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# Comprehensive Review of Behavior and Education Programs

*Cross-Cutting Research in the Areas of Behavior and Education*

**Prepared for:**
**The Massachusetts Program Administrators and the Energy Efficiency Advisory Council**

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## Executive Summary

This report provides a comprehensive review of behavior and education (K-12) programs for consideration by the Massachusetts Program Administrators (PAs) and Energy Efficiency Advisory Council (EEAC) in future program planning. The Navigant team utilized in-depth and informational interviews in addition to a thorough review of secondary literature, focusing research efforts on recent changes in the landscape of behavior and education programs. The main drivers of this study include the following:

- The PAs have extensive experience with the most common residential behavior-based program in the United States, the Home Energy Report (HER) program, but have limited experience with other behavior-based programs. Some PAs have extensive experience with education programs, though they have not yet claimed savings for these programs.
- Though HER programs have been implemented throughout the country, there are many other programs that have been tested, though certainly not at the same scale as the HER program.
- Most PAs with smaller service territories currently do not implement the HER program due to the large upfront costs and the expectation of not covering those costs due to population size limitations.
- The PAs have had little experience with small and medium commercial behavior-based programs.
- While Cape Light Compact, Eversource and Columbia Gas have engaged in K-12 energy education outreach, none of these PAs have yet claimed savings, and many of the Massachusetts' PAs have no education programs in place.

There may be an opportunity for the MA PAs to expand their portfolios of behavior-based and education programs. The objective of this research is to provide an overview of program offerings for consideration by the PAs. Table 1 identifies the specific research topics.

**Table 1. Research Topics**

| Specific Research Areas |
|---|
| **Behavior Review** |
| Recent developments in residential behavior programs, including the use of new technologies, such as smart phone applications, web portals, and Wi-Fi enabled thermostats |
| Programs implemented in small markets, including methods for addressing barriers to implementation |
| Program offerings applicable to the small and medium commercial sector |
| **Education Review** |
| Recent developments in K-12 programs, including both in-school and extra-curricular programs |
| Methods of quantifying savings associated with measures and behavioral savings, including the potential for implementing Randomized Control Trials |

### *Behavior Programs*

The review of behavior programs included (1) recent trends in residential behavior programs, (2) identifying program offerings implemented in small markets, including potential solutions to implementation barriers, and (3) small and medium commercial behavior programs. Table 2 summarizes key findings.

**Table 2. Behavior Review: Summary of Key Findings**

| Target Sector | Key Findings |
|---|---|
| Residential | There is a wide array of residential behavior-based programs that leverage various combinations of behavioral strategies. Most have not been tested at scale. |
| | Home Energy Report and Feedback programs are the most widely tested though many questions remain regarding program design and implementation. |
| | Behavioral strategies are being integrated into existing energy efficiency programs to further enhance program participation. |
| | Recent Trends:<br>- **Enhanced Customer Access and Engagement.** Programs are enhancing customer access and engagement with the use of web portals and smart phone applications.<br>- **Interaction with End-Uses.** Most recently, behavior programs are engaging customers to interact with specific end-uses, such as thermostats.<br>- **Multi-Pronged Approach.** Programs are using a multi-pronged approach, leveraging numerous behavioral strategies. |
| Small Markets | Many utilities serving small markets implement Home Energy Report programs, though several have needed to adopt strategies to improve cost-effectiveness.<br>- **Vendor Selection.** While Opower has dominated the market, there are several alternatives that may provide lower cost options, including alternate vendors and implementing behavioral programs in-house.<br>- **Partnerships.** Partnering (e.g., parent company and individual operating companies) may be able to achieve economies of scale making programs more cost-effective.<br>- **Evaluation requirements.** Consider implications for evaluation if a control group is not randomly assigned and the program can be fully deployed.<br>- **Measure life.** There is a growing body of literature supporting a measure life of more than one year. |
| | Behavioral programs identified as being particularly effective in small markets have a **high level of customer engagement** (often involving in-person/community interaction). E.g., community-based social marketing programs which rely on locally-based research to identify barriers to implementation and often use in-person interaction to reinforce positive behavior change. |

| Target Sector | Key Findings |
|---|---|
| Small and Medium Commercial | There are several classes of commercial behavioral programs. These programs typically rely on employee engagement, social interactions, competitions, feedback and benchmarking. |
| | Recent Trends:<br>- **Competitions.** Competitions may be between buildings within a geographic region or within an organization. Demonstrate savings though typically do not persist.<br>- **Workplace engagement.** Engages staff in energy-saving behaviors, typically leveraging several behavioral strategies (prompts, rewards, social norms, competition). Enhanced employee engagement may include feedback (via dashboards) and peer community involvement.<br>- **Business Energy Reports.** Similar to Home Energy Report programs but targets businesses. These programs are relatively new with limited evidence regarding whether these programs generate cost-effective savings. |

### *Education (K-12) Programs*

The review of education programs included both a review of K-12 programs, including kit-based and non-kit-based programs, as well as a review of savings calculation methodologies. Table 3 summarizes key findings.

**Table 3. Education (K-12) Review: Summary of Key Findings**

| Area | Key Findings |
|---|---|
| K-12 Programs | A diverse landscape of educational programs leverages various combinations of behavioral strategies, similar to those seen in other behavior-based programs. |
| | In addition to traditional kit-based K-12 programs, a large number of school-wide and classroom-based education programs utilize behavioral strategies to reduce student energy use at school and at home. |
| | Recent Trends:<br>- **Multi-Pronged Approach.** Many programs, including kit-based programs, are increasingly using a multi-pronged approach, leveraging numerous behavioral strategies.<br>- **Enhanced use of Feedback Technology.** Programs are increasingly using energy dashboards and web portals to provide students with meaningful energy use feedback.<br>- **Alternatives to Kit-Based Programs.** Other types of education programs, based on school-wide culture change, competition, energy feedback and other frameworks offer alternatives to kits. |

| Area | Key Findings |
|---|---|
| Savings Calculation and Randomized Control Trials (RCTs) | Most non-kit behavior-based energy efficiency programs currently employ savings calculation methodologies in line with industry current practice, rather than RCTs or regression-based methods. Many utilities are able to claim savings based on these methods. |
| | There are many examples of non-kit programs working with utilities to develop more rigorous methods for evaluating savings, including the use of RCTs. |
| | Recent Trends:<br>- **Partnership with Utilities.** Many prominent and successful K-12 education programs are developing partnerships with utilities to access better energy use feedback and to develop more rigorous savings methodologies.<br>- **Use of Advanced Metering Infrastructure (AMI) Data.** The use of smart meter AMI data is allowing programs to calculate savings using more sophisticated regression techniques in order to meet the demands of states with stringent regulatory savings calculation requirements.<br>- **RCTs and Matching Methodologies.** Some utilities are beginning to partner with education programs to run RCTs, or alternatives such as regression analysis matching methods. |

## *Considerations for Future Program Planning*

Based on the findings of this evaluation, Table 4 identifies opportunities for consideration by the PAs and EEAC in future program planning. These opportunities should be further examined to determine the cost-effective savings potential in Massachusetts.

**Table 4. Considerations for Future Program Planning**

| |
|---|
| **Behavior Programs** |
| 1. Test alternative residential behavior-based program offerings. Programs relying on web portals and smartphone applications can provide lower cost opportunities with comparable savings to the HER program. However, these programs may provide less opportunity for wide-scale implementation as not all customers have computers or smartphones. |
| 2. Consider conducting an opportunity assessment of existing program offerings to identify opportunities for employing behavioral strategies, such as commitments and framing, to further enhance program participation. Although the Home Energy Services and low-income programs already have behavioral and education components, additional integration opportunities may remain. |
| 3. Further explore opportunities for addressing barriers faced by PAs serving small markets in delivering behavior-based programs, particularly around partnership, evaluation methods and requirements for claiming savings, and assumptions regarding measure life. |
| 4. Consider testing a workplace engagement program to initiate experience with small and medium commercial behavior programs. |
| **Education Programs** |
| 5. Consider implementing kit-based education programs. Involve appropriate stakeholders in design and implementation to ensure behavioral savings can be quantified and claimed. Typically, savings are determined using TRM values for kit measures, applying measure-specific installation rates. |
| 6. Monitor the outcome of K-12 programs promoting school-wide energy-saving through culture change in similar jurisdictions with periodic, targeted reviews of key programs cited in this research. |
| 7. Consider the possibility of path-breaking, targeted research around behavior-based programs in higher education. Due to the number of college and university students per capita, Massachusetts may reap higher benefits from such efforts relative to other states. Many of the behavioral strategies and K-12 program models have application in a higher education setting. |

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# 1. Introduction

This report provides a comprehensive review of behavior and K-12 education programs for consideration by the Massachusetts Program Administrators (PA) and the Energy Efficiency Advisory Council (EEAC) in future program planning. The Navigant team utilized in-depth and informational interviews, in addition to a review of secondary literature, focusing research efforts on recent changes in the landscape of behavior and education programs.

## *1.1 Background*

The main drivers of this study include the following:

- The PAs have extensive experience with the most common residential behavior-based program, the Home Energy Report program. National Grid and Eversource Energy have been implementing this program since 2009 and currently serve more than 1.4 million households. However, the Massachusetts PA's have more limited experience with other behavior-based programs. Some PAs have extensive experience with education programs, though they have not yet claimed savings for these programs. Table 1-1 provides a summary of the PAs experience with behavior and education programs.
- Though HER programs are the most common residential behavior-based program in the United States, there are many other programs that have been tested (though generally not at scale). The PA's have some experience with feedback initiatives, offering energy usage information in near real-time, including one initiative being implemented by Cape Light Compact, since 2014. The PAs are interested in further exploring residential behavior-based program alternatives to the standard HER program, particularly behavior programs that leverage new technologies.
- With the exception of Berkshire Gas which began a program in 2014, the PAs with smaller service territories currently do not implement HER programs due to the large upfront (fixed) costs, and the fact that their customer bases often are not large enough to cover those costs. These PAs are interested in understanding opportunities to address this barrier to implementation, including alternative vendors and program offerings that can be considered.
- The PAs have had no experience with small and medium commercial behavior-based programs and as a result, are interested in seeing what is now available for commercial sector programs.
- Though some PAs have considerable experience with education programs, others have not conducted any energy efficiency outreach. As shown in Table 1-1, several PAs conduct Building Operator Certification (BOC) programs or are active in K-12 energy education outreach. Of those PAs with K-12 education program experience, none has yet claimed savings. The focus of this review is on K-12 energy education programs.[1]

[1] Navigant and Research Into Action conducted a process evaluation of the Building Operator Certification Program in 2014. *Comprehensive Review of Training and Education Programs.*

**Table 1-1. Massachusetts Program Administrators' Experience with Behavior and Education Programs**

| Program | Description |
|---|---|
| **Behavior-Based Programs** | |
| Home Energy Reports | Behavioral program implemented beginning in 2009 by National Grid and Eversource Energy East (formerly NSTAR). |
| C.A.P.E Presence Pro Energy | Behavior feedback initiative launched in 2014 by Cape Light Compact offering real-time feedback through online apps to residential and commercial customers. There is a contest for participating towns and organizations where they will earn prizes for receiving the most "who referred you?" votes. |
| C3 Energy | Piloted by Eversource Energy West (formerly Western Massachusetts Electric Company) in 2012 and 2013 offering access to an online web platform and Energy Saving Reports, in conjunction with a points-based rewards system. |
| Usage Feedback Pilot | Piloted by Cape Light Compact in 2012 offering either an in-home display with web portal or web portal with optional weekly/email reports and social networking functionality. |
| **Education Programs** | |
| Building Operator Certification | Currently sponsored by National Grid, Unitil and Cape Light Compact. |
| K-12 Energy Education | Cape Light Compact and Eversource Energy are the PAs most active in energy education outreach. For example, in 2013 Cape Light Compact conducted over 100 education-based presentations, field trips and Energy Carnivals. Columbia Gas, though less active, has partnered with Eversource Energy, Cape Light Compact and National Grid through the National Energy Education Development (NEED) project to offer teacher energy efficiency education trainings. |

## *1.2 Study Objective*

The objective of this report is to present the Massachusetts PAs with an overview of the current landscape of behavior-based and K-12 education programs for consideration in future program planning. Table 1-2 identifies the specific research topics addressed by the evaluation team.

