Evaluating Feedback Programs: Results to Date, Challenges for the Next Wave

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Mitchell Rosenberg
DNV KEMA Energy & Sustainability

Overview of Presentation

- Evaluations Reviewed
- Evaluation Methods
- Findings in regard to key research questions
  - Level of annual savings
  - Effect on participation & savings in other energy efficiency programs
  - Measures taken “outside” of energy efficiency programs
  - Persistence of savings over time
  - Relationship between delivery approaches and savings
  - Relationship between customer attributes and savings
- What’s Next?

Programs Reviewed

Sponsor/ Evaluation Dates	Region	Evaluation Period	Data Collection & Analysis	1st Year Sample Sizes
SMUD Electric Only 2009, 2011	Sacramento CA & environs	4/2008 – 9/2010	Billing Analysis Treatment Control	 ~35,000 ~50,000
Massachusetts Electric & Gas 2011, 2012	Massachusetts	10/2009 – 12/2011	Billing Analysis Treatment Control Customer Survey Cross participation analysis	 ~25,000 ~25,000 1,002
Puget Sound Energy Electric & Gas 2010, 2012	Pacific Northwest	10/2008 – 6/2011	Billing Analysis Treatment Control Customer Survey Cross participation analysis	 31,618 40,007 1,369

Evaluation Methods

- **Analysis of monthly energy bill data with random assignment to treatment and control**
  - "Difference of Differences Approach"
    - Pros: simple, easy to explain, no black box
    - Cons: not weather normalized; lower precision than regression model
  - Pooled time series/cross sectional
    - Pros: Controls for differences among households, weather normalized, higher precision
    - Cons: Difficult to explain; models may become cumbersome
- **Customer surveys**
  - The PSE and MA studies contain surveys of Treatment and Control groups; and focused on energy efficiency actions both groups took in the post-treatment period. n = 500 – 1,300
- **Cross-participation analysis**

Estimates of First-Year Annual Savings

Sponsor	Average kWh/ Year Savings	Average % kWh Savings	Average Therm/ Year Savings	Average % Gas Savings
MA Utilities	**184 kWh**	**1.61%**	**9.93Therms**	**0.77%**
90% CI	*26 kWh*	*0.23%*	*2.23Therms*	*0.17%*
SMUD	**241 kWh**	**2.13%**	**n/a**	**n/a**
95% CI	*+/- 18 kWh*	*+/- 0.16%*		
PSE	**204 kWh**	**1.84%**	**12.8 Therms**	**1.33%**
95% CI	*+/- 12 kWh*	*+/- 0.11%*	*1.3 Therms*	*0.13%*

Electricity savings equivalent to replacing 3-4 incandescent lamps with CFLs.
Natural gas savings equivalent to installing one faucet aerator.

Savings from Incremental Participation in Other Programs

	Massachusetts Utilities		Puget Sound Energy*	
	Electric	Gas	Electric	Gas
Participation Rate in Other Programs: Treatment*	4.22%	3.85%		4.15%
Participation Rate in Other Programs: Control	3.86%	3.21%		4.11%
Δ in Participation Rate	0.35%	0.64%		0.04%
Average Savings in Program Year**	184 kWh/Yr	9.93 Th/Yr	278 kWh/Yr	12.9 Th/Yr
Average incremental savings from measures in other programs	--	0.61 Th/Yr	2.0 kWh/Yr	1.3 Th/Yr

***Cross participation rates available only as aggregated across fuels.**

Pattern of small effects on participation in other programs and relatively low savings from cross participation persists Year 3

Cross participants account for ~ 2% total annual program participation

Savings from Installation of Measures Outside Programs

Measure Category	Massachusetts		PSE		
	Treatment	Control	Treatment	Suspended	Control
Heating/Cooling	10.2%	8.4%	11%	11%	9%
Efficient Appliances	★ 24.8%†	19.8%	n/a	n/a	n/a
Efficient Consumer Electronics	★ 20.4%††	13.6%	n/a	n/a	n/a
Efficient Lighting (not incl. CFLs)	10.0%	7.8%	37%	40%	36%
Air Sealing	n/a	n/a	20%	20%	19%
Water Heating	n/a	n/a	34%	31%	30%
Discard Old Refrigerator	n/a	n/a	3%	5%	3%
Building Envelope	★ 16.0%††	9.0%	n/a	n/a	n/a
Low-Cost Measures	45.3%	39.1%	n/a	n/a	n/a

