

The Making of the Smart Grid

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Smart Grid – Elements and Theory

- Customer Benefits: Higher Reliability, Greater Flexibility, Lower Cost, Greenhouse Gas Reductions
- Key Elements:
 - Hierarchical Control – Grid Status & Conditions to Individual Utilities
 - Flexible Generation – For Ramping-Capability to Counteract Intermittent Renewable Generation
 - Distributed Generation – Power Resource Close to Load (CHP, Solar, Community Wind, Storage-EV batteries)
 - Demand Response – Modify Customer Demand (Direct Load Control, Real-Time Pricing)
 - Reliability – Self Healing (Fast Switching, IEDs, Microgrids)
 - Advanced Meter Infrastructure – Billing & Intelligence

PGE Smart PowerSM Initiatives

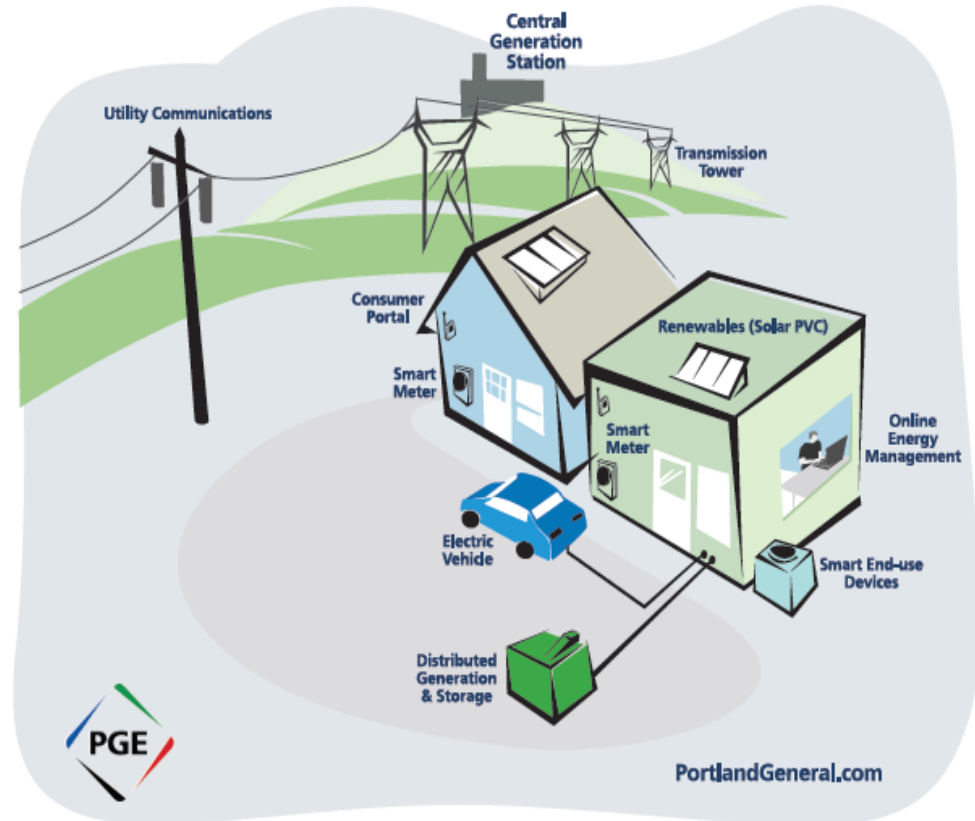


Smart meters

- 820,000 installed and operating

Smart grid initiatives

- Energy Partner (demand response)
- Distributed generation
- Renewable integration
- Energy storage
- Smart feeders/automatic switching



