The Future of the New England Power System & Electric Vehicles

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Evolution of the New England Power System is Underway

- Shifting from reliance on traditional generation resources to greater reliance on alternative resources
  - Demand Resources, renewable resources, storage devices and other “smart grid” resources
  - State initiatives promote significant growth in these resources, including energy efficiency, over time
  - Effective integration of these resources into operations is essential
- Yet, capacity utilization continues to deteriorate (average demand/peak demand)

Integration of Demand & Renewable Resources

Further advances the smart grid concept in New England

- Demand Resources require:
  - Improved communications infrastructure
  - More frequent demand resource activation, including off-peak months
  - Greater dispatch precision to avoid fatigue

- Large amounts of wind resources will require:
  - Model to evaluate AGC, reserve and load following requirements
  - Effective wind forecasting and development of dynamic resource production forecasts
  - Transmission infrastructure to interconnect remote resources

State Initiatives also Further the Smart Grid

- **CT** and **NH:** Testing Plug-In Hybrid Electric Vehicles (PHEVs) that can respond to price signals
- **MA** and **VT:** Establishing pilot programs to reduce customers' peak and average loads through smart meters and load management
- **ALL STATES:** Net-Metering for behind-the-meter wind and solar generation, innovative "neighborhood metering" to share renewable credits

Smart Grid Vision

- Department of Energy's seven characteristics of the Smart Grid:
  - Consumer participation
  - Accommodate generation and storage
  - Enable new products, services, and markets
  - Provide power quality for a digital economy
  - Optimize asset utilization and operating efficiency
  - Responds to system disturbances in a self-healing manner
  - Operate resiliently against physical/cyber attack and natural disasters

ISO New England Objectives for Smart Grid Success

- Standardization
- Elimination of Barriers
  - Markets
  - Planning
  - Operations
  - Regulatory
- Open to a Variety of Technologies
- Collaboration between States, Federal Government, RTOs and all participants

Technologies for the New England Grid

- Peak shaving
  - Demand Response Reserve Pilot Program
    - Distributed Generation (including micro-grids in the future)
- Electric energy storage
  - Examples: PHEVs, flywheels, batteries, other storage devices
  - Pilot program allows flywheels and batteries to provide regulation services
- Advanced Grid Simulator
  - Analyzes operational impacts of alternative resources
  - May also provide economic analysis

Technologies for the New England Grid (cont.)

- Transmission
  - Flexible Alternating Current Transmission Systems (FACTS)
    - Can help integrate wind
    - Allow controllability of network and provide voltage support
  - High-Voltage Direct Current (HVDC)
    - Network control
    - Transmission over long distances

Advanced Meters Essential to Smart Grid

- Advanced Metering
  - Offers:
    - Open Architecture
    - Data Synchronization
    - Communication Standards
  - Provides consumers with information to make informed decisions about their energy consumption
  - Provides operators with operational flexibility