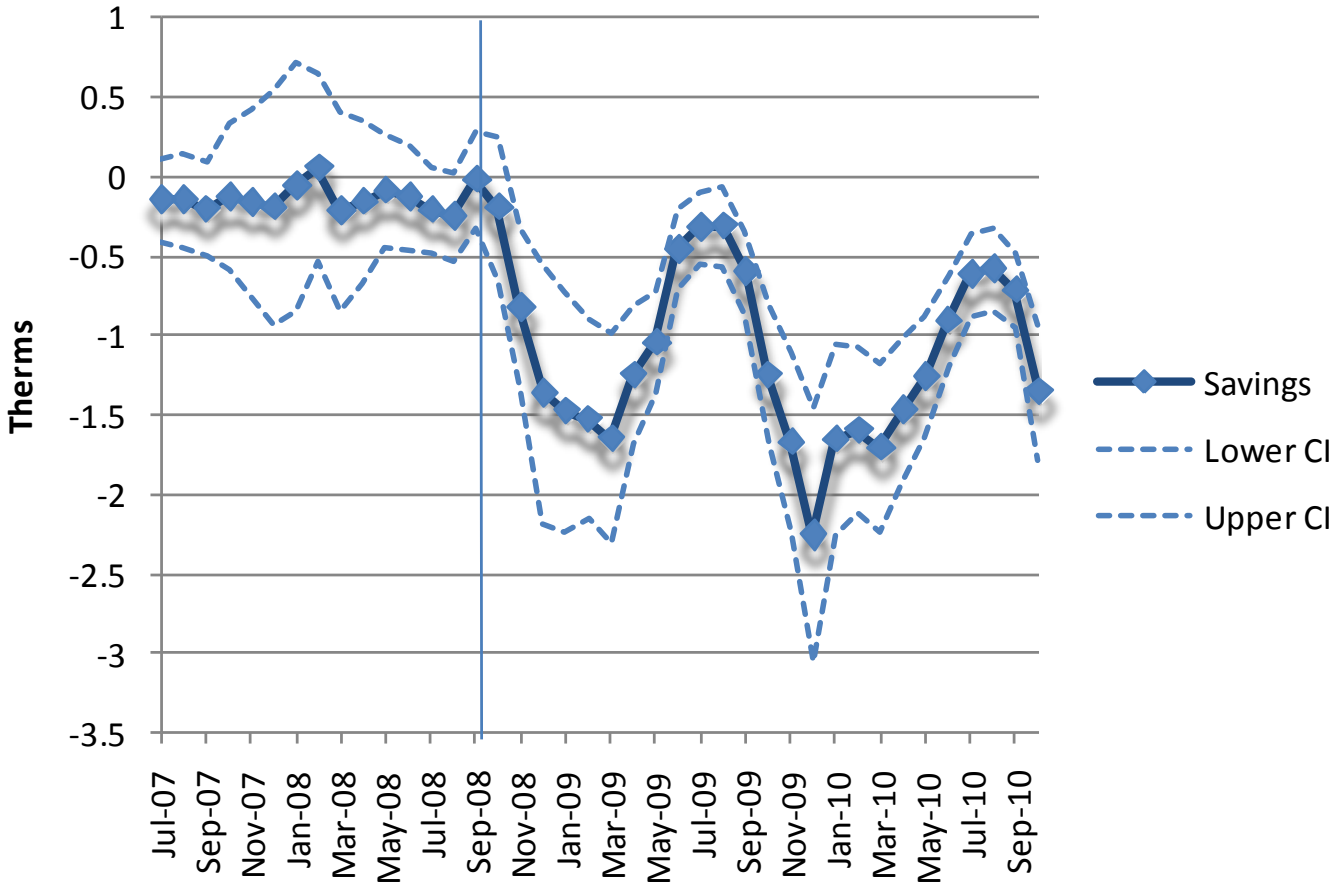
††Difference is significant at the 95% probability level; † Difference is significant at the 90% probability level.

Among PSE customers, there were no significant differences between the Treatment, Suspended, and Control groups for any of the measure categories. Among the MA customers, there were small but statistically significant differences in rates of adoption for three measure categories but the difference in measure adoption rates was less than 7 percent.

Savings from Incremental Adoption of Behaviors

- Surveys also used to identify and characterize energy efficiency and energy conservation **behaviors and practices**
  - Adjusted thermostat settings for heating, cooling, and water heating equipment
  - HVAC and refrigerator maintenance
  - Unplugging idle electronics
  - Cold water washing
- Results indicate **no significant differences** between Treatment and Control group adoption rates
  - May reflect limitations of survey techniques since billing analysis, supported by tens of thousands of observations, demonstrates measured differences
  - Measured differences in monthly gas use during winter period suggests heating-related measures likely (e.g., lowering thermostat setting)
  - Measured differences in monthly electricity use were flat suggesting non-weather related measures

