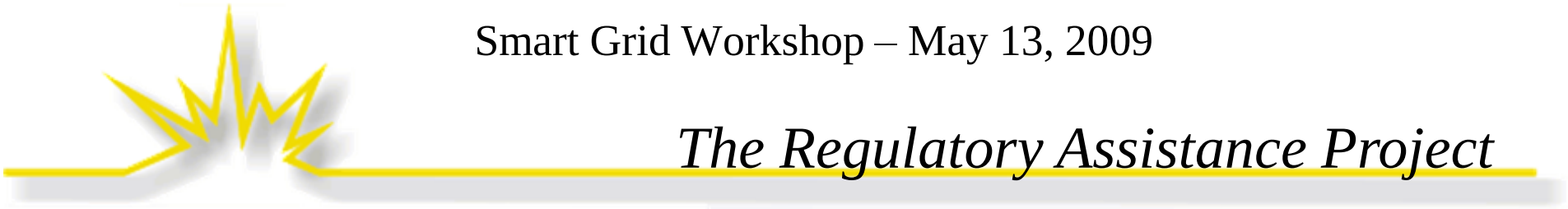
Tour of Smart Grid Projects

Lisa Schwartz

Presentation to Utah Public Service Commission

Smart Grid Workshop – May 13, 2009



The Regulatory Assistance Project

50 State Street, Suite 3
Montpelier, Vermont USA 05602
Tel: 802.223.8199
Fax: 802.223.8172

27 Penny Lane
Cedar Crest, New Mexico USA 87008
Tel: 505.286.4486
Fax: 773.347.1512

P.O. Box 210
Volcano, California USA 95689
Tel: 209.296.4979
Fax: 716.296.4979

429 North NE Nebergall Loop
Albany, OR 97321
Tel: 541.967.3077
Fax: 541.791.9210

P.O. Box 507
Hallowell, Maine USA 04347
Tel: 207.623.8393
Fax: 207.623.8369

Regulatory Assistance Project

- Nonprofit organization founded in 1992 by experienced energy regulators
- Advises policymakers on economically and environmentally sustainable policies in the regulated energy sectors
- Funded by U.S. DOE & EPA, the Energy Foundation, the World Bank, Asian Development Bank, and other foundations
- We have worked in 40+ states, and 16 nations

Getting Smart

- Advanced metering infrastructure (AMI – smart meters and 2-way communication) may be a 1st step, providing new capabilities such as:

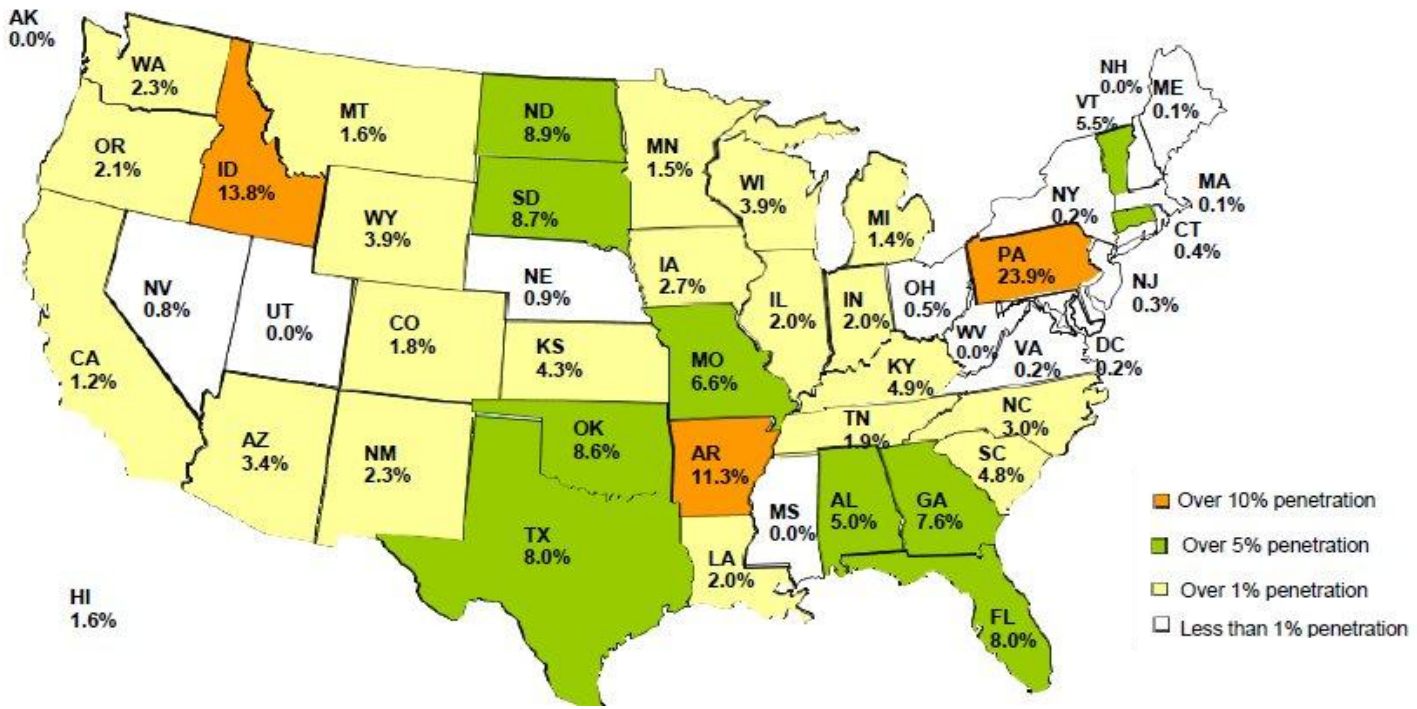
  - Time-varying pricing options coupled with enabling technology like smart communicating thermostats
  - Useful usage information for consumers and CSRs
  - Improved outage detection and response
  - Right sizing of distribution assets

