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QUANTIFYING AND BENCHMARKING BEHAVIORAL OPPORTUNITY FOR ENERGY RESOURCE PROGRAMS

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U.S. DEPARTMENT OF
ENERGY

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Project Objectives

- Develop a working definition of behavioral program efforts that expands beyond Home Energy Reports
- Identify behavior-based energy efficiency programs that produce energy savings
- Catalog and benchmark success metrics across programs
- *[MN only]* Determine practices associated with measurement, evaluation, and claiming behavioral savings
- *[DOE only]* Identify opportunities for behavioral strategies in traditional DSM programs

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Contributors

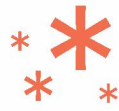
CARD and DOE reports prepared by:

- Anne Dougherty, Founder
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Overview

- Behavioral Program Taxonomy
- Example Findings
- Conclusions

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DEFINITION AND TAXONOMY



First, we developed a definition of Behavioral Programs:

- Adapt California working definition* of “behavioral programs” to differentiate these programs from traditional, incentive-based DSM programs.
 - Rooted in social science: Apply **social-science based** theories and behavioral intervention strategies.
 - Evaluable: Energy savings impacts are **quantifiable** using industry-standard approaches...*Plus additional criterion for purpose of benchmarking* - savings results must be provided in a manner that **allows for comparisons** across our taxonomy

No restriction on what type of actions people take

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*Developed through CA IOU working group behavior summit in 2013, as an expansion of the whitepaper “Paving the Way for a Richer Mix of Behavioral Programs”

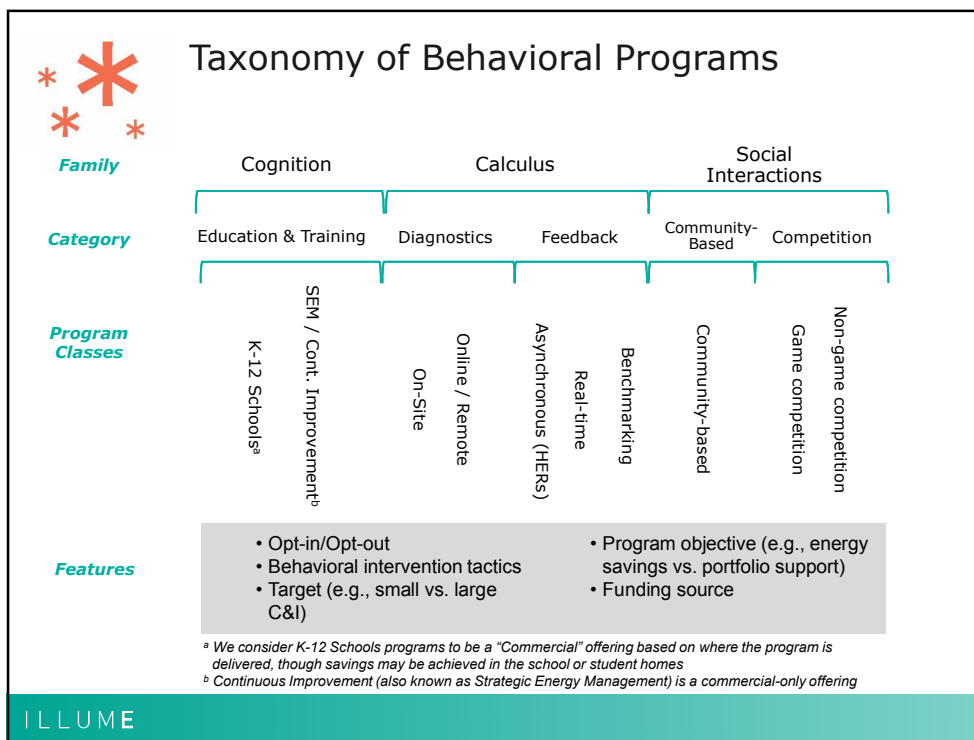


Eight Behavioral Strategies

List based on the CA whitepaper “Paving the Way for a Richer Mix of Behavioral Programs,” and the “ACEEE Field Guide to Utility-Run Behavior Programs”

- Commitment (including goal-setting)
- Feedback
- Follow-through
- Framing (e.g., choice architecture)
- In-person interactions
- Rewards or gifts
- Social norms
- + *Multi-pronged or “stacked” strategies – use two or more strategies.*

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OVERVIEW OF LITERATURE REVIEW & BENCHMARKING RESULTS



We reviewed more than 170 studies, and excluded many programs for lack of comparable results

- Of these, 58 behavioral program models met our screening criteria and had evaluated energy savings (35 Residential and 23 Commercial)
- Many excluded due to lack of claimed savings or results that allow for comparisons (time to standardize reported metrics?)