**Table 1-2. Research Topics**

| Specific Research Areas |
|---|
| **Behavior Review** |
| Recent developments in residential behavior programs, including the use of new technologies, such as smart phone applications, web portals, and Wi-Fi enabled thermostats |
| Programs implemented in small markets, including methods for addressing barriers to implementation |
| Program offerings applicable to the small and medium commercial sector |
| **Education Review** |
| Recent developments in K-12 programs, including both in-school and extra-curricular programs |
| Methods of quantifying savings associated with measures and behavioral savings, including the potential for implementing randomized control trials (RCTs) |

## *1.3 Research Methods*

Navigant relied on interviews and a secondary literature review to conduct the review of behavior and education programs. While the work plan originally called for only a handful of in-depth interviews, and heavy reliance on a thorough literature review, Navigant found that much of the most current and ground-breaking developments have not yet been published. From this perspective, the informational interviews allowed us access to the most recent information on trends and develop a better understanding of the evolving landscape of behavior and education programs. The review of secondary literature sources complimented and enhanced our primary research findings.

As shown in Table 1-3, Navigant conducted in-depth interviews and informational interviews with over twenty thought-leaders including researchers, program administrators (PAs), program implementers, policy makers and more. In addition, the team reviewed conference proceedings, evaluation reports, whitepapers, academic research, utility website, vendor websites, regulatory filings and more to conduct the secondary literature review.

**Table 1-3. Primary and Secondary Research**

| In-Depth Interviews |
|---|
| Michael Li, Department of Energy |
| Kira Ashby, Consortium for Energy Efficiency |
| Suzan Mazur-Stommen, Indicia Consulting |
| Kate Crosby, Acton-Boxborough Regional School District |
| Scott Thach and Merrilee Harrigan, PowerSave Schools |
| Gayle Bodge and Leigh Peak, Gulf of Maine Research Institute |
| **Informational Interviews** |
| Marsha Walton, NYSERDA |
| Summer Goodwin, BPA |
| Jennifer Tabanico, Action Research |
| Jan Cook, MyMeter |
| Lindsay Bashline, Loveland |
| Lucey Lutes, Palo Alto |
| Monique Hampton, Turlock Irrigation District |
| Paola Rosselli, SDG&E |
| Adam Block, Simple Energy |
| Mickey Daniel, Georgia Power |
| Ann Price O'Neill, True Market Solutions |
| David W. Grider, Resource Action Programs |
| Debby Yerkes, Ohio Energy Project |
| Debbie Fitton, Cape Light Compact |
| Gary Swan, NEF |

The remainder of this report is organized as follows:

- Chapter 2, Behavior Programs
- Chapter 3, Education programs
- Chapter 4, Conclusion and Considerations for Future Program Planning

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# 2. Behavior Programs

This chapter contains a comprehensive review of behavior programs across the United States, with the following specific areas of focus:

1. Recent developments of residential behavior-based programs, including the use of new technologies, such as smart phone applications, web portals, and Wi-Fi enabled thermostats.
2. Approach to implementing behavior-based programs in small markets, and
3. Program offerings applicable to the small and medium commercial sector.

Table 2-1 summarizes key findings in each of these areas.

**Table 2-1. Review of Behavior-Based Programs: Summary of Key Findings**

| Target Sector | Key Findings |
|---|---|
| Residential | There is a wide array of residential behavior-based programs that leverage various combinations of behavioral strategies. Most have not been tested at scale. |
| | Home Energy Report and Feedback programs are the most widely tested though many questions remain regarding program design and implementation. |
| | Behavioral strategies are being integrated into existing energy efficiency programs to further enhance program participation. |
| | Recent Trends:<br>- **Enhanced Customer Access and Engagement.** Programs are enhancing customer access and engagement with the use of web portals and smart phone applications.<br>- **Interaction with End-Uses.** Most recently, behavior programs are engaging customers to interact with specific end-uses such as thermostats.<br>- **Multi-Pronged Approach.** Programs are using a multi-pronged approach, leveraging numerous behavioral strategies. |

| Target Sector | Key Findings |
|---|---|
| Small Markets | Many utilities serving small markets implement Home Energy Report programs, though several have needed to adopt strategies to improve cost-effectiveness.<br>- **Vendor Selection.** While Opower has dominated the market, there are several alternatives that may provide lower cost options, including alternate vendors or implementing behavioral programs in-house.<br>- **Partnerships.** Partnering (e.g., parent company and individual operating companies) may be able to achieve economies of scale making programs more cost-effective.<br>- **Evaluation requirements.** Consider implications for evaluation if a control group is not randomly assigned and the program can be fully deployed.<br>- **Measure life.** There is a growing body of literature supporting a measure life of more than one year. |
| | Behavioral programs identified as being particularly effective in small markets have a **high level of customer engagement** (often involving in-person/community interaction). E.g., community-based social marketing programs which rely on locally-based research to identify barriers to implementation and often use in-person interaction to reinforce positive behavior change. |
| Small and Medium Commercial | There are several classes of commercial behavioral programs. These programs typically rely on employee engagement, social interactions, competitions, feedback and benchmarking. |
| | Recent Trends:<br>- **Competitions.** Competitions may be between buildings within a geographic region or within an organization. Demonstrate savings though typically do not persist.<br>- **Workplace engagement.** Engages staff in energy-saving behaviors, typically leveraging several behavioral strategies (prompts, rewards, social norms, competition). Enhanced employee engagement may include feedback (via dashboards) and peer community involvement.<br>- **Business Energy Reports.** Similar to Home Energy Report programs but targets businesses. These programs are relatively new with limited evidence regarding whether these programs generate cost-effective savings. |

## *2.1 Behavioral Strategies*

There are a variety of behavioral strategies that can be employed to motivate behavior change, as presented in Table 2-2. These behavioral interventions are founded in social science research and have increasingly been leveraged to encourage energy-saving behaviors over the past decade. Behavior-based programs that rely predominantly on behavioral strategies have emerged, as well as integrating behavioral interventions into existing energy efficiency programs to further enhance program participation.

Feedback and information-based strategies are one of the most common behavioral interventions. The monthly utility bill a household receives is included in this category (though a very ineffective form of feedback). Social norms have become prominent over the past five or so years due to the wide-scale implementation of Opower's HER program which motivates energy-saving behaviors by comparing a household's energy use to their neighbors'. Commitments and competitions along with rewards and gifts are also becoming more common.

**Table 2-2. Behavioral Strategies[2]**

| Behavioral Strategies | Description |
|---|---|
| Social Norms | Activates social norm by providing a comparison of individual or firm behavior or beliefs to others actions or beliefs |
| Feedback and Information-based | Provides information on energy usage in frequent intervals (e.g., weekly, daily, real-time), costs, social or behavioral benchmarks, etc. |
| Commitment, Targets and Goal Setting | Encourages individuals or firms to commit to an action by a specific date |
| Follow-Through | Strategies to encourage follow-through with change in behavior using prompts, reminders, established plans |
| Framing | Provides information in a way that leverages biases (e.g., loss aversion, choice overload, cognitive dissonance) |
| In-Person Interactions and Social Diffusion | Emphasizes person-to-person interactions |
| Rewards or Gifts | Rewards or gifts are awarded in recognition of achievement (e.g., through competition) |

[2] Informed by taxonomies developed by:
EnerNoc Utility Solutions. (2014). *Paving the Way for a Richer Mix of Residential Behavior Programs.* Prepared for the California Investor-Owned Utilities.
American Council for an Energy-Efficient Economy. *(2013). ACEEE Field Guide to Utility-Run Behavior Programs. Report Number B132.*

## 2.2 Recent Trends in Residential Behavior-Based Programs

The evaluation team conducted interviews and a review of secondary literature to identify recent trends in residential behavior-based programs. The primary focus for this review was on the next generation of behavior-based programs (beyond Home Energy Reports) and programs that leverage technology.

In a report published by the American Council for an Energy-Efficient Economy (ACEEE), nearly 240 behavior-based programs run by over 100 utilities between 2008 and 2013 were identified (Mazur-Stommen and Farley, 2013). Similarly, the Consortium for Energy Efficiency maintains a database of behavior-based programs in which over 100 programs are identified.[3] Since 2008, the Behavior, Energy and Climate Change conference has served as the primary conference for sharing information on behavior-based programs related to energy use, climate change and sustainability with hundreds of presentations each year. Hundreds of behavior-based programs have been implemented, but few have been tested at scale.

The exception is the Home Energy Report program. The leading implementer of HER programs, Opower, has implemented programs with nearly 100 utilities in 31 of the 50 states, as well as in five other countries including Canada. There are several factors which may have contributed to the wide scale implementation of HER programs over other behavior-based programs:

- ***Implemented as a Randomized Control Trial.*** A State and Local Energy Efficiency Action Network report (2012) on behavior-based programs, widely considered the industry primer on the evaluation of behavior-based programs, identifies RCT as the "gold standard" in evaluation and recommends this method be used to achieve robust and unbiased savings estimates.[4] Beginning with the pilot program sponsored by the Sacramento Municipal Utility District, Opower designed and implemented the program as an RCT.[5] The requirement that Home Energy Reports were distributed to households randomly assigned to receive the reports, and maintaining a group of households that were randomly assigned to a control group to serve as the counterfactual, instilled confidence in the resulting savings estimates. As more and more HER programs were implemented and demonstrated savings, the question was not whether the savings were real (i.e., whether the results were internally valid) but instead whether the magnitude of savings would vary over time and for a particular service territory (i.e., whether the results were externally valid).
- ***A Single Behavioral Strategy Rooted in Social Science Literature.*** The HER program is rooted in the social science literature which identifies social norms as an important motivator of behavior.[6] Opower's strategy of comparing energy use to neighbors is informed by research conducted by

[3] http://library.cee1.org/content/2014-cee-behavior-program-summary-public-version/

[4] State and Local Energy Efficiency Action Network. (2012). *Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations.* Prepared by A. Todd, E. Stuart, S. Schiller, and C. Goldman, Lawrence Berkeley National Laboratory.

[5] Summit Blue Consulting. (2009). *Impact Evaluation of Opower SMUD Pilot Study*.

