010
  - OMS/DMS - 2011
  - Condition Based Maintenance - 2008-2015
  - Asset Investment Strategy – 2009
  - Forecasting, Scheduling, Dispatch, and Mobile – 2009
  - Work Management – 2009
  - Single View of the Customer – 2009
  - Intelligent Customer Experience – 2008 - 2011

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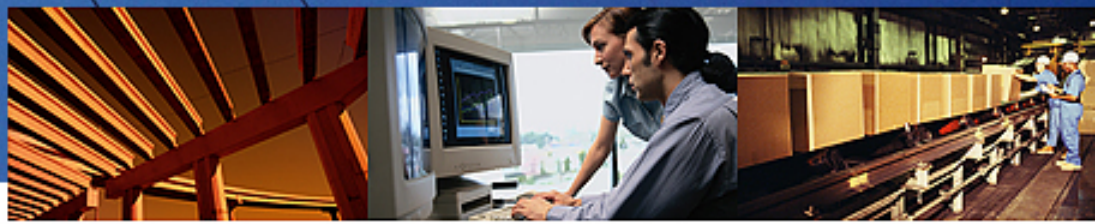
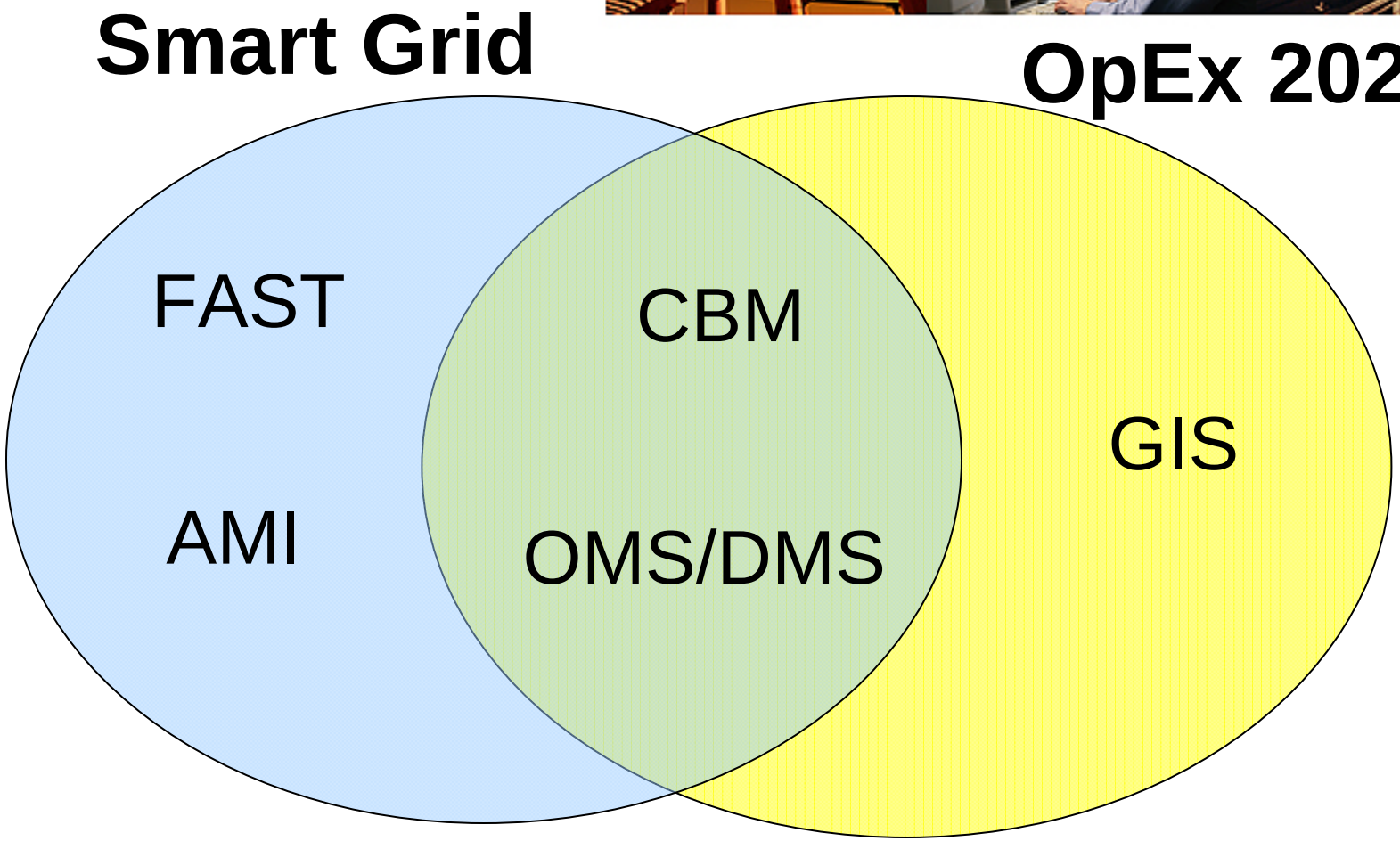
Smart Green Grid and OpEx2020





