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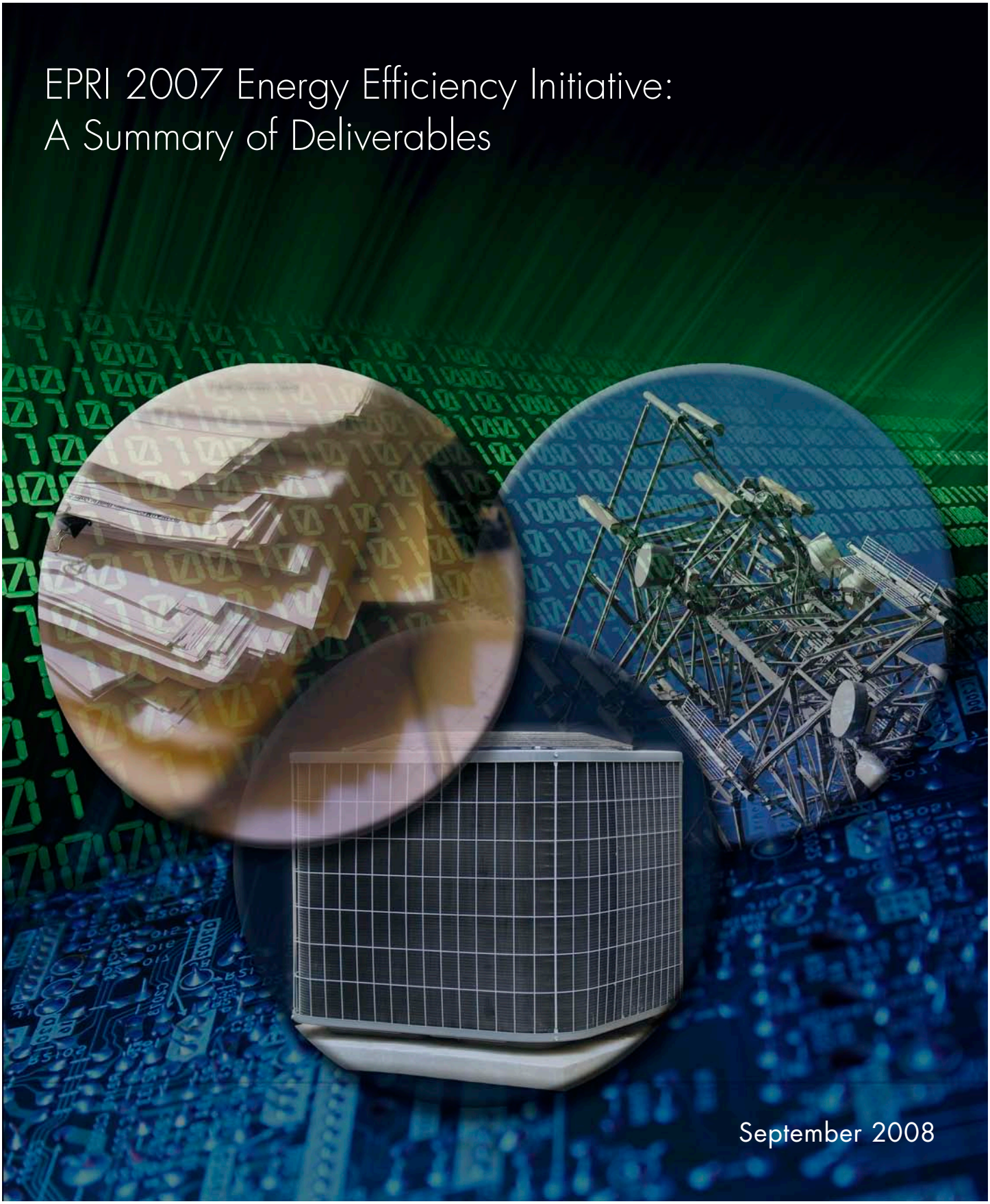
EPRI 2007 Energy Efficiency Initiative: A Summary of Deliverables



September 2008

Abstract

This document provides an overview of the reports, databases, and tools that resulted from the 50+ research projects conducted for the EPRI 2007 Energy Efficiency Initiative.

