EPRI ELECTRIC POWER RESEARCH INSTITUTE

ElectriNet℠

2009 Technology Innovation Strategic Programs

Overview

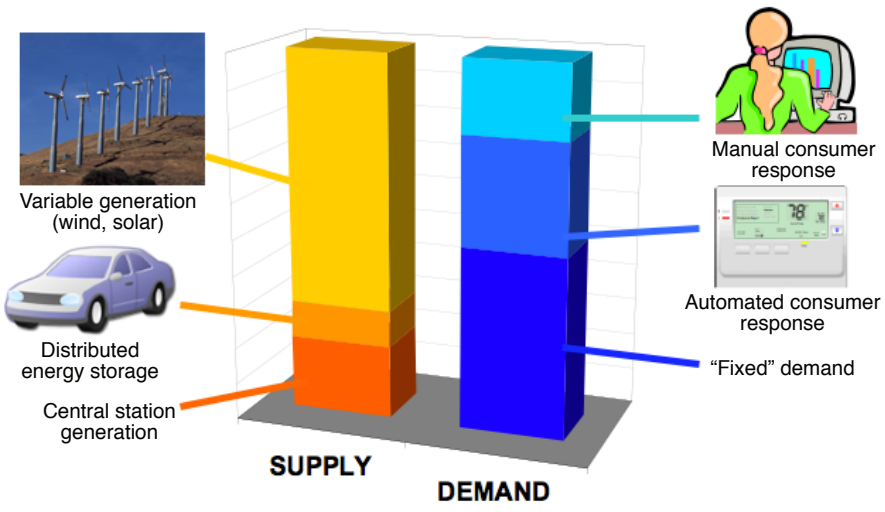
This program will create the framework for an interconnected, integrated electricity-based network through which generators, providers, and users interact to optimize efficiency, reliability, security, and economic and environmental performance. Strategic work addresses knowledge and technology gaps relating to the data exchange, communications, control, and management infrastructure required to support mutually beneficial interactions among individual generation, delivery, storage, and end-use components and the entire ElectriNet.

Current Situation

Efforts to curb CO_2 emissions is leading to expanded adoption of central station and distributed renewable power and electric energy storage, as well as expanded electric transportation and demand response technologies. Regulatory and economic drivers may increase penetration of these technologies to unprecedented levels in the next decade. However, the power delivery infrastructure in its current state may not be able to effectively accommodate the extent and types of these carbon reduction technologies.

The Opportunity

The objective of the ElectriNet concept is to upgrade the transmission grid to a 'machine' that uses state-of-the-art systems engineering, information technology, sensors, communications, microprocessors, and visualization technologies to optimize performance and efficiency. The ElectriNet can be the smart grid of tomorrow. The "breakthrough technology" in this Strategic Program is the development of the ElectriNet itself.



The ElectriNet will balance supply and demand using storage, renewables, demand response, electric transportation, and enhanced power delivery technologies.

Strategic Connections

- Grid Transformation
- Electric Transportation
- Energy Efficiency
- Renewable Energy

The following scenario illustrates the ElectriNet: Advanced detection systems installed near large wind farms sense that within minutes the wind will stop blowing, causing the output from the wind installations to decrease to near zero. As a result, hundreds of megawatts of generation will ramp down. The grid operations center sees the change coming and automatically balances load to match the reduced generation, without affecting consumer comfort or critical services, in the following ways:

- Storage units pump energy back onto the system.
- Consumers receive a "high cost period" pricing signal.
- Plug-in hybrid electric vehicles stop charging and pump power onto the grid.
- The set points on air conditioning thermostats are raised by two degrees.
- The heating coils in clothes dryers turn off.
- One of two heating coils in each storage electric water heater turns off.

- The lights at large retail stores are gradually reduced by 20%.
- Refrigerator and freezer compressors are cycled off.
- Back-up generation at commercial and industrial facilities comes on-line.
- Consumer-owned electric storage units discharge.
- Thermal energy storage units stop charging and are tapped to cool buildings.

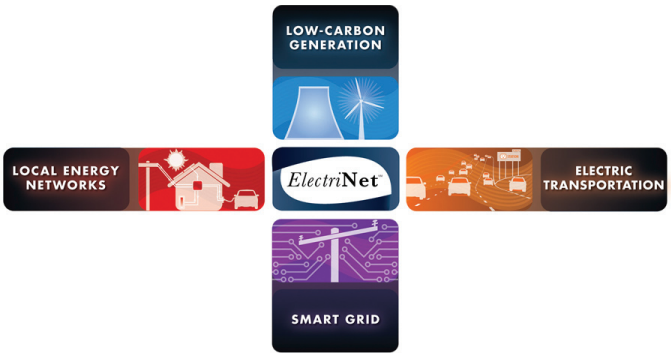
The Program

Working with utilities, equipment manufacturers, and other stakeholders, EPRI will provide fundamental advancements that can make the ElectriNet a reality. The first project in this program will help to further refine the ElectriNet concept to form essentially a blueprint – what it should be, what it should do, and how it should be accomplished – as well as determine requirements, organization, interaction, and components. The second project will define a range of needed analytics. For example, EPRI will assess efficiency and demand response, develop a framework for characterizing market structure, study human behavior factors, and perform cost/benefit analyses. In the third project, the TI team will define hierarchical control structures, develop open standards-based designs for controllers at various levels (e.g., home, neighborhood, area, and region), and assess intelligent agent technology. These controllers will enable load control to optimally balance economy, reliability, and carbon reduction. The fourth project involves a systemic analysis to address the need for open standards for large-scale network management, systems management, and security management. This project will also review requirements identified in the first project, perform gap analyses, and perform R&D to fill these gaps.

Value

The ElectriNet could provide for new linkages and integration in four advanced technological infrastructures. These include a low carbon electricity generation system and an electric transportation system with a seamless grid interface. Additionally, local energy networks may optimize efficiency with diverse, on-site resources in energy consumption, management and production that are grid-connected and optimize energy use and management system wide. The enabling infrastructure will be a smart electricity grid to maximize efficient use of transmission and distribution systems, to integrate intermittent renewables and large-scale storage, and to increase flexibility in siting new generation.

These technological infrastructures will interact in real-time and work together to deliver the most reliable, efficient, and lowest carbon emitting electricity service possible. Utilities benefit by leveraging their advanced infrastructure to provide a range of services to consumers, generating new revenue streams. Utilities may be able to operate their power generation and delivery systems more cost-effectively. They could also be able to install renewable and storage technologies that help them meet renewable energy standards and other requirements. At the same time, utilities may be able to use electric transportation as a distributed load for increased revenue and as distributed resources for a lower cost means of meeting load.



For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com)

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