



# Federal stimulus opportunities for Smart Grid

Discussion document

March 30, 2009

# PG&E's integrated approach accelerates the reliable deployment of SmartGrid technologies



## Standards definition

- PG&E plays a broader role in shaping and accelerating the standards that will underlie future smart-grid implementations
- Expands upon PG&E's proven leadership role in shaping standards



## Testing facilities

- PG&E expands and accelerates its plans for a fully-functional, extensible testing facility to enable rapid prototyping and testing of smart-grid technologies
- Accelerates technology development and ensures standards compliance early on
- Builds upon PG&E's state-of-the-art off-grid testing facilities



## Pilots

- PG&E implements tested technologies in a real-world setting to demonstrate value of the end-to-end smart grid
- Partnerships spanning the smart-grid ecosystem ensure that insights are scalable



## Full system deployment

- PG&E extends current pilots to full-scale roll-out, assuming benefits and technology are proven
- PG&E's industry-leading smart-meter deployment allows it to be at the leading-edge of other smart-grid technology deployments
- Insights are used to feed the next cycle of the technology deployment cycle

# PG&E is developing 5 smart grid initiatives for potential ARRA funding

PRELIMINARY

Initiatives	Description	Total project cost \$ Millions	Jobs created No. jobs
<b>1</b> <b>Expanded smart grid test facility and accelerated standards</b>	<ul style="list-style-type: none"> <li>Expand and integrate existing facilities and expertise across PG&amp;E to perform increased proof-of-concept, interoperability, and security testing of the full range of smart grid systems</li> <li>Accelerate existing PG&amp;E standards efforts to cover all the major elements of smart grid systems within the leading standards organizations, industry alliances, and users groups</li> </ul>	35-50	20-40+
<b>2</b> <b>End-to-end smart grid community demonstration</b>	<ul style="list-style-type: none"> <li>Deploy an end-to-end, interoperable, secure smart grid for the purpose of testing and evaluating all elements of a smart grid in a real-world, commercial-scale customer environment</li> <li>Project will entail partnering extensively with a municipality in PG&amp;E's service territory, smart grid technology providers, and local universities</li> </ul>	150-200	150-200+
<b>3</b> <b>HAN demonstration</b>	<ul style="list-style-type: none"> <li>Prove the integrated value of HAN technology, innovative user interfaces, and dynamic rates in association with demand response, distributed generation, PHEV, energy efficiency, and energy conservation</li> <li>Pilot and rollout notification devices to small-medium commercial and industrial customers in connection with transitioning to dynamic pricing to maximize response rate</li> <li>Partner with Stanford University and other interested universities and DOE national labs</li> </ul>	30-60	5-10+
<b>4</b> <b>Regional synchrophasor demonstration</b>	<ul style="list-style-type: none"> <li>Equip the transmission system with expanded phasor monitoring and control tools to test impact on grid reliability and utilization</li> <li>Partner with SCE, SDG&amp;E, the California ISO, BPA, WAPA, and other western utilities and transmission operators for a truly regional demonstration of the technology</li> <li>Fully engage in DOE NASPInet initiative</li> </ul>	40-60	10-30+
<b>5</b> <b>Underground compressed air energy storage demonstration</b>	<ul style="list-style-type: none"> <li>Partner with EPRI to lead an energy storage demonstration project to validate the design, performance, and reliability of a first-ever underground CAES plant (300MW, 10 hours) in California</li> <li>Phased development over 5-7 years (economic/technical analysis, core drilling, environmental studies, plant construction, and monitoring)</li> <li>Demonstrate the use of large scale energy storage to integrate intermittent renewables, store off-peak energy, provide ancillary services, manage peak demand, and relieve grid congestion</li> </ul>	250-300	150-200+



NOTE: Cost estimates are at varying stages of development and are preliminary. Job creation estimates represent direct jobs created at PG&E and its contractors— does not include indirect jobs created via multiplier effects and does not include jobs that would be created by a full scale deployment. PG&E is awaiting formal DOE procedures and guidance on ARRA Smart Grid funding and is still in the internal review process for potential Smart Grid projects. Therefore, the projects listed do not represent commitments by PG&E for funding or for inclusion in funding applications.

## Appendix – initiative details

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- 1** Expanded smart grid test facility and accelerated standards
- 2** End-to-end smart grid community demonstration
- 3** HAN demonstration
- 4** Regional synchro-phasor demonstration
- 5** *Further details on the “Underground compressed air energy storage demonstration” initiative are not available at this time*

# 1 Expanded smart grid test facility and accelerated standards

PRELIMINARY

## Description:

- **Standards:** Expand PG&E's existing standards efforts to prove out all major elements of smart grid systems in an off-the-grid environment involving industry participants, users groups and in conjunction with leading standards organizations.
- **Test facility:** Expand and integrate existing facilities and expertise across PG&E to perform proof-of-concept testing of the full range of smart grid applications, including:
  - Smart grid substation testing
  - Distributed generation & storage testing
  - Smart appliance testing
  - Smart consumer electronics testing
  - Electric vehicle testing
  - Distribution network application, communication & sensor testing

