ATTACHMENT 9

EPRI *Smart Grid Demonstration Initiative Two Year Update* (2010).

GridSolar, LLC

State of Maine Public Utilities Commission
Docket No. 2010-267

ELECTRIC POWER RESEARCH INSTITUTE

EPRI Smart Grid Demonstration Initiative

TWO YEAR UPDATE

THE EPRI Smart Grid Demonstration Initiative

The EPRI Smart Grid Demonstration Initiative is a multi-year international collaborative initiative demonstrating the integration of Distributed Energy Resources (DER) in large scale demonstration projects. DERs integrated include demand response, storage, distributed generation, and renewable generation to advance widespread, efficient, and cost-effective deployment of utility and customer-side technologies in the distribution system and to enhance overall power system operations. Large Scale host-site projects apply EPRI's IntelliGrid℠ methodology to define requirements for technologies, communication, information, and control infrastructures that support integration of DER. Operations experience, integration issues, benefits analysis, and lessons learned will reveal the full range of standards and interoperability requirements needed to support the industry. Gaps revealed will identify critical areas of future smart grid research. Public updates are available on ***www.smartgrid.epri.com***.

In the past two years, EPRI and collaborating electric utilities have made significant progress in developing a foundation of tools and references while performing research to support the advancement of integration of Distributed Energy Resources (DER) in large scale demonstrations. Extracting knowledge from not only the individual projects, but also across multiple projects where similar research is being performed, is underway. The collaborative members are identifying the most important smart grid research needs and EPRI will coordinate research across multiple projects to extend more value for all members. This update provides information on the direction moving forward as well as an overview of the work performed since 2008.

Project Overview - Work Performed Since 2008

Task 1: Development of Analytic Methods & Tools

Task 2: Integration Technologies & Systems Development

Task 3: Host-Site Demonstration Selection and Research

Task 4: Technology & Knowledge Transfer

An early part of the project included a heavy emphasis on Tasks 1 and 2 to provide a foundation of resources to be leveraged not only by the host-site projects, but also as long-term resources for smart grid projects being deployed now or in the future. The timing of the US Department of Energy (DOE) Smart Grid Stimulus projects enabled EPRI to coordinate several research activities with them such as the joint development of a common Cost Benefit Analysis Methodology for smart grid projects.

The demonstration part of the project (Task 3) employs the analytical and technical framework in Task 1 coordinated with the new development activities in Task 2. The experience gained from a wide variety of technologies and systems supplies data to models and methods to address barriers and lessons learned, and are combined in Task 4 to provide overall industry results in the form of newsletters, webcasts, reports and face-to-face meetings.

Since mid 2008, the team has been identifying the large-scale host-site projects and as those projects are progressing, EPRI has been able to perform research and provide early results to the collaboration. As of August 2010, EPRI has selected eleven host-site projects and has a solid picture of project activities enabling the collaborative to prioritize ongoing and engage all members of the initiative more fully whether they are a host site or not.

EPRI has a continuous effort to engage utilities around the world as members of this initiative to extend collaboration and lessons to advance the industry. Contact Matt Wakefield (mwakefield@epri.com) for more information.

Collaborators & Host Sites

Extending Value of Individual Host-Site Projects by Cross-Collaboration across Similar Activities Based on Prioritized Smart Grid Needs

Host-Site Demonstrations

Utility Host-Site Demonstrations provide the core foundation of the initiative moving forward beyond 2010. The demonstrations are supported by EPRI in design, implementation, and application of key integration technologies and alignment of project objectives to resolve the information and technology gaps.

The EPRI IntelliGrid℠ architecture is being applied to develop use cases and specify highest priority requirements for communication and control of distributed resources. For each demonstration project implemented, a combination of performance, security, benefits, and/or interoperability assessments are conducted based on data collected through the deployments.

The key to this project is to use the demonstrations to increase knowledge and define the overall industry needs for integration into the overall system, and to build a consensus on the approaches that work best for integration and industry standards based on these approaches.

Issues Based Research - Extending Collaboration across the Demonstrations

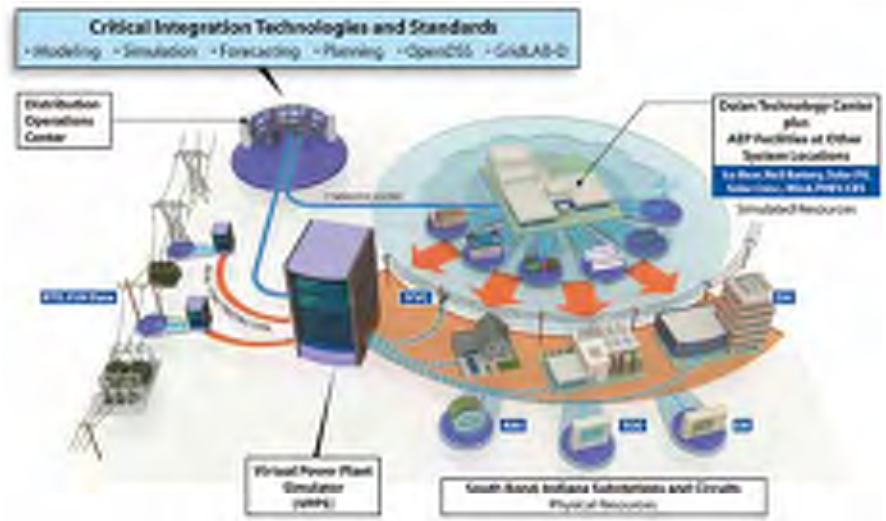
The Collaborative reviews the highest Smart Grid needs and issues annually

	Primary Integrated Technologies & Applications	Smart Grid Demonstration Members																	
		Host Site Collaborators											Collaborators						
		AEP	Con Ed	Duke	EDF	ESB	Exelon	FE	KCP&L	PNM	SCE	Southern	Ameren	CHG&E	Entergy	SPP	SRP	TVA	WPS
Distributed Energy Resources	**Demand Response Technologies**	■	■	■	■	■	■	■	■	■	■	■							
	Electric Vehicles	■		■		■			■		■	■							
	Thermal Energy Storage	■			■	■	■	■	■	■									
	Electric Storage <= 100 kWh (Utility Local Storage, Customer Storage,...)	■	■	■	■		■	■		■	■	■							
	Electric Storage > 100 kWh (Typically at substations or near renewables .)	■						■	■	■	■	■							
	Solar Photovoltaic	■		■	■		■		■	■	■	■							
	Wind Generation	■				■	■												
	Conservation Voltage Reduction (volt/var management and related)	■		■		■			■		■	■							
	Distributed Generation (Microturbin, Fuel Cell, Diesel Generator, Biogas,...)	■	■		■		■		■	■									
Communications and Standards	**Customer Domain** (SEP, BACnet, HomePlug, WiFi, etc.)	■	■	■		■	■		■	■	■	■							
	Transmission & Distribution (IEC 61850, 60870, DNP3, IEEE 1547)	■	■	■		■	■	■	■	■	■	■							
	Operations Domain (IEC 61968/61970, MultiSpeak, OpenADR,...)	■			■	■	■		■	■		■							
	Cyber Security (Authentication, Certificates, Encryption, Intrusion Detection,...)		■	■	■	■	■			■	■	■							
	AMI or AMR	■		■		■	■		■	■		■							
	RF Mesh or Tower	■				■	■	■	■		■	■							
	Public or Private Internet		■	■	■	■	■		■	■	■	■							
	Cellular Based (1xRTT, GPRS, EVDO, CDMA, 3G, LTE, 4G,...)	■		■		■			■	■	■	■							
	WiMAX (IEEE 802.16) Communications			■							■								
Programs	**Price Based (RTP, DA, CPP, PTR, TOU, Block,...)**	■		■		■	■	■	■	■	■	■							
	Incentive Based (DR, DLC, Ancillary Services, Interruptible, Bidding,..)	■	■		■	■	■	■	■	■	■	■							
Ops & Planning	**Integration with System Operations** (RT Visibility of DER, DMS Integration)	■	■	■		■	■	■	■	■	■	■							
	Integration with System Planning (Visibility of DER in planning,..)	■	■	■	■	■		■		■	■	■							
	Modeling and/or Simulation Tools	■	■	■	■	■		■		■	■	■							