Getting Smart (cont.)

- FERC survey conducted in 1st half of 2008
  - 4.7% of meters in U.S. are "advanced"
    - Highest penetration rates in Pennsylvania, Idaho, Arkansas, North Dakota and South Dakota (IOUs in PA and ID; co-ops elsewhere)
    - That does not include installations by the three California IOUs, CenterPoint, Oncor, Southern Co., PGE, Detroit Edison, Alliant, etc.
  - 8% of U.S. consumers participate in a demand response program
    - Potential resource contribution is about 41,000 MW – about 5.8% of U.S. peak demand

Getting Smart (cont.)

AMI Penetration Rates – 2008



Source: KEMA presentation to Northwest Energy Efficiency Alliance, 2/11/09, using FERC survey data from the first half of 2008

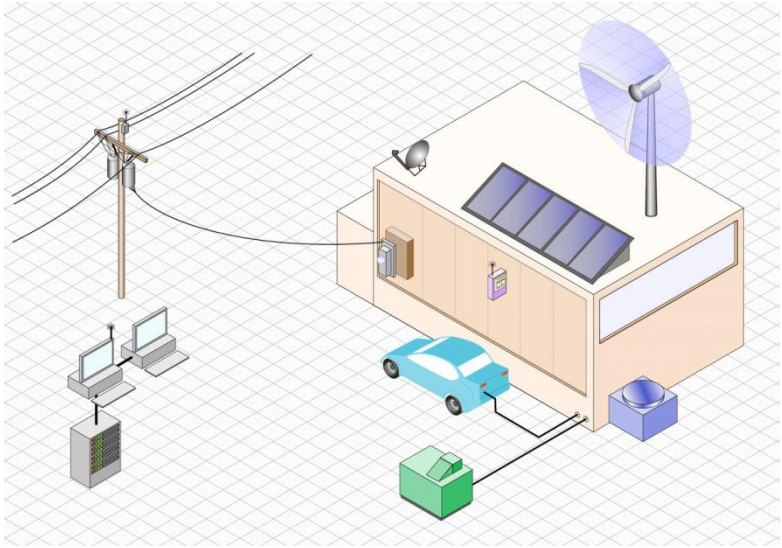
IOUs Are Not Alone

- COUs account for half of advanced meters in survey
- 50% of co-ops have begun smart meter roll-outs; coops installed almost half of smart meters last year[1]
- 26% of co-ops have already integrated their outage management systems with their AMI system[2]
- Poudre Valley REA invested some $1.5 million in SCADA deployment to about 70% of its system and plans to invest another $460,000 in the next 3 years[3]

