



Environmental Energy Technologies Division Lawrence Berkeley National Laboratory

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

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- 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

# LBNL Cost of Saved Energy Project



The cost of saved energy (CSE) has not been comprehensively documented or analyzed at the program level

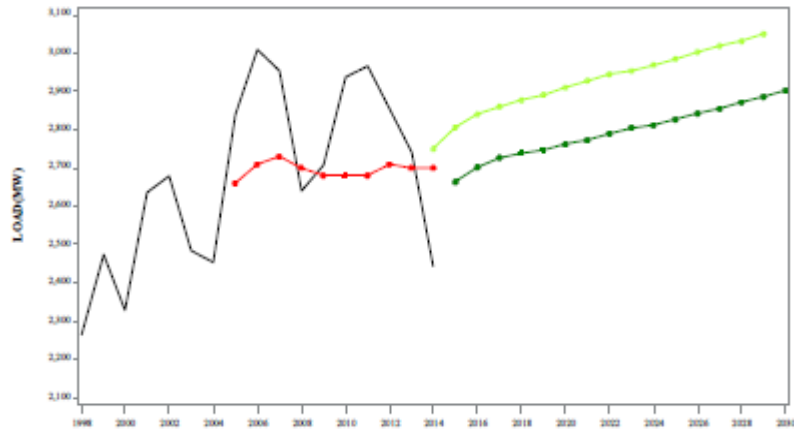
## *Approach*

- 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

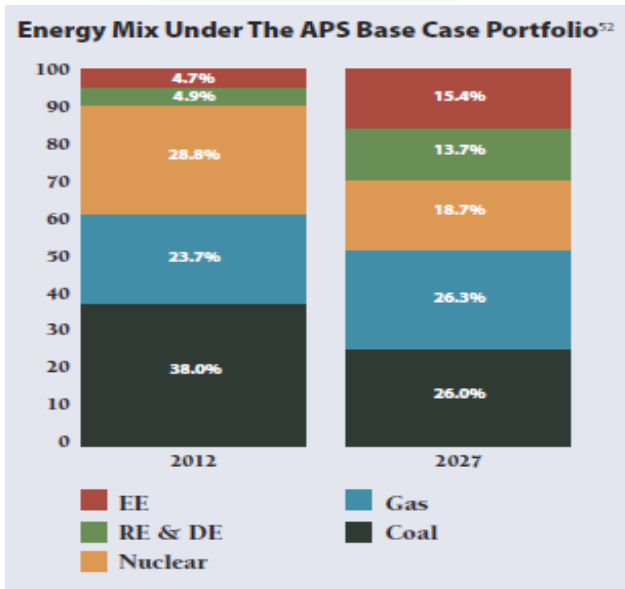