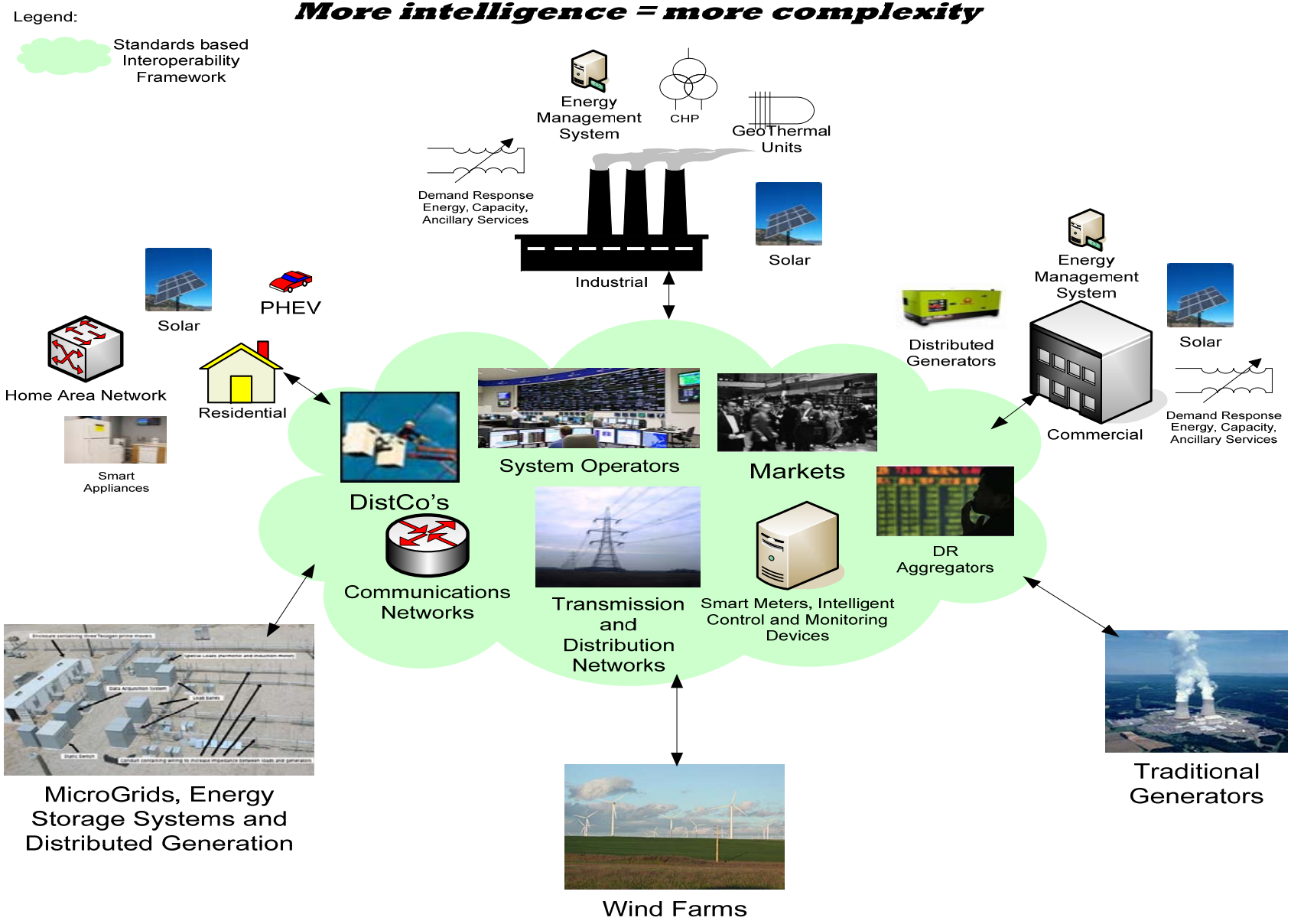
Smart Grid Challenges

- Policy:
  - Lack of national standards
  - Cost allocation for Smart Grid investments across transmission and distribution systems
  - Need for better coordination

- Implementation:
  - Centralized control vs. reliance on distributed resources
    - Observability, performance/reliability, controllability
  - Integration of existing technologies with automated Smart Grid devices
  - Enhanced planning processes
  - Interoperability Framework

The Smart Grid

More intelligence = more complexity



Expected Benefits of PHEV-V2G

- Fast response/ramp time for energy balancing and system emergencies
- Potential to store wind power during off peak periods
- Able to provide ancillary services
- Reduce greenhouse gas emissions

PHEV Integration Issues and Actions

- The ISO/RTO Council effort underway to:
  - Identify products and services that PHEVs could provide under existing market and reliability structures
  - Analyze the impacts to ISO/RTO operations of integrating high volumes of PHEV into markets
    - Identify Technology, Communications, Security and protocol requirements
    - Ensure compatibility with Distribution System Requirements including AMI
    - Identify barriers to entry into wholesale markets

PHEV Integration Issues (cont.)

- Produce recommendations to integrate PHEVs into ISO/RTO markets as seamlessly as possible
  - Propose market design changes and operational requirements
  - Enhancements to existing operational and market infrastructure to ensure real-time performance and visibility to the system operator

- Expected project completion date is October 2009

Conclusions

- The New England power system will undergo major changes in the next two decades
- ISO New England working to ensure that there are no barriers – either in the structure of the market or in our planning – to the development of a Smart Grid and deployment of PHEVs
- ISO/RTOs are committed to working together to create standards and implement solutions for a Smart Grid future