[1] Personal communication from Jay Morrison, National Rural Electric Cooperative Association, 4/20/09
[2] Kenneth Rose and Mike Murphy, *Reference Manual and Procedures for Implementation of the "PURPA Standards" in the Energy Independence and Security Act of 2007*, August 2008
3 Testimony of E. James Byrne, Manager of Engineering Services for Poudre Valley REA, 12/23/08

From Smart to Smarter

- "Smart Grid" continuing to evolve
  - Demos and rollout of pieces
  - Fully integrated projects with these features are just starting
    - Real-time communication
    - Active interaction with loads
    - Distribution system management
    - Optimized integration of distributed generation and storage



EPRI graphic

SELECTED PROJECTS IN THE U.S.

California

Pacific Gas & Electric – SmartMeter™		
Project description	Two-way RF AMI for all customers w/home area network (HAN) gateway; load-limiting remote connect/disconnect on all meters; critical peak pricing (CPP) and peak time rebate in summer; online access to usage data in real time	
Number of meters	Electric – 5.3 million*	Gas – 4.5 million
Costs and benefits	Cost - $2.2 billion	Est. benefits - $135 million
Deployment	Fall 2006 through 2011; 2.3 million meters so far	
Planned enhancements	Load control, power outage detection, remote-controlled "smart charging" and vehicle-to-grid for PHEVs; proposed SG initiatives include compressed air storage and full SG community demo	

*California IOU customers >200 kW already have smart meters.

California (cont.)

Southern California Edison – Edison SmartConnect™		
Project description	AMI with 2-way LAN/WAN; HAN interface for household devices to communicate w/meter; programmable communicating thermostats (PCTs); near real-time energy usage information; remote connect/disconnect; peak time rebate and CPP rates for residential and business customers; Circuit of the Future pilot	
Number of meters	Electric – 5.3 million	Gas utility may connect to AMI
Costs and benefits	Cost - $1.63 billion	Net benefits - $9 million to $304 million (CPUC est. range)
Deployment	2008-2012	
Planned enhancements	Customer control of HAN; load control programs through PCTs; ARRA proposals include demo of fully-functioning SG from a single substation and 15 MW compressed air storage demo	

