ACEEE Field Guide to Utility-Run Behavior Programs

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Executive Summary

This report joins the ongoing conversation about how best to construct cost-effective behavior programs that deliver appreciable energy savings. As the first comparative analysis of utility-run behavior programs, it lays the groundwork for further program development by developing a classification scheme, or taxonomy, that sorts programs into discrete categories. Practitioners, evaluators, and regulators will be able to use this taxonomy as they implement and assess strategies and develop policies for utility-run behavior programs.

The majority of utility-based energy efficiency programs focus on physical energy efficiency improvements. But all demand-side and energy efficiency programs involve human activity and decision making. Programs can achieve greater impact and deeper savings by incorporating insights from social and behavioral sciences. Many utilities have undertaken behavior-based programs to help meet savings targets set by regulators and their own business needs. This study counted 281 such programs, many with multiple iterations, offered by 104 energy providers and third parties between 2008 and 2013.

Several challenges currently face managers who seek to run a successful behavior-change program. Many of them are hindered by their unfamiliarity with social science and by confusing labels and vague definitions as they try to choose among prospective offerings. The term "behavior" itself has multiple definitions. Human decision making and technology are often inextricably intertwined in energy efficiency programs. This entanglement makes it difficult to assign causality with respect to energy savings and to track and justify behavioral strategies.

Regulators need to see results that justify program costs. Since many behavior initiatives are still in the pilot phase, regulators do not have sufficient evidence to justify treating such programs as energy efficiency resources. In many states, regulatory language either fails to recognize the programs or defines them too narrowly. In states where behavior programs may be counted toward an energy efficiency resource standards (EERS) plan, utilities may miss this opportunity by labeling their programs as marketing initiatives rather than as energy savings mechanisms.

The current study aims to focus and clarify terminology about behavior programs for both regulators and developers. By putting each program into a single category and providing common metrics for disparate program types, we can compare the success of various strategies in changing behavior, as well their cost effectiveness and how much energy they save. The categories we have developed are concrete and practical. Each of them is grounded in the behavioral and cognitive sciences and represents a unique way of affecting consumer behavior.

This study builds on previous work on behavior program classification. Prior researchers have focused on constructing typologies of the underlying mechanisms (called drivers) that power behavior change programs. Examples of drivers include feedback, reward, and social norms. Typologies are primarily conceptual structures; rather than starting with actual programs and their observed characteristics, they derive their categories or types from an abstract social science model.

Our shift from a typology to a taxonomy enables a comparative analysis of real programs as opposed to ideal constructs. It also eliminates the confusion caused by the fact that typological categories tend to overlap and many real-world programs fall into more than one of them. Our new taxonomy fills the need for an organizational scheme in which every program fits into just one category, each of them defined by the unique features of its members.

To construct such an empirically based taxonomy, we collected data from several sources on nearly 300 programs run by over 100 utilities and similar entities between 2008 and 2013. We eliminated duplicates, technology initiatives, market transformation efforts, and so on until we arrived at our final sample of 238 behavior-based programs. After sorting them by distinguishing features such as delivery channel and incentive type, we arrived at 20 major program categories grouped in 3 large families:

- *Cognition* programs focus on delivering information to consumers. Categories include general and targeted communication efforts, social media, classroom education, and training.
- *Calculus* programs rely on consumers making economically rational decisions. Categories include feedback, games, incentives, home energy audits, and installation.
- *Social interaction* programs rely on interaction among people for their effectiveness. Categories include social marketing, person-to person efforts, eco-teams, peer champions, online forums, and gifts.

Multi-modal programs combine several program categories in a single initiative. Going a step further, what we call stacked programs combine a minimum of one program strategy from each of the three families. We suggest that program managers make a deliberate design decision to stack program types in order to simultaneously engage multiple drivers of decision making and action. Holistic programs that appeal to consumers through information, economic incentives, and social interaction are likely to achieve the greatest impact.

Due to the paucity of data, we were able to draw only limited conclusions about the cost-effectiveness of utility-run behavior programs. Only ten electricity programs reported both program cost and actual energy savings. Their average cost of saved energy (CSE) was 1.61 cents per kWh saved.

We conclude with a number of further recommendations besides the suggestion that managers stack behavioral strategies for maximum impact. Much work needs to be done in tracking, collecting, and analyzing behavior program data in order to document benefits and drive broader adoption. Metrics should be standardized across programs so that researchers, evaluators, and regulators can compare their cost effectiveness. Data on savings, participation rates, and persistence of savings should also be tracked and analyzed. We also recommend that program results be compiled and made available via a central public platform.

Finally, we recommend that utilities coordinate their behavior programs with others in their region. Electric, gas, and water suppliers can build synergies among their efforts, as can neighboring suppliers, especially smaller and larger entities. To avoid oversaturation, we recommend the development of a geographic information system to map program distribution.

Introduction

Many utilities and third-party organizations that deliver energy services on behalf of ratepayers have developed a variety of energy efficiency programs, particularly in states with strong energy efficiency resource standards (EERS).[1] These standards are set by laws that require utilities to decrease their customers' energy demand by a certain percentage each year. EERS and the energy efficiency programs designed to meet them are conditioned by the fact that energy consumption involves behavior mediated by some form of technology. No one uses energy directly; rather, people consume energy embedded in goods and delivered through services. The management of energy through technological means may reduce the amount of active decision making on the part of consumers, but it does not eliminate the role of behavior.

Despite the hybrid nature of energy consumption, the majority of energy efficiency programs focus on physical energy efficiency improvements. The preference for physical measures (colloquially known as "widget programs") is based on a model where consumer behavior and choice are "secondary to the devices, machines, and appliances that are seen as the actual users of energy" (Lutzenhiser 2009). Physical measures have dominated utility programs for decades. One seeming advantage of such physical programs is that they appear easy to scope and measure. Selecting a particular technology or system is relatively straightforward, and the calculation of before-and-after savings is firmer. Utilities can easily demonstrate to regulators that their energy efficiency program was successful because it resulted in a reduction of a certain number of kilowatt-hours (kWh) or therms. These cut-and-dried results are harder to come by in programs that require interpretation and where assigning a degree of causality to outcomes is trickier, as it is when humans become involved.

Despite the dominance of this model in utility program design, all demand-side and energy efficiency programs involve human activity and decision making. Many programs could achieve greater impact and deeper savings by incorporating insights from social and behavioral sciences. Joined with widget programs, behavioral strategies can generate increased measurable effects. They can also be used on their own in standalone behavior programs that address how people make decisions and interact with goods and services that use energy.

We have evidence from diverse sources to support these assertions. Schwartz et al. (2013) reported that energy savings of 2.7% were achieved simply due to people believing they were under observation for a study. This percentage is higher than that stipulated by many annual EERS goals. Ingo Bensch's (2013) paper on a Wisconsin game called Cool Choices reported that participants achieved 6 to 9% median savings. Many similar reports are available in the archives of the Behavior, Energy, and Climate Change Conference (BECC) and on the Precourt Energy Efficiency Center website (pec.stanford.edu). The American Council for an Energy-Efficient Economy (ACEEE) has published on this subject for many years, and its research on topics including feedback, utility bill design, and community-based social marketing is available for download (www.aceee.org/portal/behavior). Finally, the ACEEE Summer Study series has been home to a panel on behavior and human dimensions since its start in 1980

[1] Organizations like the New York State Energy Research and Development Authority (NYSERDA) and Energy Trust of Oregon deliver energy services on behalf of ratepayers on a regional or even statewide level, making them comparable in scope to utilities.

(www.aceee.org/conferences/ssb/past). All these sources are searchable, and they contain a wealth of resources demonstrating the effectiveness of individual behavior-based programs.

Given the emerging evidence for their effectiveness, many utilities have begun to consider or undertake behavior programs as a way to achieve savings targets set by regulation or their own business needs. In the last several years, dozens of utilities (including most of the largest suppliers of both electricity and natural gas) have conducted hundreds of behavior pilots and programs. These programs take many forms due to factors that include a variegated regulatory landscape, diversity of utility business models, and the range of climate zones across North America. We have counted 281 distinct programs (many of which have multiple iterations) offered by 104 individual energy providers and third-party vendors between 2008 and 2013.

One of the most common questions asked of the ACEEE Behavior and Human Dimensions Program is, How much energy could be saved through behavior-change programs run by utilities? This query is usually followed by, How do we measure these savings and verify that they occurred as a direct result of the intervention? These are reasonable questions, as are questions about persistence of savings: How long will the effect from treatment last, and how do we record the impact?

This report joins the ongoing conversation about how best to construct cost-effective behavior programs that deliver substantial energy savings. Above all, it lays the groundwork for addressing these questions by developing a classification scheme (technically called a taxonomy) that will enable practitioners to compare one behavioral program with another.

Challenges Facing Utility-Run Behavior Programs

Several challenges currently face program managers who seek to run a successful behavior-change program. First, the case regarding exactly how much energy utilities can save through these types of programs when run at scale has not yet been made. Since many of the initiatives discussed in this report are still in the pilot phase, regulators do not have the evidence they need to justify treating behavior-based programs as energy efficiency resources. Managers are also hindered by their unfamiliarity with social science and by confusing labels and vague definitions as they try to choose among prospective programs. They waste time, money, and energy developing new programs from scratch when, with minor adjustments, they could convert well-developed marketing, communications, education, and training initiatives into effective full-blown behavior programs.

Neither regulators nor implementers are typically familiar with the social sciences, the basis for many behavior-based energy efficiency programs. Understanding what happens during the stimulus-sensation-response sequence is challenging, and careful academic study is needed to supply verified results and useful data. Practitioners and policymakers who fund and implement programs may find themselves tempted to use simplified models that do not adequately represent reality. As a result, they may not get the results they seek in terms of energy savings.

Adding to the challenge is the fact that a single agreed-upon definition of behavior does not exist. Researchers, practitioners, and policymakers each have their own lay perspective as to what constitutes behavior and thus what qualifies as a behavioral program. At the most basic level, behavior refers to the relationship between the stimulus and response experienced by an individual. However, this definition fails to describe the complete situation. We need to decide if the stimulus is direct or indirect and if the response is immediate or delayed. Is the route of transmission physiological or psychological? Do internal forces determine the response, or do external social and cultural values structure the effect?

This struggle over a clear definition of behavioral programs has real-world consequences. Behavioral programs must be defined separately from widget measures in order to support their growth and implementation. On the other hand, because all energy consumption involves behavior to some degree, proponents could label any program behavioral. But if everything is behavioral, then the concept loses meaning and ceases to be helpful. Technology-based and market transformation activities, for example, are only distantly related to individual decision making. They are not directly seeking to induce persistent behavior change in people. Instead, such programs are concerned with upstream incentives and pricing aimed at moving whole markets. This type of economic leverage is concerned with macro-level change. Although this *is* a form of behavior change, the degree is remote and difficult to detect.

In practice, many facets of energy consumption rely on human decision making interacting with technology. This entanglement of behavior with widgets makes defining behavior-based programs difficult and assigning causality with respect to energy savings complicated. It can be difficult to separate out the various components of a program in order to evaluate their respective contributions to energy savings and precisely attribute decreases in energy to specific interventions.

This lack of boundaries has regulatory implications. In order to fulfill their primary mission of protecting rate-paying citizens, regulators need to see results that justify program costs. Few states have regulatory language treating behavior-based programs, and those that do have defined them narrowly, not reflecting the existing and potential diversity of models and approaches. Regulatory language in California, for example, may preclude the adoption of behavior program types that fall outside its strict definition (Ehrhardt-Martinez, Laitner & Keating 2009). We hope that regulators will develop language that encourages new programs. Regulatory philosophies around behavior-based programs should be flexible and broad enough to include innovative uses of older program types and interventions that test out new combinations of social science principles.

