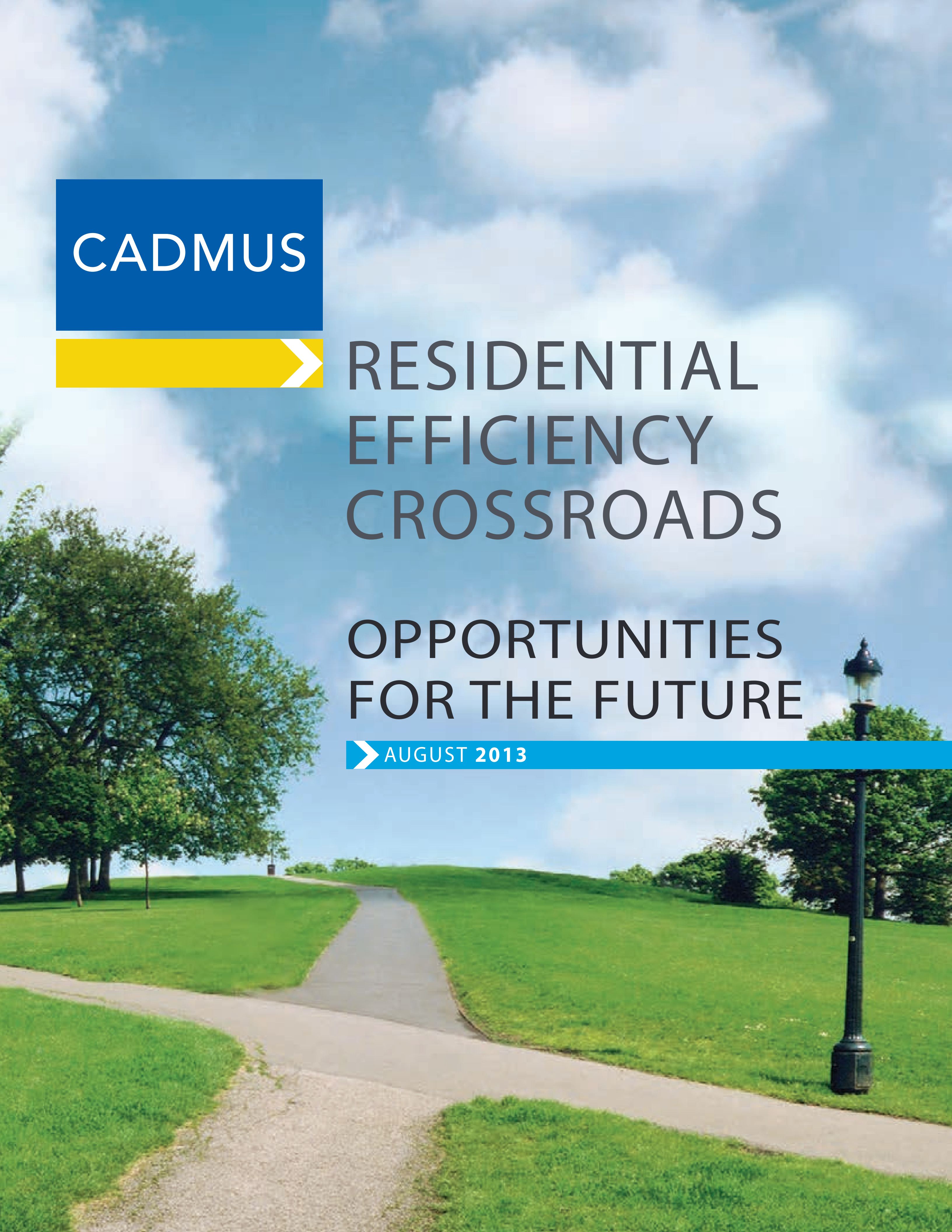
CADMUS

# RESIDENTIAL EFFICIENCY CROSSROADS

## OPPORTUNITIES FOR THE FUTURE

AUGUST **2013**



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# Contents

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*continue their productive use will require a combination of new dire*

## Executive Summary

*Recent assessments of achievable U.S. energy savings indicate significant remaining potential can be realized. However, capturing this potential is becoming increasingly difficult through traditional utility program mechanisms as market forces and regulatory constraints continue to put pressure on achievable opportunities. Residential energy-efficiency program administrators in particular are well aware of this market evolution – the question is what can be done to continue attainment of cost-effective savings with residential energy-efficiency portfolios? This white paper explores the current challenges facing utility-driven residential energy-efficiency programs observed by Cadmus. It offers possible directions for residential program planning that emphasize low delivery costs with high participation and conversion rates. The paper also explores current and future prospects for coordinating program funding, financing tools that increase access to capital, educational/behavioral outreach strategies, and ways to credit energy-efficiency programs for facilitating adoption of new codes and standards. Finally, we consider the Total Resource Cost test framework and alternative methods for calculating cost-effectiveness. However, in the evolving energy-efficiency environment, there is no single solution. Residential energy-efficiency programs are now at a crossroads; the best chances to continue their productive use will require a combination of new directions.*

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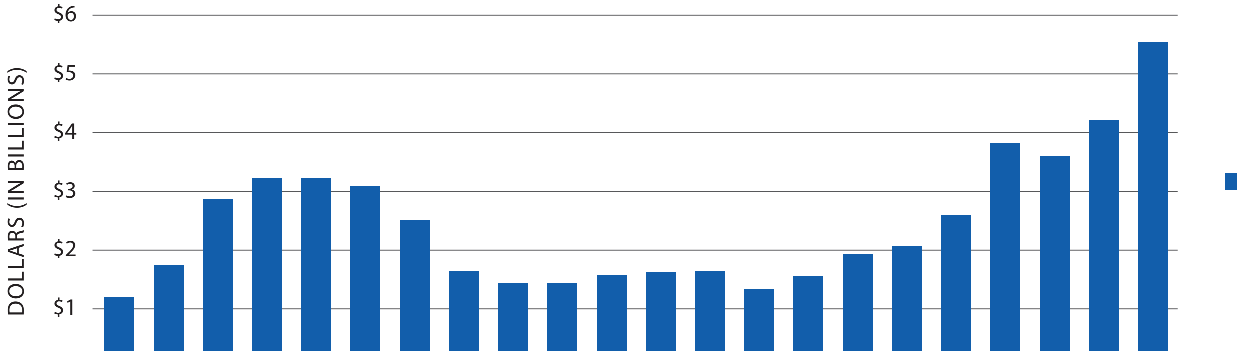
# Introduction

In the past three decades, the United States has achieved impressive improvements in efficient energy use. Increased budgets for efficiency programs, federal and state policies and standards, and creative utility incentive mechanisms have prompted energy users to tap a significant portion of potential energy savings. Moreover, the value of these savings has exceeded the cost to achieve them, indicating that efforts to date have been cost-effective.

Recent analyses of the total energy savings potential in the United States indicate that significant efficiency potential is still available. [1] Whether utilities can achieve these savings cost-effectively, however, is not as certain. In the residential sector in particular, it has become increasingly challenging for utility efficiency program planners to achieve economic realization of the remaining savings potential.

### DSM Costs/Expenditures




Source: Energy Information Administration

1 See, for example, the savings potential analysis prepared by American Council for an Energy-Efficient Economy (ACEEE), based on the Energy Information Administration's (EIA) Annual Energy Outlook 2012, Frontiers of Energy Efficiency: Next Generation Programs Reach for High Energy Savings. ACEEE (January 2013): Report Number U131 and Energy Information Administration, Annual Energy Outlook 2012. Available online at: "http://www.eia.gov/forecasts/aeo/pdf/0383(2012).pdf".