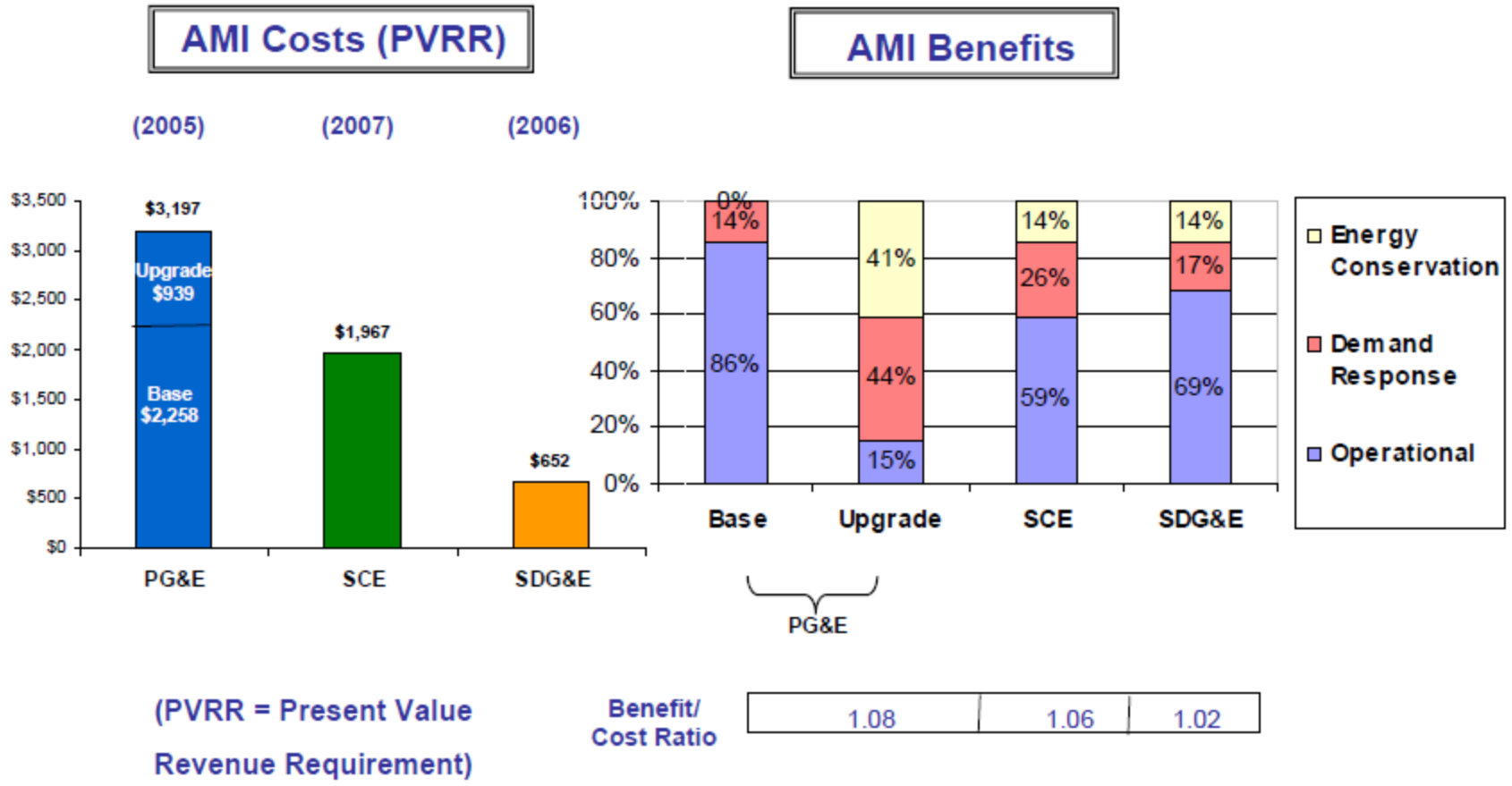
California (cont.)

- SCE SG technology at the *transmission* level
  - 19 Phasor Measurement Units
    - Real-time grid monitoring
    - Black-start capabilities
  - 2 static VAR compensators
  - 28 Centralized Remedial Distribution Action Schemes using high-speed fiber/microwave communications
  - Advanced conductors
- SCE substation automation (*distribution* level)
  - >500 automated substations
  - Advanced Energy Management System
    - Condition-based monitoring

California (cont.)

- SCE *distribution automation*
  - Extensive distribution automation deployments
    - 1,600 circuits automated
    - 10,000 automated capacitor controllers, 4,000 switches
- SCE *distribution* Circuit of the Future pilot
  - Advanced protection with high-speed centralized control
  - Fault current-limiting technology
- SCE *customer participation*
  - 1,600 MW DR/efficiency capacity enrolled
  - 4,000 distributed energy projects totaling 270 MW

California (cont.)



Source: Presentation by Aloke Gupta, CPUC energy analyst, 9/4/08

Colorado

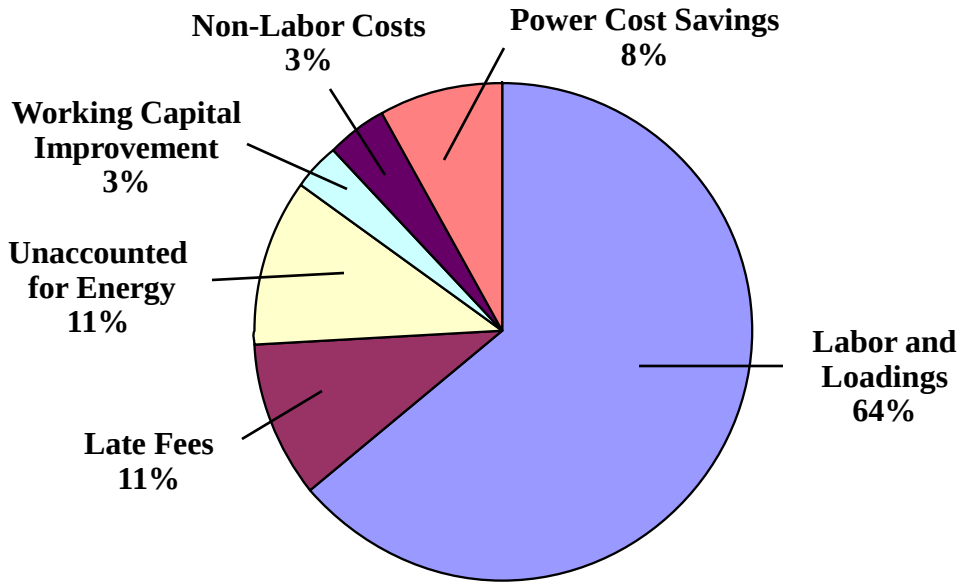
- Xcel Energy Smart Grid City
  - Next presentation