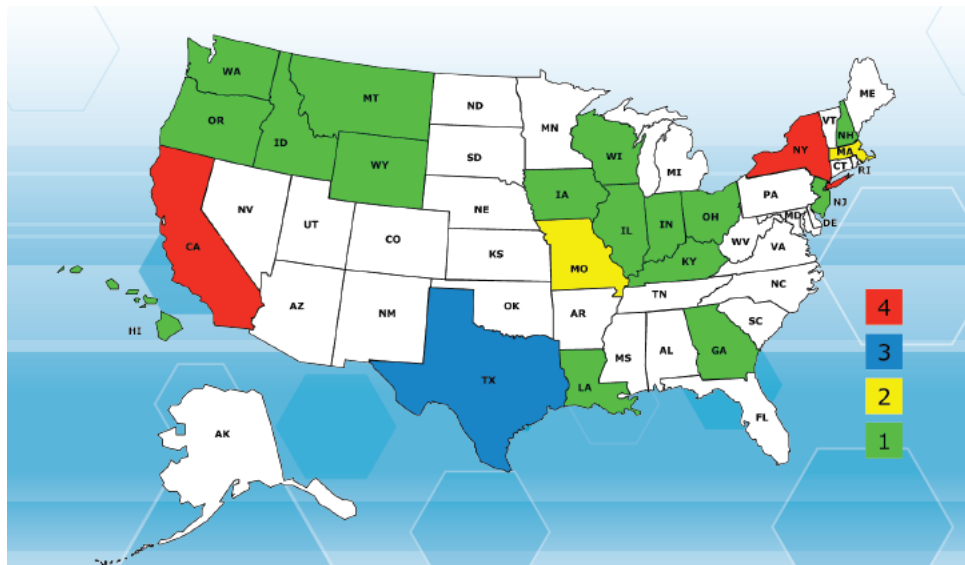
Salem Smart Powersm project

- A project of the Pacific NW Smart Grid Demonstration Project

Recovery Act: Smart Grid Regional Demonstrations

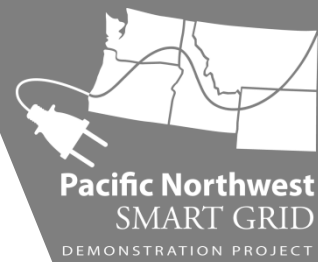
(\$435M Federal; \$877M non-Federal)

16 Awards Support Projects in 21 States



- December 2008 Recovery Act: Smart Grid Regional Demonstrations
- Demonstrate cutting edge SG technology (including integration of renewables)*
- Prove ability/ease to replicate
- Show benefits (with actual data)
- Validate business models
- Address regulatory and scalability issues

Pacific Northwest Demonstration Project



What:

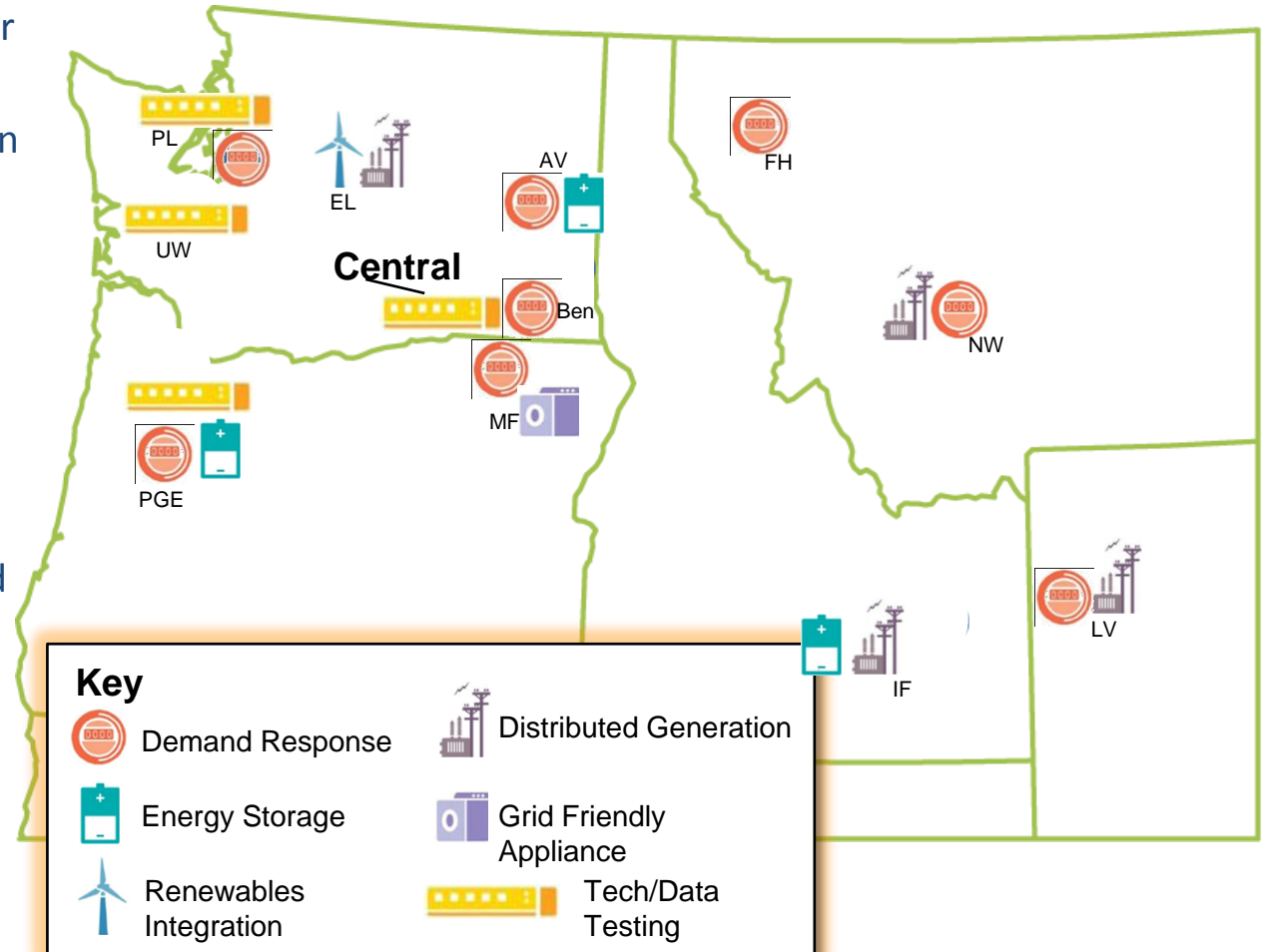
- \$178M, ARRA-funded, 5-year demonstration
- 60,000 metered customers in 5 states