# Value of the Cost of Saved Energy



Load Forecasting



Weighing Cost and Performance Among Efficiency Resources



Integrated Resource Planning



Assessing Market Dynamics and Trends

## 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

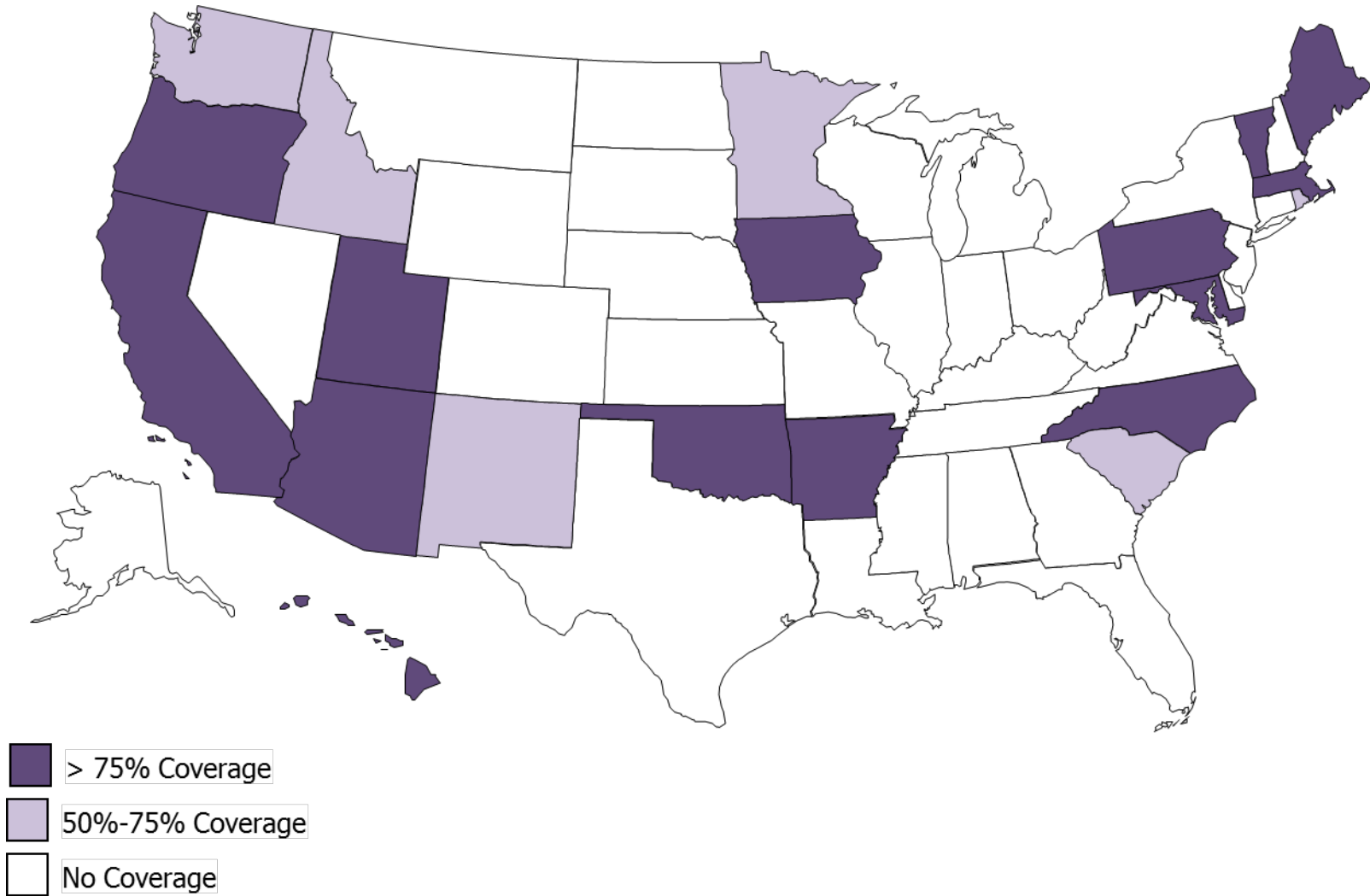
## Types of Data Collected

- **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**

# Data Coverage in States with Available Total Costs



# LBNL Efficiency Program Typology

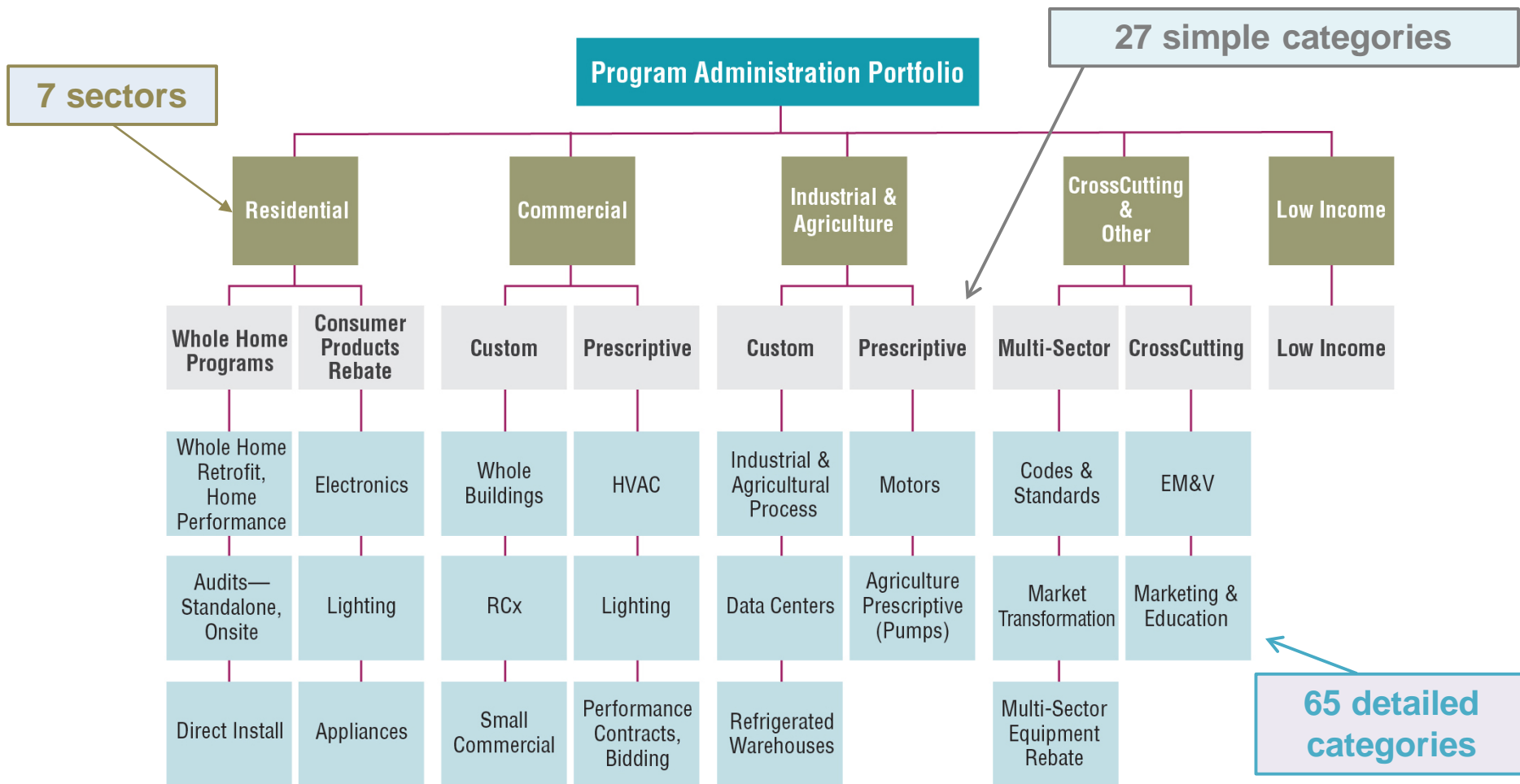
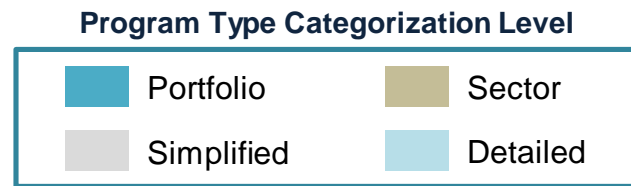