Oregon

Portland General Electric		
Project description	Two-way RF AMI, remote connect/disconnect on all multi-family meters	
Number of meters	850,000	
Costs and benefits	Capital cost - $132 million	Est. operational savings in 2011 - $18.2 mil. (*not* incl. DR, etc.); net benefits $33 million (20-yr PVRR)
Deployment	Mid-2008 (systems acceptance testing) through 2010	
Planned enhancements	CPP pilot for residential customers beginning 2010, turnkey demand response programs (via recent RFP) may use AMI system, integration of AMI with new outage management system, energy usage and tools on Internet, better information on bills, distribution asset utilization, stimulus fund projects	

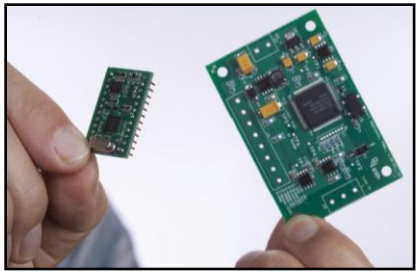
Oregon

- Where are Portland General Electric's expected operational savings?



Oregon (cont.)

- More on PGE
  - Participated in regional appliance pilot to test utility control for voltage support



  - Largest dispatchable standby generation program in U.S. (50 MW controlled by ops center and synchronized with grid when needed)

PGE is working with local businesses and governments to install about a dozen charging stations to help develop and test the infrastructure needed to support PHEVs. PGE's investment in smart meter technology may allow PHEVs to provide power to grid during peak load times.

Pennsylvania

- Six electric distribution companies have fully deployed or are completing deployment of advanced metering networks with varying levels of “smart” functionality
  - PECO, PPL Electric, Duquesne, Citizens, Wellsboro and UGI
- Most must upgrade their system to provide hourly pricing consistent with Act 129

Pennsylvania (cont.)

PPL Electric Utilities	
Project description	AMI with fixed power line carrier (PLC) network; hourly interval data for all customers available on-line within two days; TOU pilot for 700 customers began February 2009
Number of meters	1.3 million
Costs and benefits	$163 million investment (capital and O&M costs); estimated 5- to 7-year payback
Deployment	2002-2004
Planned enhancements	Voluntary TOU rates offered to all customers by 2010; Act 129 compliance plan under development (rules not yet final)

Source: Personal communication with Michael Godorov, PPL Electric Utilities, 5/11/09

Texas

CenterPoint Energy - Houston		
Project description	AMI with two-way network (WiMax radios); remote connect/ disconnect; consumer education; home monitors for low-income	
Number of meters	2.4 million	
Costs and benefits	Capital cost - $639.6 million	Est. savings and benefits - $120.6 million during surcharge period (12 years)
Deployment	2009 through 2014	
Planned enhancements	ARRA funding proposal may include remote control switches, a Distribution Management System to enable management and control of microgrids and integration of wind and solar, fault location characterization software, predictive failure analysis software, and PHEV demo	

Sources: Filings in TPUC Docket No. 35639; *Smart Grid Today*, 4/27/09; CenterPoint filing in Project No. 36674.

Texas (cont.)