[6] "Social norms" refers to being influenced by the actions or beliefs of peers or respected individuals.

Dr. Robert Cialdini's, professor emeritus of Psychology and Marketing at Arizona State University and an advisor to Opower in optimizing the messaging in HERs to maximize savings.[7] Relying on the social normative comparison as the defining attribute of HERs allowed Opower to draw on the body of literature and deliver a clear and concise message. Further, the ability to attribute savings to a behavioral strategy that could easily be replicated from one jurisdiction to the next reduced uncertainty for PAs facilitating widespread adoption of the HER program.

- ***Low Cost***. For medium to large utilities, HER programs offered a relatively low cost and easy approach to energy savings (though start-up costs can be substantial). Large scale programs could be implemented and achieve 1-2% savings on average across treatment customers simply by mailing out a paper report.

Though the HER program is the most widely implemented and tested behavior program, many questions still remain given that the program has only been implemented for the past seven years. For example, it remains unclear how long savings continue to increase, whether savings plateau or decay (and at what rate), and whether savings persist if reports are suspended. Other questions that have been studied though not on a wide scale surround the actions taken that lead to observed savings and what impact differences in the reports themselves (e.g., frequency, delivery channel, content) have on savings. As HER programs evolve to provide more information/feedback in different forms and incorporate other behavioral strategies (such as rewards and goal setting), it will be important to design programs so strategies can be evaluated both as standalone strategies and in combination.

Feedback programs, which provide information on energy usage in frequent intervals (e.g., weekly, daily, real-time), are the second most widely studied behavior-based program. ACEEE conducted one of the most comprehensive meta-reviews of feedback programs to date, gathering information from 57 studies (including journal article, research papers and program evaluation reports) and nine countries over 40 years.[8] This research found savings ranging from 4% to 12% with savings increasing with the frequency and type of feedback (indirect versus direct). Maximum savings were attributed to feedback programs that provide real-time information specific to end-uses.

Recognizing feedback as a promising strategy for energy conservation, more than 200 feedback technologies have emerged in recent years. These vary from plug-load monitors, end-use-specific displays, to in-home displays (IHDs). IHDs have been a dominant form of feedback technology, but as the popularity and availability of data received on smartphones and tablets have increased in the past few years, the market for IHDs has softened. A recent report by Navigant Research predicts minimal worldwide growth for IHD shipments due to customers using their existing devices to receive similar

[7] For example, Cialdini, R. and W. Schultz. (2004). *Understanding and Motivating Energy Conservation via Social Norms.* Grant from the William and Flora Hewlett Foundation.

[8] Ehrhardt-Martinez, K., Donnelly, K. and S. Laitner. (2010). *Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities.* Prepared by the American Council for an Energy-Efficient Economy. Report Number E105.

energy consumption data.[9] Feedback technologies accessed through existing devices enhance customer engagement, allows for integration of other behavioral strategies, and connects to external sites (e.g., social networking sites, retail chains for redeeming rewards).

While feedback programs have demonstrated larger savings than other behavior-based programs, there are several limitations.

- Feedback technologies each have a different design, limiting the ability to test which characteristics are most effective in motivating behavior change.[10]
- Feedback technologies which require hardware increase program implementation costs.

**Enhanced Customer Access (and Engagement)**

The market for home energy management (HEM) products and services, and programs supporting these products and services, is gaining momentum. There is a growing awareness among customers that new tools are available to help them better manage and control their energy consumption.[11] Movement in the market, such as Google's acquisition of Nest Labs in 2014, have made headlines and raised customer awareness. Even one of the 2015 Super Bowl advertisements showcased a home energy management system, Wink.

There is a wide range of technologies and services that make up the HEM market, moving from paper bills to a networked HEM.[12]

- Paper Bills provide customers with information on energy consumption along with energy efficiency and conservation tips. The leading provider in this segment is Opower.
- Web Portals are similar to paper bills but accessed online and can support additional functionality, such as connecting to external sites (particularly social networking sites). As smartphones have become ubiquitous, behavior-based programs are increasingly relying on the use of customer's existing devices to deliver programs. Not only does this platform allow for a higher level of customer engagement, implementation costs are lower due it being a non-hardware-based HEM solution. Opower, Aclara, C3 Energy, Bidgely, and Silver Spring Networks are examples of providers in this segment.
- Standalone HEMs offer device-level tracking and automated device control capabilities. Smart thermostats are included in this category. Nest Labs and Honeywell compete in this segment.
- IHDs offer meter-based consumption and bill-to-date information on a standalone screen. Some IHDs deliver end-use-specific information. Providers in this category include EnergyHub and Aztech Associates.

[9] Navigant Research. (2014). *Home Energy Management*.
[10] Karlin, B., Ford, R. and C. Squiers. "Energy feedback technology: a review and taxonomy of products and platforms." *Energy Efficiency* (2014) 7:377-399.
[11] Navigant Research. (2014). *Home Energy Management*.
[12] Ibid.

- Networked HEM is the most integrated category of home energy management, combining a home area network with automation control capabilities.

Non-hardware-based HEM solutions (e.g., paper bills and web portals) have historically leveraged additional behavioral strategies, such as social norms, competitions, rewards, etc. However, in recent years hardware-based solutions have also begun incorporating behavioral strategies beyond feedback. For example, the Nest thermostat awards a green leaf (reward and goal setting) for making an energy-saving adjustment to the thermostat setting. Households can see how many leafs they have won and how they compare to other Nest users (social norm). As another example, Honeywell and Opower entered a partnership using social norms to influence behavior change as a demand response strategy, primarily targeting HVAC.

**Multi-Pronged Approach**

Perhaps the most notable change among behavior-based programs is the increasing use of multiple strategies. Behavior-based programs no longer rely on just feedback, social normative comparisons, commitments or competitions, but increasingly use a combination of strategies to encourage behavior change. The majority of behavior programs currently being implemented use a multi-pronged approach.

Multi-pronged approaches can be more effective than a single strategy, if the target audience faces several barriers to behavior change. For example, commitments are most effective if the target audience already believes the change in behavior is worthwhile but has failed to act, whereas norms are more effective if the target audience does not yet believe it is important to act. Using both strategies may be effective if the target audience faces both a lack of knowledge and lack motivation.

Dr. McKenzie-Mohr, founder of community-based social marketing, recommends using one strategy to address several barriers rather than multiple strategies, as the use of multiple behavioral interventions may be no more effective in motivating behavior change, but will increases program implementation costs.[13] It appears that some behavior-based programs are being designed with a "kitchen sink" approach, rather than conducting targeted research and developing program logic models to appropriately identify barriers, and then developing behavioral interventions to mitigate those barriers.

Another potential limitation of behavior-based programs that leverage multiple strategies is the inability to identify the effect of any one strategy. Program design and implementation should be design with the evaluation of both single and stacked strategies.

**Integrating Behavioral Strategies into Existing Programs**

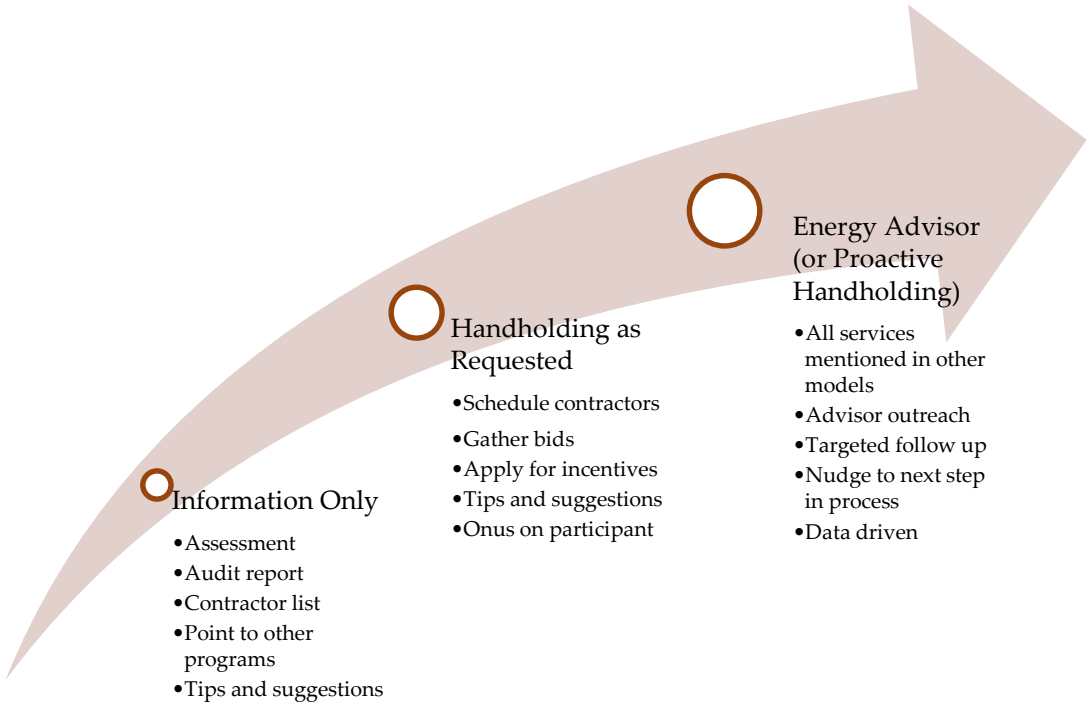
In addition to programs that primarily rely on behavioral strategies to motivate energy-saving behaviors, some energy efficiency programs are leveraging behavioral insights to further enhance

[13] McKenzie-Mohr, D. (2001) Fostering Sustainable Behavior. An Introduction to Community-Based Social Marketing. New Society Publishers. Gabriola Island, BC, Canada.

participation. The most common example is an audit and weatherization program. Figure 2-2 illustrates the spectrum of service models, starting with a program that provides information-only to the Energy Advisor model with a high level of customer engagement. Behavioral strategies employed in this model include in-person interaction, in which a single person is assigned as energy advisor and assists the customer through the entire retrofit process. The advisor frames the information in a way that is easy to understand and motivating (e.g., framing retrofits in the context of avoiding a loss rather than making a gain). Often these programs will ask customers to commit to taking an action within a specific time period, and follow up with customers to ensure they follow through with their established plan.

In addition to using behavioral strategies to target the participant, there may be opportunities to incorporate various strategies targeted at trade allies or contractors. For example, competitions, goal setting, rewards, commitments, or benchmarking can be effective strategies for engaging trade allies resulting in an increase in program participation (and savings).