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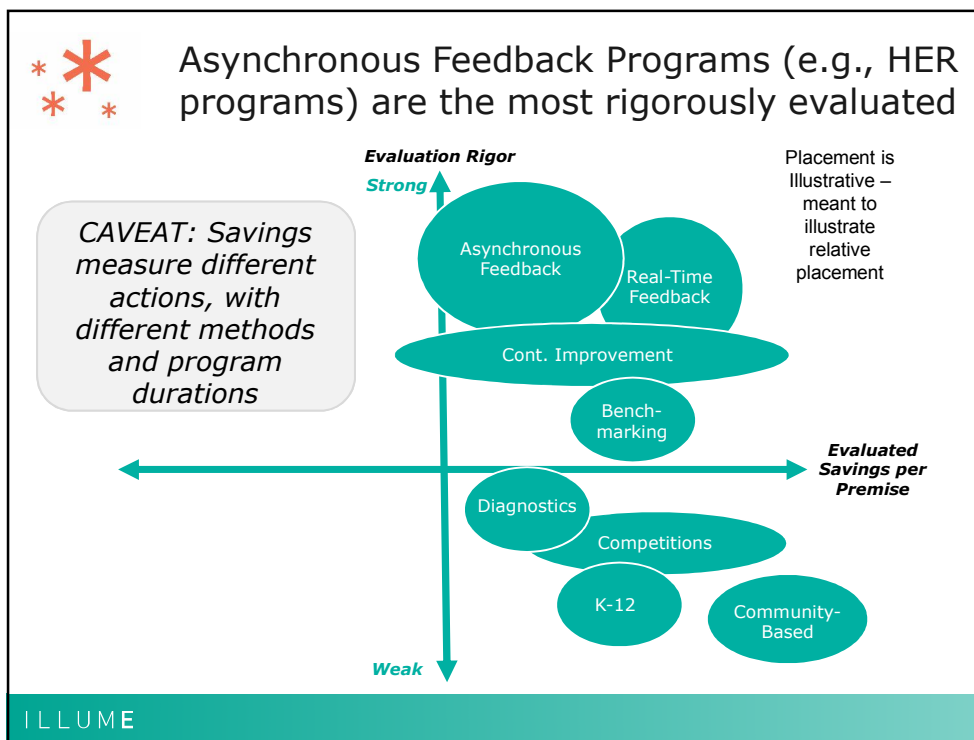


Reported savings do not represent comparable actions



- Savings for different program classes may measure different things
 - Gross, net, or net adjusted savings (only HERs and SEM typically remove double-counted savings)
 - Duration of program intervention and measurement (competitions/challenges are short-term only)
 - Actions measured (e.g., community-based programs measure deemed savings from existing DSM programs)
 - Opt-in or opt-out model

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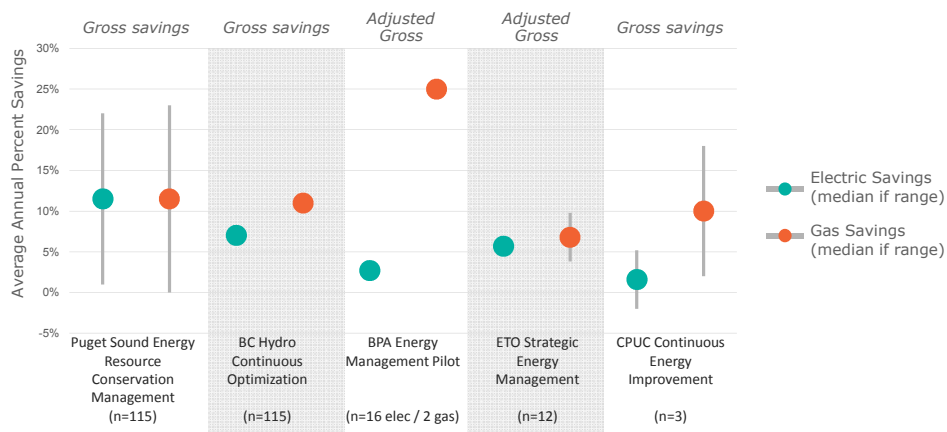
EXAMPLE FINDINGS

