Reducing Energy Waste through Municipally Led Behavior Change Programs

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Acknowledgments

Executive Summary

Local governments can influence energy use in their communities through a variety of policy and program options. They can use behavior change strategies in their energy efficiency program design to, for example, increase participation and deepen understanding and control around energy use, thereby effecting long-term energy savings. Many local governments have used behavior-based strategies to save energy, and many more are considering them.

While previous research at ACEEE and elsewhere has explored developments and advancements in energy-saving behavior change programs, this report is the first to specifically provide a large-scale review of municipally led behavior change programs in terms of their design, motivations, goals, and impacts and to provide recommendations for designing and implementing a successful locally led behavior change program.

For this project, we completed a literature review of locally led behavior change programs and administered a behavior program survey to local governments to collect program examples. We also conducted interviews with officials in three cities to develop case studies. Using this information, we compiled a list of 50 locally led behavior change programs in 40 localities in 18 states and Canada, reviewed program elements, and developed recommendations to help local governments launch their own behavior change programs.

MUNICIPALLY LED BEHAVIOR PROGRAM FINDINGS

The 50 programs included in this report illustrate that local governments can use numerous behavior change strategies in a variety of combinations to achieve program goals, among which a main objective is to reach citywide climate change mitigation targets. We include locally led behavior change program examples throughout the report, as well as more detailed program information in the appendixes. Figure ES1 indicates the behavior change strategies that are most commonly included.
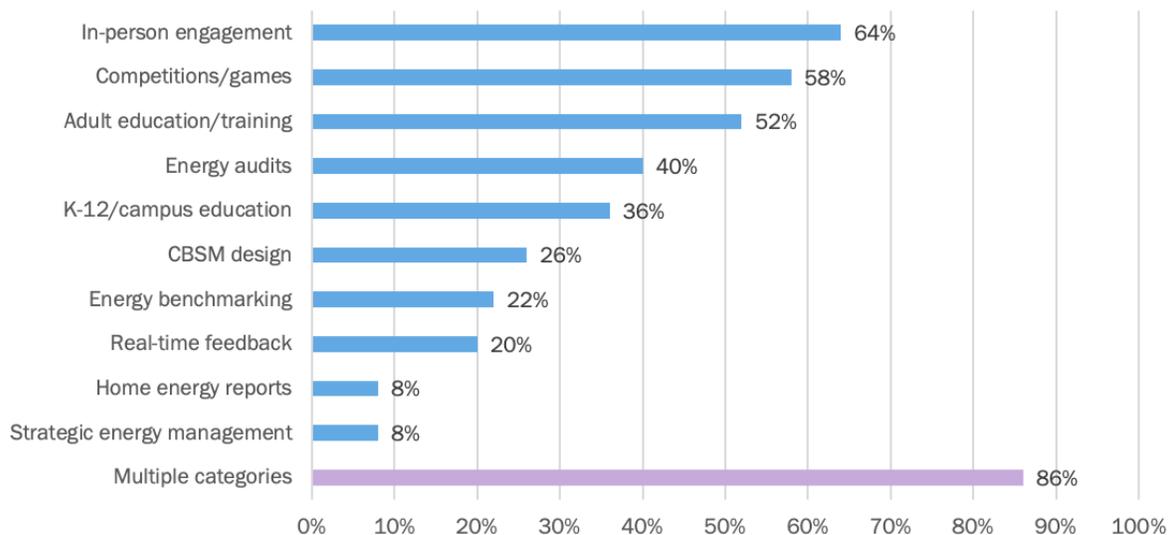
Figure ES1. Percentage of programs in study containing behavioral program categories (not mutually exclusive)

Nearly two-thirds of the programs include in-person engagement elements, which can be used alongside other behavior change strategies. In-person approaches can increase the effectiveness of other interventions. We found that 86% of the programs include more than one behavior change strategy, and that many local governments use competitions and games to engage their municipal staff, local businesses, or residents. Many local governments are motivated by climate action plans and energy-reduction goals, but they also want to engage with the community and provide economic benefits.

Almost half of the programs in this study aim to reach more than one sector (residential, commercial, municipal, transportation, and industrial), with programs most commonly targeting residential energy consumers. Many behavioral strategies are used across sectors, but there are a few exceptions. For instance, strategic energy management strategies tend to focus only on municipal, commercial, or industrial users. In addition, some approaches, such as home energy reports, benchmarking, and feedback, are more likely to exclude transportation, even though it is possible for transportation programs to use some of these strategies. Overall, we find that local governments can use many different behavior program models and strategies to achieve similar or differing behavior change and energy savings goals.

Independent third-party evaluations are key to measuring progress toward program goals and overall program success; they also lead to program improvements. Even so, the vast majority of programs in this study do not comprehensively evaluate their effectiveness. Many do track some performance metrics internally. This is often less costly than an independent program evaluation, but it also provides less thorough and comprehensive analysis.

RECOMMENDATIONS FOR LOCAL GOVERNMENTS

Based on our research into behavior program design as well as the program examples included in this report, we recommend that municipalities use the following seven steps as guidelines to design and implement effective behavior change programs.

1. *Choose a goal and target behaviors to change*. After choosing a goal, the program designer can decide which behaviors to focus on and which populations to target in order to achieve it.

2. *Conduct preliminary research.* This step includes many elements, such as reviewing relevant research, observing people engaging in the targeted behavior, and conducting focus groups and surveys to learn more about the behavior that the program aims to change. Program designers can seek to collaborate with or receive funding from a variety of partners.

3. *Choose a behavioral strategy*. Choose behavior change strategies that have proved impactful for the specific goal and behaviors chosen in step 1. We recommend considering in-person strategies and enlisting energy champions.

4. *Design effective materials*. Programs are most effective when they include marketing materials that speak to the target audience. The preliminary research should inform the design of these materials, especially focus group and survey research. For the

best results, behavior change programs must prioritize audience planning, strategic messaging, and the best communications channels to optimize engagement.

5. *Implement on a small scale*. Before rolling out a full program to the whole target group, first run a pilot to test the effectiveness of your program design. This allows implementers to determine how effective a set of behavioral strategies are at achieving the program goals and objectives.

6. *Evaluate program outcomes*. Evaluations are key for determining the effectiveness of an energy efficiency program. Municipalities should determine how they will evaluate program outcomes at the outset, before the program begins, so they can design it in a way that lends itself to strong evaluation.

7. *Improve and scale up*. Evaluations should lead to insights into how the program can be adjusted to increase effectiveness. This process should be iterative and should continue until the implementer has addressed the major issues hindering program success; then the program can be implemented at a large scale.

CONCLUSION

Local governments are currently designing and implementing energy efficiency programs to achieve energy savings through behavior change. They may face challenges in terms of funding and staff capacity that impact their ability to design an effective behavior change program. Even facing these barriers, local governments should invest time and effort at the beginning of the program design process. By conducting preliminary research and doing up-front evaluation design, local governments can, early in the process, develop deeper insights into effective strategies and methods and ensure proper data collection and program evaluation. Ultimately, behavior change that increases energy efficiency can benefit local governments as they aim to achieve climate change mitigation and other municipal goals, and many local governments have opportunities to expand their local energy efficiency portfolios to include behavior change programs. This report's examples and recommendations can provide direction to local governments that wish to design new or improve existing behavior change programs.

Introduction

Cities around the world account for two-thirds of the world's energy demand and 70% of the energy-related carbon dioxide emissions (IEA 2016). Without efforts to lessen per capita energy use, these values are expected to continue to increase alongside growing urban populations.

Local governments can influence energy use in their communities through a variety of policy and program options. These governments can serve as role models for their communities by promoting energy efficiency in their own operations or participating in national energy efficiency programs, such as the US Department of Energy's Better Buildings Challenge. They can increase building efficiency to achieve economic, social, and environmental sustainability goals (Layke et al. 2016). Local governments can also invest in energy-efficient technologies, such as highly efficient buildings and public transportation systems. And they can directly motivate residents through interactive energy-saving campaigns, alter mobility behavior, and encourage efficient appliance purchases (Seidi, Moser, and Blumer 2017).

Municipalities are in a unique position to design programs to meet local government operations goals as well as targeting a variety of other sectors including transportation and buildings. They often also have community-wide goals—e.g., reducing greenhouse gas emissions, stimulating the local economy, and improving residents' quality of life—that incentivize saving energy.

Municipalities can use behavior change strategies in their energy efficiency program designs. These strategies rely on behavioral science approaches to understanding and impacting human choice and action that have emerged from the fields of psychology, neuroscience, and behavioral economics, among others (Barrows et al. 2018). Local governments can use these strategies independently through education programs or in combination with energy retrofit or direct installation initiatives to achieve energy efficiency objectives such as saving energy and reducing greenhouse gas emissions, creating local jobs, engaging community members, and improving quality of life.

This report is the first to explore locally led behavior change programs in terms of their design, motivations, goals, and impacts. It includes analysis across strategies and sectors as well as recommendations for municipalities that want to design and implement their own energy-saving behavior change programs.

Methodology

To collect information on municipally led behavior change programs, we completed a literature review, administered a survey to local governments, and conducted interviews with program administrators. We then analyzed these program examples and created guidelines for local governments looking to launch their own program.

LITERATURE REVIEW

The literature review provided the framework for analyzing behavior program elements and allowed us to identify additional municipally led behavior change program examples. When we identified strong programs in our review, we reached out to the local program

administrator to encourage him or her to complete our online survey. If we were unable to locate a contact person to complete the survey but found sufficient information through our independent review, we included the program in our analysis. We also used research from this review to inform the steps laid out in the recommendation section.

SURVEY OF BEHAVIOR PROGRAMS

We distributed our survey through ACEEE's email channels and partner listservs, targeting local government sustainability offices and other local government stakeholders. The survey was open from late May through July of 2018.

Through the survey, we collected data on energy-saving behavior change programs that were: 1) run independently by local governments or in partnership with other entities; 2) saved energy in the building or transportation sectors; and 3) did so by changing behavior to some extent at the organizational or individual level.[1] The survey collected program descriptions and information on sectors served, behavior change elements, program type, goals, government offices involved, partner organizations, funders and budget, and energy savings estimates and evaluations. See Appendix B for a complete list of survey questions. We verified the survey data with those who had submitted survey responses when necessary.

Overall, we received 64 survey submissions on programs from 44 local governments and 23 states. Of these, we eliminated duplicates and programs that did not contain behavior change components or were not locally led. We ultimately used 50 survey submissions from 40 local governments in 18 states and Canada.

INTERVIEWS

We conducted interviews with three city and county governments to gain information for short case studies that would illustrate a diversity of program types and methods to address program design barriers and enact solutions. We selected the Know Your Numbers program in Fort Collins, Colorado; Arlington Green Games in Arlington County, Virginia; and Community Commutes Day in Alameda County, California. We also spoke with experts in the fields of behavior change programs and local energy efficiency policy for additional insights and feedback.

LIMITATIONS

This study of municipally led behavior change programs is limited to programs submitted through our survey or collected through our literature review. As such, it may not be representative of all types of programs. Additional municipally led behavior programs exist

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[1] Behaviors can be one-time, frequent (habitual), or infrequent. One-time behaviors can include purchasing a fuel-efficient car or energy-efficient appliance or installing a new, efficient HVAC system. Infrequent behaviors can include changing a thermostat set point or buying an efficient replacement light bulb. Frequent behaviors can include turning off lights, unplugging appliances, washing dishes and laundry only with full loads, and other daily energy-saving habits.

that are not profiled here, and this report is not a definitive analysis of all municipally led behavior change programs.

Behavior Change Program Categories

Energy efficiency program administrators can design programs that encourage people to change their behavior in order to reduce energy consumption without disrupting their daily life. These programs change behaviors using principles based on social or behavioral science, in contrast to programs relying solely on incentives, rebates, taxes, or other policies. The following is a list of several of the social science strategies that may be included in energy efficiency behavior change programs, each given with an example.

- *Tapping into social norms.* Showing people how their energy use compares with others' can lead them to change behavior in order to become more like the rest of the group (Nolan et al. 2008).

- *Changing default habits and actions.* To increase sales of renewable energy, programs can make renewables the default option for residents (while still allowing them to opt out if they wish) (Ebeling and Lotz 2015).

- *Information, outreach, and education.* Energy literacy training for low-income customers can encourage them to buy energy-efficient products or use energy more efficiently (Cadmus Group 2014).

- *Giving feedback.* An in-home energy display with real-time information can reduce residential usage (Karlin, Zinger, and Ford 2015).

- *Using trusted messengers.* An influential person within a social group (a block leader or energy champion) is more likely to effect change than an outside organization. The block leader approach may be the most effective social influence strategy for changing behavior (Abrahamse and Steg 2013).

- *Soliciting commitments.* Eliciting a voluntary public pledge from residents to reduce their energy consumption makes it more likely that they will do so (Pallak and Cummings 1976).

- *Using persuasive language.* Tailored message-framing strategies can increase residents' interest in upgrading their homes (Sussman, Chikumbo, and Gifford 2018).

- *Offering rewards or incentives along with other behavioral strategies.* A point-based rewards program may augment a home energy report program (Illume Advising and Navigant Consulting 2015).

- *Offering disincentives.* Taxes on gas, carbon, or environmentally harmful practices can encourage more mindful energy use (Scrimgeour, Oxley, and Fatai 2005).

- *Social marketing in communities.* A campaign that works with schools, businesses, and other community institutions can increase bus ridership and decrease off-peak driving (Cooper 2007).

In this study we look at programs that apply the above strategies in a variety of ways. For example, we include energy audit and benchmarking programs, even though these programs' energy savings are often derived from retrofit activities that follow an energy audit. Even so, audits and benchmarking both contain behavioral elements that may help

save energy in the building stock. The next section lays out the different behavior program types that we use to analyze programs throughout this study.

Behavior change strategies and methods can be employed individually or in combination to motivate energy savings. Some efficiency programs rely solely on behavioral strategies, while others integrate these strategies into existing energy efficiency programs to increase participation, engagement, and impact (Brannan, Podolefsky, and Seiden 2015). The use of social norms can often motivate behavior change; these can be either injunctive (what one should do) or descriptive (what others are doing) (Cialdini, Kallgren, and Reno 1991).

Mazur-Stommen and Farley (2013) identify three main categories for behavior change programs: information, social interactions, and education and training. Each of these three categories includes a variety of types of behavior change programs:

- *Information programs.* Real-time feedback, energy auditing, home energy reports (HERs), public awareness campaigns, energy benchmarking[2]
- *Social interaction programs.* Competitions, games, and additional social interaction strategies
- *Education and training programs.* Strategic energy management (SEM), adult education and training, K–12 and campus education

Table 1 presents a list of each behavioral program type, its estimated energy savings, and the quality of available program evaluations used to determine savings. Most behavior programs have not been evaluated for energy savings persistence, and more research is needed across all behavior program types to develop a strong understanding of persistence (Sussman and Chikumbo 2016). While many of these program types tend to serve the residential sector, they can also work for municipal, commercial, industrial, and in most cases transportation sectors as well.