**Figure 2-2. Audit & Weatherization Service Model**




### 2.2.1 Residential Program Profiles

In this section Navigant presents profiles of residential behavior-based programs, representative of recent trends identified in the preceding section.

| Program Name | Simple Energy |
|---|---|
| Implementer | Simple Energy |
| Website | http://simpleenergy.com/ |
| Interview | Adam Block (Simple Energy) and Paola Rosselli (San Diego Gas & Electric) |
| Savings | For largest utility customer to date, over 200,000 participants, used regression matching method, estimated 4.5% average annual savings. Savings accounted for 35% of the utility's annual residential portfolio savings* |
| Key Program Components | • *Use of multiple behavioral levers.* Program leverages feedback, social norming, gamification, competition and rewards.<br>• *Frequent and multi-modal messaging.* 1/3 of messaging paper—sent out monthly, 2/3 of messaging digital—sent out more frequently, has bigger impact on behavior.<br>• *Feedback messaging, competition and rewards.* Participants receive similar energy use feedback messaging to Opower HERs, but most messaging is digital, and involves interaction with online energy dashboards. Dashboard includes "Leaderboards" to encourage competition and leverage gamification, and participants receive points and rewards for energy use reductions.<br>• *Success driven by small, highly engaged customer segment.* Program has found that a subset of customers interact with the program more than twice a month, and these customers drive a large portion of savings.<br>• *Program learns and adapts to increase participant engagement.* Participant interaction with website, opening of digital messages, clicking on links, all recorded and analyzed, to allow program to adapt and better tailor its strategies to the participant, thereby increasing participation in a positive feedback loop.<br>• *Smart meter data critical.* Program relies heavily on smart meter 15-minute interval data. |
| Status | Simple Energy is currently implementing programs for California's investor-owned utilities (IOUs), National Grid, and other utilities around the country. |

**Savings calculated by independent third-party contractor, Brattle Group, but report not yet publically available.*

| Program Name | Home and Business Area Network Pilot Program |
|---|---|
| Implementer | Bidgely |
| Implementation Region | California (PG&E) |
| Website | http://www.pge.com/en/myhome/saveenergymoney/savingstips/han/hanpilot.page |
| Savings | 7.7%* (based on pilot program with 850 customers enrolled; participants recruited from SmartRate and Time-of-Use subscribers) |
| Key Program Components | • *Use of multiple behavioral levers.* Feedback, social norms, goal setting.<br>• *Energy end-use disaggregation.* Disaggregation technology allows the program to provide participants with appliance-level usage information.<br>• *Personalization of messaging.*<br>• *Neighborhood comparison and social sharing.* Program platform allows participants to compare their own energy use to their neighbors and community to leverage competition and social norming. It also facilitates sharing results on Facebook and other social media to build community and allow participants to share achievements.<br>• *Thermostat control.* Allows users to remotely control thermostat and other end-uses connected to the home area network.<br>• *Smartphone Application and Web portal.* The program relies on customer's existing devices to deliver the program (via the web or smartphone application). |

**Savings calculated by independent third-party contractor, but report not yet publicly available.*

| Program Name | Xcel Energy In-Home Smart Device Pilot |
|---|---|
| Implementer | Xcel Energy |
| Implementation Region | Colorado |
| Savings | 3% savings in average annual energy use (evaluated by an independent third-party contractor)[14] |
| Key Program Components | • *In-Home Smart Devices.* Participating customers received an EnergyHub Home Base (in-home display with smart controller), Wireless Thermostat, Appliance Sockets, and Wireless CT sensor.<br>• *Tested Various Demand Control Strategies and Energy Consumption Information.* The pilot implemented a split design to test savings from demand response events.<br>• *Does not rely on AMI.* Hardware was cost prohibitive in the pilot design, but advances in metering technologies, cost-sharing opportunities, and modifications to program implementation suggest potential for designing a cost-effective program. |

| Program Name | CUB Energy Saver |
|---|---|
| Implementer | C3 Energy |
| Implementation Region | Illinois (Citizens Utility Board and Commonwealth Edison) |
| Website | https://www.cubenergysaver.com/ |
| Savings | • 2% savings per participant during the sixth program year (evaluated by an independent third-party contractor)[15]<br>• 4.4% per participant during the first program year [16] |
| Key Program Components | • *Web-based opt-in program.* Implemented strictly by web and email.<br>• *Feedback and Information.* The program provides feedback about energy usage, tips on how to reduce energy consumption.<br>• *Rewards.* The program offers rewards points for saving energy that can be redeemed at local retailers. |

[14] EnerNoc Utility Solutions. (2014). *In-Home Smart Devices Pilot Program. Impact Evaluation Results 2012-2013.*
[15] Navigant. (2015). *C3-CUB Energy Saver Program PY6 Evaluation Report.*
[16] During the fifth program year, Navigant estimated savings of 3.4%. The near 50 percent decline in savings between program years five and six is likely attributed to a declining use of the portal. The program had its lowest annual increase in enrollment since inception, likely contributing to the decline in savings.

| Program Name | Power Smart |
|---|---|
| Implementer | BC Hydro |
| Implementation Region | British Columbia |
| Website | https://www.bchydro.com/powersmart/residential/team-power-smart.html |
| Savings | • 78,955 participants saving an average of 55.3 kWh per participant (2012)<br>• 61,905 participants saving an average of 109.1 kWh per participant (2011)<br>• These kWh savings numbers translate to an approximate average annual household savings of 0.5% and 1.0% by 2011 and 2012 participants respectively[17]<br>• Evaluation conducted by BC Hydro, relied on quasi-experimental design |
| Key Program Components | • *Goal setting and Rewards.* Offers a cash reward for committing to reduce energy savings by 10%, and achieving the goal.<br>• *Web portal.* Online portal allows participants to monitor energy use and compare with similar households<br>• *Monthly competitions.* Monthly competitions encourage participants to continue reducing |

[17] BC Hydro reported savings results for the program in terms of kWh saved per participant household and the number of participant households per year. These savings results were reported in BC Hydro's "Demand Side Management Milestone Evaluation, Summary Report F2013." In order to calculate percent annual savings per household, Navigant consulted BC Hydro's "Electric Load Forecast, Fiscal 2013 to Fiscal 2033," published in 2013, and available at: https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/regulatory-planning-documents/integrated-resource-plans/current-plan/2012-electric-load-forecast-report.pdf. Navigant used the actual number of residential customers and their total annual consumption for 2011 and 2012 to calculate program savings as a percentage of average annual household use (kWh) by BC Hydro residential customers in 2011 and 2012. BC Hydro had 1.67 million residential customers in both years, and total residential consumption for both years was approximately 18,000 GWh.

| Program Name | Community Energy Challenge |
|---|---|
| Implementer | Puget Sound Energy |
| Website | http://sustainableconnections.org/energy/energychallenge |
| Key Program Components | • *Energy advisor.* Customers who sign up receive an energy audit and an energy advisor helps them choose cost-effective energy savings projects and find a contractor to complete the work.<br>• *Third-party assessment of quality.* Every project is reviewed for quality assurance.<br>• *Incentives for project completion.* Community Energy Challenge offers access to incentives, rebates and financing for energy efficiency home improvements.<br>• *Business support.* The program also provides similar and enhanced program access for businesses. |

| Program Name | EnergySmart |
|---|---|
| Implementer | Boulder County |
| Website | http://www.energysmartyes.com |
| Key Program Components | • *Energy advisor.* Customers who sign up receive an energy audit and an energy advisor helps them choose cost-effective energy savings projects and find a contractor to complete the work.<br>• *Third-party assessment of quality.* Every project is reviewed for quality assurance.<br>• *Incentives for project completion.* Community Energy Challenge offers access to incentives, rebates and financing for energy efficiency home improvements.<br>• *Business support.* The program also provides similar and enhanced program access for businesses. |

| Program Name | Vermont Home Energy Challenge |
|---|---|
| Implementer | Efficiency Vermont |
| Website | www.efficiencyvermont.com/for_our_partners/community_partners/residential |
| Savings | Communities involved in the Vermont Home Energy Challenge make up only 50% of Vermont's population, but account for nearly 70% of the state's Energy Star projects.[18] |
| Key Program Components | • *Use of multiple behavioral levers.* The program leverages several behavioral strategies including feedback, goal setting, commitments, in-person interaction, social diffusion, and rewards.<br>• *Town-based competition for cash rewards.* Towns compete with each other by forming committees that encourage residents to save energy. Winners receive funding for energy-related projects or events.<br>• *Concrete energy savings goals.* Each town has a goal of getting 3% of homes weatherized.<br>• *Commitment:* Residents commit to energy efficiency investments by submitting a "pledge card."<br>• *Channeling into energy efficiency (EE) programs.* Weatherization is completed through participation in Efficiency Vermont's Home Performance with Energy Star Program or Vermont Gas Systems' Retrofits Program. |

## *2.3 Behavior-Based Programs Implemented in Small Markets*

Most of the PAs in Massachusetts serving smaller markets have not implemented the HER program due to large start-up costs and the expectation of not covering those costs due to population size limitations. Navigant explored this issue during interviews and in conducting the review of secondary literature, identifying several strategies that have been considered or implemented in an effort to improve the cost-effectiveness of behavior-based programs implemented in small markets.

1. **Vendor Selection.** While Opower has dominated the market as a provider of behavior-based programs, there are several alternative vendors that can provide lower cost options. Examples of third-party vendors include Tendril, C3 Energy, Aclara, Direct Options, Accelerated Innovations, and Simple Energy. In addition, some utilities have developed behavior-based programs in-house offering another alternative to what is currently available in the market. For example, Salt River Project's Home Energy Scorecard is similar to Opower's Home Energy Report program providing energy saving tips and energy comparisons via paper and email reports. DTE Energy's Insight App provides near real-time feedback via a smartphone application. The Insight App has demonstrated savings of approximately one percent during the first ten months of the pilot program.[19]

[18]http://www.efficiencyvermont.com/docs/about_efficiency_vermont/whitepapers/VHEC_FINAL_Report_3_27_2014.pdf

[19] Validated by third-party evaluation.

2. **Partnerships.** Partnering (e.g., parent company and individual operating companies) may allow for economies of scale making programs more cost-effective. Partnerships may take the form of sponsorships or through bundling programs (e.g., connecting to billing systems common to several partner utilities).

3. **Evaluation requirements.** To achieve greater savings, many utilities have begun reducing the size of the control group relative to the treatment group (including National Grid). Utilities should engage independent evaluators to determine appropriate sample sizes that meet evaluation requirements. In addition to modifying the ratio of treatment to control customers, some municipal utilities have moved away from designing behavior-based programs, particularly HERs, as an RCT and eliminate the control group altogether. For example, the City of Palo Alto and Fort Collins Municipal Utility initially implemented the program as an RCT to evaluate savings, then eliminated the control group to fully deploy the program. The City of Palo Alto claims savings based on the evaluation results from the first year.

   An energy efficiency program designed as an RCT was not commonplace prior to the HER program. Quasi-experimental methods of evaluation, in which a control group is identified to establish a counterfactual, can produce unbiased savings estimates and are a viable evaluation method for behavior-based programs, particularly if the program is not expected to serve all eligible customers. Small markets considering the implications of full deployment should develop program implementation design with relevant stakeholders, including evaluators.

