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Charting a Course to Energy Independence

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Smart Grid Security Considerations

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Pacific Northwest National Laboratory

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- More than 4,000 staff
- Unique capabilities and facilities
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Washington, D.C.

Energy Mission Business Area:
Electricity Infrastructure

- Electric power systems expertise
- Research and development of tools for enhancing electric power system reliability, security, and operational effectiveness
- Electricity Infrastructure Operations Center (EIOC), a national research test bed
- Real-time wide-area situational awareness of the electric grid through an integrated measurement system
- Analysis of large-scale renewable integration to the existing grid
- Advanced information, networking, and cyber security for reliability management services

Smart-Grid Vision

Bring digital intelligence & real-time communications to transform grid operations

- Demand-side resources participate with distribution equipment in system operation
  - Consumers engage to mitigate peak demand and price spikes
  - More throughput with existing assets reduces need for new assets
  - Enhances reliability by reducing disturbance impacts, local resources self-organize in response to contingencies
  - Provide demand-side ancillary services – supports wind integration
- The transmission and bulk generation resources get smarter too
  - Improve the timeliness, quality, and geographic scope of the operators' situational awareness and control
  - Better coordinate generation, balancing, reliability, and emergencies
  - Utilize high-performance computing, sophisticated sensors, and advanced coordination strategies

GridWise® Demonstration Projects

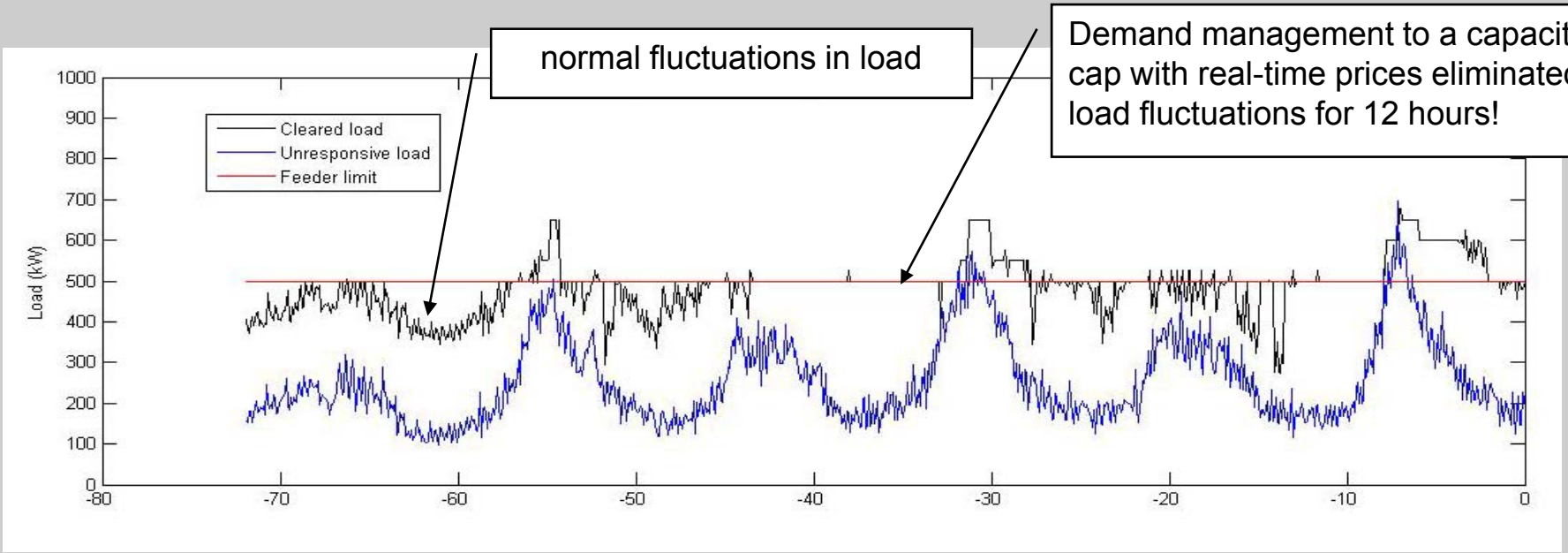
- Olympic Peninsula GridWise demo
  - Explored how consumers respond to real-time pricing
  - Tested smart appliances in 112 homes for one year
  - Tested commercial facility integration with backup generation
  - Real-time, two-way market with real cash incentives
- Grid Friendly™ Appliance demo
  - Tested device response to stress on grid and consumer acceptance of device in appliances
  - Installed in 150 dryers for one year

Olympic Peninsula Demo – Key Findings

- Customers will respond to (~5-min.) real-time prices:
  - Opportunity for significant savings on their electric bill
  - Technology that automates their desired level of response and keeps it simple
  - Complete control of how much they choose to respond and a 24-hour override
- Significant demand response was obtained
  - 15% reduction of peak load
  - Up to 50% reduction in total load for several days in a row during shoulder periods
  - Response to wholesale prices + transmission congestion + distribution congestion
  - Short-term response capability could provide regulation, other ancillary services
  - Same signals integrated commercial & institutional loads, distributed resources (backup generator sets)

