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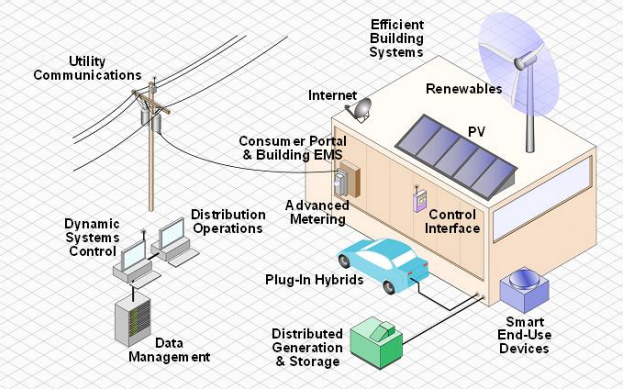
Smart Grid Demonstrations



- **Helps define role for distributed resources and integration requirements in different market environments**
- **Determines requirements for demand side technology integration with system operation**
- **Provides the basis for standards development that will facilitate widespread deployment and integration of distributed resources**

Overview

Achieving significant carbon emissions reductions in the U.S. electricity sector will involve contributions from efficiency, plug-in hybrid electric vehicles and distributed energy resources. The widespread, efficient and cost-effective deployment of these technologies requires new capabilities in the distribution system as well as integration with overall power system operation. Integration of these end-use technologies poses a significant challenge beyond the development and enhancement of the technologies themselves.

This project will conduct several regional demonstrations to integrate distributed power generation, storage, renewables and demand response technology into a demand-side "virtual power plant." Demonstrations will include both utility side and customer side technologies. The project will apply EPRI's IntelliGrid[sm] methodology to define requirements for the technologies themselves as well as the communication, information, and control infrastructures that support integration of the technologies. The main objective of the demonstrations will be to identify approaches for interoperability and integration that can be used on a system-wide scale to help standardize the use of demand-side resources as part of overall system operations and control.

Strategic Value

Integration of demand side resources into the overall operation of the grid is one of the key objectives of the smart grid concept, consistent with the priorities established in the Energy Independence and Security Act of 2007.

This effort will provide a foundation for widespread adoption of demand side resources as an integrated part of overall system operations. Within a shared environment, the operations experience, integration issues as well as management and control issues will reveal the full range of standards and interoperability requirements for these technologies and their associated controls.

The projects will take advantage of investments in infrastructure that are being made across the industry. These investments include communication infrastructures, automation systems, advanced metering, and associated information systems. The demonstration projects will build on these investments and illustrate how distributed resources can be integrated with system operations on top of these infrastructures.

Interoperability is critical in order to reach the level of penetration necessary for distributed resources to have the expected impact for mitigating carbon emissions. This project will apply all existing standards and identify additional standards necessary in order to achieve the interoperability required at all levels of the system.

Technical Description

A highly flexible and configurable interactive network of intelligent consumer devices, market data and system operations is required to enable widespread deployment of distributed resources and load-side resources management. The large number of active and passive devices must be coordinated in the form of dispatchable resources that can be forecasted and verified (virtual power plants).

A first deliverable, the architecture reference design, will provide a conceptual overview of the virtual power plant and will define scenarios of operation of the system from both the utility and consumer points of view. These scenarios will be based on a variety of different system, customer, and market structures where the concept could be applied.

The demonstrations projects will integrate distributed generation, storage, renewables and customer resources in different configurations to accomplish the project objectives. Individual demonstrations can be focused on the integration of specific feeder types that serve residential neighborhoods; a mix of residential, commercial and industrial customers; or mostly commercial customers.

Each demonstration will utilize the communication infrastructure that utilities are installing or have in place that connects consumers and distributed generation and storage located on the distribution system or at substations. The demonstration projects will make use of available and emerging smart home and building technologies, such as intelligent thermostats, energy display devices, adjustable lighting and adaptable HVAC and white goods.

Critical Elements of Smart Grid Demonstrations

EPRI's main objective of the Smart Grid demonstration projects is to identify approaches for interoperability and integration that can be used on a system-wide scale to help standardize the use of distributed energy resources as part of overall system operations and control. Demonstration projects will be selected that most closely align with this objective and have criteria that include:

1. **Application of critical integration technologies and standards**
   The project applies existing and emerging technologies and standards for distributed resource integration (e.g., common object models, communications interfaces, etc.).
2. **Integration of multiple distributed resource types**
   The project integrates multiple resource types (e.g., demand response, local storage, distributed generation, and renewable sources) at both system and customer levels.
3. **Incorporation of dynamic rates or other approaches for connecting retail customers with wholesale conditions**
   The project applies dynamic rates as a means for customer participation in markets and/or to coordinate customer response with wholesale conditions.
4. **Integration into system planning and operations**
   The project has full integration or critical steps to achieving full integration of distributed resources into system operations and planning. Tools and techniques for integration at both the local and system level are be considered. Accommodating distributed resources on an equal footing as supply-side resources in utility operations and

Electric Power Research Institute
942 Corridor Park Blvd., Knoxville, TN 37932 USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com

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planning processes further advance the state of the art in integration techniques.