Diagram is for illustrative purposes only and does not depict the full program typology. See LBNL Policy Brief: Energy Efficiency Program Typology and Data Metrics: Enabling Multi-State Analyses Through the Use of Common Terminology – at <http://emp.lbl.gov>



*Total Cost of Saved Energy*<sup>\*</sup> =

$$\frac{\left( \text{Total Program Administrator Costs} + \text{Participant Costs (exclusive of incentives)} \right) * \text{Capital Recovery Factor}}{\text{Gross Annual Energy Savings (in kWh)}}$$

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

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

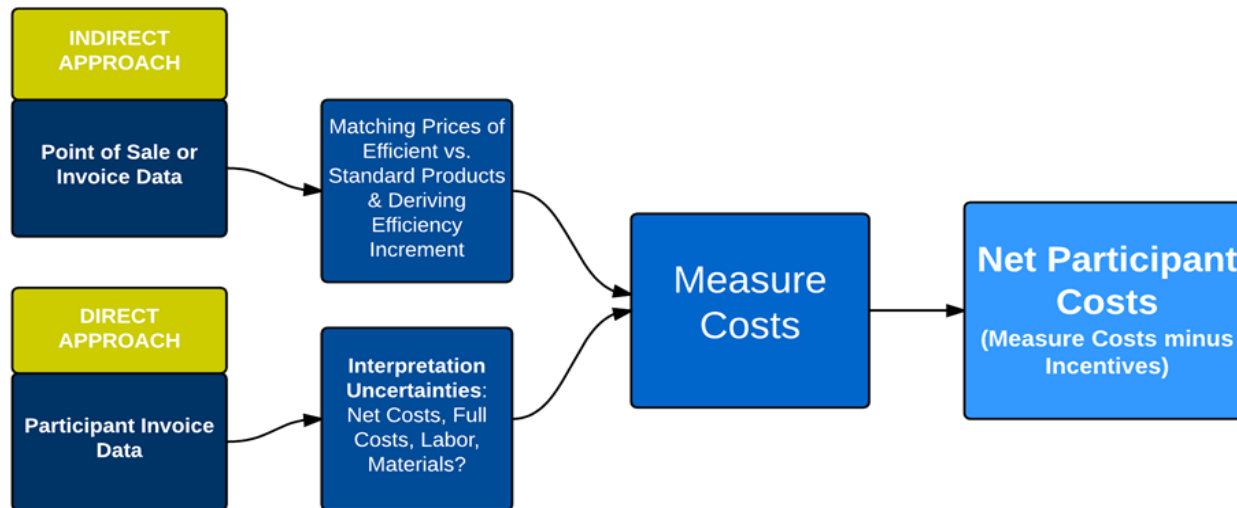
**Critical value: Net Participant Costs** (in constant 2012 dollars)