The estimated energy savings values in table 1 are derived from Sussman and Chikumbo (2016) and are based on a thorough analysis of program evaluations. These values do not necessarily predict savings for a similarly implemented program, due to the limited number of studies and the expected variation in program designs. In most cases, more research is needed to determine a more accurate energy savings estimate for each behavior change program, based on strategies and design elements employed.

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[2] Benchmarking programs are not traditionally categorized as behavior change programs. Nevertheless, they apply several empirically demonstrated behavioral insights. One of these is public observability (Yoeli et al. 2013), in which people are more likely to engage in positive energy-related behaviors if they are publicly observed. Another is competition, in which people are motivated to save energy because they want to win rewards, conform to group norms, and have fun (Vine and Jones 2016). Therefore benchmarking programs sufficiently meet our definition of behavior change programs for the purposes of this report.

Table 1. Behavior change program types, sectors served, estimated energy savings, and quality of evaluations

Program type	Usual level and sectors served	Description	Estimated energy savings and quality of evaluations on which they are based
		Information programs	
Real-time feedback	Levels: individual, building, or community Sectors: residential, commercial, municipal, industrial, transportation	Information about immediate energy use, provided by websites or in-home devices	1–15% for information-based devices and 1–17% for control-based devices. High evaluation quality.
Energy audits	Level: building unit Sectors: residential, commercial, municipal, industrial	Audits, done online or in person, in which a customized evaluation of energy use in a home or business is followed by specific recommendations for saving energy	1.3–6.5%. Low evaluation quality.
Energy benchmarking	Level: building Sectors: residential, commercial, municipal, industrial	Mechanism to measure energy performance of a single building over time, relative to other similar buildings or to modeled simulation of a reference building	3–8% over a two- to four-year period.* Low evaluation quality.
Home energy reports (HERs)	Level: building unit Sector: residential	Reports sent intermittently to residential customers with feedback about energy use, energy efficiency tips, normative comparisons to similar neighborhoods, and other information	1.2–2.2% for electricity and 0.3–1.6% for natural gas by second year. High evaluation quality.
		Social interactions	
Competitions and games	Levels: individual, building, or community Sectors: residential, commercial, municipal, industrial, transportation	Competitions in which participants try to achieve the highest rank compared with other individuals or groups; games in which participants try to reach goals by reducing energy consumption	0.7–14% for residential electricity; 0.4–10% for residential gas; 1.8–21% for commercial electricity. Moderate evaluation quality.
Additional social interaction and community-based strategies	Levels: individual, building, or community Sectors: residential, commercial, municipal, industrial, transportation	Strategies to augment programs through direct social interaction by one or more people (not a program)	From 4.4% (personal goal setting) to 27% (public commitment) per participant; also can increase utility program enrollment by 300%. Moderate evaluation quality.

Program type	Usual level and sectors served	Description	Estimated energy savings and quality of evaluations on which they are based
		Education and training	
Adult education and training	Level: individual Sectors: residential, commercial, municipal, industrial, transportation	Non-school-based education or training programs to teach community members strategies for reducing energy consumption	No strong evaluations
K–12 and campus education	Levels: individual or community Sectors: residential, transportation	Programs in K–12 schools or on college campuses that involve education of students on energy efficiency	13–37% for electricity (gross) in schools. Low evaluation quality.
Strategic energy management (SEM)	Levels: individual or building Sectors: commercial, municipal, industrial	Program administrators work with industrial and commercial customers to train energy managers and encourage curtailment and efficiency behaviors with goals and project tracking	0–22% for electricity (gross). 0–23% for gas. Moderate evaluation quality.

*Savings from Mims et al. 2017. *Source:* Sussman and Chikumbo 2016.

INFORMATION PROGRAMS

Most energy efficiency programs employ information strategies to lead to energy savings. While most researchers agree that information is necessary to change behaviors, it is rarely sufficient (Owens and Driffill 2008). To achieve behavioral changes, in most cases information needs to be combined with other strategies, as social norms, community or individual identity, values, and default behaviors may impact the effectiveness of information.

Often there is a large discrepancy between peoples' observable behavior and their self-reported knowledge, values, attitudes, and intentions (Frederiks, Stenner, and Hobman 2015). Nevertheless, information or awareness campaigns, which are usually disseminated through media and advertising, can be helpful in laying the groundwork for future behavior change. The transtheoretical model of behavior change (Prochaska and DiClemente 2005) suggests that there are five stages of change, and before people can get to the *action* and *maintenance* stages, they must first progress from *precontemplation* through *contemplation* and *preparation*. An awareness or information campaign can help move people from precontemplation, in which they are not yet aware of the possibility of change (or may think negatively about it), to contemplation, in which they begin to think that change is a good idea.[3]

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[3] The transtheoretical model provides a useful framework for selecting behavior change strategies. It explains how behavior change interventions should be customized for individuals who are in different stages of change. For example, Friman, Huck, and Olsson (2017) review 13 studies of transportation-related behavior change interventions that were tailored according to the transtheoretical model.

For individuals who are beyond the precontemplation stage, programs can use behavioral insights to enhance messages and trigger actual behavior change (rather than just attitude change). For example, they can connect informational messages with the recipients' existing values and feelings of self-efficacy (the idea that one has the power to change and is able to make a difference). These existing mental constructs within the message recipient help him or her turn knowledge into action (Estrada et al. 2017).

Four types of information-based programs exist: feedback programs, energy audits, energy benchmarking, and home energy reports (HERs). Most of these combine actual energy-use data with suggestions for actions to save energy.

Feedback

Tailored feedback programs have proved successful in encouraging energy savings (Karlin, Zinger, and Ford 2015; Podgornik, Sucic, and Blazic 2016; Abrahamse et al. 2007). Feedback programs provide information on energy use in frequent intervals (e.g., weekly, daily, or real-time). High-quality evaluations catalogued in Sussman and Chikumbo (2016) found that feedback programs save 1–15% for electric and 1–17% for natural gas end uses. Achieved savings vary greatly among programs. Feedback programs that achieve the greatest energy savings tend to provide real-time energy-use information and information specific to end uses (Brannan, Podolefsky, and Seiden 2015). These are most easily implemented at a large scale and often require smart meters to collect energy-use information. Depending on the program design, the need for new technologies may mean an added cost for the program administrator or the participant. These costs can make programs that require new technologies prohibitive for some households (Dietz et al. 2009).

Energy Audits

Energy audit programs involve either in-person or online inspection of a building's energy systems and equipment in order to determine measures to reduce energy use. Nudge techniques based on social science can play a crucial role in energy audit programs, in terms of best utilizing in-person strategies to achieve the greatest impact or creating effective follow-up materials. For example, audits use the foot-in-the-door technique, based on the idea that an initial small action (requesting a free or low-cost audit) increases the likelihood that a household will take a bigger action (e.g., an energy upgrade) (Freedman and Fraser 1966; Fehr and Gächter 2000). Sometimes energy audits can invoke the "reciprocity effect," which rests on a social norm of responding to a positive action with a positive action of one's own. For example, when a household receives free or low-cost upgrades following an energy audit, it may be more motivated to respond by paying for higher-cost upgrades as a result of the reciprocity effect.

By using foot-in-the-door, reciprocity, and educational strategies, energy audits can motivate energy-efficient behaviors and building retrofits or upgrades of equipment or appliances. Most energy audits provide detailed building energy-use information, along with suggestions of cost-effective energy efficiency retrofits or building retro-commissioning

options.[4] Audit evaluation quality tends to be low due to the difficulty of differentiating between incremental savings attributed to the audit and savings from efficiency rebates or actions suggested through the audit. Even so, studies have indicated that energy audits can lead to 1.3–6.5% annual energy savings (Sussman and Chikumbo 2016).

Energy Benchmarking

Energy benchmarking programs can encourage behavior changes and energy-efficient actions (Mims et al. 2017). Building energy-use benchmarking is the practice of comparing the measured performance of a building with that of other, similar buildings over time, with the goal of informing and motivating performance improvement. Benchmarking helps to increase the visibility of energy performance data in the real estate and large-building markets, allowing owners to compare their building's energy use to that of similar buildings and identify areas for efficiency improvements. Municipal governments can use information obtained from benchmarking results to help local buildings comply with energy-saving mandates or see how their energy use stacks up against similar buildings. This information can act as a behavioral motivator by sparking competition among buildings over time (Hart, Yong, and Prieto 2018).

Building benchmarking can also encourage building owners to perform energy audits or retrocommissioning in order to match the energy performance of similar buildings. Behavioral motivators such as social norms, public observability, and competition come into play to encourage energy savings among benchmarking program participants. In this way, benchmarking programs can often overlap with other behavior components, such as competitions or games. Certification programs may work in a similar way by encouraging building owners to make changes and upgrades to their building stock in order to achieve public recognition through a certification.

Currently benchmarking program evaluations remain limited, increasing the difficulty of determining energy savings from behavioral changes. The Lawrence Berkeley National Laboratory analyzed the impact of benchmarking policies in eight cities and found that, on average, these policies resulted in energy-use reductions of 3–8% over a two- to four-year period (Mims et al. 2017). Even so, more research is needed to reliably determine the savings and behavioral impacts of benchmarking programs.

Home Energy Reports

Many home energy reports (HERs) use social norms and feedback to encourage behavioral change by comparing residential or commercial building energy use to that of neighboring buildings or similar homes or businesses. HERs are the most widespread behavior change program to date. An early and large-scale implementer of HER programs, Opower–Oracle, runs such programs with nearly 100 utilities (both investor-owned and municipal) in more than half of all US states and at least five additional countries (Brannan, Podolefsky, and Seiden 2015). Home energy reports and other feedback programs tend to be the most widely

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[4] Retrocommissioning is the process of boosting existing building efficiency by improving the operation and maintenance of equipment and systems rather than by making more costly capital investments. It can lead to significant energy savings at minimal cost.

tested and evaluated programs, though researchers indicate that questions remain in regard to program design, implementation, and persistence (Brannan, Podolefsky, and Seiden 2015). Even so, HER programs usually achieve energy savings of 1.2–2.2% for electricity and 0.3–1.6% for natural gas, with these savings dependent on many factors, such as ramp-up and persistence, frequency of delivery, and opt-in and opt-out elements (Sussman and Chikumbo 2016). HERs can reduce energy consumption through direct behavioral changes and also increase uptake of appliance rebates and other home upgrades (Allcott and Rogers 2014).

SOCIAL INTERACTION PROGRAMS

Social interaction can be an effective motivator for energy-efficient behaviors (Mazur-Stommen and Farley 2013). Research has found that social norms enlisted through methods devoid of emotion (such as home energy reports) have less impact than those engaged through personal and emotional interactions, such as an efficiency training workshop or community event (Sussman and Chikumbo 2016). These interactions allow social cues to impact decision making. Social interactions can lead to changes in default behaviors—those that are the norm or are preset—to achieve long-lasting energy savings. For example, competitions and education campaigns can encourage householders to set a dishwasher's default to a shorter cycle or a clothes washer's default to cold water instead of warm, one-time actions that will save energy in the long term (Frederiks, Stenner, and Hobman 2015).

Direct, in-person strategies can effectively influence behavior change and energy savings. They act as a component of other types of behavior change programs and are especially prevalent as part of education and training, energy audit, and SEM programs. Programs that apply behavioral insights in person can be more or less effective depending on how the contractor or in-person educator decides to engage (Sussman and Chikumbo 2017). When a program aims to solicit commitments, set goals, or make actions publicly observable, using an in-person strategy can lead to more effective uptake and outcomes. In-person strategies and community intervention in small markets tend to lead to high levels of customer engagement (Brannan, Podolefsky, and Seiden 2015). Many municipal behavior change programs use some form of in-person strategy to engage with participants, either through educational events or in-home visits.

Competitions and Games

Competitions and games change behaviors using a variety of motivators. Both engage participants using social norms, feedback, fun, challenge, and rewards/incentives. Most competitions and games use a combination of extrinsic rewards (e.g., money, tangible prizes) and intrinsic rewards (e.g., social reinforcement, praise, and a sense of accomplishment and belonging) (Sussman and Chikumbo 2016; Grossberg et al. 2015). These programs tend to also use goal setting, commitments, feedback, and prompts to encourage behavior change (Vine and Jones 2016).

Competitions and games can be very effective with the right groups of people (e.g., close-knit, competitive groups) and can make dramatic changes in people's actions, including behaviors that are hard to change. However there is also a risk that participants will revert to their baseline behaviors after the competition or game ends.

These types of programs vary widely. Sussman and Chikumbo (2016) found that, among the program evaluations assessed in their study, competitions and games yield savings of 0.7–14% for electricity and 0.4–10% for natural gas in residential buildings, and 1.8–21% for electricity in commercial buildings. These savings estimates may not apply to all programs, and more research is needed to calculate an accurate estimate across programs.

Additional Social Interaction and Community-Based Strategies

Most of the programs reviewed in this report could be augmented with additional social interaction components and community-based strategies. Community-based strategies focus on social interactions customized at the community level, and they can target not only neighborhoods but also communities of employees of an organization or workers in a given building. Community-based strategies can lead to higher participation rates, greater understanding of how actions lead to energy savings, deeper and longer-lasting changes, expanded consumer understanding, increased demand for efficiency measures, and stronger relationships (DOE 2017).

Social interaction can make a program plea more personal and activate an emotional connection. Social interaction components can be added in several ways. Programs that make actions public within a community can increase motivation to change behavior (Yoeli et al. 2017). Examples of this include public pledges or commitments, public benchmarking data and disclosure, and badges or stickers indicating energy-efficient actions. In one program, residents who were asked to reduce their energy consumption saved more if they thought their pledges to save would be made public in newspaper articles (Pallak and Cummings 1976). Energy savings from some additional specific behavioral strategies range from 4.4% (goal setting) to 27% (public commitment), with moderate evaluation quality. Some in-person components have also been shown to increase program participation by up to 300% (Sussman and Chikumbo 2016).

EDUCATION AND TRAINING PROGRAMS

Traditionally, government-led energy savings campaigns have assumed an information deficit model, meaning that they aim to use education to help individuals link policy and action (Owens and Driffill 2008). In actuality, information is necessary but insufficient to effect behavior change on its own. For information and education strategies to be effective, they are often combined with energy-efficient technology or weatherization upgrades or other behavioral components. By including information and training into their design, these programs can increase effectiveness, especially when information is targeted and tailored.

Many programs include education and/or training elements to ensure that participants understand how best to achieve long-lasting energy savings. Trainings can be targeted to key stakeholders such as contractors, builders, real estate experts, architects, building operators, energy customers, and residents/tenants, and they may be used alone or alongside other elements, such as a community- or office-wide competitions or home energy audits. Information does increase energy-efficient behaviors, especially when the educational material is credible and easy to understand and the target group is willing to participate (Kang, Cho, and Kim 2012; Costanzo et al. 1986).

Adult Education and Training

Many utilities, local governments, and other stakeholders have designed education and training programs for adult audiences to teach them about energy-saving behaviors. These programs are sometimes targeted toward specific groups, such as underserved community members or specific neighborhoods with high energy bills. Currently, no strong evaluations of energy-saving impacts exist to provide an energy-saving estimate for education and training programs due to difficulties evaluating the energy-saving impacts that directly result from these trainings.