Cross Collaboration Opportunities
- Areas of Interest
- Similar Project Learnings

■ This would be a legend-definition of the Host-Site Collaborators

■ Cross-collaborative teams share early technology transfer in targeted topics across member projects.
Results and lessons support existing and emerging projects to advance integration of Distributed Energy Resources



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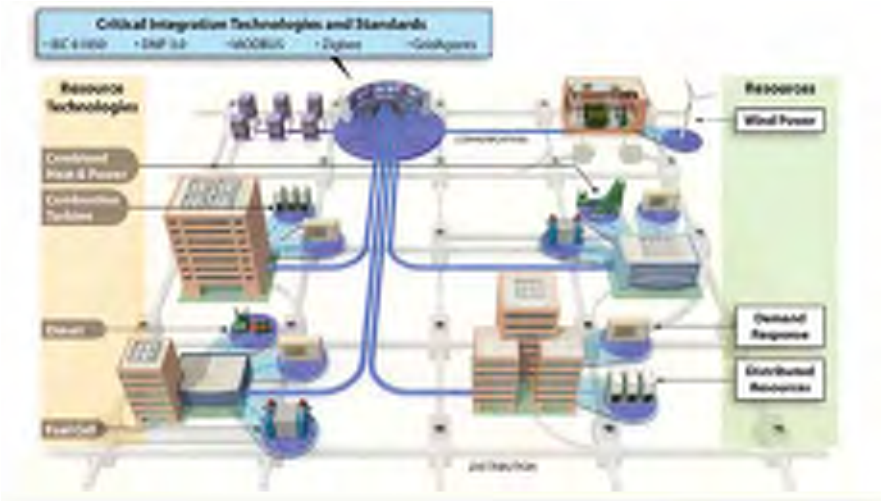
American Electric Power (AEP) Smart Grid Demonstration Project

Virtual Power Plant Simulator

This project is addressing functionality and performance of a fully integrated and robust smart grid, from end-use to Regional Transmission Operator (RTO). It leverages a foundational system (South Bend, Indiana 10,000 customer pilot) that includes smart meters, communications, end-use tariffs and controls, and distribution automation and volt/var control with robust modeling and simulation platforms (e.g. GridLab-D and OpenDSS). Through these simulation platforms we are able to integrate other distributed and end-use technologies that are being evaluated by AEP, either in a real system environment or using real resources at AEP's Dolan Technology Center.

Project Reports Available:

AEP Demonstration Project Description, Product ID 1020188
AEP Demonstration Project Overview, Product ID 1020226
AEP Project Progress Report, January, 2010. Product ID 1020354
AEP Project Progress Report, August, 2010. Product ID 1021501



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Consolidated Edison Smart Grid Demonstration Project

Interoperability of Demand Response Resources

This project targets development of interoperability techniques including the development of protocols and software to leverage multiple types of customer owned distributed generation (DG) along with evaluating the integration commercial building demand response. The primary business case for integrating customer owned distributed resources is related to a major reliability challenge of the Con Edison delivery system due to growth in demand, which is projected to increase another 10% in the next decade in an infrastructure where it is difficult to expand the delivery capacity. While enhancing the use of demand response is critical, it is also a great challenge to harness such a resource. This project will demonstrate methodologies to effectively interface customer resources with electric delivery companies via simple, safe, and cost-effective methods of interconnection to achieve virtual power plant (VPP) functionality.

Project Reports Available:

Con Edison Demonstration Host-Site Description, Product ID 1020190
Con Edison Demonstration Overview, Product ID 1020227
Con Edison Project Progress Report, February, 2010, Product ID 1020355
Con Edison Project Progress Report, August, 2010, Product ID 1021500

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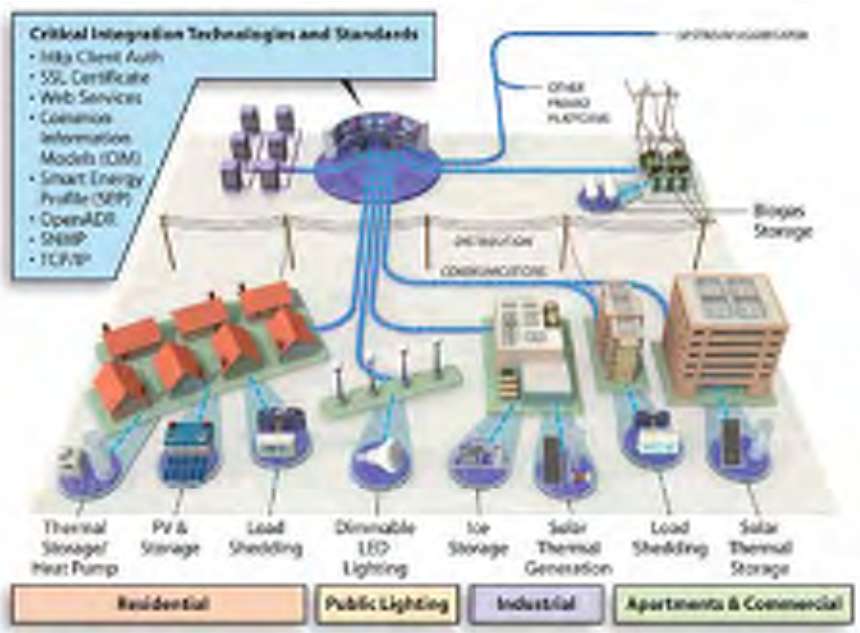
Duke Energy Smart Grid Demonstration Project

The objective of Duke Energy's Smart Grid Demonstration Project is to optimize distributed energy resources to achieve a more efficient and reliable grid, enable improved customer programs, and prepare for increased adoption of distributed renewable generation and Plug-in Electric Vehicles (PEV). To achieve its goal, Duke Energy will install 40,000 advanced meters, 8,000 communication nodes at transformers, and distribution automation including voltage/VAR control, self healing, sectionalization, and line sensors. Five homes will be equipped with solar photovoltaic panels, battery energy storage PEVs, and home energy management systems. The project will employ dynamic pricing for load control and intends for three to five hundred plug-in electric vehicles to be on the roads and charging by the end of 2011. A unique and valuable aspect of the project is the plan to evaluate commuter behavior, technical factors, and data management requirements relating to PEVs operating in different utility service areas; and measuring the transformer impacts of PEV "clustering".

