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# End-Use Energy Efficiency and Demand Response
# EPRI Program 170: 2011 Summary of Deliverables


May 2012

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May 2012 **Program 170: A Summary of Deliverables**

The EPRI research program on End-Use Energy Efficiency and Demand Response (Program 170) is focused on the assessment, testing, and demonstration of energy-efficient and smart end-use devices, as well as analytical studies of the economic, environmental, and behavioral aspects of energy efficiency and demand response.

This program is intended to advance energy efficiency and demand response through objective, independent analysis that addresses fundamental technical challenges and barriers to adoption. Members of our program apply our research findings to mitigate their risk in developing innovative, cost-effective energy efficiency and demand response programs to help achieve their goals.

## Project Set Focus

170A - Analytical Frameworks

170B - Demand Response Systems

170C - Energy-Efficient Technologies

The 2011 reports, tools and resources produced in each of these project sets are available to employees of funding companies, and can be accessed and downloaded by clicking on the download product link listed after each product description. Log-in is required for the EPRI members' website. If you are with an EPRI member company but do not have a username and ID, you can request them when you visit ***www.epri.com***.

## Analytical Frameworks (170A)

This project set develops and advances analytical frameworks, tools, and methodologies to help quantify the resource value of energy efficiency and demand response technologies and programs. Participants are well-positioned to justify associated investments in regulatory filings through frameworks ascribing $CO_2$ emissions reductions to energy efficiency, gauging the phenomenon of customer behavior in response to energy-use feedback and rate structures, as well as the characterization of end-use load data to derive meaningful insights.

### Using Smart Meter Data to Develop Customer Insights

*Technical Update*

Smart meter deployment in the United States has grown steadily in recent years, and market penetration will continue to increase. Globally, smart meters are evolving into a huge market. This flood of smart meter deployments has introduced a new quantity—a significantly large amount of meter data, which could possibly be the single largest volume of data collected and managed by utilities. The potential benefits are significant, but many utilities are assessing methods to manage the volume of data being collected, and customer data analytics have yet to be fully realized. A systematic method is needed to manage and create customer value.

This report describes current utility applications of smart meter data and potential applications for translating smart meter data into beneficial uses for both the utility and the customer.

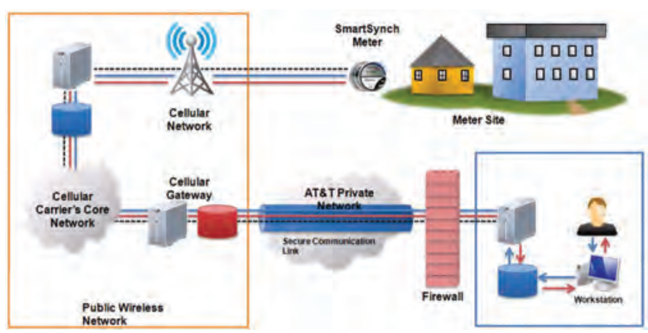
The report was developed with the following objectives:

- List potential utility applications and identify the value propositions of smart meter data
- Collect utility perspectives on current applications and activities as well as proposed plans to develop high-value uses of smart meter data.
- Develop a framework for characterizing smart meter customer data
- Draw conclusions about where data analytics will go

**Key Findings:** The key to unlocking value from the data obtained by smart meters is to develop the means to analyze the data. The deluge of meter data will require careful management and analysis to maximize value to the utility, customers, and society. (***Product Number 1021761***)

### Designing Survey Instruments for Measuring Behavior Change: Applications to Feedback Research

*Technical Update*




This report provides guidance on how to develop survey-based studies and instruments to gather self-reported changes in participant behavior that can be attributable to feedback interventions. The report provides guidelines, intended to complement past EPRI work on behavioral research evaluation, to move researchers through the study design process, from overarching considerations, to setting up the survey research methods to establish attribution, to providing techniques for collecting behavioral information from a survey instrument. Specifically, this report includes key definitions used when discussing survey-based research as well as key questions that should be asked when considering survey

# Laboratory Testing: Energy Efficiency & Demand Response Technology

Located at EPRI facilities in Knoxville, Tennessee, the laboratory is used to test energy efficiency, demand response, and peak shifting technologies and their interoperability in both standard and smart grid environments.

In 2011 EPRI's Thermal Lab brought on line a one-of-a-kind multi-zone space conditioning test stand. It is principally designed for testing advanced thermal systems like Variable Refrigerant Flow (VRF) under controlled conditions. It complements the existing dual-room climate simulation chambers and has added to EPRI's ability to evaluate thermal technologies. Using this new test stand, VRF systems from two manufacturers were tested in 2011 with a third planned for 2012. Additionally, in late 2011, a larger single-room chamber was constructed to enable testing of rooftop and small commercial air conditioning and heat pump systems and commercial heat pump water heaters.

The EPRI Lighting Lab characterizes lighting technology for energy efficiency, demand response, power quality, compatibility, and reliability performance. Technologies include compact fluorescent lamps, electronic high-intensity discharge (HID), induction, light-emitting diode (LED), organic LED, and solid-state plasma lighting devices. In 2011, the EPRI Lighting Lab tested many electronic lighting sources, including OLED-based lighting and mini HID retro devices for HPS replacement, and novel wired and wireless controls, while continuing work with micro HID, halogen, advanced incandescent, LED, CFL, and linear form factor lighting. The EPRI Lighting Lab constantly evaluates new, maturing, and evolving lighting and lighting control technologies to help our members understand lighting technologies and applications.

In 2012, the EPRI Lighting Lab will expand its capabilities by adding a two meter digital integrating sphere which will allow for the absolute measurement of lumen output of large LED systems, electronic HID, induction, linear fluorescent, and other large format and/or high lumen output devices. The addition of a thermal testing unit to this new sphere is currently planned.

EPRI's Living Lab, a unique space that showcases and demonstrates end-use technologies and integrated communications, has been completely renovated. Previous displays have been removed to make way for new and exciting thermal technologies, building technologies, and advanced electronics. An extensive wirelessly-controlled lighting demonstration features advanced lighting technologies including step-dimming induction, Edison-based LED track and can lighting, halogen lamps, and a wide range of novel lighting control technologies. These physical displays are scheduled to be updated regularly as new technologies become available. Various other efficient technologies are displayed via a custom presentation tool used to highlight the technologies and their impacts for utilities and consumers. These presentations occur within a state-of-the-art theater section of the lab which makes use of the latest in 3D video and surround sound audio. In addition, an end-to-end demand response demonstration shows how actions and communications flow from the system operator through the utility to the point of end use.

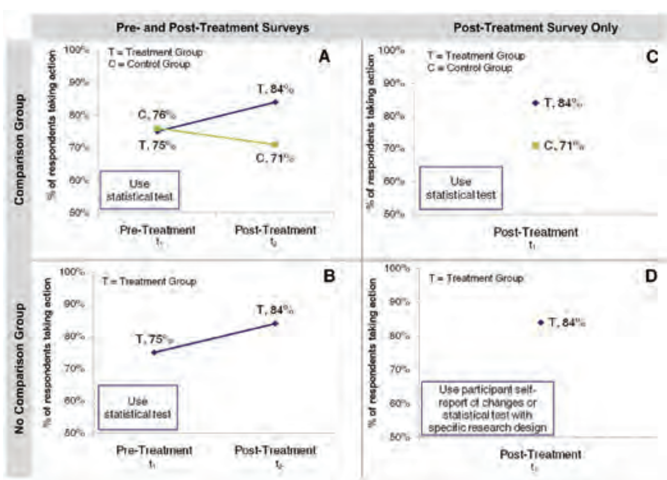
As an educational and demonstration center, the laboratory is a venue for numerous tours. Representatives of many different organizations, including utilities, major media outlets, manufacturers, regulatory agencies, academic and government institutions visit the laboratory, and we look forward to demonstrating our latest features and technologies to new visitors.

design, data collection methods, and data analysis processes. In addition, this report describes the advantages and disadvantages of using different types of survey study designs and data collection methods. Specific tactics for collecting information on behaviors and minimizing bias through a well-designed survey instrument are also described in this report. Finally, the report provides examples of survey questions as well as a survey review checklist for helping researchers draft an appropriate survey instrument for the purpose of collecting data on behavior and behavior changes. Although this report focuses on the specific application of feedback, it is important to note that the report is also relevant to other types of behavioral programs.