Family	Cognition		Calculus		Social Interactions				
Category	Education & Training	Diagnostics	Feedback	Community-Based	Competition				
Program Classes	K-12 Schools	SEM / Cont. Energy Improvement	On-Site	Online / Remote	Asynchronous (HERS)	Benchmarking	Community-based	Non-game competition	Game competition



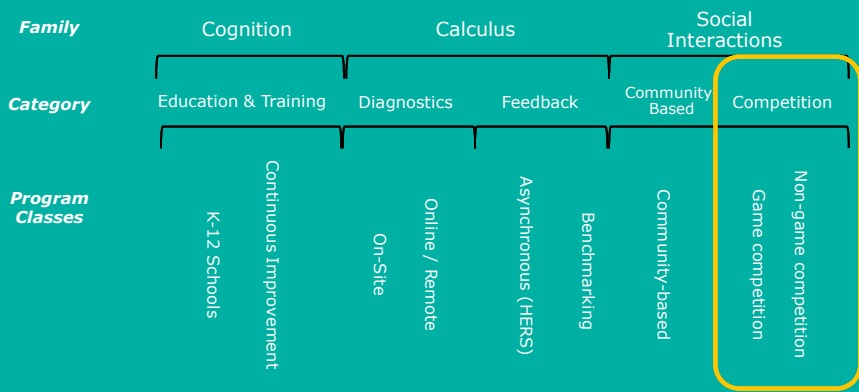
Commercial **SEM / Continuous Energy Improvement** use multiple behavioral strategies

- Common tactics: Goal-setting, commitment, in-person interactions, feedback, follow-through
- Typically measure **gross** or adjusted gross (removing double-counted savings)



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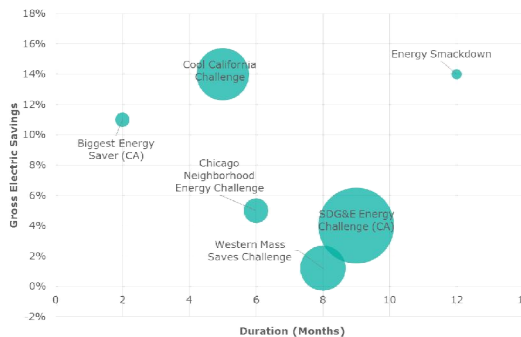
EXAMPLE FINDINGS





Competition programs seem to save in short-term but use inconsistent success metrics; present an opportunity for more rigorous evaluation

- Most common tactics: Peer-to-peer interactions, social norms, goal-setting, feedback, rewards (incl. recognition)
- Savings appear high, but they are typically **gross savings**, and the program and evaluation period typically a **short duration**



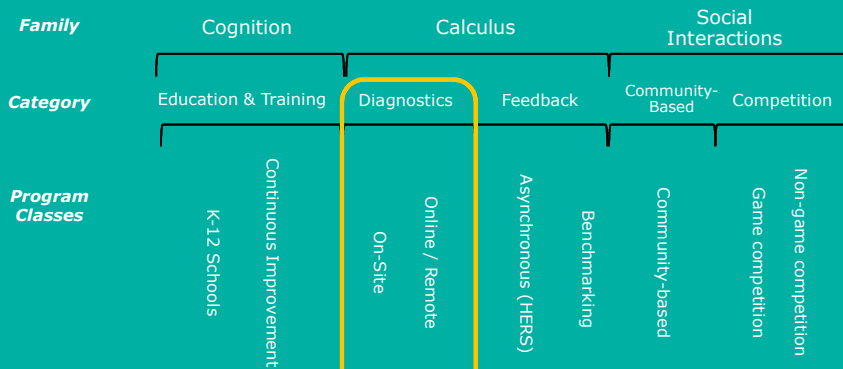
Bubble size is number of participants
Select programs shown. See report for details of all programs included in study.

Vine, E., and Jones, C. (2015). *A review of energy reduction competitions studies: scaling up deeper savings through comparative feedback and recognition*. Prepared for California Public Utilities Commission. California Institute for Energy and Environment.