Project Reports Available:

Duke Energy Demonstration Project Description, Product ID 1021399
Duke Energy Demonstration Project Overview, Product ID 1021421



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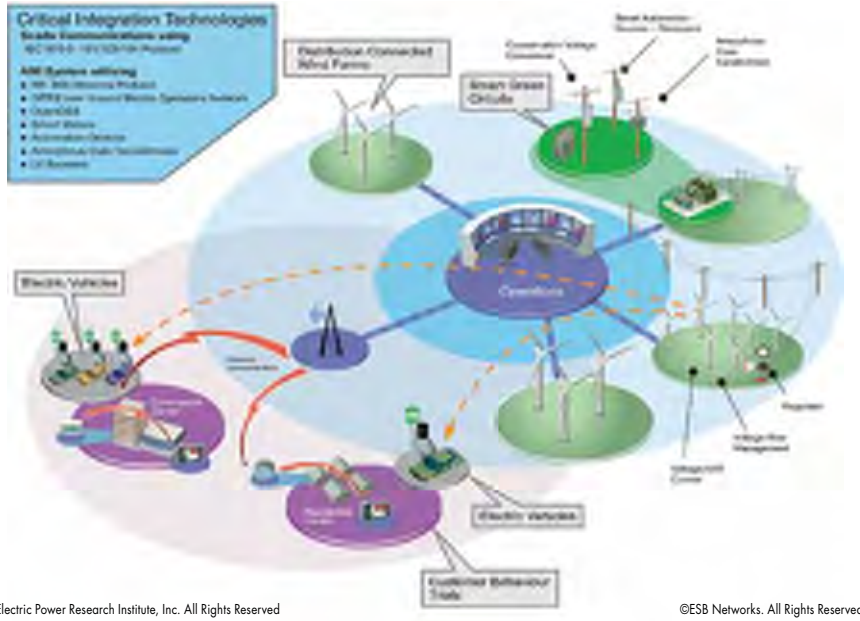
Electricité de France (EDF) Smart Grid Demonstration Project

PREMIO: Distributed Energy Resources Aggregation & Management

The project objective is to demonstrate an innovative, open, and repeatable architecture to optimize the integration of distributed generation, storage, renewable energy resources, demand response and energy efficiency measures in order to provide load relief, local network support and reduce CO_2 emissions in the PACA region (South East of France). This region of France is an electric peninsula supplied by a unique 400kV transmission line to fulfill most of the electricity needs of the customers and local electricity generation covers less than half of the needs. This peninsula effect is aggravated by the distance between generation and consumption sites along with congestion at peak periods affecting reliability during extreme weather conditions (heat waves or thunderstorms).

Project Reports Available:

EDF Demonstration Host-Site Description, Product ID 1020191
EDF Demonstration Overview, Product ID 1020228
EDF Progress Report, August, 2010. Product ID 1021488



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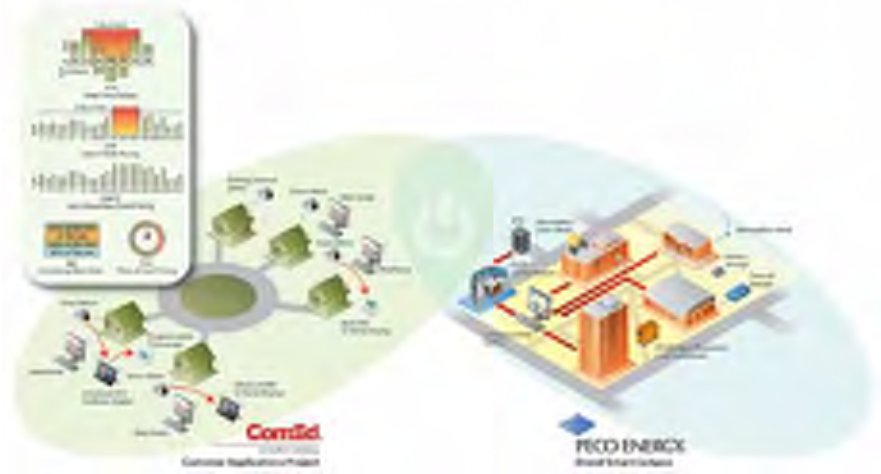
ESB Networks Smart Grid Demonstration Project

This project will explore the maximization of existing electricity networks, further development and connection of wind farms, and the effectiveness of customer response and interest in real-time demand and consumption management. ESB will maximize electricity usage by conducting customer behavior trials with Smart Meters and dynamic pricing, integrating electric vehicles and charging posts into its fleet, and installing "Smart-Green" circuits for remote control and system management. This project will also maximize the amount of wind energy connected to the system through management of voltage, reactive power, and demand. The success of these demonstration projects from a technology and cost benefit viewpoint will pave the way for their wider implementation. This is a major step in ESB reaching it's sustainability goal to have our carbon emissions by 2020, progressing to a carbon net-zero position by 2035.

Project Reports Available:

ESB Networks Demonstration Host-Site Description, Product ID 1020597
ESB Networks Demonstration Overview, Product ID 1020598
ESB Networks Project Progress Report, August, 2010. Product ID 1021489



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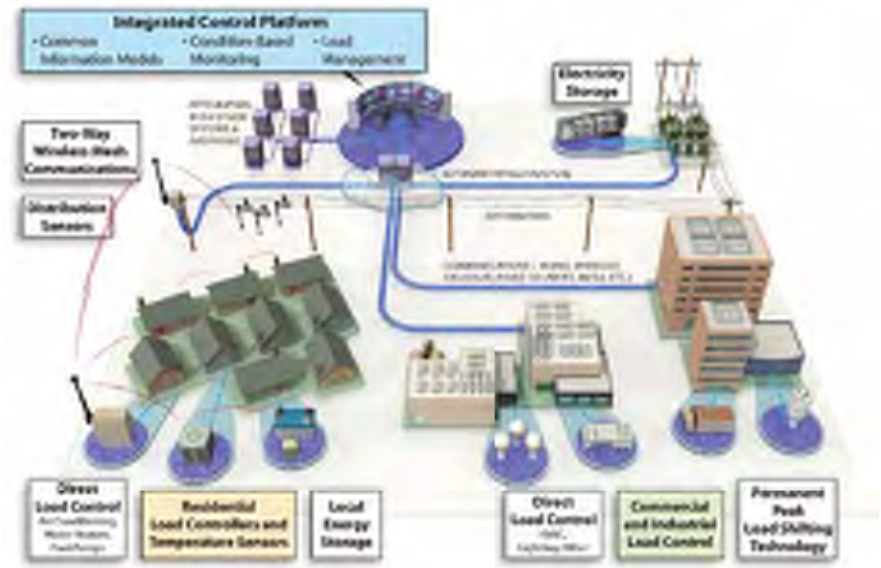
Exelon Smart Grid Demonstration Project

