Paving the Way for a Richer Mix of Residential Behavior Programs

Recent research suggests that behavior programs the California utilities currently offer use only one of many possible strategies for influencing residential energy-related behaviors. This paper was commissioned to identify behavior change intervention options for addressing behaviors inherently part of California's broad set of programs and are grounded in social science research. The paper provides three types of reference materials: a typology of residential energy-related behaviors that programs might aim to influence, a summary of social science theories relevant to consumer energy-related behavior, and a set of promising behavior intervention strategies for consideration in next-generation programs. It also provides examples of how theory, interventions, and behavior change can be integrated in different programs. The paper concludes with recommendations for next steps in developing residential behavior program policy and designs.

Prepared for:

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Prepared by:

Patrice Ignelzi
EnerNOC Utility Solutions

Jane Peters
Research Into Action

Katherine Randazzo
Anne Dougherty
Opinion Dynamics Corp.

Linda Dethman
The Cadmus Group

Loren Lutzenhiser
Portland State University

May 31, 2013

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Kira Ashby, Consortium for Energy Efficiency

Sharyn Barata, Itron

Miriam Fischlein & Derek Okada, Southern California Edison

Cathy Fogel, Energy Division, CPUC

Patricia Gonzales, Performance Management & Evaluation Systems, NYSERDA

Susan Mazur-Stommen, Behavior and Human Dimensions Program, ACEEE

Mithra Moezzi, Portland State University

Hal Nelson & Galib Rustamov, Claremont Graduate University

Daniel Ohlendorf, Pacific Gas & Electric

John Peterson, Athens Research

Valerie Richardson, Gomathi Sadhasivan & Mitchell Rosenberg, DNV KEMA

Rick Ridge, Ridge & Associates

Annalisa Schilla, California Air Resources Board

Paul Stern, Board on Environmental Change and Society, National Research Council

Annika Todd, Lawrence Berkeley National Lab

Kenneth Train, University of California, Berkeley; and NERA Economic Consulting

Ed Vine, California Institute for Energy and Environment, Lawrence Berkeley National Lab

Mary D. Zalesny, Chief of Staff of the Army, Strategic Studies Group

Foreword

The first time I heard the term “behavior-based program,” I was perplexed by the concept and its seemingly novel introduction to demand side management (DSM). The past twenty-plus years of research studies that I’d encountered in my work in Measurement and Evaluation at Southern California Edison usually addressed consumers’ decision making processes regarding participation in energy efficiency programs. The conjoint models and other analytical approaches of the 1990s were oriented to prediction of consumer action-taking, with a decided focus upon estimating the influence of a particular program or intervention.

So, what was novel about the “behavior-based” concept and what was being declared amiss in utility program portfolios? California investor-owned utilities (IOUs) needed to better understand the purpose and direction of the new wave of small pilots and trials. However, before a basic and balanced common understanding was close to achievement, policy-makers and program managers leapt into the nuts and bolts of narrowly-defined mandates for “behavior-based programs” in terms of content, presentation, and claimable savings. What was lost in this rush to include and, in California’s case, mandate such programs or intervention strategies in utility portfolios, was clarity about the goals of such inclusions and the range of useful possibilities. The mandate in the California IOU case generated at least as many questions as answers.

That’s when the California IOU EM&V team in collaboration with the CPUC Energy Division initiated this white paper to add to the body of knowledge on the topic, especially in its evolving form in California DSM portfolio implementation and policy making. I thank the project manager, Caroline Chen of StatWizards, for pulling together a “star team of experts” from EnerNOC Utility Solutions, Cadmus Group, Research Into Action, Opinion Dynamics, and Portland State University as well as reaching out to secure excellent contributory reviews from other academicians, theorists, and practitioners in the field.

This paper is not expected to provide a “Eureka!” moment for the reader. What I hope it will do is widen the horizons of the multi-perspective stakeholders interested in behavior programs and behavior-related strategies in DSM—from policy makers to intervenors, from program planners to program implementers, from program designers to program evaluators. The taxonomic nature of this white paper will help all stakeholders to acknowledge the breadth of the concept.

When a behavior-based program or aspect of a program is claimed to be savings-generating in and of itself, then the measurability of effects of the behavior-influencing intervention becomes paramount. While the white paper does not address measurement, the wide range of listed behavior theories and behaviors point towards the need for clarifying and testing the underlying causal linkages argued to be delivering savings. The paper’s listed behavior-influencing strategies also carry an important message for traditional energy efficiency programs. The range of behavior-influencing strategies stemming from established theories of behavior change point to the complementary role of such strategies in traditional programs. To policy makers, it points up possibilities for not merely adding programs to portfolios, but to augment the

strategies and activities within traditional, existing programs, including even “deep retrofit” offerings, to increase their impact and persistence. To theorist and academician, it identifies gaps in the energy efficiency field’s exposure to social science. To evaluators, it introduces the challenge of isolating and testing the causal claims of theorists, practitioners, and regulators.

Needless to say, the implicit treatment of consumer behavior in yester years’ portfolios should be made explicit in today’s portfolios. The topic opens up endless possibilities for further exploration in terms of enhancing the efficiency of an integrated DSM portfolio—via innovation at the program level and in blending behavior-influencing components into traditional programs.

Shahana Samiullah, Ph.D.
Manager of Measurement and Evaluation
Southern California Edison
June 2, 2013

Executive Summary

White Paper Background and Objectives

Recent research suggests that comparative usage feedback programs, such as those currently offered by the California investor-owned utilities (IOUs), represent only one of the ways behavioral interventions can influence energy use, thus raising the need to better define the range of energy-related behaviors toward which programs might be directed and explore additional behavior change theories and intervention policy options. Thus the IOUs, in agreement with California Public Utilities Commission (CPUC) staff, commissioned this white paper to define a full range of energy-related behavior intervention possibilities appropriate for California and develop a set of intervention strategies not limited by current programmatic classifications and/or restrictions.

This white paper seeks to provide policy makers, utility staff, and the broader community of DSM practitioners with ideas on energy-related behavior change intervention strategies to consider in developing behavior program policy and program design. The paper has two objectives:

- To demonstrate that social and behavioral science offers a rich set of theories and solid empirical research about behavior and behavior change that support using a wide range of intervention strategies in residential DSM programs.
- To identify a set of specific, promising behavior intervention strategies grounded in this social science theory and research that utility DSM program portfolios can utilize to influence energy-related behaviors.

White Paper Structure and Contents

This white paper includes an introduction followed by chapters that, although closely related, may also be used as individual sets of reference information to help policy makers and program practitioners more consciously define and integrate behavioral components into next-generation DSM programs.

Chapter 1 – Introduction

Chapter 1 addresses the white paper's purpose and scope, and outlines the topics covered within the white paper as well as those topics not covered.

Chapter 1 also discusses the general characteristics of behavior programs and behavior change interventions. Behavior change is part of every DSM program, almost by definition, and the industry lacks a commonly held definition of exactly what constitutes a behavior program. While intervention strategies are not programs, they are the lever that programs use to influence energy-related behaviors. As a starting point of the paper, the authors identify the desirable attributes that characterize behavior intervention strategies.

Behavior intervention strategies…

- *Target one or more specific behaviors that affect end users' energy use.* They may address any of the broad arrays of energy-related behaviors including those that are infrequent or habitual; those that require purchases and those that do not; those that affect when energy is used; and those that relate to renewable energy generation.
- *Are rooted in social science research.* They rely on social science concepts that explain behavior to inform their design. These interventions may be used alone or in combination with traditional program interventions.
- *Consciously consider which behavior(s) they will affect.* Each intervention used in a program identifies one or more energy-related behaviors it aims to influence.
- *Yield evaluable effects.* They are implemented in a way that enables evaluation of quantifiable effects on energy-related behavior, both immediately after intervention and over time.

Chapter 2 – Categories of *Energy-Related behaviors*

Chapter 2 develops a characterization of the types of energy-related behaviors subject to influence by behavioral interventions. These run the gamut from infrequent to ongoing or habitual behaviors, and from purchase through installation and usage decisions. Discussions the authors had about the full range of energy-related behaviors figured heavily in the scope of the intervention strategies subsequently developed.

This chapter first examines a variety of schemes that have been used before synthesizing the various ideas to develop a recommended typology for thinking about behaviors. This typology takes the householders' point of view as they interact in various ways with their homes. It articulates seven broad categories of behaviors, from changing how and when activities are done at home all the way to committing to a different lifestyle. It suggests dozens of specific behaviors that DSM program planners might focus on trying to influence.

Chapter 3 – Social Science Research as the Basis for Influencing Energy-Related Behavior and Behavior Change

Chapter 3 provides a survey of foundational social and behavioral science theories and empirical research, and their relevance to energy-related consumer behaviors. Every social and behavioral science discipline has something to say about human behavior. The social science theories and studies described in this chapter convey a wide range of concepts from psychology, sociology, economics, anthropology, legal theory, and product design and adoption theory that can be useful in describing and invoked to influence energy-related behavior.

There is not a one-to-one correspondence between theories and behavior, and no unifying theory is sought. Individually and collectively, however, they provide considerable and applicable insight into energy-related behaviors and factors that influence them.

Chapter 4 – Strategies and Interventions for Influencing Residential Behaviors

Chapter 4 discusses promising behavior intervention strategies that program planners and implementers might use to encourage specific types of behavior change. It outlines a dozen intervention strategy categories and describes 30+ interventions, suggesting a rich set of behavior intervention strategies. This provides a way of thinking about mechanisms that DSM program policy makers, planners, and implementers can test and evaluate in pilots and full-scale programs to influence householders' energy-related behavior. It includes interventions that have proven effective in influencing similar behaviors in fields like health and environmental conservation, and some already used in energy programs. This builds on work initially conducted for NYSERDA, adapted to the market and regulatory conditions in California.

Chapter 5 – Uniting Behaviors, Theory, and Interventions into New Program Designs

Chapter 5 combines the concepts in Chapters 2, 3, and 4 by creating examples that show how the varied intervention strategies can be deployed to refresh existing programs and develop new ones. Through these examples of possible "next-generation" programs, the white paper illustrates the applicability of the varied intervention strategies, the behavioral influences and theoretical roots that support them, and the specific behaviors they aim to change—connecting the dots, if you will, from theory through specific behavior change.

This is not to suggest that designing effective next-generation DSM programs is as easy as stringing a few interventions or theories together. Social science theories, while they can inform and support specific interventions, do not present program ideas. But, with help from social scientists and evaluators who are accustomed to using program theory and logic models to understand and assess programs, policy and program practitioners can incorporate what interventions informed by social science have to offer into program design.

Chapter 6 – Implications for Behavioral Program Policy and Planning and Next Step Recommendations

Chapter 6 summarizes findings and suggests a number of steps to help policy makers, program planners, and program implementers create next-generation DSM programs, in which behavior change is a better understood and recognized component of program logic, ultimately leading to measurable and reliable reductions in energy use.

This paper is in no way a final statement on DSM behavior program design. It is but one step in a process, the goal of which is to help California policy makers and program practitioners think more expansively and creatively to achieve their intended goals. Having said that, the white paper does include recommendations that we hope can help all policy makers and practitioners, within and beyond California.

The key findings in the paper are summarized below.

- *Influencing energy-related behaviors and modifying policy to promote change are complicated things to do.* The behavior of householders is complex, with conflicting forces affecting decisions and behaviors. The social science disciplines have differing ways of explaining them, which reflects the complicated fabric of human decision-

making. No one is suggesting that theories can be randomly mixed and matched or directly turned into programs. But they do provide the basis for the wide choice of program intervention strategies that can be empirically tested. Changing the way policy makers and program planners think about programs within the regulatory environment is also complicated. Experience has shown, however, that persistent encouragement and support can bring about improvements in regulatory policy and program planning, implementation, evaluation, and the eventual transformation of various markets.

- *Developing programs that use multiple and different intervention strategies holds promise.* Social science theory and empirical research offer a rich array of concepts that can explain energy-related behavior and behavior change. For example, traditional DSM program interventions have largely focused on technology purchasing behaviors. Additional interventions can help influence post-purchase installation and use behaviors. The interventions presented in this white paper can be used either singly or in combination with one another. We urge policy makers and encourage program planners and developers to be creative and test alternative combinations of strategies.

- *More work is needed to develop policies and design programs that fully embrace behavior change.* By exploring intervention strategies, this paper addresses a key component of behavior programs. But interventions are not in themselves programs and additional work is needed to create programs that effectively engender changes in energy-related behaviors that policy makers seek.

The recommendations are briefly summarized below, with additional details given in Chapter 6.

1. **Consider using a wider-range of interventions in DSM programs as described in this paper.**

2. **Conduct trainings on how to create behavior interventions and programs from the information provided in the paper.** Intervention strategies are not programs. Policy and program staff both require training and additional resources to understand how interventions can be formulated into effective programs, with evaluable effects. We recommend engaging social scientists and possibly evaluators, who often do have the social science/behavioral training. This will require funding allocations.

3. **Devote more time to the logic of each program at the planning stage.** Past experience shows that, despite the common sense of developing logic models to articulate program assumptions, these models are seldom systematically used. While considerable experimentation has been conducted on program features and delivery alternatives, they often don't address the underlying logic. The social science concepts and studies described in this white paper remind us of the considerable body of work from which planners can draw to guide program logic, with attention to metrics for testing whether program activities produce desired outcomes.

4. **Establish a pilot design process for developing and testing pilot programs.** Imposing cost-effectiveness requirements on all small-scale pilots can stunt innovation. By developing a process by which pilots can be developed, tested, and evaluated, existing full-scale programs can be refreshed and new programs added with less risk of misdirecting funds. In this way, the boundaries of effective strategies for enhancing residential energy savings can be expanded continually and incrementally.

5. **Use pilot testing to make incremental and alternative changes to programs.** Rather than propose sweeping changes in full-scale programs, we advise testing assumptions and alternative interventions in the market using small-scale pilots. Where possible, use experimental design to compare the outcomes of different behavioral interventions. Testing that introduces multiple interventions sequentially and/or in different order, and assesses their effects separately, can help identify the most effective combinations and perhaps develop an optimal loading order of interventions. Incorporate lessons learned in the next round of programs.

6. **Conduct more research related to specific program planning and evaluation issues.** Consider examining specific energy-efficiency planning and regulatory concepts in light of the various social science theories and studies described in this paper. For example; what might careful application of social science theory and empirical research have to say about free ridership, spillover or market effects, price elasticities, measure persistence, or code compliance? Analytic literature reviews related to specific energy-efficiency problems and particularly energy-efficiency behavior program problems could lead to pilot intervention experiments specifically designed to address those issues. And, finally, these next-generation programs may require development of additional evaluation approaches and techniques to assess effects.

7. **Conduct additional activities to help articulate and embrace an inclusive vision of DSM behavior programs to reduce energy use.** Additional activities that can support better program policy, planning, implementation, and evaluation might include developing an explicit definition of behavior program that reflects policy goals, assessing how current programs meet the definition, and workshops to assess opportunities for the design of next-generation programs.

8. **Develop a companion white paper that examines organizational theory and proposes intervention strategies for non-residential energy users.** Analogous opportunities for influencing the behavior of organizations warrant exploration to help non-residential behavior programs capture additional savings as well.

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Chapter 1 – Introduction

The Purpose of This White Paper

In 2012, the California Public Utilities Commission (CPUC) directed the California investor-owned utilities (IOUs) to offer behavioral programs to at least 5% of households they serve. The CPUC further mandated that the threshold offering employ a strategy of comparative energy usage and disclosure programs on an experimental design basis, at least through 2014.[1] All of the IOUs have initiated comparative energy usage pilot programs that comply with the decision.