Grossberg, F., Wolfson, M., Mazur-Stommen, S., Farley, K., & Nadel, S. (2015). *Gamified Energy Efficiency Programs* (No. B1501). American Council for an Energy Efficient Economy. Retrieved from <http://www.aceee.org/research-report/b1501>

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EXAMPLE FINDINGS



* * * Many Diagnostic programs we reviewed did not qualify as "behavioral", while others have not been evaluated

- Many diagnostic programs rely on in-person interactions with program staff, but these are not "peer to peer" or with a "trusted community member"
- More limited use of other behavioral strategies than expected (among evaluated programs)

example of typical audit report

Recommendations

Our recommendations to you cover major energy efficiency improvements for your home that will have the most impact. We do not account for other possible monetary and nonmonetary benefits to you such as increasing the property value of your home, extending the life of your air conditioner and heater, and an overall increase in home comfort. The only items we address below are those items which received a "Low" or "Below Average" rating. We have also included any specific items you have requested.

Payback less than 10 years	Estimated Cost*	Annual Savings	10 Year Savings**	Payback**
We Recommend: AC Tune Up (2)	\$140	\$201	\$2,528	0.7
We Recommend: Upgrade to Compact Fluoresce Light Bulbs	\$250	\$226	\$2,843	1.1
We Recommend: Seal Your Ventilation Ducts	\$395	\$100	\$1,258	3.7
We Recommend: Radiant Barrier	\$957	\$107	\$1,346	7.6
We Recommend: Attic Tent	\$195	\$19	\$238	8.5
We Recommend:				

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* * * Audit reports present an opportunity to utilize framing techniques, choice architecture, and display social norms (e.g., benchmarking)

...But we did not find clear examples of this among *evaluated* programs

The screenshot shows a TVA eScore Audit Report for a home in Memphis, TN. The score is 6 out of 10. A bar chart shows the score breakdown by category: Air Sealing (4), Attic Insulation (5), Duct System (3), Lighting (4), Heating/Cooling Systems (6), Appliances/Electronics (5), Water Heating (7), Refrigerator (8), Windows & Doors (4), and Wall Insulation (10). The report includes a list of recommendations such as 'Air Sealing', 'Attic Insulation', 'Duct System', 'Lighting', 'Heating/Cooling System', 'Appliances/Electronics', 'Water Heating', 'Refrigerator', 'Windows & Doors', and 'Wall Insulation'. It also features a 'YOUR PATH TO A 10' section with a checklist of items to improve the score.

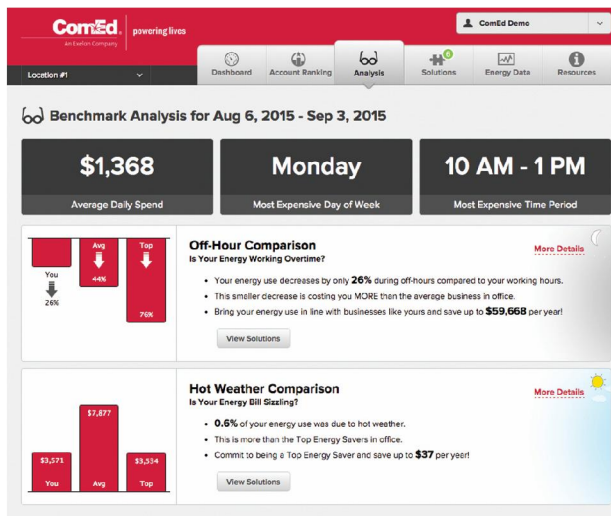
TVA eScore Audit Report, from <http://www.cemc.org/escore.asp>

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Emerging class of online diagnostics with compelling framing (choice architecture) and norms, but not been evaluated yet

ComEd Business Energy Analyzer



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<https://www.comed.com/business-savings/energy-tools/Pages/default.aspx>

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CONCLUSIONS



Program and Portfolio Recommendations

- Feedback family most rigorously evaluated, therefore may be best-suited to resource program portfolios, though persistence research is still lacking for some opt-in models
- Social interactions programs, especially competitions, may have great potential in generating **short-term savings**, but need to be more rigorously evaluated
 - These approaches spark interest and engagement and could be paired with traditional programs
- Cognition programs (like SEM) may be effective due to multi-pronged strategies, but may be costly to implement due to “high-touch” interactions
- Many existing programs still present an opportunity to utilize more behavioral strategies (e.g., go beyond feedback)
- Consider ways to use behavior programs as channeling mechanisms