The Exelon project is a collaborative effort bringing together ComEd and PECO technologies and applications to further the industry in regards to integration of Distributed Energy Resources (DER). The ComEd Customer Application Pilot (CAP) is a comprehensive customer behavior study that will provide research to understand consumer responses to varying types of pricing programs in various combinations with enabling technology and education in an opt-out format. The project will enhance the assessment of ComEd's AMI options and support other utilities experience-based data on engaging customers via technology, education, and time-based pricing. The PECO demonstration is a project with Drexel University that will develop and deploy an advanced distributed energy management system to demonstrate economic and environmental value of integrating and optimizing DER through a "Smart Campus" micro-grid capable of aggregating dispatchable demand reduction resources to the regional grid.

Project Reports Available:

Exelon Demonstration Project Description, Product ID 1020893
Exelon Demonstration Project Overview, Product ID 1021419



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The FirstEnergy Smart Grid Demonstration Project

Integrated Distributed Energy Resources (IDER) Management

FirstEnergy is deploying a smart grid project including Integrated Distributed Energy Resource (IDER) management in its Jersey Central Power & Light operating company. Focused on demand management with distributed resources it includes monitoring and direct load control of 23 MW of equipment at 10,000 residential and approximately 100 commercial & industrial locations via two-way wireless mesh communications. An Integrated Control Platform (ICP) monitors the local distribution circuits for system reliability while also monitoring for wholesale energy market opportunities. The ICP can aggregate multiple types of DER over a wide area providing operations management via real-time system status based on pre-defined operating rules. DER technologies include electricity storage, ice storage for permanent peak load shifting, distribution line sensors, substation meter/monitors, and photovoltaics to maximize the learnings of this smart grid project.

Project Reports Available:

FirstEnergy Demonstration Host-Site Description, Product ID 1020189
FirstEnergy Demonstration Overview, Product ID 1020229
FirstEnergy Project Progress Report, March, 2010, Product ID 1020352
FirstEnergy Project Progress Report, August, 2010, Product ID 1021485

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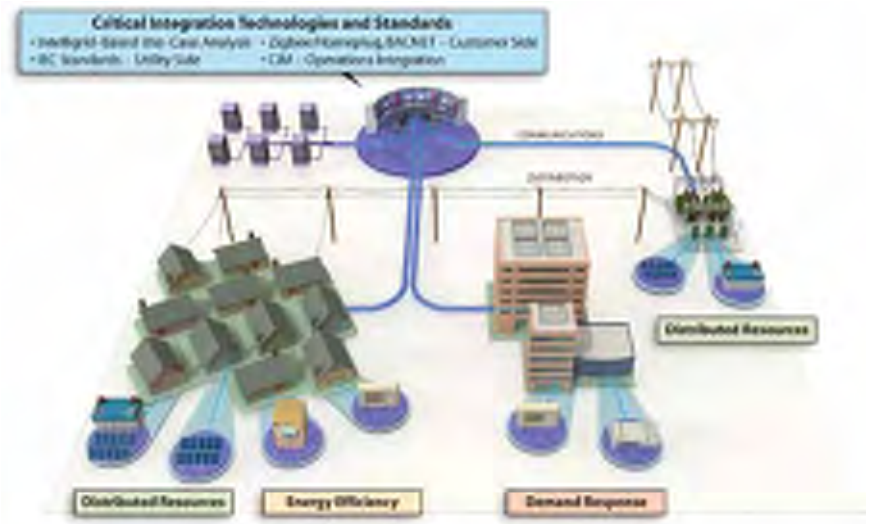
KCP&L Smart Grid Demonstration Project

The Green Impact Zone

The project objective is the integration of distributed resources into all levels of grid operations including market trading, generation dispatch, distribution operations, and consumer interaction that creates an end-to-end SmartGrid from SmartGeneration to SmartConsumption built around a major SmartSubstation. KCP&L will work with select partners to demonstrate and test renewable energy and distributed generation (DG) sources in a way that will provide benefits to an underserved population, in a designated "Green Impact Zone," while enabling key stakeholders to better understand and demonstrate the technologies, business models, and prices required to further commercialize the concepts.

Project Reports Available:

KCP&L Demonstration Project Description, Product ID 1020892
KCP&L Demonstration Project Overview, Product ID 1021418



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PNM Resources Smart Grid Demonstration Project

High-Penetration PV thru Grid Automation and Demand Response"

The project is integrating high-penetration distributed Photovoltaic (PV) systems, local storage, and substation-sited PV and storage with both local distribution system management and overall load management at the system level. At the local level, the project will evaluate smart inverter interface technologies to enhance system benefits, applying previous work in the area of smart inverter interface software to residential and substation-based PV. This project aims to match local loads with rate structures to identify and resolve tech nical issues related to high penetration of renewable generation at the utility distribution level. The project will investigate and analyze additional consumer-based demand response opportunities using a modern communication infrastructure integrated with a Home Area Network (HAN), commercial building control systems and smart devices.

Project Reports Available:

PNM Resources Demonstration Host-Site Description, Product ID 1020187
PNM Resources Demonstration Overview, Product ID 1020230
PNM Project Progress Report, February, 2010. Product ID 102353
PNM Project Progress Report, August, 2010. Product ID 1021490

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Southern California Edison (SCE) Smart Grid Demonstration Project

Irvine Smart Grid Demonstration (ISGD)

This project will deploy Smart Grid technologies to improve the operating performance of local distribution systems and encourage customer participation in the control of electricity demand. The project will illustrate how today's infrastructure will function when combined with a diverse range of Smart Grid technologies; create a better understanding of issues related to integration among utilities and Independent System Operators; and provide an analysis of associated benefits to customers and the environment. The integration efforts will span fundamental energy delivery segments such as system protection and automation, a centralized integrated control platform, distributed energy resources and an array of "edge of the network" devices. The ISGD project is divided into four topic areas including energy smart customer devices, year 2020 distribution system, secure energy network, and workforce of the future. Interacting components will create greater value by supplying additional information used to optimize operation of the components, thus enhancing the reliability of the entire system. The intent of the project is to produce an integrated system of protection, performance, efficiency, and scale that extends across the energy delivery system to provide multiple stakeholder benefits.