# SECTION 1: CHALLENGES FOR RESIDENTIAL DEMAND-SIDE MANAGE-

Utility-sponsored demand-side management (DSM) programs arose in the 1980s as a response to rising energy prices. Since then, 25 states have adopted energy-efficiency resource standards that require utilities to deliver binding energy-savings targets. [2] Utility commissions, tasked with overseeing compliance with the regulations, rely on a series of cost-effectiveness tests that measure the utilities' cost to deliver programs against the benefits of avoided energy and capacity costs, ensuring programs deliver real value to rate payers. The increasing cost of avoided energy, along with the advent of low-cost, easily implemented efficiency measures (epitomized by the compact fluorescent light bulb [CFL]), helped programs remain cost-effective, allowing utility program sponsors to achieve consistent energy savings through the 1990s and into the new millennium.

Meanwhile, advances in state building energy codes, along with increasing federal efficiency standards for common heating, cooling, and lighting technologies, drove energy savings even further. This shared pursuit of market-driven efficiency programs with codes and standards was a productive combination for supplying energy-efficiency resources for upwards of three decades.

## Competing Factors Impacting Energy Savings

Recent trends indicate that the converging market effects of successful efficiency programs with government intervention require rethinking the utility energy-efficiency program model. The more efficient buildings and equipment baseline makes it harder for utility programs to produce savings within the confines of their regulatory requirements to deliver energy efficiency cost-effectively. The most important of these issues are summarized here.

### Cost of Energy

Primary energy prices drive benefits in cost-effectiveness calculations; the ratio of avoided fuel costs[3] measured against the value of savings determines an energy-efficiency program's economic viability.

Natural gas costs have decreased from an average of $16.49 per thousand cubic feet in 2008 to a projected average of $10.83 in 2013.[4] This drop, along with persistently low electricity costs in some regions such as the South, makes energy efficiency difficult to justify from a utility cost-effectiveness standpoint. It also makes it difficult for customers to justify energy-efficiency projects from a return-on-investment perspective.

### Cost of Delivering Savings

While natural gas costs have decreased, the cost of capturing energy savings has increased. "Low-hanging fruit" has become increasingly scarce; reasons include both the amount of time many programs have been running and growing consumer acceptance of efficient technologies. These factors, combined with the higher-efficient product costs and the economic downturn that decreased consumers' discretionary spending, drove utilities to dedicate ever-greater resources to capture deeper energy savings and engage harder-to-reach customer segments and later adopters.

### New Building Code Adoption

Residential new construction programs are a long-time mainstay of utility DSM portfolios. But the recently-released 2012 International Energy Conservation Code (IECC) calls for significantly higher energy-efficiency standards in new residential buildings than did the previous code. In many jurisdictions, adoption of the new code increases the efficiency baseline against which utilities measure residential new construction program savings. Using traditional measures such as insulation or more efficient lighting to exceed the code may no longer be economically viable for builders or cost-effective for residential new construction programs.

2 Policy brief, State Energy Efficiency Resource Standards (EERS). ACEEE (July 2013). Available online at: "http://www.aceee.org/topics/eers".
3 Combined with the cost to produce and deliver fuel to end users.
4 Average price of natural gas delivered to residential sector customers, according to Energy Information Administration.

### Changing Equipment Standards

Much like the adoption of new building codes, higher equipment efficiency standards raise many measures' efficiency baseline. New and pending efficiency standards for lighting, boilers, and appliances decrease the energy savings available from these measures, such that many are no longer cost-effective. Utilities must reconsider whether they can continue to offer some energy-efficiency measures that have previously produced large portions of their energy savings.

The most important new energy-efficiency performance standard, the Energy Independence and Security Act of 2007 (EISA), represents a major advance in energy efficiency. EISA increases efficiency standards for lighting as well as other energy-using equipment and appliances, and presents utilities with a dual challenge: the Act simultaneously reduces the energy savings programs can achieve from CFLs by about 30% and leaves programs (for now) with less cost-effective successors for lighting program measures such as light-emitting diodes (LEDs). Even with a 30% reduction in savings, CFLs will still be a cost-effective option for utilities (especially in light of possible negative incremental costs compared to an energy-efficient incandescent alternative, e.g., halogen), but the days of utilities achieving upwards of 75% of their savings targets through CFLs may well be over.

### Product Innovation and Adoption Cycles

In many cases, increasingly stringent standards mean that energy-consuming equipment and systems are reaching the limit of cost-effective achievable savings. At the same time, promising newer technologies, such as LEDs, ductless cooling and heating systems, and tankless water heaters, remain too expensive to stimulate large-scale market adoption or anchor cost-effective residential programs. In other cases, the incremental cost of high-efficiency equipment compared to standard-efficiency option (e.g., the delta between ENERGY STAR® computers versus non-efficient computers) is too low to allow for cost-effective program delivery (i.e., the cost to administer the incentive is higher than the incentive itself). The cumulative effect of these market barriers is a reduction in utility programs' ability to integrate new technologies to replace existing measures that are no longer cost-effective.

The trend toward greater efficiency benefits society as a whole through nation-wide reductions in energy demand and pollution, and deferred needs for energy infrastructure. But these market changes have the cumulative effect of making program design and development more challenging for utilities. At the same time, while utilities have fewer cost-effective technology options, politicians and regulators continue to call for utilities to achieve ever-increasing energy-efficiency targets in many states. [5]

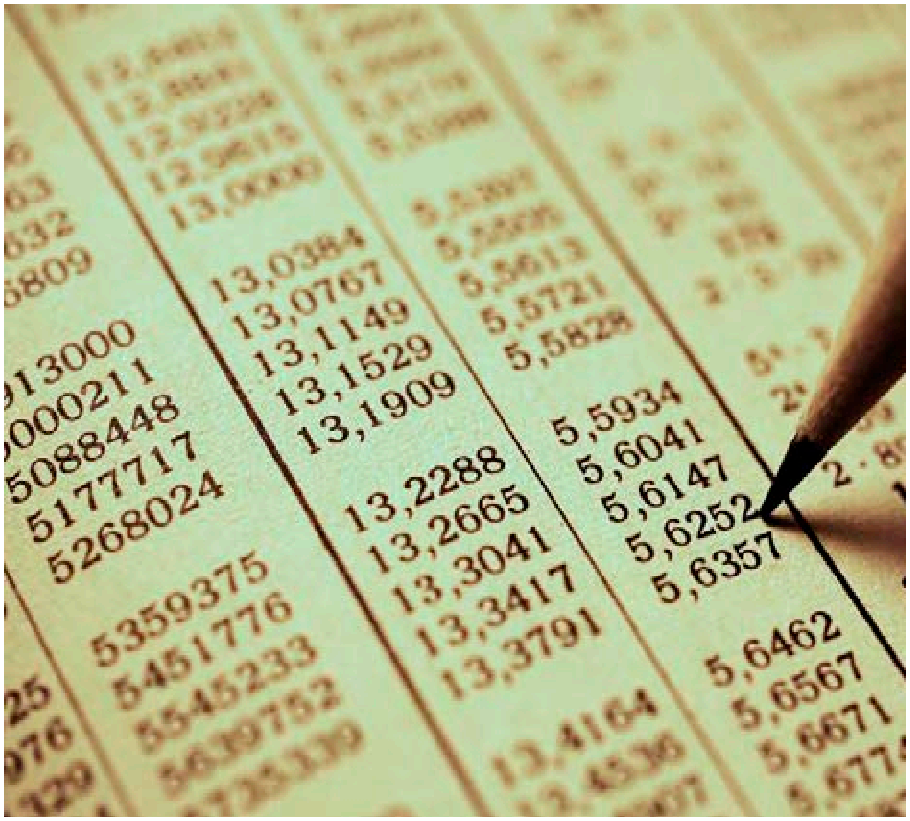
This paper explores new sources of cost-effective energy savings that DSM program planners can tap to improve the efficiency of their program investments. Past programmatic approaches have reflected a range of transaction costs relative to energy savings captured, with low costs for mass-market upstream/midstream programs (e.g., CFLs) and relatively higher program delivery costs for more resource-intensive, comprehensive home energy audit and upgrade programs. Moving forward, the challenge for utilities is to devise and deliver creative programs that offer new products and services to a broad spectrum of consumers, while achieving energy benefits and managing transaction costs.