Another serious challenge stands in the way of deciphering the impact and cost effectiveness of behavior-based programs. Because of the lack of regulatory requirements (or sometimes due to barriers erected by regulations), many programs that effectively change behavior and are offered through utilities go unrecognized as behavior based. Or, even if utilities do label them as behavior based—for example, in the Consortium for Energy Efficiency (CEE) Behavior Program Summaries, e.g., CEE 2012 and CEE 2013—they may offer them under marketing rubrics rather than as energy-saving mechanisms to be counted under a state's EERS plan. Once they are classified as non-resource programs, they may not count as savings or get reimbursed under lost-revenue adjustment mechanisms (LRAMs) that are in use in some states.[2] As a result,

[2] See Hayes et al. 2011 for more on LRAM mechanisms.

utilities may have a reduced incentive to track the impact of these programs and to share cost information with outsiders.

While the acceptance of "behavior based" as an organizing principle for energy efficiency programs has grown, comparable data is hard to come by. Programs are so multifarious and so entangled with widget solutions that it is not easy to compare them. What has been missing to date is a single study that maps the whole landscape of behavior-based programs to a comparative grid. We need a standardized set of terms by which to refer to program types, a common language that will help program designers and implementers integrate the two aspects of the technology/behavior nexus. The lack of clarifying language stifles the implementation of behavior-based programs at scale and their integration with physical programs to achieve the levels of energy savings demanded by EERS.

Goals of this Research

We intend this report to be a useful overview of the diversity of behavior program types that utilities have implemented and run over the past five years. The goal of the study is to help focus and clarify the discussion about these programs for both implementation and regulatory purposes. As the first comparative analysis of recent behavior programs run by utilities, it looks at the function and purpose of specific program types and how they deploy such behavior intervention strategies as commitment, feedback, follow-through, trusted messengers, rewards, and social norms.

The body of the report breaks programs into categories to show how behavioral insights have been deployed in widely distributed utility efforts ranging from communication, education, and awareness to incentives and audits. We believe that messaging strategies already in use by utilities can become more effective through increased grounding in the behavioral and cognitive sciences. Our intent is to bridge theory and practice, particularly for those designers and implementers who wish to reap the benefits of using social science insights but who do not have the time to delve into the mechanics that underlie them.

The taxonomy section of this study presents a comprehensive categorization of utility-run behavior programs. We hope that this taxonomy will eliminate confusion about the variety of behavior program types, their definitions, and the mechanisms that drive them. By applying the standardized set of categories we introduce, program designers, implementers, evaluators, and regulators will have a common basis for discussion and comparison.

This common ground becomes particularly important in assessing the performance of various kinds of behavioral programs. No one wants to throw away money on unproven investments. By putting each program into a single category and providing common metrics for disparate program types, we can compare the success of disparate approaches in changing behavior, as well as their cost-effectiveness and how much energy they typically save on average. Once program developers can compare the cost per kWh of various strategies, they can decide where a particular program type might fit within a broad utility energy efficiency portfolio.

Once they are familiar with the taxonomy, not only will program developers have an easier time choosing among various potential programs, but they will be able to combine or stack program elements (e.g., games and incentives) to discover and create innovative hybrids. Our hope is that the taxonomy will provide a framework that can accommodate innovations and discoveries far into the future.

Prior Work on Program Classification

Previous work has focused on constructing typologies of drivers. Like a taxonomy, a typology is a form of classification that looks at the traits or features of an artifact or phenomenon and sorts them into common categories. But whereas a taxonomy starts with actual programs and bases its classification on their observed characteristics, a typology starts at the other end, with a theoretical or conceptual model from which it derives the program types. According to Kevin Smith (2002):

> The key characteristic of a typology is that its dimensions represent concepts rather than empirical cases. The dimensions are based on the notion of an ideal type, a mental construct that deliberately accentuates certain characteristics and not necessarily something that is found in empirical reality . . . . As such, typologies create useful heuristics and provide a systematic basis for comparison.

Several typologies of behavior program types have emerged in the past few years. CEE published one of the first classificatory systems in 2010. Kira Ashby (2010) detailed the theoretical underpinnings of behavior program types in a paper that drew upon the social science disciplines to develop a framework consisting of five overarching drivers:[3]

- Framing
- Follow-through
- Decision making
- Person to person
- Rewarding

According to Ashby, these drivers animate current programs and utilities can use them to develop programs in the future. Her paper provides program designers with examples of programs that use these various types of strategies and with details of selected programs, all in a relatively short and easy-to-use document.

In 2012 and 2013, Jane Peter of Research Into Action worked on typologies for the New York State Energy Research and Development Authority (NYSERDA). Like the CEE scheme, these typologies focus on theoretical elements underlying social-science-derived programs and develop a framework of overarching drivers, in this case with nine categories:

- Feedback
- Follow-through
- Framing
- In-person
- Reward
- Commitment

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[3] As discussed below, drivers are the underlying mechanisms that power behavior-change programs.

- Social norms
- Sunk costs
- Multi-pronged strategies

To briefly summarize the membership criteria of each type of driver:

- *Feedback programs* use a variety of media to give customers frequent feedback on their energy use and related cost.
- *Follow-through programs* provide prompts (again through a variety of means) to nudge people to make a behavior change.
- *Framing* refers to the semantic construction and context of a message, for example, one that emphasizes benefits, or conversely emphasizes preventing a loss rather than incurring a gain. Framing can also refer to how the default options on a product or program are set (e.g., opt in versus opt out). Framing can leave the ability to choose undiminished while using the context to encourage or discourage a particular choice.
- *In-person programs* use individuals as credible messengers or as models for desirable behavior.
- *Reward* trades on the exchange of financial incentives for behavioral adaptations.[4]
- *Commitment programs* ask people to set explicit goals or make public pledges.
- *Social norms programs* provide participants with comparative data to encourage them to conform to local behavioral expectations.
- *Sunk costs programs* are designed to dismantle consumer reluctance to upgrade still-functional appliances in return for an uncertain and indeterminate (to them) benefit.
- *Multi-pronged strategies* are not a separate type, but a combination of types, such as framing and feedback, for synergistic impact.

Jane Peters collaborated on another paper (Ignelzi 2013) that examined "Some of the most widely recognized and potentially useful social science theories that could be applied more systematically in energy efficiency intervention design and evaluation." Because that paper was primarily concerned with theoretical drivers, it also featured a typology of analytic constructs rather than a taxonomy of programs.

Finally, the Energy Trust of Oregon (ETO) issued an internal memo in 2012 that also sought to describe the traits of behavior-based programs (Scott 2013). ETO described such programs as distinct from older, more established utility program types such as rebates, and it classified them into three types:

[4] Unlike the taxonomy in the current report, this model conflates rewards with gifts, and gifts with free audits.

- Energy benchmarking
- Feedback devices
- Information and training

Since the ETO organizational scheme focuses more on program features than on theoretical traits, it could be seen as a rudimentary taxonomy rather than a typology.

Table 1 illustrates how we reconciled the theoretical typologies of these studies and mapped from one to another. For example, the Energy Trust splits the NYSERDA *Feedback* type into three subtypes. CEE does not offer a standalone *Feedback* category, subsuming it under *Framing*.

Table 1. Typologies

<table>
<tr><th>CEE</th><th>NYSERDA</th><th>Energy Trust</th></tr>
<tr><td rowspan="3"></td><td rowspan="3">Feedback</td><td>Energy benchmarking</td></tr>
<tr><td>Feedback devices</td></tr>
<tr><td>Information and training programs</td></tr>
<tr><td>Framing</td><td>Framing</td><td></td></tr>
<tr><td>Follow-through</td><td>Follow-through</td><td></td></tr>
<tr><td rowspan="2">Decision making</td><td>Commitment</td><td></td></tr>
<tr><td>Social norms</td><td></td></tr>
<tr><td>Person to person</td><td>In person</td><td></td></tr>
<tr><td rowspan="3">Rewarding</td><td>Reward</td><td></td></tr>
<tr><td>Sunk cost</td><td></td></tr>
<tr><td>Multipronged strategies</td><td></td></tr>
</table>

These typologies are all well researched, and they are helpful in several ways. For one thing, they have introduced concepts from the social and behavioral sciences to the utility industry and energy efficiency community. These theoretical perspectives explain why people behave in particular ways with regard to energy consumption. In addition, the typologies have likely boosted the rate of diffusion of behavioral innovations as program developers have applied their strategies and program examples to their own initiatives.

The Need for a New Taxonomy

Despite the usefulness of the typologies described above, behavior program practitioners also need a taxonomic organization in addition to the typological one. While typologies are helpful, they are models, and as such they depend on simplifying complex realities for much of their intuitive power. Whereas a typology is an analytic construct based on concepts, a taxonomy classifies items on the basis of empirically observable and measurable characteristics. Shifting from a typology to a taxonomy enables a comparative analysis among *real* (i.e., actually existing) programs as opposed to *ideal* constructs.

The typologies of Ashby, Peters, and others categorize behavior programs according to the types of drivers that make them go (feedback, for example). Drivers are the social or psychological mechanics that affect decision making and thus the underlying mechanisms that power behavior-change programs. The problem, however, is that some drivers have overlapping definitions depending on who is talking, a slipperiness that can lead to confusion and miscommunication. In addition, many of the typological categories house more than one driver, albeit somewhat cryptically. Some examples of overlapping drivers include the following:

- *In-person programs* tend to point to the interactive effect as a motivator but fail to mention that the status of individuals matters for the interaction to be effective.
- Status also plays a role in *social norms*, where it matters that people are like you, or in *framing*, where a gain in status is one benefit that can be emphasized.
- *Commitment* depends on the principle of reciprocity. *Gifts*, which are *rewarding,* also use this principle for their motivating power
- *Sunk costs* should be considered subordinate to *rewarding* as another form of financial incentive.

Another issue is that many real-world programs fall into more than one typological category. For example, competitions, a well-established program type, uses more than one driver or behavioral insight for its effect. To minimize confusion, we need an organizational scheme in which every program fits into just one category. By sorting each approach into a single category, we can begin to compare how successful they have been in changing behavior, how much different types typically cost, and how much energy they save.

To move to another field for a moment, consider the tree metaphor that many of us learned in school to describe the diversification of life on Earth. Each creature in the world fits on one branch of the tree and on no other. Another way of putting this is to say that each branch is monophyletic; it represents only one phylum. All animals with backbones, for instance, constitute a monophyletic group. So do all flowering plants. Each monophyletic branch contains only the set of members that share a feature, something that distinguishes them from other sets.[5]

The tree of life is an example of a taxonomy; it constructs sets containing members with contrasting features. These features constitute the parameters of each category. The categories can nest within each other, so that categories can hold subcategories within them and simultaneously be members of larger groupings. Smaller branches of the tree come from larger ones, and twigs branch off each smaller branch. All the phenomena on a large branch share a characteristic that distinguishes them from the phenomena on other branches. Similarly, phenomena on each of the twigs can be distinguished from the phenomena on the other twigs of that branch.

The contrasting features that define the tree of life are physical characteristics, for example, a backbone. When we turn to utility-run behavior programs, the contrasting features are factors such as the social context of information consumption, what channel delivers the information,

[5] We borrow this metaphor from biology simply to illustrate the landscape of behavior programs. We do not mean to imply evolutionary relationships between programs. Many of the programs we describe came into being separately and did not evolve from other programs. The metaphor is useful for describing *the relationships among observed characteristics*.

the specificity of the information, and so on. Each of these features defines a unique category of behavior programs. In this case, each category or set is not a kind of creature but a cultural domain.