Project Reports Available:

SCE Demonstration Project Description, Product ID 1021398
SCE Demonstration Project Overview, Product ID 1021420

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Southern Company Smart Grid Demonstration Project

This project intends to approach the Smart Grid in a fully-integrated systems approach across four retail operating companies: Alabama Power, Georgia Power, Gulf Power and Mississippi Power. Southern Company demonstrates a more complete model of a Smart Grid by incorporating an Integrated Distribution Management System (IDMS), renewable energy generation including PV, landfill gas, and wind, energy storage at transformer and substation level, an intelligent universal transformer, advanced distribution operational measures, customer response to dynamic pricing in two different demographic regions, and new communications applications. By deploying and demonstrating integration of these technologies and applications, it will address many of he unknowns and enable Southern Company to create an overall aggregated virtual power plant, increase system reliability, lower greenhouse gas emissions, and lower system demand.

Project Reports Available:

Southern Company Demonstration Project Description, Product ID 1021400
Southern Company Demonstration Project Overview, Product ID 1021422

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Time

A Smart Grid Reference Library

Tasks one and two of the smart grid demonstration initiative provide a foundation of analytic methods and tools as well as references to support integration of technologies and systems in support of DER integration.

A significant amount of effort up until now has been focused on creating this "toolbox" of resources for our members to support deployment of their own smart grid projects as well as in direct support of the host-site projects. The intent of this library of resources is to make available a large array of tools to support smart grid projects whether they are being deployed today or five years from now.

The following section provides an overview of all of the deliverables developed to-date for task one and two.

Analytic Methods & Tools

Analytics provide a structured framework for characterizing the integration issues to be addressed and guiding principals for supporting large scale demonstrations.

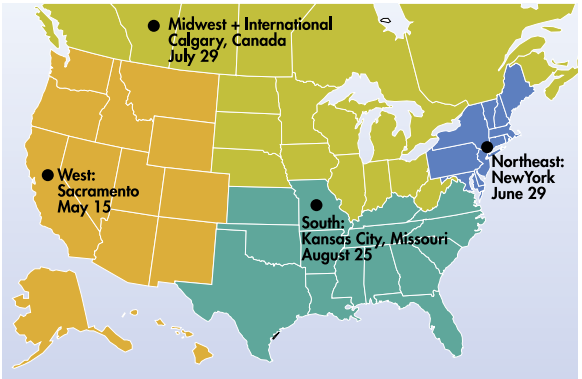
Objectives of this task include environmental and economic impact, system reliability, power quality, system security, and other goals for applying distributed resources.

This task draws upon the foundation of research developed in relevant EPRI program areas such as Energy Utilization and the IntelliGrid℠ methodology. Areas of focus includes DER as a factor in planning and operations, integration approaches, quantifying the firmness of these resources that can be coordinated to support grid and market operations, and their potential impact in mitigating green house gas emissions.

Integration Technologies and Systems

Critical integration technologies and systems include smart grid architecture design, common information model, DER controller specifications, and communications interfaces and protocols. This task focuses on identifying and supporting the design and deployment requirements of technologies that may be instrumental in achieving widespread integration of DER.

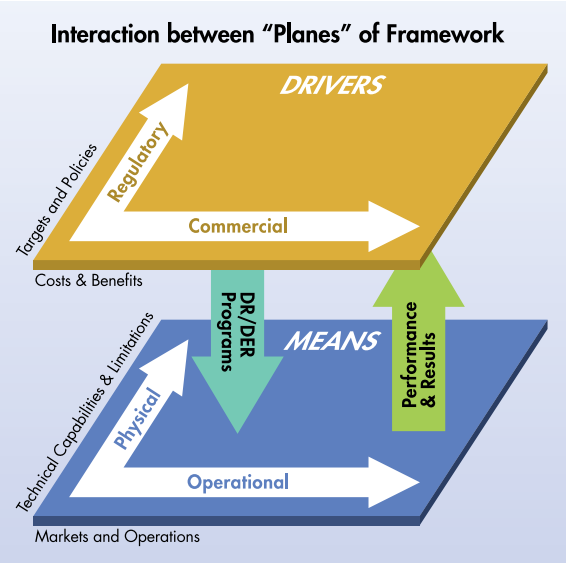
Tasks include developing common information models for DER, system interfaces, and local controllers. This task includes working with standards bodies and organizations like NIST to identify critical gaps in market and system protocols and develop workable methods that can be demonstrated to address the identified gaps. Many of these subtasks occur in conjunction and interactively with the actual demonstration efforts and contribute to the objectives of the demonstrations while the demonstrations provide the foundation for these development efforts.



Regional Profiles on Drivers, Barriers, and Activities for Distributed Resource Integration

Product ID 1020312.

In 2009 EPRI conducted regional workshops and surveys to identify 1) regional drivers and challenges for distributed resource integration, 2) activities to integrate distributed resources in grid and market systems, and 3) existing and planned smart grid demonstrations. The report summarizes regional profiles and lessons learned from literature search, surveys, and workshops. The report also highlights regional differences and identifies demonstration needs.



Distributed Resource Integration Framework; A Reference Model for Characterizing Projects and Relating Programs that Integrate Demand Response and Distributed Energy Resources.

Product ID 1020313

This report defines a framework for assessing current issues and considerations associated with the deployment and operation of distributed resources. The framework is a guide that can assist utility personnel, distributed resource owners, and other stakeholders in planning and comparing distributed resource integration projects and programs. The framework provides a structured organization of the various elements associated with distributed resource integration, including regulatory, business, technical, and operational issues.

Methods to Firm Distributed Energy Resources

Product ID 1020385

Traditional energy delivery system planning and forecasting struggle to accommodate the value-based integration of DER, this report discusses what quantifications need to be made in an integrated service and value model and what operational aspects are required to support accurate implementation of this model.

> *In general, the more precise the interactions between the specific and dynamic services, the more firm the resource, the greater the benefit and the higher the value derived.*

Methodological Approach for Estimating the Benefits and Costs of Smart Grid Demonstration Projects

Product ID 1020342

This report represents a jointly funded effort between EPRI and the US Department of Energy (DOE) to develop comprehensive framework for estimating the benefits and costs of smart grid projects and a step-by-step approach for making those estimates. Four main benefit categories have been identified

Benefit Category	Sub-category
Economic	Improved Asset Utilization
	T&D Capital Savings
	T&D O&M Savings
	Theft Reduction
	Energy Efficiency
	Electricity Cost Savings
Reliability	Power Interruptions
	Power Quality
Environmental	Air Emissions
Security & Safety	Energy Security
	Safety

Given a standardized set of smart grid functions, benefits and mappings of the functions to benefits, a ten step process is outlined to estimate the project benefits and costs. EPRI developed a guidebook to facilitate a thorough application of this methodology to facilitate the process.

Cost Benefit Analysis Guidebook

Product ID 1021423

This report is an instructional guidebook for conducting cost-benefit analysis of smart grid demonstration projects based on the "Methodological Approach for Estimating the Benefits and Costs of Smart Grid Demonstration Projects"– Product ID 1020342. The guidebook provides the tools necessary to describe the research plan, identify project impacts, associate impacts with project benefits and perform the cost benefit analysis. The guidebook also provides a framework for analyzing and communicating results. Coming Fall 2010.