4. **Measure life.** There is a growing body of literature supporting behavioral measures having a measure life of more than one. For example, a recent whitepaper proposes a measure life of five years assuming 20% savings-decay each year after HERs have been suspended, citing third-party research demonstrating the persistence of savings.[20] Additional research suggests that HER programs lead to the installation of (incented and unincented) energy efficiency equipment and habitual behavior changes providing further evidence for persistent savings. However, the literature suggests persistence varies significantly with program maturity (e.g., one program which suspended reports after just six months found 83% of savings dissipate in the following five months whereas another program showed persistent savings three years after reports were suspended even though the program was only implemented for two years).[21] There is currently not enough evidence to support an extension of the measure life in Massachusetts. Additional persistence research is warranted in which reports are suspended for cohorts of varying program maturity.
   Utilities are increasingly considering the implications for assuming a measure life of greater than one and recognize the value of research on persistence in this context. Several utilities have suspended reports for a segment of their program to explore this issue further within their own jurisdictions

[20] The Cadmus Group. (2014). *Long-Run Savings and Cost-Effectiveness of Home Energy Report Programs.* Allcott and Rogers (2014), DNV-GL (2014), NMR Group, Tetra Tech and Allcott (2013), and Integral Analytics (2012).
[21] Integral Analytics (2012). *Impact & Persistence Evaluation report: Sacramento Municipal Utility District Home Energy Report Program.* DNV-GL (2014). *Home Energy Report Program: 2013 Impact Evaluation.* Prepare for Puget Sound Energy.

(e.g., Washington, Connecticut, California, Michigan, and Illinois).[22] To Navigant's knowledge, only Avista Utilities and Puget Sound Energy have proposed a measure life of greater than one year.[23] A final ruling has not yet been made.

5. **Program Delivery.** During the interviews, the behavior-based programs that were identified as being particularly effective in small markets are programs with a high level of customer engagement, often involving in-person and/or community interaction. For example, community-based social marketing programs that rely on locally-based research to identify barriers to implementation and use in-person interaction to reinforce positive behavior change were cited as being particularly effective in small markets.

### 2.3.1 **Small Market Program Profiles**

In this section Navigant presents profiles of select residential behavior-based programs, representative of programs implemented in small markets.

[22] Cadmus (2014/2015), *Long Run Savings and Cost-Effectiveness of Home Energy Report Programs,* by Khawaja, M. and Stewart, J., cites a number of studies on HER savings persistence involving several states and regions including Connecticut, California, Washington, Michigan and Illinois. This report is available at: http://www.cadmusgroup.com/wp-content/uploads/2014/11/Cadmus_Home_Energy_Reports_Winter2014.pdf

[23] http://www.utc.wa.gov/_layouts/CasesPublicWebsite/GetDocument.ashx?docID=42&year=2013&docketNumber=132045

| Program Name | MyMeter |
|---|---|
| Implementer | Accelerated Innovations |
| Implementation Region | 30 utilities in 15 states and two countries; mostly MN, AL, CO, TX, HI – most small markets. |
| Websites | http://mymeter.co/ |
| Interview | Jan Cook, MyMeter |
| Savings | • 1.8% to 2.8%(evaluated by an independent third-party contractor)[24]<br>• Higher savings among high energy users<br>• Higher savings with higher levels of engagement |
| Key Program Components | • *Multiple behavioral strategies.* The program leverages feedback, social norms, benchmarking, goal setting, contests and challenges. The program integrates external social networking sites.<br>• *Offers pricing and demand response options.* In addition to energy conservation, the platform offers bill pay features, pricing and demand response capabilities.<br>• *Data visualization and platform*. The program offers interactive charts of energy usage accessed online, by tablet or smartphone.<br>• *Low Cost.* Average of $0.02 to $0.03 per kWh saved.[25] |
| Status | Beginning to develop applications for the commercial sector. |

[24] Illume Advising. (2014). *MyMeter Multi-Utility Impact Findings.*

[25] Average cost per kWh saved is inclusive of start-up and equipment costs.

| Program Name | Project Porch light |
|---|---|
| Implementer | One Change |
| Implementation Regions | New Jersey, Puget Sound, Vermont, Alberta, British Columbia, Ontario, Saskatchewan, Yukon Territory |
| Websites | http://www.onechange.org/<br>http://www.projectporchlight.com |
| Savings | • 275,000 compact fluorescent lamps (CFLs) distributed by 1,100 volunteers in 2009 (Puget Sound Energy)<br>• 30,000 CFLs distributed by 400 volunteers in 2008 (Burlington Electric Department and the Vermont Energy Investment Cooperation) |
| Key Program Components | • *Community volunteers.* Mobilizes community volunteers to encourage residents to switch out incandescent lamps for CFLs (provided for free).<br>• *Focus on one, simple change.* The program is designed around the theory that one simple change can be the catalyst for future energy savings behaviors and actions (often referred to as the "foot-in-the-door" technique).<br>• *Low Cost.* Average cost of $0.01 per kWh saved.[26] |

## *2.4 Small and Medium Commercial Behavior-Based Programs*

Across the United States there is considerably less experience with small and medium commercial behavior-based programs compared to residential behavior-based programs. This is likely due to the fact that the residential sector is larger and more homogenous, providing a greater opportunity to test behavioral strategies. Nevertheless, there are several classes of commercial behavior-based programs that have emerged.[27]

**Competitions.** These programs rely on gamification (or the use of game design) to encourage energy conservation. The competition itself may be the primary behavioral strategy employed, or it may be paired with other behavior interventions such as feedback, goal setting, rewards, norms, etc. Competitions are typically short-lived and while they demonstrate savings, it is not clear whether these savings persist.[28] Competitions were most common in the education setting between college dormitories,

[26] American Council for an Energy-Efficient Economy. (2013). *ACEEE Field Guide to Utility-Run Behavior Programs.* Prepared by the American Council for an Energy-Efficient Economy. Report Number B132. Average cost is inclusive of bulbs, labor and other costs.

[27] In addition to the program-types identified in this section, training programs are also a behavior-based program providing information through in-person interaction, encouraging follow through, and often involving commitments or goal setting. A review of training programs is provided in the "Comprehensive Review of Non-Residential Training and Education Programs, with a Focus on Building Operator Certification" prepared by Navigant and Research Into Action, 2015.

[28] American Council for an Energy-Efficient Economy. (2015). *Gamified Energy Efficiency Programs.* Report Number B1501.

campus buildings, or campuses – and have expanded to residential and commercial settings, and even cities. In the commercial setting, competitions are typically between buildings within a geographic region (e.g., buildings on a city block or buildings on opposite sides of the street) or between geographic locations within an organization.

**Workplace Engagement.** These programs work to engage small and medium commercial businesses in energy-saving actions by offering feedback on energy usage as well as targeted and tailored energy-saving tips. Similar to residential behavior-based programs, engagement programs are increasingly using multiple behavioral strategies to engage businesses; feedback using dashboard displays, goal setting, competitions, rewards, social norms, prompts, and peer community involvement are all common. Engagement programs may be targeted at occupants (employees), facility managers, owners, or all of the above.

**Business Energy Reports.** Several utilities are piloting the Business Energy Report (BER) which is essentially the HER for businesses. The report provides a comparison of energy use to similar businesses, along with customized recommendations for saving energy.[29] EnerNoc Utility Solutions is the leading implementer of this program. Several utilities are piloting this program. To date the results have been mixed with some reporting no observable savings while others reporting savings reaching one percent within the first year.

[29] Businesses are compared to other businesses within the same industry/business type.

### 2.4.1 **Small and Medium Commercial Program Profiles**

In this section Navigant presents profiles of small and medium commercial behavior-based programs, representative of programs identified in the preceding section.

| Program Name | Starbucks Coffee Competition Pilot Program |
|---|---|
| Service Territory | Snohomish County, WA |
| Sponsors | Snohomish County Public Utility District, Puget Sound Energy, Portland Energy Conservation Inc., Bonneville Power Authority, Lucid |
| Savings | 2% (evaluated by an independent third-party contractor)[30] |
| Key Program Components | • *Competition.* Ten Starbucks Coffee stores competed over a four-week period to reduce energy use in a pilot program.<br>• *Feedback.* Real-time feedback provided via in-store dashboards. Dashboards were designed to provide two-way communications, providing savings tips and accepting feedback and suggestions. Dashboards remained in stores for four months following the competition.<br>• *Information.* Energy-saving tips and energy education were provided through collateral and the dashboard.<br>• *Employee Engagement.* Encourages employee engagement, assigning an in-store energy efficiency champion.<br>• *Key components for program success.* Supportive management, a strong in-store program leader, and active communication within teams were found to be critical elements of program success.<br>• *Short term focus on competition detracts from persistence.* A key program finding was that the focus on short, four-week competition period detracted from longer-term program results and persistence. |
| Status | Expansion of the competition beyond this initial pilot is being explored. |

[30] The Cadmus Group. (2013). *Behavior Based Energy Efficiency Pilot Evaluation.*

| Program Name | Smart Energy in Offices |
|---|---|
| Website | http://smartenergyinoffices.com/ |
| Service Territory | Duke Energy Carolinas |
| Savings | 6.2% (three-year pilot program implemented in Charlotte, North Carolina named "Smart Energy Now" evaluated by an independent third-party contractor)[31] |
| Key Program Components | • *Engagement.* Engages individuals, companies and buildings to reduce energy use with a dedicated Engagement Manager and online platform.<br>• *Feedback and Benchmarking.* Provides real-time energy use, load factors and historic trends.<br>• *Goal Setting*. Work with Engagement Manager to set goals and establish priorities through an Energy Action Plan.<br>• *Follow-Through.* Initiate campaigns, games, competitions. Create opportunity for building engineers to enhance operations and share with peer community.<br>• *Rewards.* Provides recognition within the building as well as within the community. |
| Status | Commercialized in 2014, proposed expansion to other states. |

| Program Name | Workplace Conservation Awareness |
|---|---|
| Website | https://www.bchydro.com/powersmart/business/programs/workplace-conservation.html?WT.mc_id=rd_oldworkplaceconservationawareness |
| Implementer | BC Hydro |
| Implementation Region | British Columbia (30 large customers representing approximately 300 sites across six building types, including higher education and K-12) |
| Savings | 1% to 3% (evaluated by an independent third-party contractor)[32] |
| Key Program Components | • *Utility-assigned consultant.* BC Hydro assigns a consultant to participating businesses to develop a plan, implement the plan, and report on efforts.<br>• *In-person interaction.* Program requires buy-in from senior management and identification of an energy champion to encourage energy-saving behavior change (e.g., turning off lights, use of natural lighting, turning off office equipment when not in use). |

[31] TecMarket Works. (2014). *Impact Evaluation of the Smart Energy Now Program (NC) (Pilot).*

[32] The Cadmus Group. (2013). *BC Hydro PowerSmart Workplace Conservation Awareness Initiative Evaluation.*

| Program Name | Sustainability Circles |
|---|---|
| Implementer | REV (formerly True Market Solutions) |
| Website | http://revsustainability.com/sustainability-circles/ |
| Service Territory | California |
| Savings | 5-year average savings per business of 1.4 million kWh. Does not report validation of savings by external party. |
| Key Program Components | • *Expert coaching and peer feedback.* Small group in-person repeated interactions create peer communities where feedback and best practices guide program development by participants.<br>• *Development of a "Sustainability Plan."* End product of 6 week course—each participant/group of participants creates a sustainability plan for their business, school or school district.<br>• *K-12 schools component*. Sustainability Circles recently began working with California school districts and utilities to optimize school energy use.<br>• *Utilities directly engaged in program*. Utilities have representatives participate directly in each circle to facilitate claiming of savings by the utility. |

| Program Name | PG&E Business Energy Report Pilot Program |
|---|---|
| Implementer | EnerNoc |
| Implementation Region | California (PG&E) |
| Website | http://www.pge.com/en/mybusiness/save/ber/index.page?WT.mc_id=Vanity_ber |
| Savings | Directional savings of 0.3% electric (not significant)* (23 business sectors; 15,000 treatment and control business customers) |
| Key Program Components | • *Multiple behavioral strategies employed.* Similar to HER programs, the BER program leverages social norms, historic comparisons, and energy-saving tips.<br>• *Data analytics*. Data analytics is used to draw comparisons between businesses with common attributes based on building data, operating hours, energy use, energy rates, weather data, and customer feedback.<br>• *RCT.* The program is implemented as an RCT, the preferred design and implementation for evaluating behavior-based programs. |

**Savings calculated by independent third-party contractor, but report not yet publically available.*

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## 3. Education (K-12) Programs

The Massachusetts PAs have some experience with K-12 energy efficiency education programs, though none have yet claimed savings. Cape Light Compact has the most extensive experience, including outreach through presentations, field trips and Energy Carnivals. Cape Light Compact has reached over 6,000 students and teachers through its all-school Energy Carnivals, engaging students in Science, Technology, Engineering and Math (STEM) and standards-based energy lessons in an exciting and hands-on environment. In addition to special events, this PA designs state standards and STEM-aligned curricular materials on energy and energy efficiency, and trains teachers through a graduate level standards-based course in teaching about energy in K-12 classrooms. Other MA PAs, particularly Eversource Energy conduct energy efficiency education outreach as well. While Eversource Energy has implemented education programs similar to those offered by Cape Light Compact, Columbia Gas has more limited experience. Columbia Gas has participated in education outreach by partnering with Eversource for teacher trainings. Many MA PAs have not yet begun to offer K-12 energy efficiency programs or conduct education outreach activities.