Evaluability and comparability limits benchmarking – consider reporting standard metrics

Opt-in programs

- Inputs to participation rate and/or marketing response rate (e.g., marketed/targeted n)
- Targeting criteria
- Participant n
- Average baseline consumption of enrolled participants
- Average savings per premise
- Percent savings (vs. comparison or baseline; specify)
- Savings duration
- Any adjustments made to savings (e.g., double-counting)

Opt-out programs

- Percent and per-premise savings commonly reported
- Could improve reporting of targeting criteria

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Resources

Upcoming SEE Action Webinars

Oct 27	SEE Action: Isn't it all behavior change anyway?	2pm ET
Nov 3	SEE Action: Benchmarking Behavioral Programs on Savings and Impacts	2pm ET
Dec 2	SEE Action: Behavior Change Strategies in Traditional EE Programs	2pm ET

Minnesota CARD Benchmarking Report

<https://mn.gov/commerce/energy/images/energy-efficiency-behavioral-programs.pdf>

or Google: Minnesota CARD behavioral benchmarking

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APPENDIX



Full Definition of Behavioral Programs

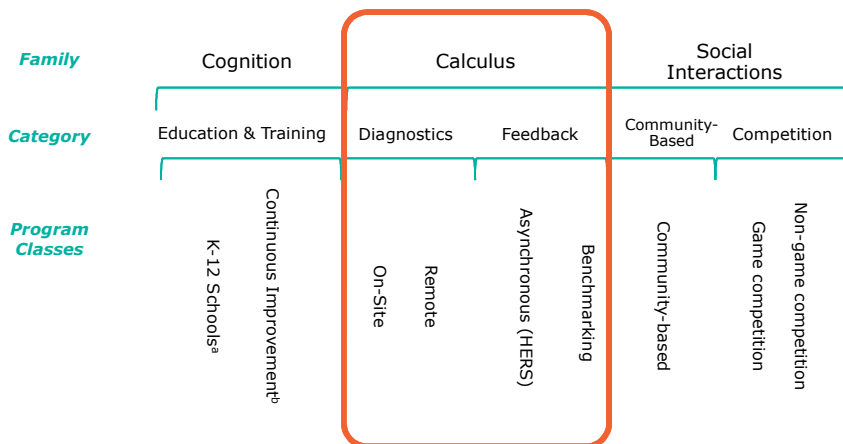
To differentiate behavior-based innovations from traditional, incentive-based demand-side management programs, the CA IOUs classified behavior-based interventions as those that:

Definition

1. Identify energy usage behaviors that are intended to be changed
2. Identify which social science theory or combination of theories the intervention is drawing upon.
3. Deploy **behavior intervention strategies**.
4. Utilize messaging strategies grounded in behavioral and cognitive sciences.
5. May be evaluated using experimental design, quasi-experimental design, or other evaluation methods approved by the California Public Utilities Commission.
6. Outcomes are typically measured on an ex-post basis, using approved evaluation methods; in some cases, forecasted metrics may be used.

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CALCULUS FAMILY FINDINGS



Key feature: Provide energy-related information that customers need to make economically rational decisions about energy use

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Residential **Asynchronous Feedback** Programs: First-year savings range from -2.2-2.2% for Electric and from 0.4-1.2% for Gas

First-year savings only

Program	Behavioral Strategies	Participants (n)	Net Unadjusted Electric Savings	Net Unadjusted Gas Savings
Ameren IL Behavioral Modification	Feedback, social norms	198,183	0.9-1.3%	0.4-1.0%
ComEd HER (IL)	Feedback, social norms	259,261	1.2-1.7%	NA
CUB Energy Saver (IL)	Feedback, social norms, rewards	8,793	2.0%	NA
MN Enerlyte	Enhanced bill mobile application	24,326	2.2%	NA
NGRID RI Statewide	Feedback, social norms, rewards	269,174	-2.2-1.6%	0.3-0.5%
PG&E HER (CA)	Feedback, social norms	542,411	0.9-1.5%	0.4-0.9%
Puget Sound Energy HER (WA)	Feedback, social norms	31,618	1.7%	1.2%
SMUD HER (CA)	Feedback, social norms	100,347	1.6-1.8%	NA
Xcel HER (MN)	Feedback, social norms	32,762	2.1%	0.6%
NGRID HER (MA)	Feedback, social norms	653,908	1.0-1.7%	0.5-1.2%