Oncor – Dallas/Fort Worth (formerly TXU)		
Project description	AMI with remote connect/disconnect; in-home power monitors for low-income households; comprehensive program to educate consumers about acquiring benefits of AMI	
Number of meters	3.4 million	
Costs and benefits	Capital cost - $686 million (plus $153 million O&M during surcharge period)	Est. savings and benefits - $204 million during 11-year surcharge period
Deployment	2009 through 2012	

Source: Texas PUC order in Docket No. 35718

Multiple States

American Electric Power – *gridSMART*	
South Bend, Indiana, Pilot *(late 2008-late 2009; $7 million)*	10,000 meters installed; customer access to prior day hourly data; A/C load control; TOU rate option; remote connect/disconnect; 6-10 MW/yr of utility-scale battery storage; PHEV charging, dist. mgt. system on 2% of circuits (reconfiguration/optimization, real-time monitoring and diagnostics, fault location i.d.)
Texas	Installing 1 million smart meters in Texas over next several years
Planned enhancements	Smart meters to all 5 million customers by 2015; microgrids; EPRI "green circuit"; 25 MW of energy storage by 2010; 1,000 MW of demand reduction from efficiency and DR by 2012
Ohio substation pilot	Demo of high-speed, IP-based communications to connect three substations using high-voltage BPL (USDOE funding); applications include protective relaying, SCADA expansion, remote station surveillance and advanced sensing

Multiple States (cont.)

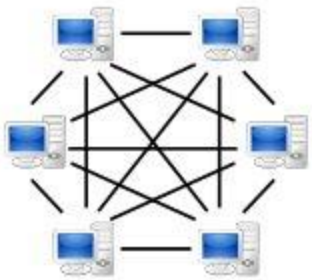
- AEP gridSMART Ohio *(Case Nos. 08-917-EL-SSO; 08-918-EL-SSO)*
  - Three-year pilot (2009-2011) with three main components: AMI and HAN for 110,000 meters and distribution automation on 90 circuits
    - PCT and load control switch for customers with central A/C
  - Real-time information to customer and company on usage and loads
  - Distribution automation (implemented in 2011) for real-time control and monitoring of electrical equipment such as capacitor banks, voltage regulators, reclosers and automated line switches
  - Projected cost is $109 million over 3-year Electric Security Plan period
  - Commission approved a rider to recover costs
    - Required AEP to seek federal stimulus funds for 50% of project cost
    - Rider initially set for 2009 ($33.6 million)
    - Subject to annual true-up and reconciliation based on prudently incurred costs

Multiple States (cont.)

Duke Energy – *Utility of the Future*	
Project description	South Charlotte – 14,700 smart meters w/PLC Upstate S. Carolina – >7,000 smart meters w/PLC and RF Cincinnati, Ohio – 50,000 smart meters w/PLC 36 energy management, storage and control units installed
Planned enhancements	•Microgrid project in South Charlotte •146,000 more smart meters in Cincinnati in 2009, ramping up to 10,000 meters/day in Ohio pending regulatory approval •*Docket No. 43501:* Smart meters with PLC and wireless communications for all 800,000 of its meters in Indiana, IP-based distribution system communications (e.g., line sensors, capacitor banks), distribution automation including circuit breakers and electronic reclosers, switched capacitor banks and voltage regulators, enhanced sectionalization and self-healing technology, $10 million for solar thermal, PV and small-scale wind (5-yr capital costs-$435.89 million; 20-yr NPV B/C-$365.08 million)

Sources: David Mohler, Duke Energy, Grid Week 2008 presentation (9/08); Duke filings in Indiana Docket No. 43501.

Microgrids



- Interconnected network of distributed energy systems (loads/resources) that can function connected to or separate from grid
- During a grid disturbance, a microgrid isolates itself from the utility seamlessly with no disruption to loads within; automatically resynchronizes and reconnects to grid seamlessly when grid conditions return to normal
- Existing projects
  - CERTS Microgrid Test Bed (AEP) - Testing started 11/06
  - GE demo - Advanced controls, energy management and protection technologies
  - US Army CERL/Sandia Labs Energy Surety Project - Controls, optimization of resources and storage

Microgrids (cont.)

- ATK Launch Systems, Utah
  - Demonstrate benefits of integrating diverse, distributed renewable energy technologies (2.6 MW) and intelligent automation system w/2-way communication
    - Wind, heat recovery, concentrating solar, steam and hydro turbines
    - Use wind to pump well water into elevated storage; compress air at night and use in generator to meet peak demand
    - Microgrid functions in control system for distributed generation
  - Designed to produce a verifiable, on-demand reduction of at least 15% of substation load with no disruption of facility operations
  - $800,000 in annual energy savings
  - Rocky Mt. Power: Customer/utility web interface, $700,000 in incentives

Source: Presentation by Roger Weir, ATK, Renewable and Distributed Systems Integration Peer Review, 10/29/08

Microgrids (cont.)