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EPRI 2007 Energy Efficiency Initiative

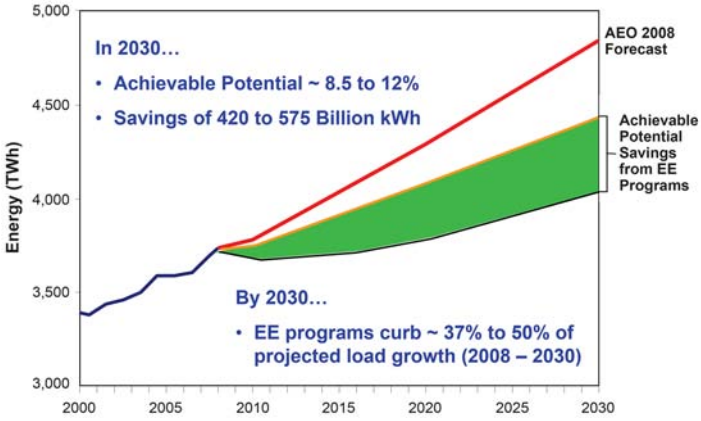
The electric utility industry launched a new initiative in 2007 to investigate, demonstrate, and assess application of efficient end-use technologies and demand response systems. This effort, the 2007 Energy Efficiency Initiative, reestablished the electric utility industry as a leader in energy efficiency RD&D. More than 40 utility companies collaborated to identify cost-effective technology and system options for increasing efficiency and enabling dynamic energy management.

Key Initiative accomplishments include:

- **Creation of a Living Laboratory to test energy efficiency and demand response technologies and their interoperability.** Perhaps the single largest achievement has been establishment of a Living Laboratory dedicated to testing the functionality of products necessary to support energy efficiency and demand response in a smart grid environment—as well as in today's system infrastructure. Products ranging from dimmable advanced lighting systems to programmable communicating thermostats to communication and control gateways have been assessed. Through bench tests and through "living" applications at EPRI staff offices, performance results have been documented, with emphasis on items that can lead to field tests and demonstrations—and system interoperability. The laboratory, located at EPRI facilities in Knoxville, Tennessee, has also served as an educational center, providing a venue for technology tours and demonstrations for utility representatives and the public.

Demonstration in Living Laboratory
Brian Fortenbery, lab manager, discusses with staff how electricity prices displayed on the screen are sent to a demand-response gateway being tested. The gateway routes price signals to equipment such as fans and lights, which are shut off or dimmed in response to varying prices.

- **Development of an information repository on energy efficiency and demand response.** Research results are available as a significant collection of reports and data on technology and program potential, including material related to influencing factors such as greenhouse gas emissions and smart grid development. Through EPRI research, the industry has developed information on load growth (which could potentially offset efficiency benefits) and the potential cost/benefit of energy efficiency and demand response. Major converging factors that affect efficiency and load management are addressed, such as greenhouse gas effects and integration with advanced metering infrastructure and smart grid deployment. A few examples of the studies that have been of exceptional value to utilities are featured in the following section, *Resource Highlights*. A comprehensive list of reports and other resource materials are listed in the section *A Guide to Information Resources*.



Load Growth Could be Cut in Half

Based on modeling used in this study, achievable savings from energy efficiency programs can significantly reduce load growth. ("Achievable" is less than maximum technical potential.)

Resource Highlights

More than 50 projects were conducted for the Energy Efficiency Initiative; the following represent a few that have been of significant value to the utility industry.

Energy Efficiency and Demand Response Potential Study

A joint effort with the Edison Electric Institute, this study assesses the energy efficiency and demand response potential for the U.S. on a regional basis. Many different organizations have estimated these numbers, with sometimes varying and confusing results. This study was designed as a clear assessment of the potential for energy efficiency measures and technologies, based on various scenarios: technical potential, economic potential, and achievable potential.

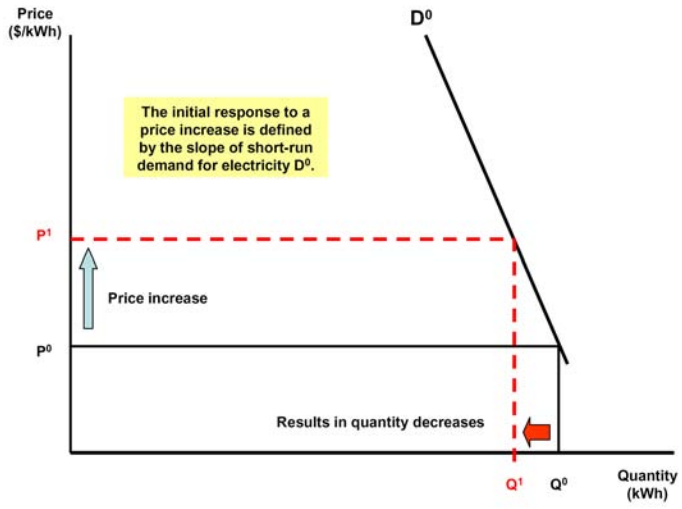
The study includes information on the necessary events and assumptions used to achieve projected energy efficiency levels—data that is often missing from energy efficiency estimates or targets. Results can be sorted to assess what end-use technologies or applications offer maximum achievable potential by region. A PDF version of presentation slides from a June 2008 webcast is available to Initiative members at www.epri.com/eei under What's New. (1016987)

Price Elasticity of Demand for Electricity: A Primer and Synthesis

This groundbreaking paper shows that a wide variety of consumers respond to price when given an opportunity to do so—and that the impacts of price response can be accurately estimated.

