Jump-Starting Your EE Portfolio:

Quick Start, Quick Return Energy Efficiency Programs

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Advancing energy-efficiency practices and demand response among electric utilities.

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INTRODUCTION

Utility-sponsored energy efficiency (EE) and demand-side management (DSM) programs have been administered for decades. Such programs have multiple goals such as saving energy and reducing customer bills, delaying the need to build new power plants, and reducing environmental impacts. More recently, energy efficiency is now used as a resource in the forward capacity markets in the Northeast. While some utilities have long track records administering energy-efficiency (EE) programs, others are just getting started. Launching a portfolio of EE programs can be a daunting task; learning from the experience of others can help you jump-start your own EE portfolio.

When creating a new EE portfolio, which programs should be first in line? Leading EE experts from around the country agree that, when launching a new EE portfolio, two criteria are critical: focus on areas of high energy use and focus on programs that can be implemented quickly. This paper describes nine program areas that will help you jump-start your energy efficiency portfolio.

- **Residential appliance efficiency.** Programs that encourage the purchase of high-efficiency appliances for replacement or new home construction.
- **Residential appliance recycling.** Programs that encourage homeowners to turn in old, secondary refrigerators and freezers and sometimes old air-conditioning (AC) window units.
- **Residential peak load reduction.** Programs that reduce the load during high-priced peak demand hours. These programs typically target central air conditioners and use a remote switch or thermostat.
- **Residential lighting.** Programs that encourage the sale of energy-saving or efficient lighting, especially compact fluorescent lamps (CFLs) for use in homes.
- **Residential consumer electronics and plug load.** Programs that seek market transformation to increase the efficiency of electronic devices such as televisions, computers, chargers, game consoles, and set-top boxes.
- **Commercial lighting.** Programs that encourage, primarily through rebates, exchange of older, inefficient lighting for new, efficient lamps, ballasts, and controls.
- **Commercial HVAC.** Programs that encourage—through rebates—the purchase of high-efficiency heating, ventilation, and air conditioning components.

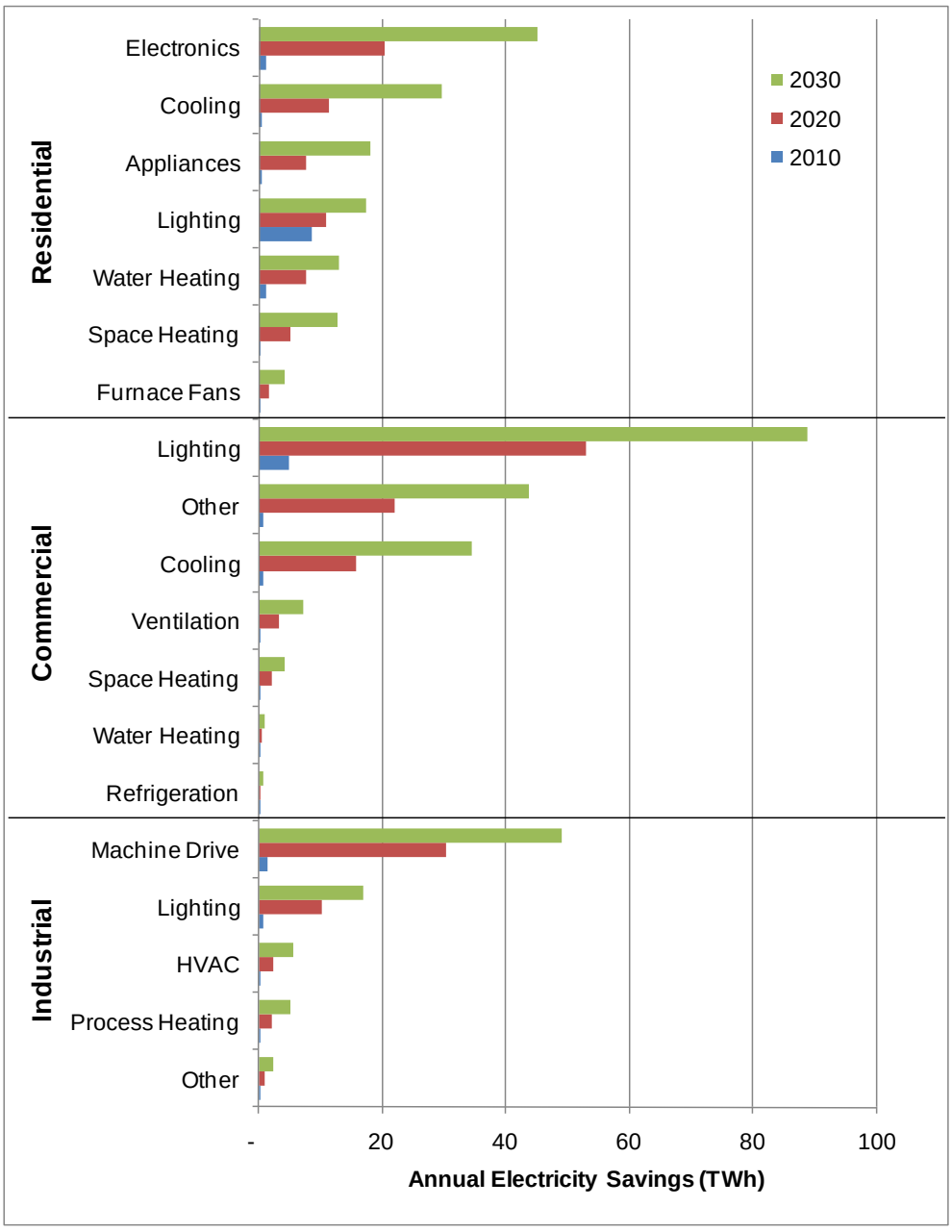
- **Industrial motors.** Programs that provide incentives for end users to purchase high-efficiency motors and drives and incentives for upstream players (such as distributors) to carry such equipment.
- **Industrial custom.** Programs that allow industrial customers with unique needs who are relatively sophisticated energy users to propose their own energy-saving projects.

According to the Electric Power Research Institute's (EPRI's) recent report on EE potential, energy-efficiency programs have the realistic achievable potential to avoid nearly 400 billion kilowatt hours (or 400 TWh) of energy use by 2030; this represents over 8 percent of forecasted baseline use.[1] As shown in Figure 1, commercial lighting offers the single largest opportunity for savings, with almost 90 TWh of potential savings, followed by industrial machine drives with 50 TWh of potential savings, residential consumer electronics with 45 TWh, commercial cooling with 34 TWh, and residential cooling with 29 TWh. In addition to reducing energy use, EE programs also reduce peak demand.