The guidebook includes a scenario that provides a complete example of the cost-benefit analysis process and a set of templates providing a user-friendly manual for applying the analysis to smart grid demonstration projects.

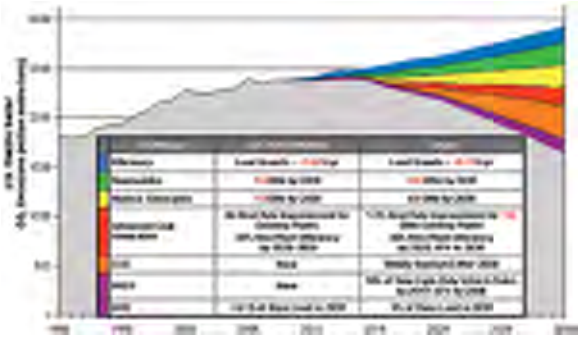
Smart Grid Distributed Energy Resources (DER) Project Assessment

Product ID 1018945

This report includes a Smart Grid Project Self-Assessment spreadsheet that identifies important characteristics of projects integrating DER and the extent to which these projects can fulfill the Smart Grid objectives. The report lists examples of smart grid benefits and summarizes standardization efforts in the power industry as shown in the figure below

Example Smart Grid Initiatives

The Smart Grid Project Self Assessment Tool applies an assessment value to smart grid characteristics such as Reliability, Efficiency, Financial, Security and Environmental Rating based on Technologies Deployed.



The Green Grid; Energy Savings and Carbon Emissions Reductions Enabled by a Smart Grid

Product ID 1016905

This paper, prepared as part of the EPRI Energy Efficiency Initiative is being leveraged in the Smart Grid Demonstration Initiative to support estimating energy savings and CO_2 emissions reduction impacts related to integration of DER.

Impacts are quantified for five applications enabled by a Smart Grid: 1) continuous commissioning for commercial buildings; 2) distribution voltage control; 3) enhanced demand response and load control; 4) direct feedback on energy usage; and 5) enhanced energy efficiency measurement and verification. In addition, estimates of CO_2 emissions reductions impacts were quantified for two mechanisms not tied to energy savings: 6) integration of intermittent renewable resources and 7) facilitation of plug-in hybrid electric vehicle (PHEV) penetration. The emissions reduction impact, based on these seven mechanisms, is estimated as 60 to 211 million metric tons of CO_2 per year in 2030.

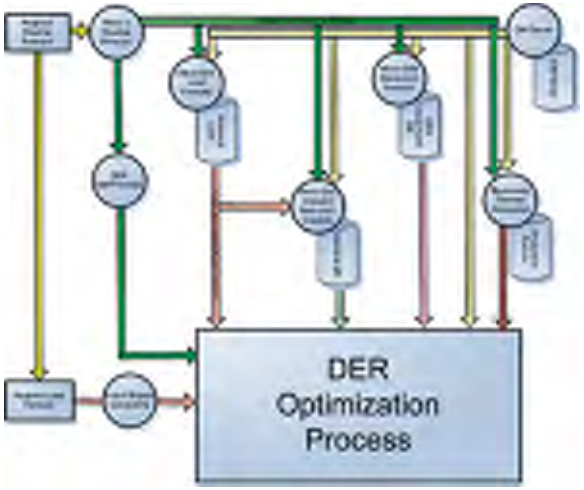
Guidelines for Designing Effective Energy Information Feedback Pilots: Research Protocols

Product ID 1020855

This report identifies protocols for three phases of energy information feedback pilots—research design, analysis, and reporting—along with three example applications. When used as the common basis to develop multiple feedback pilot designs, these protocols provide the opportunity to draw meaningful comparisons across pilots, thus helping to increase experimental generalizability and avoid redundancy.

This report was made available as part of an EPRI Energy Efficiency supplemental project and is a resource of the Smart Grid Demonstrations.

Enhanced and timely information regarding consumers' electricity use and costs may significantly influence their behavior across a broad spectrum of usage and acquisition decisions. Such information feedback has become increasingly important in light of widespread investments in Smart Grid technologies.



Architecture Reference Design for Distributed Energy Resources Integration

Product ID 1020340

The integration of significant distributed energy resources (DER) highlights the complexities of the smart grid. This report develops guidelines for deploying technology and systems that meet emerging requirements for DER communication and control in a way that minimizes the chance of obsolescence during the asset's economic lifetime..

Looking at the breadth of tasks that must be undertaken by DER control systems, it becomes apparent they fall into four broad categories; Deductive, Inductive, Reflexive, and Analytic.

Utility Reference Guide to NIST Smart Grid Standards effort

Product ID 1020343

This report provides an update on the status of NIST Smart Grid Roadmap efforts along with strategies for utilities to consider supporting their smart grid roadmap and corporate strategic plan.

Seven key activities for utilities to support a smart grid roadmap and strategic plan include:

1) Develop a Smart Grid Standards Vision

2) Perform a Smart Grid Standards Self-Evaluation

3) Get Involved and Raise Internal Awareness

4) Engage Suppliers

5) Implement an Organization Structure to support a Smart Grid Infrastructure

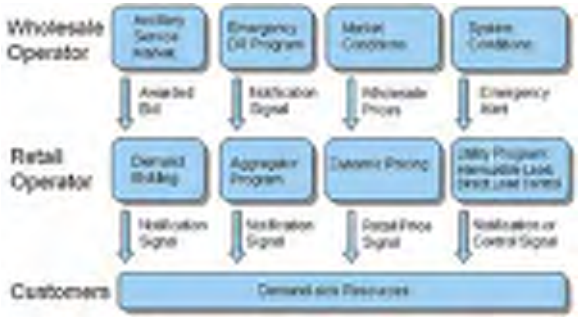
6) Perform a Benefit Assessment

7) Collaborate

Development of Data Information Exchange Model for Distributed Energy Resources

Product ID 1020832

The study includes discussions on Advance Distribution Automation applications in the Smart Grid environment with integration of Distributed Energy Resources as active participants of power system operations. The potential benefits of integration of DER into dynamic optimization are analyzed. The existing and the requirements for the future information exchange with the DER are addressed. Views on the actors, logical interfaces, and object models involved in the information exchange with DER are presented. The gaps between the current and future states of the information exchange with DER are described, and the migration strategy to overcome the gaps is outlined. Future work is recommended.



Decision Support Tool for Demand response Trigger System (DR Triggers) to Connect Retail to Wholesale Electricity Markets.

Product ID 1020311

This report describes a project conceptualized and executed to help bridge the disconnect between retail and wholesale electricity markets. This project developed a methodology and prototype for a decision support tool to help electricity market participants understand and quantify the value of triggering demand response (DR) to mitigate wholesale settlement costs. Though the methodology is generally applicable, the prototyped tool was developed to prove the concept in the California market. A live demonstration illustrated how the DR trigger methodology could assist short-term procurement personnel in making operational decisions in day-ahead and day-of timeframes. The approach helps market participants determine the financial impact of triggering a megawatt of demand response by time interval and by location.

