The Total Cost of Saved Electricity for Utility Customer-Funded Energy Efficiency Programs

Ian M. Hoffman, Gregory M. Rybka, Greg Leventis, Charles A. Goldman, Lisa C. Schwartz

Electricity Markets and Policy Group
Lawrence Berkeley National Laboratory

May 13, 2015
Overview

• Why study the cost of saving energy through efficiency programs?
• LBNL DSM Program Database and the Total Cost of Saved Electricity
• Data Issues: Total and Participant Costs
• Results
  ➢ National
  ➢ Sectoral
  ➢ Program
  ➢ State
• Summary
The cost of saved energy (CSE) has not been comprehensively documented or analyzed at the program level.

**Approach**
- Collected & analyzed reported annual EE program data in 34 states

**Objectives**
- Enable policymakers and program administrators to weigh different energy resource options
- Enable assessment of program performance and approaches across different markets, delivery mechanisms and designs
- Encourage more consistent reporting of EE program impacts and costs
Value of the Cost of Saved Energy

Load Forecasting

Weighing Cost and Performance Among Efficiency Resources

Assessing Market Dynamics and Trends

Integrated Resource Planning
Data Collection and Standardization

**LBNL DSM Program Database**
- Program Administrator (PA)
  - CSE: 100+ administrators in 34 states
    - 5,900 program years for 2009-2013
- Total Cost of Saved Energy:
  - 50+ administrators in 20 states
    - 2,100 program years for 2009-2013

**Types of Data Collected**
- Net & gross savings
- Annual incremental & lifetime savings
- Budgets & expenditures
  - Administrative costs
  - Incentive costs
  - Education, marketing & outreach
  - Evaluation
- Participant costs
- Measure lifetimes for programs
- Number of program participants

**Standardization Is Critical to Aggregating Data and Comparing Cost Performance**
- Developed a common DSM lexicon
  - Standard terms and definitions for program data and metrics
  - A national typology of programs
Diagram is for illustrative purposes only and does not depict the full program typology. See LBNL Policy Brief: Energy Efficiency Program Typology and Data Metrics: Enabling Multi-State Analyses Through the Use of Common Terminology – at http://emp.lbl.gov
Defining the Levelized Total Cost of Saved Energy

Total Cost of Saved Energy =

\[
\frac{(\text{Total Program Administrator Costs} + \text{Participant Costs (exclusive of incentives)}) \times \text{Capital Recovery Factor}}{\text{Gross Annual Energy Savings (in kWh)}}
\]

Where the Capital Recovery Factor = \[A \times (1 + A)^B] / [(1 + A)^B - 1]\]

A = Discount rate (LBNL uses 6% real as a proxy for an electric utility WACC)
B = Years of program savings, calculated as the savings-weighted life of the efficiency actions in aggregate

Critical value: Net Participant Costs (in constant 2012 dollars)

*The total cost of saved energy is not the Total Resource Cost test.*
Data and Definition Issues: Participant Costs

Two Primary Challenges

1) Program administrators define and calculate the participant portion of total costs differently
   - Some leave out all incentives
   - We fix these inconsistencies in data collection

2) More fundamentally, participant costs are derived most commonly from
   a) measure costs or b) participant invoices. Both pose difficulties.
   - Raw price data often hard to interpret and translate into generalized measures
   - Ex ante values often borrowed and rarely updated or adjusted for markets, time
Metrics used in the results

- **Focus on total costs:**
  - at national and state levels
  - by market sector (e.g., C&I, residential)
  - by program type (e.g., residential whole house programs, commercial retro-commissioning, and industrial custom programs)

- **CSE values are calculated in two ways:**
  - **Savings-weighted average total and program administrator CSE:**
    - Calculated using all savings and expenditures at the national, state and sector levels, regardless of whether
  - **Program-specific total CSE medians, weighted averages and inter-quartile ranges:**
    - Calculated for each individual program with claimed savings
Total vs. Program Administrator Cost of Saved Energy

- **Savings-weighted average** Total CSE ($0.046/kWh) was roughly twice the PA CSE ($0.023/kWh).
- **Residential programs** had the lowest savings-weighted total CSE ($0.033/kWh) followed by **C&I programs** ($0.055/kWh).