## "Rules of the Game" For Assessing Cost-effectiveness

With cost-effectiveness either mandated or a high priority for DSM portfolios, the question becomes how to assess cost-effectiveness.

Most of the states that have adopted Energy Efficiency Resource Standards (EERS) have selected the Total Resource Cost (TRC) test as the cost-effectiveness criterion utilities must meet. The TRC test compares the total combined utility and participant cost of installing an energy-efficiency measure or implementing a program to that of the measure or program's total benefits. Cost components include incremental measure cost and utility administrative costs. Benefits include the avoided costs of energy and capacity. A ratio of 1.0 or higher indicates that the value of savings exceeds its overall costs.

5 Twenty-three states still do not have energy-efficiency requirements (either efficiency resource standards or goals) [dsireusa.org]. As some of those states struggle to implement newly-adopted Energy Efficiency Resource Standards, they face the issues presented here.



*This paper explores new sources of cost-effective energy savings that DSM program planners can tap to improve the efficiency of their program investments.*

On the surface, it appears these states are using the same standard. Upon closer review, however, significant differences appear between how jurisdictions calculate and apply the TRC.[6] Many states apply the TRC at the portfolio level, across all programs. In other jurisdictions, regulators require that every program pass the TRC, and some states require each individual measure within a program to be cost-effective. [7]

## Can Residential Energy-efficiency Programs Remain Viable?

A recent study estimated that residential energy consumption could be reduced 7% from its 2008 level by 2025 in a scenario that included moderate expansion of codes and standards (C&S). Under a more aggressive scenario, the estimated usage could be reduced by 11%. [8] But, as traditional utility program mechanisms become increasingly unable to capture this potential, the question for both utilities and regulators is, "What can be done to continue to attain cost-effective savings?" Or, from another perspective, "If potential remains, but it cannot be cost-effectively captured under traditional program models, are those models still relevant?"

This white paper, which is informed by hundreds of residential energy-efficiency program design and evaluation projects performed by Cadmus, presents strategies for addressing the current challenges. It offers possible directions for residential program planning that emphasize low delivery costs with high participation and conversion rates. The paper also explores current and future prospects for coordinating program funding, financing tools that increase access to capital, educational/behavioral outreach strategies, and ways to credit energy-efficiency programs for facilitating new codes and standards. Finally, it covers the variations within the general TRC test framework that balance alternative energy-efficiency program benefits and value outputs from multiple alternative tests.

6 See "Picking a Standard: Implications of Differing TRC Requirements," by Elizabeth Daykin, with Jessica Aiona and Brian Hedman of Cadmus. Paper presented at the AESP National Conference and Expo, January 2011.

7 For a critique of the TRC test, and a recommended cost-effectiveness test alternative, see the article "Valuing Energy Efficiency," by Hossein Haeri and M. Sami Khawaja. Public Utilities Fortnightly (July 2013): pp. 28-36.

8 Assessment of Electricity Savings in the U.S. Achievable through New Appliance/Equipment Efficiency Standards and Building Efficiency Codes (2010-2025). Institute for Electric Efficiency May 2011.

# SECTION 2: ADDRESSING RESIDENTIAL PROGRAMMING CHALLENGES

As market and regulatory challenges continue to evolve, utility program administrators must look for new ways to capture achievable energy savings despite shrinking opportunity. The era of vast, inexpensive energy savings appears to be following in the path of the CFL. So, how can utility program administrators continue to meet their regulatory goals, while still achieving the overall objective of providing ratepayer value? There are several areas where potential exists to use new sources of cost-effective energy savings and improve the efficiency of utilities' program investments through alternative delivery models and innovative investment strategies.

## Promising New Technologies

Cost-effective CFL programs and other residential measures have become harder to justify in the past three years due to increased market saturation, changing baselines, and high freeridership associated with market transformation. However, other emerging technologies exist in varying stages of development that can offset a portion of the energy savings no longer available through CFL and other marginal residential measures. A few such technologies include:

- Light Emitting Diodes (LEDs)
- Heat Pump Water Heaters (HPWH)
- Controls
- Ductless Mini Splits

None of these technologies offer the potent combination of low-cost, high-savings, and consumer acceptance that made CFLs the efficiency workhorse of the 1990s and 2000s. Each has challenges that will require effort and investment to overcome. Yet, they are among the more promising new alternatives for traditional, technology-based DSM.

### LEDs

LED replacement light bulbs are becoming commonplace at retail stores. Anecdotal information indicates that consumers are using LED light bulbs to replace not only incandescent light bulbs, but also CFLs due to their superior quality, long life, and efficiency.

Some program administrators are testing pilot initiatives or implementing LED replacement light bulb programs to compliment or supplement CFL programs. Program administrators face several challenges as they work to incorporate LEDs into their residential efficiency programs at a large scale. Once true for CFLs, LED replacement light bulbs entered the market with a high price tag, which is dropping rapidly as consumer demand increases. In April 2012, consumers could purchase a 60-watt equivalent LED bulb for $25. Today, they can purchase the same bulb for $13—a nearly 50% price drop in one year.

While LED light bulbs are more efficient than CFLs, the jump from CFLs to LED bulbs does not offer nearly the incremental savings of the jump from incandescent bulbs to CFLs. Prices for LED bulbs will continue to drop, which will benefit both consumers and program administrators. But for now, the high cost of LED bulbs, combined with lower incremental savings, has hindered the technology's ability to pass the TRC test in most jurisdictions.

Long measure life is a benefit, but could also be a potential challenge. As consumers switch to LED replacement light bulbs, rated for 25,000 hours, they will need fewer replacement bulbs in the future. In other words, LEDs are not likely to replace the sheer volume of savings utilities have traditionally relied on from CFL programs. Instead, they must look to other measures to replace an enormous amount of CFL-attributable savings.

### Heat Pump Water Heaters

Like LED lighting, heat pump water heater technology has existed for decades, but it's only in the past five years that the industry has perfected the quality of these products. HPWHs pay for themselves in less than five years. According to the U.S. Environmental Protection Agency, a HPWH can pay for itself through energy savings in less than two years when used by a family of four.

The challenge with HPWHs is that they are not ideal for use in every region in the United States because they use ambient

heat and humidity to heat water. Humid markets, such as Florida, are ideal for HPWH saturation. In addition, nearly 50% of residential U.S. homes are heated with gas, making the switch to HPWH (an electric technology) a major undertaking.

A greater challenge for utilities is driving consumer uptake of HPWH. The majority of water heater retrofits are emergency replacements. Although rebates, marketing tools, and sales training exist to support installers in the sale of a HPWH, when equipment malfunctions, consumers' concerns for immediate hot water on demand (at the lowest cost) overrides any considerations about efficiency. Program administrators face a challenge in overcoming this market barrier and increasing consumer demand for HPWH retrofits—an event that typically occurs once every 12 to 15 years.

### Controls

The advent of reliable home-area networks, improved Internet security, and proliferation of "smart" mobile technology, have made residential control technology[9] more feasible, desirable, and potentially cost-effective than ever before. Two types of controls exist—product controls and system controls.

- Product controls have limited functionality and interface with one product. Examples of product controls are dimming switches and occupancy sensors for lighting, programmable or smart thermostats, and advanced or smart power strips (APS). Energy savings available from product controls vary considerably based on user behavior. Programmable thermostats can save 5 – 15% on annual heating costs, [10] and APS can save a portion of the 5 – 10% of electric energy lost to vampire plug loads annually.[11] Various studies have shown a savings potential for lighting controls in the 5 - 40% range.
- System controls consist of lighting, HVAC, and outlet controls, managed by one central mobile technology interface or an installed monitor in the home. Energy savings gained through system controls depend on the technologies they control, and further research is needed to better understand how they interact and quantify savings. This market is anticipated to grow 60% annually through 2017[12] making it a measure worth tracking.