**Key Findings:** Behavior types can be delineated as purchase behavior (large, moderate, or small purchases) and usage/habitual behavior (conscious or automatic). The most rigorous methodological approach involves surveying before and after the behavioral intervention for both the treatment and the control group. Some tips for enhancing accuracy and reducing bias of self-reports include asking longer questions to provide context and jog memories (but not too long), and mitigating social desirability bias with non-judgmental question wording. (***Product Number 1021961***)

## A System for Understanding Retail Electric Rate Structures

*Technical Update*




Due in part to rising concerns about global climate change and energy sustainability, there is renewed interest in the role that more efficient pricing can play in improving overall efficiency in the consumption and production of electricity. This increased interest is also related to the potential opportunities that investments in Smart Grid and Advanced Metering Infrastructure (AMI) would enable. A Smart Grid enables suppliers to offer dynamic pricing as part of a comprehensive portfolio of ways for consumers to buy electricity, and would facilitate the implementation of enabling technology that could make that decision-making easier. Conversely, a substantial portion of the potential benefits associated with Smart Grid investments are unlikely to be realized unless better (e.g., more efficient) forms of electricity pricing are adopted more broadly.

The many changes in how electricity is supplied and delivered, including the possibility for on-site generation for some needs, will require more diverse pricing plans than are in general use today. Realizing the environmental benefits attributable to many electrification opportunities, like electric vehicles and hyper-efficient devices, requires sending consumers price signals that reflect prevailing system conditions.

This report is part of a larger initiative aimed at clarifying how retail pricing structures influence electricity usage. The first in a planned series of studies, it presents a comprehensive system for characterizing and comparing different retail electric pricing plans. A consistent, transparent system will provide a way to assess the advantages and shortcomings of a wide variety of alternative rate structures, including not only traditional uniform rates, inclining (block) rates, and time of use rates, but also real-time pricing (RTP), critical peak pricing (CPP), time of use (TOU) rates, interruptible/curtailable rates, direct load control (DLC), demand bidding, and demand subscription service. The system will also serve as a foundation for the development of portfolios of pricing structures that accommodate diverse consumer needs in ways that improve the utilization of available supply resources and direct the development of new ones.

**Key Findings:** All rate structure designs can be explained via five "decision stages:" differentiation by time, differentiation by usage level, billing determinants used (connection/service fee, kWh, kW, kVAR), overlay options (call options that modify basic rates for firm service under specific and infrequent circumstances, such as direct load control or critical peak pricing), and degree of price and quantity hedging. Considering these stages to assess how well rate structures achieves high-level policy goals, in general design attributes that score highly on the ability to encourage some goals (such as improve economic efficiency) score poorly on others (such as understandability); some structural components (such as billing determinants) are, by themselves, neutral with respect to all goals. (***Product Number 1021962***)

## Fielding a Plug Load Self Audit – A Case Study Snohomish County Public Utility District Residential Home Theater and Office Equipment Load Study

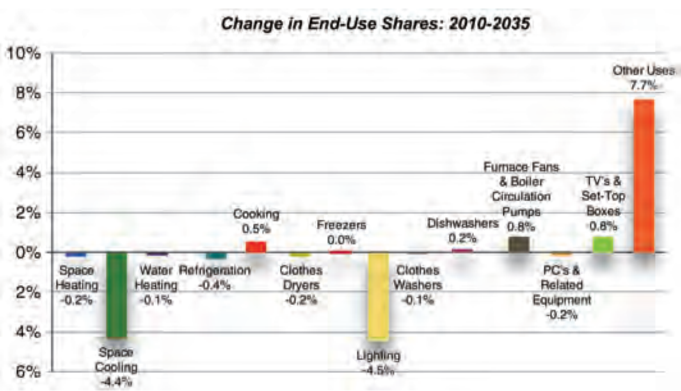
*Technical Update*

This report summarizes the efforts of the Snohomish County Public Utility District and EPRI in developing a low-cost and accurate plug load study. This project had the following three objectives:

- Use low-cost, self-installed metering equipment to collect and analyze end-use load data for a large number of residential customers,
- Develop a list of lessons learned about collecting end-use data that could be shared with other utility members conducting similar projects, and
- Provide a launch pad for new, cost-effective methods for end-use load data collection.

Two types of systems were monitored—home theaters and office computer systems. This study was also a small-scale attempt at developing a conditional demand analysis estimate for load shapes, which shows promise. A brief market study of smart plugs is also included.

**Key Findings:** Self audits appear to be a good way to build customer outreach programs but are not suitable for use in utility rate-making and forecasting. (***Product Number 1022362***)




*Source: DOE/EIA Annual Energy Outlook, 2011.*

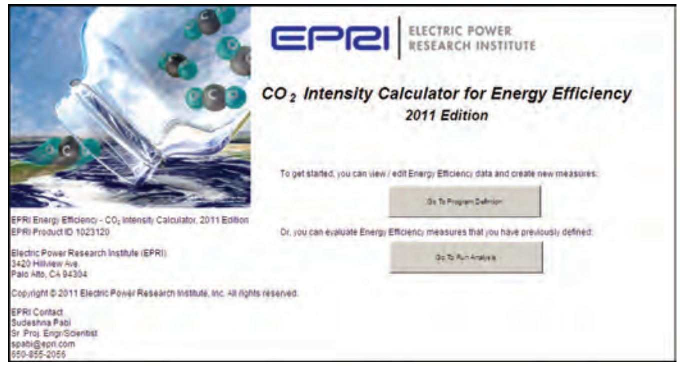
## EPRI Energy Efficiency $CO_2$ Intensity Calculator Version 2.0 (2011)

*Assembled Package*

This package consists of a MS-Excel based calculator, its user guide, as well as a Technical Update that provides details about the calculator, including enhancements in its functionalities, user experience, and possible ways the calculator can be used.

The EE-$CO_2$ Intensity Calculator spreadsheet calculator allows members to quantify the impact of their energy efficiency savings on carbon-dioxide emissions, specific to their region and the end-uses for which the savings emanate. Platform: Windows™ XP/Vista/7

**Key Findings:** Modeling improvements in 2011 have improved the usefulness and value of this tool to EPRI funders by enhancing and revamping the user interface based on user inputs. The 2011 edition of the tool is able to assess $CO_2$ impacts at the utility level apart from the regional level allowed in past editions. (***Product Number 1023120***)




## Translating Energy Efficiency into $CO_2$ Emissions Reduction: A Modeling Approach

*Whitepaper*

This paper describes a methodology that EPRI has developed to model the marginal carbon dioxide ($CO_2$) emissions impact of energy efficiency. Though energy efficiency is intuitively recognized to reduce carbon emissions, one barrier to its broader application is the lack of precision in attributing emissions reductions to specific program activities. Coarse estimates based on utilities' average emissions factors, while straightforward to calculate, do not provide enough specificity on emissions reductions at the margin.

Recognizing this barrier, EPRI has been conducting research over the past several years to apply an electricity production simulation model to quantify the impact of energy efficiency on marginal CO2 intensities (metric tons of $CO_2$ avoided per MWh of energy efficiency savings) that are specific to both end-use and region. These intensity values can be applied to more accurately translate energy savings from energy efficiency activities into $CO_2$ emissions reductions, by taking into account both temporal variation—i.e. when the savings occur based on end-use load shapes—and regional variation—i.e. where the savings occur based on differences in generation mix by region—as each factor impacts the avoided dispatch of generation from which emissions reductions result. EPRI offers this approach for consideration as an industry-standard methodology that electric utilities, regulators, regional planners, and policymakers can apply to more accurately assess the environmental impact of implementing specific types of end-use energy efficiency programs.

Moreover, EPRI's modeling approach using a least cost generation model strikes a balance between analytical rigor for precision and ease-of-use for practical application. Results from the EPRI simulation model are conveniently condensed into $CO_2$ emissions intensity values, specific to U.S. region and type of end-use. To quantify resulting emissions reductions, energy savings from a particular type of energy efficiency measure, such as a more efficient residential lighting or commercial space cooling program, can be simply multiplied by the corresponding intensity value obtained from the model. EPRI has also developed for its members an associated calculator tool to help them conduct more customized calculations of the emissions reductions impacts of their energy efficiency programs.