The Navigant team conducted a review of K-12 education programs to identify education programs and offerings for consideration by the PAs. Specific research areas within education included:

1. A review of recent developments in K-12 programs, including both in-school and extra-curricular programs
2. Identification of methods for quantifying savings associated with measures and behavioral savings, including potential for implementing Randomized Control Trials (RCTs)

Table 3-1 summarizes key findings in each of these areas.

**Table 3-1. Review of Education Programs: Summary of Key Findings**

| Area | Key Findings |
|---|---|
| K-12 Programs | A diverse landscape of educational programs leverages various combinations of behavioral strategies, similar to those seen in other behavior-based programs. |
| | Recent Trends:<br>- **Multi-Pronged Approach.** Many programs, including kit-based programs, are increasingly using a multi-pronged approach, leveraging numerous behavioral strategies.<br>- **Enhanced use of Feedback Technology.** Programs are increasingly using energy dashboards and web portals to provide students with meaningful energy use feedback.<br>- **Alternatives to Kit-Based Programs.** Other types of education programs, based on school-wide culture change, competition, energy feedback and other frameworks offer alternatives to kits. |
| Savings Calculation and Randomized Control Trials (RCTs) | Most non-kit behavior-based energy efficiency programs currently employ savings calculation methodologies in line with industry current practice, rather than RCTs or regression-based methods. Many utilities are able to claim savings based on these methods. |
| | There are many examples of non-kit programs working with utilities to develop more rigorous methods for evaluating savings, including the use of RCTs. |
| | Recent Trends:<br>- **Partnership with Utilities.** Many prominent and successful K-12 education programs are developing partnerships with utilities to access better energy use feedback and to develop more rigorous savings methodologies.<br>- **Use of AMI Data.** The use of smart meter AMI data is allowing programs to calculate savings using more sophisticated regression techniques in order to meet the demands of states with stringent regulatory savings calculation requirements.<br>- **RCTs and Matching Methodologies.** Some utilities are beginning to partner with education programs to run RCTs, or alternatives such as regression analysis matching methods. |

The remainder of this chapter considers kit-based programs, school-wide and classroom-based alternatives to kit programs, and evolving savings calculation methodologies for behavioral K-12 education programs, including RCTs.

## *3.1 Kit-Based Programs*

Kit-based programs are the leading example of a K-12 energy efficiency education program. These programs are comprised of both an in-classroom curricula and a take-home kit component. In the classroom, implementers focus on educating students about energy efficiency, often relating it to curricular standards by incorporating content into math and science lessons.

Students are then provided with take-home energy efficiency kits, containing a variety of free energy efficient items, such as CFLs, faucet aerators and low-flow showerheads. Students are also provided a take-home survey to be completed by their parents, indicating which kit items the family has chosen to install in their home. Based on statistics compiled from returned student surveys, installation rates are estimated for kit components and multiplied by deemed measure savings values to arrive at total savings claimed by the utility. Kit-based programs are popular with utilities largely due to ease of administration and widely accepted savings claim methodology.

### 3.1.1 **Kit-Based Program Profiles**

The following program profiles provide information on three of the more prominent and successful kit-based programs available in the U.S. Program profiles include information on the program's implementation region and utilities, savings and key program components.

| Program Name | LivingWise |
|---|---|
| Implementer | Resource Action Programs (RAP) |
| Implementation Region | 27 states across the U.S.[33] |
| Savings | 166 kWh and 0.742 MMBTU per student[34] |
| Informational Interview | David Grider, Program Consultant |
| Key Program Components | • *Take-Home Kits.* Each participating student receives a take-home kit including two light-emitting diode (LED) bulbs, a low-flow showerhead, two faucet aerators and other energy efficient items for home installation.<br>• *Classroom Curriculum.* LivingWise provides teachers with lessons and curriculum aligned with state and federal standards, in order to teach lessons related to energy efficiency.<br>• *Turn-Key Approach.* According to Mr. Grider, the key to his program's success is its ability to deliver a "turn-key approach that offers quick, reliable savings" for the utility.<br>• *New Technology.* The program incorporates the use of energy efficiency games which students can play using smart boards in the classroom. Students can also access games and additional energy efficiency resources through the program web portal, in order to reinforce energy efficiency learning. |

[33] The full list of states with utilities implementing RAP programs includes: AR, AZ, CA, CO, FL, GA, ID, IL, IA, KS, MI, MS, NE, NV, NJ, NM, OH, OK, OR, PA, SC, TX, UT, VA, WA, WI and WY.

[34] This savings figure is based on installation rates determined through student surveys in other jurisdictions, multiplied by Massachusetts-specific TRM deemed measure values for two LED light bulbs, one showerhead and two faucet aerators. The installation rate for measures in this kit based on surveys range from 51% for LED light

| Program Name | Think!Energy |
|---|---|
| Implementer | National Energy Foundation (NEF) |
| Implementation Region | Michigan, New Mexico and Pennsylvania |
| Savings | 214 kWh and 0.596 MMBTU per student[35] |
| Informational Interview | Gary Swan, Vice President of Development |
| Key Program Components | • *Take-Home Kits.* Each participating student receives a take-home kit including three CFLs, one LED, a low-flow showerhead, two faucet aerators and other energy efficient items for home installation.<br>• *Classroom Curriculum.* Think!Energy provides teachers with standards-aligned curricula geared to students of different ages, from second grade through high school.<br>• *Hands-on Science.* According to Mr. Swan, his program's hands-on approach to science activities excels at "getting the students excited about energy and how it applies to their lives."<br>• *Well Tested Program Design.* NEF has been implementing classroom kit-based energy efficiency programs for over 30 years, producing consistent results for utilities. |

bulbs to 37% for faucet aerators. These are lifetime savings per kit (i.e., per student) based on Massachusetts TRM measure life values.

[35] This savings figure is based on installation rates determined through student surveys in other jurisdictions, multiplied by Massachusetts-specific TRM deemed measure values for three CFL light bulbs, one LED light bulb, one showerhead and two faucet aerators. The survey-based installation rates for these measures range from 67% for lighting to 26% for showerheads. These are lifetime savings per kit (i.e., per student) based on Massachusetts TRM measure life values.

| Program Name | Ohio Energy Project |
|---|---|
| Implementer | Ohio Energy Project (OEP) |
| Implementation Region | Ohio |
| Savings | 242 kWh and 0.782 MMBTU per student[36] |
| Informational Interview | Debbie Yerkes, Executive Director |
| Key Program Components | • *Take-Home Kits.* Each participating student receives a take-home kit including four CFLs, a low-flow showerhead, two faucet aerators and other energy efficient items for home installation.<br>• *Classroom Curriculum.* OEP provides teachers with standards-based energy efficiency curriculum for classroom lessons.<br>• *Multiple Behavioral Levers.* The program also uses social norming and culture-change behavioral levers to change student energy use behavior. For example, the program engages students in teaching roles where they deliver energy efficiency science lessons to younger peers.<br>• *New Technology.* The program uses online energy efficiency games accessible through computers, smart phones and smart boards to reinforce energy efficiency lessons.<br>• *Additional Outreach beyond Kits.* According to Ms. Yerkes, her program goes beyond traditional kit programs by holding energy fairs across the state, professional development for teachers, bus-tour field trips for students to visit energy sites and day-long energy workshops for students and teachers. |

### 3.1.2 Recent Changes to Kit-Based Programs

In this section, the evaluation team presents key findings related to recent trends in kit-based programs.

**Multi-Pronged Approach**

Most prominent kit-based programs are branching out to utilize multiple behavior-based strategies in addition to in-classroom curriculum and take-home kits. For example, NEF now offers a program called Energy Action Schools, which uses social diffusion and school-wide culture change to reduce school energy use. A social diffusion component of the program is the formation of student "Energy Action

[36] This savings figure is based on installation rates determined through student surveys in other jurisdictions, multiplied by Massachusetts-specific TRM deemed measure values for four CFL light bulbs, one showerhead and two faucet aerators. The survey-based installation rates for these measures range from 60% for CFLs to 35% on faucet aerators. These are lifetime savings per kit (i.e.,-per student) based on Massachusetts TRM measure life values.

Patrols," groups of students who monitor energy use in classrooms and encourage energy-saving behavior by their peers and school personnel. Similarly, RAP is also experimenting with the addition of behavioral levers into its kit-based programs. LivingWise students are encouraged to use smart boards in the classroom or home computers to access energy efficiency games through RAP's website. OEP utilizes multiple behavior levers in addition to kits, engaging students in peer-teaching, playing energy efficiency games online to reinforce classroom learning, and holding energy fairs, professional development events for teachers, bus-tour field trips for students to visit energy sites around the state, and holding energy workshops which use personal interaction to reinforce energy learning.

**Behavior-Based Savings**

This shift toward inclusion of different behavioral levers and a multi-pronged approach in kit-based programs begs the question of whether or not utilities are claiming additional savings beyond kit measures from these programs. Currently none of the utilities implementing these programs is claiming behavioral savings (i.e., only savings associated with measures included in the kit are being claimed). Improved methodologies for claiming savings from behavior-based programs are emerging rapidly, and utilities should explore ways to start claiming some of these additional behavior-induced savings. These emerging methodologies are described in more detail in Section 3.3.

**Incorporating New Technologies**

LivingWise's use of smart boards in classrooms allow students to interact with energy efficiency games through RAP's website is a good example of the use of new technologies in program delivery. Similarly, OEP has made its energy efficiency games accessible through smart phones, smart boards, laptops and home computers in order to reinforce energy efficiency lessons learned in the classroom. Kit-based programs are continually incorporating new technologies to improve their take-home kits. For instance, NEF has stopped including CFLs in its program kits, and has begun including LEDs. In addition to LEDs, smart strips are another new technology being incorporated into take-home kits.

