

RESIDENTIAL SECTOR RESEARCH FINDINGS for Behavior Based Energy Efficiency

December 2010



While the promise of BBEE programs (in terms of energy savings) is significant, there is much to be learned about effective strategies and tactics to motivate consumers, the persistence of energy savings, and effective methods to evaluate the energy savings.



About This Report

This report is the result of four tasks conducted by BPA staff and contractors in Fall 2010, including

1. Gathering and reviewing readily available residential sector literature and information
2. Conducting interviews with key contacts for the most relevant residential sector regional and out-of-region programs
3. Summarizing the findings with particular emphasis on what has been learned to-date and what is underway
4. Using the findings to guide a forward looking BPA behavior change action plan.

BPA aims to update the report annually.

Contents

- BPA Definition of BBEE
- Background
- BPA Interest in BBEE
- Literature Review
- Program Mechanisms and Components
- Behavior Based Energy Efficiency Programs
 - US and Canada
 - Regional
- Sources

How does BPA define behavior based energy efficiency (BBEE) programs?

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

Examples

- Provide residential end-users with information on their energy use, comparisons with usage by others, goal setting, rewards and additional tactics that encourage efficient energy use.
- Assist commercial end-users to benchmark their building(s) energy use and improve operating performance through building or equipment tune-ups and changes to O&M routines.

Background

BSEE programs are growing in prominence around the country, and represent a source of energy savings beyond traditional utility programs focused on encouraging adoption of EE technology. There is a substantial body of knowledge and experience associated with behavior change that is rooted in the social sciences. Waste management, healthcare and transportation industries have been applying behavior based approaches for some time. Utilities and others in the energy industry are now using it as a means for encouraging energy efficiency and savings. Behavioral based efforts hold the promise of expanding both the breadth and depth of energy efficiency activity. However, as a society we are just beginning to examine and gain a greater understanding about the relationship between human behavior and energy use.

BPA Interest in BBEE

BPA has initiated a behavior change strategy which aims to enable, validate and increase the amount and persistence of energy savings achieved through behavior based energy efficiency programs in the Northwest. BPA will be convening regular meetings for customers to share information about behavior based programs, examining best practices, using the evaluated custom program track to encourage regional BBEE program activities, and looking to encourage innovative BBEE programs.

BPA's Objectives

- Monitor and assess national and regional behavior based energy efficiency (BBEE) programs and activities, identify and promote use of best practices.
- Create policies that help build program infrastructure that all Northwest public utilities can use to operate BBEE programs and achieve related energy savings.
- Collaborate with Northwest public utilities and market partners to implement and evaluate innovative BBEE pilot programs.

Literature Review

This review focuses on energy efficiency related behavioral research and illustrates some ways of characterizing residential energy use and behavior based energy saving opportunities. The literature review included a scan of articles and presentations from a number of sources, including the American Council for an Energy Efficient Economy (ACEEE); the Behavior, Energy and Climate Change (BECC) conferences; E Source; the Consortium for Energy Efficiency (CEE); and other select reports, papers and articles. The focus of this research was limited to the residential sector.

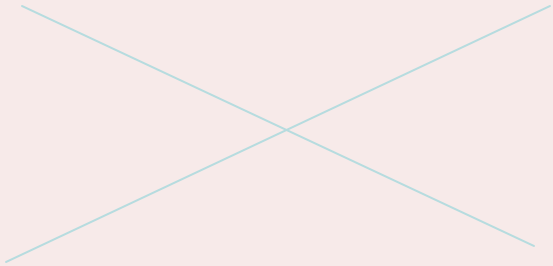
Lit. Rev.: Perspectives to Understanding Household Energy Use

Perspective	Basic Explanation	Objective	Policy Strategy
Technology	Characteristics of buildings and technology determine energy use	Understand and increase device and thermal efficiency	Promote technological innovation and dissemination via regulation or appeals to market
Economics	Consumer as price influenced utility maximizer	Understand and use price signals to influence consumer action	Change or communicate prices of energy or energy using goods
Psychology	Individual expression through choices: mental processes affect conservation behavior	Understand /influence individual perceptions about and actions related to energy use	Convince people that they will be better off using less energy or more efficient products
Sociology	Socially negotiated patterns of consumption: focus on groups, cultures, and larger social systems	Understand variability and patterns of consumption and the social origins of these patterns	Target people's life circumstances, identify winners and losers, look for sources of constraint and outside influences