## Benefits:

- Drives smart grid interoperability through standards development – utilities like PG&E, as the market deciders on technology and the only entities responsible for complete system reliability, are in a unique position to drive this process
- Safeguards grid reliability by allowing high risk technologies to first be proven in a test facility before being deployed
- Optimizes use of funds by utilizing existing test facility infrastructure at PG&E with an estimated asset value of \$22 million
- Leverages PG&E expertise at existing test facilities to potentially yield results sooner than might occur at alternate distributed facilities

**Jobs created:** 20-40+

**Project cost:** \$35-50 million

## Potential partners:

- Standards bodies: *IEEE, ANSI, ASHRE, IETF, NIST, IEC*
- National labs: *LBNL, NREL*
- Industry associations: *EEI, NEMA, SAE*
- Industry standards alliances
- Smart Grid Vendors
- Universities
- Cal-ISO
- Others: *UTC, GWAC, UCAiug*

## 2 End-to-end smart grid community demonstration

PRELIMINARY

### Description:

- Deploy an end-to-end, interoperable smart grid for the purpose of demonstrating and evaluating all elements of a smart grid in a real-world, commercial-scale customer environment
- Includes four components:
  - Transmission, substation, and distribution system upgraded for greater reliability, efficiency, and to support expanded services
  - Distributed generation, distributed and utility-scale battery storage and renewable integration
  - Customer-facing programs and technologies that optimize electricity consumption in the targeted area
  - The underlying communication network and IT system architecture deployed on a commercial scale
- Entails partnering extensively with a municipality in PG&E service territory

### Benefits:

- Provides greater transparency to future smart grid investments by defining and quantifying the costs, benefits, and risks associated with full scale deployment of smart grid technologies
- Strengthens the grid by enabling greater reliability and grid efficiency, enhancing operational experience, lowering generation costs, and enhancing integration of distributed generation & storage
- Improves customer service by lowering costs, enhancing control, improving customer knowledge, and providing market intelligence
- Improves communications and IT services by verifying field performance, scaling architecture, enhancing understanding of tool requirements, and improving processes

**Jobs created:** 150-200+

**Project cost:** \$150-200 million

### Potential partners:

- Community partners: *Communities, Association of Bay Area Governments, universities, and private sector businesses*
- Customer system partners
- Transmission & distribution system partners: *S&C, SEL, ABB, GE*
- Communications and IT Partners: *IBM, Accenture, Silver Spring Networks, Cisco*

### 3 HAN demonstration

#### Description: Project has 3 components

- **Residential HAN pilot**
  - Cross-geography, multi-demographic study of 20,000 PG&E residential customers
  - Customers are provisioned with various HAN devices, including in-home displays, smart appliances, and EV chargepoints
  - Customers participate in various EE/DR programs
  - Goal to understand customer energy consumption and methods to influence it
- **C&I notification devices pilot**
  - Pilot notification devices with small and medium C&I customers
  - Potentially rollout notification devices to 200,000 C&I customer, provided pilot is successful
- **Stanford smart energy multi-dwelling unit**
  - A new student residence on Stanford campus geared towards real-world testing of promising innovations in energy efficiency, material & water usage, and consumer behavioral modification
  - Leverages transient residential population and flexible infrastructure to rapidly deploy and test devices

#### Benefits:

- Provides insight into shaping future EE/DR programs
- Helps California meet its load reduction and demand response goals
- Ensures commercial and industrial customers transition to dynamic pricing smoothly

#### Jobs created: 5-10+

**Project cost:** \$30-60 million

#### Potential partners:

- Universities: *Stanford*
- Building operators: *General Services Administration*
- Technology vendors: *Silver Spring Networks, Tendril, Control4, Trilliant*



## 4 Regional synchro-phasor demonstration

PRELIMINARY

### Description:

- Equip the Western transmission grid with monitoring and control tools to test impact on grid reliability and utilization
- Install additional phasor measurement units, software and analytical systems to demonstrate and confirm the feasibility of using synchronized phasor measurements in transmission system monitoring and control.
- Develop specific tools for system operators to 1) monitor and control the transmission system (e.g. displays, alarms, triggers) and 2) simulate significant contingency scenarios and initiate appropriate corrective measures
- Develop integrated data platform with future EMS/DMS systems and effectively manage output data for use both within and outside PG&E

### Benefits:

- Demonstrate across a significant portion of the Western Interconnection a technology identified as having a great deal of potential to improve grid operation
- Monitor real-time operational health of the bulk electric transmission system and provide early warning of potential problems that could lead to system instabilities and blackouts – this would allow dispatchers and operators to take appropriate preventive measures
- Better understand where transmission capacity is being overstressed or underutilized in order to maximize capacity while maintaining reliability
- Monitor impact on grid stability of new generation and storage to allow safer and more reliable integration of renewables
- Achieve greater transmission and distribution reliability through
  - Adaptive Security and Dependability
  - Adaptive Controls

**Jobs created:** 10-30+

**Project cost:** \$40-60 million

### Potential partners:

- Utilities and balancing authorities: *SCE, WAPA, SDG&E, CAISO, BPA, and other transmission owners*
- CEC PIER Program:
- Manufacturers
- Universities
- Systems integrators and technical consultants
- National labs