The programs described in this report have a track record of results at multiple utilities over many years. This report provides key summary information about designing EE programs that can be quickly initiated and ramped-up. Each section contains a brief description of the general program type and information relevant to the program-development process. A recent EPRI report provides detailed information on energy efficiency planning ("Energy Efficiency Planning Guidebook," EPRI 1016273, Final Report, 2008). This paper provides guidelines only; all utilities must adapt as markets change, prices rise and fall, new technologies are introduced, others are phased out, and codes and standards evolve.

1 Electric Power Research Institute, "Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S. (2010-2030)" (January 2009), http://mydocs.epri.com/docs/public/000000000001018363.pdf.

Figure 1. Realistic achievable potential for energy efficiency by end use, 2010–2030 (Source: EPRI, 2009)



RESIDENTIAL PROGRAMS

RESIDENTIAL APPLIANCE EFFICIENCY PROGRAMS

Residential appliances, excluding central heating and cooling, account for nearly two-thirds of energy use in a typical residence.[2] Major appliances include refrigerators, freezers, clothes washers and dryers, dishwashers, room air conditioners, and cooking appliances. Programs that push customers toward the highest-efficiency appliances are excellent targets for efficiency initiatives. Many utilities currently have appliance rebate programs to help offset the incremental cost of high-efficiency appliances to the end-user.

The U.S. Environmental Protection Agency's (EPA's) Energy Star program has significantly influenced the efficiency of appliances in the U.S. Today, Energy Star is a well-recognized brand across the country. Many utility EE programs have adopted Energy Star standards as the core specification and use Energy Star as a model for their own programs. Other utility programs focus "upstream" on providing information, training, and incentives to retailers and distributors to stock more high-efficiency appliances.

Appliance rebate programs are straightforward from the customer's perspective. The programs are typically designed to provide a specific rebate amount that is tied to the purchase of specific appliance models. In some cases, rebates are "tiered," meaning that within an appliance category, the rebates increase as models become more efficient. Programs that focus incentives "upstream," on retailers and trade allies, have also proven effective.

SPECIFICATIONS FOR APPLIANCE EFFICIENCY

Utilities typically use the recommendations of two national organizations to set their specifications for appliance rebates—EPA's Energy Star and the Consortium for Energy Efficiency (CEE). Some utilities set their own specifications. Certain appliances earn the Energy Star label by operating at a significantly higher efficiency than current government standards require. The Energy Star label and logo are usually on the appliance or its packaging.

2 U.S. Department of Energy, "End-Use Consumption of Electricity 2001," www.eia.doe.gov/emeu/recs/recs2001/enduse2001/enduse2001.html (accessed February 10, 2009).

Currently, Energy Star-qualified appliances include clothes washers, dishwashers, refrigerators, freezers, dehumidifiers, room air conditioners, and room air cleaners.[3]

The CEE is a nonprofit corporation whose members include utilities, statewide and regional EE administrators, environmental groups, research organizations, and state energy offices in the U.S. and Canada. CEE uses a tiered rebate approach and complements the Energy Star program through coordinated efforts, but establishes standards for appliances that exceed Energy Star minimums. CEE sponsors the Super Efficient Home Appliance Initiative which includes room air conditioners, dishwashers, and clothes washers.[4]

CODES AND STANDARDS FOR APPLIANCE EFFICIENCY

The U.S. Department of Energy (DOE) and state and local governments are responsible for the establishment and maintenance of appliance codes and standards (rules governing the minimum legal operating efficiencies for appliances). Codes and standards can be very effective ways to increase energy efficiency. However, depending on program design, updates to codes and standards can also threaten "achieved" energy efficiency savings and therefore the cost effectiveness of efficiency programs. As codes and standards are updated, utilities must keep ahead of these standards and modify their EE programs to ensure cost-effective savings above and beyond levels in the updated code.

As an example, many utilities offered rebates for high-efficiency residential central AC units in the past. But, when the national standards changed in 2006 from a minimum seasonal energy-efficiency ratio (SEER) of 10 to a minimum SEER of 13, many of these rebate programs were discontinued.[5] The programs were no longer cost-effective because, while costs remained stable, significant savings were no longer attributed to the programs but rather to the new standards. In response, many utilities changed the focus of their AC programs to optimizing the installation practices for new air conditioners.

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3 Energy Star, "Appliances," www.energystar.gov/index.cfm?c=appliances.pr_appliances (accessed February 10, 2009).

4 Consortium for Energy Efficiency, "Residential Programs Super-Efficient Home Appliances Initiative (SEHA)," www.cee1.org/resid/seha/seha-main.php3 (accessed February 10, 2009).

5 U.S. Department of Energy, "Appliances and Commercial Equipment Standards," www1.eere.energy.gov/buildings/appliance_standards/residential/central_ac_hp.html (accessed March 26, 2009).

PROGRAM EXAMPLES

Appliance rebate programs typically provide rebates in the $25 to $50 range for Energy Star–qualified appliances. Some rebates are higher due to higher regional electricity prices. Rebates are often provided through a mail-in process, although some utilities are now allowing submission through the web and others are working with point-of-sale rebates.

Pacific Gas and Electric (PG&E) has a robust EE portfolio and provides a number of appliance rebates. In particular, PG&E provides a $35 rebate for CEE Tier 2 clothes washers, rising to $75 for CEE Tier 3. For dishwashers, the utility provides a $30 rebate for units with an energy factor of 0.65 to 0.67, and $50 if the energy factor is 0.68 or above. Room air conditioners with the Energy Star label are eligible for a $50 rebate.[6]

The New York Energy $mart program, administered by the New York State Energy Research and Development Authority (NYSERDA), offers an upstream solution for promoting Energy Star appliances. The program works with retailers, manufacturers, and distributors to stock more Energy Star appliances. It conducts sales training for retailers and provides point-of-purchase marketing support to help drive consumer sales. Energy $mart also conducts general promotions on behalf of the retailers to spur demand for Energy Star appliances.[7] This program seeks to permanently change the marketplace by altering the way that upstream providers do business.[8]

TIPS FOR SUCCESS

- Engage market actors along the entire distribution chain. Retailers are particularly important.
- Use existing organizations such as Energy Star and the CEE to help define qualified appliances. "Piggyback" on the brand recognition of Energy Star to help promote programs.
- Be aware of changing government standards for appliances.

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6 Pacific Gas and Electric, "Appliances Catalog," http://pge.com/includes/docs/pdfs/shared/saveenergymoney/rebates/08_residential_appliance.pdf (accessed February 10, 2009).

7 Dan York, Marty Kushler, and Patti White, American Council for an Energy-Efficient Economy (February 2008), "Compendium of Champions: Chronicling Exemplary Energy Efficiency Programs from Across the U.S., Pub. U081."