K–12 and Campus Education

Some programs provide energy education for kindergarten to 12th-grade (K–12) students and university students on college campuses. For K–12 students, these programs typically involve classroom education, student commitments to energy saving, and a variety of student-led educational initiatives. Some programs provide students with energy kits to take home to measure direct energy use and savings (Sussman and Chikumbo 2016). These programs often aim to not only educate but also excite children about energy efficiency actions, using competition elements and/or in-person interactions. Theory-based, child-focused energy interventions have the potential to increase energy-saving behaviors among children and their parents (Boudet et al. 2016).

College campuses often design behavior change programs to influence energy use in dorms or university labs. University- and college-run energy efficiency programs tend to have strong program designs and evaluations due to the availability of academic resources.

While evaluations of K–12 and college campus behavior programs are not comprehensive or strong, the studies included in Sussman and Chikumbo (2016) indicate gross electricity savings in schools ranging from 13–37% across programs. More studies are needed to determine an accurate average savings estimate.

Strategic Energy Management

SEM programs are commonly administered in industrial or commercial settings to train representatives on how they can achieve energy savings in their organizations. Energy savings from SEM programs tend to arise from low-cost solutions involving equipment use, maintenance, optimization, and other key factors (Cross 2014). SEM programs often involve a designated energy manager or internal energy champion (NEEA 2014). Many successful SEM programs also include financial incentives for energy managers, such as bonuses for achieving goals, as well as ongoing support and coaching (Ochsner et al. 2015).

Evaluations of SEM programs estimated gross electric savings of 0–22% and gas savings of 0–23%, with moderate evaluation quality (Sussman and Chikumbo 2016). SEM programs are relatively new and are not always evaluated for energy savings. As more evaluations become available, we will be able to determine a better estimate for SEM program savings.

PROGRAM DESIGN APPROACHES

Applied researchers have proposed several evidence-based systems for designing behavior programs, all of which share common steps in diagnosis, implementation, and evaluation. Steg and Vlek (2009) provide a four-step approach. Geller recommends a six-step method

abbreviated *DO-RITE* (Geller 1992). Perhaps the best-known and most commonly used approach is McKenzie-Mohr's community-based social marketing (CBSM) approach (McKenzie-Mohr 2011).

CBSM is a systematic strategy for a behavior change program. The process consists of five steps: 1) Identify a specific behavior to change. 2) Identify barriers and benefits of change within the target population. 3) Select behavior change strategies and develop an intervention. 4) Implement the program. 5) Evaluate the program (McKenzie-Mohr and Schultz 2014). This method allows the customization of programs to specific behaviors, populations, and contexts. Program designers can choose the behavior change strategies that will have the most effective messaging and the greatest impact.

STACKED/MULTIMODAL APPROACHES

Most behavior change programs are multimodal, meaning that they include multiple types of behavior change strategies. Many researchers believe that the most effective behavior change programs are those that stack multiple approaches together, especially elements of information, rational decision making, and social interaction (Mazur-Stommen and Farley 2013; Abrahamse et al. 2007; Gardner and Stern 2002). These multimodal or stacked approaches can more effectively address multiple barriers to program participation and engagement (Brannan, Podolefsky, and Seiden 2015). In addition, Dietz et al. (2009) found that more energy savings arise from a combination of policy tools including social design approaches, such as CBSM.

Even with this potential for added effectiveness, the use of multiple behavioral components does not always lead to better results. Using many behavioral strategies may make a program more expensive to implement and make evaluations of program impact and effectiveness more difficult and complex (McKenzie-Mohr 2011; Sussman and Chikumbo 2016). Multimodal programs are rarely evaluated using experimental or quasi-experimental methods to test their effectiveness. Therefore the efficacy of these combined approaches usually cannot be compared with similar programs that use one method (Sussman and Chikumbo 2016).

Survey and Research Results

In this report, we analyze municipally led behavior change programs we received information about through our survey, alongside information gleaned from additional research. We provide findings in terms of program categories, additional key program information, goals, funding, partners and implementers, energy savings, and evaluations.

In total, we include 50 programs in our analysis, 48 of which were submitted through the online survey and 2 of which emerged from our literature review. Table A1 in Appendix A includes a list of all the programs in the study, including a short program description, as well as the population of the administering municipality or local jurisdiction.

BEHAVIOR CHANGE PROGRAM TYPES

Figure 1 shows the percentage of programs using elements of each behavioral category. Overall, 86% of the programs contain more than one behavioral program category. The most common categories are in-person engagement, competitions and games, and adult

education and training, with each of these elements found in more than half of all programs. Home energy report programs—which are typically run by utilities—and strategic energy management are the least commonly included program elements in our program sample. Table A3 in Appendix A indicates the behavior components included in each program.
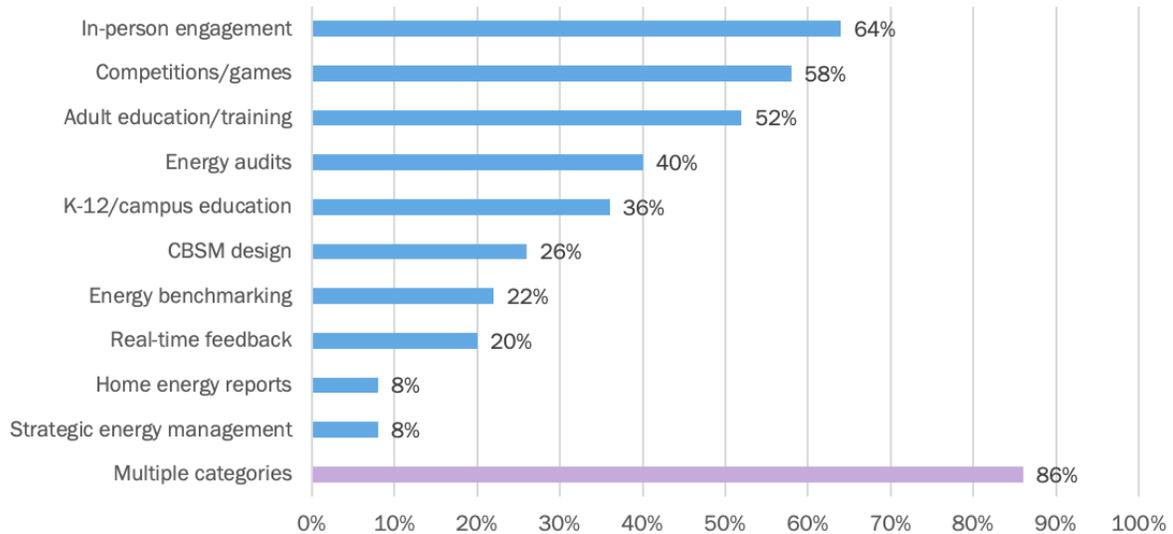
Figure 1. Percentage of programs in study containing behavioral program categories (not mutually exclusive)

While some programs use only one category, others include up to six, with programs averaging three behavior change elements. In-person strategies are most common and can often be easily incorporated into other types of programs, such as education and training, K–12 and campus programs, audits, and competitions and games. For example, Colorado's Boulder County runs a transportation program, the Summer Clean Air Challenge, that uses a competition model to improve summer air quality by encouraging alternative transportation use. In contrast, Portland, Oregon, runs a municipal program called Sustainable City Government that includes a competition element, energy audits, in-person strategies, and adult education and training. Few local governments currently run SEM programs for their internal operations, and home energy reports are also not a common strategy for locally led programs. Even though energy benchmarking can lead to high energy savings if it motivates investments, less than a quarter of programs in this study incorporated benchmarking components.

Augmentation with In-Person Strategies

More than half of the programs in our study were augmented with some form of in-person strategy used as a tool to increase the effectiveness of other types of engagement. In-person strategies often prove more persuasive than other forms of interaction due to liking, rapport, and the sense of connection (Wilson and Sherrell 1993). Municipal governments include in-person interactions in a variety of ways to encourage energy-efficient behaviors. For example, in California, Alameda County's Community Commutes Day uses peer-to-peer information sharing through trained "Clean Commute Champions" to encourage municipal employees to adopt cleaner commute options. This program focuses on the transportation

and municipal sectors and also uses a game-based competition and CBSM techniques to encourage participation.

Another type of in-person strategy is providing expert advice to community members and business owners to encourage energy savings. For example, the Port of San Diego's Green Business Network provides commercial business owners with resources and information to encourage efficient actions to save energy and water and reduce transportation emissions. This program manages a network of 88 businesses—including waterfront industries, hotels, marinas, restaurants, tourist attractions, and retail shops—all of which benefit from the in-person strategies offered through the program. These trainings include educational workshops, networking events, information on rebates and incentives, and one-on-one sustainability advice.

Similarly, Colorado's Boulder County offers the Partners for a Clean Environment (PACE) program to the commercial and industrial sectors. The program provides free expert adviser services, financial incentives, and a certification program to help businesses measure and gain recognition for their achievements in energy, waste, water, and transportation efficiency. The program matches businesses with advisers who help them identify specific opportunities, ranging from employee engagement and low- and no-cost measures to large efficiency upgrades and other sustainability improvements. Numerous aspects of interpersonal interactions, such as developing rapport and gaining commitment, help make the program effective. As of 2018, the conversion rate from a business receiving advising to completing an energy efficiency upgrade is 46%.

Some programs focus engagement on specific partners and communities. For example, in Montgomery County, Maryland, the Let There Be Light Bulb Exchange program partners with the county and various faith communities within it to educate individuals about basic sustainability and energy conservation actions. Through events at congregations, residential customers can they swap out inefficient light bulbs for LEDs and sign up for a Quick Home Energy Checkup (QHEC). A QHEC is an in-person service run through the local utilities in which an energy efficiency professional checks the condition of a residence's insulation, heating and air-cooling system, lighting, and appliances, as well as provide energy-saving smart strips, light bulbs, and efficient showerheads. This service is offered through the utility-funded EmPOWER Maryland energy efficiency program, available at no additional cost to ratepayers.

Competitions and Games

Competition and game strategies are often used by local governments to encourage energy-saving actions in their communities or internal operations. These programs focus on different sectors, such as neighborhoods, cities, businesses, schools, dormitories, and municipal government offices. Some competitions focus on changing commuting behaviors and transportation use, while others focus on home, business, or office energy-saving actions. Notably, these programs capitalize on trusted messengers (i.e., community members) or energy champions to advocate for the program. Among all social influence strategies, energy champions (also known as block leaders) may be the most effective for encouraging pro-environmental behaviors (Abrahamse and Steg 2013).

One example of a program operating on the neighborhood level is the residential Green Living Challenge in Arlington County, Virginia. This friendly competition between neighborhoods ran from 2007 to 2008. The Challenge included a checklist of about two dozen actions (e.g., getting an energy audit, installing efficient lighting, walking or biking instead of driving to work once a week). At the end of the year, the neighborhoods with the most participants and deepest average participation (actions per participant) were recognized by the county and partner organizations. The program incorporated other behavioral elements, such as in-person strategies, energy audits, and social norms.

Some programs focus on encouraging energy-saving actions. For example, in January 2018, in collaboration with neighboring California cities, San Leandro launched a social media-based behavior change effort called GoGreenSL to address the residential and transportation sectors. GoGreenSL encourages residents to take energy-saving actions in their own home and accumulate points on behalf of their neighborhood, school, or other community-based organization. The program especially engages high school students in the San Leandro school district to encourage their families and neighbors to join in the energy-saving challenge.

Case Study: Alameda County Community Commutes Day

In 2016, California's Alameda County held a Community Commutes Day competition to encourage government employees to change their behavior in regard to sustainable transportation. The county's climate action plan motivated the competition as a way to address the high carbon impact of municipal employee commutes. Community Commutes Day used community-based social marketing to influence employees' commuting practices. The goal of the program was to encourage employees to switch from driving to cleaner and more efficient commute options such as carpooling, taking the bus, and bicycling.

Before this one-day event, the county ran a month-long online game that encouraged municipal building employees to compete as teams against other buildings for points. They could earn points by completing tasks like encouraging colleagues to consider clean commute options, signing up for these options themselves, and submitting photos of their own clean commutes. The program's goal was to aim for "small steps, big difference."

This program successfully used social diffusion and social norms to encourage clean commuting. It used fun and engaging tactics for visibility, such as filling shuttle buses with balloons, visiting buildings to talk to employees who expressed interest in clean commuting, and encouraging enjoyable competitive activities. Ultimately, Clean Commutes Day surpassed its goal of 600 participants by engaging 750 employees, 135 of whom were first-time clean commuters. The county faced a participation challenge due to some staff facing barriers to using the online platform, as some staff are less familiar with computers and do not use them at work. This challenge led to new program developments such as removing the log-in requirement and using more in-person rather than digital communications.

Alameda County's advice for other local governments who want to launch a similar program is to think about employee diversity and how different individuals engage and learn. Keep clear about your goals and reach out to all groups, even those who you'd least expect to participate. You may be surprised!

Some local governments participate in statewide energy-saving challenges. For example, the CoolCalifornia Challenge is an intercommunity residential program to see which city in California can achieve the greatest reduction of greenhouse gas emissions from household energy and transportation use. Participating households track transportation and home energy use to earn "green points" for having low greenhouse gas emissions relative to similar households, and bonus points for lowering their emissions over time. Participants

can also earn points by sharing their stories and photos on the program website. The city earning the most points at the end of the program is named Coolest California City.

Some competitions encourage nonresidential sectors to save energy. While not a local government example, the statewide Michigan Battle of the Buildings program—modeled on the ENERGY STAR® Battle of the Buildings Challenge—encourages commercial, municipal, and industrial buildings to compete for awards and recognition from energy-saving achievements. The competition is hosts an annual Energy Summit with 250–300 attendees as well as periodic local engagement activities. Overall, the Challenge has included participants representing 192 million square feet of building space and saved approximately $10 million in energy costs.

Adult Education and Training

Many programs focus on strategies to change adult behavior through education and training. Most of the training programs in this study focus on the residential sector, with a few also targeting commercial and municipal operations. For example, multiple local governments in the Los Angeles area run Lunch 'n Learns for Saving Money and Energy, which provide education and training to municipal staff on a variety of topics. Similarly, in Oregon, Portland's Sustainable City Government program aims to create a healthier and more equitable workplace for municipal employees through technical assistance and advocacy. It conducts a number of trainings and office-wide challenges that aim to encourage staff to bike to work, reduce waste, and lower fleet emissions.

While many programs include training as part of a larger effort, some focus entirely on education and training strategies. For example, in Canada, the Empower Me program in the cities of Vancouver, Calgary, Edmonton, and Surrey and the township of Langley is a free education and energy conservation initiative that helps residential multilingual and multicultural communities save energy and make their homes more comfortable and safer. The program hires mentors from these communities, creating both employment opportunities and a trusted bridge for communication among peers.

Another example of an education program with an equity focus can be found in Sarasota County, Florida. Its residential Energy Upgrade program offers an hour-long energy-saving training and a do-it-yourself (DIY) energy-saving kit for interested community members. Local nonprofits partner with the county to schedule trainings for community members and groups. Since 2016 the program has included an equity focus and aims to serve low-income groups through its nonprofit partnerships. In late 2018, administrators plan to add in-home energy evaluations and consulting to the educational components of their program (Sarasota County 2018).