Values in this figure are based on the 2009-2013 data in the LBNL DSM Program Impacts Database. CSE values are for program administrator costs are based on gross savings. Savings are levelized at a 6% real discount rate. The savings-weighted average CSE is calculated using all savings and expenditures at the level of analysis. The inter-quartile range and median CSE values are calculated for each program type.

Source: LBNL DSM Program Database
Total Cost of Saved Energy by Sector

- Median across all sectors is $0.069/kWh
- Ranges are narrowest in the C&I sector, widest for low income

Values in this figure are based on the 2009-2013 data in the LBNL DSM Program Impacts Database. CSE values are for program administrator costs and are based on gross savings. Savings are levelized at a 6% real discount rate. The savings-weighted average CSE is calculated using all savings and expenditures at the level of analysis. The inter-quartile range and median CSE values are calculated for each program type.

Source: LBNL DSM Program Database
Residential Total CSE: Program Weighted Averages

- Low residential total CSE driven by **lighting programs** (60% of sector savings at $0.018/kWh)
- **Behavioral feedback programs** were $0.057/kWh – with 1-year lifetime for savings
- Many multi-measure programs – MF/SF retrofits and new homes – were $0.07-$0.11/kWh

Source: LBNL DSM Program Database
Residential Total CSE: Program Medians and Ranges

- Sector median is $0.07/kWh, with the average for most programs at $0.05-$0.07/kWh
- Cost performance ranges 3x-5x among residential program types
- Variability in measure mix, maturity, state of the market and program design
C&I Total CSE: Program Weighted Averages

- Average values for most C&I sector programs are $0.04-$0.06/kWh
- C&I programs garner more participant investment than residential programs, particularly in custom and prescriptive programs

Source: LBNL DSM Program Database
C&I Total CSE: Program Medians and Ranges

- Median values for most C&I sector programs close to savings-weighted averages and ranges are narrower

Source: LBNL DSM Program Database
Large variability in the relationship of program costs to participant costs from state to state

Values in this figure are based on the 2009-2013 data in the LBNL DSM Program Impacts Database. CSE values are for program administrator costs are based on gross savings. Savings are levelized at a 6% real discount rate. The savings-weighted average CSE is calculated using all savings and expenditures at the level of analysis. The inter-quartile range and median CSE values are calculated for each program type.

Source: LBNL DSM Program Database
Total CSE and Relative Savings by State

- Greater savings moves states up the efficiency supply curve
- Coverage is percent of IOU retail sales in each state

Sources: LBNL DSM Program Database & Energy Information Agency Form 861; MA Energy Efficiency Advisory Council
Factors That May Influence Total CSE

CSE may vary across program administrator portfolios for reasons other than programmatic efficiency.

- **Lower CSE**
  - Focus on low hanging fruit
  - Longer Assumed Program Lifetimes
  - Solely incremental measure costs

- **Higher CSE**
  - High labor costs
  - Comprehensive programs
  - All Cost-Effective EE
  - Lower Assumed Program Lifetimes
Summary

• U.S. savings-weighted average total cost of saving energy: $0.046/kWh. Median: $0.069/kWh

• Residential programs had lowest total CSE, influenced strongly by lighting rebate programs

• Commercial & industrial programs on average drew greater participant investment

• Many factors influence total CSE and relative administrator vs. participant cost contribution

• Improved estimation and reporting of total costs help satisfy regulatory needs and instill market confidence in the efficiency resource
Forthcoming Work

• **DSM Reporting:** A summary of the state of DSM reporting nationally with one or more reporting templates suggested for addressing multiple regulatory needs (utility and air).

• **Influences and Trends Analyses for the Cost of Saved Energy:** An investigation of the likely policy, program and market influences over the cost of saving energy, as well as trends in cost performance over time for different programs and utilities at different stages in resource acquisition.
Thank You

Project Contacts

• Principal Investigators
  – Chuck Goldman cagoldman@lbl.gov
  – Lisa Schwartz lcschwartz@lbl.gov

• Senior Project Team
  – Ian Hoffman, project leader, ihoffman@lbl.gov
  – Gregory Rybka grybka@lbl.gov
  – Greg Leventis gleventis@lbl.gov

• Sponsors: DOE Office of Electricity Delivery and Energy Reliability, National Electricity Delivery Division, and DOE Office of Energy Policy and Systems Analysis