Why:

- Quantify costs and benefits
- Develop communications protocol
- Develop standards
- Facilitate integration of wind and other renewables

Who:

Led by Battelle and partners including BPA, 11 utilities, 2 universities, and 5 vendors



PNW Smart Grid Demo Project: PGE Smart Feeder

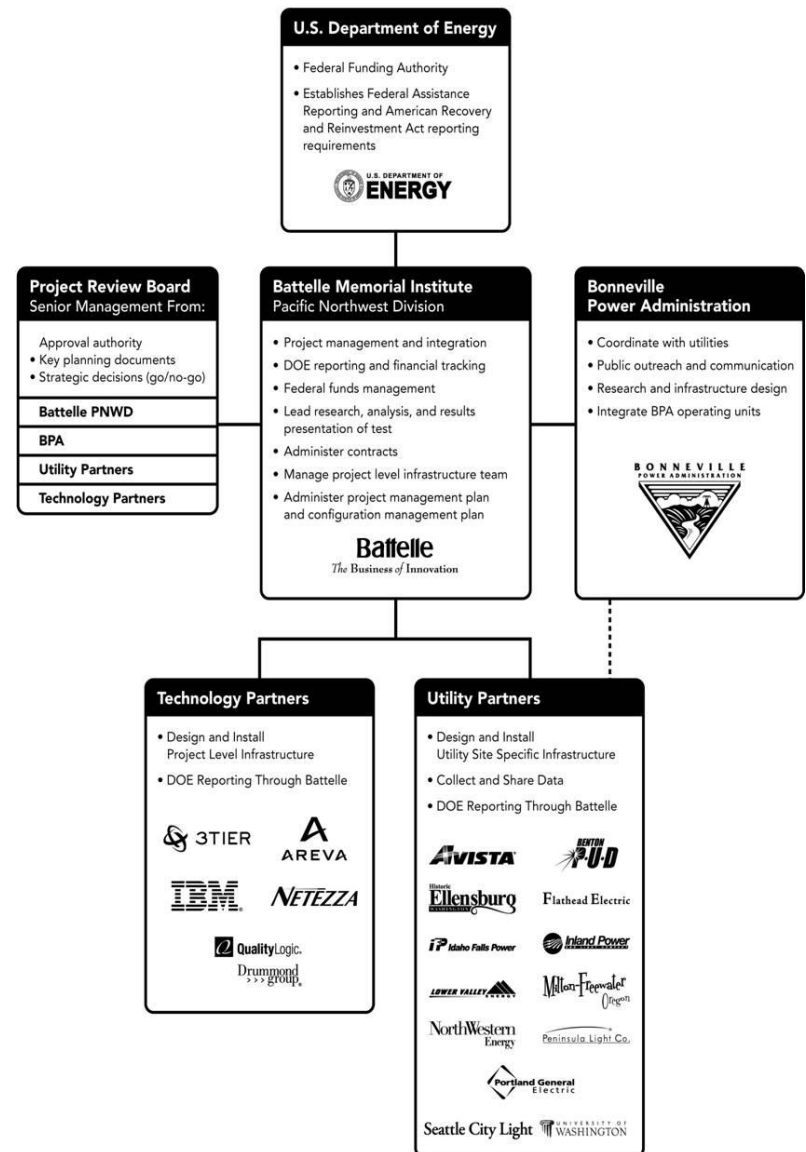
Where: Salem, Ore.

