Bringing the Electric System into the Information Age

Information technology will profoundly transform the planning and operation of the power grid …

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Pacific NW National Laboratory

Modernizing the Grid
Skamania, WA – April 2006
Pacific NW GridWise™ Testbed Projects
Unleashing the power of distributed resources

Summary of Projects
★ Olympic Peninsula Demand Response Demonstration:
  - Integrating in-the-field demand response and backup generators in a virtual operating environment
  - Experimenting to relieve transmission and distribution congestion during peak periods.
★ Grid Friendly Appliance Controller Demonstration:
  - Equipping 150 homes in Washington and Oregon with Grid Friendly appliance controllers on water heaters and clothes dryers.
  - Testing ability to automatically reduce load in response to stress on the grid.

Project Objectives
- Illustrate how the transformed power grid envisioned in GridWise will function and explore key operational benefits.
- Demonstrate how transmission and distribution capacity can be deferred.
- Define the role demand response can play in the future grid.
- Provide demonstrations of significant power quality improvements.
- Develop models for utilities to use to determine cost-effectiveness.
- Make a comprehensive business case for grid-transforming technologies.

Two Current Projects:
★ Olympic Peninsula
★ Grid Friendly™ Appliance

Who Benefits from GridWise?
Bonneville Power Administration
- Reduce constraints on transmission grid
- Provide ancillary services that increase reliability and minimize outage size and duration.
- Optimize cost-effectiveness by minimizing power purchases and maximizing power sales to regional wholesale market

Local utilities
- Avoid need to expand local capacity by managing peak load on distribution system
- Deliver more reliable power to consumers
- Minimize peak demand charges for power

Pacific NW GridWise Project Team
U.S. Dept of Energy
Bonneville Power Administration
Pacificorp
Portland General Electric
IBM
Whirlpool/Sears Kenmore
Port Angeles Municipal Utility
Clallam County PUD #1

Pacific NW National Lab
Invensys
Celerity
Preston Michie Associates
Dr. Lynne Kiesling, IFREE
Olympic Peninsula GridWise Demonstration

Invensys

IBM

Market

ancillary services

distribution congestion

transmission congestion

wholesale cost

Mason 3 & Clallam PUDs
n = 200, 0.8 MW DR

Johnson Controls

Internet broadband communications

Port Angeles Water Supply District,
0.9 MW DR,
0.9 MW DG, parallel

Celerity

Mason 3 & Clallam PUDs
n = 200, 0.8 MW DR

Sequim Sciences Lab,
0.3 MW DR
0.5 MW DG

Port Angeles Water Supply District,
0.9 MW DR,
0.9 MW DG, parallel

Battelle

Northwest National Laboratory
U.S. Department of Energy
Testing Market-based Customer Incentives

- Virtual market – least-cost bids for demand & DG sufficient to manage T&D constraints
- Real-time (5-min.) market clearing — real cash deposits & shadow billing
- Real-time & historical display of resources, costs, prices
- Customer contract choice
- Contract Accepted
- Real-Time Contract Offers
- CPP/TOD Accepted
- Fixed CPP/TOD Real-Time
- Power Price
- Load Behavior
Grid Friendly™ Appliances Demonstration

- Apply autonomous GFA under frequency curtailment response to 200 appliances in 150 residences
  - 150 Whirlpool/Sears dryers
  - 50 water heaters
- Assess performance through correlation with frequency events
  - Event log & load data collection (Invensys)
- Assess consumer acceptance – Whirlpool post-survey
- Perform preliminary assessments of costs and benefits
FACT: In the next 20 years, the U.S. will spend $450B on electric infrastructure, just to meet load growth.

CHOICE: Perpetuate a 20th Century solution OR Invest in a 21st Century system

Information: The Virtual Electric Infrastructure

$ bits << $ iron

The choice is easy because...

Revealing Values + Advanced Controls + Communications = Electric infrastructure

Invest in a 21st Century system saving ratepayers $80B while increasing reliability and flexibility. OR Perpetuate a 20th Century solution

$ bits << $ iron