Source: What's missing in Theories of the Residential Energy User, 2010 ACEEE Summer Study, Moezzi and Lutzenhiser

Lit. Rev.: Categories of Residential Energy Behavior

Source: CIEE/LBNL

Frequency of Action\ Cost	Infrequent	Frequent
Low-cost or No cost	Energy Stocktaking Behavior and Lifestyle Choices <i>Install CFLs</i> <i>Pull fridge away from wall</i> <i>Install Weather Stripping</i> <i>Choose a Smaller Living Space</i>	Habitual Behaviors and Lifestyle Choices <i>Wash in Cold Water</i> <i>Take Shorter Showers</i> <i>Air Dry Laundry</i> <i>Turn off Computer & other Devices</i>
Higher cost/Investment	Consumer Behavior & Technology Choices <i>New EE Windows</i> <i>New EE Appliances</i> <i>Additional Insulation</i> <i>New EE AC or Furnace</i>	

Lit. Rev.: Potential Near-Term Household and Personal Transportation Energy Savings

Category of Actions	Potential National Energy Savings (Quads)
Conservation, Lifestyle, Awareness, Low-Cost Actions	4.9 (57% of total savings)
Investment Decisions	3.7 (43% of total savings)
Total Energy Savings	8.6 +/- 1.5 (22% of HH energy)

Source: Laitner, Ehrhardt-Martinez, and McKinney 2009

Lit. Rev.: Ethnographic Research

(learning from people)

- **There is complexity in behaviors and actions**
 - Understand the variety of actions taken by individuals
 - Decide what you want to explore (ask the right questions, educate in the right areas)
- **Language is important**
 - Understand the language people use
 - Speak the same language, use language your target understands
- **Frame of reference provides context**
 - Understand perceptions that individuals are doing what they can
 - Determine correct way to ask questions and/or best ways to provide information
- **Interplay between motivators and barriers can be critical**
 - Understand that barriers are more strongly linked to action, and they can be complex
 - Don't just stop at exploring motivators, barriers are critical

Source: Using Ethnographic Research to Understand Residential Energy Practices, Mitchell-Jackson, Opinion Dynamics Corp, BECC 2009.

Lit. Rev.: Language: In Their Own Words...

■ Personalization of energy conservation:

- Is an action that I can do, because I can choose to reduce my energy use
- Has limits, because there's only so much energy use I can cut back on

To me energy conservation is...not doing that at all, behavioral, like...walking, a human behavior, consciously not using unnecessary energy, more of an awareness...it's a personal action to use less energy, more human.

■ Less control over energy efficiency:

- Is the property of an object, not something humans have control over day to day
- Is viewed as wasteful if it requires replacing a product before the end of its life cycle, because it also requires consuming

To me, energy efficiency is...doing something better, an inherent property of the equipment, like a Prius, a mechanical attribute, something the appliance/machine does, building a product that uses less energy, more mechanical.

Lit. Rev.: Social Marketing and Behavioral Economics

Some points to consider about human behavior and social marketing include

- We don't always behave logically
- We're not all alike
- We prefer rewards today
- We don't know why we do things
- We follow our friends
- Beliefs do not necessarily translate to behavior

Behavioral economics complements conventional economics by applying psychological insights and research findings.

- Human behavior is hard enough to change when self-interest is at play, even more difficult when the benefits accrue largely to others
- Favor solutions that minimize individual decision making
- Exploit decision errors that ordinarily contribute to suboptimal behaviors (use of lottery incentives plus social norms)

Sources: Social Marketing, The Art of Engineering Common Sense; Bill Smith, becc 2009.
Using Decision Errors to Combat Climate Change; Loewenstein, BECC 2009

Lit. Rev.: Behavior Insights and Tools

- Anchor Bias (people's starting point)
- Status Quo Bias (default effects)
- Single Action Bias
- The Paradox of Choice (choice overload)
- Self-Efficacy (is a given behavior change perceived as possible)
- Cognitive Dissonance (discrepancy between beliefs and behavior)
- Discounting the Future (time inconsistency)
- Loss Aversion
- Priming (intention to perform)
- External Barriers (constraints on choice)
- Foot-in-the-Door Technique (small concessions)
- Reciprocal Concessions (Door-in-the-Face Technique)
- Reciprocity Rule (Gift Exchange)