8 E Source, "DSMdat: Who's Doing What in DSM Programs," database (2009).

- Use creative marketing methods with your customers to promote high-efficiency appliances. Pay attention to seasonal needs for appliances, and include specific campaigns for key demographics that would not be reached through normal channels.

Table 1. Sample Rebate Programs and Incentive Levels

Utility	Appliance	Rebate
Sacramento Municipal Utility District	Clothes washer	CEE Tier 1: $100*
	Clothes washer	CEE Tier 2: $200*
	Clothes washer	CEE Tier 3: $200*
	Dishwasher	CEE Tier 1: $25
	Dishwasher	CEE Tier 2: $75
	Refrigerator	Energy Star: $100
	Window AC	Energy Star: $50
Avista	Freezer	Energy Star: $100
	Refrigerator	Energy Star: $25
	Dishwasher	Energy Star: $25
	Clothes washer	Energy Star: $50
Efficiency Vermont	Clothes washer	Energy Star: $50
	Refrigerator	Energy Star: $25
	Freezer	Energy Star: $25
	Refrigerator/freezer	CEE Tier 1 or 2: $40
Southern California Edison	Refrigerator	Energy Star: $50

* Electric water heating only

RESIDENTIAL APPLIANCE RECYCLING PROGRAMS

The goal of refrigerator and freezer recycling programs is to permanently retire older, second (or third) refrigerators or extra freezers from residential customers. Many residential customers keep their old refrigerators when they purchase new units. These older units are relatively inefficient and are often kept in unconditioned spaces, such as garages or basements, which can increase the refrigerator's load during peak hours.

Recycling programs have been popular for many years and can provide energy savings quickly. They also provide the added benefits of properly recycling old appliances, reclaiming metals, and disposing of refrigerants.

Typical refrigerator recycling programs focus on residential customers and will remove refrigerators in the range of 10 to 30 cubic feet that are in working condition. Some programs

also recycle window AC units using the same approach. Customers typically receive a rebate of $30 to $50 for recycling their refrigerator or freezer.

These programs are typically outsourced on a turnkey basis to a third-party administrator, making it easy for a utility to get started since little internal staffing is required. According to the E Source DSMdat database, virtually all of the current programs in the U.S. have contracts with one of two companies: JACO Environmental or Appliance Recycling Centers of America (ARCA).[9]

JACO services include:[10]

- Market analysis,
- Marketing and outreach,
- Customer service for phone and web sign-ups and scheduling,
- Design and implementation of customer incentive programs, and
- Program tracking.

ARCA has been in business since 1976 and has served more than 50 electric utilities throughout the U.S. and Canada. ARCA services include:[11]

- Turn-in programs—acceptance and recycling of old refrigerators, freezers, air conditioners, and dehumidifiers;
- Early-retirement programs—encourages the replacement of primary, inefficient appliances with new super-efficient models, and the recycling of the old appliances;
- Data management;
- Energy monitoring;
- Advertising and marketing;
- Incentive fulfillment; and
- Program operations assistance—includes program enrollment and customer service.

9 E Source [8].

10 JACO Environmental Inc., "JACO Services," www.jacoinc.net/services.aspx (accessed February 6, 2009).

11 ARCA Inc., "Welcome to ARCA," www.arcainc.com/home.html (accessed March 26, 2009).

Utilities in California have had refrigerator recycling programs since 1990. Between 2004 and 2007, PG&E's program recycled more than 83,000 refrigerators, 14,000 freezers, and 1,300 window AC units for a total energy savings of 70 gigawatt-hours (GWh) and peak demand reduction of more than 11.6 MW. For the three-year budget cycle 2006 to 2008, the program budget was $22 million, about $7 million per year.[12]

TIPS FOR SUCCESS

- Simplify customer sign up. Possibly offer online appointment scheduling. Include Saturdays.
- Identify specific customer benefits of disposing of the second appliance, including energy bill savings, the reduced cost of repairs, the ease of disposal, and that the units are recycled in an environmentally responsible manner.
- Consider using advertising that shows customers that their neighbors and others in the service territory are recycling their older appliances.
- Contract with a firm that has a strong track record of success.

RESIDENTIAL PEAK LOAD REDUCTION PROGRAMS

Utilities offer both price responsive demand and direct load-control (DLC) programs to residential customers to reduce peak demand. DLC programs have been offered to customers by utilities for two decades; some utilities have huge DLC programs with hundreds of thousands of customers enrolled. Price responsive demand programs, where customers respond to time-varying rates, are becoming more popular in the U.S. but are still primarily in pilot stages and not yet widespread.

DIRECT LOAD-CONTROL PROGRAMS

The most popular residential load control programs control central air conditioners (CAC); some also control electric water heaters and, to a lesser extent, pool pumps. Utilities enroll residential customers in these programs who are willing to reduce their CAC in return for an incentive. Then, during specific hours of high demand days typically in the summer months (i.e., event days), the utility sends a signal to a switch on the residential customer's CAC unit or to a smart

12 American Council for an Energy-Efficient Economy [7].

thermostat at the customer's site, which automatically cycles, or turns off, the air conditioner for a specified amount of time. Program design issues include selecting the hardware and communications approach, developing an attractive incentive for customers to enroll, and developing a load-management plan (i.e., number of days and hours when devices will be controlled) that works for both the utility and the customer. In some service areas, large numbers of customers are enrolled in DLC programs.

Load-control programs can help avoid the need for new peaking plants and also play an important role in system reliability. Many peaking plants are only activated during the 5 to 20 highest demand days in a given year and for a maximum of 80 to 120 hours per year. Most utilities in North America are summer peaking, driven by high air-conditioning loads on the hottest days. Thus, the majority of residential load-control programs focus on central AC loads and target load reductions during the peak hours of the day on the hottest days of the year.

SWITCHES OR THERMOSTATS?

A decade ago, almost all residential DLC programs used switches that controlled CACs by cycling the compressors off and on. Now utilities can use two-way communicating programmable thermostats to automatically adjust temperatures upward in homes, which reduces the air-conditioning load. Switch technology has also progressed and now smart switches can automatically optimize cycling strategies for an individual customer's pattern of use.

Simple switch: This switch is placed on or near the central AC unit and receives a remote signal from the utility (typically a radio signal) that cycles the unit off and on in intervals such as 15 minutes on and 15 minutes off, depending on the specific program design. Switches are relatively inexpensive and can reduce load over a multi-hour event. However, the temperature rise in any particular home is hard to predict and is dependent on the AC unit. In addition, switches may break or become disabled.