Program administrators have implemented pilot initiatives for product controls with some success. Efforts to deploy programmable thermostats, lighting controls, and APS have been ongoing for several years. The current challenges in increasing penetration and adoption of these products stem from short product life cycles and rapidly advancing technology. The lack of data needed to quantify typical per-unit energy savings, and the cost to conduct this research, also makes including controls in residential utility programs difficult to justify under traditional efficiency program parameters.

### Ductless Mini Split Systems

Ductless HVAC products, such as ductless mini split system heat pumps and ductless mini split system air conditioners, are designed to provide space conditioning to rooms that lack a duct system due to design or cost. They can decrease energy loss from a space conditioned by a traditional duct system by up to 30%[13] and are a beginning to draw attention from some utility program administrators.

Yet, overall penetration among utility efficiency programs remains relatively low. The challenges prohibiting greater penetration include high upfront cost, low consumer awareness, and geographic constraints. These products cost up to double that of a standard HVAC system replacement. Additionally, since ductless mini split systems have been historically used in multifamily and commercial applications, consumers are unaware of their benefits.

9 Here, residential controls encompass feedback and input devices that are capable of controlling a home's lighting, HVAC, and outlets.
10 http://energy.gov/energysaver/articles/thermostats-and-control-systems
11 http://standby.lbl.gov/
12 http://www.electronichouse.com/article/abi_research_90_million_homes_with_automation_by_2017/P245
13 http://energy.gov/energysaver/articles/ductless-mini-split-air-conditioners

Finally, geographic characteristics limit the technology's application. Ductless mini split heat pump systems work better and are more efficient in warmer temperatures. So, like a heat pump water heater, ductless mini split systems may not be the best product for every climate.

Utility programs can reduce these barriers by implementing ductless mini split systems in pilot programs that compliment residential home audit and retrofit programs. A ductless mini split system pilot program is well matched to programs that are designed to provide consumers with a diagnostic overview of potential HVAC, building envelope, and lighting efficiency upgrades, particularly when quality installation and marketing training are primary features.

## Alternative Program Design Concepts

As utilities struggle with the challenges described in this paper, program models encouraging higher participation with reduced transaction costs have the potential to help program sponsors meet their energy-savings targets within the confines of cost-effectiveness criteria.



### Upstream Programs

Upstream or point-of-sale retail programs are not new; this program design has allowed utilities to capture enormous energy savings from CFLs for many years. The program design is simple. Rather than requiring customers to submit a rebate application for a given consumer product, the utility provides an incentive directly to the manufacturer or retailer, and the product is "marked down" on the shelf.

The consumer may be unaware that when they purchased the higher-efficiency product they participated in an energy-efficiency program. This program design virtually eliminates barriers associated with mail-in-rebates and the difficulties of getting contractors and low-wage, high turnover retail staff to promote program incentives. Administrative, marketing, and delivery costs are comparatively low. However, there are disadvantages with these types of programs. The utility has no ability to capture consumer information usually needed to conduct measure savings analysis and no control over who purchases the discounted product, which limits this model's usefulness for higher cost products. The inability to effectively target specific customer segments impedes penetration of efficient products in segments known to have high saturations of less efficient products. The limitations on measuring claimed savings is an important challenge for evaluation, measurement and verification (EM&V).

Despite the success of upstream CFL programs, and perhaps as a function of the noted disadvantages noted, this design is not widely adopted by utilities for other products. A few jurisdictions have experimented with using an upstream mechanism for other low cost measures, but examples are few and product diversity is limited. Other measures potentially worth exploring could include programmable thermostats, advanced power strips, air-sealing products, and hot water measures such as pipe wrap, faucet aerators, and shower heads.

### Instant Rebates

Many utilities allow trade allies to apply incentives directly to the energy-efficiency measures they install, such as insulation and HVAC equipment. However, applying this approach at the retail level is relatively untested.

A mechanism for instant rebates may offer a viable alternative to a pure upstream model and help overcome some of its disadvantages. It would require minimal effort on the customer's part and retain the simplicity and ease of applying the incentive directly to the product at the store. It would allow utilities to capture participant information and verify their program eligibility—essentially, creating a delivery mechanism for more expensive consumer products. Rather than applying the incentive at the register, the customer would provide data, such as name and address, into a computer terminal connected to a searchable database. The computer would perform a quick check to verify the customer as an eligible program participant and produce a printed coupon or voucher, which retail staff could apply at the register. This program would be most appropriate for higher cost products available through retail outlets such as appliances, consumer electronics, room air conditioners, or ceiling fans.

While this program model implies some up-front cost associated with installing the enabling technology (i.e., computer terminal) at the retail location, participation would likely increase, and administrative costs associated with rebate processing would be minimal. Savvy utilities would leverage the computer terminal to provide additional marketing and education and would help ensure customers are aware that the incentive was supplied by their utility, increasing overall utility satisfaction.

But, what if program sponsors could leverage currently available multimedia channels and social networking to deliver similar services at a significantly lower cost? A few utilities and some municipal program sponsors have begun experimenting with an approach that finds a middle ground between a costly on-site audit and a limited value online audit, by shifting the hands-on support from an in-home audit to a post audit energy advisor model. Using phone-based, one-on-one technical support coupled with online analytical tools, live video streaming, and other communication platforms, participants can diagnose basic residential efficiency opportunities in their own homes. By adding demonstration videos, customized client dashboards, phone and/or online-based assistance identifying contractors, reviewing bids, and completing rebate paperwork, program sponsors can provide the personalized assistance that customers need to support their investment decisions (such as providing cost and payback estimates) at a lower cost and with lower hassle for the customer. Customers can track their actions and improvements, and the utility can use the online platform to collect segmentation information, educate customers on efficient behaviors, and promote appropriate programs based on the customer's needs. This approach can also incorporate a more traditional on-site audit for homeowners that prefer this approach or whose homes require more hands on diagnostics.

*What if program sponsors could leverage currently available, multimedia channels and social networking to deliver similar services at a significantly lower cost?*

### Off-site Residential Audits

Residential on-site energy audit programs have been at the core of many utilities' portfolios for more than two decades. Their advantages and disadvantages are many and well documented. They are expensive to implement and, on their own, offer no energy savings. But they provide a valuable entry-point to utilities' broader energy-efficiency incentives; offer opportunities to capture energy savings from low cost, direct install measures; and provide customers with the technical expertise needed to prioritize their energy-efficiency investments. It is also clear from many years of program delivery history that when program sponsors invest in hands-on diagnostic testing, customized analysis, and one-on-one technical support and follow up, participant conversion rates and energy savings go up, along with program costs.

However, customers are typically unwilling to pay more than a nominal share of the audit cost, leaving an ever-greater expense for program sponsors to shoulder. Additionally, the hassle-factor barrier can be significant (customers typically must be at the home with the auditor, sometimes for several hours), and programs frequently suffer from poor conversion rates, bringing down their overall cost-effectiveness. Some utilities have given up justifying audit programs on a cost-benefit basis and have simply relegated their audit programs to a marketing function, or have abandoned them all together in favor of online audit tools that offer little in the way of customization, participation, or energy savings.