5. **Compatibility with initiative goals and approach**
   The project is compatible with EPRI's underlying initiative approach and goals to enable high penetration of distributed energy resources (e.g., renewable resources, distributed generation, and demand response) through full integration and supporting interoperability particularly through the application of EPRI's IntelliGrid methodology.
6. **Leverage of additional funding sources (e.g., internal, state, DOE, other research organizations like CEC, NYSERDA)**
   The project leverages additional sources of external funding applied for or already secured.

Roles

EPRI will design the overall scope and manage the demonstration projects. The EPRI collaboration will fund the development of shard requirements, business cases and design efforts. EPRI will lead production of the final deliverables of the project and will disseminate results to the collaboration, suppliers and stakeholders to encourage product development, standards development, and new research to resolve gaps in technologies. The lessons learned and application guidelines developed from the demonstrations will account for interoperability and the more widespread deployment of these technologies to the benefit of the overall system.

Each host utility (or group of utilities) will provide the demonstration site(s) for implementing the virtual power plant concept. Host utility responsibilities will include procurement, funding and installation of the smart devices, controllers and equipment, and customer support for participating utility customers. The host will fund, in addition to the items listed in the roles sectioni, the utility specific requirements definitions and designs.

It will be necessary to coordinate with a wide range of technical stakeholders, standards bodies and other smart grid initiatives. EPRI is planning to form a technical advisory team comprised of members of UCA international, Users Groups, the GridWise Architecture Alliance, DOE, IEEE, other research organizations and manufacturers.

Benefits to Industry

There are a number of benefits to be realized from these demonstrations.

1. Define supporting standards for interoperability between devices and applications
2. Develop guidelines for implementing integrated demand side resource applications (virtual power plant)

Benefits of Joining

Numerous analyses, including the "Prism" analysis at the Electric Power Research Institute (EPRI), show that energy conservation and distributed resource integration are critical elements of an overall strategy to reduce carbon emissions. The smart grid is the enabling infrastructure that makes much higher levels

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of distributed resource integration possible. The value is maximized by Distributed Energy Resources (DER) leveraged at both the local level and the overall system level as a “virtual power plant” to better match energy supply with demand along with related value-added benefits.

Due to the complexity, number and scale of the systems and devices involved in creating a demand-side virtual power plant, interoperability between the various systems is the key to success. An interoperable smart grid Increases competition among suppliers, furthers innovation, increases choice, reduces costs, minimizes capitol risk caused by technology or vendor obsolescence and enables automation resulting in increased value and improved reliability.

Unfortunately, interoperability cannot be achieved by a single entity and requires collaboration from numerous organizations including utilities, regulatory bodies, standards bodies, vendors and more. EPRI’s smart grid demonstration projects are designed to promote and evaluate integration of distributed resources at all levels of the power system operation and the interoperability required to achieve the integration.

Collaborators in the demonstrations will provide the industry leadership necessary to promote and further interoperability. The series of demonstration projects are designed to promote and evaluate integration of distributed resources at all levels of the power system operation and the interoperability required to achieve the integration by taking advantage of the IntelliGrid[sm] methodology to define requirements for the technologies themselves as well as the communication, information, and control infrastructures that support integration of the technologies. The resulting use cases and requirements will be coordinated with many other demonstrations in the industry (such as DOE distribution integration demonstrations) to help develop overall industry technology interoperability requirements.

Collaborators will provide active oversight and guidance to the demonstration projects gaining value based on their unique requirements. Collaborators will also be candidates to serve as a Host Utility for specific project activities. Demonstration activities including analytics, technology development, systems integration and operations experience will be shared directly among participants.

No matter what stage a smart grid project is in from concept to deployment, participants will directly benefit from timely access to industry experts and resources from the EPRI demonstration projects that will identify methods of integration to achieve wide-scale interoperability for the long-term benefits of the industry.

Contact Information

For more information, contact Matt Wakefield at 865.218.8087 (mwakefield@epri.com).

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Electric Power Research Institute
942 Corridor Park Blvd., Knoxville, TN 37932 USA
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