By "cultural domain," anthropologists mean an agreed-upon description of a phenomenon that has some kind of reality in the culture. For example, people share a broad consensus around the concept of crime. Crime is a cultural domain, and so are behavior programs as opposed to widget programs. Cultural domains are more than just sets of items of the same type, and membership in the cultural domain is determined by more than any single individual respondent. The domains actually exist "out there," either in the language, in the culture, or in reality (Borgatti 1999).

While cultural domains may not manifest themselves materially (you generally cannot see them), they nonetheless have features that allow us to distinguish and sort them, much as a butterfly specialist can tell a monarch butterfly from a swallowtail butterfly. If asked, "What constitutes a behavior program?" we can give a set of rules or relationships that define and distinguish the cultural domain of "behavior programs" from the cultural domain of "widget programs."

Cultural domains are nested just like the entities on the tree of life. So the overarching cultural domain of utility-run behavior programs contains subdomains such as *social interaction* that in turn contain smaller sets such as *gifts*.

The purpose of classification is to summarize and organize knowledge by examining relationships, particularly those that derive from one another or are dependent on one another (McCaffrey 1991). Anthropologists study and categorize the relationships within cultural domains that help us to distinguish them from each other and so to classify them.[6] James Spradley (1979), for example, maps the possible relationships that may exist within a given cultural domain as shown in the first two columns of Table 2 below. The third column in the table gives examples of how these relationship rules might be expressed within the cultural domain of behavior programs.

We reviewed hundreds of behavior programs and analyzed the kinds of relationships that existed among them in order to develop the taxonomy in this study. We discuss many of these relationships in the descriptions of individual categories in the section after next.

[6] For an in-depth analysis of domain analysis and similar methods in anthropology, see Borgatti (1999) as well as Spradley (1979).

Table 2. Relationships Within Cultural Domains

Relationship type	Definition	Examples from behavioral programs
Strict inclusion	X is a kind of Y	Rebates are a form of economic incentive.
Spatial	X is a place in Y, X is a part of Y	Learning is integrated into educational programs.
Cause-effect	X is a result of Y, X is a cause of Y	Energy savings can be a result of social interaction.
Rationale	X is a reason for doing Y	Reciprocity is a reason for participation.
Location for action	X is a place for doing Y	Residential is a place for doing audits.
Function	X is used for Y	Games are used for motivating savings.
Means-end	X is a way to do Y	“Push” is a way to do a media campaign.
Sequence	X is a stage in Y	Assessing barriers is a step in community-based social marketing.
Attribution	X is an attribute of Y	Asynchronous delivery is an attribute of home energy reports.

Research Methodology

We collected data from several sources on nearly 300 programs run by over 100 utilities and similar groups between 2008 and 2013. The core of our data comes from the series of Behavior Program Surveys conducted annually by CEE. The most recent version is accessible to the public on the CEE website, with an expanded version reserved for members. We input data from the 2012 and 2013 CEE reports.[7] In addition, we reviewed reports by the Federal Energy Regulatory Commission (FERC 2011) and the Edison Electric Institute (Rosenstock and Sohl 2012), as well as the databases of state energy efficiency reports housed at the website run by the National Association of State Energy Officials (NASEO).[8] Finally, we drew data on 59 utilities from the Energy Information Administration (EIA), who also published their State Energy Efficiency Program Evaluation Inventory during our data collection period.

In order to boost our confidence in the quality of data available to us, we spoke with the managers at 10 utilities who were running programs in some of the key areas we were interested in, including communications, online forums, and commercial training. We visited the websites of a further 46 utilities to flesh out aspects of their programs and territories. Where possible, we triangulated data through other sources; Opower and One Change Foundation both provided helpful additional data on home energy reports and community-based social marketing, with Opower confirming its customers and One Change providing detailed information on programs run for four utilities. The Alliance to Save Energy (ASE) shared

[7] CEE has run the Behavior Program Summary data collection effort since 2010, but since the 2010 and 2011 summaries were not released to the public we were asked not to include data from those reports in our database. CEE also requests that data on individual programs not be cited without permission. We obtained this permission for programs we cite.

[8] http://www.naseo.org/sreeps

extensive data on their education programs with us. We also requested information and encouraged utilities who had behavior programs to get in touch with us. We used e-mail blasts, Twitter, posts to Facebook and LinkedIn, announcements at conferences, and word of mouth.

Some programs ran for multiple years under the same name. If they changed their approach and content substantially, we considered them separate programs. There were very few programs of this nature, but it did occur. Where programs ran for several years and had slight variances due to data input, we combined the information into one program with the earliest date available as the start date.

As with any research project, the validity of our findings depends on the quality of our data. There is no single clearinghouse for information about behavior-based programs, so we combined input from multiple sources to create the most comprehensive collection of data assembled to date. While we substantially expanded on the data in the CEE surveys, we are sure that additional programs have been offered. The data in resources like the CEE surveys vary by reporting institution, and there are disparities with respect to quality, quantity, coverage, and detail.[9] We restricted ourselves to using only the data that we felt were reasonably reliable. However the great majority of behavior-based programs have not undergone evaluation, measurement, and verification. This fact has important implications for what can be asserted using program data.

At the end of our collection process, we had 280 unique programs that had run at least once between 2008 and 2013. We determined that approximately 85% of the programs were behavior based as we defined this domain. The remainder were technology-based programs, market transformation activities,[10] ENERGY STAR-related programs, and programs with behavioral labels where we could not find a description or be sure they took place.

We entered information about the behavioral programs in a spreadsheet that broke them out by sector, mode, participants, audience, timescale, cost, and savings. At that point we began sorting them according to distinguishing features such as the following:

- Specificity of the information type
- Channel of delivery for information
- Speed of delivery for information
- Social context of consumption
- Type of audience (e.g., targeted vs. undifferentiated)
- Type of incentive offered (monetary vs. non-monetary)
- Mode of incentive offering (e.g., gift vs. reward)

[9] Kira Ashby, the behavior program facilitator for CEE, has requested that we include her opinion that the conclusions of this report cannot be supported by the CEE data available.

[10] ACEEE defines “market transformation” as the process of intervening in a market to create change in market behavior by removing barriers or exploiting opportunities to accelerate the adoption of cost-effective energy efficiency. See http://aceee.org/portal/market-transformation.

We ultimately ended up with 20 categories of programs. Some of them have variants; for example, feedback programs come in either real-time or asynchronous varieties. Including these subcategories, we constructed a taxonomy based on 40 program types.

Taxonomy of Behavior Programs

Figure 1 on the next page shows our suggested taxonomy of utility-run behavior programs. In the broadest grouping, we found that programs cluster around three aspects which are in line with the typologies discussed above. To put it another way, the primary mechanisms driving people's participation in utility-run behavior programs fall into three categories, which we have labeled families:

- *Cognition.* Programs where intrinsic psychological processes are foremost.
- *Calculus.* Programs where the deliberation of extrinsic aspects is a primary motivator.
- *Social interaction.* Programs whose key drivers are sociability and belonging.

COGNITION

We have assigned all behavior programs that focus primarily on delivering information to consumers to the family called Cognition. These programs are typically unidirectional, with information flowing from the utility (or third-party vendor) to the customer, and with the consumption of information being the end-point of the relationship. Utilities have used these types of programs extensively, and they will look very familiar to most readers. But only recently have utilities begun to consider them behavioral programs, with social science–derived tweaks to improve the chances that people will act upon the information they receive.

Cognition includes the following categories:

- *General communication efforts.* Campaigns using all traditional mass market channels (e.g., broadcast television, cable television, print, and billboard).
- *Targeted communication efforts*. Enhanced billing, direct mail, bill inserts, and bill redesigns for consumer comprehension and usability.
- *Social media*. Facebook, Twitter, Tumblr, and blogs (i.e., any format intended to be primarily one directional, with information provided by and commented on, but not created by, recipients).
- *Classroom-based education*. Teaching and learning in K-12 classrooms and in higher education.
- *Training*. Commercial, industrial, and other institutional educational efforts.

General communication efforts

General communication campaigns implicitly aim at changing behavior. Despite a few exceptions (*Flex Your Power* in California comes to mind), they are rarely designed to track impacts and outcomes. They include campaigns in all traditional mass-market channels including broadcast and cable television, print, and billboards. Some campaigns (Pepco 2011–2012) have incorporated specific social science insights into the text ("I pledge to set my thermostat to 68") but do not have any mechanisms for consumers to respond directly to the utility or otherwise record and publish their activities. Information is pushed at the consumer with no means for interactivity. These campaigns are distinguishable by the medium (television, radio, print) as well as whether they are dynamic (television) or static (billboards).

Figure 1. Taxonomy of Utility-Run Behavior Programs

- COGNITION
  - **Communication efforts**
    - General
      - Cable or broadcast TV
      - Radio
      - Billboards
      - Other traditional media outlets
    - Targeted
      - Enhanced billing
      - Direct mail
      - Bill inserts
      - User-friendly bill designs
  - **Social media**
    - Facebook
    - Twitter
    - Tumblr
    - Blogs
  - **Education and training**
    - In schools
      - K-12
      - Higher education
    - In companies or institutions
      - Commercial
      - Industrial

- CALCULUS
  - **Feedback**
    - Real-time
    - Asynchronous
  - **Games**
    - Competitions
    - Challenges
    - Lotteries
  - **Incentives**
    - Cash
    - Rebates
    - Subsidies
  - **Home energy audits**
    - Audit only
    - Audit+
  - **Installation**
    - Direct install
    - DIY

- SOCIAL INTERACTION
  - **Human scale**
    - Community-based social marketing
    - Person-to-person
    - Peer champions
    - Eco-teams
  - **Online forums**
  - **Gifts**

A good example of a traditional communication campaign is the South Jersey Gas initiative *Local on the 8s*, which has run for several years on a local weather channel on cable in their territory. Tips about home energy savings run on the banner (technically called a *Chyron*) that loops underneath the ongoing weather information. This campaign offers the benefit of juxtaposition with relevant weather data. It also has the potential for reaching into other utilities' territories, given that broadcast reach likely extends beyond (possibly well beyond) the geographical boundaries comprising the South Jersey Gas customer base. This reach into neighboring utility areas extends the campaign's relevance and immediacy for consumers regionally.

FINDINGS

We found 18 general communication programs run by 14 utilities, serving about 16.5 million customers. On average, these programs had been running for 2.5 years, costing on average about $1.1 million a year per program. None tracked or reported actual energy savings.

Targeted communication efforts

In contrast to both mass and social media, targeted communication efforts are not broadcast to all customers or all residents within a utility's territory. Instead, these communications are directed at an individual or household with whom the utility already has a relationship, and about whom they have collected a great deal of data concerning such things as energy usage patterns and bill payment practices. Common channels for targeted communication efforts include direct mail, bill inserts, and bill redesign.

Enhanced billing—bill redesign and bill inserts—can enable utilities to refine the amount of information they provide customers as well as its presentation, which may depend on third-party software such as Oracle. Redesigning bills to help customers interpret and subsequently use their energy information is one way that utilities can engage consumers in behavior change efforts. Many utilities point to increased customer service as one of the motivations behind the investment in enhanced billing processes.

The established relationship between a utility and its customer base enables targeted communications to reach much higher rates of penetration than generic direct mail typically achieves, with open rates of 41% reported in Kempton and Layne (1994) as opposed to the 1-2% found typical by the Direct Mail Association of America. Classically, it was this relationship that provided the rationale for utility bill inserts with behavior-change messaging as an easy and relatively inexpensive means of customer education.