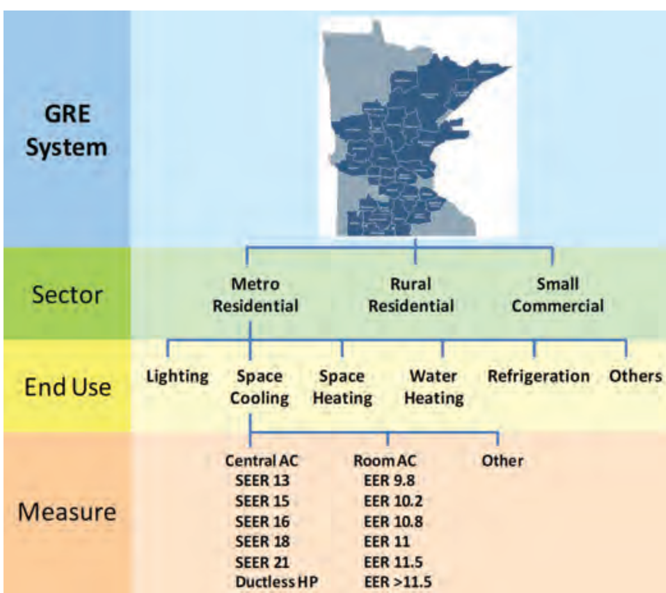
**Key Findings:** This whitepaper gives a broad overview of the multi-year research conducted at EPRI on this particular topic and gives an assessment of what is unique about this approach. This EPRI product provides a sound framework for utility industry stakeholders to establish a societal business case for energy efficiency and new technological innovations therein. (***Product Number 1023185***)

### Assessment of Achievable Potential from Energy Efficiency Programs for Great River Energy (2009-2030)

*Technical Update*

This report documents results of a study to assess the achievable potential for electricity energy savings and peak demand reductions for Great River Energy (GRE) for the years 2009 through 2030. The study applies the methodology and technology data developed for the EPRI study *Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S.,* (2009, ***1016987***). The study took into consideration the specific market sector characteristics of the GRE territory. Estimates of economic potential are adjusted to account for market barriers and program implementation factors to quantify the energy efficiency potential that can be realistically achieved.

**Key Findings:** There is significant remaining energy efficiency potential in the GRE service territory that can help GRE achieve its regulatory requirements. (***Product Number 1023674***)




## Demand Response Systems (170B)

This project set assesses and tests the application of technological advances in smart end-use appliances and integrated energy management control systems—including smart thermostats, lighting controls, smart distribution panels, and other technologies—to enable more sophisticated and effective demand response and dynamic energy management. EPRI also examined technological advances in permanent load shifting, namely thermal storage, and its integration into demand response systems for load shaping and peak load management.

### Peak Load Shifting by Thermal Energy Storage

*Technical Update*

This technical update reviews the technology of storing energy in hot water and explores the potential for implementing this form of thermal energy storage—through means of smart electric water heaters—as a way to shift peak load on the electric grid. The report presents conceptual background, discusses strategies for peak load shifting and demand response, documents a series of laboratory tests conducted on a representative model of smart water heater, and explores possible scenarios for operation and control.

Wholesale energy prices were used in this study as a proxy for the load on the grid. Peak load shifting ability was demonstrated in terms of the savings generated in terms of water heater operating costs (wholesale prices). For a fixed water draw profile, tests results showed that using Locational Marginal Pricing strategy reduced the operating cost by 22.5% and using a Regulation service strategy the operating cost was reduced by 55% (including payout for providing regulation service).

**Key Findings:** A Smart Electric Water Heater with advanced control and communication capabilities can be used in numerous ways to satisfy grid needs including, but not limited to, peak load shifting, ancillary services and renewable integration. The ability to constantly monitor charge (temperature of water stored) and to communicate with a remote server allows the smart electric water heater to implement various control strategies without causing any discomfort to the end user. (***Product Number 1021965***)

## System Compatibility of Modern Lighting Control Systems

*Technical Update*

The use of energy-efficient dimmable lighting devices and control systems is accelerating. While penetration and application will be different across customer sectors, the goal is to dynamically reduce lighting load without compromising productivity and the quality of light and life. Continual improvement of dimmable devices and controls is paramount to achieving that goal. EPRI research in system compatibility for modern lighting control systems, aimed at enhancing customer satisfaction and product performance, again revealed results in 2011 that are useful for utilities and manufacturers. Five lighting control systems—three add-on devices and two integrated systems—were evaluated in this project. This report addresses four wireless systems and one AC line-side control device. One system enables wireless communication for commonly used dimmable lighting using analog-based (0–10 volts dc) control. The report also defines and discusses two areas of lighting control—add-on and integrated—that are gaining momentum in the industry.

**Key Findings:**

- 4 out of 5 lighting control systems tested were immune to common everyday voltage sags; immunity to combination-wave surges varied.
- All dimmable technologies tested indicated nearly linear dimming response and efficacy ranges 37% to 92% collectively. (***Product Number 1021967***)

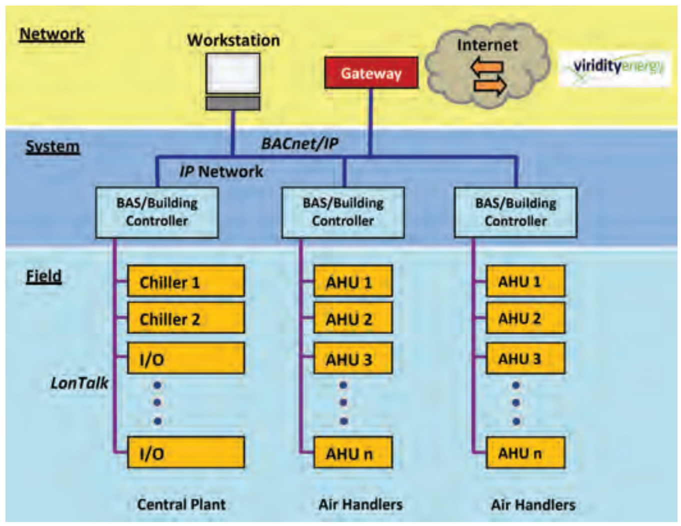
## Intelligent Building Series, Volume 1: Large Commercial Buildings

*Technical Update*

Commercial and institutional buildings represent substantial electrical loads that account for approximately 30% of all electric power consumed in the United States. Given the right circumstances, these energy consumers can serve as demand-side resources by reducing their electrical demand in response to grid conditions. While demand response applications in commercial buildings are not new, a progression to automated demand response offers increased participation and reliability and is supported by ongoing developments in building systems standards and technology.

Building on prior work, most notably EPRI reports *Assessment of Commercial Building Automation and Energy Management Systems for Demand Response Applications* (***1017883***) and *Integration of Demand Response Gateways into Building Automation Systems: Case Studies in Four Commercial Buildings* (***1020128***), this Technical Update goes behind the scenes on automated demand response implementations for two commercial building projects: one experimental and one operational. For each case study, this report explores the technology and standards applied, key roles in the implementation process, and lessons learned, thus illustrating the automated demand response solutions with their benefits and challenges.

**Key Findings:** Results include automated demand reduction of 8% to 21% of peak demand in one case study and projected demand response revenue of 12% of the annual energy bill in the other case study. (***Product Number 1021968***)




## Evaluation Framework for Sustainable Demand Response Implementations: A Framework for Evaluating Demand Response Implementation Alternatives for Sustainability

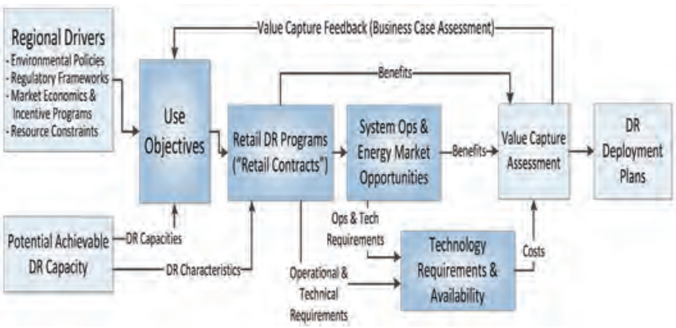
*Technical Report*

This report presents a framework for evaluating demand response (DR) implementation options for sustainability. The DR evaluation framework provides a structured, systematic approach to assist utility personnel (e.g., program designers) in evaluating program design options to achieve sustainable DR implementations, supportive of utility objectives, regional policies, and other drivers for DR.