Recent research suggests that comparative usage feedback programs represent only one of the ways behavioral interventions can influence energy use, thus raising the need to better define the range of energy-related behaviors toward which programs might be directed and to explore additional behavior change theories and intervention policy options.[2]

The IOUs, in agreement with CPUC staff, commissioned this white paper to define a full range of energy-related behavior intervention possibilities appropriate for California and develop a set of intervention strategies not limited by current programmatic classifications and/or restrictions. Specifically, the interventions are to include options for addressing behavior inherent in conservation, energy efficiency, demand reduction, solar, integrated demand-side management, dynamic pricing options, behavior enabled by automated metering infrastructure and technology options, mass marketing, social media, gaming, etc.

The California IOUs assembled this team of researchers based on their influential contributions to demand-side management (DSM) programs, including extensive study of behavioral motivation to leverage in DSM. The work presented in this paper synthesizes and builds on previous work by the authors and by other social science researchers.

This white paper seeks to provide policy makers, utility staff, and the broader community of DSM practitioners with ideas on energy-related behavior change intervention strategies to consider in developing behavior program policy and program design. The paper has two objectives:

- To demonstrate that social and behavioral science offers a rich set of theories and solid empirical research about behavior and behavior change that support using a wide range of intervention strategies in residential DSM programs.
- To identify a set of specific, promising behavior intervention strategies grounded in this social science theory and research that utility DSM program portfolios can utilize to influence energy-related behaviors.

The Scope of This White Paper

The paper focuses on defining intervention strategies that programs designed to influence residential energy consumers' behavior might employ. Interventions are not programs. Rather, they are used by programs. Whether programs that use certain of these strategies are or should

be separately categorized within a DSM program portfolio as “behavior programs” is a separate discussion, not included here.

In defining suitable intervention strategies for DSM programs, we developed a set of desirable attributes. Behavior intervention strategies…

- *Target one or more specific behaviors that affect end users' energy use.* They may address any of the broad arrays of energy-related behaviors including those that are infrequent or habitual; those that require purchases and those that do not; those that affect when energy is used; and those that relate to renewable energy generation.
- *Are rooted in social science research.* They rely on social science concepts that explain behavior to inform their design. These interventions may be used alone or in combination with traditional program interventions.
- *Consciously consider which behavior(s) they will affect.* Each intervention used in a program identifies one or more energy-related behaviors it aims to influence.
- *Yield evaluable effects.* They are implemented in a way that enables evaluation of quantifiable effects on energy-related behavior, both immediately after intervention and over time.

This white paper includes:

- A characterization of the types of energy-related behaviors subject to influence by behavioral interventions. These run the gamut from infrequent to ongoing or habitual behaviors, and from purchase through installation and usage decisions.

- A survey of foundational social and behavioral science theories and empirical research, and their relevance to energy-related consumer behaviors. The survey covers theories of behavior drawn from multiple social science disciplines, including: psychology, sociology, economics, anthropology, product design and adoption theory, and also legal theory. The different disciplines offer unique perspectives on consumer behavior. There is not a one-to-one correspondence between theories and behavior, and no unifying theory is sought. Individually and collectively, however, the theories provide considerable and applicable insight into energy-related behaviors and factors that influence them.

- A set of promising intervention strategies that program planners and implementers might use to influence energy-related behaviors, many of which have already proven effective in health and environmental conservation programs. Comparative usage feedback is one of a dozen categories of strategies in the set. This builds on work initially conducted for NYSERDA, adapted to the market and regulatory conditions in California.

- A few illustrative program designs that show how the energy-related behaviors, the social science theories and research that explain them, and the intervention strategies can be combined to create next-generation DSM programs.

Issues in Discussing Intervention Strategies

- *Energy-related behaviors.* We devote a full chapter to describing and characterizing energy-related behaviors, from many points of view, ultimately focusing on organizing them from the householder's viewpoint. Discussions we had about specific behaviors and the full range of energy-related behaviors figured heavily in the scope of the intervention strategies we developed.

- *Behavior programs.* There is no commonly held definition of a "behavior program." We consulted and reviewed ones developed by other colleagues and organizations[3] and, while many may serve their intended use, almost none incorporates the breadth of behaviors or activities, noted in the purpose of this paper, that California's programs might want to address. Nor is the difficulty in defining behavior programs surprising. As we know, virtually all DSM programs aim to influence energy-related behaviors. It is useful, however, to look more closely at how "traditional" DSM programs do or do not incorporate the four desirable attributes of behavior interventions that we outlined above and summarize in the text box at right. Traditional DSM does not exclude addressing any particular energy-related behavior; most programs simply do not extend much beyond purchase or infrequent behaviors. Many DSM interventions might be said to draw on social science concepts, but usually only a few highly selective concepts (mainly from microeconomics) and not always explicitly. These programs do know what behaviors they intend to affect (e.g., buy a widget, turn off devices during a DR event), but usually target a very limited set of behaviors. And traditional programs are required to yield measurable results; however, the impacts of behavior changes are usually entangled with the effects of hardware upgrades.

Behavior Intervention Strategies

- Target one or more specific behaviors that affect end users' energy use
- Are rooted in social science research
- Consciously consider which behavior(s) they will affect
- Yield evaluable effects

- *Linking social science theory to behavior interventions.*[4] Current DSM programs are required to develop program theories and logic models as a part of planning for program activities and evaluation. This is a natural place for social science theory and research findings to be used to improve the design of behavioral interventions, both in traditional DSM programs and new initiatives. Care is advised in doing this, however. Application of social science insights to program design is not a cookbook business with "recipes" for easily used tools and practices. Energy use behavior is highly varied, nuanced and not easy to change. The richness and diversity of the social science literature offers a wide variety of insights into energy use behavior and multiple possibilities for effective behavior change interventions. This means, however, that social science concepts must be thoughtfully selected, operationalized, tested, and evaluated in order to be applied with maximum impact.

- *Implications for future policy on behavior programs and program development.* This paper is in no way a final statement on DSM behavior program design. It is but one step in a process, the goal of which is to help California policy makers and program practitioners think more expansively and creatively to achieve their intended goals. Having said that, we do include recommendations that we hope can help all policy makers and practitioners, within and beyond California.

What We Don't Address (work planned for later phases)

- *Behavior affecting non-residential energy use*. This paper limits discussion to energy-related behaviors and intervention strategies to affect energy use in residential buildings. This includes the behaviors of decision-makers who determine energy use in residential buildings—not only homeowners and tenants but also building owners, landlords, and maintenance staff—and the interventions that can influence their energy-related behavior. The taxonomy of intervention strategies presented recognizes that some of the interventions work through other market actors (e.g., codes and standards that may be implemented by builders and manufacturers; upstream programs aimed at changing the stocking practices of retailers and product lines of manufacturers). But, along with behaviors exhibited by business decision-makers as energy consumers, the behaviors of these intermediary business decision-makers are best explained by the social science field known as organizational theory (not behavior theory). The behavior of organizational decision-makers deserves special study of its own and is not addressed in this white paper.

- *Program evaluation issues*. The paper does not attempt to provide guidance on how to evaluate behavior programs. Nonetheless, we cannot overstate our position on the critical importance of considering how program effects will be measured as part of program design and our recommendation that all programs should be pilot-tested for evaluability and effectiveness prior to full-scale launch.

- *Current program offerings*. Mapping the set of DSM programs currently offered by California IOUs to the promising intervention strategies is an anticipated next step.

How to Use This White Paper

While the chapters in the paper are related, it is possible to focus on them individually. We aimed for each to have its own practical use as a reference. We encourage readers to use them individually, as needed.

If you are especially interested in…

…Characterization of different types of energy-related behaviors, consult **Chapter 2**.

…Information about how different theories and empirical research treat behavior and behavior change, consult **Chapter 3**.

…Discussion of promising strategies that programs can utilize to encourage specific types of behavior change, consult **Chapter 4**.

…Use of the concepts in Chapters 2, 3, and 4 to design a program, consult **Chapter 5**.

…A summary of key findings, implications, and suggested next steps, consult **Chapter 6**.

Chapter 2 – Categories of Energy-Related Behaviors

Although California regulators have identified a behavior intervention strategy for the IOUs to use, in ruling on behavior programs, there is not much guidance yet on specific current behaviors that need to be influenced. Therefore, this chapter explores the observable individual behaviors and behavioral routines or habits that result in patterns of energy use in homes, condos, apartments, and manufactured housing, with the goal of determining how household energy-related behaviors might be usefully defined and categorized. We then propose a particular approach for organizing behaviors that will inform subsequent chapters.

Existing Categorization Schemes

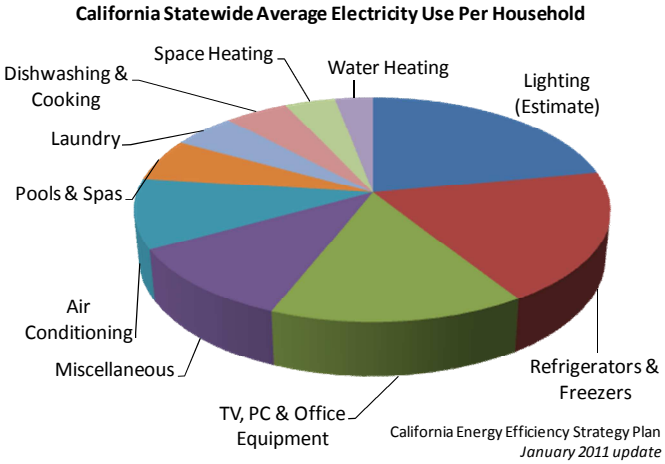
Drawing upon a review of energy-related articles, presentations, program materials, and websites, as well as discussions among the white paper authors,[5] we first compiled a large list of energy-related actions—that is, all the behaviors that people engage in that affect their energy use, from the equipment they buy to the personal and household choices they make every day. We then searched for schemes that utilities and other energy efficiency organizations have used to organize energy-related behaviors into useful categories for their purposes—for instance, groups of behaviors that might be focused on in a particular type of energy efficiency program or with a particular type of intervention.

Please note the schemes listed below may not be mutually exclusive nor comprehensive. Still, it is important to note that the type of behavioral scheme that we choose may influence or reveal how we think about energy-related behaviors. For instance, the scheme discussed first—end use categories—tends to focus our thinking on energy using equipment (e.g., refrigerators, TVs, PCs, office equipment, lighting), rather than on the behaviors people engage in to purchase, install, and operate equipment or manage an end use.

Other schemes tend to focus thinking on the financial aspects of energy-related behaviors (i.e., no/low cost versus major cost), but don't tend to acknowledge other non-financial but equally important costs, such as time and convenience, that interfere with consumers taking steps to save energy.

The bullet points below reflect the most common types of categorization schemes that we found for energy-related behaviors.

- **End use.** These category schemes reflect the long-standing and familiar focus of DSM programs to target the end uses found in a home, such as lighting and air conditioning, as shown in the figure at right. As



mentioned above, end-use schemes tend to focus on equipment not discrete behaviors. Still, desired behaviors can be attached to each end-use wedge, even though similar energy management behaviors might be housed under different end-uses. Consider, for instance, an effort to reduce hot water use. Turning down the water heater temperature and taking shorter showers, washing clothes in cold water, regulating water heating in a hot tub, and buying a high-efficiency dishwasher, all relate to managing hot water usage, but each would be housed in a different wedge.

- **Purchase versus non-purchase.** Discussion about behavior change typically centers on building habits and adjusting how we use equipment—changes that require minimal financial investments (although they may require others types of investments, such as time or inconvenience factors). But clearly, behaviors associated with energy-related purchases also affect energy use. We use these terms as follows to distinguish between energy-related behaviors characterized by purchase criterion:

    - *Purchase behaviors* are decisions and actions that influence selecting and buying energy-using products based on the product's use of energy (e.g., an energy efficient refrigerator) or how energy use is impacted or controlled (e.g., insulation or automatic setback thermostat). For some products, buying ordinarily includes special installation (e.g., a central furnace), though for other products it does not (e.g., CFLs).

    - *Non-purchase behaviors* are actions that do not require any monetary outlay to control energy-using or energy-influencing products, including installation of those products if it does not ordinarily occur as part of their purchase.

- **No/low-cost versus major cost.** This approach groups behaviors by the level of financial investment involved, often in two categories: no/ low-cost actions and actions that require a larger financial investment. No/ low-cost investments might include adjusting thermostats, replacing furnace filters and air-drying laundry. Higher cost investments include equipment purchases such as buying appliances, HVAC systems, installing insulation or windows etc.

  DSM programs typically view financial cost as a key factor in energy-related decisions and consumers also often report cost as a significant barrier to equipment purchases. The no/low cost action category of behavioral groupings typically ignore non-financial costs that consumers may associate with making changes to their energy use, such as time required to learn new behaviors and habits or the level of convenience/ inconvenience involved in changing behaviors.

- **Response to Messaging.** Messaging and "call-to-action" for of energy-related behaviors focuses on customers reacting to information that is of interest to them in a way that influences their mindset, prior assumptions/habits, etc. Such messaging can be distinguished by the following common types:

  - **Energy or dollar savings potential.** Messaging that tries to convey a sense of the best investment, either in absolute dollar terms (e.g., "Save up to $40 per year by adjusting the display on your TV") or length of payback (e.g., "In less than three years, you will recoup the cost for a more efficient product through reducing your energy bill"). Predicting dollar savings, of course, is quite dependent on situation specifics; for instance, if you always wash clothes in cold water, you will realize fewer energy or dollar savings by buying a high-efficiency clothes washer. Also, while payback often is a clear criterion for business customers, who are accustomed to thinking in accounting terms such as depreciating equipment, payback tends to be unfamiliar to residential customers who seldom make purchases thinking that those purchases will pay for themselves over time.
  - **Frequency or popularity of actions.** DSM program surveys often collect self-reports of the energy-related behaviors that customers engage in. This leads to lists such as the top ten most frequent energy-related behaviors, e.g., turning off lights, adjusting thermostats. These lists reflect behaviors that programs have stressed, or behaviors that are easiest to change. While these lists are instructive, they leave major gaps if we are trying to develop a robust view of energy-related behaviors.

- **Difficulty or complexity.** This approach attempts to separate changes that appear to be easier to understand and implement (such as turning off the lights), from more complex ones that involve a longer or more complicated string of behaviors, such as buying and installing a high-efficiency heat pump. However, behaviors classified as simple tend to be habitual behaviors, while those that are more complex tend to happen less often—either periodically or rarely. It is possible that habits, which require consistent, but automatic, responses to stimuli over time, may be equally (or perhaps more) difficult to develop and maintain than periodic or rare behaviors requiring a higher level of attention.

Several researchers have suggested alternative categorization schemes they hope will better reflect consumer viewpoints.[6] The categories themselves embed behaviors and tend to be larger and more inclusive, such as making alternative technology choices and buying new houses. These categorization approaches do not address some of the other dimensions such as frequency, although it may be useful to add these other dimensions into these schemes. Experience has shown that understanding and incorporating human preferences and perspectives into behavior change is highly important if programs are to succeed.

Recommended Behavior Typology

In the end, we found there may be more than 100 energy-related behaviors that need to be clearly considered when efficiency interventions target behavior change We also concluded that all the categorization schemes described above have their strengths and limitations. Some do not reflect how people are likely to categorize their own behaviors, some will be foreign to prevailing category schemes, and some make it hard to sort what behaviors belong where.

One thing common to the various behavior categorization schemes is that all start with the basic premise that consumers need to know what actions to take and to be motivated to do them, often again and again. In this White Paper, we offer an approach that attempts to look at how energy saving behaviors might fit with a householder's view of what he or she needs to do to operate and maintain their home. This behavioral category scheme, like the other schemes, has not been tested out with consumers to see how well it resonates with their needs and thinking. However, it does put the consumer at the center of the behavior universe, where he or she belongs, as shown in the schematic below.

A more detailed view of this category scheme is shown in Table 1. The first column characterizes how a homeowner thinks about the things that need to be done around the home Subsequent columns provide sample energy-related behaviors that fit within that need; the upfront financial cost to invest in that behavior; the other costs involved in adopting that type of behavior,; and the frequency, one time or ongoing, of the behaviors.