Source: Behaving Ourselves: How Behavior Change Insights Are Being Applied to EE Programs, 2010 ACEEE Summer Study

Lit. Rev.: Targeting Market Segments for Behavior Change

- Characterizing and segmenting residential customers by attitudes, preferences, interests and needs is particularly important for motivating behavior change. Segmentation helps assess customer response and allows tailoring to groups.
- A recent comparison of 7 west coast segmentation studies shows that segmentation schemes vary. The good news is that regardless of the study, high priority segments (those likely to take action) appear to make up 50-60% of residential consumers.

Source: Challenges & Rewards of Comparing Seven West Coast Segmentation Studies, Dethman et al, BECC 2009

- Commonwealth Edison, Seattle City Light, and Snohomish PUD have used segmentation information to target their BBEE programs at specific audiences.
- BPA conducted a segmentation study in coordination with studies by Snohomish PUD, Tacoma Power, and Puget Sound Energy

Lit. Rev.: Results: Energy Savings and Persistence

- Traditional energy efficiency programs – aimed at the installation of new, more EE technologies alone – are likely to result in a small fraction of potential behavior-related residential energy savings.
- People centered programs are different:
 - They start with a focus on needs.
 - These programs seek to empower consumers to become better energy managers, and view EE technologies as one set of tools in a larger toolbox (conservation, curtailment and efficiency).
- Energy savings of 2 to 10% have been claimed with some suggesting up to 20% are available.
- There are some indications that behavioral energy savings are persistent over time.

Lit. Rev.: Claimed Energy Savings

Program	Energy Savings	Evaluation
Home Electricity Reports (OPower) - SMUD	1.9% reduction in electricity use, 1.4% excluding rebated measures	Participants compared to control group over 2 years
The Power Cost Monitor– A Treatment & Control Experiment - Wisconsin	1.5% reduction in electric usage 3.8% savings by active users (41% of participants)	Participants compared to control group over 1.25 years
Real-Time Monitoring Pilot – Hydro One	6.5% avg. reduction in electricity use	Comparison of participants with control group over 2.5 years
The Energy Detective Pilot – Florida Solar Energy Center	7% avg. reduction in energy use	Measured energy use, controlling for weather, comparison with control group
Energy Saver - Citizens Utility Board (Illinois)	8% net savings per participant 6.6% compared to control group	Normalized pre & post usage Control group with similar characteristics
Energy Monitoring Pilot – Cape Light Compact/Grouped Power	9.3% avg. reduction in energy use	Participants compared to a control group

Sources: 2010 ACEEE Summer Study Papers; Can I Get Credit for That?, Gwen Farnsworth (E Source); How Households Interact with in-Home Feedback Devices, Mendyk, et al (Energy Center of Wisconsin); Visible and Concrete Savings: Case Studies of Effective Behavioral Approaches, ACEEE Oct. 2010 report.

Lit. Rev.: Behavior Change Evaluation Methods

- Behavior change as a means of acquiring energy efficiency as a resource is very different from energy efficiency technology oriented activity
- Credible energy savings evaluation findings are limited due to the newness of these types of programs and the evaluation challenges
- It is particularly important to know what you are testing or evaluating for with behavior change programs, and set up both the program design and evaluation effort to directly address or answer these questions.
- [BPA, working with others in the region, have developed evaluation guidelines that have been accepted by the regional technical forum \(RTF\)](#)
- Use of randomized control groups as a means of evaluating behavioral impacts is common practice in other fields and viewed as credible.
- Technology (smart meters) may be important in enabling effective and cost conscience evaluations.