### Residential Performance Contracting

The concept of performance contracting has existed in the large commercial and industrial sector for many decades, and many believe, peaked in the 1990s. This financing model allows customers to install comprehensive efficiency projects with no up-front costs, and pay for the upgrade through energy savings resulting from the upgrades. Conventional wisdom holds that this model only works when financiers are able to consolidate the financing risk by installing very large projects. Past attempts to replicate this model in the residential sector have been fraught with issues ranging from a lack of willing capital markets to inscrutable project developers, and a distrusting target audience. But, over the last few years, financial

environments have changed and new models for financing energy projects have come to the fore. Specifically, the concept of solar leasing has turned the conventional wisdom around consumer lending upside down. What if a similar model could be applied to residential energy-efficiency upgrades?

Following many years of theoretical posturing, energy-efficiency financing is beginning to take hold, with new and innovative financing models finally gaining traction among a growing number of forward-looking utility program sponsors. A later section of this white paper explores some of these models in greater detail, including a Property Assessed Clean Energy and tariffs approach, which upon which this concept is based. As efficiency financing continues to evolve and new players enter the market, there may be potential for third-party actors to influence residential efficiency, by acting as a lease holder in intermediary between the customer and their utility bill. The trick for utility program administrators will be in developing collaborative program strategies that still allow them to capture the resulting savings.

## Leveraging Codes and Standards

Energy-efficiency codes for buildings and standards for appliances offer a way for government intervention to stimulate a significant transformation of the residential efficiency market. Traditionally, regulators adopt and implement building codes at the state or local level. However, local codes increasingly draw from national model codes such as the International Energy Conservation Code for residential buildings. Stimulated largely by the American Reinvestment and Recovery Act, the number of states and local jurisdictions adopting the latest residential model building codes has grown rapidly in the past four years.

Likewise, under the Obama administration, adoption of national equipment standards that affect residential energy use has accelerated, driven by the U.S. Department of Energy. As discussed in the introduction of this paper, increasing the baseline from which savings are measured can impact a program's cost-effectiveness and therefore, a utilities' ability to maintain the program. Under typical rules for setting efficiency targets and rewarding performance, utilities have no incentive to support codes and standards—tighter C&S raise the efficiency baseline, making it harder for acquisition programs to produce energy savings.

However, with appropriate regulatory mechanisms in place, there may be new opportunities for utilities to capture energy savings as a result of increasing consumer appliance standards, residential building codes, and code compliance enhancement. These opportunities can be a significant source of cost-effective energy savings, helping utilities respond to the challenge of diminishing residential acquisition opportunities.

Started by the California investor-owned utilities (IOUs), utilities and other program administrators around the country have begun to venture into the world of codes and standards as a way to achieve significant energy savings. A recent study examined how program administrators could get involved in supporting building energy codes, and the basic findings from that study apply to appliance standards as well.[14]

Utilities are natural partners in the codes and standards arena. They bring energy-efficiency technical knowledge and expertise, skilled staff, program experience, and resources. Utility support of C&S efforts has been limited to date, but the experience in California and studies elsewhere suggest that C&S activities can produce significant energy savings very cost-effectively, especially from the utility perspective.

For building codes, utilities can support residential code development, adoption of model codes or upgrades to those codes, industry compliance, and enforcement. For appliance standards, utilities can participate in federal proceedings to support higher standards or work with state bodies to develop and adopt standards for products not covered by federal standards. California efforts have produced a portfolio of standards that utilities in other states can pick from to support for state adoption.

To make it desirable and feasible for utilities to engage in C&S activities, regulators must work with utilities to establish an appropriate regulatory framework. As the California IOUs expanded their C&S program to the point where now it is estimated to deliver more than 20% of portfolio savings, the California Public Utilities Commission (CPUC) has established a process for measuring and verifying C&S savings, counting those savings toward efficiency targets, and including the savings in the financial risk-reward mechanism.

## Focusing on Energy Choices—Behavior-based Programs

Participa tion in any energy-efficiency program requires a behavioral effort; customers decide to purchase a particular product or take an energy-saving action. Until recently, most residential energy-efficiency programs have been based on the microeconomic concept that consumers will act in a rational, self-interested manner. Thus, energy-efficiency programs have focused on consumers' economic behavior by providing rebates or incentives. The upstream lighting programs previously discussed build the rebate directly into the consumer's purchase price; air conditioner cycling programs pay an incentive to customers who allow the utility to control their air conditioning systems during peak-load periods.

The advent of behavioral economics or, as Thaler and Sunstein call it, "the emerging science of choice,"[15] introduces new ways to look at energy-efficiency programs. Once we assume that individuals are not always rational decision-makers, and that more than money influences their choices, we can design programs that will address those other influences. Thaler and Sunstein introduced the idea that inertia often overcomes economically rational behavior, so it is more effective to enroll consumers in a program and offer them the opportunity to opt out than it is to tell them about the program and encourage them to opt in. A program for which this might work in the energy-efficiency world would be a load control program supported by smart meter technology. Rather than inviting consumers to participate in a load control program, the utility automatically enrolls all eligible consumers and gives them the

14 Lee, A., D. Groshans, P. Schaffer, A. Rekkas, R. Faesy, L. Hoefgen., and P. Mosenthal. 2013. Attributing Building Energy Code Savings to Energy Efficiency Programs. Prepared for Northeast Energy Efficiency Partnerships, IEE, Institute for Market Transformation. Portland, Ore.

15 Thaler, Richard H. and C. R. Sunstein. Nudge. (2008): p. 7

opportunity to opt out. Obviously this type of program would need regulatory approval and, given the current environment in many states, a marketing campaign to get it approved.

Several utilities have begun to implement programs that rely on behavioral science and the concept of normative behavior to influence consumers' energy consumption patterns. OPower, tested its comparative usage feedback program in Sacramento, California in 2008-2009. The program concept was a simple one: consumers are motivated to keep up with their peer groups, so consumers who receive a report telling them that they use energy less efficiently than their neighbors will want to become more energy-efficient. OPower now works with over 80 utilities in the United States and Canada and claims over 2 Terawatts of energy savings.[16]

A recent white paper, co-authored by Cadmus staff, provides the most comprehensive discussion of behavior and residential energy-efficiency programs to date.[17] The paper breaks new ground by presenting the full range of social science theories that utilities can apply to influence energy-related behaviors. The paper makes the critical point that there does not seem to be an optimal approach, or mix of approaches, to influence behavior—a wide range of factors influence consumer decisions, so utilities may need to offer a menu of options, marketed through a variety of channels, for maximum appeal.

Using behavior theories to sway consumers to make energy-efficient choices holds tremendous potential for utility residential efficiency programs. The greatest challenge associated with these programs is the utilities' abilities to monitor and evaluate them. Because utilities may need to employ several different approaches to move consumers to take action, it could be difficult to disaggregate the extent to which a particular action contributed. Cadmus is one of several firms engaged in this research.[18]

## The Role of Financing in Driving Residential Efficiency

Up-front cost is often cited as a barrier to completing comprehensive energy-efficiency improvements. With whole-house retrofits costing upwards of $10,000 or more, [19] the 2007-2009 economic recession and reduced availability of credit made deep energy-efficiency retrofits out of reach for many consumers who could have benefited from lower energy costs. In response, many energy-efficiency program sponsors began offering financing solutions on a pilot basis to help participants complete projects without up-front costs. [20]

### Types of Financing Solutions

Today, the number of financing solutions available for energy-efficiency has expanded considerably, largely due to public utility commission directives and American Recovery and Reinvestment Act funding. Programs with a utility partner sometimes use on-bill financing, where the utility incorporates project payments and financing charges into a customers' utility bill. There are also special products offered directly to borrowers by more traditional lenders to fund energy-efficiency projects; credit enhancements often help finance these products.