A synthesis of recent and relevant studies, this white paper begins with a primer on how price influences demand—and the role of compounding factors. Findings demonstrate that several factors determine consumers' ability to respond.

The relative tight bunching of elasticity estimates from a variety of dynamic pricing pilots, involving different customer segments under different market circumstances, suggests that the effect of



Short-Run Price Response
This figure is one of several in the price elasticity white paper that illustrate effects of price response and concepts of price elasticity.

price response can be estimated quite confidently and accurately. This may embolden those who are already inclined to launch new pricing initiatives, and serve to motivate those that have remained skeptical to take another hard look at the benefits of dynamic pricing of electricity. 40 pp. (1016264)

Commercial Building Energy Efficiency and Efficient Technologies Guidebook

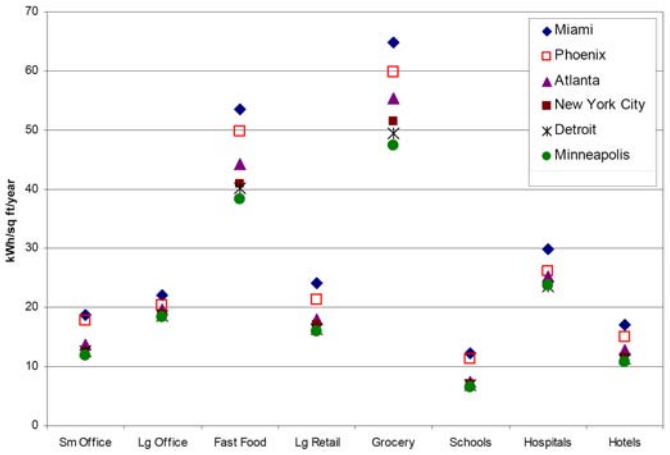
Researchers analyzed the energy use patterns and potential for efficiency improvements for the major commercial building segments that encompass the vast majority of the U.S. building stock. This resulted in a reference that can be used by utilities to benchmark and assess commercial building energy use and efficiency options.

Nine building types were examined for the study—small offices, large offices, fast-food restaurants, large retail facilities, grocery stores, schools, hospitals, hotels, and data centers.

Efficiency improvements for these commercial building types were assessed for six climate regions represented by Miami, Atlanta, Phoenix, New York City, Detroit, and Minneapolis.

For each building and climate zone, two efficiency scenarios were evaluated: an "efficient" case and an "ultra-efficient" case. The energy savings for the efficient scenario range from 12-30% relative to the baseline; for the ultra-efficient scenario, savings range from 19-42%. The report also presents the energy use reductions for a summer peak day at 3 p.m. The peak demand savings for the efficient scenario range from 10-29%, and the peak demand savings for the ultra-efficient scenario range from 22-41%.

This report identifies a set of measures that can potentially be used to achieve energy efficiency savings possible in various scenarios. These include available technologies and operational changes that can be readily implemented in most existing buildings, as well as more advanced technology options that may be used in new construction situations or during a major remodel. 126 pp. (Plus a 182-page appendix) (1016112)



Annual Electricity Intensity by Building Type and Climate
Excluding data centers, this graph illustrates electricity use per square foot in various buildings examined in this commercial building energy efficiency report.

A Guide to Information Resources

Results of research conducted for the 2007 Energy Efficiency Initiative constitute a major repository of unbiased information on efficiency and demand response programs and technologies. Reports, databases and tools that document results are organized according to three different areas: Analytics, Infrastructure, and Smart & Efficient Devices and Equipment.

How to Obtain Reports

2007 Energy Efficiency Initiative reports are available online to funding utilities and can be downloaded by searching www.epri.com by product number (listed after each report description), or clicking on report title or product number links in the electronic version of this overview. Reports—as well as access to databases—are also archived at the Energy Efficiency Initiative website (URL: www.epri.com/eei/). A user name and ID are needed to access the EPRI members' web pages. If you are with an EPRI funding company but do not have these log-in identifiers, you can request them when you visit www.epri.com.