Switch with adaptive algorithm: This switch cycles the central AC unit, but has built-in intelligence that learns about the natural AC duty cycle of each home and adjusts the cycling strategy to reduce loads more evenly. Switches with adaptive algorithms are somewhat more expensive than simple switches.

Thermostats: Smart or programmable thermostats offer advantages over switches. These thermostats can act as switches by cycling the air conditioners, but the utility can also control the temperature setpoint on the thermostats remotely (and will typically alter the setting by a few degrees during event hours). Once the new, higher setpoint is reached in the home, the air conditioner turns on again. Thermostats are more expensive than switches, but they are also more flexible. A benefit to customers is that they receive programmable thermostats that can be used year-round to manage heating and cooling loads. Some thermostats have two-way communications, sending data from the home back to the utility.

PROGRAM DESIGN

The average cost of a single participant in a DLC program to the utility is between $180 and $450. This includes the hardware costs, installation costs, and customer acquisition costs.[13] Simple one-way switches are the least expensive technology and two-way programmable thermostats are the most expensive. Advanced metering infrastructure (AMI), currently being deployed in many states in the U.S., will improve DLC program implementation (and will increase the penetration of price-responsive demand programs too).

The key elements of a DLC program design include:

- *Number of days.* How many days per year and how many consecutive days will CACs be controlled?
- *Duration of operations.* How many hours will a CAC be controlled in any given day?
- *Cycling or temperature rise.* For switches or cycling approaches, what percentage of time is the CAC compressor off (e.g., a 50 percent duty cycle turns the compressor off for 15 minutes then on for 15 minutes)? In the case of a thermostat, how much can the temperature increase during an event day?
- *Season and days of the week.* Almost all programs operate during specific months, typically June through September. Most operate only on weekdays (excluding holidays) when peak loads are most likely to occur.
- *Incentive or payment level.* Programs vary widely in terms of the payment to customers for participation. Some offer a fixed rebate for the summer just for being available and others pay based upon the number of operational days or the amount of demand shifted. Some utilities offer a free thermostat as the incentive. Some utilities offer no payment.

13 Paul Komor, "Best Practices in Residential Direct Load Control Programs," *E Source Efficiency & Demand-Response Programs Service, EDRP-F-8* (November 2006).

PROGRAM EXAMPLES

Xcel Energy's load-management program, started in 1990, is called Saver's Switch. In the utility's Minnesota service territory, Saver's Switch offers a 15 percent electricity bill discount for the months of June through September. Xcel cycles CAC compressors using a switch, with 15- to 20-minute cycling intervals. The CAC circulation fan stays on. The maximum number of hours for operation during a single year is 300, but according to Xcel, a more typical number is 40 hours per year. Typically the program operates in the afternoons and early evenings. There are 440,000 homes enrolled in Xcel's Saver's Switch program.[14]

Idaho Power's A/C Cool Credit program offers a rebate of $7 per month from June through August. The program cycles the AC units using switches at intervals of 15 minutes, but reserves the right to cycle more aggressively under a system emergency. Idaho Power allows customers the option of "opting out" of one event per month. Idaho Power's program operates weekdays between 4 p.m. and 7 p.m.[15]

Austin Energy's Power Partner Program provides a free programmable thermostat and installation as an incentive for customers to sign up (a value of $200 to $280). In exchange, the utility can cycle the air conditioner compressor no more than 10 minutes every half hour during periods of peak demand.[16] The program operates June through September from 3:00 p.m. to 7:00 p.m., excluding holidays and weekends.

Florida Power & Light Co. (FPL) has over 770,000 accounts signed up for its On Call® load management program. In addition to central air conditioners, On Call allows customers to sign up for control of their electric water heaters, central electric heating, and pool pumps. FPL offers two program options. The Cycle Option turns equipment off for 15 minutes each half hour for a

14 Xcel Energy web site, http://xcelenergy.com/Residential/Programs_Resources/Saver_sSwitch/Pages/SaversSwitch.aspx (accessed March 20, 2009).

15 Idaho Power web site, www.idahopower.com/EnergyEfficiency/Residential/Programs/ACCoolCredit/ACfaqs.cfm (March 20, 2009).

16 Austin Energy web site, www.austinenergy.com/Energy%20Efficiency/Programs/Power%20Partner/index.htm (accessed March 26, 2009).

period of up to six hours and offers $21 in annual savings for CAC enrollment and an additional $10 for central electric heating. The Extended Option turns the equipment completely off for up to four hours (three for CAC) and provides $63 per year for CAC, $20 for central electric heating, $18 for water heating, and $36 for pool pumps. On Call is activated only three or four times in a typical year.[17] FPL achieves a reduction of approximately 1.44 kilowatts (kW) per account, which results in about 1,000 megawatts (MW) per event.[18]

IMPACTS AND PARTICIPATION

The amount of peak energy savings that a DLC program can provide varies by utility and program based on factors such as weather, home size, program design, and cycling strategy. In a study by E Source, the average amount of savings was approximately 1 kW per home. On the high end, Louisville Gas & Electric's 2003 Demand Conservation program reported a reduction of 1.79 kW per customer using a 100 percent cycling approach. Puget Sound Energy's 2000 household pilot used a thermostat setback of 4 degrees Fahrenheit during the evening, and reported a reduction of 1.7 kW per customer. On the lower end, Jersey Central Power & Light achieved a reduction of 0.72 kW per customer with a 50 percent cycling approach, and Idaho Power achieved a reduction of 0.76 kW per customer in its 2003 study with a 50 percent cycling strategy.[19]

Some utilities have had great success in enrolling customers in their load-management programs. Xcel Energy had more than 285,000 participants just in its Minnesota service territory in 2006, representing almost 25 percent of its residential customers. FPL has approximately 770,000 participants (about 21 percent of its residential customers), Austin Energy has more than 50,000 participants (about 16 percent of its residential customers), and Otter Tail Power has 7,000 participants, or 7 percent of its residential customers.[20]

17 Florida Power & Light Residential On Call, https://app.fpl.com/secure/forms/oncall.shtml (accessed April 14, 2009).

18 Ed Malemezian, FPL On Call—1,000 MW and Eighteen Years Later, Oregon PUC Advanced Metering Workshop, February 6, 2005, http://www.oregon.gov/PUC/electric_gas/010605/malemezian.pdf (accessed April 14, 2009).

19 Paul Komor [13].

20 Paul Komor [13].

TIPS FOR SUCCESS

- Determine how the load-management resource will be used before the program is designed. Programs that address system emergencies (i.e., emergency load management) will be designed differently than those that are intended to address high peak power prices (i.e., economic load management).
- Choose hardware and communications systems that can grow with the utility's future needs. Thermostats with two-way communications may cost more today, but they may also provide more benefits.
- Work with system operators to understand their needs for peak load savings and reliability so that the programs are acceptable to the supply side of your business.
- Address customer comfort up-front. Use focus groups and test marketing to determine the program features that matter most to customers.
- Use advertising messages that resonate with your customers. Use market research to develop these messages.