Drivers for DR include utility objectives for using DR and regional conditions like resource constraints, market economics, and energy policy. DR enablers include retail contracts or programs with provisions for DR, wholesale opportunities for DR, and enabling technologies and requirements for DR. The evaluation framework clarifies the linkages between DR enablers and drivers as well as technology requirements and resource types supportive of DR programs and objectives.

The framework provides a guide for planning, deploying and expanding DR programs in retail and wholesale applications. It can help utilities and other program planners evaluate requirements and implement strategies for DR applications. The framework is particularly applicable during the planning phases of a DR project. The framework can also inform deployment and operation of DR programs by providing a systematic structure for considering DR capabilities, organizing DR program characteristics, and identifying opportunities for enabling greater value through DR implementation choices.

**Key Findings:** Clarity on regional drivers and utility objectives are starting points for devising sustainable DR implementations, from which particular program types, pricing structures, technology choices, or other implementation alternatives then follow. Furthermore, retail programs supportive of wholesale market products can be determined based on compatibility of technical requirements. (***Product Number 1024504***)




## Demand Response-Ready Technology Capabilities: A Summary of Multi-Stakeholder Workshop and Survey Perspectives

*Technical Update*

End use equipment (e.g., air conditioners, water heaters, pool pumps, etc.) retrofitted by utilities with communications, and in some instances with remotely controllable switches, allow the utility or demand response program operator to adjust electricity usage during critical periods. In the foreseeable future, however, end-use devices may increasingly come equipped with these capabilities built-in; that is, "Demand Response-Ready" (DR-Ready).

This technical update describes a diversity of grid needs for applying DR, a range of technology capabilities supportive of DR, and differences in capabilities inherent among categories of end-use devices. It summarizes findings from both primary and secondary research conducted through online surveys, workshop activities (including small group exercises), and literature review. Perspectives were collected from utilities, regulators, government agencies, end-use equipment manufacturers, vendors, their trade associations, and researchers, among others. Through broad-based collaboration considering diverse perspectives, technology capabilities are identified that support the enablement of mass market demand response aligned with grid needs.

**Key Findings:** Grid needs for demand response vary by geographic region and across organizations. Moreover, grid needs can change over time, leading to more futuristic uses of DR, such as applications to improve distribution phase balancing. Characterizing technology capabilities in terms of response time, adjustability of electrical loading, and potential to respond to local measurements helps to clarify the potential for end-use devices to support grid needs. Devices that support fast response capability, flexible loading patterns, and response to multiple types of local measurements may more aptly support a variety of grid needs. (***Product Number 1021964***)

*EPRI DR-Ready Technology Workshop, December 1-2, 2011, AEP Headquarters, Columbus, Ohio*

# Energy-Efficient Technologies (170C)

This project set addresses the application of advanced energy-efficient technologies across the residential, commercial, and industrial sectors. Activities include performance testing and field applications to assess barriers and benefits of implementation. In 2011, research was conducted on novel heat pump technologies for space conditioning and water heating, and advanced lighting technologies for the buildings sector. For the industrial sector, activities focused on the assessment of advanced motors and motor-drive technology, and electrotechnologies for process heating. In addition, opportunities for energy efficiency in areas of energy growth, such as data centers and power supplies for consumer electronics were also assessed.

## Evaluating Strategies for Separating Latent and Sensible Cooling for Energy Efficiency Improvement

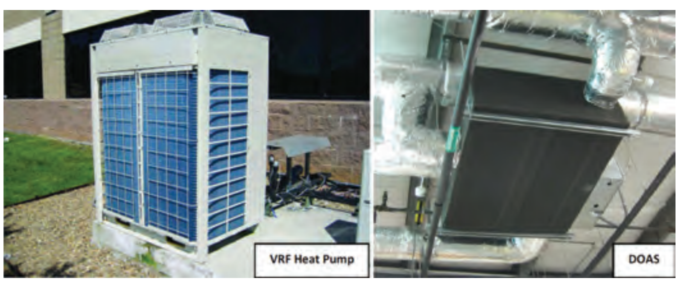
*Technical Update*

Space conditioning is a primary driver of load shape and seasonal peak for electric utilities. One substantial but often overlooked factor in building energy consumption is the impact of fresh air ventilation requirements on overall building loads. Investigators theorized that if air at outside conditions could be pretreated with dedicated, efficient equipment, the main building HVAC system could potentially operate more efficiently, resulting in a net system benefit.

The concept of separating latent and sensible cooling is particularly applicable in the eastern United States during the cooling season, with extension into the spring and fall shoulder seasons where humidity load can be present without sensible load.

To this end, a variable refrigerant flow (VRF) heat pump coupled with a dedicated outdoor air system (DOAS) was installed in eight EPRI offices in Knoxville, Tennessee, in order to examine possible energy savings of separating the sensible and latent loads in conditioning a space. The DOAS was capable of lowering the latent load of the fresh outdoor air before the air was ventilated into the zone treated by the VRF system. Comparisons of system energy consumption were examined between conditioning the fresh ventilated air and ventilating the fresh air untreated into the testing space. When the DOAS system conditioned the fresh air, then the VRF heat pump operated at a higher evaporator temperature, reducing compressor power. The coupled VRF system was also compared against a baseline ducted split system previously installed in the testing area.

**Key Findings:** Energy savings for the coupled VRF system, which treats ventilated air and thereby separates sensible and latent loads, were on average 15% over a previously installed ducted split system. Greater temperature differences between the outdoor and indoor spaces corresponded to greater energy savings in conditioning the ventilated air and operating the VRF system at a higher evaporator temperature. Separating latent and sensible loads by having dedicated equipment for each one promotes system flexibility, reduces or eliminates the need for reheat strategies, and allows for dryer warmer indoor air setpoints, reducing heat transmission through the building envelope. These effects can collectively reduce energy use and power demand throughout the cooling season. (***Product Number 1021969***)




## Heat Pump Water Heaters for Commercial Buildings

***Technical Update***

Heat pump water heaters (HPWH) heat water at higher efficiencies than conventional electric water heaters, and can be used as an energy efficiency and load management resource by utilities. By removing heat and moisture from the air and using that thermal energy to heat water via a refrigeration cycle, HPWHs can operate with coefficients of performance above 4.0, and provide space cooling as a secondary benefit. They operate for long durations at steady power, providing a stable load.

The 2011 project tested two new HPWH systems designed specifically for commercial building applications to quantify energy and power usage, water-heating capacity, and air-cooling capacity in an array of conditions. The systems were tested in the steady state as well as in tank-integrated simulated usage scenarios.