Energy Audits

All the programs in our study that include energy audits also include other behavior change methods, such as in-person strategies or adult education and training. Many audits also serve as a component of a competition or game program. These programs offer either in-person or virtual energy audits to help households or businesses better understand their energy use and identify opportunities for energy efficiency upgrades. The Takoma Park (Maryland) Energy Challenge and the Kukui Cup Project in Honolulu are examples of

programs that have provided materials for households and student housing to conduct virtual self-audits of their residences. In contrast, programs such as the Bozeman (Montana) Energy Smackdown provide free household energy audits by the local utility, along with an online platform allowing residents to track their energy use to encourage energy upgrades. In Campbell River, Canada, the Power Down Campbell River program has provided free home energy evaluations to more than 150 households for committing to a specific retrofit or behavior change in their home, with a focus on low-income households.

K–12 and Campus Education

Numerous programs provide education to K–12 and college students in regard to saving energy and changing habits. These programs tend to include in-person strategies, competition and game elements, and in some cases real-time feedback. For example, the Austin Energy All-Stars program provides materials for teachers to use in the classroom. The Energy All-Stars program contains a curriculum for sixth-grade teachers to teach about and experiment with products that save energy in residential homes and increase home comfort. The program partners with a third-party vendor to recruit teachers from public, private, and charter schools to adopt the five-day curriculum into their science instruction. The curriculum includes a teacher guide, student workbooks, student guide, a classroom kit, and student kits to take home to their families. The student kits include a number of energy-saving products such as an advanced smart power strip, LED bulb, return air whistle, digital thermometer, and other education materials, plus instructions on how to properly use each product.

Most programs target either K–12 or college students, though one program in this study targets both groups using real-time feedback and other behavioral strategies. The Smart and Connected Kids for Sustainable Energy Communities program in Fremont, California, was launched in 2017 and will run for three years. The program, funded by the National Science Foundation in partnership with Oregon State University and Stanford University, utilizes multiple behavior change strategies to reach young people and their families.[5] The program focuses on residential energy-saving strategies and includes real-time data feedback and educational programming to encourage energy savings among K–12 and college students, while tasking them with using plug load devices to measure appliance energy use in their homes. The program uses human-centered design methods to teach development of individualized energy reduction plans, prototyping and testing of plans, and pitching energy reduction to family and community members.

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[5] The National Science Foundation (NSF) is an independent federal agency created by Congress in 1950 to promote the progress of science and to advance the national health, prosperity, and welfare. NSF has an annual budget of $7.5 billion (FY 2017) and funds about 24% of all federally supported basic research conducted at colleges and universities. For more information, see www.nsf.gov/about/.

Real-Time Feedback

Some programs collaborate with a utility or university to provide real-time information, such as through an in-home display or phone app.[6] The previously mentioned Smart and Connected Kids for Sustainable Energy Communities program in Fremont, California, utilizes real-time feedback for students to encourage energy savings.

Some municipal governments partner with investor-owned utilities to provide real-time feedback. For example, the Energize Phoenix program partnered with Arizona Public Service to provide real-time feedback to encourage energy savings. As part of the program, the city ran two pilot studies—one in an undergraduate residence hall and the other in a low-income, publicly subsidized apartment complex—to measure the impact of real-time electricity use feedback on energy consumption. The program determined that real-time feedback may lead to greater energy savings than alternative strategies. The program evaluation found that between 2011 and 2013, participants achieved an average of 8% (residential) reduction in energy use.

In some cases, universities partner with local governments or utilities to help evaluate real-time feedback programs. For example, the Burlington (Vermont) Electric Department—a municipal utility—worked with the University of Vermont (UVM) to design, implement, and evaluate a randomized, controlled trial of real-time energy information feedback and incentives in residential renters (UVM students and others living in off-campus apartments) in Burlington. This program, called Rental Customer Experience with In-Home Displays, collected data during the 2015–2016 academic year for 240 single-family and multifamily households with UVM undergraduate, graduate, medical, and continuing education students and nonstudents. The pilot program results suggest that the residents enjoyed having the real-time information and were interested in continuing to use the technology. The study also found that the home environment and personal user preferences were important variables that impacted customer cost savings and grid benefits.

Energy Benchmarking

As of September 2017, 25 cities across the United States had enacted benchmarking policies for public, commercial, and/or multifamily buildings (IMT 2018). Municipalities can lead by example by requiring public buildings to benchmark energy use, and they can also create voluntary guidelines or mandatory requirements for large commercial and multifamily buildings to do so as well. Benchmarking improves building owners' understanding of energy consumption patterns, helps identify energy savings opportunities, and helps building operators manage their bottom line through consistent data collection and tracking.

Through our survey and research, we identified examples of jurisdiction-led benchmarking programs. Some use benchmarking as the main energy-saving strategy, such as the Mid-Ohio Regional Planning Commission (MORPC) Benchmarking Program; the Montgomery

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[6] For more information and strategies for fostering and building local government-utility partnerships, see ACEEE's online toolkit at aceee.org/sector/local-policy/toolkit/overview-local-govt-utility.

County (Maryland) Commercial Building Energy Benchmarking program; Orlando's Central Florida Battle of the Buildings; and Energize Denver.

In most cases, the local government facilitates building owners in publicly disclosing their benchmarking energy data. Each ordinance has different building requirements and necessitates different data follow-up. For example, Montgomery County and Denver both have benchmarking programs that require large buildings to use ENERGY STAR Portfolio Manager to benchmark certain commercial buildings over a specified square footage (50,000 square feet in Montgomery County and 25,000 square feet in Denver). Both municipalities have used the data to create interactive online maps, which can help increase the value of energy efficiency in the building market (City and County of Denver 2018; Montgomery County 2018).

Case Study: Arlington, Virginia's Green Games

Arlington Green Games ran from October 2010 to December 2011 and targeted energy savings in the commercial office sector, which constitutes the county's largest greenhouse gas emissions source. The program aimed to engage building owners through data benchmarking and tenants through behavioral and operational changes to reduce energy and water use. Green Games based its marketing and design on the Olympic Games, making it fun and emphasizing friendly competition among buildings.

The first iteration of Green Games proved successful for the commercial office sector due to extensive staff engagement. Staff members recruited building owners and tenants in person and made the program a resource for participants by organizing mingling sessions, panel discussions, and expert webinars throughout the year. The program included 140 participating tenants, and more than 14 million square feet of commercial space was benchmarked in Portfolio Manager over the course of the program.

However Arlington faced challenges when it attempted to expand the program to other sectors, such as retail and restaurants, apartments and condominiums, and hospitality. County staff experienced limited success recruiting participants from these sectors, which led to the county putting the program on hold. It found that motivations for office property owners and managers to participate differed from those in these other sectors, and the county's strong relationship with the commercial sector had helped the original program succeed. John Morrill, Arlington County's energy manager, attributes the success of the original program to the fact that it was "not passive engagement with participants, but active and personalized." The county is building on this lesson as it designs and delivers other energy-saving programs.

Some programs include audit requirements alongside benchmarking policies. These programs can require buildings that meet certain criteria (e.g., energy use, building age) to complete an energy audit after submitting benchmarking data. Audit and benchmarking requirements can help influence the energy-efficient behaviors and buying decisions of building owners. Some cities have put this into practice. For example, in 2013 Boston established the Building Energy Reporting and Disclosure Ordinance, which

requires residential and commercial buildings that are not ENERGY STAR certified or do not have documented energy reductions to take an "energy action" such as an energy audit (City of Boston 2018). Similarly, Austin has the Energy Conservation Audit and Disclosure Ordinance, which requires all homes and multifamily buildings of more than five units that are at least 10 years old to have an energy audit performed at the time of sale, with results disclosed to prospective buyers (Austin Energy 2008).

Home Energy Reports (HERs)

While many utilities run home energy report programs, they are less commonly run by local governments. Some municipal utilities run HER programs through Opower and other vendors, such as those in Gainesville, Florida; Boulder, Colorado; Seattle; and Sacramento. Other programs provide community members with monthly energy-use data along with comparisons and tips; among these is the Bozeman (Montana) Energy Smackdown. This program partnered with WattzOn to offer automatic utility bill tracking; personalized activities, tips, and resources; information on rebates and grants; and monthly emails detailing energy-use data and low- and no-cost energy reduction strategies.

Strategic Energy Management

Municipal governments have the opportunity to lead by example and ensure that their municipal facilities are operated efficiently by city staff. SEM programs allow continuous energy performance improvements by incorporating energy considerations and energy management into daily operations using set processes and systems. The US Department of Energy (DOE) and Northwest Energy Efficiency Alliance (NEEA) formed a team of experts to develop a framework to enable cities to lead by example by developing and enacting SEM programs (NBI 2018).

This report includes two locally led programs that worked with NEEA and US DOE to develop SEM programs. The first is the Community Strategic Energy Management program in Eugene, Oregon, which provides a long-term approach to energy efficiency in public building portfolios, using SEM principles to achieve energy savings. The program streamlines the benchmarking process, creating a replicable template that can be used in decision making for future municipal building upgrades, while also standardizing performance reporting and improving communication between departments and between key staff and policymakers. The Community SEM plan establishes clear performance targets for both high-performance and lower-performance buildings. In this way, the group avoids a common problem inherent in competitions, the potential for those performing worst to stop trying. Eugene's building inventory includes 60 facilities, including police and fire stations, offices, airport buildings, community and recreational facilities, public service buildings, warehouses, shops, and other buildings.

Second, with the Community Strategic Energy Management Plan, the city of Missoula, Montana, aims to lead by example in achieving carbon reduction goals. The city's SEM program includes benchmarking and remote diagnostic data for 33 of the city's 65 facilities using ENERGY STAR Portfolio Manager. The city conducted a deeper analysis of a subset of 19 buildings, including fire stations, public service buildings, offices, one museum, and other building types. The city also formed an energy team with an energy conservation coordinator to better use the SEM data and achieve its emissions reduction goals.

PROGRAM ADMINISTRATION AND DESIGN

In this section we discuss programs by sector, notable elements, goals, local government offices, partners, funders and funding, development and motivation, and energy savings and evaluations. We include program-level information in Appendix A.

Sectors

Figure 2 shows the percentage of programs in our study targeted at each sector. Local government-led programs focus on the residential sector more than any other, followed by the municipal and commercial sectors. Overall, 46% of programs target multiple sectors.
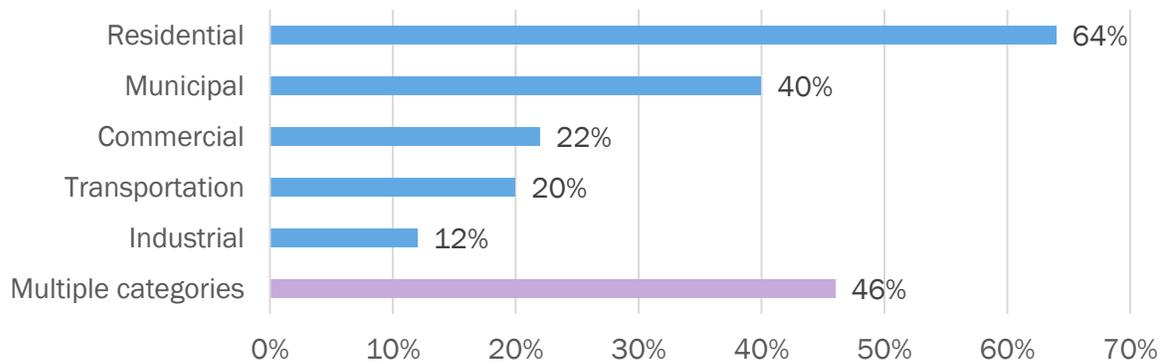

Figure 2. Percentage of programs in study serving each sector (not mutually exclusive)

Notably, 40% of the programs that include the transportation sector focus only on that sector. Similarly, more than half of the programs that serve the residential sector focus solely on that sector. Within the municipal sector, programs target municipal government operations, local employee commuting options, and local school districts. Table A2 in Appendix A indicates which sectors each program serves.

Case Study: Fort Collins Know Your Numbers

In 2017 the city of Fort Collins, Colorado, launched a pilot of the Know Your Numbers program, a lead-by-example effort to encourage employees in local government operations to reduce their energy use in order to help advance the goals of the city's climate action plan. The city's sustainability staff identified some government office buildings that were not meeting the city's energy goals and aimed to create a program to increase knowledge and reduce energy use through changes in behavior.

The program was split into three phases built on community-based social marketing strategies. During the first phase, aimed to increase awareness of the program, the city provided energy-use data to each municipal office building as a baseline from which to improve. The second phase focused on action and included pledges, micro-challenges, and energy audits. This phase tracked participants' pledges and completion of tasks using the city's online platform, Engage. The third phase included recognition and awards for all who contributed.

The 2018 program incorporated changes based on the lessons learned from the pilot. The city decided to shift the program to run during winter months instead of the summer, as it wanted to focus on lighting behavior and employees use more lighting in the winter months. The city also identified the need for clearer communication about the purpose of the challenge, dedicated staff to manage the challenge, and a clear program and process plan for knowledge transfer. Moreover, it found that having executive-level support proved key to encouraging staff to participate. As the program moves forward, the city will continue to focus on employee engagement and aim to make energy-use reduction not only data driven but fun, so that staff enjoy making a difference.

Goals

The majority of local governments indicate that their primary behavior program objectives include achieving reductions in either energy use, greenhouse gas emissions, water use, or waste production. Local governments also cite community engagement, economic development and job creation, and equity or energy affordability as main goals of their behavior change programs.

Some local governments lay out multiple, complementary goals for their behavior programs. For example, New York City's NYC Carbon Challenge focuses on a variety of program objectives to achieve savings in the residential and commercial sectors. The program's goal is a 30% to 50% reduction in building-based greenhouse gas (GHG) emissions. This will improve local air quality and the health and well-being of New Yorkers, create jobs, lower energy costs, and help the city reach its goal of reducing GHG emissions by 80% by 2050.

Some local governments indicate that achieving climate action plan goals was the major motivator for the development of their behavior change program. For example, in Fort Collins, Colorado, the Know Your Numbers and Take Two programs both aim to help the city meet its climate action plan goals: a 20% carbon emissions reduction by 2020 (relative to 2005 levels), 80% by 2030, and carbon neutrality by 2050. Similarly, the Let There Be Light, Bulb Exchange program in Montgomery County, Maryland, aims to help the county achieve its ambitious climate goal of zero emissions by 2035. Energize Denver aims to contribute to the city's 80x50 Climate Action Plan and its goal to reduce carbon emissions by 80% below 2005 levels by 2050.

In Saint Paul, Minnesota, the Race to Reduce program aims to illustrate the city's engagement on energy efficiency and climate change by reducing utility bills in the residential, commercial, and municipal sectors. The city's intent is to act as a one-stop shop and expert resource to help manage energy costs and implement best practices in operations and maintenance. This reduces barriers to action by using the simple behavioral principle that making actions easier makes them more likely (Yoeli et al. 2017). The program also aims to make the city more resilient, reduce GHG emissions, and take concrete steps toward achieving the city's climate action plan goals.