Such bill inserts remain a good foundational tactic for utilities; however, the fact that feedback about energy usage does not come at the same time as energy consumption means that the low expense of bill inserts is matched by their low impact.

FINDINGS

ACEEE reported in 2011 that 90% of all utility bills still lacked the most innovative elements that motivate customers to take action, including pro-efficiency messaging, energy efficiency specific tips and contacts, and peer-comparisons (Foster and Altshuler 2011). In the five years prior to 2011, 44% of utilities responding to a survey stated that a bill redesign had occurred; however, only 24% of them reported conducting consumer-based research on what that bill redesign should incorporate (Foster and Altshuler 2011). Into this gap have stepped companies like Opower, Tendril, and C3. Their treatment of the customer-utility relationship goes well beyond a graphical redesign and will be discussed following the section on feedback below.

Social media

As with their mass media campaigns, utilities use social media efforts to broadcast information to a relatively undifferentiated audience (although particular demographics and psychographics may be desirable). These efforts may use any social media platforms; most commonly they involve Facebook and Twitter. Less established platforms like Tumblr, Pinterest, and Instagram could conceivably play a future role. One of the key features of social media is the transparency of the medium: anyone who has a Twitter account can see a tweet from another account, and the same holds true for Tumblr and Pinterest. These are all public-facing platforms.

One of the key distinctions between social media and mass media is the ease with which the public can redistribute content, reaching audiences far beyond the geographical territory of the utility. Another key distinction is social media's interactivity. Consumers of social media content not only can reproduce and share it, beyond the control of the content creator, but they can also respond to it in multiple ways and with incredible speed. On Twitter, for example, customers can use the @ symbol to direct comments to the utility's own social media management team, or hashtags (#) to highlight utility-related issues (e.g., outages) for their followers to pick up and retweet. This can have the positive effect of simplifying the reporting of problems, but it can also have the negative effect of amplifying the perception of a problem. The usefulness of Twitter in energy efficiency programs remains an open question in the absence of any significant evaluation, measurement, and validation (EM&V).

Two utilities that are leaders in promoting new behavioral approaches are the Sacramento Municipal Utility District (SMUD) and the Salt River Project. SMUD has both a Facebook page and Twitter feed, with information about relevant SMUD programs, news, and community events. SMUD also uses the page to share tips and tools, as well as to address ad hoc customer service needs. SMUD also uses Flickr, YouTube, and LinkedIn accounts to promote additional content like photos, videos, and links to web-based articles.

The Salt River Project's use of Facebook offers a good model for sophisticated interaction with customers. The project has a regular Facebook page, but it also has comments running on the Facebook engine embedded within its web page for its *Time of Day* price plan, where consumers can comment directly and specifically about their engagement with this program.

FINDINGS

When compared with more traditional communication efforts, social media campaigns in the behavior program space seem to be underreported. This may be due to the recent vintage of technologies such as Facebook (founded 2003) and Twitter (founded 2006) as well as utilities' concomitant lack of experience with such technologies and their incorporation into educational efforts. As with general communication efforts, none of the social media programs tracked or reported energy savings. Additionally, none of these programs reported program expenditure or budget information.

Classroom education

Classroom-based education is another information-delivery platform commonly used in energy efficiency behavior change efforts. Classroom-based delivery is distinct from other forms of communication in several ways. In contrast to more general communication efforts, this type of program targets consumers by age group for specific information delivery. Further, educational programs use materials, media, and language suitable to the developmental stage of the target group.

Our research saw two program clusters, one for primary and secondary grades and the other for higher education. ASE, for example, runs two programs: *PowerSave Schools* in six states and Washington DC and *PowerSave Campus* at 23 colleges and universities.

Many programs in elementary schools take advantage of science-based curricular requirements. Another advantage is that parents often oversee their children's homework; therefore the message gets passed along, enhancing any other messages householders may be receiving through broadcast campaigns and enhanced billing.

The ASE programs are particularly interesting. Both at the K-12 and higher education levels, *PowerSave* not only encourages behavioral change in individuals such as turning off lights when exiting a room, but it also motivates participating students to become true energy activists who take part in transforming their site via infrastructural upgrades such as lighting change-outs. In addition, ASE provides tracking that schools can access monthly.

FINDINGS

We counted 22 educational programs, which have been in place on average for just under six years. However over 30% of the programs were launched in 2011 or later, suggesting that there has been an increased level of interest in these programs in recent years. Data on energy savings were generally unavailable, and most of these programs do not report the number of participants; however, for the ones that do, the range is 400 to 25,000. Five of the 22 programs are offered by ASE. Using data we received from ASE, we estimated the cost of saved energy of their *PowerSave Schools* program to be about six cents per kWh if we assume the savings last an average of 1.5 years.[11]

It is important to distinguish between the K-12 schools program, where the savings reported are from immediate behavior changes, and the higher education campus programs, whose savings calculations include retrofits and upgrades (Harrigan 2013). The higher education programs can point directly to their impact on the environment through the retrofits and through the policy changes enacted at the local level as reported to us by ASE.

[11] Utilities use CSE to compare energy efficiency with other energy sources. In this report we are reporting the CSE in $/kWh (and $/therm). We are using a levelized cost to be able to compare programs of different duration. The formula for establishing this levelized cost is common across ACEEE publications:

Cost of Saved Energy (in $\$/\text{kWh}) = (C \times 10^6) \times \frac{\text{Capital Recovery Factor}}{D \times 10^3}$. Capital Recovery Factor=$\frac{A \times (1+A)^B}{(1+A)^B - 1}$, where A = Discount Rate; B = Estimate measure life in years; C = total program cost in millions of dollars; and D = Total MWh saved that year by the energy efficiency program. For these calculations, we estimated an average measure life of 1.5 years based on our review of the limited available data. This estimate is subject to a high degree of uncertainty and is an important subject for further research.

Other than being organized by age-based cohort, the demographics of program participants are outside the program vendor's control. For K-12, they largely reflect the makeup of the region in which they are situated. Geography has less of an effect on demographics for higher education, but it is still a factor. Attendance is mandatory in the K-12 cohort, which biases the sample, as it is neither opt-in nor opt-out.

Training

Training is distinguished from education in several ways: setting, activities, purpose, and the presence of an incentive structure. Training is oriented toward adults, and this removes the mandatory aspect of attendance in favor of providing incentives for participating. One of the most common settings for energy-related training is the workplace, whether it is a commercial or industrial establishment. In a commercial setting, the primary focus might be on managing individual plug-loads through the creation of good energy hygiene in turning off the personal computers, printers, and monitors that are responsible for the majority of energy consumption under the control of individuals (as opposed to cooling and lighting) (Kwatra, Amann & Sachs 2013). In industrial settings, training is likely to concentrate on production processes and the interaction of employees with systems and software that regulate energy use. An example of this approach is the Energy Trust of Oregon *Kaizen Blitz* program, an intensive team-based strategy where groups identify local issues and recommend solutions (Crossman & Brown 2009). Despite some progress, however, little to no work has focused on the implications of habit and kinetics (the complex of motions needed to accomplish a task) for energy consumption in manufacturing.

Because the workplace is a common setting for training, at a minimum the implied incentive is the regular pay employees receive for attendance and participation in company-mandated events. In addition, some programs may offer the opportunity for prizes. *Cool Choices* of Wisconsin and the online program *Practically Green* are two non-utility-based examples. Both offer customized workplace solutions for engaging employees in energy saving and other sustainability practices. According to the executive director of *Cool Choices*:

> Prizes vary from location to location. Typical prizes are $5.00 coffee gift cards, a water bottle, etc. In some companies, prizes are corporate swag. The most important prize at a law firm where we implemented recently was getting your photo taken with a trophy as the Cool Chooser of the Week. Folks didn't get to keep the trophy but their photo was posted on the corporate intranet. (Kuntz 2013)

FINDINGS

We counted 17 training programs, 5 of which were aimed strictly at improving industrial practices, and the remainder with a mixed focus on the commercial sector (e.g., foodservice and contractors) and even residential (through low-income assistance agencies). Only 5 of the 17 programs provided information on their annual budget, which varied from $200,000 to $75 million, averaging about $5.5 million. The programs date back only to 2005, suggesting that the behavioral component is relatively new. (Energy efficiency training definitely predates 2005.) Unfortunately, none of the commercial and industrial programs reported the energy savings achieved, and only one, Efficiency Vermont's *Energy Leadership Challenge*, reported participation, with 23% of the targeted set of commercial customers participating. Without further data, we do not know if this is a favorable percentage. None of the programs provided estimates of energy savings.

CALCULUS

We placed behavior programs that rely on consumers making economically rational decisions in the family called Calculus. Our use of the term "rational" is worth clarifying, since it has several definitions depending on the discipline using it. In addition, people make decisions that may seem rational in one sphere but not another, for example, when they buy a fast food "value meal." This meal delivers more calories for the money, but at the same time it undermines long-term health by delivering more of those calories via fat than is nutritionally necessary. People may also make rational decisions in one sphere (psychological) while being irrational in another (economic) when they choose a shorter-term goal (e.g., investing in an entertainment center) over a longer-term goal (investing in energy efficiency).

The term "rational" in this section involves the practical weighing of risks, benefits, and payoffs to come to an overt decision regarding action. Utility-run behavior programs that take advantage of rational ways of thinking may give consumers feedback, engage them in games, or provide some form of incentive, whether it is cash, rebates, or free products. Any program that involves a clear economic tradeoff in a direct exchange between activity and result belongs in this family.

Calculus includes the following categories:

- *Feedback*. Includes real-time feedback and asynchronous feedback.
- *Games*. Includes competitions, challenges, and lotteries.
- *Incentives*. Includes cash, rebates, and subsidies.
- *Home energy audits*. Includes free and market-rate, as well as what we call audit +, where products are included either as do-it-yourself (DIY) or direct install.

Feedback programs

In 2010 ACEEE published a major report on feedback and its potential to save energy and money for consumers. The publication, *Advanced Metering Initiatives and Residential Feedback Programs,* reviewed a set of programs and found that on average they reduced individual household electricity consumption by 4% to 12% (Ehrhardt-Martinez, Donnelly & Laitner 2010). The authors also estimated that, on a national scale, feedback programs for the residential sector might generate electricity savings of up to 6% of total residential electricity consumption. This is something ACEEE has discussed in more detail elsewhere, in *Results from Real-Time Feedback Pilots* (Foster & Mazur-Stommen 2012) as well as in *Tamagotchi Buildings Project: Environmental Cues in Context* (Mazur-Stommen 2012).

Many programs use advanced metering to generate data on a household's consumption of energy. Feedback about energy consumption may be either real time (immediate) or asynchronous (delayed). The more recent the time frame, the more effective the feedback in changing behavior (Ehrhardt-Martinez 2011).

REAL-TIME FEEDBACK

In-Home Display

Unlike a generic insert with tips that comes on a schedule with the bill, feedback can be delivered in real time. With real-time feedback, the communication channel is dissociated from the spatial location of energy consumption. One example of the use of advanced metering in combination with online accounts is a program in which consumers can have their energy consumption data delivered to them via text message wherever they happen to be. Thanks to the rapid proliferation of smartphones and to Moore's Law,[12] the processing power carried about in the hands of the everyday utility consumer means that utilities can more easily share data through better interfaces, at shorter and shorter intervals. Web widgets, smart phones, and in-home displays are all used in feedback campaigns; for example, Pacific Gas and Electric piloted a program jointly with Honeywell and Opower that pushed messaging to smart phones and gave homeowners the ability to control a household thermostat remotely.