**Key Findings:** Water heating COPs during simulated use testing were between 3.0 and 4.0, and as high as 6.0 in steady state testing. The estimated energy savings in a laboratory simulation of a restaurant application was as high as 65%, with payback periods of 1.8–4 years. Analysis is provided on cost savings, climate applicability, operating cost compared with gas, and other items. The results of analysis, based on test results and manufacturer cost information, show that HPWH system designs can accommodate many climates and desired outcomes. The analysis also suggests that current commercial heat pump water heater products can be more cost-effective than gas water heaters in some conditions. Heat pump water heater installations can be designed to provide annual COPs of 3.0 or greater today, and future products are expected to be more efficient. Finally, the best results can be seen in cases where the water heating and air cooling effects can both be used beneficially; integrated heating and cooling COPs of over 10.0 can be realized in hot climates, greatly reducing payback times. (***Product Number 1021970***)


## Electric Motor Efficiency Standards and Regulations

***Technical Update***

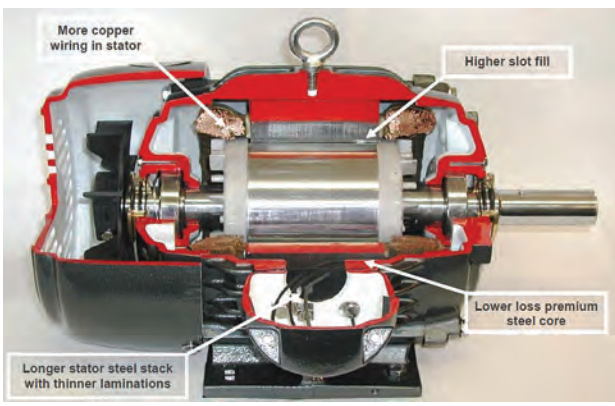
The last few years have seen the introduction of new standards and regulations for electric motor efficiency in the United States and elsewhere. The Energy Independence and Security Act (EISA) of 2007 is perhaps the most significant of these and is expected to have a considerable impact on electric motor efficiency in the United States. Based on the National Equipment Manufacturers Association (NEMA) MG 1 2010 Premium Efficiency standard, EISA 2007 mandates that all new induction motors (with some exceptions) manufactured and sold in the United States after December 19, 2010 must be at least Premium Efficiency. As such, this act is having a profound effect on motor manufacturers, original equipment manufacturers that use motors in their products, electric utilities, and end users. EISA 2007 is expected to save approximately 9.781 TWh of energy annually according to the American Council for an Energy-Efficient Economy. Fortunately, most motor manufacturers have been working to meet or exceed NEMA Premium Efficiency standards for the last decade, and many motor products on the market are already NEMA Premium.

In parallel, similar efficiency standards and regulations are being developed elsewhere. The International Electrotechnical Commission (IEC) 60034-30 standard is similar to NEMA MG 1 and is intended to harmonize electric motor efficiency standards around the world. Together, NEMA MG 1 and IEC 60034-30 serve as the basis for new electric motor efficiency regulations worldwide. The European Union and Canada have passed new regulations similar to EISA 2007, and similar legislation is expected to be considered in other countries, including Australia and New Zealand.

This report presents the results of an in-depth investigation of the impact of these standards and regulations, particularly the EISA 2007 legislation, on motor and motor-based system manufacturers, electric utilities, and end users.

**Key Findings:**

- EISA 2007 is not expected to cause significant disruptions or pose serious technological hurdles.
- In Europe, the IEC is already working on a higher efficiency class called IE4 which goes beyond the premium efficiency levels stipulated by EISA 2007.
- The two major factors that impact the end-use customer, namely, rebates and repair/ rewind, are illustrated with case studies. (***Product Number 1021971***)




*Advances in motor construction techniques result in reduced energy consumption and increasing reliability (Source: Nidec Motor Corporation)*

## Process Heating: Trends in Electrotechnology-Based Process Heating Applications

***Technical Update***

This technical update uses real world examples to discuss electrotechnology applications in industrial process heating and to highlight some emerging technologies that can provide significant energy savings and increase productivity.

The 2011 project is a continuation of previous research activities. In 2010, the technical update described the physics and operating principles behind four major electro-technologies in process heating, namely: induction, microwave, radio-frequency and infrared. The 2011 project covers the practical industrial applications of these technologies.

The report presents three case studies of successful implementation of two different electric process-heating technologies in three different industries. The case studies show that in some instances the plants may prefer productivity gains or reduced energy intensity over energy efficiency. The case studies show that the existing technology replaced by advanced electrotechnology could sometimes be a fuel-fired or electric technology, though it should be noted that the application requirements take precedence over the choice of technology.

The report includes a plant assessment using the U.S. Department of Energy's (DOE) Process Heating Assessment and Survey Tool (PHAST) software (Version 3.0).

**Key Findings:** The figure shown is an example of an industrial application for curing paints in a foundry using infrared technology which replaced a natural gas based burner-blower system. The results from this case study showed 1-2 years payback. In another example, the application of electrotechnology has reduced the process cycle time by 75%. Other non-energy benefits associated with the electro-technology applications are also discussed in this technical update.

The PHAST software is versatile and allows the user to do preliminary assessments quickly with available general plant information—for detailed analysis, specific information related to each process should be included. The utility representative or plant engineer who is a potential user of PHAST can use the example provided in the report to learn the various nuances available in the software.

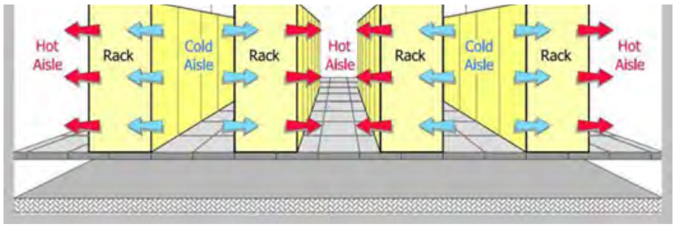
This technical update also identifies areas for future research in industrial process heating. (***Product Number 1021972***)


## Airflow Management: Energy Efficiency Opportunities in Data Centers

***Technical Update***

This technical update provides an overview of airflow management, with an emphasis on how reduced airflow can improve energy efficiency in data centers. In addition, some early results of a separate field demonstration project for this technology are shared. Airflow management within a data center can have a dramatic impact on energy efficiency. Typically, much more cold air circulates within conventional data centers than is actually needed to cool equipment related to information and communication technology (ICT).

**Key Findings:** It is not uncommon for facilities to supply more than two to three times the minimum required airflow in order to overcome losses from air leakages and short circuiting and to prevent recirculation of hot air in ICT equipment—problems that can be dealt with by changes in design and operation. Reducing airflow is a basic and cost-effective means of reducing power demand and energy use in data centers. It reduces not only direct fan energy use but saves energy indirectly through reduced fan heat losses. (***Product Number 1021973***)




## A State of the Art Assessment of Zero Net Energy Commercial Office Buildings

*Technical Update*

This report is a review of the state of the art of zero net energy commercial office buildings (ZNEOs), which are high performance buildings that optimize energy efficiency and the use of on-site renewable energy to produce as much energy as the building uses on an annual basis. The focus is on commercial office buildings, a subsector where policy, the design community, and building owners have converged to significantly advance ZNEO development in recent years.

This report provides an overview of the zero net energy concept as applied to commercial office buildings and describes current drivers for zero net energy office building projects. It identifies the overarching concepts of integrated design and technology systems integration as keys for successful ZNEO implementation. It addresses expected ZNEO impacts on the grid, including the need for grid and control enhancements to adequately manage large-scale ZNEO adoption. This report also addresses the regulatory, policy, and business-model advances needed to support higher levels of ZNEO building penetration. It includes case studies of seven ZNEOs that are operating successfully in a wide range of U.S. climate zones.

**Key Findings:** Emerging technologies will support achieving ZNEO performance, including potential integrated energy efficiency and renewable generation systems. These may include smart windows that incorporate PV modules, and solar energy systems that combine PV & solar thermal collection. Current ZNEO designs can reduce summer mid-day peaks but may require additional technology to reduce peaks at other times such as winter mornings. Finally, grid and control enhancements will be needed to adequately manage the electric distribution system when high levels of ZNEO penetration and building density occur. (***Product Number 1021974***)

## Latest Opportunities for Efficiencies in Electronic Power Conversion Devices

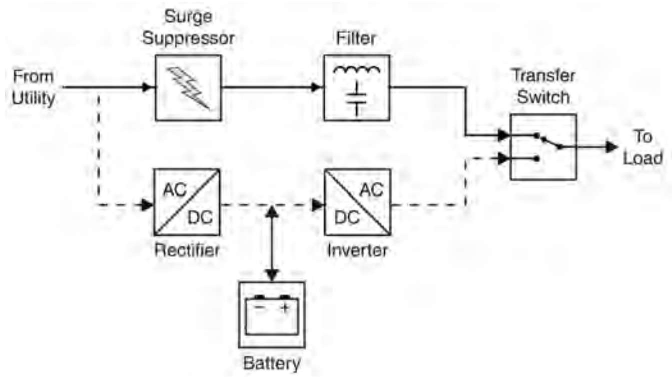
*Technical Update*

With more than 1 billion external power supplies in use in the United States alone, addressing their energy efficiency is an obvious first step on the road to a broader strategy of improving power-conversion efficiency. Substantial progress has been made by several agencies between 2002 and 2004 in measuring and comparing efficiencies of single-voltage, AC-to-DC external power supplies. After considering a dataset of measured efficiency values for more than 800 external power supplies, the U.S. Environmental Protection Agency's (EPA's) ENERGY STAR program and the China Center for Energy Conserving Products (CECP) have established joint energy-efficiency specifications and labeling programs for external power supplies. The California Energy Commission (CEC) has passed mandatory efficiency standards for these products, and various other regions of the world also are moving to encourage greater efficiency in that product category.