Table 1. Householder-Based Behavior Scheme

Householder Need*	Sample Energy Related Behaviors	Initial Cost 0 to $$$$	Other Potential Costs	Frequency • One-Time • Ongoing
Change your habits	• Do full loads • Hang out laundry • Use cold water • Shift timing (e.g., laundry at night) • Dress warmer/cooler • Use pot lids • Limit oven use • Take shorter showers • Unplug • Turn off lights, other equipment	0	Learn new habits Inconvenience Time required	Ongoing
Get rid of stuff	• Recycle extra refrigerators and other appliances and equipment	0-$	Inconvenience	Ongoing or revisit regularly
Maintain your home	• Replace furnace filters • Tune-up HVAC • Weatherstrip/air seal • Install window film • Install low-flow showerheads, faucet aerators	$ - $$	Inconvenience Time required	Ongoing, though installing some equipment may be one-time or infrequent
Use your equipment better	• Turn thermostats up/down • Turn down hot water temperature • Close vents in unused rooms • Close doors • Open or close windows or curtains • Use fans instead of A/C • Un-plug chargers	0-$	Learn new habits Comfort	Ongoing
Upgrade your home	Install: • CFLs or LEDs • Ceiling or other fans • High-efficiency equipment (e.g., HVAC, water heating, appliances.) • Windows, shades, awnings • Higher levels of insulation • Smart house systems	$-$$$$	Inconvenience Time required	One time, although some may need to be repeated
Automate your home	• Install power strips, timers • Install smart thermostats • Install household feedback system	$-$$$	Inconvenience Time required	One time, although some may need to be repeated infrequently
Invest in your home	• Buy a high-efficiency home • Whole-house retrofit existing home • Install solar panels	$$$$	Inconvenience Time required	One time, although some may need to be repeated infrequently

Chapter 3 – Social Science Research as the Basis for Influencing Energy-Related Behavior and Behavior Change

Traditionally, our industry has focused on two major approaches to influence behavior, information and incentives, which have been the staple of program intervention design theory for many years. A major goal of this paper is to go beyond our traditional program intervention design theory and highlight some of the most widely recognized and potentially useful social and behavioral science theories that could be applied more systematically in DSM behavior program intervention design and evaluation. By delineating these theories, which theorize *how* behaviors *are influenced* throughout the daily life of individuals, cultures, and societies, our goal is to expand our thinking on *how* behaviors are changed in order to inform more innovative and effective behavioral interventions.

When reading this chapter it is important to understand the following:

- **The theories discussed here are not limited or directly tied to behaviors outlined in Chapter 2.** Although these theories detail influences that could impact a wide-range of behaviors, here we focus only on their potential to affect energy-related behaviors.
- **The behavioral influences outlined here could be leveraged using any number of intervention strategies outlined in Chapter 4.** While some popular behavior interventions rely on a few specific theories, behavior interventions should not be limited to specific theoretical frameworks. Rather, those seeking to impact behavior should identify the most meaningful influences for a given behavior and tactic and leverage that influence to change behavior.
- **This chapter conveys an appreciation of the wide range of perspectives, approaches, and/or lenses that can be used to influence behavior.** Some of these theories are commonly applied in non-energy fields, such as public health and consumer product design. Some have a long history in energy programs and policy, while others have scarcely been recognized, let alone implemented. These approaches may differ on how behavior can be affected. All have adherents and detractors, and the list is undoubtedly incomplete. Nonetheless, outlining these theories establishes a framework for understanding energy-related behaviors and interventions to influence them.

We organized the theories by the disciplines from which they emerge and divided them into three categories: individual-focused theories, socially focused theories, and science and technology studies. We acknowledge that this is an oversimplification of the theories and their respective schools of thought and that there is significant cross-pollination among these theories. That said, we believe this framework is useful when considering points of intervention for energy programs. We offer the main concepts that grow out of the theoretical perspectives and that may influence energy-related behavior. The reader will note that some concepts appear under more than one theory, suggesting that that these concepts are considered

important in multiple disciplines and also that they have been researched from varying perspectives.

Throughout the chapter, we provide tables illustrating how the theories can be used to think about behavior intervention design, targeting and messaging. The third column of each table provides explanations and examples of the concept's relation to energy behavior.

Individual-Focused Theories

The theories discussed in this section center on the decision-making processes of individual actors. We note that many of these theories also consider social circumstances and individuals as social actors; this is not, however, the primary focus. We begin with a theoretical perspective that is the basis for many of our traditional programs, microeconomics, and then move to other individual-focused theories, starting with psychology and cognitive science, followed by behavioral economics (which largely makes use of cognitive science concepts), concluding with social psychological theories.

Microeconomics

As Paul Krugman succinctly states, microeconomics is the study of how people make decisions.[7] Neoclassical economic thought has a long history in describing consumer choice behavior, based on a set of rather strict assumptions which constitute "rational" behavior. Behavioral economics refutes some of these assumptions.

Neoclassical Economics: [8] Originating with 19th century "marginalist" theorists Alfred Marshall and W. S. Jevons, the neoclassical (or "conventional") school of economics posits consumer choice or decision-making as entirely self-interested, rational and based upon a careful evaluation of marginal benefits and costs (the *additional* benefits or costs for one *additional* unit of consumption), captured in the theory of utility maximization. [9] [10]

- **Utility Maximization Theory:** The basic premise of neoclassical decision-making is that individuals act "rationally," choosing options that give them the most "utility" (i.e. happiness, satisfaction, profit, etc.) possible, within their budget constraints. [11] [12] An individual's preferences are assumed to be strictly ordered (able to be compared and ranked) and consistent (if A is preferred to B and B preferred to C, then A is preferred to C), fully known by the individual (not subconscious or instinctual), and unchanging ("invariant and consistent".[13]).[14] [15] Different individuals can and do have different utility functions, which is what we mean when we say that they have different preferences. Because of this, two consumers may each choose a different combination of products and services available to them both.[16] The implications for energy-related decisions are that different individuals value energy efficiency differently and that budget constraints can keep them from choosing more energy-efficient goods and services. Intervention strategies that help consumers rethink the value of energy efficiency and/or allow them to afford more efficient equipment influence energy-related behavior.

Table 2. Ideas for Influencing Behavior Based in Neoclassical Economics

Broad Theoretical Concept	Specific Concept	Explanation of Concept's Relevance to Energy Behavior
Utility Maximization	Constrained optimization and budgetary constraints	Consumers will choose the ideal product based on what they gain (happiness, end-use utility, energy savings) within their budgetary constraints; may be interested in using energy efficiently, but not have sufficient discretionary income to purchase efficient equipment
	Substitution effects	Customers choose less desirable, but more affordable, products and services to meet their needs. Rebates reduce the price differential between high-efficiency and standard-efficiency equipment, making the more desirable choice more likely.
	Income effects	As customers have more access to capital, they can buy more of anything, including energy-saving products, if that is what they value.
	Short-/long-term costs and benefits	Energy-efficient behaviors may have short-term costs and long-term benefits. How such costs and benefits are perceived can be important in decision making and can be influenced by program messaging
	Discount rates	Adjusts the value of future income; i.e., a dollar today is worth more than a dollar tomorrow. Thus, individuals require higher return in the future in exchange for sacrificing consumption now.
	Risk aversion	Resistance to changing a behavior or purchasing a new technology because people don't want to take a chance on it not serving their needs.

Psychology

Psychology is the scientific study of mental processes through both applied and academic research. This area of research is both broad and deep, ranging from clinical and behavioral interventions to theoretical work in areas as esoteric as phenomenology and symbolism. Most relevant to energy-related behavior are cognitive psychology, cognitive science, and social psychology, all of which offer theories that can be used to identify, delineate, and differentiate the models of individual decision-making and resultant behaviors.

Cognitive Psychology and Cognitive Science: [17] Cognitive psychology and cognitive science examine individuals' internal mental processes, including problem solving and decision-making.

- **Priming**: Priming increases the speed at which a stimulus (such as an energy-efficiency offering) is recognized due to prior experience with related prime-stimuli. Priming is a very basic cognitive function in both memory and language that can influence short- and long-term recognition of stimuli as well as decisions.[18] [19] Priming interventions can include images, words, or environmental cues such as physical sensations.

- **Decision Frame and Reference Dependence:** The decision-frame (alternative options, outcomes, probabilities and attributes presented to the decision-maker) can be manipulated to change an individual's order of preferences in their decision-making process or it can be used to anchor the decision-maker to certain reference points to ultimately change the decision outcome. [20] [21] [22]

- **Metaphor Theory and Mental Space Theory:** Both metaphor and mental space theories propose that a person can take information from one domain and apply it to another. [23] [24] For example, when explaining a complex concept such as love one often uses more concrete concepts such as a long-distance journey. These concrete concepts

contain features that one maps to the complicated and abstract concepts to make them more accessible and create a more concrete understanding of the complex concept. Within the context of behavior change, choosing or manipulating the correct concrete mapping, such as supplying useful, everyday metaphors, can help spur change.

- **Bounded Rationality and Decision Heuristics:** These ideas posit that a psychological threshold limits the number of options that an individual can process. This threshold prevents them from weighing all alternatives to make the utility-maximizing decision[25] and leads them to rely on simple rules (heuristics) to eliminate or prioritize options.[26] The limitations of our capacity to consider and to the information we have at our disposal is most properly called Bounded Rationality. The use of Decision Heuristics is what we do to make decisions given those limitations. The dividing line between the two is not clear cut. Thus we have combined them in Table 3.

Table 3. Ideas for Influencing Behavior Based in Cognitive Psychology and Cognitive Science

Broad Theoretical Concept	Specific Concept	Explanation of Concept's Relevance to Energy Behavior
Priming	Positive & negative stimuli	A stimulus given prior to an offer than can lead householders to feel or act favorably or negatively to the offer. The stimulus can be as simple as a single word or a simple picture or as complicated as messaging or experiences.
	Conceptual priming	Information provided to activate representations in one area, such as a paragraph in an offer letter that activates "good" and "trustworthy" concepts. This activation can alter the meaning or importance householders place on a target behavior.
	Reducing negative stimulus	Householders may raise or lower thermostats based on feeling hot or cold, therefore reducing drafts or increased shading can minimize cue to change the thermostat.
	Associative priming	Providing a stimulus associated with positive EE behavior that can increase the probability of the behavior. For example, using "green imagery" on computer lock screens.
	Social cohesion—group inclusion priming	Using mimicry or a stimulus to induce a person to belong to a group. It can then highlight EE behaviors of that group.
Decision Frame and Reference Dependence	Inattention to target behavior or issues	Lack of interest in a target behavior that must be overcome before a desired change is affected.
	Salience/relevance of issue or behavior	Perception that a behavior or technology is not salient or relevant, which must be overcome before a desired change is affected.
	Points of reference/comparison	A point of reference, such as the ENERGY STAR© label that makes it easier for householder to choose high-efficiency equipment.. What friends and family have/do can also serve as a point of reference.
	Loss aversion	The tendency that people would rather avoid a loss than hope for a gain.
	Anchoring	Similar to a point of reference, but uses alternative choices, such as the least expensive one, by which to judge the other choices.
Metaphor & Mental Space Theories	Mapping concepts onto concrete images and understandings	Messaging about target behavior constructed to increase householder's understanding of its impact and importance and thus make the message more compelling; e.g.,, replacement of half of a household's lamps with LEDs would have comparable environmental impact to taking 500 cars off the road .
Bounded Rationality and Decision Heuristics	Recognition of target behavior	A behavior that seems foreign or outlandish is less likely to be adopted. Over time, with consistent messaging, the behavior can be recognized as normal and be adopted.

Broad Theoretical Concept	Specific Concept	Explanation of Concept's Relevance to Energy Behavior
	Elimination (of choices so they are less overwhelming)	A strategy that makes decisions about choices more manageable, e.g., eliminating the most and least expensive options.
	Descriptive norms	Existing behavior patterns that reflect the descriptive norm.
	Cognitive capacity	Differences in householders ability to understand behavioral choices and weigh relevant trade-offs because everyone has limits to what can be retained in a decision-making context. This gives rise to decision heuristics.
	Ease and convenience	A target behavior that is inconvenient or difficult and thus is less likely to be adopted. If messaging shows how it can be easy to accomplish the behavior, adoption rates could be positively affected.
	Personal norms	How *we* think we *should* act.
	Fads/trends	Fads or trends that can affect willingness to adopt behaviors or technologies.
	Subjective norms	A person's perception of social pressure about a behavior—how *others* think we *should* act.

Behavioral Economics: Behavioral economics challenges the fundamental assumptions of neoclassical economics by bringing in psychological insights about actual behavior and choice. Behavioral economics theories postulate that individuals are decision-makers that are not always rational in the neoclassical definition of rationality.[27].[28] The outcome of decision-making and salient preferences depends heavily on the ways in which the decision is framed.[29] Most of the concepts used in this field that are pertinent to energy behavior came from cognitive psychology, in particular bounded rationality and decision heuristics. To that list we have added time inconsistency. The difference lies in the methods of measuring such concepts.

- **Time Inconsistency:** Individuals do not use a constant discount rate to properly account for present and future value to maximize utility (i.e., depreciate the value of the future benefits by a constant factor to assess the cost of sacrificing consumption now for consumption later). Instead, individuals use higher discount rates for short-term costs leading to long-term benefits (i.e., they depreciate the value of future benefits very rapidly, which results in much lower value for future benefits than if they were using the constant discount rates).[30] [31]

- **Bounded Rationality and Decision Heuristics:** These ideas are discussed under cognitive psychology above, but are mentioned here as well because the field of behavioral economics makes use of them, and sometimes with a somewhat different application; i.e., the concept is the same, but the application is specific to economics.

Table 4. Ideas for Influencing Behavior Based in Behavioral Economics

Broad Theoretical Concept	Specific Concept	Explanation of Concept's Relevance to Energy Behavior
Time Inconsistency	Short-/long-term costs & benefits	Energy-efficient behaviors may have short-term costs and long-term benefits. How such costs and benefits are perceived can be important in decision-making and can be influenced by program messaging.
	Patience/impatience	If a new technology requires waiting (e.g. CFLs) for full return on investment, effectiveness, or quality enhancements, householders who are impatient are less likely to be willing to adopt it.
Bounded Rationality & Decision Heuristics	Points of reference/comparison	A point of reference, such as the ENERGY STAR© label that makes it easier for householder to choose high-efficiency equipment. What friends and family have/do can also serve as a point of reference.
	Elimination of choices	A strategy that makes decisions about choices more manageable, e.g., eliminating the most and least expensive options.
	Loss aversion	The tendency that people would rather avoid a loss than hope for a gain.
	Anchoring	Similar to a point of reference, but uses an alternative choices, such as the least expensive one by which to judge the other choices.

Social Psychology

Social Psychology: Cognitive psychology, as described above, examines individuals' internal mental processes, including problem solving and decision-making. Social psychology additionally suggests that individuals' thoughts, feelings and behaviors occur within social situations.[32] Personal values dictate beliefs and attitudes towards a behavior, but external conditions, including economic conditions, ultimately limit the ability of the individual to act. Three theories from social psychology are central to this conversation:

- The **Theory of Planned Behavior (TPB)** views decision-making as driven by attitudes and beliefs about a behavior's outcomes, perceptions of behavioral control, and social influences especially from those closest or most important to the individual.[33]
- The **Values-Beliefs-Norms (VBN)** model introduces emotion as a driver and suggests that an individual begins with a worldview or personal values (either self-interested or altruistic), which leads to beliefs about self-responsibility for a behavior and the consequences of adopting or not adopting it, which then determines the individual's behavioral norms.[34]
- The **Attitude-Behavior-External Conditions (ABC)** model goes beyond VBN to argue that psycho-social drivers only matter if they are allowed by external circumstances, for instance financial, social, legal, and physical resources and constraints.[35]

Paul Stern has proposed an overall psychological model of household energy use and conservation that encompasses much of this work.[36] Others, including Corinna Fischer,[37] have also proposed integrative models of energy-related behavior. Table 5 summarizes concepts for influencing energy behavior from social psychology.