Residential Behavior Change Program Mechanisms or Components

Category	Products/Services	Provider (Examples)
Energy Consumption Feedback	On-line In-home Mail (paper)	Efficiency 2.0, Google, etc. TED, Grounded Power, Intel OPower
Social Norms & Marketing	Self Comparisons Community Comparisons Competitions, Recognition	All of the Above OPower, Efficiency 2.0, Cape Light, BC Hydro BC Hydro, Smackdown
Customer Tips & Assistance	Advice Assistance	OPower, Efficiency 2.0, BC Hydro, Cape Light, etc. SMUD, BC Hydro
Energy Reduction Commitments	Personal goal/commitment Community goals	OPower, BC Hydro, etc. CUB, FortisBC
Financial Incentives	Fixed Reward Random Reward	BC Hydro, CUB Stanford project

Energy Consumption Feedback

Feedback refers to providing individuals with information on their energy use or related costs

- Feedback can take a variety of forms (paper, web-based, in-home display, telephone)
- How often information is updated and available may influence impact.
- Direct or real-time feedback can be enabled through in-home display or smart meters technology.
- A number of companies have developed products along these lines, from software companies (Google, Microsoft) to technology providers (Intel, TED) to specialty providers (OPower, Efficiency 2.0, Enerlyte)
- SCL's Customized Home Energy Reports program was set up as an opt-out program, with just 57 out of 20,000 electing to opt-out.
- Feedback can be complemented by comparisons, advice, tools (on-line energy audit tools) and assistance.

Social Norms and Marketing

Leveraging the influence of social norms to save energy is powerful and gaining in popularity

- People are influenced by the actions and beliefs of their peers (though they are often reluctant to admit it)
- Comparing a household's energy use to other households with similar characteristics is one way of using social norms
- OPower sends customers a monthly or quarterly report that compares energy usage to neighbors
- BC Hydro and others use household comparisons within their on-line home energy use display or dashboard
- BC Hydro's program uses a number of key social marketing elements to engage consumers; such as endorsements, events, and contests
- The [Energy Smackdown](#) creates teams of people in different communities that compete to reduce energy use and GHG emissions

Customer Tips and Assistance

Customer tips and assistance help guide and enable actions to reduce home energy use

- BC Hydro Power Smart includes tips/personal energy planner, on-line interactive tools, a telephone consultation and links to rebate programs.
- OPower reports include action steps, which are personalized tips to reducing usage.
- Touchstone Energy's TogetherWeSave campaign website includes tips, videos, and an online home energy audit tool.
- On-line tools are getting very sophisticated, for example, EnergyLogic's Optimiser is a comprehensive home energy audit tool. Right now it is being used by auditors but may be used by homeowners in the future.

Energy Reduction Commitments

Commitment is important in shaping whether people change their behavior

- Experiments have been shown that commitments by utility customers can result in up to 10% savings. In one study, the effects of goal setting persisted at least until the follow-up measurements were taken 5 months later.
- BC Hydro's Power Smart program asks participants for a commitment to save 10% and provides constant feedback, support and encouragement
- Goal setting, which entails having individuals or households set specific goals for reducing their energy consumption, has been demonstrated to be effective.
- An OPower goal setting experiment showed goal setters saved over 3 times as much electricity as regular program participants.
- Whether personal goals are made public may also influence outcomes.

Incentives

Financial incentives are viewed as an additional motivational tool in encouraging behavior change

- Financial incentives have been the mainstay of utility EE technology oriented programs for decades.
- In a behavior change setting there is some concern that financial incentives could get in the way of tapping into other customer motivations and drivers.
- Nominal rewards or incentives are being used as an extra to further entice customer participation (per kWh financial incentive, chance to win a gift card or a home audit or power strip)
- BC Hydro offers Team Power Smart participants a \$75 reward when they reach their 10% savings goal.
- Random incentives (use of lotteries, etc.) may encourage greater levels of customer participation it has worked in other sectors

Some Program Examples

US and Canadian Programs

- BC Hydro Team Power Smart
- SMUD Home Electricity Reports (with OPower)
- Cape Light Compact Smart Home Energy Monitoring Pilot (with Grounded Power)
- Citizens Utility Board (CUB) Energy Saver (with Efficiency 2.0)
- Touchstone Energy TogetherWeSave (a Co-op marketing organization)

NW Regional Programs

- Puget Sound Energy Home Energy Reports (with OPower)
- Snohomish PUD Energy Challenge
- Seattle City Light Home Energy Reports (with OPower)