## *3.2 Alternatives to Kit-Based Programs*

A wide variety of alternatives to kit-based education programs have emerged, with recent developments focused on quantifiable and claimable savings, the integration of energy use feedback and technology, and the use of multiple behavioral levers. While some of these programs focus on school-wide energy use reductions, other programs target students' at-home energy use.

Massachusetts PAs expressed interest in our providing a current view of what program alternatives to traditional kit-based programs exist and are capable of generating claimable savings. In exploring this question, Navigant conducted in-depth and informational interviews with a number of successful and innovative behavior-based programs. Key findings include:

- Behavioral levers common to these programs include social diffusion and culture change, feedback, competition, gamification and rewards.

- Savings calculation methodologies currently in use by these programs range from simple to complex, though there is a trend toward partnerships between program implementers and utilities in program design and implementation, ensuring more rigorous evaluation methodologies to claim savings.
- While some programs create school-wide energy use reductions, the goal of other programs is to reduce students' home energy use.

### 3.2.1 **K-12 Behavioral Programs to Change School Energy Use**

Programs focused on school-wide culture change and energy use reduction offer an alternative to kit-based programs, and are becoming increasingly prominent. These programs typically utilize multiple behavioral levers including social diffusion, feedback, personal interaction or competition and rewards to encourage school-wide energy use reductions. While changes in school energy use may affect student at-home energy use as well, these programs are focused on quantifying changes in school-wide energy use. PowerSave Schools, ReNew Our Schools and the Powering Down program implemented by Massachusetts' Acton-Boxborough Regional School District provide innovative examples.

| Program Name | PowerSave Schools |
|---|---|
| Implementer | Alliance to Save Energy |
| Implementation Region | Primarily California and Tennessee |
| Savings | 8-12% annual school-wide energy use reduction* |
| In-Depth Interviews | Merilee Harrigan, Program Founder and former Program Director, and Scott Thatch, current Program Director |
| Key Program Components | • *Multiple Behavioral Levers*. PowerSave Schools utilize social norming, rewards, feedback, and personal interaction to reduce energy use school-wide.<br>• *School-Wide Culture Change*. Central behavioral lever is social norming through school-wide culture change toward energy efficient behavior and expectations.<br>• *Energy Use Feedback.* Utility provides monthly energy use feedback to the school so students and staff can track progress.<br>• *Active Science Engagement and Technology Use.* The program promotes standards and STEM-based energy efficiency curriculum focused on engineering. Teams of students measure energy use around the school using watt-meters, light-meters and other technologies, then analyze the data they collect along with utility data on school energy use, using computer software.<br>• *Workforce Development.* Encourages middle-school and high school students to consider energy and engineering as viable career paths. This positive effect of the program is not claimed as savings, but should be considered by utilities and municipalities as a positive externality of the program.<br>• *District Returns Savings to School.* Participating school districts agree to return 50% of estimated school-wide energy savings dollars to the school, which serves as extra encouragement and a behavioral lever.<br>• *Well-Established Program*. PowerSave program began in 1996, and has been tracking and calculating savings through an independent evaluator in California since 2000. |
| Status | Utilities in Tennessee are already claiming savings through the program, while California IOUs are partnering with the program to begin pilots and RCTs that will enable them to claim rigorously calculated behavioral savings. |

*Savings are calculated by a third-party evaluator, Utility Management Services. Program year 2013 savings for participating Southern California schools within Southern California Edison (SCE) service territory are published in "Energy Saving Success Stories from Southern California, 2012-2013," which can be downloaded at: http://www.powersaveschools.org/uploads/3/5/9/9/3599340/powersave_schools_success_book_2012-13.pdf

| Program Name | ReNew Our Schools |
|---|---|
| Implementer | Center for ReSource Conservation |
| Implementation Region | Colorado |
| Savings | 10% average annual school-wide energy use reduction[37] |
| Key Program Components | • *Uses Multiple Behavioral Levers.* The program uses competition, rewards, feedback, social norming and personal interaction.<br>• *Behavior Change in Tandem with Infrastructure Upgrades.* ReNew Our Schools pairs behavior change with infrastructural and equipment upgrades to reduce energy use.<br>• *Daily School Performance Feedback.* Schools and students competing in each years' program can view their schools' performance relative to competitors through an energy use dashboard updated daily.<br>• *Focus is Both School and Home Energy Use.* The program is not solely focused on school-wide energy use reduction, but energy efficiency at home as well.<br>• *Competition for Prize Money.* Schools compete for $25,000 in prize money.<br>• *Mentorships by Conservation Experts.* Energy efficiency experts mentor students to design and implement energy conservation programs at school, at home, and in the community.<br>• *In-Classroom and Extra-Curricular Components.* Unlike most education programs, this program includes an extra-curricular component, engaging students in after school energy efficiency programs. |

[37] The program does not currently work directly with any utilities. It works directly with schools and school districts in Colorado.

| Program Name | Powering Down |
|---|---|
| Implementer | Kate Crosby, District Energy Manager and Extra-Curricular Energy Club Advisor |
| Implementation Region | Acton-Boxborough Regional School District, Massachusetts |
| Savings | 13% average annual school-wide energy use reduction, self-reported |
| In-Depth Interview | Kate Crosby, District Energy Manager and Extra-Curricular Energy Club Advisor |
| Key Program Components | • *Use of Multiple Behavioral Levers.* This program uses social norming and personal interaction to change school energy use.<br>• *Incorporation of Extra-curricular Programs.* The Powering Down program largely operates through extra-curricular high school "energy clubs."<br>• *School-Wide Culture Change.* The key to Powering Down's success is the ability to affect school-wide culture change. When all students, faculty and staff are invested in energy efficiency, and abide by energy efficiency norms, school-wide culture change occurs. Key is to engage all school occupants, including building managers, custodial staff and students equally in the program, in order to affect school-wide culture change.<br>• *Student Team-Based Approach.* Students form energy action teams, which work to encourage energy efficiency norms throughout the school and identify sources of energy waste.<br>• *Student Engagement and Innovation.* Ms. Crosby says that the students are the innovators, and Powering Down was invented by students at the local high school, Henderson High, where students in the energy club invented "Powering Down" Fridays, which in turn became the Powering Down program. |
| Status | Active in the Acton-Boxborough Regional School District, MA. Potential for partnerships with Eversource Energy and other utilities in Massachusetts and the northeastern U.S. |

| Program Name | PowerDown! |
|---|---|
| Implementer | Baltimore City Public Schools |
| Website | http://www.baltimorecityschools.org/Page/26754 |
| Implementation Region | Baltimore, Maryland |
| Savings | Winning school in program year 2013/2014 reduced energy use by 8.5% compared with previous 3-year average. Savings self-reported by program. |
| Key Program Components | • *Leveraging competition to reduce school energy use.* Entire schools compete against other Baltimore schools to reduce energy usage the most<br>• *Feedback at end of competition.* Rather than ongoing, feedback only provided at end of competition<br>• *Utilizes curriculum developed by other programs.* This program is limited to one district, so rather than develop its own materials, it links classrooms and teachers to curriculum developed by the US Dept. of Energy, Alliance to Save Energy, National Energy Education Development (NEED) project and US Energy Information Administration (US EIA) Energy Kids guides. |
| Status | Competition implemented annually by Baltimore schools. |

| Program Name | Eco-Schools USA |
|---|---|
| Implementer | National Wildlife Federation |
| Website | http://www.nwf.org/Eco-Schools-USA.aspx |
| Implementation Region | U.S. and international |
| Savings | Savings values have not been calculated by the program. |
| Key Program Components | • *Holistic approach to environmental culture change.* Ten focus areas, (water, waste, energy, etc.)—energy efficiency is just one.<br>• *School-wide culture change.* Social diffusion lever used to change attitudes toward energy use school-wide, and make energy efficiency a shared norm.<br>• *Aligned with science curriculum.* Focus on providing K-12 teachers with STEM-aligned energy efficiency curriculum.<br>• *Comprehensive environmental school review.* Each school undergoes a comprehensive environmental review at the start of the program to assess energy use, water use and waste, for post-program comparison. |
| Status | Program is not currently in use by U.S. utilities or PAs to claim savings, but schools throughout the country participate in the program. |

### 3.2.2 K-12 Behavior-Based Programs to Change Home Energy Use

Behavior-based education programs that pair in-classroom learning with at-home behavior change are intended to reduce student energy use at home offer an alternative to kit-based programs. These programs are becoming increasingly prominent and offer significant potential savings. These programs typically utilize multiple behavioral levers including social diffusion and energy use feedback, particularly in the form of school and home-accessible energy use dashboards, where students can track changes in their home energy use over time. Program implementers typically engage or partner with utilities to provide this level of access to student home energy use. PowerHouse and LearningPower provide two very different examples of these types of programs; program profiles for each are provided below.

| Program Name | PowerHouse |
|---|---|
| Implementer | Gulf of Maine Research Institute (GMRI) |
| Website | http://powerhouse.gmri.org/ |
| Implementation Region | Maine |
| Savings | 3-5% annual student home energy use reduction, self-reported |
| In-Depth Interviews | Gayle Bodge, Program Manager, and Leigh Peak, Chief Educational Officer |
| Key Program Components | • *Use of Multiple Behavioral Levers.* The program uses feedback, social norming, competition and personal interaction.<br>• *Science, Energy Efficiency and Climate Change Curriculum.* PowerHouse focused on middle-school, and worked with teachers to co-design STEM-aligned science lessons related to energy efficiency and climate change, incorporating "authentic science experiences." Brings students to GMRI site on energy field trips to conduct lab experiments.<br>• *Energy Use Feedback.* The program's key component is use of an energy dashboard to provide students with home energy use feedback, using AMI data from Central Maine Power (CMP). Feedback is provided both in terms of kWh and CO2 reductions.<br>• *Social Norming and Competition*. Use of public service announcements (PSAs) to promote energy efficiency and engage the community in dialogue about energy use reduction. Is also planning a leader-board-style web portal component, where households can benchmark their energy use against others in the community and foster energy use reduction through competition.<br>• *Utility Partnership and Use of Technology Key.* Ms. Bodge and Ms. Leigh highlighted the importance of strong relationships with utilities as the key to program success, enabling access to smart meter data. Also, student access to laptops and other computing devices is critical in order to interface with the energy use dashboard and web portal.<br>• *Current Program Recent Development.* Though GMRI has existed since the 1960s, it launched the current PowerHouse program 5 years ago with funding from the Department of Energy (DOE). The program is not yet at scale, but growing quickly. |
| Status | PowerHouse partners primarily with CMP to offer students access to home energy use feedback. Long-term plan is to follow smart meter rollouts across the country with program introduction. The program is nearly ready to begin operations in New York. |

| Program Name | Learning Power |
|---|---|
| Implementer | Georgia Power |
| Website | http://www.learningpower.org/georgia/ |
| Implementation Region | Georgia |
| Savings | Not estimated |
| Informational Interview | Mickey Daniel, Energy Efficiency Education Team Lead |
| Key Program Components | • *Utility-Designed and Managed Program.* Learning Power is unique in that it is a classroom-based behavioral education program focused on home energy use reduction, designed and implemented wholly by a utility.<br>• *In-Classroom Science Field Trip*. Georgia Power designed the Learning Power program to offer cash-constrained Georgia schools the opportunity to offer students "in-classroom field trips" focused on active engagement science learning.<br>• *Focus on New Technologies and Hands-on Science.* The program uses novel technologies such as energy sticks and light bars, as well as energy measurement technologies such as watt-meters and infrared thermometers which students use to collect data. Students engage in "research," drawing observations, generating hypotheses and calculating energy savings.<br>• *Energy Lessons Targeted to Specific Grade-Levels.* Learning Power curriculum is built around grade-level science standards. For instance the third grade curriculum focuses on heat transfer, a key science standard, while the fourth grade lessons are built around electric lights and circuits.<br>• *Claimable Savings.* While the program has the capability of estimating and claiming savings based on participating student home energy use, Georgia's regulatory environment has not provided sufficient incentive for the program to claim savings to date. |
| Status | Many school districts within Georgia Power service territory participate in Learning Power programs. |

## *3.3 Methodologies for Claiming K-12 Behavioral Savings*

Current methods for calculating K-12 behavioral program savings are varied. Kit-based programs typically calculate savings by counting measure savings, based on a state's Technical Reference Manual, for the items included in the take-home kit. A measure-specific installation rate, estimated with self-reported survey data, is applied. Kit-based savings calculation methods are well-established and accepted.