Table 5. Ideas for Influencing Behavior Based in Social Psychology

Broad Theoretical Concept	Specific Concept	Explanation of Concept's Relevance to Energy Behavior
Theory of Planned Behavior	Value of target behavior to person	How important the efficiency behavior is to the householder.
	Probable success of behavior	Sense that householder is part of a larger effort that makes a difference.
	Subjective norms	Perception of social pressure about a behavior—how *others* think we *should* act.
	Beliefs	Beliefs about target behavior and why one should or shouldn't engage in it
	Specificity	E.g., asking someone to conserve will be less successful than asking them to set the thermostat to 75° F in July
	Perceived behavioral control	The householder's perception of ability to take an action. A person may feel committed to energy efficiency but not be able to purchase appliances or CFLs because someone else in the family does this. Or the person may want the lights to be turned off when not in use, but others in the household will not cooperate
	Actual behavioral control	Different from perceived behavioral control in that the behavior in question may actually *not* be under his/her control.
	Self efficacy	A person may want the world to use less energy but does not feel his/her actions will make a difference or effect a change.
Values-Beliefs-Norms (VBN)	Worldviews/values	A common typology of energy-related world views that includes Humanistic Altruism, Biospheric Altruism, and Egosim. Biospheric values or world view would usually be associated with behaviors that are good for the environment.
	Personal norms	How *we* think we *should* act.
	Knowledge/Awareness	Awareness of lack thereof related to issues relevant to target behavior.
	Cognitive dissonance	Trying to make beliefs/actions consistent with one another, or making our beliefs consistent with those of others that we like or admire. E.g., if someone thinks of themselves as "green" and their non-green habits are pointed out, they may be motivated to change their habits.
	Personal Norms activated	Personal norms about how to act in certain situations that may not be felt relevant until a person or event points out the relevance, which activates the person's personal norms.
	Ascription of responsibility to self	The belief that using energy efficiently is a positive thing, but not feeling personal responsibility to do so.
Attitudes-Beliefs-External Conditions (ABC)	Worldviews/values	See above.
	Awareness/ knowledge of consequences	Awareness about a behavior or the reasons the behavior is important.
	Personal norms	See above.
	Cognitive dissonance	See above.
	Perceived behavioral control	See above.
	Personal norm activated	See above.
	Ascription of responsibility to self	See above.
	External constraints on behavior	A person may be committed to energy efficiency but have external constraints on what can be done, such as certain building characteristics, or being a renter.

Socially-Focused Theories

In this section, we outline theories that focus specifically on the social structures and processes that form and define the behaviors of individuals and groups. These theories examine the actions of individuals and groups by unearthing the structures, cultures, practices, and belief systems of groups. Here, we discuss the fields of anthropology, sociology, legal theories and macroeconomics.

Anthropology

Anthropology, the comparative study of humanity and culture, seeks to explain both diversity and similarity in human behavior. Among the social sciences, the field of anthropology intervenes by arguing that human behavior is highly contextualized in time and place and dependent largely on culture(s) specific to time and place. The discipline examines culture and social interactions to identify processes of meaning-making. Meaning and cultural relevance and importance are revealed through observations of individual and collective behavior, social interactions, and human engagement with the material world. Although anthropology encompasses a number of specialized areas, we focus on cultural anthropology and linguistic anthropology.

Cultural Anthropology: Specifically, cultural anthropology identifies what is valuable and important (meaningful) to humans by examining the material, linguistic, and relational practices and technologies that form culture. By examining how and why certain practices and material objects are important/not important, researchers and program implementers can identify latent barriers and drivers to the adoption of behaviors and technologies relevant to energy efficiency.

Anthropology, of all disciplines, is primarily an interpretive one, in that the discipline provides a lens to understand cultural values and meanings made visible through the behaviors and practices of individuals and groups. In this way, Anthropology as a discipline puts the people at the center of all research. It does not presume a theoretical framework before in advance of field work. Instead, it allows the subjects' values to guide analysis and identify what is important to their lives. This philosophy is made evident in the primary, participant observation-based methodology ethnography, which literally means "writing about culture."

As a theoretical engagement, anthropological theories are primarily explanatory, and can contribute to our understanding of *why* certain framing or particular interventions work differently in varied contexts. It indentified and explains the shared meanings and value in a social group (however defined) and is best used in formative research when developing messaging, outreach tactics, and engagement strategies that rely on a shared value system that may be different than those who are implementing a program. Below we outline a few theories that characterize this discipline.

- **Culture as Meaning Making:** Clifford Geertz summarizes human behavior and culture as a meaning-making process, stating that, "Man is an animal suspended in webs of significance he himself has spun. I take culture to be those webs, and the analysis of it to be therefore not an experimental science in search of law but an interpretive one in

search of meaning."[38] Through interpretive analysis of cultural practices, researchers can understand the variety of forms in which meaning is manifest and give shapes to cultural systems. Rick Wilk extends this view to consider the moral dimensions of economic exchange, including household energy use.[39]

- **Linguistic Shifters:**[40] The concept of linguistic shifters examines how individuals in conversation use words to signify placement in existing social hierarchies. This theory examines how linguistic tokens or words "shift" a conversation by revealing the participants' social placement in relationship to one another. Identifying these linguistic tokens reveals the linkage between language and culture and can inform how to develop communications to convey cultural meaning, insider and outsider status, and other important cultural signifiers.

Table 6 shows examples of concepts that are rooted in anthropology. These concepts and influences are a bit different from others in this chapter but suggest how programs can communicate the nature of the program or behavior and its place in the larger society. These concepts and influences are specific to communication or language and their impact on how the program or behavior being promoted is viewed by particular households in particular communities. In other words, the meaning of a particular behavior can be very different across subcultures and similarly, the manner of communication will have a different impact, depending on the community the householder is part of. These ideas are related to cognitive framing.

Table 6. Ideas for Influencing Behavior Based in Anthropology

Broad Theoretical Concept	Specific Concept	Explanation of Concept's Relevance to Energy Behavior
Culture as Webs of Meaning	Actions as meaning	Actions are a result not of individual rational actors but are formulated in shared systems of value and meaning. Messaging should take account of and use these meanings
	Shared meanings	Culturally shared forms of value and meaning will influence individuals' acceptance of target behaviors
Linguistic Shifters	Words as indicators of social importance	Word choices that index individuals in existing social hierarchies. Language choices determine how one sees oneself in relationship to others in a culturally specific and established hierarchy of values and thus influence behavioral choices with respect to the individual's social position and values. Word choices in communications can be used deliberately to signal in/out group status, desired social actions, and expectations.

Sociology

Sociology is the study of structure and dynamics of society and patterns of human behavior and individual life chances in relationship to society. It examines the ways in which the forms of social structure and organization such as class, race, sex, and age, as well as institutions, affect human behavior, choices, and access to goods and services. The field is particularly invested in examining the sources and consequences of these structures (and changes within them) and examines questions of access, value, conflict, power, inequality, deviance, control, order and change.

Relational Sociology: Pierre Bourdieu argues that traditional framings of capital fail to examine the ways in which cultural, symbolic, and social power are leveraged and reproduced through relationships and consumption. [41] Through this work, we can understand that capital, framed as the power to act, exists in many forms only some of which are economic. In terms of policy and implementation, this insight helps to explain why barriers to action persist in spite of substantial financial investment in programs and interventions. Making goods and services available does not guarantee their use, because their adoption is contingent on the social value and power of these goods and services to particular communities. This theory draws largely on anthropological theories of meaning while also directly addressing structural theories of access prevalent in sociology and described by Weber (see below).

Weber Life Choices and Life Chances:[42] Weber was the first to theorize that the chances of an individual to have a positive life outcome are determined by the individual's socio-economic standing. Not a determinist, he believed in the idea of social mobility and that how a person feels about their life changes impacts their outcomes. Through this work, Weber adds social complexities to Marxist determinist theories of class and introduces the problems of agency and structure. Agency represents an individual's choices and action and structure indicates the systemic and inherited hierarchies within which a person acts. Some models of equity and social justice-oriented programs offer social mobility by producing choice where it otherwise does not exist.

Social Stratification and Hierarchy:[43] This school of thought seeks to explain social action by focusing on social structures and hierarchies. These structures are characteristic of societies, not individual actors, and are passed from generation to generation and are difficult to transcend. As a result, certain members of society have greater access to goods and services while others are structurally disadvantaged by their social placement.

Social Patterning of Environmental Demands: This is a focus of environmental sociologists who are concerned with the stable and changing relationships between human groups and ecosystems. Energy has been considered a key environmental resource in these relationships and studies have focused on how social actors and social groups variously understand energy, organize energy use, approach energy conservation (as well as waste), and maintain a wide range of energy-using lifestyles. Key structural dimensions that are emphasized in this view much more than others include life course/lifecycle stage, ethnicity, household group dynamics, and the social embeddedness of households within communities.[44]

Social Exchange Theory: Social exchange theory relies heavily on theories from social psychology and sociology to explain social decision-making and processes. This theory describes human behavior as a series of social exchanges between individuals that are guided by rational and highly subjective cost-benefit analyses to arrive at negotiated and mutually beneficial relationships and practices. [45]

Labeling Theory (Social Reaction Theory): Labeling theory examines human behavior in terms of norms and deviance, postulating that that deviant social acts or groups are not inherently bad but rather that they are determined deviant in direct relation to prevailing cultural

norms and ideals. As a result, the behaviors of social and cultural minorities are often deemed deviant and result in stereotypes that negatively characterize individuals as a result of perceptions of their social group(s). [46] [47] [48]

Reference Group Theory: Merton introduced the idea of reference groups, pointing to the fact that individuals and groups judge their behavior by their reference groups.[49] These may be the groups of which they are a part, or can be groups to which they aspire. Appeals based on the groups to which we feel we belong or aspire can influence our energy-related behavior.

Table 7. Ideas for Influencing Behavior Based in Sociology

Broad Theoretical Concept	Specific Concept	Explanation of Concept's Relevance to Energy Behavior
Relational Sociology	Symbolism	Symbolic power of target behavior in maintaining and advancing an individual's place in society.
	Social power	Social power of target behavior (other than symbolism) in maintaining and advancing an individual's place in society.
Life Choices & Chances	Chances	The idea that individuals' place in social hierarchies determines whether they can or cannot get products or services
	Choices	Perceptions of what options are available to the person within the constraints of chances (described above) or access.
	Importance	Relative importance of a target choice to individuals, largely determined by their social status and place in social hierarchies
Environmental Sociology	Lifestyle fit	How target behavior fits into energy-using lifestyles of individuals and social groups.
	Lifecycle stage	How the lifecycle stage of individuals' affects their view regarding the benefits of technologies and what messaging will be effective with them.
	Cultural meanings	Ethnic/cultural meanings of target behavior that can influence adoption; these can be important considerations in how messages about desired behavior are formed and targeted. This relates closely to Weber's webs of meaning in anthropology.
	Household dynamics	How target behavior fits into household dynamics will affect how quickly it is adopted versus resisted.
	Social constraints	How an individual's friends, family, and colleagues view a target behavior; social constraints on target behavior will affect adoption of behaviors or technologies .
Social Exchange Theory	Subjective costs & benefits	Subjective sense of cost-benefit of target behaviors. Costs and benefits are not perceived or experienced the same way by all people, which affects how costly or beneficial a target behavior is seen. This relates closely to Bourdieu's theory of relational sociology.
	Fairness	Sense of fairness in what behavior is being requested compared to others.
Social Stratification and Hierarchy	Social class	Social class implications of behavior impact how easily or by what argument a behavior will be adopted. If energy conservation is viewed as something only high-income families can afford to care about, this will affect a household's willingness to adopt it.
	Economic class	Economic class implications of behavior (similar to social class implications)
Labeling Theory	Behavior labeling	How people relevant to an individual label a target behavior influences the individual's response to requests to change the behavior.
	Person labeling	Labeling of individual's engaging and not engaging in target behavior will influence how people respond to requests to change the behavior.
Reference Group Theory	Reference groups	Knowing the groups to which our target population aspires to belong can be used to influence behavior; this is closely linked to Bourdieu's intervention in relational sociology.

Legal Theories

Legal theory indicates that laws as governing rules establish and reflect social and cultural norms of the dominant social group. Within these institutionalized norms (laws), individuals and organizations conform to, or fail to conform to, institutional authority (i.e. the government) to avoid social, economic, or physical sanctions. Such institutionalized norms, whether or not fully internalized or shared, are expressed by legislative action, government restrictions, and even building codes and influence behaviors that can either be beneficial or detrimental to energy efficiency initiatives.

- **Obligations Theory:** Individuals comply with laws because the behaviors mandated by laws (obligations) are the behavioral norms embedded into formal rules and laws that activate the beliefs and values of individuals to engage in compliance. [50] [51]
- **Public Good Theory: O**bligations and incentives, perceptions of cooperation, and appeals to altruism can influence behaviors.

Table 8. Ideas for Influencing Behavior Based in Legal Theories

Broad Theoretical Concept	Specific Concept	Explanation of Concept's Relevance to Energy Behavior
Obligations Theory	Sense of obligation	Activation of a person's beliefs about obligation toward target behavior.
	Values	Activation of a person's values associated with target behavior.
Public good Theory	Benefits to society	Person's perception of the benefit of target behavior for larger society can be appealed to if present.
	Sense of cooperation	Activations of a person's sense of cooperation.
	Altruism	Appeal to a person's sense of altruism regarding target behavior.

Macroeconomics

While similar to microeconomic theories of human decision-making (predominately neoclassical economics or the theory of consumer choice), macroeconomic theories take into account how the entire economic system impacts individual behavior. Within this school of thought, human decision-making is driven not only by personal attributes (income, attitudes), but also by constraints and opportunities inherent in the larger economy (interest rates, taxes, government programs, employment rates). Human decision-making is still assumed to be completely rational.

Classical Economics: Classical economics was first examined by Adam Smith who claimed largely that free and unregulated markets regulate themselves and that markets seek out a natural equilibrium. [52] Classical economics is guided by two primary beliefs or principles, specifically that production will create enough income to create demand for the supply (Say's Law) and that prices are always flexible and not constrained either in terms of supply or wages.[53]

Keynesian Economics: This school of economic thought views consumer decision-making as affected (positively or negatively) in the short run by external economic circumstances created

by government intervention in the economy, especially fiscal and monetary policy (taxes, inflation, interest rates) as well as government programs.[54]

Neoclassical Synthesis (New Keynesian Economics): Often referred to as "Mainstream Economics" (and now the most commonly taught economic paradigm), neoclassical synthesis attempts to combine individual-level influences on behavior posited by neoclassical economics with the public influences on decision-making suggested in Keynesian economics.[55]

Table 9. Ideas for Influencing Behavior Based in Macroeconomics

Broad Theoretical Concept	Specific Concept	Explanation of Concept's Relevance to Energy Behavior
Classical Economics	Demand and supply of products and services	Energy-efficiency products and services will be supplied and new ones introduced if providers see conditions as profitable. Consumers will demand these products (e.g., use rebates to buy efficient technologies) and services (e.g., maintenance) as long as they realize benefits, either in terms of financial savings or increased satisfaction.
Keynesian Economics	Fiscal policy	Government policies and regulation of energy prices directly affect individual decision-making involving energy investment and energy consumption.
	Monetary policy	Federal Reserve policy sets interest rates that can encourage (if low) or discourage energy-efficiency investment by firms and consumers.
Neoclassical Synthesis	Short-/long-term costs and benefits	Government-funded energy-efficiency programs can influence individuals' perceptions of costs and benefits, through up-front incentives and other mechanisms
	Fiscal policy	See above.
	Monetary policy	See above.

Science and Technology Studies-Focused Theories

We next outline prevailing theories that have emerged from science and technology studies (STS), which describe purposefully interdisciplinary research focused on a specific topic or area of research. STS aims to examine scientific and technological ideas and practices and how they are informed by social, cultural, and political contexts and processes.