DYNAMIC PRICING

Dynamic pricing, also known as critical peak or time-of-use pricing, alerts consumers to changes in their rates based on the level of consumption in their region during a particular period. In theory, these pricing schemes should provide information that consumers find relevant and on which they base their decision making about energy consumption. These programs attempt to manage load distribution through changing consumer awareness and behavior. They use a form of feedback in which units of energy consumption are posited as equal units of monetary consumption. The idea behind such schemes is that there exists a straightforward relationship, or equivalence, between the two units being consumed, and that changing one will change the other in an almost linear or logarithmic fashion. Dynamic pricing programs often straddle the line between real-time and asynchronous feedback channels, but with smart metering and the slowly declining price of in-home displays, the trend will be for energy efficiency and demand-side management programs to merge.

FINDINGS

We identified 23 utility-run real-time feedback programs in our analysis, most of them instituted since 2007, with the oldest belonging to Salt River Project (circa 1994). The smallest utility had a customer base of 200,000, while the average customer base was 1.6 million. The cost of the feedback programs varied dramatically, ranging from a low of $75,000 (a pilot) to a high of $3.5 million. Removing the pilot program that had a very small sample and leaving only

[12] Intel co-founder Gordon Moore noticed in 1965 that the number of transistors per square inch on integrated circuits had doubled every year since their invention. Moore's Law is the observation that this trend will likely continue into the future. Since then, the number has generally doubled about every 18 months.

full-fledged programs gave us an average annual cost of $1.2 million. The high capital costs involved in developing and deploying a full-scale feedback program mean that these programs' appeal may be limited to larger public and investor-owned utilities or joint efforts by smaller utilities. Public and private entities engaged in these programs at a nearly identical rate.[13]

The Sacramento Municipal Utility District is currently running a large pilot program called *SmartPricing* that delivers information about pricing (differentiating between critical peak and time of use) via in-home displays. This district saw peak loads decrease by 6 to 13% depending on audience segment (Potter 2013).

ASYNCHRONOUS FEEDBACK (HOME ENERGY REPORTS)

Asynchronous feedback programs, such as the home energy reports offered by Opower and others, compare a household's energy use to that of similar households and provide relevant energy conservation tips. Home energy reports deliver their customized information either at regular intervals (e.g., monthly) or irregularly, such as whenever a customer decides to visit a website or her online account. This strategy differs from enhanced billing in that the purpose of providing energy consumption information is explicitly to steer consumer behavior towards more efficient practices. Further, the purpose of the information exchange is to create a relationship between the utility and the customer, which can then become a springboard to deeper and more regular interactions such as participation in other programs offered by the utility.

Home energy reports take advantage of social dynamics to enhance the reception of their message. They are based on the social science insight that energy consumption practices are affected by processes and dynamics at the social level rather than by individual decision making alone. Work on social norms by Noah Goldstein and Robert Cialdini showed that providing information about socially normative behavior induces people to conform to the stated baseline, in this instance becoming more efficient with energy consumed in the home (Goldstein, Cialdini & Griskevicius 2008). We listen to peers and watch our neighbors and strive to conform as closely as possible to sets of established norms.

Utilities may either have their own private-label energy reports or engage third-party vendors. Without confirmation, it is difficult to identify which is which. We counted seven utilities that offered their own reports; we were told that two of them, Duke Energy and New Jersey Natural Gas, explicitly used behavioral science. That does not mean we believe these to be the only examples of this use.

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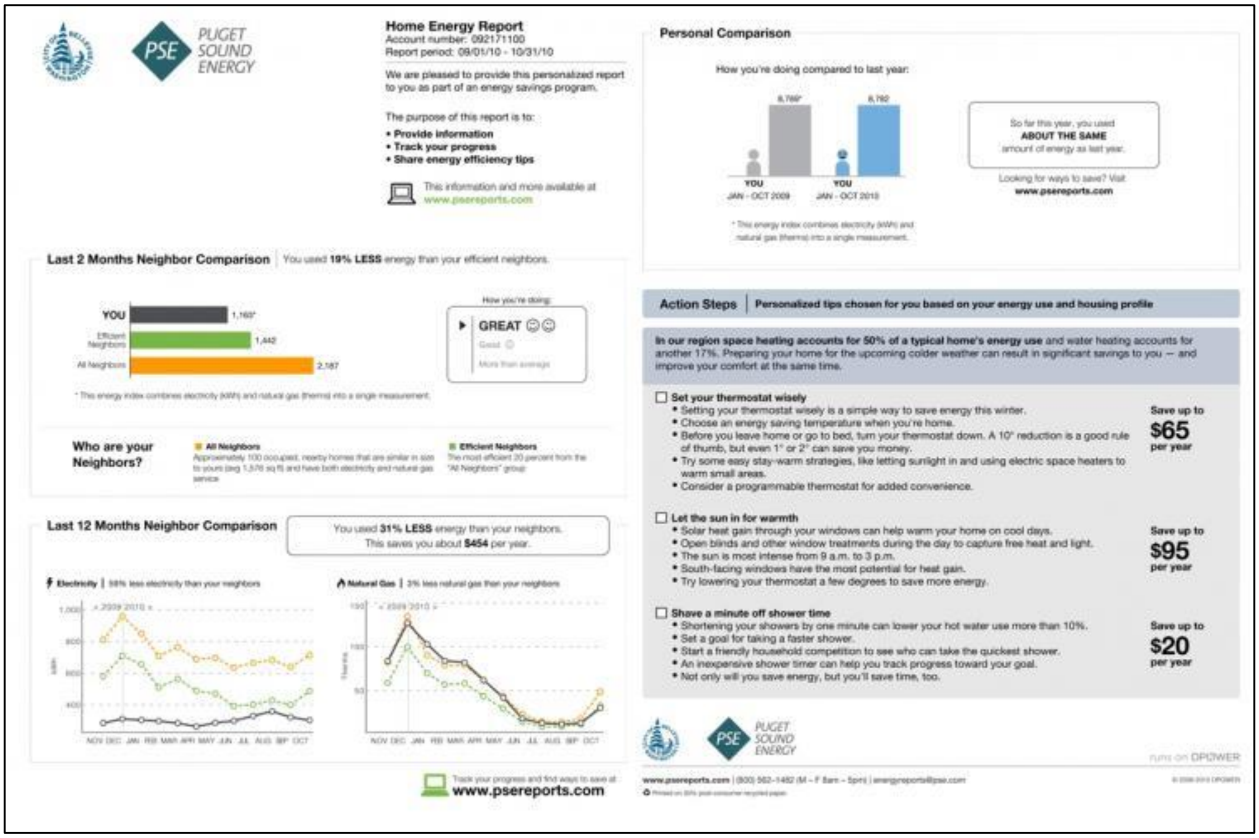
[13] We discuss this in the *Results from Real-Time Feedback* report, where per-household costs to the utility ranged from $100–870 with a mode of $500 (Foster and Mazur-Stommen 2012).



A home energy report from Energy.gov

Opower is one of the best known of several third-party vendors offering commercial platforms for the delivery of home energy reports; others include Tendril, Aclara, and C3. Over the past five years, these companies have been able to field large-scale pilots and full-fledged programs in partnership with an expanding list of clients. They also supply data mining services to analyze the information gathered about customer behavior. Opower alone now works with more than 60 utilities including their subsidiaries.

South Jersey Gas Company's *Take Control of Your Gas Bill* program, run on the Aclara platform, is an example of asynchronous feedback. It provides customers' natural gas usage on a website that also offers an online energy audit. The site links customers to the New Jersey Clean Energy Program, which offers details about statewide programs and incentives for which customers may be eligible.

FINDINGS

We found seven utilities that offer self-created home energy reports, and most of those tend to be larger utilities. The smallest is Western Massachusetts Electric Company (176,720 customers in 2011) and the largest is Ameren in Missouri, with 1.2 million customers. The average size is around 750,000 customers (EIA 2013). Using data provided to us by NSTAR, we calculated the *Western Massachusetts Saves* home energy report to have a CSE of about 6 cents per kWh ($0.06), which is lower than the retail price Western Massachusetts charges ($0.15). Additionally, the company reported energy savings of 3.8%. If meeting a percentage target is the primary goal, private-label home energy reports may serve that purpose well.

Solid data on third-party reports were hard to come by. We tried to contact Tendril, Aclara, and C3 but did not receive responses to our queries. Since Opower reports are a proprietary product, we did not have access to reliable information concerning their costs. We recommend that utilities interested in the CSE of Opower programs research that information directly. One striking fact is the range in size among utilities who run programs on the Opower platform, from tiny White River Valley Electric Cooperative, with 2,143 customers, to giants like Duke Energy and National Grid, which have seven and eight million customers respectively (EIA 2012). The wide range of scale combined with a limited number of participating utilities makes useful comparisons difficult.

For the three electric programs where we could find both program cost and savings, the Opower CSE was 8 cents per kWh ($0.08) based on our estimate of an average 1.5-year savings life. For the two gas programs, the Opower cost per therm was less than two-tenths of a cent ($0.0018). Further analysis is needed with larger sample sizes, as the electric figure strikes us as high and the gas figure, low. It is worth mentioning that with opt-out design, participation in Opower programs averaged 92%.

Hunt Alcott (2011) found that Opower's deployment of proprietary home energy reports combined with customer data mining has led to documented energy savings (Allcott 2011) and persistence (Allcott and Rogers 2012). According to Alcott, the energy consumption of households receiving home energy reports from Opower decreases on average by about 2% compared to households that do not receive such treatment. Opower and other firms have been able to deliver this figure with the regularity necessary to qualify as savings under state regulations and at a large enough scale to have a meaningful impact on utility bottom lines. In terms of persistence, results are much longer lasting following a two-year program than they are in the intervals between the initial Opower reports.

Games

Game-based programs include Efficiency Vermont's *Vermontivate* and the city of Palo Alto's *LED Contest*. Games are generally dependent on both social interaction and reward mechanisms to be engaging. A game without monetary compensation gives players a chance to enhance their social status by demonstrating more skill, deeper knowledge, or greater cultural competence than their opponents. Even solitary games are played socially against the player's past self or against others who play remotely. In addition, simply playing the game makes the player happy. This pleasure is an intrinsic value. On the other hand, many people are motivated to engage in lotteries and other competitions solely by the possibility of winning a prize or other reward with extrinsic value, something that can be used or exchanged in the material world. The act of scratching off a lottery ticket may not be intrinsically fun; the potential reward is the motivator.

Our taxonomy divides games into competitions, challenges, and lotteries, strung along a continuum from most socially rewarding to most economically rewarding.

COMPETITIONS

Competitions involve multiple persons or teams of people striving with each other in quest of a reward. These are the most social of the three subtypes of games, with personal interaction a major factor in engaging participants. Competitions may be interpersonal, communal, intercommunal, or campus-based. Intercommunal competitions like the Kansas-based

TakeCharge Challenge pit neighborhoods, cities, and even regions of a state against one another. As another example, Fortis BC held *An Hour in the Dark* for Earth Hour in 2010. This was an inter-community challenge where any customers (residential and commercial) who wished to participate were asked to make an online commitment to turning off lights and other energy-consuming equipment deemed nonessential for the hour. The community with the greatest participation won a $15,000 energy makeover for a public building of their choice.