- Fort ZED, City of Fort Collins
  - Zero Energy District - Annually creates as much energy locally as it uses
  - Fort ZED represents about 10% to 15% of municipal utility system in terms of energy consumption, peak demand and number of customers
  - Aggregating 5 MW of distributed energy resources (PV, CHP, fuel cells, microturbines, gensets, thermal storage and demand response) with plans to link to a utility-scale wind project
  - System installation and testing underway
  - 20% peak load reduction on two feeders by 2011
  - PHEV charging station and fleet conversions by 2011
  - "Greening" of public buildings and financing for commercial buildings
  - Fort Collins Utilities is evaluating a smart metering project for 2010
  - Proposal to accelerate Fort ZED to a 50 MW district

Sources: Presentation by Mike Freeman, Renewable and Distributed Systems Integration Peer Review, 10/29/08; information provided by Brendle Group

A Few of the Many Planned Pilots

- **National Grid** (MA) – 15,000-customer pilot with smart meters; in-home devices; CPP, CPR and hourly pricing (large C&I) options; PHEV charging; distributed resources; and distribution automation on 17 feeders (controls/communications for transformers, capacitor banks and reclosers)
  - Also two 40,000-customer demos in upstate NY with reliability enhancements
- **NStar** (MA) – 3,000-customer pilot to pair existing AMR equipment with broadband internet service to provide two-way communication to customer's computer and HAN, including data about electric system conditions and real-time incentives for cutting use during peak demand; smart thermostats for some customers

A Few of the Many Proposed Pilots (cont.)

- **FP&L** (FL) – Smart meters for every Miami household and most businesses; smart grid automation and communications; 300 fleet PHEVs; PV at schools and universities; small pilot of home technologies and software (deployment could begin 2009)
- **BPA Smart Grid Test Bed** (NW) – $10 million toward partnerships with utilities and vendors to test decentralized coordination and control of electric supply and demand while improving network safety, reliability and efficiency
  - To include equipment such as agricultural pump controls; backup generation; commercial HVAC; industrial process control; interval metering; residential PV, smart appliances, thermostats and water heaters; small wind projects; distribution automation/ feeder reconfiguration, volt/VAr control

A COUPLE OF PROJECTS OUTSIDE THE U.S.

European Union

Enel SpA - Italy		
Project description	32 million smart meters installed from 2000 to 2005; real-time display of home energy usage; pricing options and participation in energy markets; automatic management of the grid in case of outage; monitoring of status of network components; >100,000 substations remotely controlled; automated fault clearing; mobile applications for field crews	
Costs and benefits	Cost - €2.1 billion	Projected annual savings - €500 million
Planned enhancements	More fault detectors, new voltage and current outdoor sensors, distributed generation protection, enable active participation of small and medium customers in power market. Enel coordinates ADDRESS, a consortium of 11 EU countries developing large-scale interactive distribution energy networks.	

Sources: "Echelon teams with T-Mobile for cell-based AMI," *Smart Grid Today*, 4/23/09;
Enel Spa presentations at Grid Week 2008 and Brussels, 3/19/09

European Union (cont.)

EDF – France, Italy, Germany, UK		
Project description	2010: 1% pilot (300,000 meters, 7,000 concentrators) to test information system and deployment process and validate business case; installing advanced digital controls for distribution automation at substations 2012-2016 – 35 million meters; 700,000 collectors	
Costs and benefits	Cost - $6.4 billion (est.)	Est. yearly savings - $430M on metering services; ~$220M on non tech. losses
Smart grid demos	PREMIO - Distributed energy resources, renewable resources, energy efficiency and demand response FENIX – Aggregate distributed energy resources to create a large-scale virtual power plant	

Source: Richard Schomberg - EDF VP Research North America, GridWeek 2008

Lisa Schwartz, senior associate
Regulatory Assistance Project
lschwartz@raponline.org
541-967-3077
www.raponline.org