Adoption and Diffusion of Technology

Diffusion of technology theory views the decision-making process (for adopting technology) as influenced both by the individual's compatibility with the attributes of the technology as well as the social influence via social communication channels. This school of thought views decision-making as a linear process beginning with knowledge and ending with the intention to act. However, many of the models within this paradigm consider individuals as completely in control of their engagement in intended behaviors, and do not take into account external constraints.

- **Diffusion of Innovations (DoI)**: First posed in sociology and economics,[56] DoI asserts that individuals move from knowledge to attitude formation to initial adoption to maintained adoption based upon their perceived compatibility with the technology (i.e., attitudes, behavioral norms, and personal capabilities), the attributes of the technology (including visibility, opportunities to experiment, and perceived advantages over alternatives), and the messaging of previous adopters via social communication channels (such as peer groups, experts, and the mass media). [57] [58]

- **Hierarchy of Effects and Stages of Change Models:** Individuals require social communication from different channels and different types of reinforcement (information, incentives, etc.) at each stage of adoption.[59] [60]

- **Technology Acceptance Model** (**TAM):** A direct adaptation of the theory of reasoned action (TRA), [61] [62] TAM argues that individuals will decide to adopt a technology based on perceived ease of use and perceived usefulness of the technology.[63] [64]

- **Sociotechnical Systems Theory:** This model addresses the external constraints that are missing from the other models, and posits that a broad social component to technology mandates that innovations be created within legal or political boundaries and be made economically viable in order for individuals to choose to adopt them.[65] Rooted in studies in the history of technology, these theories develop an appreciation of the *systemic* nature of technological change, as particular parts of the system (e.g., types of lighting, sorts of appliances, innovations in housing, etc.) interact with other linked and interdependent system elements (e.g., law, engineering practices, knowledge systems, component manufacturers, retail systems).[66] An important new development in this field is *Transitions Theory*, which looks at the logics and dynamics of large scale sociotechnical change in the past and considers how they are currently unfolding for modern technologies and how transitions can be engineered for future benefit—for example in mitigating and adapting to climate change.[67]

Table 10. Ideas for Influencing Behavior Based in Diffusion of Technology Theories

Broad Theoretical Concept	Specific Concept	Explanation of Concept's Relevance to Energy Behavior
Diffusion of Innovations	Compatibility of innovation with individual's attributes	Compatibility of energy behavior, e.g., sophisticated technology may not be compatible with people who are uncomfortable with technology and therefore will not accept it.
	Awareness/ knowledge of innovation	Awareness or knowledge of an innovation that must necessarily precede an individual's action to accept the innovation.
	Cognitive dissonance	Trying to make beliefs/actions consistent with one another, or making our beliefs consistent with those of others that we like or admire. E.g., if someone thinks of themselves as "green" and their non-green habits are pointed out, they may be motivated to change their habits.
	Visibility of technology	If a technology is not often seen, it will take longer for it to be tried and accepted.
	Trialability of technology	If the technology can be tried without much investment, it will be accepted more readily if it meets needs.
	Descriptive norms	Existing behavior patterns.
	Social learning	Learning new behaviors by observing others doing the target behavior.
Hierarchy of Effects and Stages of Change	Social learning	See above.
	Economic rewards for doing target behavior	Financial rewards offered to encourage the target behavior; a concern is that unless the rewards continue, the behavior may stop.
	Social rewards for doing target behavior	Social approval that can encourage a behavior; though when the behavior is invisible or when social approval is no longer experienced, the behavior may stop.
	Intrinsic rewards (altruistic) from target behavior	Rewards that are experienced internally; these can involve feelings of mastery or altruism or other types of satisfaction. Behaviors that engender these kinds of rewards are less susceptible to cessation.
Technology Acceptance Model	Knowledge/Awareness of innovation	Awareness or knowledge of an innovation that must necessarily precede an individual's action to accept the innovation.
	Personal utility of innovation	An innovation meets people's needs by saving money or other rewards and thus is more likely to be accepted.
	Convenience and ease of innovation	How convenient or easy it is to perform or use an innovation, which affects likelihood of adoption.
Sociotechnical Systems	Compatibility of behavior/technology with individual's attributes	See above.
	Conformity of behavior/technology with political-legal context	An innovative behavior or technology goes against the law or a political force is less likely to spread quickly.
	Conformity of behavior/technology with cultural context	An innovative behavior or technology that goes against the dominant cultural understandings of what is right is less likely to spread quickly.
	Capacity to adopt a behavior	E.g., lack of access to credit, contrary habits, or rental status will work against adoption of some behaviors and purchases.
	Concern	Concern about target behavior & related issues, including technology performance that can work against acceptance. Conversely, concern about the size of one's energy bills can encourage behavior change.
	Constraints	Financial, building, or time constraints, for example, that can keep households from installing energy-efficient measures.

End-User Studies

End-user studies focus specifically on bridging the gap between two stages of the diffusion of innovations (DoI) model: implementation, when individuals have started using the technology, and confirmation, the maintained use of the technology and communication to social groups leading to diffusion.[68] From this standpoint, end-user studies view decision-making as driven by the individual's interaction with the technology.

- **Material Satisfaction Model:** User satisfaction is driven by product features,[69] which determine performance and the extent to which the technology meets the user's needs.[70] [71]
- **Emotional Satisfaction Model:** Satisfaction with technology not only depends on the material features, but also on the disparity between user expectations and performance (disconfirmation),[72] and the context through which the technology is accessed, including price and the physical setting of use (product setting).[73]
- **Consumption Studies:** Work in this area combines perspectives from sociological theories of lifestyle with sociotechnical systems thinking and anthropological insights about culture, meaning, and norms. Some consumption studies focus on large historical trends (e.g., consumer society, the over-spent American).[74] But most relevant for household energy use is work in the newly emerging field of *social practice theory.* This work builds on studies of how taken-for-granted values such as comfort and cleanliness are actually historically specific and quite variable in the population. Social practice research asks, for example, how practices that require large amounts of energy use are invented, adopted, reproduced, institutionalized, codified, altered, and abandoned.[75]

Table 11. Ideas for Influencing Behavior Based in End-User Studies

Theoretical Model	Specific Concept	Explanation of Concept's Relevance to Energy Behavior
Material Satisfaction Model	Meeting functional needs of individual	If a product or behavior performs the functions that the person needs, it is more likely to be adopted.
	Satisfaction with features	Satisfaction with the features of a product holds a high priority in the purchase decision.
Emotional Satisfaction Model	Meeting expectations of performance/outcome	Perhaps more important in determining emotional satisfaction than actual performance is whether expectations for the performance or outcomes is met. .
	Meeting functional needs of individual	See above.
	Satisfaction with features	See above.
	Physical setting of use/behavior	The surroundings for the target behavior or product use have an impact on satisfaction.

Learning Theory and Cybernetics

Within the social sciences, there are two primary theories that detail the specific interactions between living beings (here, humans) and technologies that provide information. These theories outline the way in which human behavior is modified through this exchange. We describe each below.

- **Learning Theory** describes a form of learning where an individual's behavior is changed by the consequences of their behavior or by other forms of feedback or information. There are a number of strains of learning theory described and researched by many. Some of the earliest and most well known are Skinner (1938) who introduced the concepts of positive and negative reinforcement as well as punishment, and Bandura (1977) who described social learning. The specific changes in the behavior can vary; the theory refers primarily to the process and mechanism of change. The behavior may change in form, frequency, or strength.

- **Cybernetics** is transdisciplinary science that studies complex social, informational, mechanical, and cognitive systems.[76] This area of study examines how actions initiated in a system can trigger a response that then, in-turn, modifies the system itself by altering components of the system, such as the actions of individuals or the nature of information in the system. For example, information can be provided within a social system that changes the behavior of individuals and, as a result, affects the information they are given as part of a closed feedback loop.[77]

The primary application of these theories is information (audits and collateral), feedback, and feedback loops (Karlin and Goetz).[78] [79] In the 1980s, Geller and his colleagues reviewed a variety of studies of energy behavior change and identified feedback as among the most promising and successful strategies. [80] Karlin documents recent confirmation on the effectiveness of frequent feedback. Specifically, the more frequent the feedback, the more effective it is likely to be (within limits).

Table 12. Ideas for Learning Theory and Cybernetics

Broad Theoretical Concept	Specific Concept	Explanation of Concept's Relevance to Energy Behavior
Learning Theory	Positive reinforcement	Favorable events or outcomes that are presented after the behavior such as a reward or public acknowledgement of the desired outcome.
	Negative reinforcement	The removal of an unfavorable event or outcome after the behavior. In these situations, a response is strengthened by removing something unpleasant, such as a higher electricity rate.
	Punishment	The presentation of an adverse event or outcome that causes a decrease in the behavior it follows. For example, late fees or penalty fees are a form of punishment.
	Feedback	Includes reinforcement and punishment (as above), or information about one's current behavior and its consequences. Receiving any or all of these and other types of feedback or information can help change behavior.
	Social learning	Refers to learning through observation of others' behavior.
Cybernetics	Feedback loop	Describe the process of self-modifying systems wherein a trigger (information or behavior) modifies the information or behavior in the system. In energy, the simplest feedback is the bill, which may or may not serve as a trigger to modify household behavior.
	Information	Information supplied to end users in an attempt to control/modify their actions to benefit the system. Information is a central component of cybernetics theory as it applies to energy.

Design Theory and Environmental Psychology

Design theory and environmental psychology explore how the design of products, buildings, and the physical space can impact human behavior. These schools of thought view internal decision-making processes as an interaction between internal (psychological) needs, preferences, attitudes, and stimuli from the external environment. Drawing from the humanistic and cognitive schools of psychology, external stimuli are largely processed based on the subjective and symbolic meaning of objects and spaces.

- **Perception of Space Theory:** An individual's evaluation of a space relates to three factors: the aesthetic, emotional and symbolic meaning; the energy necessary to adapt to a space; and activity within a space (i.e., noise, crowding).[81] [82]
- **System of Objects:** Individuals evaluate objects based on four criteria: function, economic (or exchange) value, symbolic value, and the *sign* of an object (brand, prestige, status).[83]

Table 13. Ideas for Influencing Behavior Based in Design and Environmental Psychology

Broad Theoretical Concept	Specific Concept	Explanation of Concept's Relevance to Energy Behavior
Perceptions of Space	Aesthetic value	The aesthetics of a product or behavior are important to its appeal
	Symbolic meaning	Products and behaviors that communicate to others a high or desired status will be more readily adopted.
	Physical setting of use/behavior	The physical setting of the product or behavior, which communicates something about its desirability and can affect how individuals view and accept it.
System of Objects	Functional needs related to target behavior/technology	The need for a particular function, which will, of course affect willingness to adopt the behavior/technology.
	Economic value of target behavior/technology	The need to achieve economic effects, which affect willingness to adopt the behavior/technology.
	Symbolic meaning of behavior/technology	What the behavior symbolizes about those who perform it or what the technology symbolizes about those who use it.
	Social value	Prestige, status, brand, and what it communicates about those who use the product or perform the behavior.

Chapter 4 – Strategies and Interventions for Influencing Residential Behaviors

Many intervention strategies could influence energy-related behavior. This list of strategies classifies a variety of intervention strategies previously demonstrated to be effective for energy behavior change, or that show promise of being effective for energy-related behavior change due to their proven applications for similar behavior change in other fields, such as conservation, other pro-environmental behaviors, or health behaviors.

Development of the List of Interventions

This list of interventions builds on a taxonomy of interventions developed for the New York State Energy Research and Development Authority (NYSERDA) in support of NYSERDA's efforts to identify behavior-based strategies to integrate into its program portfolio.[84] We then contributed insights and suggestions, which led to the list of interventions presented herein.

NYSERDA Taxonomy

The NYSERDA taxonomy project reviewed the literature in energy behavior change and environmental behavior change with a focus on individuals rather than on organizations or society. The definition of behavior change intervention built upon the categorization of behavior change interventions developed by Geller.[85] Geller and his colleagues differentiate behavior change interventions by their time sequence relative to the behavior as either antecedent or "consequence interventions:

- **Antecedent interventions or strategies** are those that occur prior to a behavioral response to influence a response. Providing prompts on how to save energy at home via a signal or verbal reminder are examples of this strategy. With prompts, the behavior occurs afterwards and the intervention is not dependent on the behavior occurring at all.

- **Consequence interventions or strategies** are those that occur after a behavioral response to either reinforce or discourage a behavior. For example, giving daily or weekly feedback on energy use or related cost is a consequence strategy. In the case of feedback, while we hope that feedback stimulates future changes in behavior, feedback requires the behavior to occur first. The feedback shows the consumer what they did, and thus each time they get feedback they can use that to assess what their behavior was and what they did similarly or differently to previous times they received feedback.

The timing of interventions is critical to their success. Thus, understanding whether an intervention is best used before or after the behavior is important given the wide range of energy behaviors (see Chapter 2) and the fact that the appropriate points for intervention vary by behavior. Social science research on energy efficiency and pro-environmental behavior suggests that many strategies are effective in reducing electricity or natural gas usage among households and firms.[86] The review conducted for NYSERDA identified 27 intervention strategies that had demonstrated effects on consumers' energy efficiency or energy

conservation choices, which the project classified in ten categories of interventions, as defined in Table 14.

Additions to the NYSERDA Taxonomy

The authors of this white paper recognized that the taxonomy developed for NYSERDA emphasized individual behavior drawing upon social psychological, behavioral economics, and sociological mechanisms was incomplete. Behavior change can also result from other types of interventions such as legal interventions and energy pricing interventions. Legal interventions in the form of building codes, land use ordinances, and appliance standards, to name a few change the way energy is used by the buildings through changes in siting, design, and construction practices. Similarly, decreased energy use occurs as energy prices rise. Other economic interventions that are not based in behavioral economics include setting the energy price higher at a particular time of day though time-of-use, critical peak pricing, or real-time pricing; or changing the supply of goods and services through upstream and midstream incentives. Therefore, the authors agreed to add two additional categories of intervention strategies, *Energy Prices* and *Legal*, which are also defined in Table 14.

We also noted that one of the terms in the NYSERDA taxonomy, *Monetary Incentives*, refers to a particular economic approach, which was not the target of the intervention category. The term *Financial Incentives* is more appropriate.

Table 14 shows the resulting enhanced set of 12 categories and 33 strategies of behavior interventions discussed and agreed upon by this white paper's authors. It also notes whether the application of the intervention should be seen as an antecedent to or consequence of a behavior, and the tie-back to specific social science theory and/or research.

While behavior programs may include strategies to influence seemingly one-time decisions, in the opinion of these authors, these programs also strive to go beyond these actions (often purchases) to also address related non-purchase behaviors—e.g., not just getting people to purchase CFLs but also install them, not just purchasing a setback thermostat but programming it. Since this paper aims to establish the basis for influencing a wide range of durable change behaviors, in the list of promising interventions we distinguish between mechanisms that focus directly on ongoing behavior from ones that aim to influence one-time decisions. Strategies for influencing ongoing behaviors can be invoked on their own or in conjunction with one-time behavior strategies.