Many of the programs targeting transportation indicate that reducing air pollution and improving air quality are program goals. For example, in San Antonio, the Breathe Today, SA Tomorrow campaign aims to raise awareness and garner community-wide participation in mitigating air pollution and improving air quality.

In addition, five of the localities in our study—Claremont, California; Takoma Park, Maryland; Park City, Utah; Summit County, Utah; and Madison, Wisconsin—state that their behavior program emerged from their participation in the Georgetown University Energy Prize. The Georgetown prize challenged local governments to develop innovative, replicable, scalable, and continual reductions in per capita energy use through new program designs. The first-place city—Fargo, North Dakota—received a variety of consulting services and recognition (Georgetown University Energy Prize 2018).

Focus on Low-Income Customers

While local governments do not limit eligibility of any behavior programs to low-income residents, 16 programs indicate that they specifically target low-income households and communities for program enrollment. For example, the Empower Me program in Canada—serving the cities of Vancouver, Edmonton, Calgary, and Surrey and the township of Langley—focuses on low-income customers, as does the Energy Upgrade program in Sarasota County, Florida. Table A2 in Appendix A indicates which programs include a low-income focus.

Some programs with a low-income element use direct engagement with low-income community members through workshops and trainings. For example, in Chattanooga, Tennessee, the Empower Chattanooga program uses community action and advisory groups, as well as CBSM strategies, to encourage local residents to save energy and take control of their utility bills. They aim their workshops and training at low-income communities, while also working to build relationships with neighborhoods and community partners to better reach and connect with low-income residents.

Another example is the Way to Save, Burlington! program, which ran from 2010 to 2014 in Burlington, Wisconsin, piloting a CBSM approach to marketing energy efficiency programs in the residential, commercial, municipal, and industrial sectors. The program tested three core elements. First, it introduced an Energy Ambassador who engaged directly with the community to identify and eliminate barriers to participation. Second, it formed an Energy Task Force, made up of volunteer community leaders who served as an advisory board to the program. Last, the program ran a Community Challenge with goals of saving energy and increasing participation using pledges.

Funding and Funders

Programs vary greatly in terms of funders and budgets. While municipal governments typically provide some internal funding for their locally led programs, many also form strategic partnerships with other organizations for additional financial support. Some receive funding from for-profit organizations, state or federal government programs or grants, individual donations, nonprofit groups, or foundations. Utility ratepayer charges on customer bills also support multiple programs. Table 2 shows funding and budget information for programs in this study that made these data available. For more details on each program and the population served, see table A1 in Appendix A.

Table 2. Municipally led behavior change programs by primary funder and program budget

State	Municipality	Program	Primary funding source	Budget
AZ	Phoenix	Energize Phoenix	Federal funds	$27 million total (2011–2013)
CA	Fremont	Fremont Green Challenge	Municipal funds	$10,000 annually
CA	Fremont	Smart and Connected Kids for Sustainable Energy Communities	Federal funds, university funds	$999,951 (2017–2020)

State	Municipality	Program	Primary funding source	Budget
CA	Numerous	Lunch 'n Learns for Saving Money and Energy	Utility ratepayer funds	$1,400 per event
CA	San Leandro	GoGreenSL	Municipal funds	$23,000 annually
CO	Boulder County	EnergySmart	Municipal funds	$800,000 annually
CO	City of Fort Collins	Efficiency Works Neighborhoods	Municipal funds, Platte River Power Authority, American Public Power Association grant	$420,000 total (2015–2016)
CO	City of Fort Collins	Take Two	Municipal funds, Platte River Power Authority, Urban Sustainability Directors Network	$50,000 (est.) (June–Aug. 2018)
FL	Sarasota County	Energy Upgrade	Federal grant, municipal funds	$176,500 total
HI	Honolulu	Kukui Cup	National Science Foundation, HEI Charitable Trust	$400,000 total
MD	Takoma Park	Takoma Park Energy Challenge	Municipal funds	$211,000 total (2015–2017)
MN	Saint Paul	Race to Reduce	Foundation	$2,500 (2018)
MT	Bozeman	Bozeman Energy Smackdown	Municipal funds, utility, state government	$14,000 annually (2012–2017)
NY	New York City	NYC Carbon Challenge	Municipal funds (levied through taxes)	1 full-time staff member and 1 intern
TX	Austin	Austin Energy All-Stars	Utility ratepayer funds	$200,000 annually
UT	Park City	Library Conservation Kits and Challenge Website	Municipal funds, Urban Sustainability Directors Network, Marketing for Action	$20,000 annually
UT	Summit County	Summit Community Power Works	Utah Clean Energy, municipal funds, utility ratepayer funds, foundation grants, private donations, corporate sponsorships	$363,531 total (2015–2016)
VA	Arlington County	Arlington Green Games	Municipal funds, Energy Efficiency & Conservation Block Grant (EECBG) funds	$160,000 annually
VA	Arlington County	Green Home Choice Program	Municipal funds	$110,000 annually
VA	Arlington County	Green Living Challenge	Municipal funds (strictly staff liaison)	$0 (volunteer-based)
VT	Burlington	Rental Customer Experience with In-Home Displays	Municipal funds, utility funds, university funds	$141,448 total (2015)
WI	Burlington	Way to Save, Burlington!	Utility ratepayer funds	$350,000 annually
WI	Madison	Green Madison	Municipal funds, some community sponsorships	$249,000 total (2015–2016)

State	Municipality	Program	Primary funding source	Budget
WI	Milwaukee	STEMhero	Municipal funds	$6,000 annually

Program budgets vary widely based on program goals and objective as well as on target population size. Programs with larger budgets tend to have wider mandates that include multiple program elements or larger municipal areas. For example, Boulder County's EnergySmart program budgets $800,000 annually for energy experts to prioritize projects, provide income-qualified and non-income-qualified incentives, offer low-cost financing to make energy upgrades easy for residents, and manage a prequalified contractor pool. The Bozeman Energy Smackdown is a smaller-scale program that utilizes a $14,000 annual budget to run an annual residential energy conservation competition.

Table 3 shows some of the most common funding sources for locally led behavior programs in this study by category, including federal government, utility, nonprofit, and for-profit sources. The table also gives program examples for each category.

Table 3. Common funders by funding category

Category	Funder	Program examples
Federal government	American Recovery and Reinvestment Act (ARRA)	Energize Phoenix
	US Department of Energy's Energy Efficiency Community Block Grants (EECBG)	Arlington Green Games
	National Science Foundation	Fremont Smart and Connected Kids; Honolulu Kukui Cup
Nonprofit	American Public Power Association (APPA) Deed Grant	Fort Collins Efficiency Works Neighborhoods; Burlington Rental Customer Experience
	Urban Sustainability Directors Network	Fort Collins Take Two; Park City Library Conservation Kits and Challenge Website
	City Energy Project	Saint Paul Race to Reduce
	Universities (various)	Honolulu Kukui Cup; Oberlin Ecolympics; Burlington Rental Customer Experience
	Local charities and donations	Empower Chattanooga
For-profit	Business sponsors (often for specific events or prizes)	Boulder Summer Clean Air Challenge; Michigan Battle of the Buildings; Oberlin Ecolympics; Green Madison

Partners and Implementers

While local sustainability offices are the most common leaders on energy-saving behavior change programs, many other municipal offices also implement programs. These include municipal departments of energy, environmental protection, transportation, planning and economic development, housing and urban development, education, and health and human services.

Some programs involve multiple local departments. For example, Park City, Utah's, Library Conservation Kits and Challenge Website program involves engagement with the Park City municipal Environmental Sustainability, Community Engagement, Housing, Library, and Water teams. The Takoma Park Energy Challenge was designed and is administered by the sustainability manager in the Department of Public Works, with help from the director of public works and input from Housing and Community Development and other city departments.

Some local governments partner with local nonprofits in order to expand their reach and impact in the community. For the Let There Be Light, Bulb Challenge, the Montgomery County (Maryland) Department of Environmental Protection (DEP) partners with various congregations to educate residents about basic elements of sustainability with an emphasis on energy conservation and energy cost reduction. The DEP also partners with local utilities—including Pepco and Potomac Edison—while providing LED light bulbs to engage the community around energy-efficient education and action.

Program Performance and Evaluations

The evaluation of programs in this study varies greatly by format and data type. Most local governments collect some data on their program's energy savings and impacts but do not conduct formal evaluations. Most look at energy savings as a percentage of sales or in terms of total kilowatts (kWh) or therms, and many also consider dollars saved and participant numbers. Table A4 in Appendix A contains savings and evaluation details for programs with available information. Due to the great variation among evaluation approaches, we were unable to compare program impacts.

Overall, about half of the programs in this study track some sort of performance metric, either provided through their survey submission or publicly available in a published report or an online source. Program performance metrics, shown in table A4, include:

- Total energy saved (kWh, therms, BTU)
- Percentage of energy saved (pre and post)
- Dollars saved
- Number of program participants
- Carbon emissions reduced
- Additional miscellaneous metrics such as pledges made, actions taken, gallons of water or gasoline reduced, and energy audits completed

Few of the programs conduct independent third-party evaluations on program energy savings and cost-effectiveness. The Way to Save, Burlington! program in Wisconsin was evaluated by a third party in 2013 for We Energies, the investor-owned utility serving Burlington (We Energies 2013). The evaluation report explored program outcomes, key findings, and lessons learned from the pilot. The process evaluation indicated that customers who participated in the program by making a pledge reported adopting energy-efficient attitudes and behaviors. Even so, the evaluation found that customers in the participant group were not more likely to adopt efficient behaviors than the control group. Finally, the evaluation found that participants in the program were more likely to

participate in other energy efficiency programs and concluded that the act of making a pledge to save energy did result in increased energy efficiency among the highly engaged.

The New York City government periodically evaluates the progress of the NYC Carbon Challenge. The 2018 progress report found that since 2007 the program has lowered GHG emissions by 580,000 metric tons of carbon dioxide equivalent and saved $190 million annually in energy costs. The report also estimated that 1,600 local construction-related jobs had been created and that local air quality had improved due to reductions in particulate matter of 58 metric tons (City of New York 2018). While the evaluation was not conducted by a third party, the city has been continually tracking the program's progress through a variety of metrics.

PROGRAM DESIGN ELEMENTS

Many programs contain similar elements to foster behavior changes. Here we review program design elements, identifying prevalent and noteworthy strategies. These include the use of online platforms, prizes and rewards, pledges, community events, and certifications.

Online Platforms

In our study, ten competition programs use online platforms to engage community members, increase participation, and track engagement, progress, and competition winners. The online platforms have varying levels of complexity. Some allow participants to log actions that could translate into energy savings, while others connect directly with utility data to provide actual energy savings feedback. The following programs involve online platforms:

- Alameda County, California—Community Commutes Day
- Fremont, California—Fremont Green Challenge
- San Leandro, California—GoGreenSL
- Boulder County, Colorado—Summer Clean Air Challenge
- Durango, Colorado—Way to Go! Club
- Honolulu—Kukui Cup
- Bozeman, Montana—Bozeman Energy Smackdown
- Portland, Oregon—Sustainable City Government
- Park City, Utah—SCPW Challenge Website
- Madison, Wisconsin—Green Madison

Some local governments develop their own, independent websites to run their challenges. For example, the Fremont Green Challenge is an online residential climate action engagement platform that offers households information to save energy and water, suggesting 66 residential actions related to energy efficiency, transportation, water, home energy systems, and food waste. Actions are sortable according to level of ease, carbon impact, and user friendliness. This platform was the only program submitted in this study that provides residents with custom savings and impact estimates by using actual energy consumption data provided by the utility.

In contrast, some local governments utilize existing challenge website infrastructure to promote energy savings. For example, Portland's Sustainable City Government program focuses on saving energy and money and cutting carbon emissions while also building a more equitable workplace. The program's Green Team plans and implements challenges throughout the year utilizing existing websites such as EcoChallenge.org and BikeMoreChallenge.org. While the municipal government does not independently create these online platforms, it does form teams and encourages city staff participation.

Prizes and Rewards

Researchers have found that rewards, including noncash incentives, can be strong motivators for behavioral change (Bichard and Thurairajah 2013). Sixteen programs in this study, especially those using competitions and games, provide prizes, recognition, or rewards for participants who achieve significant energy savings. Some have prizes donated by local businesses, while others purchase them using the program's budget.

One example of a program using rewards and incentives is the Way to Go! Club program in Durango, Colorado. This is a point-based rewards program, similar to airline miles, that allows members to earn milestone gifts and rewards as they use sustainable transportation methods. Launched in 2014, the program collaborates with local businesses that offer donated or reduced-price prizes to incentivize non-driving transportation methods. Participants log on to an online platform where they can see their point totals and how their actions translate into emissions savings. Similarly, in Wisconsin, a nonprofit run organization created an energy efficiency game called Cool Choices, in which participants can choose from 58 actions in four categories, with more difficult actions earning more points. Numerous workplaces, such as the Milwaukee fire department, have implemented this program for competitions among employees. The points that participants earn do not translate into cash or physical prizes, but rather garner virtual participation rewards. The program has proved that small incentives, such as earning virtual points, can effectively motivate behavior change.

Another example of the use of rewards is provided by the PowerDown! Energy Reduction Competition in Baltimore, which encourages participating public schools to lower their electricity usage by providing prizes to the first-, second-, and third-place schools. The program has run in 2015, 2017, and 2018, with 15 schools participating in the latest challenge. Each school appoints a local energy champion who works with students to educate the school community about the benefits of conserving energy and encourages energy saving through behavior change.

Pledges

Ten programs in eight locales use pledges in order to encourage behavior change. A number of behavior change studies have found that commitments and pledges increase participation and engagement. A public and long-term commitment enhances the likelihood that an individual will engage in the committed behavior, while also fostering social norms and social diffusion (McKenzie-Mohr 2010). The evaluation of the Way to Save, Burlington! program in Wisconsin found that pledges did lead to increased energy efficiency. The following are programs in this study that include pledges:

- San Leandro, California—GoGreenSL
- Boulder County, Colorado—Summer Clean Air Challenge
- Fort Collins, Colorado—Know Your Numbers and Take Two programs
- Honolulu—Kukui Cup
- Takoma Park, Maryland—Takoma Park Energy Challenge
- New York City—NYC Carbon Challenge
- Arlington County, Virginia—Arlington Green Games and Green Living Challenge
- Burlington, Wisconsin—Way to Save, Burlington!

Community Events

Many programs include community events as a way to increase participation and engagement. Some programs include one event as the main focus, while others have periodic events. Orlando's Central Florida Battle of the Buildings, initially held from July through December 2017, used community events as a way to engage local businesses in a benchmarking program. The program began with a launch event that provided an in-person opportunity to learn about the competition and socialize with other competitors. The awards ceremony after the competition recognized the leaders in energy reduction across a variety of categories and provided an additional opportunity for in-person interaction. Another example of a program that focuses on community events and engagement is Ohio's Oberlin Ecolympics. This is an annual water and electricity conservation competition run by Oberlin College for dormitory and co-op residents, local public schools, and college offices that features community events and workshops.

