

ACEEE::30

30 Years of Energizing Efficiency

Advanced Metering Initiatives and Residential Feedback Programs



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The Immediate Conclusions

- Energy efficiency has met 75 percent of the new demands for energy-related goods and services since 1970 while new energy supplies have met only 25 percent of those demands.
- But energy efficiency remains a highly invisible success story.
- Yes. . . “Science and technology can create much better choices.” (DOE Secretary Chu 2009)
- *But we won't get there unless we bring people back into the process.*
- Among the means of integrating a people-centered process of smart technology adoption are a variety of feedback mechanisms.
- The savings are bigger than generally perceived and more persistent than imagined.
- Demand response programs will not generate as much cost-effective energy savings as programs designed for year-round savings.

Creating an Energy Revolution

A revolution doesn't happen when society adopts new tools, it happens when society adopts new behaviors.

Clay Shirky, Digital Guru

The New ACEEE Feedback Study

Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities

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The Role of Advanced Meters

- Advance metering systems record customer consumption and other information on an hourly or more frequent basis and provide for daily or more frequent transmittal of measurements over a communication network to a central collection point. (FERC 2008)
- When combined with other technologies and programs, the data collected by advanced meters **provide the opportunity** to empower households to become better energy managers and reduce consumption.
- Advanced meters alone **are not sufficient** to change household energy consumption practices.
- To empower consumers, utilities must either directly or indirectly provide this information to consumers in a useful format that contextualizes the information, motivates action, and breaks down barriers.

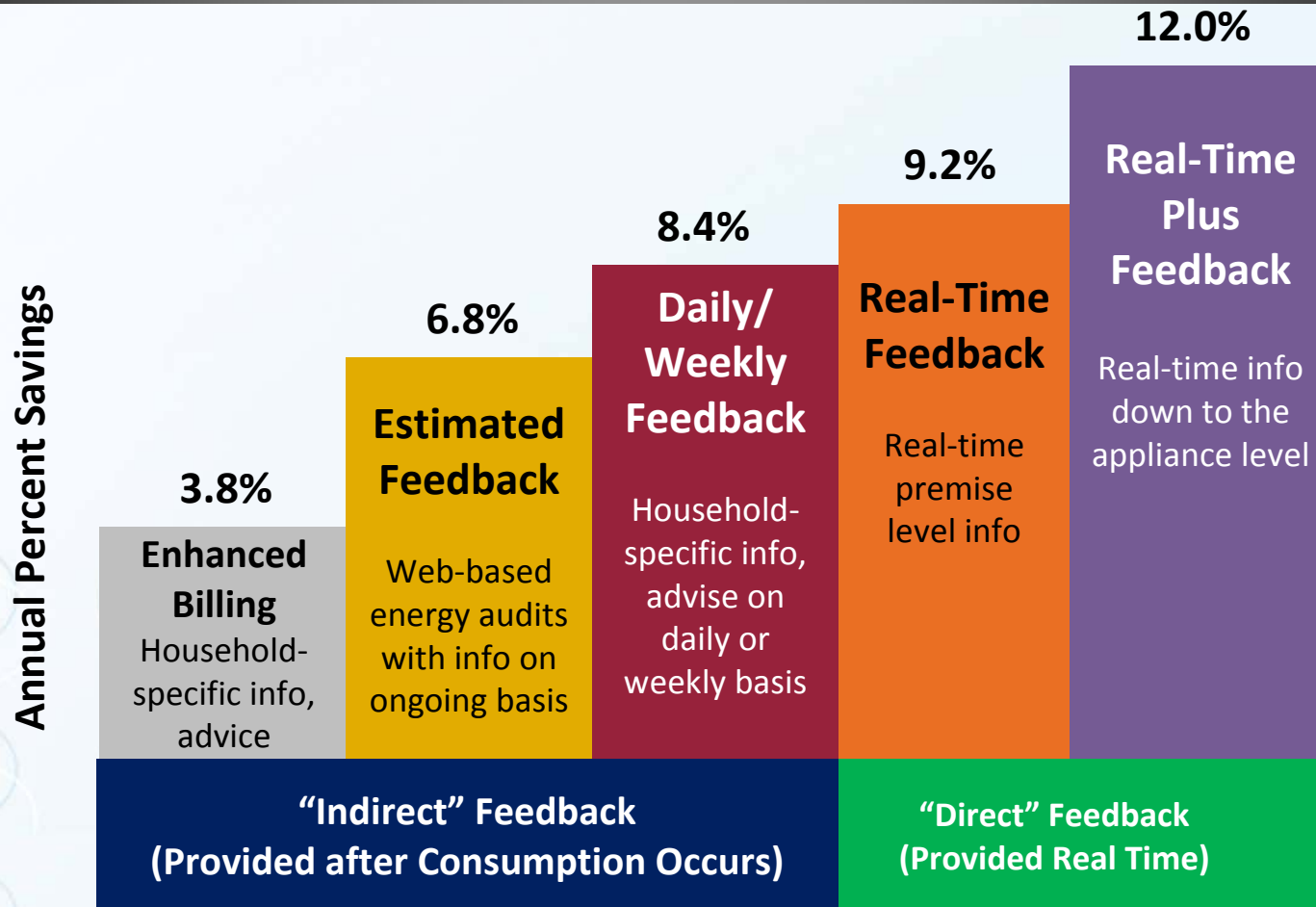
The Feedback Meta Review

An assessment of 61 primary research studies of 57 feedback initiatives:

- Several continents and 9 countries
- 21 studies 1974-1994 – What we call the “Energy Crisis Era”
- 36 studies 1995-2010 – What we call the “Climate Era”

Region	Number of Studies	Percent
United States	33	57%
Europe	13	22%
Canada	9	16%
Other	3	5%

Average Household Electricity Savings (4-12%) by Feedback Type*



Program Design and Savings

A variety of non-economic motivation strategies can effectively enhance feedback-related energy savings in households.

The Impact of Non-economic Motivational Elements

	Number of Studies	Household Energy Savings	Sources
Social Norms	14	2-10%	Alcott (2009), Ayers et al. (2009), Ehrhardt-Martinez (2009), Nolan et al. (2008), Schultz et al (2007), Wilhite et al. (1999)
Goal Setting	4	5-17%	Seligman (1978), Winett et al. (1982), Van Houwelingen (1989), Abrahamse et al. (2007)
Competitions	1	10-32%	Petersen et al. (2007)
Commitment	1	5-8%	Staats et al. (2004)

Demand Response and Savings

Feedback can be effective at:

- generating peak-load reductions and
- reducing overall levels of household energy consumption.

The focus of feedback programs influences the level of overall savings.

Program Focus	Peak Savings		Overall Energy Savings	
	Range	Average	Range	Average
Peak Demand	1.2% to 33%	12.50%	-5.5% to 8.0%	3%
Overall Conservation & Efficiency	n.a.	n.a.	1.2% to 32%	10%

Overall energy savings are much higher for programs focused on overall efficiency and conservation.

The Persistence of Feedback-Induced Savings

The evidence from 27 of the 57 studies suggests that if the feedback is persistent, then feedback-related savings are persistent over time.

Study	Country	Type of Feedback	Duration of Study (months)	Persistence of Savings
Mountain (2006)	Canada	Real Time Aggregate	13	Persistent conservation effect.
Mountain (2008)	Canada	Real Time Aggregate	24	Persistent conservation effect.
Nielsen (1993)	Denmark	Enhanced Billing	36	Persistent conservation effect.
Staats et al. (2004)	Netherlands	Enhanced Billing	36	Energy savings <i>increased</i> from 4.8% (at 8 months) to 7.6% (at 24 months).
Van Houwelingen (1989)	Netherlands	Real Time Aggregate	12	Energy conservation effect did not persist after the energy monitors were removed.
Wilhite and Ling (1995)	Norway	Enhanced Billing	36	Energy savings <i>increased</i> from 7.6% at the end of year two to 10% at the end of year three.
Wilhite et al. (1999)	Norway	Enhanced Billing	21	The longer the duration of the intervention and the more information made available to the household, the more persistent the impact.

National-Level Savings Estimates for the U.S. Residential Sector

National-level savings depend on type of feedback, program elements and level of participation, but the economics are generally favorable.

Scenario Impacts by 2030	A	B	C	D
Reference Case Electricity Demand (billion kWh)	1,637	1,637	1,637	1,637
Reference Case Electricity Customers (millions)	146	146	146	146
Participating Feedback Customers (millions)	88	6	72	75
Total Electricity Savings (billion kWh)	40	6	68	103
Savings per Participant (kWh)	458	986	942	1369
Savings per Participant (percent of reference case)	4.10%	8.80%	8.40%	12.20%
Total Electricity Savings (percent of reference case)	2.50%	0.40%	4.20%	6.30%
Total Cost (million constant 2008 dollars, 2010 -2030)	\$8,150	\$1,909	\$21,631	\$22,489
Bill Savings (million constant 2008 dollars, 2010 – 2030)	\$22,398	\$3,510	\$37,878	\$57,050
Total Resource Cost Test Ratio	2.75	1.84	1.75	2.54

Closing Thoughts

- AMI technologies provide an important opportunity.
- By themselves, however, “Smart Meters” are not smart enough to provide the full opportunity for significant electricity savings.
- Past studies suggest that feedback-related savings during the climate change era (1995-2010) are in the range of 4-12 percent.
- Greater rates of savings can be generated given the right combination of program elements and policy support.
- Given its cost-effectiveness, universal enhanced billing programs should be implemented now.

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The complete research report is entitled:

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