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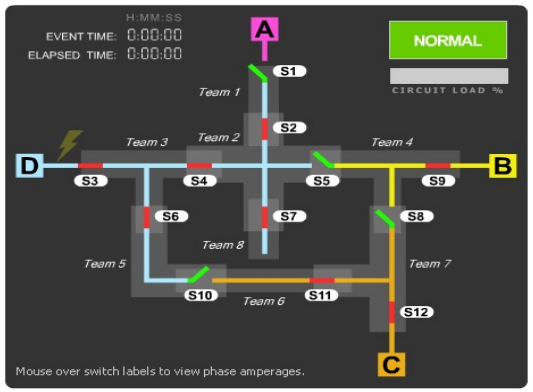
Smart Green Grid Initiatives

- Operational initiatives
  - Outage Management System/Distribution Management System
  - Condition Based Maintenance – Smart Substations
  - Feeder automation system technologies
    - Pilots of autonomous, automated switching, 9 circuits YE08
  - Department Of Energy funded Smart Grid Research
    - Grid Design: Utility-owned DG and Consumer-owned DG
  - Pending CEC funded Smart Grid Research
- Other Smart Grid Initiatives
  - Advanced conductor R&D
  - DER incorporated into the planning process
  - Real Time Phasor Measurement Data
  - Real Time Equipment Ratings
  - Distribution Fault Location
  - Congressionally Directed Funds/Predictive Analytics
- Green Initiatives
  - Sustainable Communities
  - PHEV



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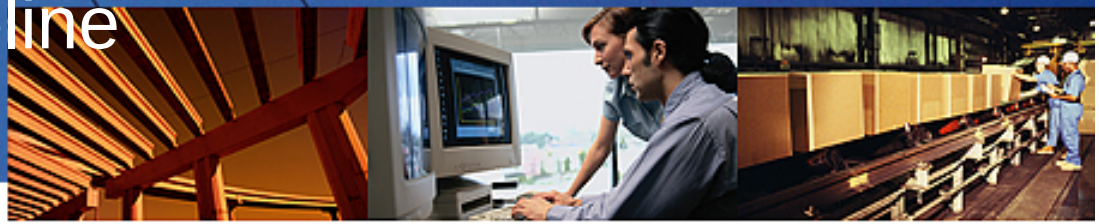
Smart Green Grid Timeline



	2008	2009	2010	2011	2012
Condition Based Maintenance "Smart Substations"	ICP Goal – 2 Substations	Complete all T&D substations within 7 years			
Self Healing Grid Pilot	Complete pilot on 9 distribution circuits				
Outage and Distribution Management					**Go-Live**
Department Of Energy Microgrid Project					**Go-Live**
Predictive Analytics Study		Conduct Analysis & Expand Algorithm Development			

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What will it take to be successful?
Key Challenges

- **Customer expectations**
  - Fewer and shorter outages
  - Information about outages, e.g. restoration time
- Employee and Public Safety
  - New hazards
  - Automated actions
- **System design**
  - New technology incorporation and new systems development
  - Information overload
- **Legacy systems investments**
  - Existing underground system - $5 billion asset
  - Modernization timeframe and interfacing with all vintages of equipment
- **Resource Adequacy**
  - Adoption of the State's Loading Order
  - Compliance with the Renewable Portfolio Standard
  - 20% by 2010

- **Staying ahead of regulation**
  - Being a "leader" in Smart Grid will help control destiny
  - Implementation of renewable resources on the Grid
- **Other Regulatory Issues**
  - Market and tariff design
  - Low rates
- **Areas of Potential Resistance**
  - Employee and Customer reluctance to change
  - R&D requirements
  - Technology and systems do not exist and/or do not talk to one another
  - Improve cost effectiveness