Certifications

Voluntary certifications—which give building owners recognition for achieving certain levels of building efficiency—act as another motivator by making energy-efficient behavior publicly observable and allowing owners a potential marketing edge over competitors. Three programs in this study created their own certification schemes to encourage energy savings in buildings: the Takoma Park Energy Challenge, Arlington County's Green Home Choice Program, and Portland's Sustainability at Work.

The Takoma Park Energy Challenge in Maryland was a two-year effort to increase energy efficiency citywide by encouraging neighborhood teams to achieve a Green Home Certification. The city developed the certification with three levels: Light Green, Medium Green, and Dark Green, with teams earning varying points depending on the level of certification each home achieved. The certification motivated residents to achieve the next level by offering clear, step-by-step instructions on how to reduce home energy consumption even further. The certification differed for single-family homes and renters and multifamily units so that all households in the city could participate.

The Green Home Choice program in Arlington County, Virginia, helps homeowners, builders, and designers create more energy-efficient homes by certifying residences that meet certain criteria for renovations or new construction. To achieve the certification, homes earn points for energy and resource efficiency, durability, and a healthy living environment. The program involves in-person consulting throughout the project and integrates energy efficiency and stormwater management rebates. As of 2018, 325 homes had achieved the certification.

Portland, Oregon's Sustainability at Work program, launched in 2007, encourages energy efficiency in businesses by awarding Sustainability at Work certification through onsite verification. The program aims to motivate and push businesses to adopt more sustainable practices to achieve higher levels of certification. There are three levels, and each level provides certain benefits, awards, and prizes. The Certified level earns a window decal and a business directory listing; Silver wins a profile in the directory and a spotlight at sustainability events; and those at the Gold level receive an award plaque.

FINDINGS

This section includes some of the key findings and takeaways from this study, such as trends in behavior change strategies across sectors, program diversity, program duration, and program evaluations.

Sectors

Almost half of the programs in this study aim to reach more than one sector (residential, commercial, municipal, transportation, and industrial). In addition, many behavioral strategies are used across sectors, with a few exceptions (e.g., SEM strategies tend to focus only on municipal operations and commercial or industrial sectors). Some strategies, such as benchmarking and feedback, are unlikely to be applied to transportation programs, even though it is possible to use these strategies for transportation. Overall, programs that aim to change behaviors within different sectors—such as residential, commercial, municipal, industrial, and transportation—use a variety of types of behavior change strategies, in similar or different ways. For example, competitions span all categories, with some specifically designed for municipal employees or commercial participants. These programs can be online or in-person and can be a one-day event or span a period of time. Local governments can think creatively about how each strategy can change specific behaviors, as these strategies can be effective across sectors.

Diverse Goals and Strategies

Local governments can use many different program models, goals, and strategies to encourage behavior change and energy savings in their jurisdictions. Many are motivated by climate action plan goals and desired reduction in energy use but also want to engage with the community and provide economic benefits. Most programs in this study have numerous goals and include more than one behavior strategy. Partnerships prove crucial for many programs, with partners assisting in providing online platforms, managing additional technology, providing financial support, and connecting with target populations.

Local governments most commonly use competitions or games as one of their behavior change strategies, followed by adult education and training. Almost two-thirds of the programs state that they use in-person strategies to increase program engagement. Competitions and games can prove especially effective for local governments because they can achieve multiple goals simultaneously, such as saving energy, creating local jobs, and building rapport and trust. Education and training can also serve as a component within other strategies, providing direct, in-person interactions that lead to long-term behavior changes.

Program Duration

Certain behavioral strategies lend themselves to short-term or long-term program implementation. For instance, competitions and games are effective when they have a start and end date and result in prizes and/or other recognition. These programs can be re-run over the course of numerous program cycles.

Our survey found that more than two-thirds of the programs ran or have run for five years or less. Even so, if a local government wants to conduct a long-term program, there are many strategies that can lead to sustained results. Benchmarking programs are effective when they collect energy-use data frequently; once established, they are designed to continue to run into the future. Energy audit, feedback, education, and training programs can all run over a long period, depending on program goals and structure. Table 4 indicates the programs in this study that have run for more than 10 years.

Table 4. Municipally led behavior change programs operating for over 10 years

State	Municipality	Program	Years in operation
Colorado	Boulder County	Partners for a Clean Environment (PACE)	1993–present
Colorado	Boulder County	Summer Clean Air Challenge	2004–2007, 2019
California	Santa Clara	Silicon Valley Energy Watch	2004–present
Virginia	Arlington County	Green Home Choice Program	2006–present
New York	New York City	NYC Carbon Challenge	2007–present
Oregon	Portland	Sustainability at Work	2007–present
Ohio	Oberlin	Oberlin Ecolympics	2008–present

These long-term programs provide a variety of examples of program goals and models. They indicate that many types of behavior programs can be long-running, and that there are numerous models for long-term success.

Program Evaluations

Independent, third-party evaluations are key to measuring the success of programs and making improvements to them. Even so, the vast majority of local governments in this study do not comprehensively evaluate their programs. Many do track some performance metrics internally; this can be less costly than independent program evaluations but is also less thorough and comprehensive. Evaluations should measure progress toward program goals (e.g., energy savings, participation rates) using sound research methods.

Recommendations for Local Governments

Based on our research into behavior program design as well as the program examples included in this report, we developed the following seven steps for local governments to follow in planning a new municipally led behavior change program. Figure 3 lays out the steps local governments can take to design, administer, and improve an effective behavior change program.
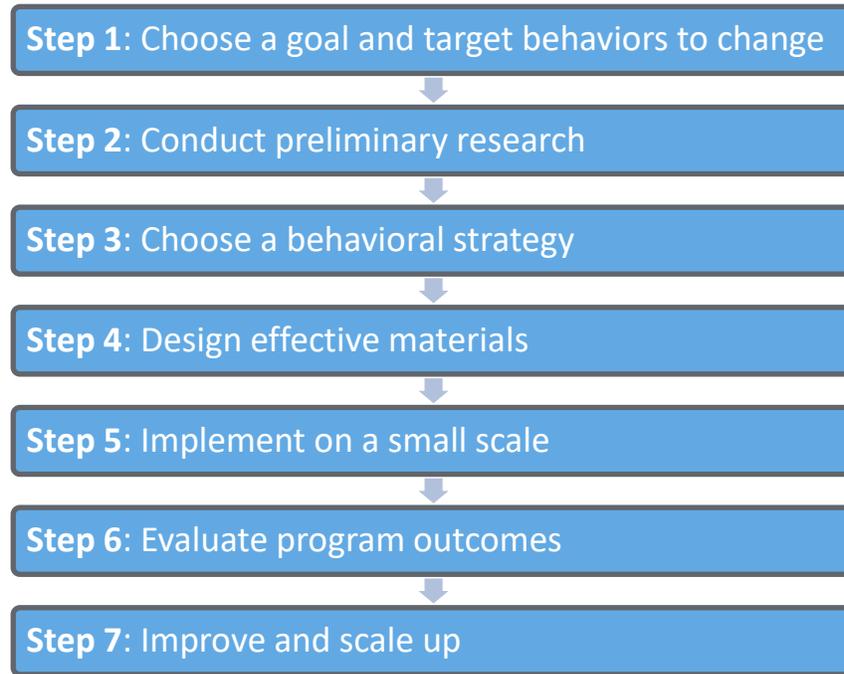
Step 1: Choose a goal and target behaviors to change

Step 2: Conduct preliminary research

Step 3: Choose a behavioral strategy

Step 4: Design effective materials

Step 5: Implement on a small scale

Step 6: Evaluate program outcomes

Step 7: Improve and scale up

Figure 3. Seven steps for designing and implementing effective programs

STEP 1: CHOOSE A GOAL AND TARGET BEHAVIORS TO CHANGE

The first step in developing a locally led behavior change program is to choose a goal. Local governments may have a variety of reasons for developing a behavior change program, such as achieving climate action plan goals, improving air quality, creating local jobs, or increasing engagement with the community.

Depending on the goal, the program designer can then choose which behaviors to change in order to achieve this goal, as well as which populations to target. For example, when designing its Community Commutes Day program, Alameda County first set a goal to reduce transportation emissions, then identified car commuting as the behavior to change and municipal government workers as the target population.

In choosing behaviors and target populations, program designers must assess the potential impacts that may result from changing certain behaviors for certain populations. This assessment can identify which behaviors will have the greatest impact on the target population and help mitigate negative impacts.

STEP 2: CONDUCT PRELIMINARY RESEARCH

The second step requires preliminary research before making other program design decisions. This research can help the program designer identify partners, funders, and champions, as well as barriers and benefits, which can be used to determine behavior change strategies and other key program design elements.

Seek Collaborations with Partners

Program designers can begin to seek out local, regional, or national organizations with similar goals to act as partners on program design, implementation, or funding. Local governments can seek synergies through collaborations between government departments and with the private sector. For example, Arlington County, Virginia, developed strong relationships with the commercial office sector, which allowed it to build up a strong participant network for the Arlington Green Games program.

Sometimes local governments partner with utilities, which can provide real-time energy data as well as additional funding, data, and outreach capabilities to help achieve more effective program outcomes. Connecting municipal programs with utility-led programs can also streamline participant benefits. Partnering with universities can be effective as well, as they often have the technology and expertise to provide strong program evaluations and comprehensive program design. Private businesses can be beneficial partners too; for example, they might help increase program participation through effective promotion strategies or provide prizes and/or incentives for participants.

Find Funders

Federal grants, utilities, foundations, nonprofits, and businesses can provide additional funding for the design, delivery, and evaluation of locally led behavior change programs. This study indicates that common funders include local and national businesses, nonprofit organizations, the US Department of Energy, and utility ratepayers. By determining available funding at an early stage, program designers can develop a budget that can help narrow the program scope.

Consider Including In-Person Components

Behavior programs that include in-person components tend to have more impact and success than those without in-person strategies. In addition, many successful programs include an internal energy champion, often a dedicated staff person who helps develop and promote the program. From conversations with program administrators, we learned that in some cases programs have ended due to staff turnover and the loss of an internal program champion. The most successful programs have strong staff buy-in and internal motivation for program success.

Another successful approach is to identify an individual within the target community to champion the program; this can help increase program reach, participation, and effectiveness. For residential programs, a champion might be a leader within the community—such as a neighborhood block representative or religious leader—who encourages community members to participate in the program. Programs targeting businesses also benefit from a champion who promotes the program within an organization.

Identify Benefits of—and Barriers to—Changing a Target Population's Target Behavior

Before choosing a behavioral strategy, program designers should identify and consider the potential barriers and benefits of changing certain behaviors within the target population. While not the only method, the CBSM framework provides four steps for uncovering barriers and benefits (McKenzie-Mohr 2010):

- *Review relevant articles and reports* and similar programs in similar areas.
- *Observe people* engaging in the behavior you wish to promote as well as the behavior that you wish to dissuade people from engaging in.
- *Conduct focus groups* to explore, in depth, the attitudes and behaviors of your target audience regarding the activities you wish to encourage and discourage.
- *Conduct a survey* with a random sample of your target audience to gain more knowledge of barriers to participation.

These four steps will provide crucial information about barriers and benefits of changing target behaviors in the target population, which will inform the decisions made in the next step of the process. This research could also lead program designers to change their assumptions and potentially choose different behaviors or populations.

STEP 3: CHOOSE A BEHAVIORAL STRATEGY

After program designers identify the target goal and changeable behaviors and also conduct preliminary research, then they can move forward with choosing one or more behavioral strategies. Choosing more than one strategy may not prove more effective than focusing on one, though this will depend on the program goal and target behaviors. Notably, Schultz (2013) states that different strategies require different levels of investment and achieve different levels of payoff, with some strategies (e.g., eliciting commitments) requiring high investment and achieving high payoff, and others (e.g., invoking social norms) requiring low investment and delivering low payoff. Program designers should keep this in mind when they choose behavioral strategies for their program, taking into consideration how many people they aim to reach and the outcome they hope to achieve.

Behavior programs often rely on more than one strategy to change behavior and often combine multiple behavioral science-based strategies. For example, the Fremont Green Challenge uses competition and games, in-person interactions, K–12 education, and adult education and training in their program design. As part of the challenge, the city of Fremont designed a high school-age competition that included an in-person kickoff event, developed youth champions and green ambassadors, and trained students to host events and conduct presentations for further community engagement.

Programs that coordinate and connect with individuals during important life transitions, such as a home move or a college transition, can take advantage of an ideal time to change behaviors (Verplanken et al. 2008). In addition, programs that focus on one-time choices or actions may have greater overall impact than programs focusing on several small and persistent habits (Yoeli et al. 2017; Poortinga et al. 2003). For example, encouraging individuals to upgrade to a more efficient HVAC system may save more energy in the long term than encouraging them to adjust their thermostats on an ongoing basis. Even so, encouraging one-time choices or actions may require high up-front costs, meaning that

limited capital can hinder program uptake. In cases where capital is a barrier, other types of behavior change strategies may be more appropriate.

STEP 4: DESIGN EFFECTIVE MATERIALS

During the process of designing a program, specific emphasis should be placed on designing effective materials. Program materials should contain strong messaging and branding and be distributed in a focused way to the target audience. The preliminary research, especially the focus groups and surveys, should inform these designs. These efforts should aim to determine what messaging will work best for the target population based on their values, goals, and priorities. For the best results, behavior change programs must prioritize audience planning, strategic messaging, and most effective communications channels for a target group to optimize engagement.

In addition, the program designer can work to develop a strong brand in relation to the program. A strong brand will positively and widely engage the public, help a program withstand turnover of staff or administration, enable strategic partnerships, and secure additional resources for outreach. New York City's GreeNYC behavior campaign developed an iconic "Birdie" mascot to promote the campaign. The development of a strong brand led to meaningful engagement not only with city residents to change behaviors but also with partners to vastly extend the reach of behavior change campaigns (City of New York 2017).

STEP 5: IMPLEMENT ON A SMALL SCALE

Before rolling out a full program to the whole target group, implementers should run a pilot program in order to test the effectiveness of the program design. This allows them to test the chosen set of behavioral strategies and determine how effective they are at achieving the program objectives. Pilot programs—which should be rigorously evaluated—may also identify unforeseen challenges that program designers and implementers can address before a full-scale launch. Many of the programs highlighted in this report began as pilots, such as the Take Two and the Efficiency Works Neighborhoods programs in Fort Collins, Colorado; the Way to Save, Burlington! Program in Colorado; and the Smart and Connected Kids for Sustainable Energy Communities program in Fremont, California.

STEP 6: EVALUATE PROGRAM OUTCOMES

Transparent, independent third-party evaluations are important for determining the effectiveness of an energy efficiency program (Todd et al. 2012). Even when not required by regulators, a third-party evaluation helps the program administrator determine if the program has met its objectives through accurate calculations of appropriate outcomes (e.g., energy savings and GHG reductions). Evaluations should measure energy use before and after the program, along with other outcomes that the program aims to achieve (e.g., quality of life, engagement, health). When evaluating a marketing-based behavior change

campaign, municipalities can assign indicators for measuring impressions, engagement, attitudes, behaviors, and ultimately environmental and energy impacts.[7]

Program designers should identify monitoring and evaluation tools and indicators when the program is still in the planning stages. By determining program goals, behaviors to change, and behavioral strategies early on, municipalities can design a program in a way that allows strong evaluation later. Many programs conduct initial pilots to test program design effectiveness before full-scale implementation. Evaluators should collect at least one complete year of energy-use data prior to implementation in order to establish a baseline from which to track energy savings progress (Tod et al. 2012).