Non-loan options also exist, such as Property Assessed Clean Energy and tariffs. Some of these solutions have the potential to address other barriers to deep energy-efficient retrofits. For instance, programs that use estimated monthly bill savings to offset financing charges appeal to homeowners who are motivated by actions that make financial sense. Tariffs, or charges that "run-with-the-meter," tie the repayment obligation to the utility meter and are transferrable to the next occupant responsible for the bills. A tariff approach can help address "split-incentives" in situations where the property owner does not pay the utility bill by ensuring that the same party paying for the retrofit also obtains the ensuing benefits. In theory, a tariff can also help homeowners invest in improvements that take longer to payback, alleviating concerns that the homeowner will move prior to recouping the cost of their retrofit. [21]

### Outreach Strategies

Financing alone does not address barriers related to establishing the value proposition of energy efficiency, but it can create demand by increasing the pool of aware and interested buyers. Having a financing option can also increase a program's credibility with potential participants. Therefore,

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16 www.OPower.com
17 Ignelzi, Peters, Dethman, Randazzo, Dougherty and Lutzenhiser, Paving the Way for a Richer Mix of Residential Behavior Programs May 31, 2013.
18 For example, see EPRI Report 1017875, Cadmus (Mulholland and Thompson), Evaluating Feedback Program Impacts: Considerations for Measuring Behavior Change, 2010
19 SBW Consulting, 2010-2012 PG&E and SCE Whole House Retrofit Process Evaluation, December 12, 2012. Energy Trust of Oregon, Report to the Oregon Public Utility Commission on Pilot Programs for the Energy Efficiency and Sustainable Technology Act of 2009, October 1, 2010
20 Examples include: Michigan Saves, Greater Cincinnati Energy Alliance, Pennsylvania's Keystone HELP, Oregon's Clean Energy Works, and Boulder County ClimateSmart.
21 Real estate industry general practices do not account for energy-efficiency in property valuation, and coupled with the fact that there are a multitude of variables that affect real estate pricing, it is unlikely a homeowner will clearly see an increase in property value as a result of improvements that are beyond code. To be conservative, we assume the payback is based only on energy savings.

financing is most effective when presented in conjunction with the measure or project under consideration. Program materials conveying the benefits of a product or measure serve to create initial interest while the financing offer communicates that those benefits are within reach. For large purchases, such as water heaters and HVAC equipment, contractors and vendors play a critical role in not only measure delivery, but also raising awareness of financing options. Contractors may have existing relationships with financial institutions, or even offer their own financing to select customers, so it is important for utilities to get feedback on whether financing programs are competitive and attractive.

## Leverage Financing

One likely benefit of financing is that it has the potential to leverage limited ratepayer funds, an aspect that can appeal to public service commissions. Some financing models allow programs to serve more participants by bringing in third-party capital, which increases the funding available for retrofits. These mechanisms use credit enhancements (e.g., loan guarantees) or other approaches to reduce investor risk, thus driving down interest rates. It is unclear whether financing can completely replace incentives altogether, but in theory, it could diminish the need for generous incentives for some customers, since up-front costs are no longer a barrier.

## Cost-effectiveness Considerations

The costs and benefits of financing programs are not always clearly defined and could change depending on how the financing program itself is structured. One major consideration is whether the program generates savings and should be assessed as a standalone program, or whether it is treated as an overhead cost under a traditional program. Another issue is whether the financing program works in conjunction with other program incentives. If both financing and incentive programs are to claim savings, then the utility must determine an attribution approach that allocates benefits fairly. Cadmus currently is working with several utilities on this type of attribution, testing several different methods.

Other challenges to assessing cost-effectiveness include determining how to qualify financing charges, such as interest rate and fees. For example, the "market rate," can be defined several ways. Utilities have taken different approaches to setting interest rates and need to consider factors such as whether they are providing the loan funding or using a third-party lender, their own cost of capital or the size of loan guarantee they may provide, the type of energy-efficiency projects and equipment that qualify for financing, and over what period to amortize program start-up fees. Cadmus has developed a screening tool that can help utilities weigh these factors to come up with an appropriate program design.

# SECTION 3: NEW DIRECTIONS FOR COST-EFFECTIVENESS SCREENING

Screening for cost-effectiveness is pivotal to the continued capture of energy-efficiency resources.[22] But, for the reasons already described, many utilities and non-utility program administrators are now straining to cost-effectively reach targeted savings with traditional energy-efficiency programs. Meanwhile, many of the emerging technologies and alternative approaches to capturing energy savings previously described do not lend themselves to cost-effectiveness assessment using traditional calculation methods. Thus, the rules of the game for assessing cost-effectiveness at the program planning and screening stage are crucial.

Though screening methods applied to efficiency resources affect all customer sectors, the residential sector is most acutely impacted. Cost-effectiveness testing, including the interaction between tests and programs, is a complex endeavor involving many choices in methodologies and assumptions.[23] Also, there is considerable variability and inconsistency across states in their approaches to cost-effectiveness testing.[24]

## Why Test Selection Matters for Screening Efficiency Resources

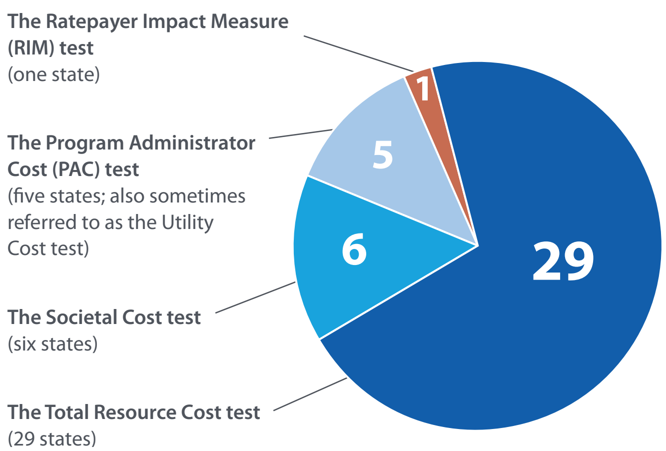
The main implications for residential energy-efficiency program cost-effectiveness screening depend on the test selected and how completely and accurately the test is applied. Also, there can be connections at the program screening stage between test selection and the ability to completely and accurately apply the test—and some argue that test selection and lack of appropriate test application can put energy-efficiency programs at a disadvantage. A review of test choices, commonly cited inadequacies in test application (focusing on the TRC), and some recommended best practices for screening efficiency resources follow.

## Test Selection

Today, the number of financing solutions available for energy-efficiency has expanded considerably, largely due to public utility commission directives and American Recovery and Reinvestment Act funding. Programs with a utility partner sometimes use on-bill financing, where the utility incorporates project payments and financing charges into a customers' utility bill. There are also special products offered directly to borrowers by more traditional lenders to fund energy-efficiency projects; credit enhancements often help finance these products.

The frameworks and methodologies for assessing efficiency program cost-effectiveness are largely derived from The California Standard Practice Manual (SPM). The SPM covers all of the tests discussed in this paper, though different states (i.e., regulatory bodies) may define tests slightly differently. The four most frequently used tests, in order of the prevalence of their use by states as the primary screening test for energy-efficiency programs[25] are :

The Four Most Frequently Screening Tests for Energy-Efficiency Programs




22 This discussion emphasizes cost-effectiveness testing as an *ex ante* planning tool for screening energy efficiency resources. The same tests have a critical evaluation (*ex post*) role in examining the value of a program's outcomes and the costs incurred to achieve those benefits. This white paper notes the potential for greater use of ex post benefit-cost analyses to calculate complete and accurate costs and benefits at the energy-efficiency program planning/screening stage.

23 Examples of interactions between tests and specific programs include the choices of discount rate and study period (analysis timeframe assumed for the test) to accurately capture energy savings benefits over the full useful lives of energy-efficiency measures, which can vary significantly.

24 Areas of inconsistency are examined in "Picking a Standard: Implications of Differing TRC Requirements," by Elizabeth Daykin with Jessica Aiona and Brian Hedman of Cadmus (presented at the AESP National Conference and Expo, January 2011).