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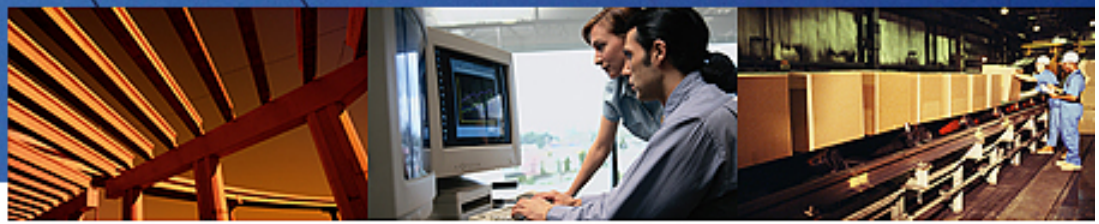
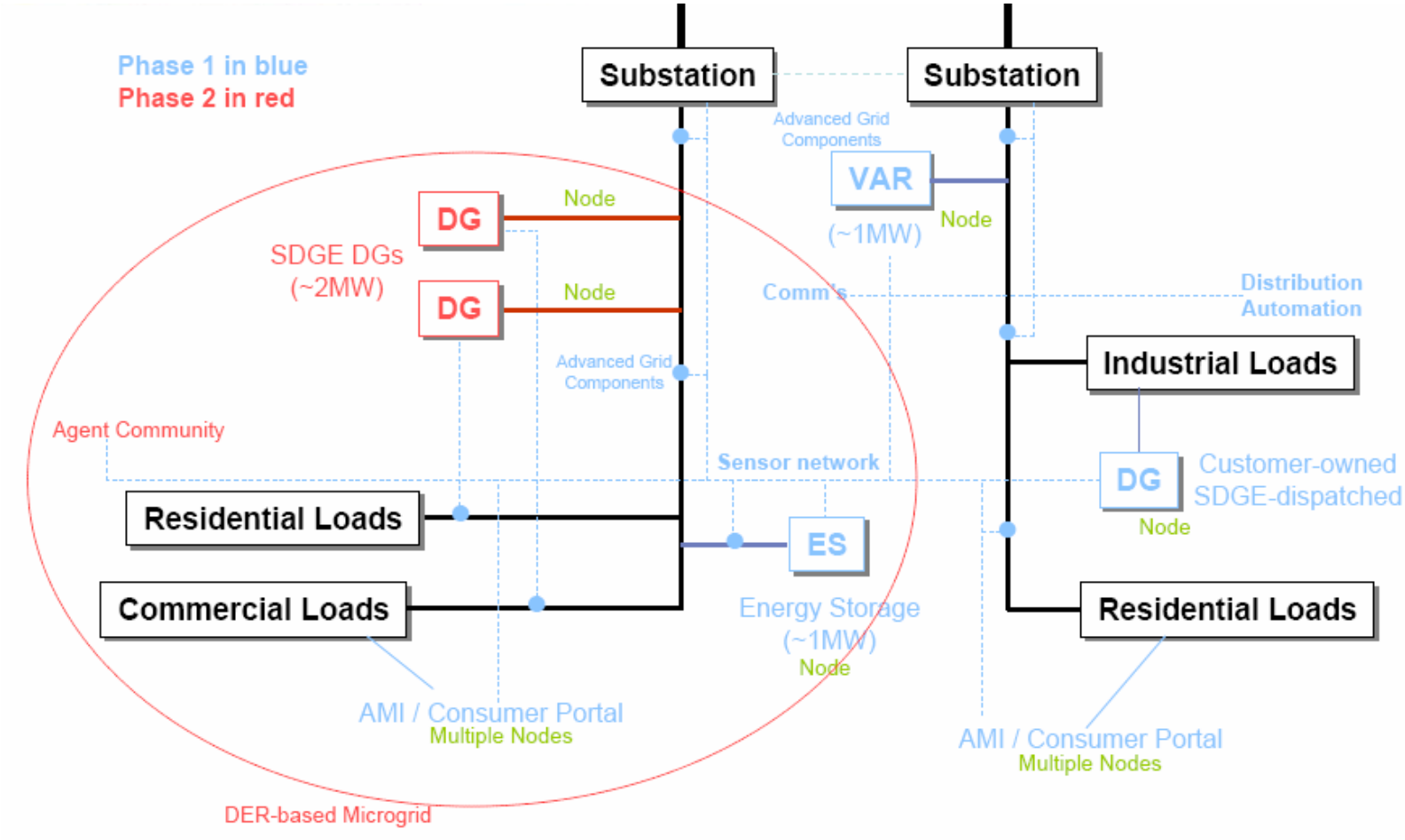
Practical Implementation?





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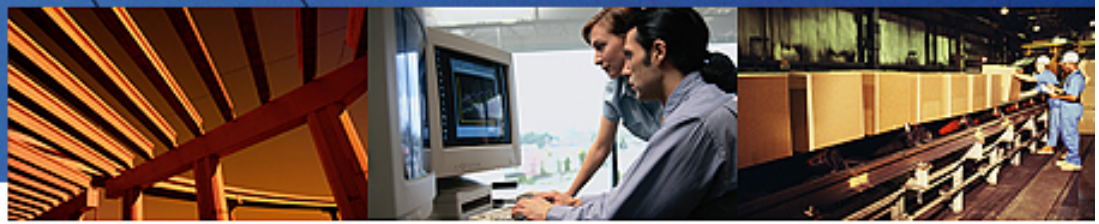
Summary & Next Steps



- Historically, SDG&E has been proactive in incorporating new technologies.
- We fully believe and endorse the need to create a power grid that meets the growing and changing needs of customers.
- Many significant challenges need to be overcome to “do it right”.
- Advancements in IT and communication systems are accelerating and provide opportunities to achieve operational efficiencies, streamline processes and incorporate new technologies.
- Incorporate modern grid technologies and building blocks when available and cost effective.
- Alignment of Smart Grid Vision: federal, state and industry
- Follow-through on foundational initiatives
- Roadmap for the future
    - Coordinate proceedings
    - Guidance to industry
    - RD&D for new technologies currently not cost effective

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