RESIDENTIAL LIGHTING PROGRAMS

For over a decade, residential lighting programs that provide incentives for CFLs have been popular and have provided substantial energy savings in utility residential program portfolios. However, because the Energy Independence and Security Act of 2007 starts phasing out incandescent lamps in 2012,[21] CFL programs will no longer provide substantial savings. Many utilities are cutting back these programs and some utilities are retooling programs for new lighting technologies and specialty lamps.

RESIDENTIAL CONSUMER ELECTRONICS AND PLUG LOAD PROGRAMS

The U.S. is experiencing a surge in electricity demand from new plug loads such as computers, flat panel and plasma TVs, set-top boxes for satellite and cable, game consoles, and chargers. Between now and 2030, consumer electronics represent the greatest potential source for EE savings in the residential sector (see Figure 1). New programs that promote high-efficiency TVs,

21 Energy Independence and Security Act of 2007, "Subtitle B--Lighting Energy Efficiency, Sec. 321. Efficient light bulbs," http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=110_cong_public_laws&docid=f:publ140.110 (accessed March 26, 2009).

improve power supplies, and provide smart plugs and power strips to eliminate "phantom" power usage (usage that continues when devices are turned off) are just beginning to emerge in the utility industry and are expected to become increasingly important given the savings potential.

PG&E recently initiated a consumer electronics program to work with manufacturers and retailers to increase the market share of energy-efficient consumer electronics. Partnering with Energy Star and CEE, PG&E helped develop new "tier 2" specifications for energy-efficient televisions. Under the program, incentive payments are made directly to participating retailers and manufacturers to increase the supply of energy efficient TVs.

COMMERCIAL & INDUSTRIAL PROGRAMS

COMMERCIAL LIGHTING PROGRAMS

Commercial lighting programs often provide the greatest energy savings in a typical utility's EE portfolio. Payback periods for customers can be relatively short, making them a great target for new and developing portfolios. Perhaps somewhat surprisingly, between now and 2030, commercial lighting programs still represent the largest potential source of EE savings nationwide (see Figure 1).

A typical lighting program provides incentives to customers and trade allies who install efficient lighting equipment specified by the utility. The specific equipment can change often, based on external input from contractors, consultants, and other industry experts.

Electrical contractors and other trade allies are important partners for lighting-efficiency programs. Utilities do not necessarily have to search for lighting retrofit opportunities; contractors view these programs as an avenue for making proposals to customers and growing business. Hence, it is important for utilities with lighting programs to educate trade allies, support their efforts, and provide streamlined approaches to program administration.

PROGRAM EXAMPLES

Well run lighting programs can quickly become top performers in a utility's efficiency portfolio. Between 2002 and 2006, Xcel's Lighting Efficiency program had more than 4,346 participants

and saved 52.4 MW and 273 GWh, approximately 13 percent of the utility's Minnesota EE savings portfolio.[22]

Alliant Energy, Madison Gas and Electric, We Energies, Wisconsin Public Service, and Xcel Energy built the Business Lighting Incentive Program in concert with Focus on Energy, an initiative that works with eligible Wisconsin residents and businesses to install cost-effective energy-efficiency and renewable-energy projects. This program provides financial incentives to purchase high-efficiency lighting equipment or controls on a per-item basis. The program uses mail-in rebates and incentives up to $10,000 per participant. Under the program, standard-wattage CFLs (equivalent to between 32 and 100 watts [W]) receive $2 per bulb and high-wattage CFLs (33 to 115 W equivalent) that are replacing a 100 W or higher incandescent receive $5 per bulb. On the upper end of the incentive scale, high-bay fluorescent T5HO (high-output) and T8 lamps receive a rebate of $150 per lamp. Incentives are also provided for specialized, high-performance lights that operate more than 18 hours a day. The program targets hospitality, healthcare, grocery, and retail facilities.[23]

Avista's commercial lighting program is another example of a well established program run completely in-house. All marketing is through internal account executives and participation in local trade-ally networks (i.e., no direct marketing). Sixty-five to seventy-five percent of achieved conversions are T12 to T8 (2, 4, and 8 feet), but the program also offers incentives for high-intensity discharge (HID) - metal halide, high-pressure sodium, and mercury vapor - to T5 or T8 conversions as well as other lighting options. In March of 2008, Avista increased incentives (by 20-65% depending on the application), resulting in an increase in projects and savings, from 325 projects and 8.1 GWh of savings in 2007 to 519 projects and 11.8 GWh in 2008.[24]

Some utility lighting programs focus on reducing demand (kW) rather than energy (kWh). A good example is PG&E's BEST (Business Energy Services Team) program. The BEST program provides free assessments and incentives for the purchase and installation of cost-effective, high-

22 American Council for an Energy-Efficient Economy [7].

23 E Source [8].

24 Leona Doege (February 2009), DSM Program Manager, Avista Utilities, 800-727-9170, leona.doege@avistacorp.com.

efficiency lighting. Standard-wattage CFLs receive $70 per kW saved; hardwired CFLs and fluorescent fixture upgrades receive $650 per kW saved, as do light-emitting diode (LED) exit signs. Lighting controls range from $150 to $250 per kW saved, and custom lighting receives $650 per kW saved. The maximum rebate is capped at 100 percent of the total project cost.

Implementation Methods

Typically, utilities offer on-site audits to commercial customers and direct installation services, usually through contractor networks. This provides utilities with the ability to better understand their clients' needs, recommend the most cost-effective measures, and verify equipment installation. MidAmerican Energy's Business Check program offers on-site, walk-through audits with its qualifying small commercial customers (facilities of less than 25,000 square feet). While on the customer's premises, MidAmerican installs the following energy-saving measures where applicable: one water heater insulation blanket, water pipe insulation, one faucet aerator, two CFLs, two LED exit-sign retrofits, one occupancy sensor, and one refrigerated vending machine controller. Rebate and financing methods for further efficiency measures offered by MidAmerican Energy are included in the audit report.[25]

Program Examples and Rebate Levels

Rebates for lighting can be complex because of potential retrofit size and replacement combinations. Examples of retrofit and incentive levels are outlined in the three sample programs below.[26]

National Grid Rhode Island's Design 2000plus Program:

- New fluorescent with T8 lamps and electronic ballast: $10.
- High-efficiency fluorescent fixture (2x2 or 2x4): $20.
- High-efficiency, low-glare fluorescent fixture (2x2 or 2x4): $25.
- High-efficiency indirect fluorescent fixture: $35.
- 4-foot fluorescent fixture with reflectors: $20.
- 8-foot fluorescent fixture with reflectors: $25.