CHALLENGES

Challenges typically involve an individual, household, or community trying to improve over its own baseline as opposed to outperforming another group. In 2012, the Public Service Company of New Mexico held a three-month-long *Energy Saver Challenge* that rewarded the two customers who saved the most energy over their consumption the previous year. Another example comes from Puget Sound Energy (PSE), where PSE offered $50,000 in prizes from Feit Electric to customers who earned the most points during the promotion period. According to PSE:

> Customers earned points by exchanging bulbs and participating in activities at a PSE Rock the Bulb Tour event; volunteering with Project Porchlight in their community; reducing their home energy use during the month of October ’09; and recruiting up to 20 friends to participate.[14]

LOTTERIES

Lotteries fall at the economically rewarding end of the games spectrum. Winning is based primarily on chance, although there may be an antecedent filter for participation. An example of the latter is Hydro-Quebec’s *Energy Wise Home Diagnostic*, which required participation in an audit for eligibility to win a car (LaLonde 2008).

FINDINGS

We counted eight utility-run game-based programs since 2003, with the majority arriving on the scene after 2009. We found that games are equally popular with public and investor-owned utilities, with customer bases numbering between half a million and a million. The reported cost of the games ranges from $3,000 to $75,000. Of all utilities using a game-based program, only PSE tracked energy savings, with a reported 118,390 MWh saved in three *Rock the Bulb* campaigns. While the program manager was helpful in other ways, PSE did not provide us with their precise program costs, so we cannot determine the cost per unit energy of these programs.

Incentives

Financial incentives like subsidies and rebates are an integral part of many utility programs. For example, Pepco's *Custom Incentives* program rewards nonresidential customers for such activities as improving the efficiency of energy management systems in commercial buildings. We include financial incentives in our taxonomy since they change the outcome of practical-rational decisions. At the same time, we strongly advise against referring to standalone rebate programs as behavioral.

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[14] Puget Sound program entry for Association of Energy Professionals award in the category: Outstanding Achievement in Program Design and Implementation. Press Release.

The chief distinction among financial incentives is the mode of delivery: upfront, built-in, or on the back end. While there may be programs that give money directly to consumers for purchasing off-the-shelf energy efficiency products and services, we recorded none in our dataset. It is much more common either to subsidize the cost of the product upstream or to reward a purchase after the fact. The former is invisible to consumers, and while its impact on decision making may be profound, it is hard to argue that there is a relationship between pricing and situated action. The role of rebates as signifiers of worth rather than as a prompt for action is discussed in Mazur-Stommen 2011.

FINDINGS

We counted eight programs offered under the ENERGY STAR label, but we left these out of the final taxonomy due to their technological orientation. In addition, utilities offer many more rebate programs than could be detailed in a project of this scope and focus. In the end, we included four subsidy and eight rebate programs. On average they ran for about two years, although Redding Utility had a program dating back to 2000. Only DTE Energy reported both cost and savings, for a CSE of 3 cents per kWh (EIA 2013). Information about program cost was not available for any of the other programs.

Home energy audits

Baseline home energy audits deliver personalized data about home energy performance to householders with the expectation that information delivered will result in action taken. Unfortunately, research has not established such a direct relationship:

> Most home energy audit and retrofit programs are rooted in a physical-technical-economic-model (PTEM) of energy consumption (Lutzenhiser 1993). The house is a physical system, the envisioned solution of increased energy efficiency is technical, and the chief criteria for the worthiness of these solutions are economic. . . . To the people who live in them, however, homes are not neutral technological settings, and increasing the home's technical energy efficiency may rarely be of much fundamental interest (Ingle et al. 2012b).

This lack of interest is evinced by the fact that uptake of post-audit recommendations remains low, despite consumers reliably stating that they are interested in purchasing energy-efficient appliances (CFA 2011) and homes (Fingerhut 2011). This gap between attitudes and actions has been described as "the energy efficiency gap." According to figures from the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy, fewer than 1% of homes have had energy retrofits (Palmer et al. 2011).

Regardless of home energy audits' actual effect on energy consumption behaviors, audits do encourage consumers to participate in incentive programs, purchase energy-efficient products, and use them in the home or as part of the building envelope.

Utilities can provide audits at no cost or at market rate, directly or through a vendor. Anecdotal evidence suggests that free audits may have lower follow-through than those paid for by the consumer. Some programs offer do-it-yourself versions of home energy audits, with utility-sponsored kits for measuring energy consumption often available for checkout from public libraries. As an example, the Public Service Company of New Mexico donated in-home plug-in meters that display electricity usage (called Kill A Watt™ devices) to public libraries in its service territory.

Online energy audits are an area where the line between an audit and a home energy report may blur. One of the better ongoing examples of an online audit is the Southern California Edison (SCE) *Home Energy Efficiency Survey*, running since 1990. This survey, which can be completed via the Internet, mail, or phone, asks a series of questions about the home and its occupants' energy practices and provides a set of recommended actions. While this may seem like a forerunner of today's home energy reports, the interactivity between utility and consumer, as well as the highly individualized information elicited, distinguish it from those types of programs. Also marking it as different is the feature by which customers prequalify themselves for further engagement. SCE considers the survey enough of a unique proposition to run it alongside its Opower home energy reports.

In addition to home energy audits, which are informational only, we formulated an audit+ subcategory that involves audits plus products. For example, participants in the City of Palo Alto's *Green@Home* audit program received compact fluorescent light bulbs (CFLs), low-flow showerheads, faucet aerators, and a yard sign reading, "I'm a Green Neighbor."[15]

FINDINGS

We found 18 audit programs with behavioral components, including 7 audit+ programs, mostly following the Home Performance with ENERGY STAR's three-tier model.[16] With the exception of two programs (SCE and Lodi) that had run for many years, audit programs ran for three years on average. Most of the programs reporting costs were from smaller utilities such as Palo Alto and Lodi, with an average customer base of just under 300,000 households. The average budget was just under $200,000 annually.

Installation

One of the fastest ways to change utility customers' interactions with energy is to change out the products in their homes. An implicit behavioral premise underlies this type of program, along the lines of the "foot in the door" socio-psychological response. The idea is that exposure to previously unknown products, and the resultant savings, will prompt householders to change their purchase decision making habits in favor of energy-efficient products. Consumers exchange their time (and sometimes privacy) in return for free products.

In direct install programs, the utility sends out a person or team to a customer's home to install low-cost energy efficiency measures. In do-it-yourself (DIY) programs, the consumer supplies time and labor but usually does not have to surrender privacy or information. Many DIY programs offer free products. Progress Energy of Florida gave out CFLs, weather stripping, wall plate seals, and thermometers as part of their DIY installation program.

Some DIY installation initiatives involve utility-sponsored television programs. One of the older behavioral programs, Alliant Energy's *PowerHouse TV*, has been running since 1996 in six broadcast markets across Iowa, Minnesota, and Wisconsin. Segments cover energy efficiency topics such as heating, lighting, and appliances. Rather than focusing on discrete tips, they

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[15] This audit+ program appears to have been discontinued in favor of an Opower-supplied home energy report. See http://www.cityofpaloalto.org/gov/depts/utl/.

[16] http://www.energystar.gov/index.cfm?fuseaction=hpwes_profiles.showsplash

emphasize choosing an energy-efficient lifestyle. Several web-only videos are also available at http://www.powerhousetv.com/.

FINDINGS FOR DIY AUDITS AND INSTALLATION

We counted ten DIY programs running between 2008 and 2013. Excluding the long-running *PowerHouse TV*, they ran for two years on average. Eight percent of DIY programs gave out free products. Of the two programs that provided budget information, one cost $300,000 annually and the other, $500,000. None of the programs reported energy savings data.

SOCIAL INTERACTION

This family encompasses all utility-run behavior programs that depend on social interaction for their effectiveness. The interaction can take place in person or online, and it can be abstract, as when utilities use social mechanisms such as reciprocity to induce behavior change. In contrast to the programs in the Calculus family, programs in this family do not activate the practical-rational form of exchange; rather, they feature the deeper impetus towards sociability and belonging experienced by most people on a daily basis.

Social Interaction includes the following categories:

- *Human scale*. Includes community-based social marketing, person-to-person efforts, eco-teams, and peer champions.
- *Online forums*. Includes any forum that foregrounds community-based or peer-to-peer horizontal communications.
- *Gifts*. Restricted to incentives that are non-monetary and upfront; generalized reciprocity.

Human scale

Some of the newest utility programs take advantage of some form of face-to-face social interaction. This interaction varies in intensity and duration. Participants at an outreach event may have only a few minutes with any one individual, yet collectively interact with hundreds of people in one day. A program such as *Neighborhood Saver* (which also includes the direct installation of low-cost energy efficiency measures in low-income households) can be relatively time consuming and labor intensive, as it includes an in-depth conversation between householder and utility representative. Eco-teams, which are popular in many settings including workplaces, may be involved in a series of events that also can add up to a significant time investment.

Programs in this category also differ in terms of organization, spanning a spectrum from individual encounters to community-wide events. At one end, Progress Energy in North Carolina has a *Neighborhood Saver* program that stresses one-on-one interaction.[17] In the middle are utilities such as Seattle City Light, which ran the Empowerment Institute's *Low Carbon Diet* program using teams of five to eight persons. At the far end, community-based social marketing (CBSM) campaigns may involve hundreds of volunteers.

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[17] https://www.progress-energy.com/assets/www/docs/company/NCProgramRS-NES.pdf

CBSM targets the social context (a community) as opposed to the individual. CBSM recognizes that behavior is never isolated, but occurs under specific, local circumstances with both historically and culturally determined parameters. Working at the community level, CBSM practitioners use locally-based research to identify barriers to the implementation of a program. They also use human sociability to reinforce positive behavior change.

Engaging local innovators and early adopters, CBSM implements a program through social diffusion. By communicating through trusted social networks and making community-wide action visible, CBSM programs also activate the process of social norming. This process applies when we see the behavior of others and are prompted to understand it as widely accepted, socially supported, and therefore natural. Courses of action are most swiftly adopted when presented via actors with a high (local) status and in a context that is normative. Utilities that undertake a CBSM program will have an initial outlay of time and labor to identify barriers and reach innovators. But this outlay is ultimately offset by a reduced need for financial incentives, by higher savings, and by the spread and persistence of energy efficiency resulting from the new social norm.

FINDINGS

We counted ten major CBSM campaigns since 2007. They appeal equally to public utilities and investor-owned utilities, which, according to our analysis, have run them at approximately the same rate. The smallest utility to report running a CBSM campaign was Omaha Public Power, with 352,182 customers (*Neighborhood Energy Efficiency Program*). The largest was the Ontario Power Authority, with over 12 million customers (*Project Porchlight*). CBSM campaigns are flexible enough to be used in a variety of settings: they have run with as few as 1,000 participants and with as many as 200,000. Although most campaigns run for only three to six months, they tend to have relatively high participation rates. Tucson Power's *Community Education* program, which began in 2011, partners with groups in neighborhoods, congregations, and workplaces. It reported 45% participation.

Four of the CBSM programs we counted ran under the *Project Porchlight* aegis. *Project Porchlight* is a program from the One Change Foundation, which provided us with results from an independent auditor. According to founder Stuart Hickox:

> One Change worked with third-party polling and research firms for every campaign to verify the installation rate, impact on brand favorables of sponsors, and to identify shifts in attitudes toward energy efficiency, compared to control communities where program activities did not take place (Hickox 2013).

On average, a *Project Porchlight* campaign cost approximately $4.4 million and saved 300,000 MWh, for a CSE of a penny per kWh ($0.01). One utility that ran a *Project Porchlight* campaign, Puget Sound Energy, normally charges 10.37 cents per kWh, but with the campaign they are achieving CSE of less than a penny ($0.009) per kWh. Table 3 shows data for the four *Project Porchlight* campaigns we analyzed.