25 American Council for an Energy-Efficient Economy, "A National Survey of State Policies and Practices for the Evaluation of Ratepayer-Funded Energy Efficiency Programs," Kushler, Nowak, and Witte, Report Number U122, February 2012.

A fifth test, the Participant test, is not used by any jurisdiction as the primary screening test.

## Defining Benefits and Costs

Each of the five tests combines various program costs and benefits in different ways. They also provide different types of information, reflecting different perspectives and purposes. However, in terms of test selection, commissions and program sponsors must consider how inclusively or exclusively each test defines costs and benefits. [26]

Typically, a more narrow consideration of efficiency program impacts only includes direct energy impacts, where the avoided costs of direct energy savings, and perhaps energy savings from market effects, are counted as benefits. [27] Tests that include a broader range of program effects and corresponding costs are usually seen as more liberal, but also, some argue, more realistic. However, including this broader set of effects relies on metrics that may be somewhat harder to measure reliably. Examples of expanded program impacts are: [28]

- **Quantified non-energy benefits attribute to programs.** These can range from benefits attributed to a utility (e.g., reduced arrerages' carrying costs and write-offs), to impacts on program participants (e.g., other fuel and resource savings, increased productivity, and reduced maintenance costs).
- **Avoided emissions' externality costs for expected future emissions offset markets.** Avoided externalities typically include the avoided air emissions associated with reduced electricity (kWh) and natural gas (therms) consumption (though there are clearly other externalities also impacted by efficiency programs). These are externalities that have been "internalized" via trading markets or emissions caps, and would include SOx, NOx, and CO2.
- **Net impact on the economy, as determined with an economic impact analysis.** The economic impacts analysis, done in tandem with benefit-cost analysis, takes into account the ripple effects of energy-efficiency expenditures and bill savings on a state's economy (e.g., job and income creation, additions to gross state product). These impacts need to be assessed relative to the alternate use of the funds.

How utilities apply the scope of impacts, for example in the TRC and Societal tests, is a policy decision that involves trade-offs between overall energy-efficiency portfolio objectives and larger public policy considerations. [29] These tradeoffs largely revolve around public policy priorities with regard to non-energy benefits (e.g., economic, environmental, other fuels, health and safety), the minimization of utility revenue requirements, and use of energy-efficiency programs to reduce energy costs to customers. Selection and application of cost-effectiveness tests define the "rules of the game" for realizing these tradeoffs.

## Some Commonly Cited Inadequacies of the TRC Test

It has been argued that the prevalent cost-effectiveness test

26 The scope of impacts included is primarily relevant to the TRC and Societal tests, as they represent the broadest perspectives among the tests (all customers in the case of the TRC, and all of society in the Societal Cost test).

27 Increasingly, these avoided costs also include the value of avoided (displaced) emissions for which active offset markets currently exist (SOx and NOx).

28 The non-energy benefits identified here can be defined as "economic" benefits, (i.e., they result in dollar flows in an economy). They are typically more readily quantified and monetized than non-economic, non-energy benefits that may have value to customers but typically do not affect dollar flows (e.g., safety, health, and comfort effects of energy-efficiency programs).

29 For a recent explication of relationships between selection and application of cost-effectiveness tests and policy implications for energy-efficiency programs, see "Best Practices in Energy Efficiency Program Screening: How to Ensure that the Value of Energy Efficiency is Properly Accounted For," Synapse Energy Economics, July 2012.

Allocation of Benefits and Costs from Different Perspectives

| | Stakeholder Perspective | | | |
|---|---|---|---|---|
| | Participant | Utility | All Customers (RIM) | Societal |
| **Benefits** | | | | |
| Avoided energy costs | | ✔ | ✔ | ✔ |
| Avoided capacity costs | | ✔ | ✔ | ✔ |
| Avoided transmission and distribution losses | | ✔ | ✔ | ✔ |
| Avoided secondary fuel costs | | ✔ | | ✔ |
| Bill reductions | ✔ | | | |
| Externalities adder | | | | ✔ |
| Utility incentives | ✔ | | | |
| **Costs** | | | | |
| Incremental measure costs | ✔ | | | ✔ |
| Utility costs incurred as incentives | | ✔ | ✔ | |
| Utility costs other than incentives | | ✔ | ✔ | ✔ |
| Lost revenues | | | ✔ | |

Source: California Energy Commission. *California Standard Practice Manual for Economic Analysis of Demand-Side Management Programs and Projects.* October 2001.

framework—the TRC—is often applied in ways that undervalue energy-efficiency resources.[30] Here are some frequently cited factors associated with this issue.

## The Level At Which Cost-Effectiveness Is Determined

Cost-effectiveness tests can be applied at a measure-, participant-, program-, or portfolio-level. Screening at the measure-level carries the greatest risk of excessively limiting program offerings and the resulting ability to deliver targeted savings. For example, residential programs are often designed to "bundle" measures, but by rendering a specific measure uneconomic (e.g., glazing, certain appliances), measure-level cost-effectiveness screening can diminish the value of a measure bundle and thereby reduce an entire program's viability.

## Discount Rate

While there is no "right" discount rate, the selection of the discount rate can have a significant effect on screening results. This has been particularly problematic if the cost-effectiveness test includes program impacts more than 15 years in the future. Also, it is sometimes argued that funding energy-efficiency programs conveys less risk to a utility than applies to other new resource acquisition strategies. Thus, a lower discount rate may be more appropriate for energy-efficiency activities. Additional considerations include willingness to use different discount rates in cost-effectiveness testing that informs least cost planning models and whether risks of resource acquisition are considered in selecting a discount rate.

The choice of the discount rate has enormous impacts on the amount of energy efficiency considered cost-effective. For example, $1 worth of energy savings in 30 years is worth either 6 cents or 42 cents today based on whether you use a 10% or 3% discount rate. Many argue that benefits to future generations should have higher value than those accruing in the present. This argument is not based entirely on moral grounds. A pure economic argument is that as resources dwindle and emissions increase, the value of future resources will increase and the value of one fewer ton of carbon in the atmosphere should also increase. This argument, at its extreme,

30 Ibid. See also "Is it Time to Ditch the TRC? Examining Concerns with Current Practice in Benefit-Cost Analysis," Neme and Kushler, 2010 ACEEE Summer Study on Energy Efficiency in Buildings.

calls for a negative discount rate.

### End-User Incremental Measure Costs

Obtaining accurate, current incremental measure costs is a challenge, particularly in light of rapidly changing energy-efficiency product markets and the microeconomic effects that can influence local product prices. Cost-effectiveness screeners may not have access to adequate incremental cost data for all measures and collecting this data can be costly and time consuming. Program sponsors may rely on national averages or secondary research from other jurisdictions that can under-or over-value measure costs.

### Avoided Costs

The ways in which program planners apply avoided costs (i.e., transmission and distribution system expansion costs, capacity costs, and costs associated with environmental compliance) in energy-efficiency resource screening can be inconsistent. When these avoided costs are not included, the full benefits of energy efficiency are understated and the internal consistency of the test compromised.

### Infrequent Use of Multiple Tests to Reflect Multiple Programs Benefits

Using two or three tests provides a more complete picture of energy-efficiency program cost-effectiveness than relying solely on the TRC. Some advocate using a primary test applied at the program level and a second test at the portfolio level. This allows program evaluators to assess programs from a broader set of perspectives that value different priorities. Another approach, as suggested in the Haeri and Khawaja paper, is the use of the PAC test.

### Expanded Program Impacts

A criticism of the TRC test is that it is skewed because it does not consistently reflect both participant costs and the full range of participant benefits. It is understandably challenging to develop empirical values for some of the more difficult to quantify program benefits at the cost-effectiveness screening stage. However, there is increasing primary research that may help to improve the methods evaluators use for *ex post* benefit-cost analyses.