Assessment of Wholesale Market Opportunities for Participation and Aggregation of Distributed Resources

Product ID 1020314

This report provides an assessment of existing opportunities for participation and aggregation of distributed resources in organized wholesale electricity markets. The result is a reference guide that can assist utility personnel and other stakeholders in identifying real revenue opportunities and associated requirements for the provision of valuable services using distributed resources.

The nine ISO/RTO markets in North America, with a few exceptions, provide opportunities for generation resources to participate in the following market product types

- *Regulation Reserve*
- *10-Minute Spinning Reserve*
- *10-Minute Non-Spinning Reserve*
- *30-Minute Supplemental Operating Reserve*
- *Real-Time Energy*
- *Day Ahead Energy*
- *Capacity*
- *Reliability Unit Commitment*

Opportunities offered to DR and DER are not necessarily the same.

Concepts to Enable Advancement of Distributed Energy Resources

Product ID 1020432

Advancing the ability of the smart grid to utilize DER in a scalable yet straight-forward manner is outlined in the concept paper. We can allow device manufacturers to develop smart-grid products without concern for particular regions or utility programs with a simple, yet flexible, framework. If the utility entity accesses DER via a defined entry point, able to provide the necessary information, the structure beyond that point is flexible and supports innovation opportunities. The entry point for the utility entity is via a REC (Resource Energy Controller). The REC manages Virtual End Nodes (VEN) that can be designed independently as products, devices, buildings, or systems able to interface via the same standard protocols.

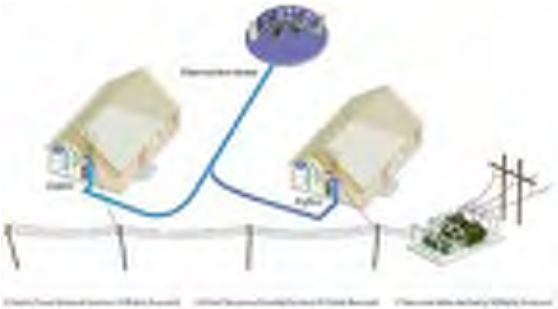
Architecture Considerations for Integration of Distributed Energy Resources; EPRI Smart Grid Demonstration Meeting Panel Session Proceedings, March 4th, 2010

Product ID 1021265

This report summarizes the March 2010 Smart Grid demonstration meeting panel session on approaches for integrating DER.

The meeting included eight presentations focused on architectural approaches to integrate DER comparing various approaches to integrate DER including describing the high-level architecture, functional requirements, benefits and gaps.

A relatively common theme emerged in regards to common functions required to integrate DER. At a high-level, those functions can be broken down into four categories: Distributed Intelligence, Visualization, Forecasting, and Interoperability.

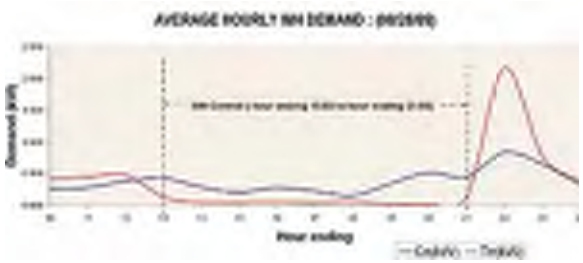


Tennessee Valley Authority (TVA) / Bristol Tennessee Essential Services (BTES) Smart Water Heater Technology and Lessons Learned

Product ID 1020213

This report is a technical description of "smart" devices, i.e. water heaters, and communication infrastructures, particularly Fiber-to-the-Home (FTTH) and ZigBee related to BTES and their electricity supplier, TVA, two-way water heater direct load control project. The report discusses the technical objectives and functional description of the infrastructure in the project.

The smart water heater project is evaluating how electric water heaters can be used to effectively shift peak electric load on a daily basis with no customer discomfort.

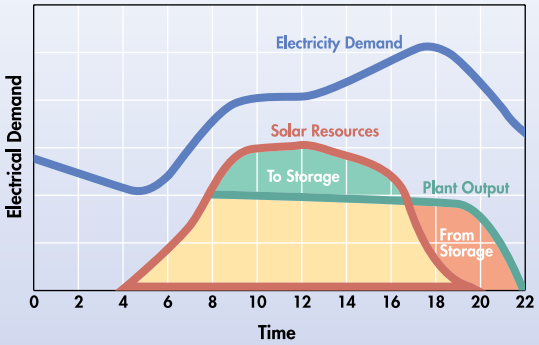


Tennessee Valley Authority (TVA) / Bristol Tennessee Essential Services (BTES) Smart Water Heater Pilot: Summary of Data Analysis and Results

Product ID 1020674

This report describes the results and analysis of electric consumption (demand), demographic, and customer satisfaction data collected from Smart Water Heater Pilot participants in summer 2009. The study evaluates peak demand reduction, recovery peak magnitude and customer satisfaction for sites grouped by similar occupancy and demographic characteristics. The research provides insights into water heater load profiles, impact of control strategies on peak load reduction and the effects of missing data on the validity of the assessment.

The statistical confidence level of demand-shifting and load control analysis relies comprehensively on the accuracy of the first-hand measured data.



Example Technology: Comparison of electrical demand to availability of solar energy from a solar thermal plant

The State of Smart Grid Technology

Product ID 1020415

This report focuses on recent advances in products, methods and software available today or currently in field testing. It is organized based on the fundamental technologies that drive the Smart Grid, integrated communications, energy storage, sensing and measurement technologies, distributed generation, home and building systems, electric transportation and situational awareness and decision support. This report provides an overview with a collection of examples for each of the topic so the reader will gain insight into the current "state of smart grid technology," but is not intended to be an in-depth reference for smart grid technologies. Coming Fall 2010.

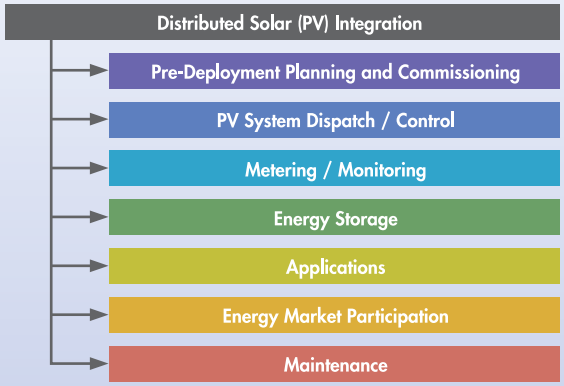
Summary of Potential Use Cases for Distributed Solar (PV) Integration

Product ID 1019584

This report provides a collection of use-case abstracts with potential relation to widespread photovoltaic integration. The collection process focused specifically on applications that drive or are enabled by communications between the utility and the devices in the field.