BC Hydro Team Power Smart

- Goal setting model: Participants commit to use 10% less electricity in 12-month period, in exchange they receive tools to help them reduce their consumption. If goal is met, \$75 reward.
- Includes feedback, social norm, tips, and incentives via website and email contact
 1. Recipients' current and historical energy use
 2. Comparison to similar neighbors
 3. Energy-saving tips
 4. Motivational tools
 5. \$75 monetary incentive, if goal achieved
- Open to any residential customers
- Loyalty program, communicate regularly
- Approximately quarter million participants with 3 levels of participation
 - Residence (logging in)
 - Enjoyment (attending events)
 - Affiliation (hosting)
- 25,000 challenge participants (2010)
- Results: 5.2 Gwhs saved
 - 20% of challenges successful to-date (17% avg. savings)
 - 4-5% avg. savings for those that don't reach goal
 - Some don't save
- Insights: Best is yet to come, it takes 5-6 years to build it up, follow social marketing knowledge, look outside energy industry, connect with what people really care about.



Sacramento Municipal Utility District Home Electricity Reports

- Best documented and longest OPower pilot (24-months)
- Used OPower to mail monthly and quarterly reports (not bills)
- Reports showed feedback, social norm, and tips.
 1. recipients current and historical energy use
 2. comparison to neighbors and 'efficient' neighbors
 3. personalized tips
- Randomly selected 35,000 participants and control group
- Results: aggregate savings 1.9% (213 kWh), 1.4 % excluding rebated measures
 - Monthly report recipients saved more on average.
 - More savings in summer and winter than the rest of year (summer 2.6%, winter 2.2% vs. rest 1.7%)
- Voluntary “pledge to save” goal participants achieved 3x the savings
- Evaluation shows savings for 30 months, continuing to measure persistence
- Insights: 20,000 additional customers for 2nd phase, expect to double savings with enhancements (UCLA advising), use opt-out strategy.



Cape Light Compact Residential Energy Monitoring Pilot

- Goals: evaluate savings from in-home energy monitoring systems, gain insight to behavioral aspects of energy use, and inform future Smart Grid projects (Mass. regulatory support).
- One year using internet-based dashboard (in home display added later).
- Includes feedback, social norm, and tips via website and email contact
 1. Recipients' current and historical energy use
 2. Comparison to similar neighbors
 3. Energy-saving/cost-saving/carbon-saving tips
 4. Social networking aspect, personal goal
- 340 responded, 100 treatment, others control group
- Results: 9.3% savings; 75% reduced energy consumption; 1/3 reduced kWh per day (compared to control group).
- Six other utilities in Massachusetts are launching this soon. Phase II will include a much larger group of participants.
- Insights: Savings are there, think through staff support, people informing each other an important part of it.



Citizens Utility Board (CUB) Energy Saver (with Efficiency 2.0)

- Goal: Energy savings from behavioral science based efforts by customers of Commonwealth Edison and People's Gas in Illinois.
- Personal energy efficiency rewards program based on Efficiency 2.0, an internet-based customer interface.
- Includes feedback, social norms, tips and rewards
 1. Participants' usage, community comparisons
 2. Social networking, personal goal, contests
 3. Tips, feedback on goal progress
 4. Reward points based on measured savings
- Rewards redeemed through RecycleBank
- Results: 8% net savings per participant; 6.6% calculating the change in usage compared to control group.
- US DOE involvement, also used by Cambridge Energy Alliance, Western Mass Electric initiating soon, in discussions with SMUD (mail component).
- Insights: Goal setting and rewards are key, utilize a combination of behavioral strategies and effectively integrate the components.



Touchstone Energy

(A Co-op Marketing Organization)

- Goals: Inspire consumers to save energy and money through information and awareness, web-based tools for learning and to stimulate action.
- National rural electric cooperative (NRECA) energy efficiency marketing campaign since August 2009, coupled with TogetherWeSave.com (website).
- Website features
 1. Tips on how to save electricity
 2. Interactive videos, virtual home tour
 3. Customer comments feature
 4. Articles & links to other info sources
- On-line residential energy audit (developed by LBNL for DOE)
- Results: No information
- Connected with Cooperative Research Network, which recently hosted a webinar on behavioral energy savings
- Insights: PNGC members are NRECA members as well and participants in the Together We Save marketing campaign. Collaborating with NRECA could help build credibility with co-ops and share costs.