Savings calculation methods for non-kit-based behavioral programs are not as well-established, and in many cases savings are neither calculated nor claimed. Typical current industry practices involve gathering both pre and post-program data on energy use, creating an energy use baseline for the pre-period, and comparing energy use during and after program implementation to the pre-period baseline, attributing savings based on the difference. These methods typically account for the effects of seasonal weather variations, physical infrastructure and equipment upgrades, and occupancy changes on energy use by adjusting savings estimates accordingly.

Several programs have recently shifted toward more rigorous approaches, partnering with utilities to run multiple regression models using interval data or to launch RCT pilots. The majority of programs still using typical industry current practices for savings calculation suggested during interviews that they intended to switch to more rigorous methodologies in the future, often involving partnerships with utilities.

### 3.3.1 Current Practice Methods

PowerSave Schools uses a methodology typical of the current state of savings calculation. The district shares billing information with the program and creates a twelve-month baseline of every school during the pre-program period, then compares this with energy use during the program.[38] Although the current method does not utilize multiple regression analysis, it does normalize for weather, and uses univariate regression to account for cooling days. The model also manually adjusts and accounts for building infrastructure or equipment changes, furlough days, school vacations and other confounding variables affecting school load.

The program works with the custodial and building managerial staff at schools to ensure they have all pertinent data on changes to facilities and occupancy. The inputs and outputs are tracked in a spreadsheet, making calculations transparent. Unlike many other programs using this approach, PowerSave Schools utilizes an independent third-party contractor, Utility Management Services, to perform these calculations and maintain savings spreadsheets. Many other programs including Powering Down and PowerHouse currently employ similar savings calculation methods.

This calculation methodology is sufficiently rigorous for some utilities to be comfortable claiming behavioral education program savings. For instance, the Tennessee Valley Authority (TVA) claims savings based on PowerSave Schools' current calculation methodology.

### 3.3.2 Regression-Based Methods

Programs like PowerSave Schools are moving toward using more rigorous methodologies that allow for savings to be claimed in states such as California where regulated utilities are subject to a strict regulatory regime. By partnering with SCE and PG&E, two large investor-owned utilities in California,

[38] Currently PowerSave Schools receives daily school-level energy use data from the utilities in districts where it operates, but this data is not sub metered. PowerSave Schools is partnering with the California investor-owned utilities in which 15-minute interval data will be used, enhancing the ability to disaggregate the effects of the program.

PowerSave Schools will implement their program as an RCT, using interval data and multiple regression methods in order to meet the rigorous standards of the California Public Utilities Commission (CPUC) and claim behavior-based savings. Similarly, Powering Down in Massachusetts is exploring the possibility of using RCTs or advanced matching methods in tandem with multiple regression analysis to produce estimated savings.

CMP in Maine partners with PowerHouse to provide energy usage data for program participants and non-participating comparison households. PowerHouse uses a matching methodology, as opposed to an RCT, to estimate savings by identifying the difference in energy usage between treatment and comparison households. In line with similar programs, PowerHouse is currently working to increase the rigor of its savings estimation methodologies to meet strict requirements of regulatory regimes across the country. PowerHouse also has plans to use matching methods and multiple regression-based savings estimation methodologies to be able to identify spillover attributable to the program.

#### *3.3.2.1 RCT*

In an RCT, customers are randomly assigned to the treatment (participant) and control group prior to program launch. Due to random assignment, the control group serves as the counterfactual, identifying what the participants' energy use would have been in the absence of the program. In the context of education programs, participant/control groups may be established at different levels, depending on the program. For example, the program may be implemented at the school-district-level, school-level, or even classroom-level.

In the case of programs aimed at reducing school-wide or district-wide energy use, districts or schools can be randomly assigned to control and treatment groups. One way to accomplish this while avoiding issues of equity (some schools receiving the benefits of participation, while others do not), is to have rolling program launch dates (i.e., recruit and delay)—so that some schools or districts begin participating in the program earlier than others—with a lag-time sufficient to measure the program's effects. Implementing RCTs for classroom-based programs focused on reducing student home energy use may be slightly more complicated, but is feasible. The utility can partner with the program to randomly assign schools to treatment and control—so that the treatment classrooms receive the program, and control classrooms do not (or have a delayed program start). The utility can then track home energy use for the treatment and control students, thereby measuring the effect of the program on home energy use.[39]

Random Encouragement Designs (RED) are a variant of the standard RCT which may be considered in order to alleviate concerns over equity. REDs are typically utilized in opt-in programs, where it is not

[39] Privacy is often raised as a concern with implementing RCTs involving access to student home energy use data. However, through in-depth interviews with a number of programs currently implementing RCT pilots or using student home energy use data in other ways confirmed that there are no direct issues with confidentiality. A typical reported approach was to have parents sign either an online or paper permission statement, granting the program access to student home energy use.

ideal to implement an actual RCT. In a RED, rather than randomly assigning customers to treatment and control groups, the *likelihood of participation* is randomized by offering extra encouragement to participate to a random sample of customers. REDs can both help to alleviate concerns over equity and reduce self-selection bias associated with savings evaluation of most opt-in program designs.[40]

#### *3.3.2.2 Matching Methods*

While an RCT with multiple regression is the ideal high-rigor approach to estimating savings from behavioral programs, it is not always possible—especially in the case of programs where individual teachers, classrooms or schools opt-in to a program *without* district or school coordination. In these cases, a well-designed matching methodology can be employed in tandem with multiple regression to produce results similar to an RCT. Matching methods do not randomly assign treatment and control groups. Instead, comparison groups are chosen based on their similarity to the treatment group—in terms of energy use and other observable factors prior to program launch. Similar to an RCT, this comparison group can then be used as a baseline for comparison of energy use against the treatment group. The benefits of using matching over RCTs are numerous. First, matching methods can be employed after a program has already been launched and data collected—whereas RCTs have to be set up and deployed prior to program initiation. Second, matching methods can help alleviate perceived problems associated with opt-ins and equity concerns—the idea that randomly assigning some, but not all, schools or students to an energy efficiency program is unethical or inequitable.

[40] Violette, D. and Rathbun, P., *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, Chapter 17: Estimating Net Savings—Common Practices*, National Renewable Energy Laboratory (NREL), 2014.

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# 4. Conclusions and Considerations for Future Program Planning

This review of behavior and education (K-12) programs provides an overview of the landscape of current program offerings for consideration by the Massachusetts PAs and EEAC in future program planning. The interviews and secondary literature reveal that numerous opportunities exist across all areas of interest to the PAs.

- Navigant's research identified several residential behavior-based programs, though most have not been tested at scale. Following HERs, feedback programs are the most widely tested behavioral program. Increasingly feedback programs are moving away from IHDs to customers' existing devices (smartphones in particular).
- Residential behavior programs are increasingly using a multi-pronged approach in which multiple behavioral strategies are being employed. While this approach may be effective in addressing multiple barriers to conserving energy, it appears programs are being designed with a "kitchen sink" approach rather than developing logic models or conducting targeted research to appropriately identify barriers, and then developing behavioral interventions that mitigate those barriers.
- PAs serving small markets face program scale barriers to implementing cost-effective behavior programs. Navigant identified several potential solutions, including exploring whether opportunities exist to work with vendors that may offer lower cost opportunities, including potential for developing a program in-house. Establishing partnerships may also provide an opportunity for cost savings.
    - Programs successfully implemented in small markets include the HER program and programs that rely on in-person interaction and/or community involvement.
    - Other factors influencing cost-effectiveness that should be revisited include requirements for evaluation and ability to claim savings, as well as assumptions regarding measure life.
- Though there is considerably less experience with small and medium commercial behavior programs, Navigant identified several classes of programs for consideration by the PAs and EEAC including: competitions, workplace engagement programs, and BERs.
- Kit-based programs are the primary type of K-12 energy efficiency education programs, with reliable savings associated with measures included in the kits.
    - Navigant identified several alternatives to kit-based programs focused on school-wide and at-home energy savings.
    - Programs and utilities across the country demonstrate a wide range of more and less-rigorous approaches to estimating savings. Many are moving toward more rigorous methods that will capture both measure-based and behavior-based savings.

## *4.1 Considerations for Future Program Planning*

Table 4-1 identifies opportunities for consideration by the PAs and EEAC in future program planning. These opportunities should be further examined to determine the cost-effective savings potential in Massachusetts.

**Table 4-1. Considerations for Future Program Planning**

| |
|---|
| **Behavior Programs** |
| 1. Test alternative residential behavior-based program offerings. Programs relying on web portals and smartphone applications can provide lower cost opportunities with comparable savings to the HER program. However, these programs may provide less opportunity for wide-scale implementation as not all customers have computers or smartphones. |
| 2. Consider conducting an opportunity assessment of existing program offerings to identify opportunities for employing behavioral strategies, such as commitments and framing, to further enhance program participation. Although the Home Energy Services and low-income programs already have behavioral and education components, additional integration opportunities may remain. |
| 3. Further explore opportunities for addressing barriers faced by PAs serving small markets in delivering behavior-based programs, particularly around partnership, evaluation methods and requirements for claiming savings, and assumptions regarding measure life. |
| 4. Consider testing a workplace engagement program to initiate experience with small and medium commercial behavior programs. |
| **Education Programs** |
| 5. Consider implementing kit-based education programs. Involve appropriate stakeholders in design and implementation to ensure behavioral savings can be quantified and claimed. Typically, savings are determined using TRM values for kit measures, applying measure-specific installation rates. |
| 6. Monitor the outcome of K-12 programs promoting school-wide energy-saving through culture change in similar jurisdictions with periodic, targeted reviews of key programs cited in this research. |
| 7. Consider the possibility of path-breaking, targeted research around behavior-based programs in higher education. Due to the number of college and university students per capita, Massachusetts may reap higher benefits from such efforts relative to other states. Many of the behavioral strategies and K-12 program models have application in a higher education setting. |