Multi-voltage, AC-to-DC internal power supplies also have been the subject of significant attention but are more technically complicated because they come in a wide variety of configurations and form factors. Some form factors, like those common to desktop computers, have their own housing and are easily removable from the product that they power. Other internal power supplies, like those commonly found in set-top boxes or TVs, may lack housing and sometimes are located on the same circuit board that controls product functionality. Lack of standardization of power supply form factors in such electronic products makes it more challenging, but no less urgent, to improve their efficiency.

Progress has been made by Australia, China, the U.S. EPA ENERGY STAR, and others on a universal test procedure that would measure all internal power supplies uniformly, regardless of product category and form factor. The test procedure described in this document, developed by EPRI and Ecos, is based on Intel's guidelines for computer power supplies. The procedure has been refined in the past few years and has been accepted by the power supply industry and the U.S. EPA ENERGY STAR program (the latest test procedure is available at ***http://www.efficientpowersupplies.org/methods.asp***). With an established test procedure, it is hoped that specifications could be developed for classes of products beyond computers.

EPRI has begun to assess efficiencies of three types of devices, including uninterruptible power supplies (UPSs); networking devices such as rout-




ers, modems, and switches; and smart-meter power supplies to investigate whether similar specifications could be developed for these products, if appropriate. This report includes the findings of this effort to collect efficiency data and an assessment of topologies of these supplies.

**Key Findings:**

- UPS efficiencies currently range from 88% to nearly 95% at 50% load. Therefore, there is some potential for energy savings at the low end of that range.
- Network device power supply efficiencies range from 65% to 85% across all load factors. This represents a large potential for energy savings.
- Smart meter power supplies use very little power – even in large numbers, the aggregate savings possible is too small to justify further effort. (***Product Number 1021975***)

### Advanced Lighting Technologies: New Electronic Light Sources for Sustainability in a Greener Environment

*Technical Update*

This report features the technical assessment of advanced lighting technologies in the following six product areas—dimmable light-emitting diode (LED) screw-in replacement lamp, hybrid compact fluorescent lamp/halogen screw-in replacement lamp, replacement recessed can LED downlight, organic LED (OLED) disc, replacement mini high-intensity discharge (HID) lamp and ballast system, and solid-state plasma lighting (miniature HID technology) high-bay fixture. The project demonstrates show a wider variety of advanced light sources are entering the marketplace as replacement devices for existing lighting designs.


**Key Findings:**

- Product efficacy ranged from about 30 to 74%. True power factor ranged from 0.39 to 0.99. Input current THD ranged from about 5% to about 225%.
- One product had poor immunity to ring-wave surges. All products were immune to common everyday voltage sags. (***Product Number 1021976***)

## Supplemental Products

### Test and Evaluation of a Hybrid Desiccant Dehumidifier

*Technical Update*

Advanced dehumidification technology is being investigated for potential savings in building air conditioning systems. The potential for savings lies in separating the sensible and the latent cooling loads to more efficiently address the combined conditioning needs of the space. The Munters DryCool HD combined desiccant/vapor compression system was tested in the EPRI Knoxville psychrometric chambers for a host of indoor and outdoor conditions. The system provides cooling at a rate of approximately 1–1.5 kW in most conditions. The sensible portion ranges from about 0.7–0.6 kW of heat addition. The moisture removal is as high as 5.7 lbs/hour (2.6 kg/hour) in the conditions tested. The coefficient of performance was typically between 1 and 2, which is strong for dedicated dehumidification technology. A performance map was developed using test results to create a simplified building model. The model, which could represent a small commercial or institutional facility, suggests a total energy savings of 20%–25%.

**Key Findings:**

- Combinations of desiccant and traditional direct expansion (DX) cooling offer potential for greater than 20% efficiency improvement over traditional DX only systems.
- Energy efficiency benefits are dependent on the geographical region and the details of building thermal load. (***Product Number 1022629***)


### Analysis of Hybrid Liquid Desiccant Technologies

*Technical Update*

Two advanced dehumidification liquid desiccant systems by DuCool—DuTreat and DuHandling—were tested in the EPRI Knoxville psychrometric chambers to assess the potential for savings from separating the sensible and latent cooling loads to more efficiently address the combined conditioning needs of the space. DuTreat uses an internal vapor compression system to regenerate a liquid desiccant, while DuHandling uses hot and cold water supplies. Each system was tested in the laboratory for a variety of indoor and outdoor conditions, and a performance map was developed. The DuTreat system provides cooling in the range of 4-7 kW, with latent cooling ranging from 2.0 to 4.5 kW. The coefficient of performance (COP) was as high as 1.34. The DuHandling system provided cooling for indoor air in the range of 5-7 kW, with latent cooling ranging from about 4 to 5 kW. The COP in the baseline condition was 4.36. DuHandling was also tested for pre-treating outdoor air, with cooling capacity of 11.4 kW, latent capacity of 7.6 kW, and a COP of 8.14. In addition, simulations were performed for using each system to treat indoor air. Florida and New Jersey were the primary focus of the simulation efforts. The model, which represents a small commercial or industrial facility, suggests cooling energy savings ranging from 17 to 34% in Florida and 34 to 37% in New Jersey using the DuHandling. With the DuTreat, savings were 0-24% in Florida and 15-30% in New Jersey.

**Key Findings:**

- Combinations of desiccant and traditional direct expansion (DX) cooling offer potential for greater than 20% efficiency improvement over traditional DX only systems.
- Energy efficiency benefits are dependent on the geographical region and the details of building thermal load.
- Modeling indicates good applicability in the eastern regions of the United States, with the most potential in the Northeast. (***Product Number 1023129***)

## Electricity Pricing Structures for the 21st Century: Remodeling or New Construction? A Summary of Workshop Presentations and Dialogue

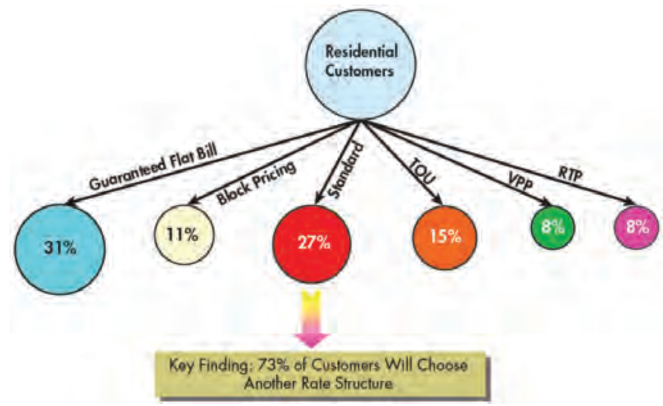
***Technical Update - Supplemental Project***

EPRI's workshop *Electricity Pricing Structures for the 21st Century* was held on July 14th and 15th, 2011 in Nashville, Tennessee, co-hosted by the Tennessee Valley Authority. It was the first of two workshops to delve into what factors drive customers' electricity consumption decisions. Together with the second workshop (*Understanding How Customers Value and Use Electricity*, October 2011, co-hosted by CPS Energy), the knowledge gathered was used to assist utilities who are grappling with these issues, as well as inform the research agenda for EPRI's new program for 2012, *Understanding Electric Utility Customers* (Program 182).

The Pricing Structures workshop featured 13 panelist presentations and interactive dialogue with the audience.