Table 3. *Project Porchlight* Cost, Savings, and Customers Served

	Year	Duration (years)	Customers served	Cost	Savings (kWh)
Ontario Power Authority	2007	0.3	12,851,821	$3,500,000	300,800
Puget Sound Energy	2009	0.5	957,025	$1,700,000	129,700
New Jersey Board of Public Utilities	2008	4.0	8,864,590	$10,942,383	690,515
SaskPower	2008	0.5	490,000	$1,440,000	94,000
Total			23,163,436	$17,582,383	1,215,015
Average		1.33	5,790,859	$4,395,596	303,754

According to Stuart Hickox:

> On average, on a per-contact basis, a complete One Change campaign costs approximately 3 times the cost of the reciprocity measure (bulb or other efficiency measure) that was used to stimulate the person-to-person engagement. The cost of the Project Porchlight campaign in New Jersey, for instance, where 1.3 million doors were reached, was approximately $5.60 per customer, including the bulb.

CBSM programs may not be inexpensive in terms of upfront investment, but their return appears to be high and the payback period is short.

Online forums

At first glance online forums may look as if they belong with the other social media formats (e.g., Facebook), but in fact their setup, purpose, and usage differ significantly. We included in this category any forum where community-based or peer-to-peer horizontal communication was the primary mode.

Social forums are spaces where people can bring their own experiences and information. They are primarily for people to share their knowledge and so resemble a pool rather than a pipeline. User-generated content has equal status with that of the hosting entity. Participants have a voice in determining the value of content (e.g., by voting on posts) and instituting social norms specific to their community. Forums are typically branching rather than linear; topics may multiply and produce offshoots, while cross-posts wind through multiple conversations. People are free to use forums for their own purposes, meeting like-minded individuals and setting up communities that may evolve and extend beyond the original online setting.

FINDINGS

The unique nature of social forums can pose significant challenges for utilities who want to use them to drive behavior change. An early example of a program centered on a social forum was the Sacramento Municipal Utility District's (SMUD) *OurGreenCommunity.org*, which ran in 2009, but was terminated due to low participation, weak momentum, and the lack of a critical mass of engaged participants. According to Bruce Ceniceros, the principal demand-side specialist for SMUD:

> In the post-mortem discussions, we hypothesized that there is a chicken-and-egg dilemma that is a barrier to the formation of new online social networks: that online forums have a hard time attracting new users until they have achieved a critical mass of current users that results in a robust level of discourse (e.g., ample posts, replies, comments, likes) . . . . Ultimately, we concluded that a better strategy would be to leverage existing popular social networks where people were already going (Ceniceros 2013).

One pilot program that appears to have successfully incorporated social forums is the Cape Cod Light Compact program, *Smart Home Energy Monitoring Pilot Phase 1*, also begun in 2009. It is a small sample, limited to 100 slots, of which 93 were filled.[18] That small group, however, saved an average of 9% off their monthly bills, due in large part to participation in the social forum. [19] In a subsequent phase of the pilot, the program expanded the intake of participants to 500 but dropped the online forum feature, resulting in lower associated energy savings.[20]

Gifts and reciprocity

Reciprocity comes into play when we enter into a relationship of exchange with another individual. It has been the subject of research in disciplines such as social psychology, economic anthropology, and behavioral economics. Reciprocity tells us a great deal about how emotions, social structures, and money work when these forces are combined. Dennis Regan experimented with the strength of the need people have to return a favor or gift they have received, even when the gift was unrequested (Regan 1971). Robert Cialdini has also explored the ways in which the sequences and amount of gifts can affect the emotional willingness to reciprocate (Goldstein et al. 2008). In a follow-up to Cialdini, Elizabeth Keenan and her co-authors explored the impact of reciprocity on in-room energy consumption at a well-known resort. They found that the presence of an up-front gift, in addition to messaging and signed pledges, significantly boosted the likelihood that a hotel guest would participate in the sustainability effort (Baca-Motes et al. 2013).

For taxonomic purposes, we are limiting the denotation of reciprocity to what we might call a true gift, one that generates a weak obligation to reciprocate since there is no time limit or overt social code for its return.[21] Unlike programs in the Calculus family, programs in this category offer a gift that is non-monetary (i.e., it is not an economic incentive), upfront (as opposed to a subsidy, for example), and without stated expectation of a return of any kind. In the latter use it would be a reward and would trigger practical-rational ways of thinking as opposed to social-emotional ones. Examples of such pure gifts include CFLs, buttons with logos, or free trees (Riverside Public Utilities has such a program).

Findings

Despite the common inclusion of upfront giveaways in home energy audit programs like Duke Energy's, we found that simple giveaways are typically characterized as marketing rather than

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[18] http://www.bpa.gov/energy/n/pdf/Cape_Light_Compact_Dec_2011.pdf

[19] http://www.capelightcompact.org/2011/03/28/shemp-phase-ii/

[20] The material on the Cape Cod program has been presented at several events, including the 2011 ACEEE Market Transformation and EER conferences. Information about the current status is also available online at the Cape Cod website: http://www.capelightcompact.org/ee/.

[21] We might also call this "generalized reciprocity," a term coined by anthropologist Marshall Sahlins (1974).

as behavior-based programs, and thus outside the scope of this study. On the other hand, initiatives originally conceived as marketing have deeper social roots than is widely understood and could easily be reformulated as true behavior programs.

MULTI-MODAL PROGRAMS

Multi-modal behavior programs combine several types of approaches in a single initiative. Going further, some utility strategies have combined tactical approaches drawn from all three families of our taxonomy; these we call stacked programs. By selecting a minimum of one type from each family, these stacked programs simultaneously affect several key aspects of behavior. As we use the term, stacked programs are not simply a fortuitous assemblage of elements; they involve a deliberate design decision to incorporate social and behavioral science insights into energy efficiency programming.

The FortisBC *Energy Efficient Laundry* campaign may qualify as a stacked program as it draws elements from all three families. The program gives away clotheslines, offers rebates for ENERGY STAR washers, and includes an educational component on the energy savings benefits of washing clothes in cold water. In addition, a June 2012 press release reads:

> To further encourage people to hang their laundry out, FortisBC PowerSense Ambassadors will be visiting neighborhoods and leaving prize packs for homes they observe to be actively using a clothesline. People can sign up to "get caught hanging out" either online or when they pick up their laundry line.[22]

While the program ended last year (after four years), Fortis BC has continued to deploy the PowerSense Ambassadors in other programs with impressive results. In 2011–2012, they ran a pilot project variation of a home energy retrofit program called *Live Smart* in the city of Rossland (Kootenay region). This pilot used the PowerSense Ambassadors to hold in-depth conversations with homeowners about their energy assessments and act as their ongoing point of contact with the utility.

Another good prototype of a stacked program is the ASE *PowerSave Schools* program. Although we originally placed it in the family Cognition, it incorporates a strong person-to-person social element by using teams of students to encourage other students, teachers, and staff to change their behavior. Students do the research and share their findings with their teachers and facility staff. *PowerSave* also integrates elements from the Calculus family in the form of incentives and competitions. In the K-12 program, many superintendents agree to give half the dollars saved by energy-use behavior changes back to the schools that saved them. The campus program features intracommunal residence hall competitions and intercommunal competitions between campuses.

FINDINGS

Utilities have run five major multi-modal behavior programs since 2008, all situated in Oregon and British Columbia. The *Live Smart* pilot project demonstrated a 22% uptake on home energy recommendations. The *Energy Efficient Laundry* program distributed over 35,000 clotheslines in

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[22] http://www.fortisbc.com/MediaCentre/NewsReleases/2012/Pages/Hang-out-and-save-with-free-laundry-line.aspx

the course of the four-year campaign at a reported cost of $450,000 or $12 (Canadian) per participant. While energy savings through clotheslines is hard to verify, the utility estimates that saving "even 25 per cent of their annual dryer loads will collectively save more than 5.2 gigawatt hours of electricity, enough to power 417 homes every year."[23] If we use its estimate, *Energy Efficient Laundry* has the potential for a CSE of 6 cents per kWh. This is 38% lower than the average retail price for energy (13.87 cents per kWh) charged by the 55 utilities for which we had EIA data.

Conclusions

Cost Effectiveness of Utility-Run Behavior Programs

Keeping in mind the qualifications regarding data availability and the uncertainty in the average life of the measures discussed throughout this paper, we are able to see some preliminary indications of the overall cost effectiveness of utility-run behavior programs.

We counted behavior programs in 104 entities, but EIA does not collect data for many of them, including regional energy efficiency organizations (REEOs) and nonprofit organizations like the Alliance to Save Energy and the Northwest Energy Efficiency Alliance, government-owned power producers and distributors like Bonneville and the Tennessee Valley Authority, and Canadian entities (for which the EIA collects data but in a different currency). The 55 utilities for which we did have EIA data charge their customers a median price of 12.47 cents per kWh.

Fifty of the 104 entities in our sample gave us cost figures for 83 individual programs (30% of the total number of programs). Over the lifetime of the programs (which can vary from a few months to multiple decades), the reporting utilities have spent a total of $355,204,597 on them, at a median cost of $565,750 per program.

Twenty-nine programs reported their program budgets along with an energy savings goal, an achieved amount, or both. Table 4 shows these figures.

Table 4. Total Program Budgets, Saving Goals, and Achieved Savings Reported

Total cost of 29 programs	Average cost per customer	Electric savings goal (MWh)	Electric savings achieved (MWh)	Gas savings goal (therms)	Gas savings achieved (therms)
$128,889,166	$3.52	921,950	1,311,125	7,650,938	378,364

Since we did not have actual savings for all of these programs, we could not calculate their cost of saved energy.[24] For 12 of these programs (10 electricity and 2 gas), we were able to acquire both actual program cost and energy savings from public sources. We confined ourselves to

[23] Puget Sound program entry for Association of Energy Professionals award in the category: Outstanding Achievement in Program Design and Implementation. Press Release.

[24] See the definition of CSE in the footnote on p. 16.

estimating the CSE of the electricity programs to avoid the complication of comparing MWh to therms.

Our estimation of CSE was complicated by the fact that there is much uncertainty as to the measure life of behavior programs. Research by Ehrhardt-Martinez and Opower (Ehrhardt-Martinez, Donnelly & Laitner 2010) indicates that energy savings often persist if the stimulus that elicits the behavior response continues, but that if the stimulus ceases, then savings decline substantially. Some behavior programs have follow-up and others do not. For this analysis, we assume that some programs have no follow-up beyond the first year and therefore a one-year measure life is appropriate, whereas other programs have follow-up and therefore a measure life of two years or more may be used. Overall, absent better data, we used a standard measure life of 1.5 years. This estimate is subject to high uncertainty; more information needs to be collected.

Table 5 shows our estimation of the CSE for the ten electricity programs.

Table 5. CSE for Ten Electricity Behavioral Programs

	Program cost	Savings achieved (MWh)	CSE (per kWh)
Total	$30,129,489	1,321,988	
Average	$3,012,949	132,199	1.61 cents

Four of the programs were *Project Porchlight* CBSM campaigns run in four different utilities. They were very cost effective, with an average CSE of 1 cent per kWh. Three programs ran on the Opower platform and averaged 8 cents per kWh. The final three electricity programs featured a grab bag of approaches, among them *PowerSave Schools*. Their scale ranged from tiny Palo Alto with 29,335 customers to AEP with 1.5 million customers. The average CSE of these 3 programs was just under 8 cents per kWh. When the bottom and top 20% are excluded from the analysis, the range for all 10 programs is 1 to 6 cents per kWh.

We conclude that although there may be less expensive routes to energy efficiency than the average behavioral program, the ten programs we were able to evaluate demonstrate that behavior programs can be cost effective. A secondary conclusion is that larger utilities appear to reap greater returns than smaller ones. If this turns out to be the case, it should be seen as a positive indicator, since concerns about scaling up have traditionally been one of the barriers to the widespread implementation of behavior programs.