## Reforms Needed to Improve Cost-Effectiveness Screening

There are two outlooks for reforming cost-effectiveness testing methods for energy-efficiency programs. The first is detailed in the article "Valuing Energy Efficiency," already cited,[31] which advocates reforming the current testing framework largely derived from The SPM.

A second outlook focuses the importance of considering the combined attributes of cost and risk inherent in new generation resources. Investment decisions should consider not just the price of the resource, but also the relative risk of acquiring it. Reforming the regulatory and utility frameworks for analyzing generation resource investments, however, will still require analysis of energy-efficiency investment and decisions about which programs and measures warrant investment (i.e., their cost–effectiveness).

### Modify the TRC or Replace It?

In their article, Cadmus' Haeri and Khawaja note that "arguments for a modified TRC come in many guises, but they share the objective of lowering the threshold for determining cost effectiveness." They elaborate on three ways this can be accomplished: expanding benefits, eliminating certain costs, and/or using a lower discount rate.

In summary, these authors argue that there are important shortcomings with the TRC test and significant impediments to the kinds of modifications that would systematically make it easier for energy-efficiency measures and programs to pass the test. Based on their detailed assessment of the TRC's inadequacies—and in contrast the treatment of specific test components with the PAC test—they contend that the PAC is an "inherently superior" cost-effectiveness test:

> *"The advantages of using the PAC test are many and obvious. It reduces the uncertainties associated with estimating incremental measure costs, avoids the complexities of estimating potential non-energy benefits to participants and worrying about how to discount them; above all, it provides a more rational basis for designing programs and incentive structures that are more compatible with how utilities' procure resources."*

31 See "Valuing Energy Efficiency," (Public Utilities Fortnightly, July, 2013).

## The Advantage of Efficiency As Lowest-Cost, Lowest-Risk Resource

It is likely that as much as $2 trillion of utility capital investment will be required over the next 20 years to meet rising demand—an unprecedented and dramatic investment in the electric sector. All concerned parties (regulators, utilities, investors, consumers) will demand rigorous investment analysis that explicitly considers the full cost and relative risk of alternative resource acquisition strategies.

In calculating resource acquisition costs, there is wide acceptance that generation costs can be summarized and compared in a metric called the "levelized cost of electricity". [32] Using this metric, efficiency has the lowest relative cost of all new generation resources. [33]

A forward-looking assessment of energy efficiency resources' cost-effectiveness should consider not just the price of the resource, but also the relative risk of acquiring it. In terms of risk exposure associated with new resource generation (e.g., permitting and initial construction cost, fuel supply and operations and maintenance risks, and exposure to carbon mitigation costs), efficiency ranks as the lowest risk resource.

In addition, energy efficiency can offer utilities a significant return on investment (ROI). Existing power plants are fairly depreciated, typically have small book value and provide little ROI. Building new power plants is also problematic for utilities and is becoming more so – it entails high resource cost and acquisition risk. This leaves few viable investment options, save energy efficiency, for utilities to meet increasing demand. However, energy efficiency needs to be treated as a resource and allowed into the rate base. The authors strongly support treatment of DSM resource as a regulatory asset. Utilities need to not just recover the cost of their investment, but also earn a rate of return on such an investment.

Yet, if efficiency is the lowest cost resource, with relatively low risk, how could residential energy-efficiency programs be in decline? As previously discussed, much of the answer to this question rests with how cost-effectiveness is calculated.

Decision makers considering investments in energy-efficiency programs against other new resources will almost certainly need to consider both resource cost and risk of acquisition in the determination of cost-effectiveness. Leveling the playing field for these decisions will require important changes in how all types of avoided costs are calculated, including: energy, capacity, transmission and distribution, and avoided environmental compliance costs (especially if carbon controls come into play). In the longer term, an explicit assessment of true costs and risks will favor energy efficiency in energy supply portfolios. But historically the regulatory process has been notoriously slow to evolve. The question then is how can efficiency's relative cost and risk advantages translate to increased investments in energy efficiency in the short term?

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32 Two commonly cited sources of LCOE data for new U.S. generation resources are the Energy Information Administration (EIA) of the Department of Energy, and the California Energy Commission (CEC).

33 For a discussion of LCOE for various generation technologies – and each resource's relative exposure to future carbon costs see, Freese, Barbara, Steve Clemmer, Claudio Martinez, and Alan Nogee. "A Risky Proposition: The Financial Hazards of New Investments in Coal Plants. Cambridge, MA: Union of Concerned Scientists, 2011.

# RESIDENTIAL DSM CROSSROADS:

The energy-efficiency landscape is changing. This change is most profound in the residential DSM offering. While the converging influences of market evolution, consumer acceptance, and government intervention have significantly improved energy-efficiency in the United States, these and other factors are simultaneously reducing available residential efficiency potential and impacting the long-term economic viability of continued gains.

Yet, potential remains. Energy demand continues to grow, as do the accompanying climate impacts, so the imperative for continued effort has not diminished. Climate change is a real and dangerous threat to our environmental and economic sustainability and energy efficiency is an indisputably essential piece of the mitigation puzzle. As traditional approaches to capturing energy savings become less and less workable within existing frameworks, energy-efficiency program sponsors and regulators must be prepared to adjust in order to continue realizing the momentum gained thus far.

Energy efficiency is now at a crossroads. Through many years work as energy-efficiency program evaluators and designers, Cadmus has concluded that, for utilities, these issues come down to two key questions: How can energy-efficiency program sponsors meet increasing regulatory targets when their savings potential is shrinking and their traditional programs may no longer be "cost-effective"? What will the efficiency landscape of the future look like as traditional, measure-based rebate programs become less viable, and how can we hasten the transition with minimum pain and maximum gain?

This paper examines the issues surrounding these questions, and more importantly, provides some insights to help utility program managers envision alternatives to traditional efficiency program models. Cadmus believes the future of DSM lies at the intersection of real-time communications, a better understanding of behavioral drivers, investment in research and development, creative approaches to working with codes and standards, and more effective and diverse financial support mechanisms.

A regulatory framework that focuses on narrow definitions of costs and benefits applied to a static calculation of value is one barrier to utilities' experimenting with new program approaches that leverage these converging opportunities. Regulators and industry experts designed and used this framework effectively as a screening tool for the types of programs that, over three decades, brought the concept of efficiency into the mainstream and achieved staggering success. But as consumers and technology become increasingly sophisticated, programs must keep pace or risk being marginalized. Perhaps even more importantly, to encourage innovation, regulatory frameworks need to be reimagined to recognize a truer array of costs and benefits and the industry must apply them consistently.

To begin the transition to a reimagined residential DSM framework, the authors offer the following recommendations:

- Incorporate externalities in avoided cost calculations. The benefits of reduced air emissions and job creation are real and have value; they should be recognized in a way that ensures a level playing field across jurisdictions.
- Move away from the TRC and embrace the PAC test. The PAC provides a more rational basis for integrating programs and incentive structures with utilities' resource procurement practices.
- Do not use the traditional cost of capital as a proxy for discount rate. Cost of capital does not accurately value the reduced risk of energy efficiency compared to investing in new generation.
- Experiment with new technologies and alternative program design approaches. This white paper offers several examples (though by no means an exhaustive list) of new and emerging program strategies. Only through on-the-ground experience will utilities begin to fully understand the potential – and the pitfalls – of new program concepts.
- Offer financing. Even if residential energy-efficiency financing remains a niche market, the utility programs of the future must offer more diverse options to account for a more diverse customer base.
- Treat energy efficiency as an asset that accurately represents its value in relationship to other utility resources. In order to fully capture the potential of energy-efficiency, it must be competitive in strict economic terms. Utilities need to be allowed to earn a return on their energy efficiency investments.

# WHAT'S

*The future of DSM lies at the intersection of real-time communications, a better understanding of behavioral drivers, investment in research and development, creative approaches to working with codes and standards, and more effective and diverse financial support mechanisms.*

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