**Key Findings:** Several common themes emerged from panelist presentations and subsequent discussion, including:

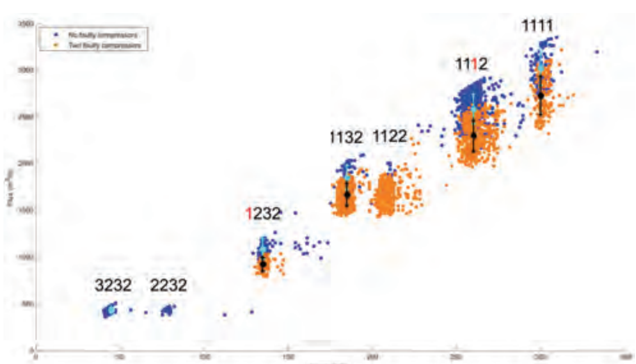
- The industry is undergoing organizational and technological restructuring that presents new opportunities to communicate with customers and involve them actively in their usage decisions
- No one size fits all with regard to customer preference for rate structures
- A range of barriers exist to realizing the potential of demand response, such as limited price offerings that lag market innovation due to regulation and uncertainty about new rates and adequate revenue recovery
- The necessity to take both industry and customer needs into account when developing rate structure options
- and the need for education—for the customer, as well as for policymakers, utility managers, and regulators. (***Product Number 1023561***)




## Extracting Individual Load Information from Total Load Power: A New Approach to Disaggregation and Fault Detection

***Technical Update - Supplemental Project***

This report describes two proof-of-concept studies of a first-of-its-kind non-intrusive load monitoring technique for an industrial compressed air system. The method is minimally intrusive because it relies only on measurement over time and on the analysis of the electric load and air flux of the whole system. Électricité de France provided field data from a system made of four compressors located in an industrial plant in France. The



software tool GoSUM (Global Optimization, Sensitivity and Uncertainty in Models) was used to disaggregate total load of a compressed air system and detect defective behavior of compressors. GoSUM was able to break down the data and identify the contribution of each individual compressor to the total electric load and air flux. It was also able to point out the faulty compressors, the amount of their leakage, and the violations of compressor priority calling order.

**Key Findings:** A first-of-its-kind non-intrusive load monitoring technique disaggregated a total load of a compressed air system and detected defective behaviors. (***Product Number 1024497***)

## Investigation of an Electromagnetic Interference (EMI) Problem Involving Light-Emitting Diode Streetlights and an Amateur Radio Transceiver: Identifying the EMI Mechanism and Solution

***Technical Update - Supplemental Project***

Any type of electronic device has some level of susceptibility to energy from the electromagnetic environment. This technical update describes an investigation of electromagnetic interference (EMI) problems associated with amateur radio, distribution hardware, and light-emitting diode (LED) streetlights at a customer's home in Camden, Tennessee. Because LED streetlights were deemed the direct cause of the EMI problem, an investigational plan involving a two-level effort was customized to address the problem. First, field observations and measurements were made at the customer's residence, followed by laboratory measurements at EPRI's Electromagnetic Compatibility (EMC) Laboratory on the same manufacturer and model of LED streetlight as installed on the street in front of the customer's residence.

During the project, the use of ferrite core materials and their placement inside the fixture was investigated in an effort to reduce the spectral content of the radiated emissions in the frequency band of interest. Results indicate that complex emissions from the installation of LED streetlights in proximity to a vertical amateur radio system can be solved with the installation of ferrite cores on the input in the common-mode configuration.

In addition, EPRI is working with IEEE, ANSI, and other standards-making bodies to update EMC standards. Toward that effort, EPRI will prepare an EMI data report and present it for possible action that may result in the development of a new standard addressing compatibility between electronic lighting devices and end-use equipment. (***Product Number 1024599***)

**Key Findings:**

- Emissions from electronic lighting devices complying with industry standards can interfere with end-use equipment.
- There is a need for embedded emissions-reducing technologies with higher performance internal to electronic lighting devices.

## Typical and Emerging Technologies for Power Flow and Heat Transfer in Data Centers

***Technical Update - Supplemental Project***

A data center is a large concentrated load about 20 times more energy-intensive than the typical commercial building and 80 to 100 times more energy-intensive than the typical home. They operate continuously 24 hours a day, 365 days a year. Paradoxically, data centers are both the result of America's shift to a service economy and one of its most powerful drivers. Because information technology (IT) equipment is vital to modern, seamless communication, reliability naturally tends to be the most important criterion for the selection of IT equipment, with first-cost typically next in importance, followed by operating and energy costs. The power density of IT equipment in data centers has been increasing, causing the energy requirements for cooling and other infrastructure to increase.

**Key Findings:**

- Available technologies for energy savings are outlined and discussed.
- Server power supply efficiencies have increased from an average of 78% to 87%.
- Specific cooling technologies outlined include airside and waterside economizers, efficient power supplies, and DC power distribution. (***Product Number 1024624***)

| Application | Fraction of Facility Power |
|---|---|
| Servers | 46% |
| HVAC Cooling | 23% |
| HVAC Fans | 8% |
| UPS | 8% |
| Lighting | 4% |
| Other | 11% |

## Demonstration of Demand Control Ventilation Technology: Macy's Kailua Town Branch Store in Hawaii

***Technical Update - Supplemental Project***

Demand Control Ventilation (DCV) is one of the control strategies that can be used modulate the amount of ventilation air for space conditioning in commercial buildings. DCV modulates the amount of ventilation air introduced into the heating, ventilation and air conditioning (HVAC) system based on carbon dioxide levels sensed in the areas served. The carbon dioxide level is a proxy for the number of people within the space, from which the required quantity of ventilation air is determined. By using this strategy, the amount of ventilation air can be modulated, thereby leading to potential energy savings.

This project demonstrated the application of DCV in a retail department store in Hawaii. The retrofit of the existing air conditioning system consisted of installation of motorized dampers on outside air intakes, and carbon dioxide sensors in the air conditioned spaces and return air paths, as well as a direct digital control system. The carbon dioxide sensors provided a means to estimate the number of people in the spaces, and this information was used in a feedback control loop to modulate the outside air intake to the air conditioning system to maintain a maximum space carbon dioxide level.

**Key Findings:** This demonstration project showed a 10% to 15% reduction in annual air conditioning usage for retail occupancies in Hawaii. This drop in energy usage is due to reduction in the quantity of ventilation air that needed to be conditioned for use in the HVAC system. (***Product Number 1024633***)

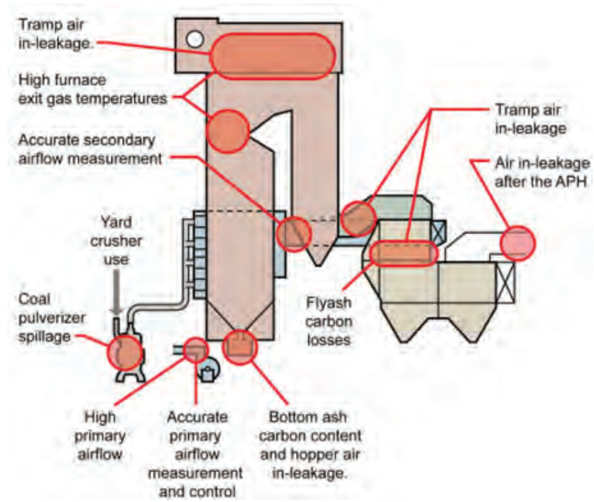
## Program on Technology Innovation: Electricity Use in the Electric Sector: Opportunities to Enhance Electric Energy Efficiency in the Production and Delivery of Electricity

***Technology Innovation Project***

While many utilities are encouraged by regulators to engage in end-use energy efficiency programs, few consider options to reduce energy losses along the electricity value chain, even though the electricity sector is the second largest electricity-consuming industry in the United States. Electricity used to facilitate power production, transmission, and distribution alone consumes approximately 11% of generated electricity. A number of technologies can be applied to reduce this electricity use.

This report addresses the energy currently expended in the form of electricity used for power plant auxiliaries and transmission and distribution losses. The report shows that electricity consumption in electric utilities can be reduced by up to 15% and describes some of the technical options available to lowering power usage, including the increased employment of variable speed drives in power plants and ways of improving transmission and distribution efficiency by reducing transmission and distribution losses. The report sketches out a strategic framework for realizing these opportunities.