RECOMMENDATIONS

We offer the following suggestions to increase the effectiveness, and cost effectiveness, of utilities' behavior-based efficiency programs. We have examined over 40 different types of behavioral programs, a diverse group that makes it possible for any utility—large investor-owned, medium-sized public service, or small rural cooperative—to include behavioral elements in its energy efficiency portfolio. But despite the vast opportunities, utilities are not maximizing their efforts in this direction.

Ironically, we have also found that many utility programs that effectively change behavior go unrecognized as behavior-based because of a lack of regulatory requirements or, conversely, barriers erected by regulations. The fact is that nearly every utility is running a behavioral program whether or not it is formally recognized as such. In practice, if Utility A is running a community-based social marketing program and reports it through a regulatory filing or a voluntary effort such as CEE's Behavior Program Summary, then Utility B, which is running a very similar program, perhaps from the same vendor, is also engaging in behavior programming even without the label. As discussed earlier, in the absence of proper labeling, managers try to develop behavior programs from scratch when they could easily convert marketing or training initiatives into full-fledged behavior programs with ongoing data collection, analysis, and reporting.

Stack

As we discussed at the end of the taxonomy section, multimodal behavior programs effectively tie together disparate activities such as communication and education efforts. Puget Sound's *Rock the Bulb* campaign, for example, saved over 118 million kWh in a three-tiered initiative to promote and educate customers about energy efficiency with a focus on lighting.

As a step beyond such multi-modal efforts, we recommend that program developers design holistic, stacked programs with a conscious eye toward engaging multiple facets of decision making and behavior, most importantly, emotions, reason, and social interaction. A stacked program might (for example) combine a home energy report with an audit program using a community-based social marketing approach. We believe that, compared to a potpourri of approaches, the judicious stacking of program types, one or more from each of the families in our taxonomy, will activate multiple complementary drivers of human behavior and thereby yield deeper, more consistent results. Our recommendation is based on social science theory on material culture (Howes 2006) as well as advertising and marketing studies of media and consumption (Pilotta & Schultz 2005).

This hypothesis will remain untested until we see more stacked programs in the marketplace. In the meantime, Fortis BC is on the right track with their *LiveSmart* campaign, which uses ambassadors from the company to inform, educate, and guide program participants through an audit process. The campaign draws on the cognitive aspects of communication and framing, the practical-rational aspect of saving money and getting free products, and social interaction with a live person. For more detail on what this specific combination might look like, see the ACEEE white paper written in collaboration with One Change Foundation, *Reaching the "High-Hanging Fruit" through Behavior Change: How Community-Based Social Marketing Puts Energy Savings within Reach* (Vigen & Mazur-Stommen 2012).

Track

More work needs to be done collecting data and analyzing programs in order to document their benefits and drive broader adoption. Therefore we strongly recommend that utilities recast programs to include ongoing data collection, analysis, and reporting. Utilities should track programs across the board. This means that programs that may not currently require tracking for regulatory purpose should still receive it for the purpose of improving energy savings through behavior interventions. We also recommend that developers:

- Understand the kinds of outcomes different program types will supply and plan accordingly
- Determine what results to track by using logic models to lay out what the programs are intended to accomplish
- Use experimental approaches to evaluate programs in order to obtain more robust data

All programs need metrics, even the ones meant to generate goodwill or broadly educate consumers about offerings. The more standardized the data from behavior-based programs, the more quickly organizations like ACEEE can issue assessments useful for making the case for their adoption to state-level regulatory agencies. Utilities should regularize data collection and reporting so that researchers and evaluators can estimate cost effectiveness more accurately. They should report both program cost and energy savings in order to compare the cost effectiveness of programs across providers. On the other hand, CSE should not be the only factor used to determine which behavior programs to implement. Some programs with a slightly higher CSE may be better at meeting percentage-of-energy-sales targets.

Many of the reports that were available to us focus on metrics that are difficult to compare, such as the number of events held or the touches achieved by personnel engaged in outreach. Media campaigns long ago standardized the art of counting impressions, or tracking responses via specific channels, and it would be an excellent start to follow best practices from other fields with more experience in sophisticated marketing programs. These are efforts that ACEEE would be willing to pursue if the need is not being met by others and if funding were available.

We also recommend the reporting of confidence intervals, net versus gross savings and costs, and, most importantly, participation rates. Recording participation across programs is critical to assessing the scalability of different program types as they develop, and, ideally, are reported longitudinally. Information about persistence of savings is also very important, especially if it has been evaluated and verified. We need better information on the average life of savings for each program category.

Despite a natural focus on energy savings, we should also be interested in the outcomes of behavioral energy efficiency programs as they relate to market effects and market transformation. Behavior programs contribute to long-term structural shifts in how people use energy and make decisions about energy consumption, shifts that are important beyond the simple kilowatts saved.

Share

The collection and reporting of data from behavior programs currently varies by state. ACEEE would like to see these results distributed via a central platform. A centralized location and more uniform presentation would make it easier for researchers to draw robust and replicable results from the larger ensuing datasets. We therefore recommend that utilities share results either through efforts such as the CEE annual behavior program summaries and public database or through a public website like the one proposed by Ingo Bensch at the Energy Center of Wisconsin (2013b). Drawing on such a central, public repository of shared information, the database that ACEEE has constructed for this study could continue to grow and become the basis for ongoing analysis.

Coordinate

Finally, we recommend that utilities coordinate their behavior program efforts with others in their region.[25] Such coordination will require some creativity and leadership on the part of progressive utilities. Energy Trust of Oregon, for example, has had success in coordinating with Puget Sound Energy in Seattle, in part due to similar customer bases and climate. Smaller organizations may want to piggy-back on the efforts of larger regional suppliers or work together with other smaller organizations. As we discuss in the section on home energy audits, scale may affect the performance and cost effectiveness of specific program types.

We also suggest that electric utilities coordinate their efforts with other local utilities such as gas and water. In Arkansas, for example, both Centerpoint Energy and Source Gas are running Opower-based home energy report programs, which means that much of the state's population is receiving these reports. Smaller electric coops in and around territories whose customers are already receiving a home energy report might want to consider complementary game-based programs such Efficiency Vermont's *Vermontivate* or the City of Palo Alto's *LED Contest*, which have a cost range of $3,000 to $75,000.

Especially as behavior programs become more popular with utilities, their geographic proximity could also lead to challenges as messaging and influence begin to overlap. A pioneering utility that invests in the first behavior program in a large geographic area does not have to worry about this problem, but issues can arise when several utilities in a relatively densely populated area all implement energy efficiency programs. For one thing, customers living in one utility's service territory might be attracted to the offerings of the neighboring territory's provider. Another possibility is that consumers living in a region where many utilities offer behavior programs could overload on energy efficiency messaging, resulting in diminished savings.

Given these concerns, a future project might use a geographic information system to map the distribution of behavior programs. Where are they concentrated? Can we predict which regions of the country might trend towards message fatigue? By considering this additional dimension of behavior program design and the other recommendations in this section, utilities could develop even more successful, cost-effective programs that help achieve to targets set by regulators, meet utility business needs, and deliver substantial energy savings.

[25] There have been some examples in this area (Opinion Dynamics 2012).

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Glossary

Cooperative utilities (COOPs): A utility that is owned by those who benefit from its service. Most electric coops were originally financed by the Rural Utilities Service (formerly the Rural Electrification Administration), which was established as a part of the New Deal in the 1930s. Coops are generally exempt from federal income tax laws.

Demand response: The reduction of customer energy usage at times of peak usage in order to help address system reliability, reflect market conditions and pricing, and support infrastructure optimization or deferral.

Dynamic pricing: A utility rate structure that is designed to change in response to overall usage in the system over the course of a day, usually with the most expensive rates occurring at times of peak usage.

Energy Information Administration (EIA): Created by the Congress in 1977, the EIA is the statistical agency of the U.S. Department of Energy and as such is the nation's premier source of unbiased energy data, analysis, and forecasting. By law, EIA's products are prepared independently of policy considerations of the current Administration. EIA neither formulates nor advocates any policy conclusions. The EIA's mission is to provide policy-neutral data, forecasts, and analyses to promote sound policymaking, efficient markets, and public understanding regarding energy and its interaction with the economy and the environment.

Evaluation, measurement, and verification (EM&V): Analysis that demonstrates the value of energy efficiency programs by providing accurate, transparent, and consistent assessments of their methods and performance.

Extrinsic value: An object that can be used or exchanged in the world has extrinsic value as a motivation to play a game. For example, a prize has extrinsic value.

Family: In biology, a taxonomic rank. In this report, we assign efficiency programs to three families: calculus, cognition, and social interaction.

Feedback: Programs that provide consumers with information about their energy consumption, through a variety of media.

Framing: The semantic construction and context of a message, for example, one that emphasizes benefits, or, conversely, emphasizes preventing a loss rather than incurring a gain. Framing can also mean the way in which the default options on a product or program are set (opt in vs. opt out). This can mean leaving a person's ability to choose undiminished, but using the context to encourage or discourage a particular choice.

Free rider: Someone who benefits from a service or program without paying for it.

Gamification: The use of game mechanics to solve problems or achieve goals by leveraging people's natural desires for competition, status, or achievement.

Holistic: For the purposes of behavior program design, a quality of a program that tackles all aspects of rational calculus, emotions, the physical aspect of habit, and the experience of being social.

Home energy audits: An assessment of a home's energy use, performed either by the homeowner following a set of instructions or by a professional energy auditing service.

Home energy report: Information and statistics about a home's energy consumption over a certain period of time. Home energy reports are often sent with customer utility bills.

Home Performance with ENERGY STAR: A national program administered by the Department of Energy that is designed to improve home energy efficiency.

Incentive: A financial enticement for an individual to make a certain investment or engage in a certain behavior.

Intrinsic value: Something intangible that creates motivation to play a game, such as pride associated with winning or enjoyment of the game itself.

Investor-owned Utilities (IOUs): Also known as private utilities, IOUs are utilities owned by investors or shareholders. IOUs can be listed on public stock exchanges.

Monophyletic: In biology, a monophyletic group contains all of the organisms that descended from a given common ancestor. Since our analysis does not consider the evolution of programs per se, a monophyletic group in this report is one that contains only the set of members that share a defined feature, or in other words, an innovation, something that distinguishes it from other sets.

Nudge: Something that "alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives. To count as a mere nudge, the intervention must be easy and cheap to avoid. Nudges are not mandates" (Thaler and Sunstein 2008).

Persistence: The amount of time that the effects of a program or intervention last.

Social norms: Local behavioral expectations. Programs that use social norms establish a norm of energy efficiency and encourage people to conform to this norm.

Split incentive: A situation in which one party is responsible for the costs of an investment or behavior change that another party benefits from. For example, in a rental building where the owner pays for utilities, tenants are less likely to make energy-saving changes because the owner would most directly benefit from the resulting lower utility bills (and the converse is also true).

Time–of-use pricing: A rate structure that employs standard differentiated prices for electricity consumed during peak and off-peak periods, which are generally consistent throughout the year. In some cases, time-of-use pricing also includes seasonal price differentiation.

Taxa (singular, taxon): A category of items in which all exhibit similar characteristics. One taxon can contain more specific taxa. For example, in biology, "vertebrates" is a taxon, as is "mammals."

Taxonomy: A form of classification that looks at empirically observable and measurable characteristics. A taxonomy can also be hierarchical (with a type-subtype structure) that a typology does not necessarily have.

Typology: A form of classification that looks at the traits or features of an artifact or phenomenon and sorts them into common categories.