What: 13kV Feeder serving commercial and residential customers

When: 5-year project 2010-2014

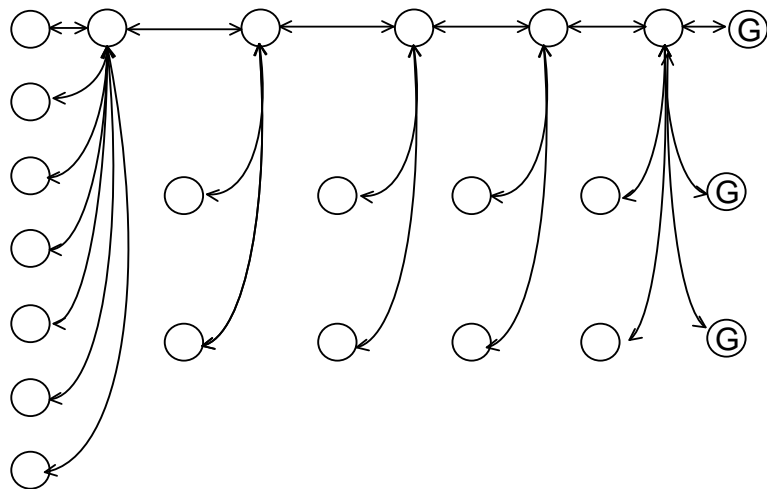
Project objectives:

- Self-healing feeder: Faulted segmented automatically isolated from Grid
- High Reliability Island: Auto isolation of feeder segment from Grid and loads served with available distributed generation
- Advanced battery system. DR, VAR, Power Cost Hedge, & Ancillary Services
- Link system with Battelle's demonstration of a Transactive Control System to demonstrate real time solutions for regional power issues such as low/high wind

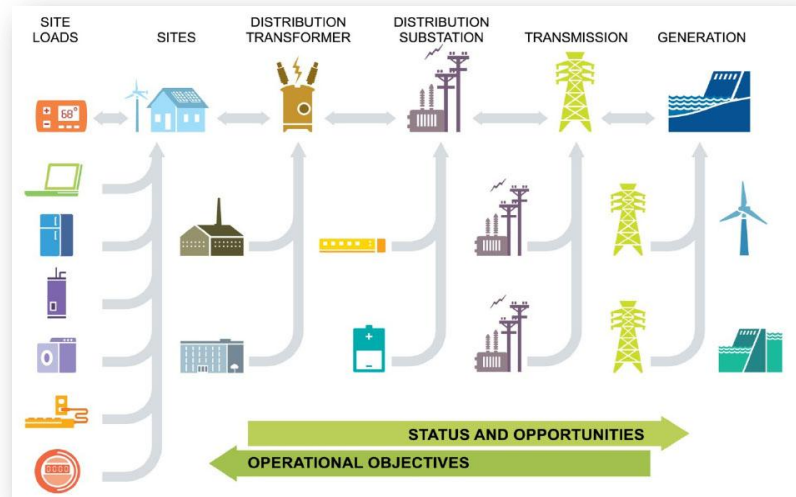


Propagation of the Incentive and Feedback Signal

Incentive signals and feedback signals propagate through an information network that parallels the physical network



**Information
Network**



**Physical
Network**



07-23 9:32:50

Alarm Audio
OFF

07/23/2010 09:08...	UNACK_RTN	3	PSU_Plant	PSU_Lube_OilLubeOilHeat...
07/23/2010 08:28...	UNACK_RTN	1	PSU_Plant	PDIF_Protection_Relays_0...