1. Analytics: Economic and Environmental Impacts

EPRI assessed existing data and methods for measuring the economic and environmental impacts of energy efficiency and demand response. Analyses provide approaches and information that can be applied industry-wide, and customized according to specific sectors or territories.

Important results include quantification of the load growth attributable to "plug loads" such as consumer electronics and office equipment, and assessment of the potential for increased efficiency in power electronics. In addition, a model was developed by which to estimate realistic, economic, and technically achievable efficiency potential in all key sectors in the U.S.

Analytics projects included the assessment ***Price Elasticity of Demand for Electricity: A Primer and Synthesis*** and the ***Energy Efficiency and Demand Response Potential Study***, which are featured in *Resource Highlights*. Other projects include:

Energy Efficiency Planning Guidebook

This guidebook explains the process by which utilities can plan, design, and execute energy efficiency and demand response programs. It draws upon fundamental principles and practices of demand-side management, as documented in seminal EPRI studies and honed over decades of utility experience. The guidebook reviews key program activities, including forecasting, screening, estimating savings potential, measuring cost effectiveness, and implementation. This guide is the first of two volumes on demand-side planning. Volume 2, being developed in 2008, focuses on evaluation, measurement and verification of demand response. 298 pp. (1016273)

Levelized Cost of Electricity Analysis: Energy Efficiency and Demand Response versus Generation

This report presents a methodology for calibrating the value of efficient end-use technologies and measures on a levelized cost basis. This enables analysts to compare the cost of demand reduction and efficiency options to generation resources. (1016904)

Assessment of Methods to Quantity CO_2 Impacts

This report explores methods to account for carbon dioxide (CO_2) emission reductions specifically associated with the implementation of energy efficiency programs. It focuses on how to understand, account for, quantify, verify, and optimize how electricity savings may both reduce CO_2 emissions and potentially be granted credits for CO_2 savings that may be traded in cap-and-trade regimes. It also assesses the rationale used by certain emissions trading schemes to disallow energy efficiency as an eligible project category for CO_2 offsets. 74 pp. (1016903)

Utilization of Energy Efficiency and Demand Response as Resources for Transmission and Distribution Planning

This report categorizes delivery-capacity scenarios for which energy efficiency and demand response are—and are not—reasonable options based on existing data. Also included are suggested actions for potentially broadening the use of demand-side resources for T&D planning. 108 pp. (1016360)

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

First-order estimates of energy savings and CO_2 emission reduction impacts were 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 program measurement and verification capabilities. In addition, first-order estimates were quantified for two mechanisms not tied to energy savings: 6) facilitation of expanded integration of intermittent renewable resources and 7) facilitation of plug-in hybrid electric vehicle (PHEV) market penetration. 64 pp. (1016905)

Customer Preference and Behavior: Exploring Customer Segmentation for Utility Energy Efficiency Programs

Despite the benefits of customer segmentation, many utilities still rely on limited (or no) customer segmentation strategies due to high upfront costs and data compilation obstacles. Utilizing both primary and secondary data sources, the paper assesses the merits of previous segmentation approaches, including those developed by EPRI and those used more recently by several featured utilities. Segmentation schemes from other industries that may be relevant to utilities are also addressed. 55 pp. (1016386)

Best Practices in Energy Efficiency and Load Management Programs

This report profiles fourteen exemplary energy efficiency and load management programs and summarizes programmatic best practices based on these and other studied programs. Those selected were identified through surveys of utility members as well as reviews of compendiums of program best practices published by reputable third party organizations. 102 pp. (1016383) In addition, **a database on demand response and load management programs** is available at http://www.epri.com/eei/ (Analytics page)

Dynamic Energy Management: An Approach for Optimal Energy Utilization

This study explains the concept of dynamic energy management, which encompasses the integration of energy efficiency, demand response, and distributed energy resources to optimize the use of electricity to benefit consumers, electric service providers, and society. It entails the application of emerging communications and control technologies enabled by a smart grid. Utility professionals can apply this document as a thought piece to stimulate the formulation of next generation customer energy efficiency and demand response programs. 50 pp. (1016986)

2. Infrastructure

Infrastructure research included technology functionality assessments, development of a design basis for dynamic energy management infrastructure and components, and investigation of application and integration issues. Work in this area established interoperability as the lynchpin for creating an open architecture for advanced metering infrastructure (AMI) systems and has created tools and reference materials that can advance implementation and demonstration of systems. Projects include:

Interoperability Guidelines

EPRI assessed the interoperability of components in advanced metering and demand response systems to assess application requirements. Results include:

Interoperability Robustness Checklist for Metering and Customer Communications

This checklist provides a set of guiding questions to help utilities develop their own requirements for metering and customer communication systems, with the goal of enabling development of systems that can be easily upgraded later on. A strategic framework is provided along with a simplified checklist for the development and design of dynamic customer-to-utility and customer-to-service-provider systems such as advanced metering and demand response. The intent is to help utilities identify technology that is flexible and robust enough to avoid premature obsolescence, vendor "lock-in," and/or system-wide "forklift" upgrades. 106 pp. (1016268)

Interactive Tool for Mapping Applications to Commercially Available Products

This Beta-version software helps utilities assess trade-offs when selecting advanced metering infrastructure systems. It is a simple "expert system" that enables matching technologies to a utility's functional requirements, expediting a process that currently takes months. Functions and benefits can be mapped to technology profiles to help create a list of suitable equipment. To download this tool, go to www.epri.com, log in, and enter product number E230623 into the search field. This will take you to a link to the download. From there, please download the file, extract the contents, and install the files.

Guidelines for System Security and Information System Management

Security and system management are areas that have typically not been addressed in utility automation networks, although they are widely implemented in general computing networks. This document attempts to remedy this lack of information by providing a concise set of guidelines and best practices for performing risk assessment, security management, and system management within utility automation networks. 54 pp. (1016890)

Guidelines for Mapping Requirements to Technologies

In a concise format, this report describes the IntelliGrid methodology for determining appropriate technologies to meet a given set of system requirements for advanced metering infrastructure (AMI). The process consists of three steps: 1) map technologies to functional areas of AMI, 2) map requirements to components and, therefore, functional areas of AMI, and 3) map individual requirements to technologies. 54 pp. (1016889)

Establish a Living Laboratory and Product Database

EPRI tested the functionality of energy efficient and smart technologies and system components in a new Energy Efficiency and Demand Response Living Laboratory created at EPRI facilities in Knoxville, Tennessee (see *Resource Highlights*). In addition to test-bays, the "living" part of the laboratory involves installation of technology in offices and meeting rooms to assess real-world functionality and performance.

Product Database

To identify components and products available for deployment in a smart infrastructure, EPRI surveyed vendors and developed a product database. The Product Database is available to Initiative members at http://www.epri.com/eei (under ***Infrastructure*** and ***What's New***).

Living Laboratory Functional Assessments

A number of technologies of interest for residential and commercial applications were tested to determine if they functioned according to manufacturer specifications. These included residential energy display devices, programmable communicating thermostats, advanced lighting systems, and system gateways for demand response. Assessments available are:

- Residential Energy Display Devices: Power Cost Monitor (1016490)
- Residential Energy Display Devices: The Meter Reader (1016491)
- Residential Energy Display Devices: The Energy Detective (1016492)
- Residential Energy Display Devices: Energy Consumption Monitor (1016493)
- Programmable Communicating Thermostats: Prolifix Internet Thermostat NT20e (1016512)
- Advanced Lighting Technology: Surface Mounted Under Counter Dimmable LED Strip (1016511)
- 400-Watt Electronic High-Bay Fixture for Metal-Halide High Intensity Discharge Lighting (1016521)
- Lightolier's Agili-T Dimmable Fluorescent Lighting System with DALI Controller (1016522)
- IntenCity 2 Solid-State Outdoor Luminaire SL-3200 High Output LED Street Light (1016539)

System Design Basis

So that utilities have roadmaps for a "no regrets" approach for developing infrastructure that can meet emerging requirements for customer communications, EPRI documented system design to ensure that more advanced, later-generation systems will not make initial deployments obsolete. Results include:

Dynamic Customer Design Basis: Assessment of Common Communications Language for Heating, Ventilation, Air Conditioning, and Building Automation

Developing a common communications language for integrating consumer appliances as well as heating, ventilation, and air conditioning (HVAC) equipment is a precondition for massively scaling dynamic customer energy systems capable of demand response and other new functions. This report assesses the status of work on creating such a language and makes recommendations for integrating, extending and harmonizing these efforts. 72 pp. (1016267)

Design Basis for Advanced Metering Infrastructure (AMI)

This report presents a roadmap to creating an AMI system, based on the latest developments in the AMI industry. (1016967)

Member-Requested Infrastructure Research

A number of important and pressing items were added to the infrastructure research agenda of the Energy Efficiency Initiative by advisors and executive council members after the Initiative was launched. Presented in the form of white papers, results include:

Meter Technology

The market for electricity meters is shifting away from kilowatthour only devices to those containing advanced features and functions. This paper focuses on metering technology available today (or in the near future in production volumes) and the features relevant to the future generation of solid-state devices. Critical elements such as meter type (forms), class (current and accuracy), service switches and attributes related to data measurement and transport are presented. In addition to metering technology, a high-level overview of wired and wireless communications technologies used in the metering industry is provided. 16pp. (1016940)

Wide Area Networks for Advanced Metering and Demand Response

A communications system that can securely connect the wide range of intelligent devices in the modern grid requires three layers of technology: a physical means of communications, network infrastructure standards and hardware, and applications level software that allows devices to exchange information. Arriving at a grid modernization vision requires making decisions about all three layers. The report briefly describes the technological options currently available and also discusses the role of vendors in choosing and implementing these options. 17 pp. (1016959)

Securing Utility Networks: Defense in Depth

The utility grid is undergoing major transformations and advancements. New services are being applied to the infrastructure, requiring tremendous emphasis on security. This study is a high-level analysis of securing the grid from a defense-in-depth perspective for the devices that comprise the communications network. Wireless technologies are also discussed because of their widening acceptance and flexibility in the market. 10 pp. (1016942)

Meter Data Management

Harmonizing, normalizing, and validating field-collected meter data presents significant technical chal¬lenges because data must be collected from a wide variety of modern and legacy equipment and yet emerge from the process in a uniform, usable form. This white paper reviews some of these challenges, especially as it pertains to deployment of advanced metering infrastructure. The existing and potential functionality of new meter data management (MDM) systems is covered, and a skeleton MDM deployment strategy is provided that can be adapted to fit specific utility circumstances. Information on five MDM system vendors and their installed systems is also presented. 24 pp. (1016941)

3. Smart and Efficient End-Use Devices and Equipment

To assess the extent to which smart and efficient end-use equipment could function in accordance with utility and consumer energy management needs, the Energy Efficiency Initiative conducted numerous R&D projects to quantify the efficiency potential and application issues related to multiple technologies for the residential, commercial, and industrial sectors.

One outcome of this effort was identification of "hyper-efficient" technologies from all over the world that are now part of a multi-year Energy Efficiency Demonstration that entails field applications designed to fundamentally change how energy is used in U.S. buildings. See sidebar, *A Foundation for Ongoing EPRI Research and Demonstrations*, page 13.

Results, including those leading to the demonstration project, are documented in the following materials:

Commercial Building Energy Efficiency and Efficient Technologies Guidebook

This report details opportunities for improving energy efficiency in commercial buildings. Nine commercial building types in six climate regions represented by Miami, Atlanta, Phoenix, New York City, Detroit, and Minneapolis are addressed. For each building and climate zone, two efficiency scenarios were evaluated: an "efficient" case and an "ultra-efficient" case. The energy savings for the efficient scenario range from 12-30% relative to the baseline; for the ultra-efficient scenario, savings range from 19-42%. The report also presents the energy use reductions for the summer peak day at 3 p.m. 126 pp. (Plus a 182-page appendix) (1016112)

Variable Refrigerant Flow Air Conditioners and Heat Pumps for Commercial Buildings

Used widely in Japan and Europe, variable refrigerant flow (VRF) space conditioning systems have yet to make major in-roads in the U.S. However, because of their energy efficiency potential EPRI examined application of these ductless systems in U.S. multi-zone commercial buildings. This report offers an overview of VRF system technology, advantages and disadvantages for the customer, possible impact on the electric utility, applications recommendations, technology attributes, and market barriers. 20 pp. (1016258)

Guide to Energy-Efficient Ventilation Methods for Acceptable Levels of Indoor Air Quality Levels in Commercial Buildings

This report identifies ventilation methods that can generate energy savings ranging from 5% to 75% relative to conventional methods—without compromising indoor air quality. Ventilation methods covered include an airside economizer combined with demand-controlled ventilation; energy recovery ventilation; ventilation air conditioning; and media filtration combined with gas sorption/chemisorption/biopolar ionization. 104 pp. (1013872)

Space Conditioning Technology Options for High-Bay Facilities

Increasingly, end users recognize that adding space cooling to warehouses or other high-bay facilities may improve occupant comfort, enhance operations, and reduce likelihood of thermal or moisture damage to stored products. But which technologies are cost effective and energy efficient? This report provides results of a comparative analysis of space conditioning systems according to climate region. 168 pp. (1013873)