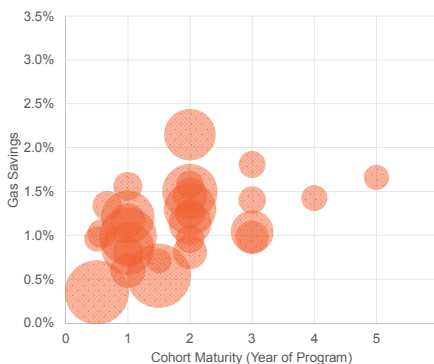
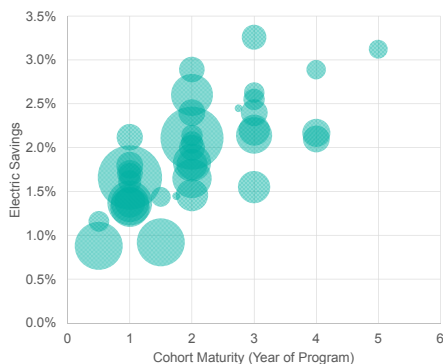
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Select programs only. See full report for all programs reviewed.



Residential **Asynchronous Feedback** Programs: Savings generally increase after the first year, under continued treatment

- Results reflect savings under continued treatment



Bubble size corresponds to program participation for one cohort of a program.

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Residential **Real-Time Feedback** Programs, without pricing, report electric savings ranging from 0%-3.1%

Program	Behavioral Strategies	Participants (n)	Net Unadjusted Electric Savings	Summer Peak Load Reduction (%)
Edison SmartConnect; Budget Assistant	Goal-setting; notification tools in "My Account"	117,337	0.92% (diminish over time)	NA
Edison SmartConnect: IHDs	Feedback via IHD without real-time cost	163	3% in first 30 days; 0% thereafter	NA
Minnesota Power AMI Pilot	Feedback via online portal with either daily or hourly consumption	2,523	0%	NA
Minnesota MyMeter	Feedback via online portal/app, comparative usage, goal-setting	14,156	1.8-2.8%	NA
National Grid EmPower (RI)	Feedback via online portal; communicating outlet or thermostat	90	1.7%	Range from 30% savings to 19% increase in consumption
Tucson Electric Power: Power Partners	Feedback via online portal with AMR data, recommendations, goal-setting, challenges	1,521	1.2-3.1%	NA



Residential **Real-Time Pricing** Programs report summer peak reduction ranging from 8%-26%

Program	Behavioral Strategies	Design	Part. (n)	Net Unadjusted Electric Savings	Summer Peak Load Reduction (%)
SMUD SmartPricing Options: CPP	Feedback via IHD, web portal	Opt-in	1,651	NA	26%
SMUD SmartPricing Options: CPP	Feedback via IHD, web portal	Opt-out	701	NA	12%
SMUD SmartPricing Options: TOU	Feedback via IHD, web portal	Opt-in	2,199	NA	13%
SMUD SmartPricing Options: TOU	Feedback via IHD, web portal	Opt-out	2,018	NA	6%
SMUD SmartPricing Options: CPP	Feedback via web portal only	Opt-in	223	NA	22%
SMUD SmartPricing Options: TOU	Feedback via web portal only	Opt-in	1,229	NA	10%
SMUD SmartPricing Options: CPP + TOU	Feedback via IHD, web portal	Opt-out	588	NA	8% summer peak; 13% critical peak
Edison SmartConnect: IHDs	Feedback via IHD with real-time cost	Opt-in	183	6% in first 60 days; 0 thereafter	NA

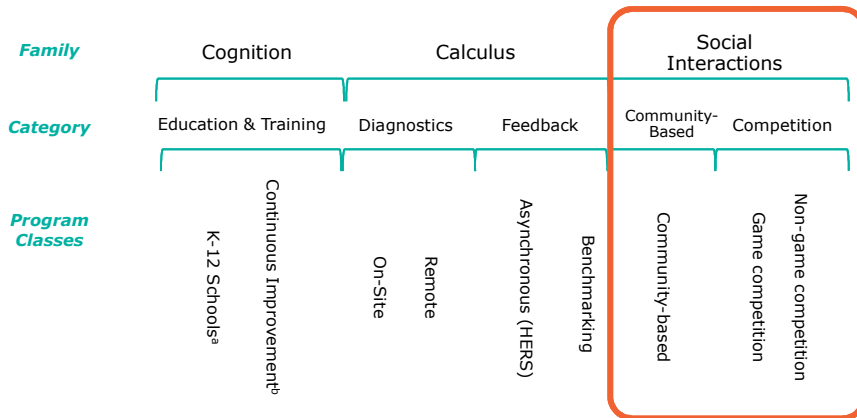


Commercial Benchmarking Programs
 Generate Savings from 1.1-5% (Electric) and 0-7% (Gas)