These abstracts are categorized and presented in tabular format with the sources of the information identified. In cases in which a single use case covered a broad set of scenarios, each applicable part was captured.

In total, 81 use cases were identified.
These were loosely sorted into seven categories:



Accuracy of Digital Electricity Meters

Product ID 1020908

Although this white paper was not developed within the Smart Grid Demonstration Initiative, it is an example where EPRI collaborates internally to develop public white papers and reports that support smart grid research across multiple programs. This EPRI white paper reflects on the transition in residential metering and assesses and identifies several factors that may influence how digital meters are perceived. Three key takeaways from this paper are:

1) In the last decade, the electricity industry has witnessed the close of a 100 year history of electromechanical metering. Electromechanical meter production has halted.
2) The reason for the move to digital meter technology has been functionality. Today with the greater needs for more information so the meter can do more, the industry has moved to this platform.
3) The industry must continue with the ongoing refinement of these solid state products and optimize them as far as reliability and durability.

Technology Transfer

This task provides timely and useful interpretations of the results and syntheses of lessons learned across all demonstrations. Sharing of results occurs in face-to-face meetings three times per year, webcasts, reports, newsletters, and the EPRI Smart Grid Resource Center (website). The workshops include presentations on status of field demonstrations, lessons learned thus far, architectural challenges, issues impacting standards, and common interest areas to explore. Technical summaries in the form of presentations and white papers/articles are prepared for public dissemination. These publications include synthesis of contributions to standards bodies and common messages to deliver to industry and public entities such as state and federal agencies. The purpose is to inform and coordinate with standards bodies, regulators, and industry at large on critical issues towards overcoming challenges in distributed resource integration. Use case and requirements contributions will be provided and housed in a common repository, along with technology assessments and lessons learned.

EPRI Smart Grid Resource Center

www.smartgrid.epri.com

The Smart Grid Resource Center is the EPRI web-site where public information regarding EPRI Smart Grid research is posted not just from the Smart Grid Demonstration, but also information from other EPRI smart grid programs.

The web-site includes presentations, whitepapers, a smart grid events calendar, news updates with an RSS feed, industry links, the use case repository, and more.

EPRI Use Case Repository

www.smartgrid.epri.com/Repository/Repository.aspx

EPRI has developed an internationally recognized use case repository outlining requirements for numerous smart grid applications.

Use cases are a valuable method of documenting applications and processes to define requirements. The EPRI IntelliGrid℠ program developed an architecture methodology for the Smart Grid that includes initial definition of many use cases across different domains that can be part of the Smart Grid. Many utilities have continued to use this method of defining processes and applications for their own Smart Grid requirements development efforts and all of the smart grid demonstration projects in EPRI's initiative will be documenting requirements and building on this library.

EPRI Pre-Workshop Proceedings: Active Distribution System Management for Integration of Distributed Resources RD&D, Nice France, December 9, 2008

Product ID 1018926

This pre-conference workshop covered two general topics with an overview discussion following the presentations. The first topic was related to national and international examples of distributed resource integration projects and integration. The second topic was related to smart-grid-related research updates. A group discussion on research needs completed the session. This report includes all presentations and a summary of discussions that took place during each presentation as well as during the final discussion phase of the meeting.

International Smart Grid Projects Update

Product ID 1020303

This Technical Update provides an overview of international smart grid projects that are similar in scope to that of the Electric Power Research Institute's (EPRI's) Smart Grid Demonstration Initiative. This initial report focused on three smart grid projects in Germany, "E-Energy: ICT-based Energy System of the Future." Updates to this report will occur throughout the duration of the initiative providing information on related smart grid activities around the world.

Strategic Intelligence Update – Smart Grid Conferences and Events

Product ID 1020214, Oct 2009
Product ID 1020566, Jan 2010
Product ID 1021444, Aug 2010

The Strategic Intelligence Update provides updates on key smart grid conferences and events. As a service to our members, EPRI staff provides trip reports on many industry events and conferences summarizing key take-aways from those meetings. We encourage our utility members to also provide trip reports to contribute to these important updates.

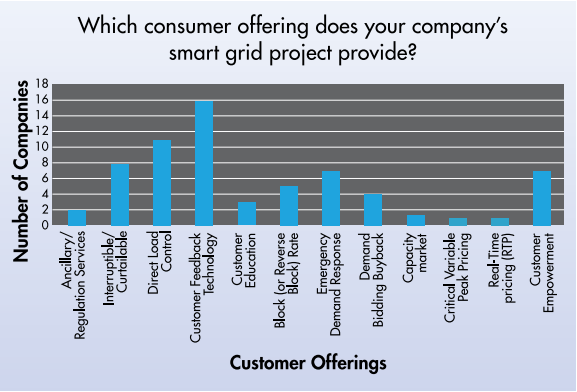
Integration Requirements and Use Cases into an Industry Model

Initial results of Developing a Set of Processes for an Industry Knowledge Base.

The complexity of the Smart Grid will require the use of more sophisticated tools for managing it throughout its lifecycle. Simple paper-based analysis is not sufficient to manage the variety of applications anticipated to share equipment, networks, communications and other enabling infrastructures. This report documents the initial steps in developing and using a model to provide further analysis of industry use cases and requirements to contribute to an industry knowledge base.

EPRI Smart Grid Demonstration Newsletters

This newsletter provides periodic updates on the EPRI Smart Grid Demonstration initiative as well as updates on relevant industry news and events. The newsletter is available via email subscription or directly for download on the home page of the Smart Grid Resource Center (www.smartgrid.epri.com).



Smart Grid Leadership Report: Global Smart Grid Implementation Assessment

Product ID 1021417

This report examines international Smart Grid activities from the perspective of industry experts and utilities actively planning or deploying smart grid projects. The goal of the report is to provide a global perspective on the key drivers for utilities deploying smart grid projects around the world, as well as to develop recommendations that could help accelerate smart grid deployments based on emerging patterns. The analysis of two surveys is underway and this report will be published in the fall of 2010. Initial results indicate the most common smart grid applications being deployed are related to:

- Demand-side integration and empowering customers through price signals, technology and ability to integrate DER
- Improving system performance and power flow through "self-healing", power quality improvements and dynamic line conditioning to improve efficiency.
- Reducing Green House Gases by deploying and integrating renewable generation and optimizing centralized generation

The Electric Power Research Institute, Inc.
(EPRI, www.epri.com) conducts research and development relating to the generation, delivery and use of electricity for the benefit of the public. An independent, nonprofit organization, EPRI brings together its scientists and engineers as well as experts from academia and industry to help address challenges in electricity, including reliability, efficiency, health, safety and the environment. EPRI also provides technology, policy and economic analyses to drive long-range research and development planning, and supports research in emerging technologies. EPRI's members represent more than 90 percent of the electricity generated and delivered in the United States, and international participation extends to 40 countries. EPRI's principal offices and laboratories are located in Palo Alto, Calif.; Charlotte, N.C.; Knoxville, Tenn.; and Lenox, Mass.

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