Air Conditioning Efficiency Under Hot/Dry and Hot/Humid Climates

This report provides background and perspective in response to the move away from one national standard for the seasonal energy efficiency ratio (SEER), to a national SEER and two regional standards. It also offers recommendations for what electric utilities can do in response to the challenges and opportunities presented by regional climate-sensitive SEERs. 50 pp. (1016977)

Automation and Control Protocols in Residential and Commercial Buildings

This scoping study, created to facilitate development of open-standards-based communications, is a guide to features and applications of both home and commercial-building protocols, as well as a guide to activities by trade and standards organizations regarding communications protocols. 124 pp. (1016113)

Residential Heat Pump Water Heaters

Heat pump water heaters are significantly more energy efficient than electric resistance water heaters, but high first costs and past application and servicing problems have limited their use in the United States. In this brief, EPRI provides an overview of heat pump water heaters available today with an analysis of their costs and performance, as well as information on a new technology from Japan, which uses carbon dioxide as a refrigerant. 16 pp. (1015428)

Residential Programmable Communicating Thermostats

Residential programmable communicating thermostats (PCTs) allow customers, as well as utilities or third parties, to program and control temperature set-points remotely, enabling demand response programs. This brief is an overview of PCT technology, with information about vendors, energy and peak load savings, and costs. Examples of utility programs that use PCTs are also described. 21 pp. (1016253)

Residential Energy Display Devices

An in-home energy information display is a tool that can help inform customers about their energy consumption and cost, enabling them to better manage consumption so that they can reduce and/or shift electric load. A description of how display devices work and a summary of how several commercially available displays functioned in EPRI laboratory demonstrations are included in this brief. The status of research on how customers respond to energy information displays is also provided, along with information on selected utility field tests. A list of display device vendors and product descriptions is included in the appendix. 34 pp. (1016972)

Survivability of Electronic Compact Fluorescent Lamps

Data from tests on CFL life, ability to withstand surges, and lumen depreciation are provided in this technical report, along with recommendations on how to avoid failures. Background information on types of CFLs is provided, along with a review of standards. Failure mechanisms of CFLs are discussed with information on how switching, cycling, thermal management, design, voltage quality, and vibration can impact CFL life. 88 pp. (1016202)

Advanced Lighting: Color and Photometrics

The report investigates the changing application of illuminance and two aspects of color performance—color rendering index and color temperature—as the industry develops new metrics for advanced light sources. Research was conducted on how the characteristics of advanced light sources might be better understood to improve lighting design, and how new metrics could help better predict their performance. 142 pp. (1016203)

LED Street and Area Lighting Technologies

This white paper reviews the trade-offs between application of conventional street and area lighting technologies, such as high-intensity discharge and high-pressure sodium, and light-emitting diode (LED) street and area lighting. These trade-offs are presented according to the comparative advantages and disadvantages of LEDs. Five manufacturers of LED street and area lighting systems are profiled, and information is also provided on standards development and research activities related to application of this relatively new LED application. 18 pp. (1016982)

A Bright Idea: Energy Efficient Holiday Lighting

LEDs save up to 98% of the electricity that is needed to power conventional painted or ceramic coated bulbs used for holiday lights. This fact sheet shows EPRI data comparing lumens per Watt of LED lights compared to conventional incandescent lights, along with cost information and examples of incentives offered by municipalities and utilities to switch to more efficient displays. 2 pp. (1017004)

Crosscutting Electrotechnologies for Productivity and Product Quality Improvements

This brief explores the potential benefits of the integrating multi-fuel gas- and electricity-based technologies, focusing on applications where infrared process heating is the electrical component. A case study of using an electric booster to speed an aluminum aging process is featured, and shows that adding the booster can significantly increase productivity as well as improve product quality. 6 pp. (1013867)

Web-Based Industrial Energy Management Tool: Alpha Version for Fruit and Vegetable Processing

This report describes continuing research on the Industrial Energy Management Tool, a web-based software resource intended for the evaluation of industrial energy efficiency measures. This report covers the status of an alpha tool that has been created with the intention of illustrating how energy efficiency information and energy efficiency measures might be prioritized for one example industry: the fruit and vegetable processing. 74 pp. (1013766)

Industrial Energy Efficient Technology Guide 2007

This report updates the 1992 Electrotechnology Reference Guide. The 2007 edition specifically updates information on industrial-sector energy consumption, and the status of energy efficient technologies. Details are provided on electricity consumption for motor drives, electrolytics, process heating, and lighting for 21 manufacturing sectors, with a major emphasis on motor drives and process heating. Current and emerging efficient electric technologies are identified and categorized into one of the following: process heating, electrolytic, or machining and welding. 72 pp. (1013998)