Table 14. List of Promising Behavior Change Interventions

Category	Strategy Description	Ante-cedent	Conse-quence	Relevant Theories
Traditional Behavior Intervention Strategies				
1. **Financial Incentives**[87]**:** Includes monetary or other strategies to motivate end-users and midstream or upstream market actors to engage in a behavior, or to change the supply of goods or services through midstream/upstream incentives.	Offer financial incentives/rebates to encourage energy efficiency investments.		✓	Microeconomics, Macroeconomics
	Change the supply of goods by incentivising upstream or midstream market actors to increase production or availability of energy-efficient products	✓		
2. **Leverage Sunk Cost**[88]: Includes strategies that minimize the sunk cost effect, which refers to the notion that people become psychologically invested in money already spent. For example, people resist discarding non-efficient goods, such as old refrigerators, that they already have paid for.	Target upgrade investments at the time of replacement of an energy-using product	✓		Behavioral Economics
3. **Legal:** Includes strategies that change/eneforce laws that apply to energy related behaviors including: energy codes, appliance standards, land use ordinances.	Establish laws that require energy-efficient choices in building desgn and construction, in land use planning, in product design and manufacturing	✓		Public Good Theory
Underused Behavior Intervention Strategies				
4. **Commitment**[89]: Includes strategies that encourage individuals or firms to commit to executing an action by a specific date.	Ask people to commit to one other person to do an EE action	✓		Cognitive Science, Feedback Loops, Social Exchange Theory
	Help customers set savings goals	✓		
	Ask customers to make a small commitment before asking them to make a larger one	✓	✓	
5. **Feedback**[90]: Includes strategies where energy use information is given to the customer frequently (e.g., in real time, daily or weekly).	Give customers periodic relevant information (real-time, daily, weekly, etc) to influence behavior. information may include energy use, related energy costs, social or behavioral benchmarks, etc.		✓	Cybernetics; Learning Theory Social Learning, Utility Maximization, Awareness of Behavioral Consequences, Social Exchange Theory

Category	Strategy Description	Ante-cedent	Conse-quence	Relevant Theories
Underused Behavior Strategies (continued)				
6. **Follow-through**[91]: Includes strategies that remind individuals or firms to follow through with the behavior intention or commitment.	Provide prompts or reminders re. behavior change via signal or verbal communication	✓		Decision Heuristics, Cognitive Science, Social Exchange Theory
	Ask customers to create plan for reducing their energy use	✓		
7. **Framing**[92]: Includes strategies to provideenergy information in a manner that takes advantage of biases, heuristics, and metaphor to influence choices in systematic and predictable ways.	Emphasize EE benefits	✓		Decision Heuristics, Decision Frame, Metaphor, Bounded Rationality, Priming, Cognitive Science
	Minimize number of choices	✓		
	Frame costs or payback on investment as reasonable to encourage EE behavior	✓		
	Frame EE behavior as a moderate and/or recognizable choice	✓		
	Frame EE behavior to encourage status or self-image	✓		
	Frame energy information as preventing a loss rather than incurring a gain	✓		
	Switch a program from opt-in to opt-out, when feasible	✓		
	Encourage program staff, manufacturers or service providers to set product EE default options	✓		
8. **In-person Interactions**[93]: Includes strategies emphasizing person-to-person interactions by someone trusted or respected in the community.	Use interpersonal communication and a credible messenger to encourage the desired behavior	✓	✓	Diffusion of Innovation, Framing, Linguistic Shifters, Social Learning, Cognitive Science, Social Exchange Theory
	Model behavior by someone with authority in the target community	✓		
9. **Energy Pricing:** Includes strategies to change the price of energy the end user pays such as with time of use pricing	Offer time differentiated pricing (e.g., Time-of-Use, Critical Peak Pricing, Real-Time Pricing, Curtailment, etc.)			Microeconomics, Macroeconomics
	Offer time-differentiated rates that penalize on-peak energy usage (e.g., Time-of-Use, Critical Peak Pricing, Real Time Pricing, Curtailment, etc.)			
	Increase price differential further within increasing block rate structures			

Category	Strategy Description	Ante-cedent	Conse-quence	Relevant Theories
Underused Behavior Strategies (continued)				
10. **Rewards or Gifts**[94]: Includes strategies where gifts or other rewards are given in recognition of achievement or willingness to engage in a behavior and to encourage reciprocity on the part of the receiver.	Offer gifts (e.g., free low-cost measures) to encourage reciprocity of energy-efficient behavior	✓	✓	Behavioral Economics, Social Exchange Theory, Learning Theory
	Offer a chance to win a larger reward (i.e., lottery)		✓	
	Offer a chance to win a prize based on increased performance (i.e., competition)		✓	
11. **Social Norms**[95]: Includes strategies that activate social norms with respect to EE and/or energy curtailment behavior. When individuals learn what the commonly accepted ways of behaving in a group is, they tend to align their behavior closer to the norm.	Activate social norms by providing comparison relative to a group others could identify with via marketing or outreach messages, customized information, or visual cues	✓	✓	Labeling Theory, Framing, Values Beliefs Norms, Theory of Planned Behavior, Reference Group Theory
12. **Multi-pronged strategies**[96]: Includes complex strategies that use more than one type of intervention to affect behavior.	Improve self-efficacy, which is the belief in one's ability to succeed or achieve goals, via person-to-person interactions/modeling a desired behavior and positive feedback	✓		Various
	Reset/frame the value of future benefits related to energy efficiency investments with monetary rewards and education/framing strategies	✓	✓	
	Provide frequent energy use feedback with reward		✓	
	Provide frequent energy use feedback with social comparison		✓	
	Activate cognitive dissonance[1] via commitment or prompt and modeling or hand-delivered feedback	✓		

Note: All intervention categories listed here, with the exception of Energy Prices and Legal, were included in the original NYSERDA taxonomy. In addition, the name of the original NYSERDA category Monetary Incentives has been changed here to Financial Incentives.

Applications of the List of Interventions

This list provides insight on behavior change intervention strategies that are available to program managers. Implementing these through pilot interventions to explore their effectiveness in different programs and different settings offers a great deal of promise for improving programs, gaining deeper savings, and engaging consumers in their energy use decisions.

A question raised in our research was whether there is a loading order of the behavior intervention strategies or perhaps some interventions are easy and cheap while others are more difficult and expensive. A recent meta-analysis indicates that certain information-related interventions consistently do lead to savings, while other information related-interventions tend to lead to increased energy usage.[97] However, no comparison of the interventions described in Table 14 has been done, and a loading order has not been determined at this time. Nor, is it clear whether it is possible to determine such a loading order, given the amount of research necessary to draw such conclusions with confidence.

The intervention strategies presented here have been successful in experimental situations to address energy or other pro-environmental behaviors. However, none of these interventions, including legal and pricing interventions is guaranteed to change behavior. Even legal interventions require compliance to be effective, hence the suggestion that penalties for noncompliance might be a viable behavioral intervention. Further, little research has been performed comparing interventions to one another, or testing different combinations of interventions to ascertain any possible loading order or preferred approach of one intervention as compared to another. This is precisely why we recommend including intervention strategies in experiments and quasi-experiments as the best way to determine which behavior intervention strategies will be most effective to integrate into program portfolios.

What seems to be clear is that program managers of energy efficiency, demand response, Smart Grid, and other types of DSM programs have not used the full palette of behavior intervention strategies in their efforts to change energy-related behaviors. Commonly used strategies today include financial incentives, energy pricing interventions for demand response, and framing to emphasize benefits. On the other hand, establishing default settings is part of the standards process, but current standards-setting processes do not address all defaults that would increase efficiency: e.g., thermostats default to 72°F, clothes washers default to warm not cold wash. In addition, framing strategies to activate loss aversion are rarely used, yet would be easy to integrate into messaging if research confirmed they were effective in certain program conditions. Using some of these intervention strategies at a societal level, by the framing of mass messages and by integrating energy-efficient behaviors into movies or television shows in a deliberate way to model behaviors, may also be effective.

Chapter 5 – Uniting Behaviors, Theory, and Interventions into New Program Designs

This chapter joins the key elements from the previous chapters and provides examples for how these elements can be used to create effective programs to change energy use behaviors. The last three chapters discussed:

- Energy-related behaviors
- Theoretical underpinnings for behavior change
- Promising energy-related behavior intervention strategies

Taken together, we hope that DSM program sponsors, designers, and managers can use these elements as a framework to:

- Review and refresh the behavioral components of existing programs
- Design new and innovative programs

As a first step we map out a four-step approach to considering behaviors, theory, and interventions. We then use this approach to create examples of four residential program designs that either present a new twist on existing programs or imagine quite different approaches to securing energy efficiency through the use of behavior change intervention strategies. We might call these “next-generation” DSM programs.

While we believe the four-step approach we lay out is a useful one, we by no means think it is a simple or mechanical process to design effective programs that combine specified behaviors, behavior change theory, and behavior interventions, In fact, we think it will be challenging work to create and try out programs that use a broader array of interventions designed to change energy-related behaviors. However, we also believe that a wider range of behavioral interventions, tied to social science theory and measurable behavior changes, can result in new, cost-effective energy savings.

Overall Approach

Step 1: Start With Behaviors, Theory, or Intervention Strategies

The genesis for a refreshed or new program design can come from any of the three elements, i.e., a focus on particular behaviors, an idea for influencing behavior from a specific theory or research, or the desire to try out or improve an intervention strategy.

For instance, one option would be to start with a focus on a targeted set of household use and maintenance activities that result in HVAC energy savings, such as using fans instead of air conditioners and having a furnace tune-up. From there, the design can invoke influences and interventions to encourage specific energy-efficient HVAC behaviors (see Table 1 in Chapter 2).

A second starting point could be to build upon ideas for influencing HVAC-related use from, say, the social psychology theory of planned behavior (see Table 5 in Chapter 3) on the belief that saving energy is important to households, that the program can change their sense of control, and that the program can include very specific recommendations. From there, the design can identify specific intervention strategies for activating those influences on specific behaviors.

A third starting point is an interest in trying out a new set of intervention strategies; for instance one that combines eliciting customer commitment to take action (such as reducing home heating and cooling bills), reminders to those who committed to take action, and regular and frequent feedback on how much energy they are saving.

Step 2: Consider All Three Elements to Get the Best Fit

While a program idea may originate anywhere, it is crucial in the early stages of designing a behavior-based program to clearly define the behaviors being targeted for change. Having a clear list of behaviors makes it much easier to turn to theories and interventions to find effective solutions.

Given this approach, program designers of a program targeted to reducing HVAC-related energy use might begin with the familiar behaviors that many householders fail to do:

- Getting a furnace tune-up
- Replacing furnace filters
- Using automatic thermostat setbacks or manually adjusting temperature settings daily to reduce use when no one is home, during the night, etc.
- Closing curtains and windows during the day and opening them at night, in summer

The program designers could then select promising interventions to prompt the targeted behaviors. For instance, consider “framing” strategies that reduce the number of choices consumers need to make and thus making it easier and more convenient for them to take action. One such framing strategy might be to structure the program so that consumers can conveniently select from a small group of certified HVAC tune-up contractors. A second such framing strategy might be to provide incentives for a limited set of qualified filters. A third such framing strategy might be to gently evoke loss aversion through program messages that set a deadline for action and limit the timeframe for decisions. A typical message of this type would say, “Act now, don’t miss your chance to…” save energy, save money, be greener, or have a cleaner or more comfortable home.

Step 3: Conduct Preliminary Research

When designers have a program skeleton that defines the targeted behaviors and promising interventions (based on social science research), it is a good time to gather additional intelligence in two areas:

- The efficacy of the program idea

- The approaches that would be used to evaluate such a program if implemented

Douglas McKenzie-Mohr suggests doing research before launching a new program to better test out program assumptions and interventions. [98] In addition, he encourages using pilot programs to test out and fine tune approaches before rolling them out on a larger scale. Both these activities help avoid pitfalls and increase the likelihood of successful programs.

In our example above for the HVAC program, talking with consumers about tune-ups and purchasing/installing filters would reveal why some consumers take these actions and some don't, and would also identify the most promising intervention(s) to stimulate more people to take these actions. This research could also identify and find strategies to overcome consumer barriers. Other research could be done with contractors about the effects of reducing product and service choices. Similarly, testing some deadline-driven loss aversion messages in focus groups or with small pilot rollouts could identify which ones are desirable and effective.

Step 4: Ensure the Program Can Be Evaluated

If preliminary research supports a viable pilot program, the next step is to set the stage for a pilot in such a way that the effects of the interventions employed can be evaluated. Crucial tasks are to use a logic model for planning and ensure that the program includes measurable metrics for assessing the outputs and outcomes.

A logic model ties together all the elements in the program design—theoretical assumptions about behavior change targeted in the program, inputs (resources), intervention activities, target audiences and delivery channels, program outputs (e.g., number of people reached and enrolled), and short- and long-term program outcomes (indicators of success, such as behaviors changed, energy savings, market transformation). While many approaches exist for constructing program logic models, the overarching purpose of a logic model is to demonstrate and ensure that causal relationships exist between the program elements so that the expected, measurable outcomes will occur.[99]

The logic model should tell a clear and persuasive story about how change will occur and what factors might interfere with the desired changes. Working without a program logic model is akin to driving in an unknown country without an adequate roadmap; even if you are lucky enough to get to your destination, you won't be able to trace how you got there. Use of a logic model can pinpoint where and why many common causes of program failure occur, including:

- Resources that are too limited to accomplish the desired activities
- Activities that do not engender the desired or anticipated behavior change
- Ill-defined or hard to reach target audiences
- Hard or difficult to track outputs
- Hard or difficult to measure outcomes

Logic models help define the key researchable issues and key performance indicators for evaluation activities. Two key components to making program evaluable are to:

- Ensure that there are before and after metrics.
- Include a comparable control group of people not receiving the new intervention.

If the program aims to use multiple intervention strategies, it is most valuable to implement and test them individually and in different sequences so that the effect of loading order can be assessed, and a most-effective loading order can be recommended. Further, whenever possible, the pilot should be tested using random assignment or random encouragement to reduce bias from self-selection.

While full guidance for the evaluation of programs with behavioral interventions is beyond the scope of this white paper, several useful resources for program planners are available.[100]

Building Program Examples from Behaviors, Theories, and Interventions

In this section, we illustrate how employing the steps outlined above can result in new ways to think about and evolve the next generation of DSM programs. We provide ideas for four different programs designed to encourage both one-time and ongoing energy-related behaviors, using an array of intervention strategies grounded in social science theory and research.

We start with two programs with roots in a conventional residential DSM portfolio, appliance purchase rebates and audits. We move on to a program that taps smart meters and devices and is more focused on non-purchase behaviors, although even it may require some purchases, such as energy apps on smart phones and advanced smart home feedback equipment. The final example shows how social marketing can be used to increase adoption of a new technology. The examples we give here all push beyond the comparative usage feedback programs that are in use at a number of utilities today and ask us to think about influencing energy-related behaviors of all types in alternative ways.

These program examples are hypothetical, not meant to represent any actual current program, although some elements are familiar parts of existing programs.

Example Program 1: Extending the Reach of an Appliance Rebate Program

Appliance rebate programs are perhaps the most familiar and well-established residential DSM programs. The behaviors they have most commonly aimed to influence are the selection and timing of purchasing new energy-using products for the home. In the parlance of Table 1 of this paper, this is behavior in the category “upgrade your home.” In this example, we focus on decisions related to a single energy use, water heating, and the behavior traditionally expected to be changed by the rebate program is purchase and installation of a new, more efficient storage water heater. We aim to illustrate how this type of program can be expanded to affect, not only the relatively infrequent purchase decision but also the ongoing decisions that affect energy usage such as changing habits, maintaining the home, and using existing home equipment more effectively. In this case, for water heating, that might mean promoting

behaviors such as turning down the water temperature, draining sediment from the tank, taking shorter showers, using cold water to wash clothes, as well as installing low-flow showerheads and faucet aerators.

Table 15 contrasts the familiar version of energy-efficient appliance incentive programs with an approach that incorporates additional theories and new influences, interventions, and behavior changes. Many programs have been designed to encourage residential customers to purchase more efficient appliances. As shown in the Current Program portion of the table, most of these programs use intervention strategies well-supported by economic and legal theories. They generally use financial incentives supplemented with information to frame the energy efficiency benefits of the purchase and address timing to minimize expenditures to influence purchase of more efficient appliances, in this example, water heaters.

These interventions have proven successful for the purchase part of behavior related to water heating energy use. They have effectively increased the availability and variety of efficient water heaters; virtually all manufacturers make them and retailers/contractors stock them. They have reduced the incremental cost of more efficient models which, coupled with information on energy savings (such as ENERGY STAR labels), has made them a more attractive choice. DOE efficiency standards together with the utility incentive and information strategies have been shown to help increase purchases that exceed the minimum efficiency standards.