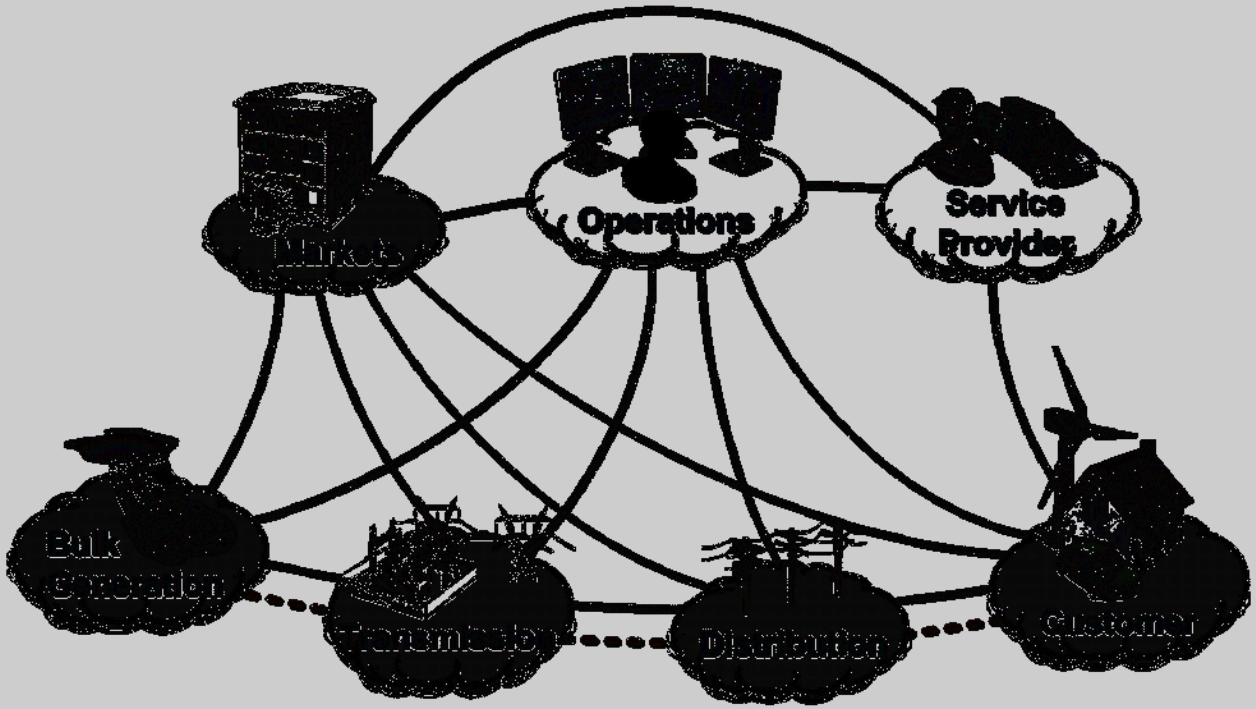
Example Results from the Olympic Peninsula Demonstration Project

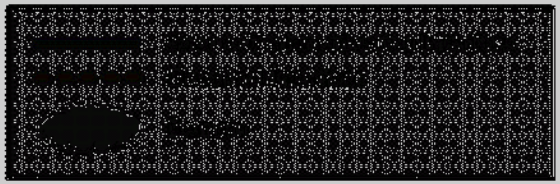
Potential for Demand to provide Regulation Services



Communication and Information Technology will be Central to Smart Grid Deployment

Conceptual Model





Final Interim Smart Grid Roadmap, prepared by the Electric Power Research Institute (EPRI) for the National Institute of Standards and Technology (NIST)

Identifying risks of implementing Smart Grid systems (an all hazards approach)

- Complexity
  - Introduces potential vulnerabilities
  - More access points (increased exposure)
  - Difficult to manage a complex system
- Power system would be more vulnerable to communication (or software) disruptions
  - Denial of service (e.g., unintentional load shedding)
  - Potential for common failure modes across connected systems
  - Software/system integrity (e.g., firmware, logic bomb, supply chain, etc.)
- Intelligence gathering tool for the adversary
- Potential for breach of customer privacy
- Implementation issues
  - Inappropriate or premature mandating of technologies that aren't appropriate for the application
  - Potential for technology obsolescence

Mitigating smart grid implementation risks

- Develop security controls
  - Policies, procedures, control baselines, reference architectures, conformance and interoperability testing, certification
- Need built-in (rather than bolt-on) security
- Apply good security practices
  - Follow best practices, established standards when available
- Apply defense-in-depth concepts
  - Redundancy, zones, proxies, role-based authority, etc.
- Instill a culture of security
  - Training, awareness, adequate resources, management support
- Develop transition strategy that maximizes interoperability, security, reliability, etc.
- Forensics and enforcement
- Establish trusted technology supply chain

Smart-Grid Deployment Is a Journey

- Smart-grid vision aligns stakeholders toward a direction
- Action plans need to prioritize incremental steps that provide acceptable return on investments
- Action plans will have regional and organizational differences
  - Starting points
  - Value propositions and preferences/priorities
  - Government and economic/market frameworks
  - Stakeholder composition (service providers, customer composition, reliability coordinators…
- Long term plans need flexibility to change

One size does not fit all