Researchers have had difficulty conducting evaluations and research on energy-saving behaviors due to the variability and inconsistency of behavior, which can change along with experiences (Lopes, Antunes, and Martins 2012). To remedy this, behavioral interventions need to be evaluated using research designs that systematically determine program effectiveness (Steg and Vlek 2009). Programs should measure actual behaviors when possible rather than relying on the validity of self-reported behaviors (Steg and Vlek 2009).

Evaluations should include control groups where possible. They should use randomized controlled trials, which will result in robust, unbiased estimates of program energy savings and other outcomes; if this is unfeasible, they may use a quasi-experimental approach. Evaluators should compare energy savings from treatment and control groups, using an equivalency check to ensure that the two groups have adequately similar characteristics. Programs should maintain a control group for each year in which program impacts are estimated (Todd et al. 2012).

Municipalities should evaluate their programs annually for the first several years, and every few years thereafter. They should measure the persistence of energy savings achieved to determine how long the behaviors last after the program ends. Little is currently known about the persistence of savings from behavioral programs (Sussman and Chikumbo 2016).

STEP 7: IMPROVE AND SCALE UP

Evaluations should lead to insights into how to increase program effectiveness. The program implementer can then make changes to the initial design and implement a revised program. This process should be iterative and continue until the implementer has addressed the major issues hindering success. Even after large-scale implementation, continuous evaluations can help identify challenges, barriers, and opportunities.

Conclusion

Across the United States, local governments are designing and implementing energy efficiency programs that aim to change behaviors in order to save energy. These programs target a variety of sectors and use a number of social science strategies to encourage

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[7] See Kazemi 2017 for more information on how to design an evaluation for a marketing campaign.

behavior change, such as competitions and games, in-person interactions, education, energy audits, and real-time feedback. Key factors in designing a behavior program include identifying a goal at the outset and conducting preliminary research in order to choose behavior change strategies that will most effectively achieve the goal. Starting with a pilot program, with iterative evaluations, helps to ensure that the program is continuously adapted and improved before a full-scale launch. Many local governments have the opportunity to expand their local energy efficiency portfolios to include behavior change programs. We hope they will use the examples and recommendations in this report to design and implement their own highly effective initiatives.

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Appendix A. Locally Led Behavior Change Program Data

Table A1. Municipally led behavior change programs: years and program description. Asterisk indicates that the program was active as of the release of this report.

State	Municipality	Population	Program	Years	Description
AZ	Phoenix	1,626,078	Energize Phoenix	2011–2013	A three-year program to model energy efficiency and sustainability through the installation of energy-efficient systems and equipment, including air conditioners, water heaters, and energy-efficient windows, as well as smart metering devices to help customers reduce energy usage
CA	Alameda County	1,663,190	Community Commutes Day	2016	A game-based competition encouraging municipal government employees to adopt cleaner commute options
CA	Fremont	234,962	Fremont Green Challenge	2016–	An online residential climate action engagement platform that offers households information on saving energy, water, and money while also reducing carbon emissions; also a high school competition to sign up households to the platform
CA	Fremont	234,962	Smart and Connected Kids for Sustainable Energy Communities	2017–	Multiple behavior change programs reaching youth and their families and community college students. Involves the use of feedback from smart meters hourly, plus plug load and real-time data. Social cognitive and social practice theory underpin program development.
CA	La Mesa	60,021	La Mesa Walk and Roll Program	2012–2016	Partnerships with local school districts, residents, community organizations, and agencies advocating for and implementing programs that promote walking and bicycling
CA	Port of San Diego	1,419,516	Port of San Diego Green Business Network	2011–	A voluntary energy efficiency and sustainability program to educate tenants and subtenants on sustainable business practices and connect Port businesses with resources to implement building and operational improvements
CA	Santa Clara County	1,938,153	Silicon Valley Energy Watch	2004–	A program that helps customers lower their energy use through upgrade programs, rebates, and educational materials
CA	San Leandro	90,553	GoGreenSL	2018–	A social media-based behavior change effort that encourages residents to take energy-saving actions in their homes and accumulate points on behalf of their neighborhood, school, or community-based organization

State	Municipality	Population	Program	Years	Description
CA	Multiple	–	CoolCalifornia City Challenge	2013–2015	A competition among California cities. Participants tracked driving and home energy use to earn "green points" for having lower greenhouse gas emissions than similar households and "bonus points" for lowering emissions over time.
CA	Multiple	–	Lunch 'n Learns for Saving Money and Energy	2016–	Educational sessions for city staff to teach about energy efficiency actions, targets, and progress with additional targeted education for the audience
CO	Boulder County	322,514	EnergySmart	2011–	A program that provides an expert energy adviser who helps homeowners prioritize projects, connect with qualified contractors, find and apply for incentives and low-cost financing, and make energy upgrades easier and more affordable
CO	Boulder County	322,514	Partners for a Clean Environment (PACE)	1993–	A program that provides free expert adviser services, financial incentives, and a certification program to help businesses measure and gain recognition for their energy, waste, water, and transportation achievements
CO	Boulder County	322,514	Summer Clean Air Challenge	2004–2017	A program encouraging residents and employees to reduce their single-occupancy-vehicle travel and use an alternative mode of travel at least once per week during the summer high-ozone season
CO	City of Fort Collins	165,080	Efficiency Works Neighborhoods	2015–2016	A pilot program that provided a streamlined process to overcome known barriers to participation and increase the number and scope of energy efficiency upgrades. Utilized behavior selection, barrier and benefit analysis, neighborhood targeting, community-specific messaging, and convenience.
CO	City of Fort Collins	165,080	Know Your Numbers	2017–	A behavior change program for employees of the City of Fort Collins with three phases—awareness, action, and recognition
CO	City of Fort Collins	165,080	Take Two	2018–	A CBSM pilot campaign designed to encourage households to take two simple actions that collectively can lead to big reductions in electricity and petroleum consumption

State	Municipality	Population	Program	Years	Description
CO	Denver	704,621	Energize Denver	2017–	A program helping residents respond to the city's benchmarking ordinance that requires owners of buildings with more than 25,000 square feet of space to annually benchmark their energy use. Programs also engage tenants to improve energy efficiency of their spaces and provide resources to improve the efficiency of buildings.
CO	Durango	17,817	Way to Go! Club	2014–	A point-rewards program, similar to airline miles, that allows members to earn points and milestone gifts as they enjoy the benefits of sustainable transportation
FL	Orlando	280,257	Central Florida Battle of the Buildings	2017–	An ongoing annual event that serves as a fun, free, voluntary opportunity for local businesses and building owners to reduce their energy costs and gain recognition, as well as an opportunity to comply with the City of Orlando's energy benchmarking policy
FL	Sarasota County	419,119	Energy Upgrade	2018–	A one-hour training provided to groups upon request. Gives away DIY energy kits to the general public if they attend a workshop.
HI	Honolulu	350,395	Kukui Cup	2011–2013	A program exploring novel ways to utilize concepts from information technology, community-based social marketing, serious games, and pedagogy to support sustained change in sustainability-related behaviors
MD	Baltimore	611,648	PowerDown! Energy Reduction Competition	2015–2018	A one-month competition to see which school could lower its electricity use by the greatest percentage relative to an average of the three prior months
MD	Montgomery County	1,058,810	Commercial Building Energy Benchmarking	2014–	A program that helps commercial buildings meet the city's energy benchmarking and transparency law by encouraging better energy management of commercial buildings as a way to achieve the county's ambitious greenhouse gas emission reduction goals
MD	Montgomery County	1,058,810	Let There Be Light, Bulb Exchange	2017–	An initiative to educate residents about the basic elements of sustainability, with an emphasis on energy conservation and energy cost reduction. Various congregations across the county exchange incandescent and CFL bulbs for more energy-efficient, cost-saving LED bulbs.

State	Municipality	Population	Program	Years	Description
MD	Takoma Park	17,567	Takoma Park Energy Challenge	2015–2017	A two-year multifaceted effort to increase energy efficiency and reduce greenhouse gas emissions citywide. The efforts were part of the city's Sustainable Energy Action Plan and supported the city's participation in the Georgetown University Energy Prize competition, in which individual and team prizes were awarded.
MI	Multiple	–	Michigan Battle of the Buildings	2014–	An awards and recognition program open to all Michigan commercial and industrial buildings for achievements in energy-use reduction
MN	Saint Paul	306,621	Race to Reduce	2018–	A program that provides large buildings in Saint Paul with a network of peers, experts, and other resources to help building owners benchmark energy performance and reduce utility costs
MT	Bozeman	46,596	Bozeman Energy Smackdown	2013–2017	A residential energy conservation competition connecting local residents to resources and information to save energy, save money, and make their homes healthier and more comfortable
MT	Missoula	73,340	Community Strategic Energy Management	2009–	An SEM strategy that uses remote diagnostics to better understand building performance issues and establish priorities for improvement. The ENERGY STAR Portfolio Manager tool is used to benchmark performance.
NY	New York City	8,622,698	NYC Carbon Challenge	2007–	A voluntary leadership initiative and public–private partnership between the NYC Mayor's Office and leaders in the private, institutional, and nonprofit sectors who have committed to reduce their greenhouse gas emissions by 30% or more over 10 years
OH	Multiple	–	MORPC Benchmarking Program	2018–	A program designed to provide local government members free access to an online dashboard that monitors their energy use in buildings and fleets, as well as water, waste, recycling, and air quality. A dashboard provides feedback needed to identify and justify changes to operations.
OH	Oberlin	8,278	Oberlin Ecolympics	2008–	An annual three-week energy reduction competition and community event series
OR	Eugene	168,916	Community Strategic Energy Management	1995–	A comprehensive and strategic approach to evaluating energy performance across the city's municipal facilities

State	Municipality	Population	Program	Years	Description
OR	Portland	647,805	Sustainability at Work	2007–	A program formed in 2007 as a solution for Portland businesses lacking in time, budget, and expertise who want to improve their workplace environmental practices (energy efficiency, waste reduction, water efficiency, sustainable transportation)
OR	Portland	647,805	Sustainable City Government	2007–	A program, hosted by the Bureau of Planning and Sustainability, that helps city bureaus save money, reduce carbon emissions, and create a healthier, more equitable workplace through technical assistance and advocacy
TN	Chattanooga	179,139	Empower Chattanooga	2014–	Community action and advisory groups working in each neighborhood to help lead community efforts on the ground—everything from park cleanups to outdoor movie nights
TX	Austin	950,715	Austin Energy All-Stars	2017–	A program designed to introduce sixth-grade students to energy efficiency concepts and products. Provides curriculum for teachers in any sixth-grade setting to teach behavioral techniques and experiment with products that save energy and make homes more comfortable.
TX	San Antonio	1,511,946	Breathe Today, SA Tomorrow	2017–	A public campaign building awareness about air quality by educating the greater community about the need for clean air and how to help San Antonio continue to be the largest "Clean Air City" in the nation
UT	Park City	8,378	Library Conservation Kits and Challenge Website	2018–	A project in which residents are called on to take action to improve the energy efficiency of their homes and lifestyles
UT	Summit County	41,106	Summit Community Power Works	2015–2016	A nonprofit-run program that reduces residential energy consumption and decreases greenhouse gas emissions through practical and innovative measures
VT	Burlington	42,239	Rental Customer Experience with In-Home Displays	2015	A randomized controlled trial of real-time energy information feedback and incentives for residential renters

State	Municipality	Population	Program	Years	Description
VA	Arlington County	234,965	Arlington Green Games	2010–2014	A program that engaged the commercial office building sector with a combination of energy data benchmarking and encouragement, and tenants with behavioral and operational changes to reduce energy and water use, increase recycling, and increase alternatives to single-occupant-vehicle commuting
VA	Arlington County	234,965	Green Home Choice Program	2006–	A green home renovation and new construction certification program similar to Earthcraft House and LEED for Homes
VA	Arlington County	234,965	Green Living Challenge	2007–2008	A friendly competition between neighborhoods consisting of a checklist of about two dozen actions (e.g., get an energy audit, install more efficient lighting, walk or bike instead of driving to work once a week, get your yard certified as a wildlife habitat)
WI	Burlington	10,978	Way to Save, Burlington!	2010–2014	A program to test the effectiveness of an intensive community-based approach to marketing energy efficiency programs
WI	Madison	255, 214	Green Madison	2015–2016	A citywide game-based program encouraging residents to adopt sustainable practices coupled with an enhanced home retrofit marketing strategy and training for facilities staff at municipal buildings
WI	Milwaukee	595,351	STEMhero	2017–	An education program in which, on a daily basis over five weeks, students collected, analyzed, and acted on water and energy consumption data from their homes. They quantified the effects of efficiency measures and behavior changes they implemented, and they created social media-ready videos that were shared with the municipal partner
BC	City of Campbell River (Canada)	32,588	Power Down Campbell River	2013	A challenge involving five families competing for 30 days to conserve energy and teach the community their tips through videos
AB, BC	Vancouver, Langley, Surrey, Calgary, Edmonton (Canada)	631,486	Empower Me	2012–	A free education and energy conservation program that helps multilingual and multicultural communities save energy and make their homes more comfortable and safe

State	Municipality	Population	Program	Years	Description
AB	Edmonton (Canada)	932,546	Change for Climate	2016–	A social marketing initiative and an umbrella for all of Edmonton's climate change programs, including its energy labeling programs, electric vehicle strategy, and residential efficiency and solar programs

US population data (2017) from American Fact Finder (Census Bureau 2017); Canadian population data (2016) from 2016 Canadian Census Profile (Statistics Canada 2018).

Table A2. Municipally led behavior change programs: sectors and focus areas.