25 E Source [8].

26 E Source [8].

- 4-foot fluorescent fixture with reflectors and tandem wired ballasts: $10.
- 8-foot fluorescent fixture with reflectors and tandem wired ballasts: $15.
- Dimmable compact fluorescent fixture: $40.
- New fluorescent fixture for high- and low-bay applications (<=219 W): $30.
- New higher-wattage high- and low-bay fluorescent fixture (>219 W): $40.
- Remote mounted occupancy sensor: $75/control.
- Daylight dimming system: $40/ballast.
- Occupancy-controlled high-low system: $40/ballast.
- Wall-mounted occupancy sensor: $25/control.
- Occupancy-controlled high-low system (HID): $100/fixture.
- Daylight dimming system: $100/fixture.
- High-intensity fluorescent occupancy-control system: $50.

MidAmerican's Energy Advantage Lighting Equipment Program:

- Fluorescent fixture, either T8 or T5, ranging from 2 to 8 feet: $6 to $12/fixture.
- Occupancy sensor: $20/control.
- Pulse-start metal halide fixture: $15/fixture.
- 360-W metal halide lamp: $3/lamp.
- CFL (self-ballast/screw-in): $2/lamp.
- CFL (hard-wired): $10/fixture.
- 150-W compact-fluorescent low-bay fixture: $25/fixture.
- LED exit sign: $5/sign.
- LED traffic lighting retrofit (red, green, don't walk): $15 to $60.
- Refrigerated case lighting fluorescent T8 fixture: $10/fixture.

Xcel's New Mexico Lighting Efficiency Program:

Retrofits:

- Fluorescent T8 lamp with electronic ballasts: $10 to $20.
- Fluorescent super-T8 lamp with electronic ballasts: $20 to $22.
- High-bay fluorescent T8 or T5 HO lamp with electronic ballasts: $75.
- Hard-wired compact-fluorescent fixture: $10 to $24.
- Metal halide and high-pressure sodium fixtures: $25 to $45.
- Pulse-start metal halide: $40 to $100.
- LED exit signs and retrofit kits: $6.
- LED traffic signals: $40.

New construction:

- Fluorescent T8 with electronic ballasts: $2.50 to $3.00.
- Low-wattage fluorescent T8 lamp: $0.75/lamp.
- High-bay fluorescent T8 or T5 HO lamp with electronic ballast: $20.
- Hard-wired compact-fluorescent fixture (excludes screw-based CFLs): $9 to $20.
- Pulse-start metal halide fixtures: $6 to $20.

TIPS FOR SUCCESS

- Be flexible—lighting technologies and controls develop quickly and technologies change frequently. Take advantage of new opportunities by updating your incentive portfolio.
- Account for both upstream and downstream approaches.
- Create programs for lighting contractors, including education and promotional support.
- Develop relationships with key distributors—create clear sales tracking and auditing mechanisms with each distributor; provide a strong incentive structure to encourage distributors to push high-efficiency lighting products.
- Generate program awareness and satisfaction with downstream customers through outreach, education, and promotion so that they support the demand for efficient products from suppliers.

- Develop customized lighting-consulting capabilities for evaluating large retrofit projects and those that don't lend themselves to prescriptive measures.

COMMERCIAL HVAC PROGRAMS

According to the DOE, HVAC accounted for over 30 percent of nonresidential energy usage and expenditures in 2006.[27] HVAC presents an excellent opportunity for most commercial customers to decrease energy usage and improve comfort. The cooling component of HVAC is of particular interest to summer-peaking utilities. HVAC programs are not always straightforward to design and implement; HVAC systems are complex, vary widely by application, and are highly sensitive to occupants' needs and comfort. HVAC retrofits also tend to have long payback periods when compared with lighting and motor applications. These factors make rapid implementation of HVAC programs more difficult. HVAC programs provide incentives for a wide range of equipment (tied to the size/tonnage of the unit) and rebates vary widely from utility to utility, generally driven by climate variation.

PROGRAM EXAMPLES

Focus on Energy runs the HVAC for Businesses program in Wisconsin, representing service territories for Alliant Energy, Madison Gas and Electric, WE Energies, Wisconsin Public Service, and Xcel Energy. Incentives that vary by size and efficiency are provided for the following technologies and applications:[28]

- Modulating hot water boilers,
- Boiler controls,
- Furnaces,
- Infrared heaters,
- Rooftop/unitary AC,
- Rooftop/unitary split-system AC,
- Packaged terminal AC (PTAC),

27 U.S. Department of Energy, "Buildings Energy Data Book," http://buildingsdatabook.eren.doe.gov/ChapterView.aspx?chap=1 (accessed March 30, 2009).

28 E Source [8]; Focus on Energy, "Heating, Ventilation, Air Conditioning and Steam System," www.focusonenergy.com/Incentives/Business/Heating_Cooling.aspx (accessed March 26, 2009).

- Packaged terminal heat pumps (PTHP),
- Energy recovery ventilator,
- Split-system AC, and
- Electric chillers: air-cooled and water-cooled.

In addition, other equipment may be eligible for a rebate on a customized basis.

Connecticut's Cool Choice program - shared between United Illuminating and Connecticut Light & Power - also offers rebates for commercial HVAC systems. Table 2 shows an example of the Cool Choice program's rebates for unitary and split systems.[29]

Table 2. Connecticut's Cool Choice Program Rebates for Unitary and Split-system HVAC Equipment (including ductless split systems)

Unitary and split-system HVAC equipment (including ductless split systems)		**Tier 1**		**Tier 2**	
Tons	*Btu*	*Minimum SEER/EER*	*Rebate ($/ton)*	*Minimum SEER/EER*	*Rebate ($/ton)*
<5.40	<65,000	14.0 SEER	80	15.0 SEER	150
5.40–11.25	65m–135m	11.5 EER	80	12.0 EER	150
11.25–20.00	135m–240m	11.5 EER	80	12.0 EER	150
20.00–30.00	240m–375m	10.5 EER	70	10.8 EER	120

Note: EER = energy-efficiency ratio; m = million.

The PG&E Motor and HVAC Distributor Program, which targets HVAC systems and motors, is an upstream incentive program for distributors to encourage the purchase of unitary packaged units (such as rooftop units) and split-system air conditioners and heat pumps that meet CEE Tier 1 or Tier 2 specifications. Over the program's first eight years, these upstream incentives have

29 E Source [8].

increased rebated HVAC equipment by 590 percent compared to the prior downstream approach (for more details on this program, see "Upstream Application of Motor Programs" below).[30]

TIPS FOR SUCCESS

- Cover as much HVAC equipment as possible, including unitary AC and split systems, dual enthalpy economizer controls, water source heat pumps, and furnaces with electronically commutated fan motors.
- Consider HVAC tune-ups as part of your program.
- Tie into a larger commercial and industrial program to increase participation and achieve greater savings.