**Key Findings:** Approximately 11% of electricity produced in the US is consumed in the production and delivery of electricity itself: ~4.6 percent in power plants; ~2.8 percent in transmission systems; and ~3.7 percent in distribution systems. Based on 2010 estimates of electricity generation, this represents 450.7 billion kilowatt hours of U.S. electricity generated making the electric sector the second largest electric consuming industry. Technologies have been identified which have the potential to reduce electricity use in electric utilities by 10% to 15%. (***Product Number 1024651***)




## Program on Technology Innovation: Advanced Space Cooling Technology Workshop

***Technology Innovation Project***

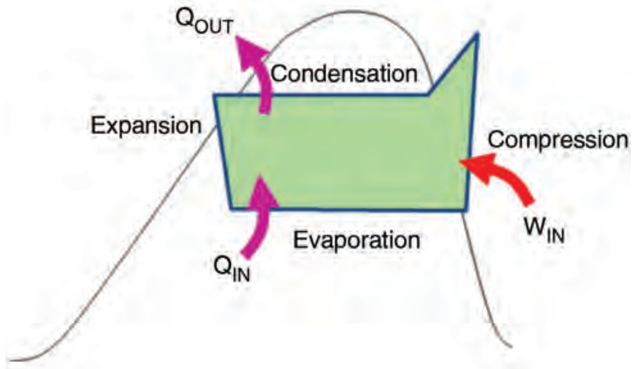
A workshop on advanced space cooling technologies was organized in order to assist EPRI in funding research in this area. Collaboration with experts from utilities, industry, and academia, allowed for the development of a roadmap outlining the areas of greatest interest and potential research projects for each.

The roadmap outlines 6 key areas of research in which EPRI could make significant contributions to benefit utilities, industry, and end-users:

- Working Fluids
- Multi-Function Heat Pumps
- Alternative Dedicated Air Treatment
- Techniques for "Filtering" Water Molecules
- Multi-T Level Heat Pump Storage
- Supermarket AC&R Integration

**Key Findings:** The roadmap that resulted from this effort provides more clear direction for research in advanced cooling technologies over the next

10 years. This includes the development of an advanced heat pump, effective ways of dehumidification, and advanced thermal storage technologies. The research projects which may follow this investigation will have significant benefits for utilities, industry, and end-users by reducing energy consumption, shifting peak loads, and providing products which meet customer needs better than existing technologies. (***Product Number 1024984***)




## Energy-Efficiency Demonstration

### Energy Efficiency Demonstration: An Interim Report

*Technical Update*

The Energy Efficiency Demonstration is a field-performance assessment of emerging, efficient end-use technologies, deployed with extensive measurement instrumentation at multiple sites throughout the United States. The selected technologies have the potential to significantly reduce energy consumption in residential and commercial applications. The Demonstration started in the spring of 2009, and will wrap up data collection on March 31, 2012, after which EPRI will complete an analysis of the complete data set and issue a final report. The interim report published in 2011—while based on an incomplete data set—offers early conclusions and recommendations for each of the six technologies addressed within the demonstration. For more information, please contact Energy Efficiency Demonstration Project Manager Tom Geist (***tgeist@epri.com***).

**Key Findings:** The results for all technologies within the Demonstration support the initial assumptions of the Demonstration and show significant energy savings. (***Product Number 1024605***)


## Coordinated Early Deployments of Efficient End-Use Technologies

### Coordinated Early Deployments of Efficient End-Use Technologies: Phase 1 Final Report

*Technical Update*

Energy efficiency is a critical piece in 34 states' plans for cost-effectively meeting electricity demand. To meet energy efficiency goals in these states, a steady stream of new efficient technologies must be ready for utility energy efficiency programs and ultimately the consumer market.

EPRI's collaborative Coordinated Early Deployments project is designed to coordinate early deployments of emerging technologies across multiple utilities. Results are intended to enable other collaborators to use the data without duplicating the early deployments. In 2011, EPRI and utility collaborators developed and vetted a framework for planning and implementing early deployments. The framework provides guidance for conducting early deployments with statistical validity and addresses market barriers related to consumer acceptance and supply-chain infrastructure. The framework was used to develop early deployment plans for two technologies: variable refrigerant flow heat pump air conditioning and heat pump water heaters.

EPRI also worked with the utility collaborators to develop a process to assess the readiness of emerging end use technologies. Using the process, EPRI assessed several technologies to determine which were qualified for early deployments. In addition to variable refrigerant flow and heat pump water heaters, qualified technologies include LED street and outdoor lighting, climate appropriate air conditioning for hot/dry climates, rooftop air conditioning units with pre-cooling and fan controls, ductless heat pumps, and voltage optimization.

The next phase of this initiative will implement the recommendations and move forward with these and additional coordinated early deployment projects. The projects will help to create larger markets to increase the success of these emerging efficient technologies and provide collaborators with results and lessons learned so that they may move ahead with new technologies in their energy efficiency programs without need to conduct the early deployment planning and testing on their own. Energy savings may come at a reduced cost. For more information, please contact Coordinated Early Deployment Project Manager Ellen Petrill (***epetrill@epri.com***).


End-Use Energy Efficiency Technology Development Pipeline

**Key Findings:** The initial work on this project indicated that coordinating early deployments among collaborators to enable sharing results will be supported by a technology readiness qualification process, and a framework for planning early deployments to yield translatable results. (***Product Number 1024626***)

## Industrial Center of Excellence

### Overview

EPRI's Industrial Center of Excellence was established to encourage specific energy and technology related developments. Using EPRI, utility, and industry subject matter expertise—the Center supports knowledge transfer, applications, and seeks to identify opportunities for demonstrations and commercialization of advanced efficient electric technologies and utilization methods. The Industrial Center of Excellence supports members and their customers through testing, training, education and outreach. The following deliverables were developed for the 2011 cycle:

1. 2011 Electro-technology Reference Guide (***1025038***)
2. Eight Case studies highlighting the results of EPRI Industrial Facility Audits (Products ***1025039*** through ***1025046***)
3. Industrial Sector TechBrief, Metalworking Machinery Manufacturing (***1024689***)
4. Industrial Sector TechBrief, Plastics Product Manufacturing (***1024690***)
5. Comparison of National Programs for Industrial Energy Efficiency (***1025047***)

**Key Findings:** In 2011, the EPRI Industrial Center of Excellence launch an important new activity in support of funders, a detailed industrial facility energy assessment to not only identify energy efficiency opportunities, but also productivity- and process-enhancing opportunities in working industrial facilities. Each of the 8 facility assessments have produced a detailed case study report. In addition, the Industrial Center of Excellence issued an updated Electrotechnology Resource Guide providing a rich resource for electrotechnologies and the demographics of electric power use in North America. The program also produced a document providing an integrated overview of major national-level energy efficiency programs for us to educate industrial end-use customers. Finally, the 2011 program produced 2 additional industrial TechBrief documents providing insights on the Plastics and Metalworking sectors.

## Energy Efficiency Media Publications

### Media Alerts

- Analytics Success Story: Residential Consumption Data Analysis
- 7 Myths of Compact Fluorescent Lamp (CFL) Light Bulbs
- Executive Summary of Light-Emitting Diode (LED) Streetlight Demonstration
- Executive Summary of Heat Pump Water Heater (HPWH) Demonstration

## For More Information

For technical information about the EPRI End-Use Energy Efficiency and Demand Response Program (Program 170) contact Program Manager, Omar Siddiqui at ***osiddiqui@epri.com***.

For general information, contact the Customer Assistance Center at 800-313-3774 or email ***askepri@epri.com***.

## How to Obtain Reports and Tools

The 2011 reports and tools of the End-Use Energy Efficiency and Demand Response Program are available to funding-company representatives, and can be accessed and 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 document. Log-in is required for the EPRI members' website. If you are with an EPRI member company but do not have a user name and ID, you can request them when you visit ***www.epri.com***

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Together...Shaping the Future of Electricity

1025002 May 2012

**Electric Power Research Institute**
3420 Hillview Avenue, Palo Alto, California 94304 • PO Box 10412, Palo Alto, California 94303 USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com