Appliance rebate programs, however, can tap additional theories of behavior change to support high-efficiency appliance purchases as well as to influence usage after the purchase, as illustrated in the Program Additions portion of Table 15. These suggest the following additional interventions:

- In-person interactions with potential buyers—inducing trusted contractors to provide better/more convincing information about the performance of tankless water heaters, or setting up demonstration projects to show how they work
- Framing to stimulate action because of information provided at the time of decision
- Follow through triggered by reminders, such as stickers or emails that remind customer who just purchased a rebated water heater to turn down the temperature setting or, later on, to drain sediment from the water heater tank to improve performance

Table 15. Example 1: Program Designed to Change Appliance Purchase and Use Behavior

	Theoretical Roots	Interventions	Behavior Change
Current Program	Classical Economics—demand and supply of products	Financial incentives to consumers reduce price differential between standard and high-efficiency models, increasing demand for more efficient models	Greater availability and variety of more efficient water heater models
	Neoclassical Economics Utility Maximization—budgetary constraints	Financial incentives—Rebates lessen constraints on purchase of higher cost model, allowing substitution of more desirable (efficient) over less	Rebates that reduce price differential increase availability and variety of more efficient water heater models Replace storage water heater with more efficient unit at purchase time
	Neoclassical Economics Utility Maximization— short-/long-term costs and benefits	Framing costs or payback as reasonable affects perception	Replace storage water heater with more efficient unit
	Behavioral Economics	(Minimize) Sunk cost—Encourage upgrade at normal replacement time	Buy more efficient water heater when need to replace
	Legal-—obligation and public good theories	Framing—Activate sense of obligation and values to comply or exceed Legal—Rebates break down barriers (higher cost) to embracing a public good (reduced energy use)	Buy above minimally efficient model at time of replacement Encourage early replacement of water heater
Program Additions	Diffusion of Innovations (and others)	In-person interactions (e.g., persuasion by a trusted contractor, word-of-mouth, behavior modeling through demonstration projects)	Buy tankless water heater (newer technology)
	Cognitive Science—conceptual priming	Frame information about energy the way customers do; e.g., by a) changing info in buyer guides to better tap into what customers understand and b) providing it in a way that customers more likely want to access it	Buy a more appropriately sized unit Install low-flow showerheads and faucet aerators Usage behaviors also (see below), if framing directed effectively
	Decision Heuristic—recognition of target behavior; ease and convenience of action	Follow-through	Turn down water heater temperature Drain sediment from storage tank for optimal performance Take shorter showers Wash clothes in cold water

In-person interactions is an intervention well-supported by theories from multiple disciplines, including diffusion of innovations, sociology (social learning, social exchange), anthropology (linguistic shifters), and cognitive science (priming, framing). For instance, while providing rebates and energy savings information may be enough to prompt purchase of high-efficiency storage water heaters, it might take an intervention like in-person interactions to get customers

to buy a tankless water heater. Acceptance of this newer technology might be achieved through public demonstration projects to move consumers through stages from increasing knowledge and persuasion, to decision, implementation, and ultimately confirmation of the benefits (i.e., energy savings).

Cognitive science offers concepts of consumer priming and information framing that can yield more cost-effective purchases, such as better-sized water heaters and installation of low-cost faucet aerators and low-flow showerheads. Framing can also influence ongoing energy-saving behaviors, such as washing clothes in cold water, if consumers can readily understand the information and it is presented at the opportune time.

It's safe to say that all program providers now include information about energy efficiency in their program web pages (such as smart buyer guides on the California IOU websites). One thing we noticed, however, is that the way in which the information is provided focuses attention on appliance purchases more than operational behaviors. On the websites, information about programs and ways to save energy largely list the options by end use or appliance type—water heater, air conditioner, lighting, etc. Often, information on non-purchase and repeat or ongoing behaviors are put off in a separate section, sometimes labeled *"other"* ways to save energy, suggesting that behavioral changes are afterthoughts or less important. What we are suggesting here is that the utilities test the effectiveness of the way they provide the information about purchase and usage. Using the current on-line buying guides as an example, test the current placement and organization of information against some alternative presentations. By framing the information differently, a program can tap into a householder's daily thinking and possibly increase the effect upon non-purchase and ongoing behaviors.

Finally, in addition to effective framing, it might require asking for follow-through to get customers to take additional non-purchase, periodic actions, such as resetting the water heater temperature, by showing them how easy it really is to do.

This water heating example shows how an already familiar DSM program can be refreshed to encourage behavior change including and beyond purchase of more energy-efficient equipment. The suggested expansion deliberately stops short of pushing consumers to making a commitment to a desired lifestyle, the ultimate behavior captured in Table 1. Some of the subsequent examples do suggest and are perhaps better suited to focus on this broadest of all behaviors, lifestyle. Modifying programs, much like modifying behavior, is a process and we encourage that it be done incrementally and always with consideration to measurability of the effects.

Example Program 2: An Enhanced Assessment Approach for a Whole-house Program

The next example, summarized in Table 16, is an on-site assessment for a whole-house program. We begin with the assumption of a traditional whole-house on-site assessment, noting that the IOUs as well as third parties and local governments offer many types of assessments including online audit tools, and checklist audits and services such as energy advisors. In addition, some whole-house services may already use some of these suggestions—but our intention is to show how a multi-pronged behavior strategy could enhance the assessment process.

A whole-house program is a how/when to invest in your home type of behavior. Whole house programs typically require an onsite assessment. The assumption is that the householder seeks to maximize energy-saving opportunities and improve the home's performance without damaging the home or the health of its occupants. The assessment is offered so the program administrator can ensure through the assessment that effective energy-reducing solutions are offered to the household.

The enhancement to the traditional assessment is to use behavior interventions to increase the probability that the recommendations will be implemented.

Current whole-house program assessments (see Table 16) estimate savings and provide assurance to the householder of what 'should be done." Often the assessor provides gifts in the form of CFLs, faucet aerators, and showerheads as a behavior intervention to stimulate reciprocity on the part of the householder and to demonstrate that savings are possible. However, if the householder also pays a fee for the assessment, this feeling of reciprocity may be lost.

Traditionally onsite assessments frame the findings around energy and costs savings to the household, which is important but tends to be less compelling than other options for framing. Finally, most assessors provide the assessment and wait for the household to call them back. If the call back comes, the next step is in the hands of the organization or firm(s) that will implement the recommendations.

In contrast, with an enhanced whole-house assessment, assessors use multiple behavior interventions to increase the possibility of measure installation including the assessor direct connection to the organization that will implement the recommendations. The types of interventions include:

- Establishing a long-term relationship with the household
- Framing to stimulate action because of concern for losses identified by the assessment
- Setting the recommendations in context of other households to activate social norms
- Structuring the action plan to be convenient for the household
    - Using annual home improvement budget to structure actions

    - Setting up follow through points with ongoing engagement (can use online tools for this)

- Gaining an immediate commitment to complete the recommendations that appear to be doable

- Providing a mechanism for feedback through integration of follow-ups with 'my account' action plan

The assessor provides the householder with an action plan for implementing the recommended upgrade activities—while on site. The action plan includes behavior changes the household can initiate as well as energy upgrade activities that require higher skills, and a timeline for making the recommended behavior changes, energy upgrades, and renewable energy investments. The assessment also provides information on how many others have installed the measures after their assessments, such as installations of insulation, efficiency lighting, water savings devices, etc., so that householders see themselves as joining the norm.

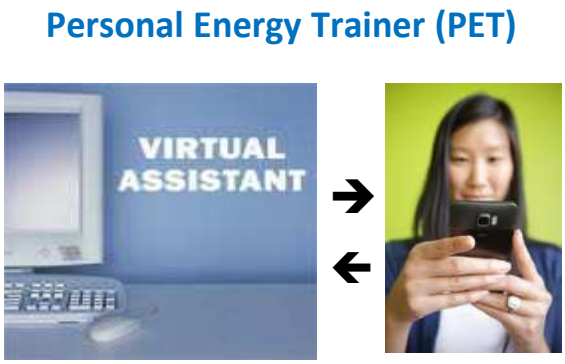
The assessor will engage with the householder over time, so that the householder knows they have a trusted advisor to aid them as they execute the plan. The assessor links the customer to their "my account" online portal (which links to their smart meter). Through the my account portal, prompts to implement the action plan can be delivered easily, and the householder can log in to view their actions taken, see the feedback on their energy use as they make changes, and learn of additional opportunities to improve the energy performance of their home.

Table 16. Example 2: An Enhanced Whole House Assessment Program

	Theoretical Roots	Interventions	Behavior Change
Current Program	Information (Cybernetics)	Provide assessment of what is needed to make home more energy efficient	Household knows what is needed and can do it
	Framing and Reference Dependence	Framing to stimulate desire for benefits	Recognition of value of installing measures
	Diffusion of Innovation	Free CFLS, shower heads, etc.	Trialability achieved – proof that measures work
	Neoclassical Economics	Financial incentives after installation	Measure installation
Enhanced Program	Market Segmentation	Screen in households who are likely to commit and install	Householder is predisposed to act
	Information (Cybernetics)	Provide assessment of what is needed to make home more energy efficient	Household knows what is needed and can do it
	Diffusion of Innovation	Assessor installs a limited number of Free CFLS, shower heads, etc. in appropriate places	Trialability achieved – proof that measures work
	Interpersonal Relationship	Focus on relationship building	Household sees assessor as trusted advisor on energy needs
	Bounded Rationality and Decision Heuristics &	Framing to stimulate desire to avoid loss (scaling the recommendations—amount of air loss equal to a football sized hole in house)	Desire to install measures to avoid losses and waste
	Framing and Reference Dependence	Activate social norms by including information on how many households commonly install recommended measures and where things like CFLs, LEDs, water savings measures, etc are commonly installed	Desire to install measures because others install measures and understanding of best places to install
	Bounded Rationality and Decision Heuristics	Convenience and ease—limit plan to affordable in annual budget for household improvements that integrates low-cost no-cost and medium and higher cost measures.	Customer can see how they can install the measures over time within their budget
	Theory of Planned behavior	Establish intention to change behavior before behavior can change by developing plan for executing audit	Household agrees to the intention to install
	Decision Frame	Commitment	Household makes commitment to install
	Decision Frame	Follow-through (prompts about planned actions from audit plan)—mail or email or utility “my account”	Installations occur as planned
	Interpersonal Relationships	Assessor maintains interpersonal relationship to household	Assessor engaged with householder for long-haul so household knows how to get help as they proceed through plan
	Feedback	Link action plan to “my account” and use “my account” to provide energy usage information linked to actions taken	Reinforces actions and encourages ongoing actions to complete plan

Example Program 3: An Immediate and Interactive Feedback Program to Support Non-Purchase Behaviors

The next example, summarized in Table 17, is a new program that we refer to as the Personal Energy Trainer program (PET). While the exact configuration of technology and software needed for PET may not be currently available, many developments, such as the Nest smart thermostat and emerging smart meter interfaces, suggest that homes with PET capabilities are in our future. Overall, PET will offer residential customers a virtual, interactive, and friendly support system to help them manage their home's energy use better; it could also offer help with other home upkeep as well.[101]



PET targets householders who want a convenient, less time consuming, and constructive way to keep up with their homes' operational well-being. The PET program would supply a reliable and timely virtual companion/trainer that could alert householders to lights or appliances being left on unintentionally, thermostats not being set properly, or furnace filters that need to be changed.

Consumers could configure the PET to their needs. PET could adopt different personas, deliver different types of behavioral strategies, and vary message timing depending upon the choices that the householder makes through filling out a survey of personal preferences. For instance, PET could have a male or female voice and name, provide limited or fuller background information in its home alerts and updates, and change its intervention strategies to focus more on loss aversion messages than on frequent polite nudges or factual feedback.

In terms of the consumer-centric behavior change category scheme presented in Chapter 2, PET is largely focused on "change your habits" behaviors. PET will use multiple intervention strategies to get its users to change their everyday behaviors related to managing home energy use. Key strategies include:

- Getting consumers to make a commitment to work with PET to reach a specified energy reduction goal
- Use of regular and convenient reminders, alerts, and nudges
- Providing consumers with better information about what actions to take
- Providing immediate positive reinforcement for actions taken

PET assumes that its participant consumers want to be informed in a timely, convenient, and polite manner about home issues that need attention, be provided with practical solutions or at least suggestions for how to resolve those issues, and be reinforced and rewarded for making choices to be more efficient. PET also assumes the consumer values convenience and time savings, perhaps as much as financial savings.

In essence, using smart meters, real-time feedback, and a really smart software application (app), the PET would check in with the householder once or twice a day to report, in layman's terms, on how the home is operating and to suggest any adjustments that could improve its operation, including its energy efficiency, preferably through an easy and remote method. Over time, the app could learn the householder's preferences so that the consumer could authorize its PET to handle small household tweaks on its own (for instance, turning off the HVAC when PET senses no one is at home).

A typical day with PET could look like this. In the morning, upon leaving the house for work, the householder would check in or be alerted, while in transit, about key operational conditions in their home. For example, they will learn if the thermostat is operating optimally for the weather, if appropriate appliances and lights are turned off, and if curtains and shades are open or closed. The PET would let the user know that, for instance, the coffee machine was left on and ask the user if it should be turned off. If the coffee machine is then turned off, the energy savings from turning off the machine, rather than letting it run until the householder typically returns home, would be automatically calculated and provided to the user, giving positive reinforcement.

The PET could deal with a good many issues and provide welcome nudges, such as tracking the timing for replacing furnace filters, figuring out optimal ways to heat or cool the home, and having clothes or dishwashing timers set to operate at times of low- or off-peak demand. At any time it could provide an up-to-date report on all the energy saving behaviors taken and what time, money, energy, and green house gas emissions the householder has saved due to the actions. In addition, it could provide non-energy reminders about other household activities, such as when it is time to replace the fire alarm batteries or water the indoor plants. Altogether, the device would be the personal assistant for the householder.

As shown in Table 17 this program is based upon aspects of several social science theories and uses a multi-pronged intervention approach to behavioral change. The system, while requiring commitment to using it, is easy and convenient, provides reliable information and help, and

provides positive reinforcement. Its pleasant app partner first provides alerts and nudges to take action, institutes the action if possible on behalf of the consumer, then provides the needed feedback and reinforcement to show progress. Over time, interaction with PET intends to instill confidence in the consumer that following behavioral suggestions yield results: an improved sense of household well-being, control, and informed energy management.

Table 17. Example 3: Interactive Feedback Program to Support Non-Purchase Behaviors

	Theoretical Roots	Interventions	Behavior Change
A New Program	Cognitive Science	Commitment to take action	Household commits to work with PET to manage energy use and reach specified energy reduction goals.
	Decision Heuristics, Cybernetics (Information Theory)	Follow-through—provides alerts, prompts and reminders about needed actions Emphasizes convenience and time savings, reduces choices Provides further information as needed, such as links to other programs, resources	Customer alerted to need to and how to take action Customers see how they will manage their home's energy use better but spend less time and mental energy doing so.
	Theory of Planned Behavior	Provides behavioral control PET asks customers for instructions/permission to take action PET asks customers for updates on other actions taken	Customer provides instructions to PET to take needed actions; e.g., turn off lights, appliances Customer places other items on To Do list, such as replacing furnace filers
	Learning Theory	Positive reinforcement/feedback Links actions taken to energy, dollars, and carbon savings Links actions to progress toward goal Links actions to a job well done in maintain the health, safety, comfort, and efficiency of home	Consumer habits are built over time, resulting in fewer alerts, less time spent on PET interactions, and more money and energy savings.

Example Program 4: Upstream LED Program with Supporting Social Marketing Campaign

This example draws on an upstream LED program and demonstrates how the program might be enhanced through a social marketing campaign that leverages behavior-change principles. We detail this effort in Table 18.