INDUSTRIAL MOTORS PROGRAMS

High-efficiency-motors programs encourage the purchase and installation of high-efficiency, or premium, motors as opposed to standard-efficiency units. High-efficiency units are interchangeable with standard motors but more expensive. Motor-driven equipment accounts for 64 percent of the electricity consumed in the U.S. industrial sector. According to EPRI's recent energy efficiency potential study, motor replacement represents the largest potential for energy savings in the industrial sector (see Figure 1). A study by the Alliance to Save Energy claims, "High-efficiency motors can reduce energy consumption by as much as 45 percent compared to standard motors."[31] Additionally, the Minnesota Technical Assistance Program reports, "High-efficiency motors make up less than 10 percent of all industrial motors in current use."[32]

Motors programs are an important component to an electric utilities' EE-program portfolio. The top industrial motors programs offered by utilities typically apply to both commercial and industrial motors and offer a direct rebate or incentive for installation of a high-efficiency motor to the end user. Prescriptive rebates usually correlate to the horsepower (hp) of the replaced motor up to 200 hp. Larger motors typically have custom rebates.

30 American Council for an Energy-Efficient Economy [7].
31 Alliance to Save Energy, "Economic Advantages of Using Energy Efficient Motors and Variable Speed Drives in Hotels," www.ase.org/content/article/detail/1369 (accessed March 30, 2009).
32 University of Minnesota Technical Assistance Program, "Motor Energy Saving Tips," www.mntap.umn.edu/energy/123-MotorTips.htm (accessed March 30, 2009).

MOTOR TYPES

Utilities typically provide incentives for three types of motors: totally enclosed, fan-cooled (TEFC) units; open drip-proof (ODP); and adjustable-speed drives (ASDs).

TEFC motors are commonly used in industrial applications. They are cooled by an external fan that blows air across the outside surface of the motor to carry heat away; air does not move through the inside of the motor. Therefore, these motors are suited for dirty, dusty, and outdoor applications but not for applications where the unit would be exposed to high-pressure water. There are specialized varieties of TEFC motors, including corrosion-protected and wash-down styles.[33]

ODP units are less expensive and are used in any application where a TEFC unit is not required. These motors have ventilated openings that allow external air to enter and move directly over and around the windings of the motor.[34] Because open drip units are less expensive, the rebates for them are also typically lower than those offered on TEFC motors.

ASDs, also called variable-speed drives (VSDs), allow induction-motor-driven loads such as fans and pumps to operate in speed ranges as wide as 10 to 300 percent of nameplate speed. By controlling motor speed so that it finely corresponds to varying load requirements, ASD installations can increase energy efficiency (in some cases by as much as 50 percent), improve power factor and process precision, and afford other performance benefits such as soft starting and overspeed capability. According to the *E Source Business Energy Advisor*, ASDs can also eliminate the need for expensive and wasteful throttling mechanisms such as control valves and outlet dampers.

REBATE LEVELS & PROGRAM EXAMPLES

Rebates range widely, even for the same type of motor. For instance, rebates payable to the end user can start as low as $40 for a 5-hp ODP motor and can go up to $2,350 for a 200-hp ODP unit. TEFC motor rebates start at $60 for a 5-hp unit and go up to $3,590 for a 200-hp unit. The

33 Automation Consulting & Supply, "Definition: TEFC," www.oddparts.com/acsi/defines/tefc.htm (accessed March 30, 2009).

34 Automation Consulting & Supply, "Definition: ODP," www.oddparts.com/acsi/defines/odp.htm; Elettra Technology Inc., "Open Drip-Proof (ODP)," www.etimotors.com/ODP-WPII.htm (accessed March 30, 2008).

incentive level for a 5-hp motor controlled by an ASD starts at about $800 and goes up to $6,300 for a 100-hp unit.[35]

Kansas City Power & Light (KCP&L) has a number of prescriptive rebate programs (see Table 3). Rebates are limited to the most common motor speed, 1,800 rpm (nominal). Larger motors or other motor speeds may be eligible under KCP&L's Custom Rebate Program. An example motor program is described below:[36]

> *Rebates are available for installing motors that exceed minimum performance requirements of local energy codes (or ASHRAE Std. 90.1) for typical applications of three phase Design A and Design B motors. Rebates are available for both Open Drip Proof (ODP) and Totally Enclosed Fan Cooled (TEFC) motor types. Motor efficiency must meet or exceed that which is classified as NEMA [National Electrical Manufacturers Association] Premium.*

Table 3. Kansas City Power & Light's (KCP&L's) Motor Rebate Program Incentives

Motor size (hp)	ODP	TEFC	Incentive ($/motor)
	NEMA nominal efficiency (%)		
1	85.5	85.5	50
1.5	86.5	86.5	50
2	86.5	86.5	60
3	89.5	89.5	60
5	89.5	89.5	60
7.5	91	91.7	90
10	91.7	91.7	100
15	93	92.4	115
20	93	93	125
25	93.6	93.6	130

UPSTREAM APPLICATION OF MOTOR PROGRAMS

Utilities in the Northeast and California have offered incentives for high-efficiency motors for over a decade. A particularly successful program is PG&E's Motor and HVAC Distributor Program which started in 1999. PG&E's program provides an upstream incentive to distributors

35 E Source [8].

36 Kansas City Power & Light, "Prescriptive Rebate Program," http://kcpl.programprocessing.com/content/prescriptiverebates (accessed February 10, 2009).

to encourage the stocking and sales of high-efficiency motors. This program's upstream incentive and an online application process started in 2004 have added to its success. Over 95 percent of all motor distributors in PG&E's service territory participate in the program. In program years 2004 to 2005, this program saved 24.4 GWh and 13.2 MW. In 2006, the program saved 16.55 GWh and 8.79 MW. PG&E has shifted the purchasing behavior of the top 10 participating distributors so that they now stock mostly premium motors, and other participants stock 25 to 50 percent premium motors.[37]

TIPS FOR SUCCESS

- Determine program emphasis—end users, contractors, distributors, or all three. Create an appropriate design for your target markets.
- Specify NEMA premium-efficiency motors.
- Offer incentives for motors that operate more than 2,000 hours a year.
- Offer rebates for replacement, renovation, and new construction.