PSE Home Energy Reports

- Uses OPower to send residential customers reports for electricity and natural gas usage
- Reports are separate from bill, including:
 1. Feedback: recipients' current and historical energy use
 2. Social norms: comparison to similar neighbors
 3. Tips: no cost, low cost equipment change, medium cost appliance upgrade
- 75% received the reports monthly, 25% quarterly
- Random selection of 83,000 single family homes, 39,755 homes assigned to treatment group and rest to control group.
- Results: 1.7-2.00% savings. About 200kWh per HH. Highest savings in last 12 months. Monthly report recipients on average saved more.
- Continuation: Dropping 1/3 of participants to see if savings continues without treatment. May choose to “boost” participant for those dropped.
- Also tried Blueline Monitors but couldn't measure savings from it



Snohomish PUD Energy Challenge

- Participants commit to use 10% less electricity, in exchange they are entered into a quarterly drawings for prizes.
- Includes feedback, social norms, tips, and incentives via paper report (not part of bill) and email contact
 1. Recipients' current and historical energy use
 2. Energy-saving tips
 3. Prize drawings for audits and other assistance
- Open to residential customers and small commercial
- 4,000 of 300,000 HH have signed up
- Report not out yet, but they are seeing savings by participants.
- Low cost behavioral program; relies on staff time and no products.



SCL Home Energy Reports

- Using OPower to send residential customers reports for electricity (10th OPower customer)
- Reports are separate from bill, including:
 1. Feedback: recipients' current and historical energy use
 2. Social norms: comparison to similar neighbors
 3. Tips: no cost, low cost equip. change, medium cost appliance upgrade
- Reports are bi-monthly (6/year)
- Random selection of 20,000 single family homes in Year 1; planned for 50,000 but funding reduced; did not target lowest users of energy
- Costs about \$15-\$20 per customer/year
- Cost effective if they achieve 2% savings.
- Results: Within target, about 2% savings since Oct 2009. Didn't expect more than 5%.
- Continuation: Ramping up to 50,000 by way of every HH in SW Seattle that received ARRA weatherization assistance.



Some Other Behavioral Based Programs

Energy Smackdown (Massachusetts)

- Friendly competition between Massachusetts communities to reduce energy consumption and CO2
- 3 communities, 10+ households each, 12 months, 4 season cycle (phase 2)
- Average electricity reduction of 14%, energy reduction of 17%

FortisBC 20/20 Energy Challenge

- 20 communities; 20,000 CFLs in 20 days
- Ask participants to make one small change (CFLs) and then commit to making another change

AEP and SWEPCO are using Earth Aid

- Feedback and social norms
- Reward points for each kWh of electricity reduced from baseline.
- Points can be redeemed for discounts at local merchants.



We Energies Peak Time Rebates

- During peak times, customers can choose to reduce energy use and earn a cash rebate of \$.47/kWh, loaded onto a Visa card.
- Customers receive a phone call/email, or text the day before events.

Sources

- 2010 American Council for an Energy Efficient Economy (ACEEE) Summer Study on Energy Efficiency in Buildings (numerous papers).
- Behavior, Energy and Climate Change (BECC) Conference presentations (multiple years/numerous presentations).
- Consortium for Energy Efficiency (CEE) reports, particularly “Behavior Insights and Tools” report (April 2010).
- ACEEE Report, “Visible and Concrete Savings: Case Studies of Effective Behavioral Approaches to Improving Customer Energy Efficiency” (2010).
- E Source reports, articles and presentations, particularly “Behavior-Change Program Elements That Create Energy Savings” (2010); E Source inquiries and behavior change group meetings.
- California Institute for Energy and Environment (CIEE), series of white papers on energy efficiency and behavior (2009-10).
- Stanford Precourt Energy Efficiency Center, list of behavioral economic principles that can inform energy policy (2010).

Sources (continued)

- Web based research on energy efficiency and behavior related products and services, such as O Power, Efficiency 2.0, Google PowerMeter, The Energy Detective (TED), Touchstone Energy, etc.
- Interviews with behavioral based program managers and evaluators, including SMUD, BC Hydro, PSE, SCL, CUB/Efficiency 2.0, Cape Light Compact, Snohomish PUD.

[Binder Available Containing Reports, Conference Papers and Presentations, Articles, Web Based Research Findings and Interview Notes]

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