Program (Commercial)	Behavioral Strategies	Participants (n)	Electric Savings	Gas Savings
ENERGY Star Portfolio Manager	Feedback, framing, social norms	35,000	2.4% (All fuels; gross)	
National Grid/NSTAR Benchmarking	Feedback, framing, social norms	99	4-5% (Net unadjusted)	3-7% (Net unadjusted)
NY Benchmarking	Feedback, framing, social norms	428	1.1-1.3% (Net unadjusted)	0-1.9% (Net unadjusted)

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SOCIAL INTERACTIONS FAMILY FINDINGS



Key feature: Utilize online or in-person social interactions. Rely on "sociability and belonged experience" (Mazur-Stommen & Farley, 2010)

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Community-Based Programs report *gross* savings from retrofits ranging from 12-30% (Residential) and 10-18% (Commercial)

Program	Behavioral Strategies	Residential Participants (n)	Commercial Participants (n)	Residential Electric Savings*	Commercial Electric Savings*
Energize Phoenix	Door-to-door outreach, events	2,014	375	12% (gross)	10-17% (gross)
Michigan Saves	Targeted neighborhood "sweeps"	7,689	81	14% (gross)	31% (gross)
Seattle Community Power Works	Events, phone center support, contractor training	3,070	153	30% (gross)	13-18% (gross)
RePower Bainbridge Island Energy Upgrades	Peer-to-peer interactions; framing; community level feedback	977	238	30% (gross)	NR
Energy Management Teams – Coordinator Resource Pilot	Social interactions; goal-setting	NA	5	NA	NR
Otter Tail Power On Community Energy Challenge	Social interactions; goal-setting; education & training	205	10	NA^	NA^

*Gross savings associated with home energy upgrades or business energy upgrades, typically delivered through existing programs. As such, the savings estimates are based on first-year program-reported measure savings, typically estimated from building energy models (implementer software) or deemed savings.



Competition Programs use inconsistent success metrics; present an opportunity for more rigorous evaluations

Program (Residential)	Behavioral Strategies	Residential Participants (n)	Duration	Electric Savings	Gas Savings
Cool California Challenge	Community competition; social norms; peer-to-peer interactions; rewards	2,700 households	5 mos.	14% (Gross)	0%
Energy Smackdown	Community competition; social norms; peer-to-peer interactions; rewards	100 households (3 communities)	12 mos.	14% (Gross)	17% (all heating fuels)
Western Mass Saves Challenge	Community competition; goal-setting; feedback via online portal; rewards	2,000 households (4 communities)	8 mos.	0.1-2.3% (per community, gross)	NA
SDG&E Energy Challenge (CA)	Household competition; social norms; peer-to-peer interactions; rewards	5,634 households	9 mos.	6% summer; 2% winter (net unadjusted)	NA
Biggest Energy Saver (CA)	Household competition; real-time feedback via IHD; rewards	200 households	2 mos.	11% (gross)	NA

Select programs shown. See CARD report for details of all programs included in study.



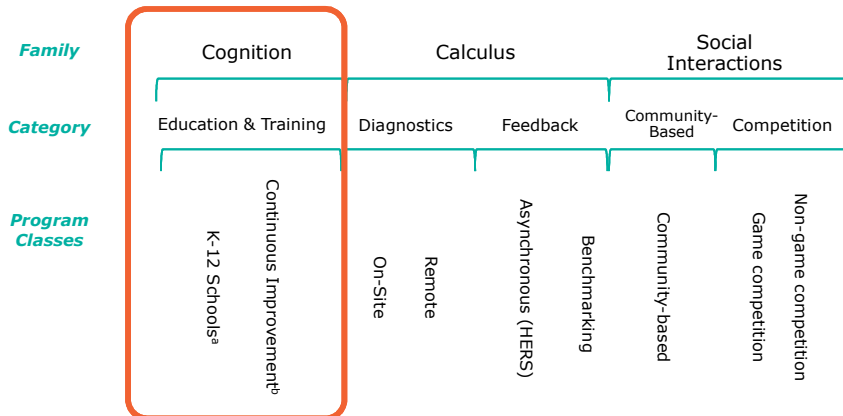
Commercial Competition programs tend to have longer duration and more rigorous evaluation approaches