INDUSTRIAL CUSTOM PROGRAMS

Industrial customers use many different kinds of equipment and have unique energy needs for their processes. In many situations, a custom program is more likely to achieve the desired savings than a prescriptive program. Programs may target retrofit, new construction, and/or major renovations. Occasionally, utilities offer a design or engineering assistance program for renovation or new construction work.

Industrial custom programs may include lighting, HVAC, water heating, motors, refrigeration, process-related equipment, and materials-handling equipment. Such programs encourage the largest and most sophisticated customers to participate in aggressive energy-saving initiatives.

In a custom incentive program, the customers and their own consultants or engineers analyze and calculate savings. Successful programs include a measurement and verification protocol to verify savings achieved. Rebates are usually based on a kW- and kWh-savings basis, so utilities typically play a role in customizing the savings calculation and analyzing the value of the

37 American Council for an Energy-Efficient Economy [7].

savings. For example, Focus on Energy (Wisconsin) provides incentives of up to $200 per kW of peak demand reduction and $0.06 per kWh for first-year usage savings. Similarly, Xcel Energy provides $195 per kW peak demand reduction and $0.067 per kWh saved for its custom program in Texas.[38]

PROGRAM EXAMPLES

In Wisconsin, Focus on Energy conducts an Industrial Program that educates customers and offers financial incentives for efficiency improvements. Its staff, located throughout Wisconsin, conduct on-site assessments and primarily target five key local industries: paper, metal-casting, food/dairy, plastics, and water/wastewater. The rebates are customized and highly cost-effective, achieving a benefit-cost ratio of almost 12. This program offers grants for project feasibility analysis that cover up to 50 percent of the cost.

Although the majority of this program is custom, there is a prescriptive element for certain measures where savings are well known. The program also has a trade-ally component, in which key market players promote the program.

Focus on Energy has achieved significant savings through this program. According to the American Council for an Energy-Efficient Economy, since July 2001 the program has saved 141 GWh; 20.6 MW; and 15,085,925 therms from projects with 1,500 customers.[39] Working with the five key local industries, Focus on Energy developed Energy Best Practice Guidebooks to advance efficiency in business culture.[40]

Avista Utilities also has a custom program in which customers propose custom energy-saving projects. Avista provides incentives directly to the customer for hard-wired improvements, such as motors, lights, controls, and high-efficiency equipment (incentives do not apply to behavioral modifications). The incentive is based on first-year energy savings. In addition, Avista provides incentives for fuel substitution from electricity to natural gas. Projects require engineering analysis of savings.

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38 E Source [8].

39 American Council for an Energy-Efficient Economy [7].

40 Focus on Energy Library, http://www.focusonenergy.com/Information-Center/Business/Industrial-Info-Library/Best-Practice-Sheets.aspx (accessed April 15, 2009).

The incentive provided is based upon the simple payback of the measure, calculated by Avista staff, based on standardized measure costs (Table 4).[41] Simple payback is defined as the capital cost of the project divided by the energy savings per year.

Table 4. Incentive Levels for Avista's Custom Industrial Program

Measures	Simple payback period (years)	Incentive level (cents per first-year kWh saved)
Energy efficiency	1–2	6
	2–4	10
	4–6	12
	6–10	14
	10+	4
Fuel conversion (electricity to natural gas)	1–2	1
	2–4	2
	4–6	3
	6–10	4
	10+	1

TIPS FOR SUCCESS

- Create a buzz with industrial customers by communicating that you have a program designed for their specialized needs.
- Use in-house or contracted engineering expertise to help customers complete the applications thoroughly and accurately, possibly through an industrial efficiency hotline.
- Ensure that the account management staff promotes the program to the largest customers and asks about upcoming retrofits and additions.

EE PROGRAM DESIGN BIG PICTURE

Utilities use a variety of approaches for implementing EE programs - there is no silver bullet or single "best practice." But, ultimately, utilities target the same technologies, end-uses, and customer types, so much can be learned by sharing information. Successful EE programs enlist the help of trade allies, retailers, and partners. In addition to deciding on which EE program

41 E Source [8].

areas to target, key decisions for utilities are: (i) whether to target the program upstream to supply channels or downstream to the end-use customer; (ii) the roles of marketing and education in supporting the program; and (iii) whether the program will be run in-house or be outsourced.

Upstream or downstream targeting? As discussed earlier in this paper, whether to target the program upstream or downstream depends on the ultimate goal of the program, the knowledge of the end user, and the targeted end-use. Applications with large per-unit energy savings lend themselves to downstream approaches because the cost of rebates necessary to influence consumer behavior is justified by the high levels of energy savings. Applications with relatively low individual unit savings are better addressed upstream, where program dollars can be used to influence the product volumes necessary to achieve significant savings.

Upstream programs focus on participating contractors, distributors, dealers, manufacturers, and retailers who are paid on a per-unit-sold basis (where each piece of equipment must meet program specifications and be installed properly). For upstream programs, it is important to have strong sales tracking and auditing mechanisms with each upstream partner. Incentive levels provided upstream can sometimes be lower than those provided to the consumer. Manufacturer representatives can be helpful in developing an upstream approach and in identifying potential incentive thresholds and distributors in the service territory. Electrical contractors purchase most equipment from several key distributors. It is not unusual for a relatively small number of these distributors to have dominant market share, so identifying and working with these distributors is important.

Downstream programs focus on end-users or customers and usually target consumer behavior by rebating the purchase of high-efficiency equipment. For downstream programs, it is important to base program design on market research, balancing the energy savings achieved by program participation against program administration and marketing costs. It is also important to consider the role of consumer education in ensuring that rebated equipment is properly installed and operated to maximize savings achieved. Partnerships with retailers can also benefit downstream programs, by enhancing the effectiveness of program marketing and streamlining program administration.

How will marketing and education support the EE program? Rebates and discounts alone may do little to move markets if not promoted effectively. In fact, there have been many successful EE programs where rebates were de-emphasized after the first few years but a strong marketing and educational component remained. Both end use customers and trade allies need to be constantly reminded about the benefits of high-efficiency options.

Does it make sense to run the program in house or outsource it? Some utilities have large EE staffs and do much of the EE program work in-house while others use an outsourcing model. Under an outsourcing model, the utility contracts with a supplier to run the energy efficiency program. This depends on strategic goals, budgets, time-to-market, and available staff.

Energy efficiency is both a resource for utilities and an opportunity. With the potential to lower customer bills, reduce environmental impacts, improve reliability, and avoid the need for new generation, energy efficiency provides increased flexibility for electric utilities in today's challenging environment. By focusing on the nine areas identified in this paper as a starting point for EE program implementation, utilities of all types can quickly jump-start their EE portfolios and seize the opportunity to tap into this vital resource.

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