Off
Re

Log Off

EMS Comm OK

Overview

Generators 1

Generators 2

Generators 3

Bio Fuel

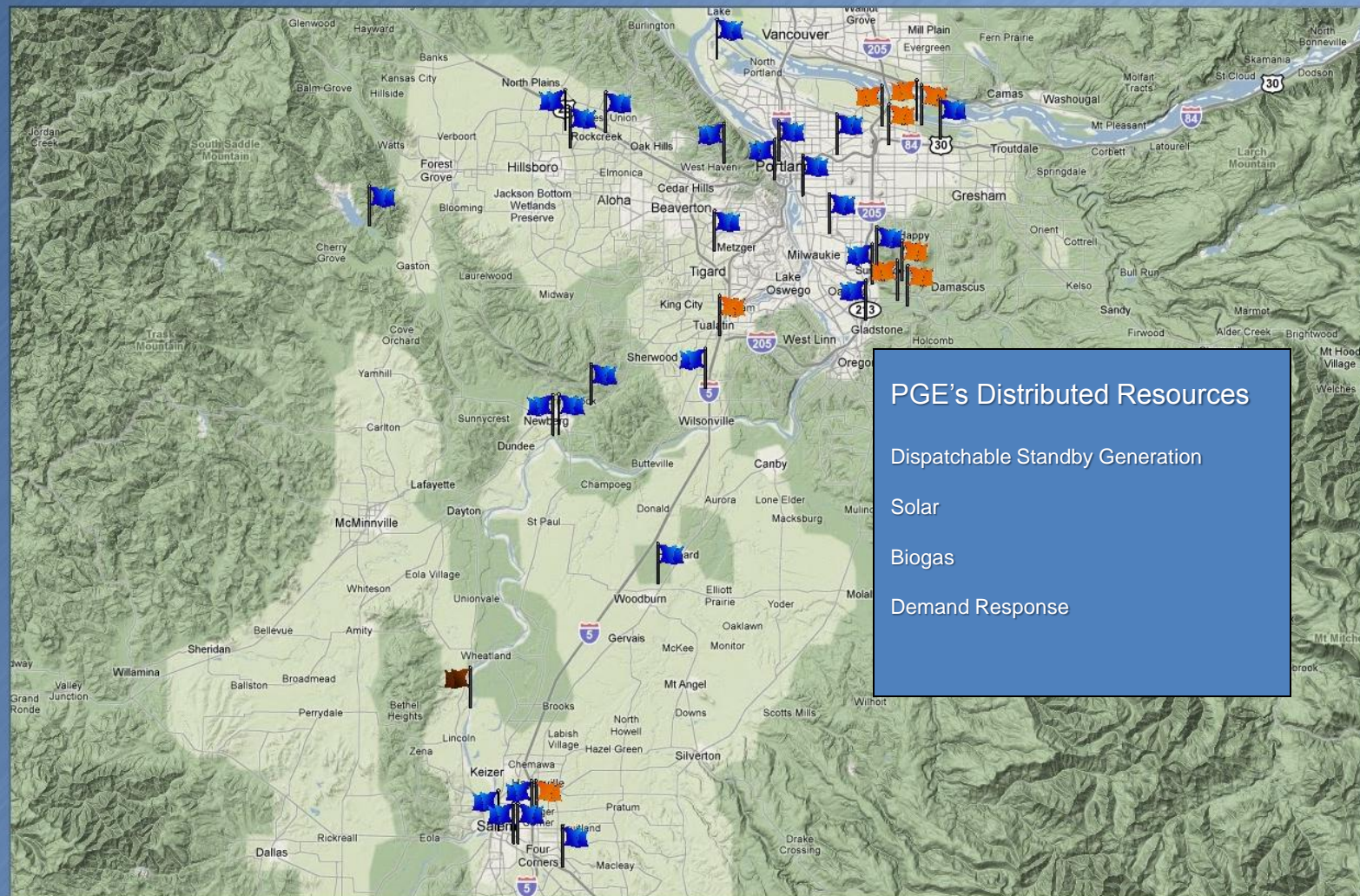
Solar

Wind

Hydro

Demand

EMS



PGE's Distributed Resources

Dispatchable Standby Generation

Solar

Biogas

Demand Response

Demand
Overview
F9

Generator
Trends
F10

Tab 3.1
Tab 3.2
F11

Tab 4.1
Tab 4.2
F12

Wregis
Data
Ctrl+F5

Feeder
Controls
Ctrl+F6

Active Factory
Trend
Ctrl+F7

Archestra
Health
Ctrl+F8

Demand Response



High Reliability Zone