Difference Plot -- Therms



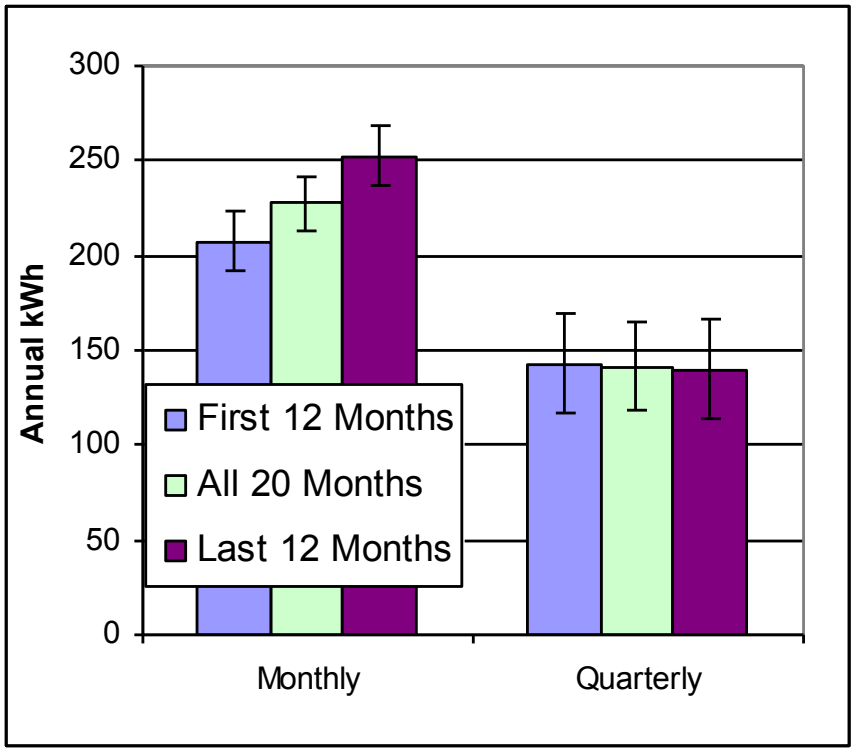
Relatively larger savings during winter months suggests adoption of more rigorous thermostat control

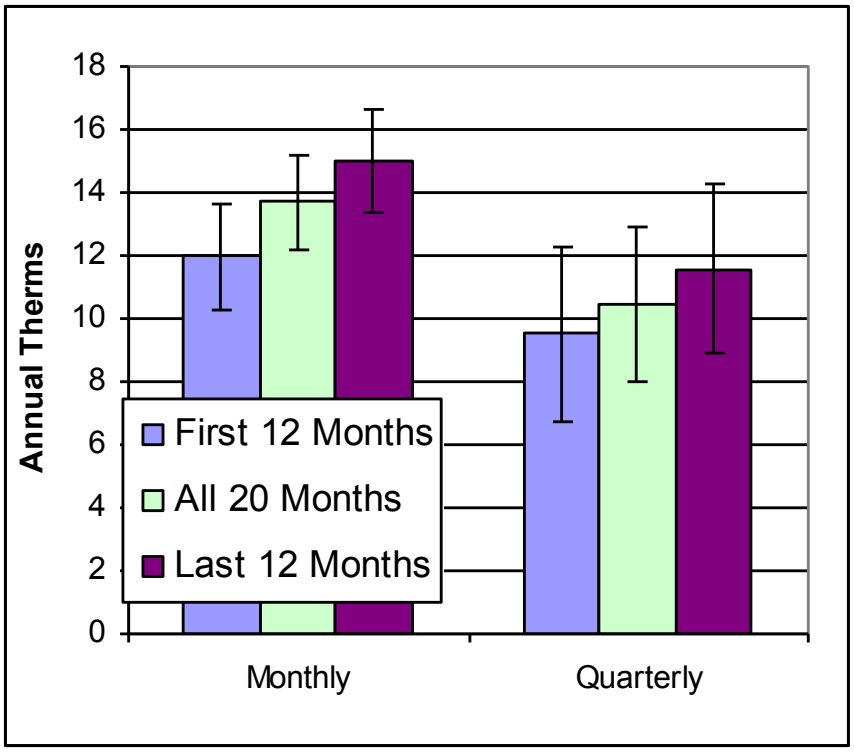
Persistence After Program Suspension – PSE Reseults

Program Year and Group	Electricity Savings		Gas Savings	
	kWh/Yr	95% CI	Therms/Yr	95% CI
Program Year One	169.7	+/- 23.9	10.7	+/- 1.7
Program Year Two	234.5	+/- 32.5	13.5	+/- 2.2
Program Year Three (Continued Treatment Group)	274.2	+/- 43.1	11.9	+/- 2.8
Program Year Three (Suspended Treatment Group)	216.4	+/- 55.6	11.9	+/- 3.6

Overall, results indicate average savings persist and in some cases continue to grow over time. Results also show savings remain positive even after reports are suspended – however, wide confidence interval suggests reduced consistency in behavior.