Efficient Electric Technologies for Industrial Heating

Three electric industrial process heating techniques that can be applied in numerous industries, and are generally more energy efficient than existing technologies, are poised to make commercial in-roads. This report provides details on induction heating and melting; microwave heating, drying, and curing; and radio frequency heating, drying, and curing. 20 pp. (1014000)

Specifications of Higher Voltage Resistant Element Process Heater

Conventional electric heaters used in industrial process heating applications typically operate at 480V to 600V levels. Operating at higher voltage levels, such as 4160V or 12kV, significantly reduces load current, which translates into reduced losses and increased efficiency. This brief presents results of the research on the applications, application issues, specifications and deployment status of the higher voltage resistant element process heater technology. 8 pp. (1014001)

Energy Efficient Industrial Waste Treatment Technologies: Scoping Report

EPRI evaluated 53 promising electricity-based advanced technologies for industrial pollution control, wastewater treatment, and solid waste treatment. Six technologies were identified as meriting further development, including photo-oxidation, electrodewatering in belt filter presses, electrohydraulic cavitation induced by ultrasonic irradiation, electrokinetic in-situ remediation, supercritical water oxidation, and UV disinfection using a monochromatic lamp. Monochromatic UV disinfection was selected as among the most promising, and is the topic of the technology brief below. 56 pp. (1016110)

Monochromatic UV Sterilization

Monochromatic UV sterilization is used to decontaminate opaque industrial fluids. This brief describes the technology, with information on its effectiveness in automotive plants for decontaminating metal removal fluids. 7 pp. (1016111)

Improving Data Center Energy Efficiency

Data center efficiency reports are archived under Featured Topics, a section of Energy Efficiency Initiative funders' webpage at http://www.epri.com/eei/. These include:

- High Performance Buildings: Data Centers Uninterruptible Power Supplies (UPS)—Covers design efficiencies, a UPS test protocol, and assesses how to improve UPS efficiency.

- High Performance Data Centers: A Design Guidelines Sourcebook—A set of baseline design approaches, based on benchmark measures from operating data centers, and input from practicing designers and operators.
- High Performance Buildings: Data Centers Server Power Supplies—an analysis of power supply efficiencies, documenting lab and field tests.

Customized data center efficiency services were offered as part of the 2007 Energy Efficiency Initiative as well. Members who want more information should contact Brian Fortenbery at bfortenbery@epri.com, or call 865-218-8012.

A Foundation for On-going EPRI Research and Demonstrations

The Energy Efficiency Initiative has transitioned into on-going, mainstream EPRI programs and supplemental technology demonstrations.

- **Energy Efficiency Demonstration.** This three-year demonstration program, launched in 2008, focuses on the foundation of electricity end-use—the energy-consuming technology that converts electricity in buildings into space conditioning and lighting. This project creates a unique opportunity to demonstrate "hyper-efficient" electric technologies identified during the course of the Energy Efficiency Initiative. These technologies have the potential to reduce energy use in applications by up to 40%, but need to be tested to help understand technical and other obstacles to widescale adoption. Hosted by utilities throughout the U.S., these demonstrations provide information on performance in diverse environments.
- **End Use Efficiency & Demand Response Technology for a Low-Carbon Future, Program 170.** This applied research program focuses on efficient energy use through the assessment, testing, and field demonstration of advanced energy-efficient technologies and integrated demand response systems, and the development of robust analytical frameworks to appropriately value their economic, environmental, and societal impact. RD&D includes tests and applications at the Living Laboratory of lighting, air conditioning, thermal storage, demand-response, and other technology.
- **Infrastructure and Technology for Integrating Demand Response and Energy Efficiency, Program 161D.** A project set of the IntelliGrid program, these projects deals with development and demonstration of low-cost, standards-based, two-way communications between energy service providers and their customers, as well as demonstration of technologies that integrate with this communications infrastructure. The Living Laboratory is used for independent, unbiased assessment of technologies and products.
- **Efficient T&D Systems for a Low-Carbon World, Program 172.** New to the EPRI research portfolio, this program investigates how to integrate energy efficiency and demand response into a comprehensive planning process; assesses the costs, benefits, and performance of technologies capable of reducing T&D losses; and explores the implications of climate change on future T&D systems to improve risk management of assets and improve reliability modeling.

For more details on these programs, see Research Portfolio on www.epri.com. You can also contact the EPRI Customer Assistance Center at askepri@epri.com, tel. 800-313-3774 or 650-855-2121.

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