Program (Commercial)	Behavioral Strategies	Duration	Commercial Participants	Electric Savings
iChoose (Milwaukee Fire Department, Wisconsin)	Team competition	2 mos.	29 buildings / 130 participants	6.6% (Net unadjusted)
Duke Smart Energy Now	Real-time feedback via lobby kiosks; energy champions (peer-to-peer), training, pre-packaged "campaign"; behavioral experts	NR	59 buildings	6.9% (Net Unadjusted)
BC Hydro Workforce Conservation	Energy champions (peer-to-peer); real-time data/feedback; commitment; rewards	1 year	300 sites	0-3% (Net unadjusted)
SnoPUD Behavior-Based Energy Efficiency Pilot	Within-store competition; real-time feedback via in-store displays; education	1 month	10 stores	2% (Net unadjusted)
Boulder 10 for Change Challenge	Business-to-business competition; peer-to-peer interaction; commitments; goal-setting	1 year	100 businesses	8% (Gross; electric and gas)

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Select programs shown. See CARD report for details of all programs included in study.

COGNITION FAMILY FINDINGS



Key feature: Rely on delivering information and/or appeal to emotions to drive behavior change. Provide general information/education.

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Commercial Continuous Energy Programs report gross electric savings from -2-22%, but savings may measure different actions

Program (Commercial)	Behavioral Strategies	Commercial Participants (n)	Electric Savings	Gas Savings
ETO Strategic Energy Management	Workshops & energy assessment; track performance; energy champion; peer to peer networking	12	4.7-6.7% (Adjusted Gross)	3.8-9.8% (Adjusted Gross)
BPA Energy Management Pilot	Technical assistance and training; co-fund staff time for O&M	16 electric / 2 gas	2.7% (Adjusted Gross)	25% (Adjusted Gross)
BC Hydro Continuous Optimization	In-person interactions; training; feedback	115	7% (Gross)	11% (Gross)
CPUC Continuous Energy Improvement	Energy assessment; technical assistance; management plan; commitment from senior management	3	-2-5.2% (Gross)	2-18% (Gross)
Puget Sound Energy Resource Conservation Management	Incentives; dedicated staff; goal-setting; Resource Conservation Manager	864	1-22% (Gross)	0-23% (Gross)



K-12 Education Programs do not typically evaluate savings in a meaningful way

- We reviewed two K-12 programs that use behavioral strategies, but only one had evaluated savings.
 - Many K-12 programs do not have evaluated savings, and as such, are not included in this analysis.
 - The one K-12 program with evaluated savings did not describe their evaluation approach.
- Of all Education and Training programs (including CIE and K-12 programs) reviewed, the following social science interventions are used frequently, listed in order of their prevalence in programs: (1) training; (2) goal-setting; (3) commitment; (4) in-person interactions; and (5) feedback.



We benchmarked several metrics for every program

Metrics	Definition
Taxonomy Membership	<ol style="list-style-type: none"> 1. Sector 2. Family 3. Category 4. Program Class
Program Features	<ol style="list-style-type: none"> 1. Opt-in/opt-out 2. Behavioral intervention strategies 3. Target population for intervention 4. Funding sources
Program Characteristics (categorical)	<ol style="list-style-type: none"> 1. Electric/gas 2. Program administrator & implementer 3. State 4. Evaluation design
Program Characteristics (numeric)	<ol style="list-style-type: none"> 1. Number of participating customers 2. Opt-in/opt-out rate
Energy Savings	<ol style="list-style-type: none"> 1. First year energy % savings (avg. % savings per premise) 2. First year energy unit savings (avg. kWh, therm, per premise) 3. Energy % savings in subsequent years
Cross-Participation	<ol style="list-style-type: none"> 1. Incremental % of behavioral program participants participating in other energy efficiency programs 2. Incremental savings per premise

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