State	Municipality	Program	Residential	Commercial	Municipal	Industrial	Transport	Low-income
AZ	Phoenix	Energize Phoenix	•					•
CA	Alameda County	Community Commutes Day			•		•	
CA	Fremont	Fremont Green Challenge	•				•	
CA	Fremont	Smart and Connected Kids for Sustainable Energy Communities	•					
CA	La Mesa	La Mesa Walk and Roll Program					•	
CA	Port of San Diego	Port of San Diego Green Business Network		•		•		
CA	Santa Clara County	Silicon Valley Energy Watch	•		•			
CA	San Leandro	GoGreenSL	•				•	
CA	Multiple	CoolCalifornia City Challenge	•					
CA	Multiple	Lunch 'n Learns for Saving Money and Energy	•		•			
CO	Boulder County	EnergySmart	•					•
CO	Boulder County	Partners for a Clean Environment (PACE)		•		•		
CO	Boulder County	Summer Clean Air Challenge					•	
CO	City of Fort Collins	Efficiency Works Neighborhoods	•					

State	Municipality	Program	Residential	Commercial	Municipal	Industrial	Transport	Low-income
CO	City of Fort Collins	Know Your Numbers			•			
CO	City of Fort Collins	Take Two	•				•	
CO	Denver	Energize Denver		•		•		
CO	Durango	Way to Go! Club					•	
FL	Orlando	Central Florida Battle of the Buildings	•	•	•			
FL	Sarasota County	Energy Upgrade	•					•
HI	Honolulu	Kukui Cup	•					
MD	Baltimore	PowerDown! Energy Reduction Competition			•			•
MD	Montgomery County	Commercial Building Energy Benchmarking		•	•			
MD	Montgomery County	Let There Be Light, Bulb Exchange	•					•
MD	Takoma Park	Takoma Park Energy Challenge	•		•			•
MI	Multiple	Michigan Battle of the Buildings		•	•	•		
MN	Saint Paul	Race to Reduce	•	•	•			
MT	Bozeman	Bozeman Energy Smackdown	•					
MT	Missoula	Community Strategic Energy Management			•			
NY	New York City	NYC Carbon Challenge	•	•				•
OH	Multiple	MORPC Benchmarking Program			•			
OH	Oberlin	Oberlin Ecolympics	•					
OR	Eugene	Community Strategic Energy Management			•			
OR	Portland	Sustainability at Work		•	•	•	•	•
OR	Portland	Sustainable City Government			•			

State	Municipality	Program	Residential	Commercial	Municipal	Industrial	Transport	Low-income
TN	Chattanooga	Empower Chattanooga	•					•
TX	Austin	Austin Energy All-Stars	•					
TX	San Antonio	Breathe Today, SA Tomorrow					•	
UT	Park City	Library Conservation Kits and Challenge Website	•					•
UT	Summit County	Summit Community Power Works	•		•			•
VT	Burlington	Rental Customer Experience with In-Home Displays	•					
VA	Arlington County	Arlington Green Games		•			•	
VA	Arlington County	Green Home Choice Program	•					
VA	Arlington County	Green Living Challenge	•					
WI	Burlington	Way to Save, Burlington!	•	•	•	•		•
WI	Madison	Green Madison	•		•			•
WI	Milwaukee	STEMhero	•		•			•
BC	Campbell River (Canada)	Power Down Campbell River	•					•
AB, BC	Vancouver, Langley, Surrey, Calgary, Edmonton (Canada)	Empower Me	•		•			•
AB	Edmonton (Canada)	Change for Climate	•					
Total programs			32	11	20	6	10	16

Table A3. Municipally led behavior change programs: categories and strategies

State	Municipality	Program	Feed-back	Audits	Competition and games	In-person	K–12 and campus	Adult ed and training	CBSM	SEM	Bench-marking
AZ	Phoenix	Energize Phoenix	•	•		•		•			•
CA	Alameda County	Community Commutes Day			•	•			•		
CA	Fremont	Fremont Green Challenge	•		•	•	•	•			
CA	Fremont	Smart and Connected Kids for Sustainable Energy Communities	•		•	•	•	•			
CA	La Mesa	La Mesa Walk and Roll Program					•				
CA	Port of San Diego	Port of San Diego Green Business Network		•	•	•					
CA	Santa Clara County	Silicon Valley Energy Watch		•	•	•	•	•			•
CA	San Leandro	GoGreenSL			•		•				
CA	Multiple	CoolCalifornia City Challenge			•						
CA	Multiple	Lunch 'n Learns for Saving Money and Energy						•			
CO	Boulder County	EnergySmart		•		•		•	•		
CO	Boulder County	Partners for a Clean Environment (PACE)		•		•		•			
CO	Boulder County	Summer Clean Air Challenge			•						
CO	City of Fort Collins	Efficiency Works Neighborhoods		•		•			•		

State	Municipality	Program	Feed-back	Audits	Competition and games	In-person	K–12 and campus	Adult ed and training	CBSM	SEM	Bench-marking
CO	City of Fort Collins	Know Your Numbers			•	•		•	•		
CO	City of Fort Collins	Take Two				•			•		
CO	Denver	Energize Denver									•
CO	Durango	Way to Go! Club	•		•		•	•			
FL	Orlando	Central Florida Battle of the Buildings		•	•	•		•			•
FL	Sarasota County	Energy Upgrade						•			
HI	Honolulu	Kukui Cup	•	•	•	•	•		•		
MD	Baltimore	PowerDown! Energy Reduction Competition			•	•					
MD	Montgomery County	Commercial Building Energy Benchmarking			•			•		•	•
MD	Montgomery County	Let There Be Light, Bulb Exchange		•		•	•	•			
MD	Takoma Park	Takoma Park Energy Challenge		•	•	•			•		
MI	Multiple	Michigan Battle of the Buildings			•	•		•			
MN	Saint Paul	Race to Reduce			•	•		•			•
MT	Bozeman	Bozeman Energy Smackdown		•	•						
MT	Missoula	Community Strategic Energy Management								•	•

State	Municipality	Program	Feed-back	Audits	Competition and games	In-person	K–12 and campus	Adult ed and training	CBSM	SEM	Bench-marking
NY	New York City	NYC Carbon Challenge				•	•				
OH	Multiple	MORPC Benchmarking Program	•								•
OH	Oberlin	Oberlin Ecolympics	•		•	•	•				
OR	Eugene	Community Strategic Energy Management								•	•
OR	Portland	Sustainability at Work		•		•				•	
OR	Portland	Sustainable City Government		•	•	•		•	•		
TN	Chattanooga	Empower Chattanooga				•	•	•	•		
TX	Austin	Austin Energy All-Stars				•					
TX	San Antonio	Breathe Today, SA Tomorrow						•	•		
UT	Park City	Library Conservation Kits and Challenge Website			•	•	•	•			
UT	Summit County	Summit Community Power Works		•	•	•	•	•			
VT	Burlington	Rental Customer Experience with In-Home Displays	•		•	•					
VA	Arlington County	Arlington Green Games		•	•	•					•
VA	Arlington County	Green Home Choice Program		•		•					
VA	Arlington County	Green Living Challenge			•			•			

State	Municipality	Program	Feed-back	Audits	Competition and games	In-person	K–12 and campus	Adult ed and training	CBSM	SEM	Bench-marking
WI	Burlington	Way to Save, Burlington!			•	•	•	•	•		
WI	Madison	Green Madison		•	•	•		•			
WI	Milwaukee	STEMhero		•			•				
BC	Campbell River (Canada)	Power Down Campbell River	•	•	•	•	•	•			
AB, BC	Vancouver, Langley, Surrey, Calgary, Edmonton (Canada)	Empower Me	•			•		•	•		
AB	Edmonton (Canada)	Change for Climate		•	•	•		•	•		•
Total programs			10	20	29	32	18	26	13	4	11

Table A4. Evaluation data for municipally led behavior change programs that provided evaluation materials. Asterisk indicates that the program was active as of the release of this report.

State	Municipality	Program	Evaluation source	Years	Energy savings %	Energy savings	CO2 (total or % decrease)	Dollars saved	Participants	Other information
AZ	Phoenix	Energize Phoenix	Report[a]	2011–2013	8% residential, 10–12% commercial	135,009 MWh total	95,256 metric tons	$12,632,863	2,014 residential units, 33,350,506 square feet commercial	—
CA	Alameda County	Community Commutes Day	Survey	2016	—	—	—	—	750	18% switched commute, and 26% persisted after two months
CA	Multiple	Lunch 'n Learns for Saving Money and Energy	Survey	2016–2018	—	—	—	—	146 staff	Increased awareness of city's energy champion and commitment to promoting energy efficiency
CA	Fremont	Fremont Green Challenge	Survey, website[b]	2016–2018	—	6,986 kWh; 301 therms	33 metric tons	$6,144	1,697 households	825 actions committed or completed; 38,250 gallons of water, 1,110 gallons of gasoline saved
CA	Port of San Diego	Port of San Diego Green Business Network	Survey	2010–2018	31% total	10,800 MWh, 299,000 therms	32% savings	$8 million cost avoidance	88 members	56% decrease in water use; enough energy saved to power 968 homes
CA	Santa Clara County	Silicon Valley Energy Watch	Survey	2017	—	8.5M kWh	—	—	—	—
CO	Boulder County	EnergySmart	Survey	2011–2018	—	7,923,120 kWh and 1,463,970 therms (residential programs)	14,127 mtCO2e	$984,130 annual cost savings (residential program)	17,231 homes served	$1,904,276 rebate dollars awarded, energy savings equivalent to emissions from 3,020 cars

State	Municipality	Program	Evaluation source	Years	Energy savings %	Energy savings	CO_2 (total or % decrease)	Dollars saved	Participants	Other information
CO	Boulder County	Partners for a Clean Environment (PACE)	Survey	1993–2018	–	25,516,843 kWh and 20,375 therms (commercial program)	20,475 mtCO2e	$2,179,947 dollars saved annually on utility bills	2,361 businesses upgraded and 130 businesses PACE-certified	$4,328,904 rebate dollars awarded, energy savings equivalent to emissions from 4,160 cars
CO	City of Fort Collins	Efficiency Works Neighborhoods	Survey	2015–2016	Reduced kWh use by 50% per home and therm use by 70% per home	—	—	—	—	-
CO	Durango	Way to Go! Club	Survey	2014–2018	–	—	674 tons	—	945 active members	118,243 logged trips; 1,462,190 miles traveled
FL	Sarasota County	Energy Upgrade	Website[c]	2018	–	—	2,900 metric tons annually	$334,000 per year total (est.) for participating families	2,000 low-income residents	Roughly the same as emissions from 621 cars
HI	Honolulu	Kukui Cup	Survey, website[d]	2011	Energy saved by residence halls in order of participation: 11.3%, 7.4%, 5.8%, 0%, 4%, and 2.5%	—	—	—	—	—
MD	Montgomery County	Let There Be Light, Bulb Exchange	Survey	2017—2018	–	66,550 kWh	49.5 mtCO2e	Approximately $6,519	300 residents received bulbs; 30 audit sign-ups	1,000 LEDs distributed

State	Municipality	Program	Evaluation source	Years	Energy savings %	Energy savings	CO_2 (total or % decrease)	Dollars saved	Participants	Other information
MD	Takoma Park	Takoma Park Energy Challenge	Survey	2015–2017	11.8% municipal elec., 25% municipal gas; 3% residential elec., 25% residential gas	29,600 MWh (1.01 BTUs)	5,364 MT	—	746 households (22% single-family)	441 comprehensive energy audits
MI	Multiple	Michigan Battle of the Buildings	Survey	2014–2017	–	–	98,425 mtCO2e	$10 million	191,979,708 square feet of buildings participated in 2018	Carbon sequestered by average 115,931 acres, GHG emissions from 241,237,746 miles driven by average passenger vehicle
MT	Bozeman	Bozeman Energy Smackdown	Survey	2015–2017	3.3% (2015–16), –4.03% (16–17)	4,972 therms (2015–17)	–	$10,887 (2015–17)	256 (2015–17)	–
NY	New York City	NYC Carbon Challenge	Survey	2007–2018	–	7.2 MMBTU	580,000 MT	$190 million	120 participants across six sectors: universities, hospitals, commercial offices, multifamily buildings, hotels, and retail	2,300 hospitalizations averted by 58 million tons of PM2.5 avoided, 1,600 jobs created
OR	Portland	Sustainable City Government	Survey	2007–2018	—	92,392 mmBtus	46% CO_2 decrease	$2.6 million	—	—

State	Municipality	Program	Evaluation source	Years	Energy savings %	Energy savings	CO₂ (total or % decrease)	Dollars saved	Participants	Other information
TN	Chattanooga	Empower Chattanooga	Survey	2015–2018	5–40% average energy savings for participants	---	---	----	Approx. 2,000 workshop participants	----
UT	Summit County	Summit County Power Works	Survey	2015–2016	4.3–9.3% residential, 2.6% municipal	—	—	—	Education and outreach to 6,822 people	100,000 LEDs installed, 150 smart thermostats sold, 100 audits, 110 residential solar PV systems installed
VA	Arlington County	Green Living Challenge	Survey	2007–2008	—	—	—	—	400,150 earned certificates	—
VA	Arlington County	Green Home Choice Program	Survey	2006–2018	55% retrofit, 42% new build	—	—	$400,000 per year	325 certified homes	—
VA	Arlington County	Arlington Green Games	Survey	2010–2014	—	—	10,000 tons	$2 million	150 participants	14 million square feet benchmarked, carbon savings equivalent to taking 1,996 passenger vehicles off the road for one year or not powering 881 homes for one year
WI	Burlington	Way to Save, Burlington!	Survey	2010–2014	—	337,042 kWh; 29,644 therms	—	—	—	1,509 pledges
WI	Milwaukee	STEMhero	Survey	2017–2018	—	—	—	—	551 students	—

State	Municipality	Program	Evaluation source	Years	Energy savings %	Energy savings	CO₂ (total or % decrease)	Dollars saved	Participants	Other information
BC	City of Campbell River (Canada)	Power Down Campbell River	Survey	2013–2018	—	—	—	—	—	75% of participants completed retrofit
AB, BC	Vancouver, Langley, Surrey, Calgary, Edmonton (Canada)	Empower Me	Survey, Website[e]	2012–2018	—	13.3 GJ of savings per household in over 1,000 follow-up home visits	14,000 tons	—	2,000 homes, 30,000 people empowered	30 jobs created

[a] Liang et al. (2017); Dalrymple, Melnick, and Schwartz (2014). [b] www.freemontgreenchallenge.org. [c] www.scgov.net/Home/Components/News/News/3487/23.
[d] www.citeulike.org/group/3370/article/12438777. [e] www.empowermeprogram.com/.

Appendix B. Survey Questions

1. Contact Information

 First and last name
 Email address
 Phone number

2. City and Program Information

 State
 City, county, or municipal region
 Name of energy-saving behavior change program
 If available, URL of program information

3. Program Description and Categories

 Please provide a short description of the program's design, implementation and stakeholders involved in these processes.

 Please provide a description of the program's goals (e.g. resident satisfaction, economic stimulus, job creation, energy affordability, energy savings).

 What year did the program begin, and is it still in operation?

 Please select which sectors the program targets: Residential, Commercial, Municipal government operations, Transportation, Industrial

 Does the program include any of the following: Home Energy Reports, Real-time feedback, Energy audits, Competitions and/or games, In-person strategies, Education opportunities for students (K–12 or college/university), Education or training for adults, Focus on low-income communities, Strategic Energy Management (SEM)

4. Program Delivery and Partnerships

 Which local government offices or municipal agencies are responsible for the design or administration of the program?

 Does the city partner with any other entities (e.g. utility, nonprofit) on the design and/or implementation of the program? If yes, please list the organizations that the city partners with on the design and/or implementation of the program and a description ft he partnership, if possible.

 Who provides funding for the program (including municipal funding)?

 What is the program's budget (indicate if total or annual)?

 Is this program part of a larger initiative/program/campaign?

 If yes, please describe the larger initiative that includes this behavior change program.

5. Program Evaluation and Impact

 Has the program been valuated to measure its impact and progress toward its goals?

 If yes, please provide information about the evaluation and measured impact.

 If no, have program implementers tracked program progress for some pre-defined key metrics? If so, please describe.

 If available, please upload a program evaluation or any other program documentation.