Differences in Savings: Monthly v. Quarterly Reports

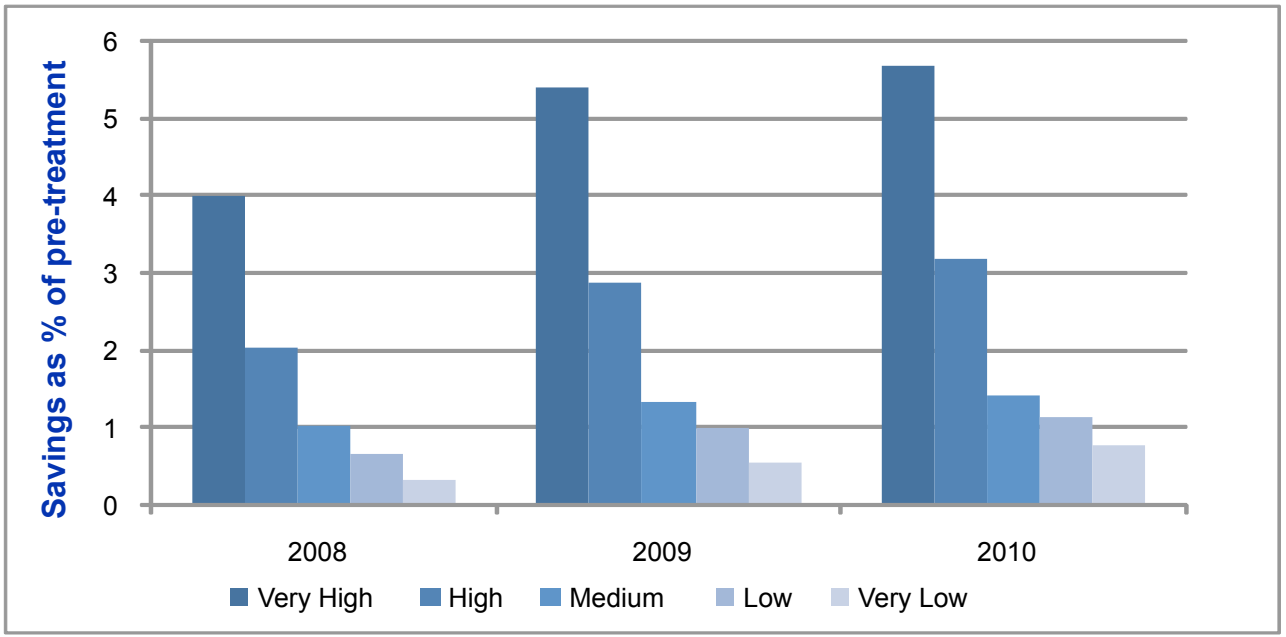




- Generally, annual savings higher for customers receiving monthly v. annual reports. Difference for gas customers not statistically significant.
- No significant differences for varying graphic treatments

Relationship of Customer Attributes to Savings Levels

- All three of the studies assessed the **relationship between customer attributes and levels of savings,** including electric end uses present; size, value, age of home, pre-treatment energy consumption.
- Only level of energy consumption during the pre-treatment period appears to be predictive of the level of energy savings post-treatment



So, to recap …

- Are there measurable savings? **Yes, averaging around 2% for electricity; 1% for gas**
- Do these savings persist if programs are suspended? **Yes – at least for 2 years, but at reduced rates if reports are suspended. Also variability increases if reports are suspended.**
- Are these savings the result of participating in other programs? **Only a very small fraction**
- Do savings increase with the frequency of reports? **Yes. Variability increases with lower frequency of reports**
- Do we know what actions are taken to save energy? **No consistent patterns**
- Are higher savings associated with specific customer attributes? **Yes, customers with higher pre-treatment consumption save more**

What's Next

- Introduction of Voluntary Participation
  - Voluntary on-line audits accessible through a Web portal.
  - Pooled cross-section time series analysis shows high savings: 5.7%
  - However, only 668 customers sign up v. tens of thousands for feedback programs
  - Need to deal with self selection
- Issues associated with scale
  - Need to maintain control groups
  - Potential increase in baseline efficiency through other diffusion channels
- Issue of identifying actions taken
  - Surveys a blunt instrument; may be best simply to extend billing analysis
  - If we're concerned primarily with persistence, do we really need to know?