Many utilities have identified LEDs as the new target for residential ambient lighting programs. Following a similar model to CFL efforts, those current programs are focused on buying down the cost of LEDs through upstream rebates in order to reduce the overall cost of the lamps to consumers. This program model utilizes neoclassical economic theory and rebate-based interventions. Specifically, it assumes that consumers will purchase LEDs if the price drops. As noted in Chapter 3, the basic premise of neoclassical decision-making is that individuals choose options that give them the most "utility" (i.e., happiness, satisfaction, profit, etc.) possible, within

their budget constraints. [102] If prices drop, consumers will purchase energy-efficient lighting options as a result of their enhanced utility (i.e., inexpensive, efficient, higher return on investment).

However, LED lamps are very expensive relative to other technologies and the rebate programs may not be able to buy-down the costs of the lamps enough in the near term to fully motivate most consumers to take action. A recent segmentation study on ambient LED lamps found that most ambient lighting purchaser segments are not yet receptive to LEDs. [103]

To highlight how an enhanced program can leverage social theory and behavior interventions to move LED sales, this example proposes introducing a targeted social marketing campaign aimed at influencing one segment, a convenience-focused shopper. This campaign uses the following intervention strategies:

- Framing
- Priming
- Prompting
- Rewards

The segmentation study showed that the convenience shopper is mostly female, and inclines to make the same repeat purchase at familiar outlets. This segment is more likely to have children, and data suggests the segment is impulse-driven. In order to influence this segment, the social marketing campaign uses school- and child-facing initiatives to prime, prompt, and reward this segment with messaging approaches that are meaningful and appeal to the segment's desire to enhance social capital.

First, in conducting research to help focus the campaign, the planners would conduct additional research to understand what is meaningful to this particular segment. Let's suppose that this research revealed that the convenience shopper is stretched thin and does not have much time or desire to conduct product-specific research before a purchase. For this reason, purchases of little consequence (such as household products) are often selected based on past purchase decision; e.g., habits. However, the research also suggested that convenience shoppers are very interested in remaining actively involved in the lives of their children, with education ranking highest among the segment's priorities. The research suggests that their role in children's education is a source of pride and that convenience shoppers will go out of their way to engage in school-based activities.

Table 18. Example 4: An Enhanced Upstream LED Campaign Using Social Marketing

	Theoretical Roots	Interventions	Behavior Change
Traditional Program	Neoclassical Economics	Financial incentives paid upstream to buy down the cost of LEDs	LED purchase by customers already receptive to this technology
Program Additions	Cultural and Social Capital from Relational Sociology	Market Segmentation—Target customers with messaging based on their needs/interests	Enhance customer willingness to purchase LED lamps
	Cultural and Social Capital from Relational Sociology	Framing—Educate target segment through channels customers are most likely to engage in; in this instance, schools are used to target the convenience-focused shopper because we know this channel already has the segment's attention.	Increased receptivity to LEDs
	Prompting	Prompting—Position products in store to remind customers to purchase. In this instance, in end caps or in the checkout line in store where convenience purchases are made.	Consumer reminded that LEDs are a lighting option when looking for lamp replacements
	Rewards	Use rewards that are meaningful to the segment of interest; e.g., provide school benefits: box tops for education, a school fundraising activity	Further encourage the LED purchase by pairing buy-downs with school rewards

Based on these findings, the campaign might use school-based initiatives to target convenience shoppers' desire to be engaged and active in their children's school activities, including homework, parent nights, and school-based fundraisers. To leverage this segment's investment in school-based efforts, the program designers have developed a social marketing campaign that has the following components:

- **Framing:** Messaging LEDs through school-based functions and as part of a "responsible" lifestyle, thus framing the LED purchase in terms that are likely to pique the interest of the convenience shopper by appealing to the segments' desire to purchase products that reaffirm their morals.
- **Priming:** Leverage school newsletters and homework to educate kids and parents on energy efficient lighting. The goal was not to prompt immediate purchase, rather to prime the parents with information that might make them more receptive to future in-store messaging on LEDs.
- **Prompting:** Display LED lamps prominently at checkout and in high-traffic end caps to target the convenience-oriented shopper.

- **Rewards:** Clearly mark LEDs with the sign “box tops for education” that *prompts* the segment to consider purchasing LEDs in order to gain the box top *rewards* for their kid’s school.

Combined, these three interventions represent one example of a social marketing focused campaign that utilizes segment-specific messaging to prompt LED purchases.

Chapter 6 – Implications for Behavioral Program Policy and Planning and Next Step Recommendations

In previous chapters, we provided organized sets of reference information—typologies of energy-related behaviors, relevant social science theories and research, and promising behavior intervention strategies, to help policy makers and program practitioners more consciously define and integrate behavioral components into next-generation DSM programs. We realize, however, that for most people, tapping into these frameworks is unfamiliar and challenging territory. In this chapter, we summarize our findings and also suggest a number of steps to help policy makers, program planners, and program implementers create next-generation DSM programs, in which behavior change is a better understood and recognized component of program logic, ultimately leading to measurable and reliable reductions in energy use.

Summary of Findings

Behavior change is part of every DSM program, almost by definition. In this paper, we focused on the behavior intervention strategies that can be used to influence an even wider range of energy-related behaviors than past programs have. Informed by social science research, these interventions consciously focus on influencing one or more technology purchase and/or non-purchase behaviors, done infrequently or habitually.

In attempting to characterize energy-related behaviors, we examined a variety of schemes and developed a recommended typology for thinking about behaviors. This typology takes the householders' point of view as they interact in various ways with their homes. It articulates seven broad categories of behaviors, from changing how and when activities are done at home all the way to committing to a different lifestyle. It suggests dozens of specific behaviors that DSM program planners might focus on trying to influence.

Every social and behavioral science discipline has something to say about human behavior. The social science theories and studies described in this paper convey a wide range of concepts from psychology, sociology, economics, anthropology, legal theory, and product design and adoption theory that can be useful in describing and invoked to influence energy-related behavior.

The set of promising behavior intervention strategies provides a way of thinking about mechanisms that DSM program policy makers, planners, and implementers can use in programs to influence householders' energy-related behavior. It includes interventions that have proven effective in influencing similar behaviors in fields like health and environmental conservation, and some already used in energy programs. We outline a dozen intervention strategy categories and describe 33 interventions, suggesting a rich set of opportunities to test and evaluate in well-designed pilot programs.

Finally, the program examples in this paper show that these varied intervention strategies can be used to refresh existing programs and develop new ones. Through these examples, we

illustrate the applicability of the varied intervention strategies, the behavioral influences and theoretical roots that support them, and the specific behaviors they aim to change—connecting the dots, if you will, from theory through specific behavior change. This is not to suggest that designing effective next-generation DSM programs is as easy as stringing a few interventions or theories together.[104] Social science theories, while they can inform and support specific interventions, do not present program ideas. But, with help from social scientists and evaluators who are accustomed to using program theory and logic models to understand and assess programs, policy and program practitioners can incorporate what interventions informed by social science have to offer into program design.

While intended to inspire creativity in program design, we offer the behavior interventions with the strong recommendation that each strategy be field tested. We do not have sufficient evidence yet to suggest a loading order of which interventions to implement first or which behaviors are easiest to change. But, in well-designed studies, the effects can be tested. Small-scale pilots using experimental design to assess performance will be useful for shaping programs that are both innovative and effective.

Implications and Recommendations for Policy and Program Development

In this section, we summarize the implications these findings have for next-generation DSM policy and program development. We also provide recommendations that we believe will help policy makers, program planners, and program implementers bring about programs that measurably and reliably reduce energy use.

Influencing energy-related behaviors and modifying policy to promote change are complicated things to do.

As this paper shows, the behavior of householders is complex. Many forces, sometimes conflicting forces, affect people's decisions and behaviors. The social science disciplines have differing ways of explaining them. The lack of a single perspective does not diminish the validity or explanatory power of the various theories, individually or collectively. Rather, the multiple explanations reflect the complicated fabric of human decision-making. No one is suggesting that theories can be randomly mixed and matched or directly turned into programs. But they do provide the basis for the wide choice of program intervention strategies that can be empirically tested.

Changing the way policy makers and program planners think about programs within the regulatory environment is also complicated. Policy has consequences, and the effects of policy changes need careful consideration. Making and implementing policy that affects program offerings is a time-consuming process. Experience has shown, however, that persistent encouragement and support can bring about improvements in regulatory policy and program planning, implementation, evaluation, and the eventual transformation of various markets. We recommend meeting this need by engaging social scientists to provide staff training and conducting additional research.

Developing programs that use multiple and different intervention strategies holds promise.
Social science theory and empirical research offer a rich array of concepts that can explain energy-related behavior and behavior change. We recommend testing of the interventions informed by social science to identify effective combinations of strategies to increase influence on energy-related behaviors. For example, traditional DSM program interventions have largely focused on technology purchasing behaviors. Additional interventions can help influence post-purchase installation and use behaviors. The interventions presented in this white paper can be used either singly or in combination with one another. We urge policy makers and encourage program planners and developers to be creative and test alternative combinations of strategies.

More work is needed to develop policies and design programs that fully embrace behavior change. By exploring intervention strategies, this paper addresses a key component of behavior programs. But interventions are not in themselves programs and additional work is needed to create programs that effectively engender changes in energy-related behaviors that policy makers seek.

We recommend the following to advance behavior policy and program design:

1. **Consider using a wider-range of interventions in DSM programs.** This paper identifies a dozen types of behavior intervention strategies and describes more than 30 specific interventions grounded in social science theory and research and that hold promise for use in programs designed to influence energy-related behavior.

2. **Conduct trainings on how to create behavior interventions and programs from the information provided in the paper.** Intervention strategies are not programs. Policy and program staff will need training and additional resources to understand how interventions can be formulated into effective programs, with evaluable effects. For program planners and implementers to take this step up front, they require the skills and resources. We recommend engaging social scientists and possibly evaluators, who often do have the social science/behavioral training, to provide help. This will require a funding allocation to support training.

3. **Devote more time to the logic of each program at the planning stage.** Past experience shows that, despite the common sense of developing logic models to articulate program assumptions, these models are seldom systematically used. [105] While considerable experimentation has been conducted on program features and delivery alternatives, but they often don't address the underlying logic. The social science concepts and studies described in this white paper remind us of the considerable body of work from which planners can draw to guide program logic, with attention to metrics for testing whether program activities produce desired outcomes.

4. **Establish a pilot design process for developing and testing pilot programs.** The challenge of operating programs within a regulated environment is that programs are expected to be cost-effective. But imposing this requirement on all small-scale pilots can

stunt innovation. By developing a process by which pilots can be developed, tested, and evaluated, existing full-scale programs can be refreshed and new programs added with less risk of misdirecting funds. In this way, the boundaries of effective strategies for enhancing residential energy savings can be expanded continually and incrementally.

5. **Use pilot testing to make incremental and alternative changes to programs.** The value in having a broader palette of intervention strategies is that they provide opportunities for creativity in program design. But rather than propose sweeping changes in full-scale programs, we advise testing assumptions and alternative interventions in the market using small-scale pilots. Where possible, use experimental design to compare the outcomes of different behavioral interventions.[106] Where many programs currently introduce multiple interventions or treatments simultaneously, testing that introduces them sequentially and/or in different order, and assesses their effects separately can help identify the most effective combinations and perhaps develop an optimal loading order of interventions. Incorporate lessons learned in the next round of programs.

6. **Conduct more research related to specific program planning and evaluation issues.** Consider examining specific energy-efficiency planning and regulatory concepts in light of the various social science theories and studies described in this paper. For example; what might careful application of social science theory and empirical research have to say about free ridership, spillover or market effects, price elasticities, measure persistence, or code compliance? Analytic literature reviews related to specific energy-efficiency problems and particularly energy-efficiency behavior program problems could lead to pilot intervention experiments specifically designed to address issues, such as minimizing rebound effects, maximizing market effects, and locking-in savings to ensure persistence. And, finally, these next-generation programs may require development of additional evaluation approaches and techniques to assess effects.

7. **Conduct additional activities to help articulate and embrace an inclusive vision of DSM behavior programs to reduce energy use.** The 2012 CPUC decision articulated one particular intervention and program design as a behavior program in California. This white paper is a step toward encouraging the expansion of interventions strategies to further influence energy-related behaviors. Additional activities that can support better program policy, planning, implementation, and evaluation might include developing an explicit definition of behavior program that reflects policy goals, assessing how current programs meet the definition, and workshops to assess opportunities for the design of next-generation programs.

8. **Develop a companion white paper that examines organizational theory and proposes intervention strategies for non-residential energy users.** Analogous opportunities for influencing the behavior of organizations warrant exploration to help non-residential behavior programs capture additional savings as well.

References and Endnotes

1 2010-12 EM&V Decision restricted the definition of behavior based programs to the "comparative energy usage disclosure programs" defined in SB 488. As defined by SB 488, comparative usage programs are specifically programs "…pursuant to which an electrical corporation or gas corporation discloses information to residential subscribers relative to the amount of energy used by the metered residence compared to similar residences in the subscriber's geographical area." By the SB 488 and the CPUC decision, these programs need to have an experimental design and be able to claim savings on an ex post basis. Decision 12-11-015 (November 8, 2012) summarizes the directive regarding 2013-2014 program offerings.

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We know that other organizations, including SEE Action, CEE Behavior Forum, and NYSERDA, are also studying behavior program strategies.

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"Residential behavior-based programs (RBBP) encourage participants to save energy through changes in behavior (e.g., turning off lights, setting thermostats) and increasing investments in energy-efficiency measures (measures that themselves actually save energy such as heating/cooling equipment). Specific program offerings may include multiple aspects to influence consumer behavior."

www.aceee.org/glossary/

"Behavior-Based Programs—Energy efficiency programs that utilize an understanding of how individuals interact with energy in order to decrease energy demand."

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

"Behavior-based energy efficiency programs are those that utilize strategies intended to affect consumer energy use behaviors in order to achieve energy and/or peak demand savings. Programs typically include outreach, education, competition, rewards, benchmarking and/or feedback elements. Such programs may rely on changes to consumers' habitual behaviors (e.g., turning off lights) or one-time behaviors (e.g., changing thermostat settings). In addition, these programs may target purchasing behaviors (e.g., purchases of energy-efficiency products or services), often in combination with other programs (e.g., rebate programs or direct install programs). These programs are also distinguished by normally being evaluated using large-scale data analysis approaches involving experimental or quasi-experimental methods, versus deemed savings or measurement and verification approaches."

K. Friedrich, J. Amann, S. Vaidyanathan, and R. N. Elliot. Visible and Concrete Savings: Case Studies of Effective Behavioral Approaches to Improving Customer Energy Efficiency. ACEEE report # E108. Oct 2010.

"Behavioral Program (as defined in this report): At some level, any type of energy efficiency program involves intervention to influence participant behavior. Even a standard rebate program is directed at influencing customer purchase behavior. The distinction we draw for this report is to focus on programs and interventions designed to

influence ongoing individual and/or organizational behavior and habits, rather than discrete one-time behaviors such as equipment purchases. This review covers both information and everyday energy use habits, but does not focus on policy decisions, one-time purchases, or the choice to participate in energy efficiency programs."

BPA Residential Sector Research Findings for Behavior Based Energy Efficiency. December 2010. Presentation accessed March 9, 2013. http://www.bpa.gov/energy/n/pdf/Behavior_Change_Report_Dec_2010_July_5.pdf

"BBEE programs focus on energy savings resulting from changes in individual or organizational behavior and decision-making. BBEE programs use an energy use feedback mechanism to show the end user how much energy they have used compared to another point in time."

S. Barr, A. W. Gilg, and N. Ford. "The household energy gap: examining the divide between habitual- and purchase-related conservation behaviours." *Energy Policy*, 33(1), 1425-1444. 2005.

"Everyday reductions in energy use that require either no or minimal structural adjustment" and "are evidently related to the everyday habitual element of an individual's lifestyle as they undertake daily activities."

4 Throughout this paper, we refer to social science theory and research. In fact, we draw on both social science and behavioral science research. While we recognize that these are two separate areas of study, we refer to them collectively as social science, strictly for convenience.

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PG&E Residential Energy Efficiency Website. Save Energy and Money. http://www.pge.com/en/myhome/saveenergymoney/index.page?

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