<sup>\*</sup> *The total cost of saved energy is not the Total Resource Cost test.*



## Two Primary Challenges

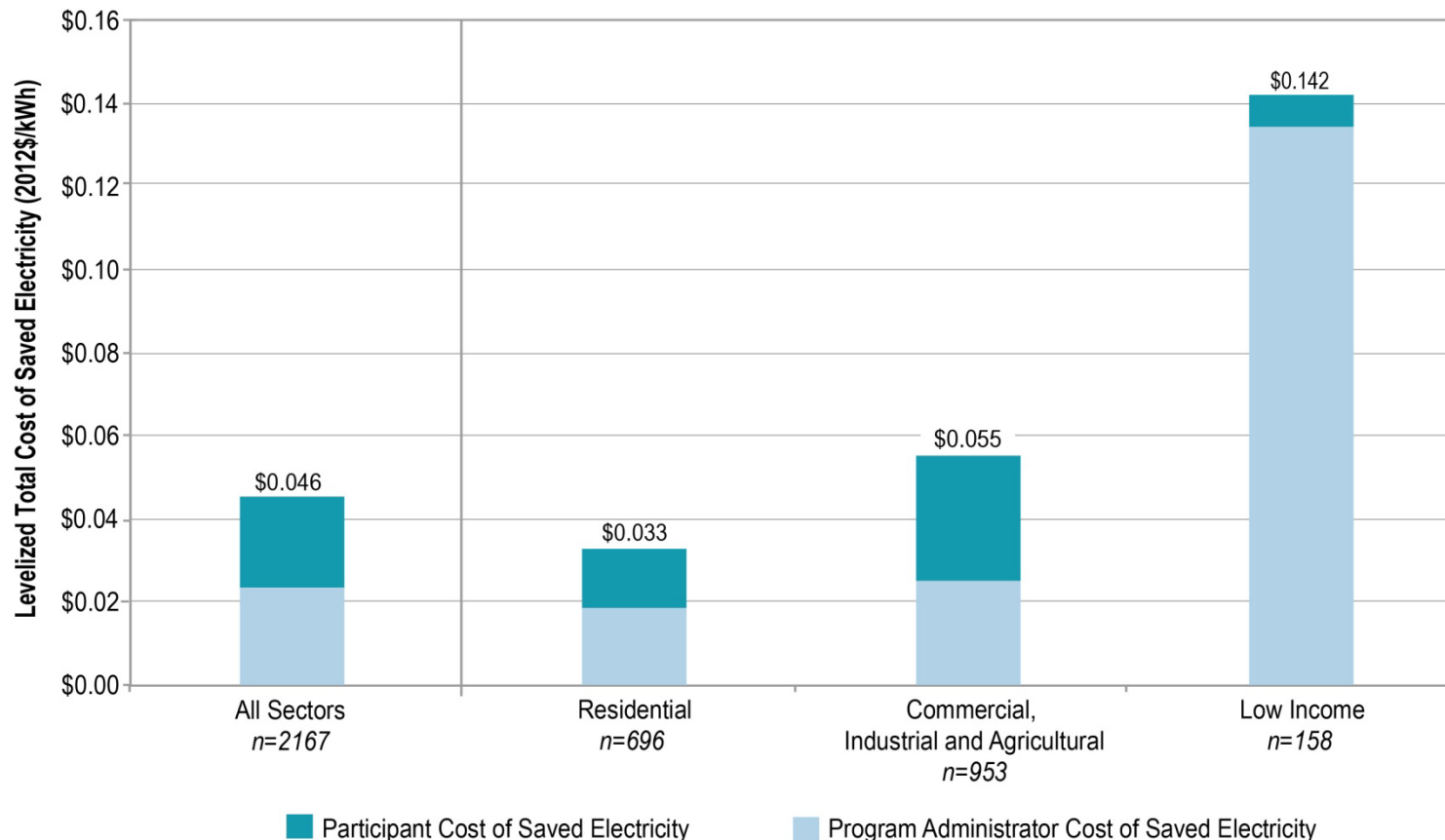
- 1) Program administrators define and calculate the participant portion of total costs differently
  - Some leave out all incentives
- We fix these inconsistencies in data collection
- 2) More fundamentally, participant costs are derived most commonly from
  - a) measure costs or b) participant invoices. 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**



- 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

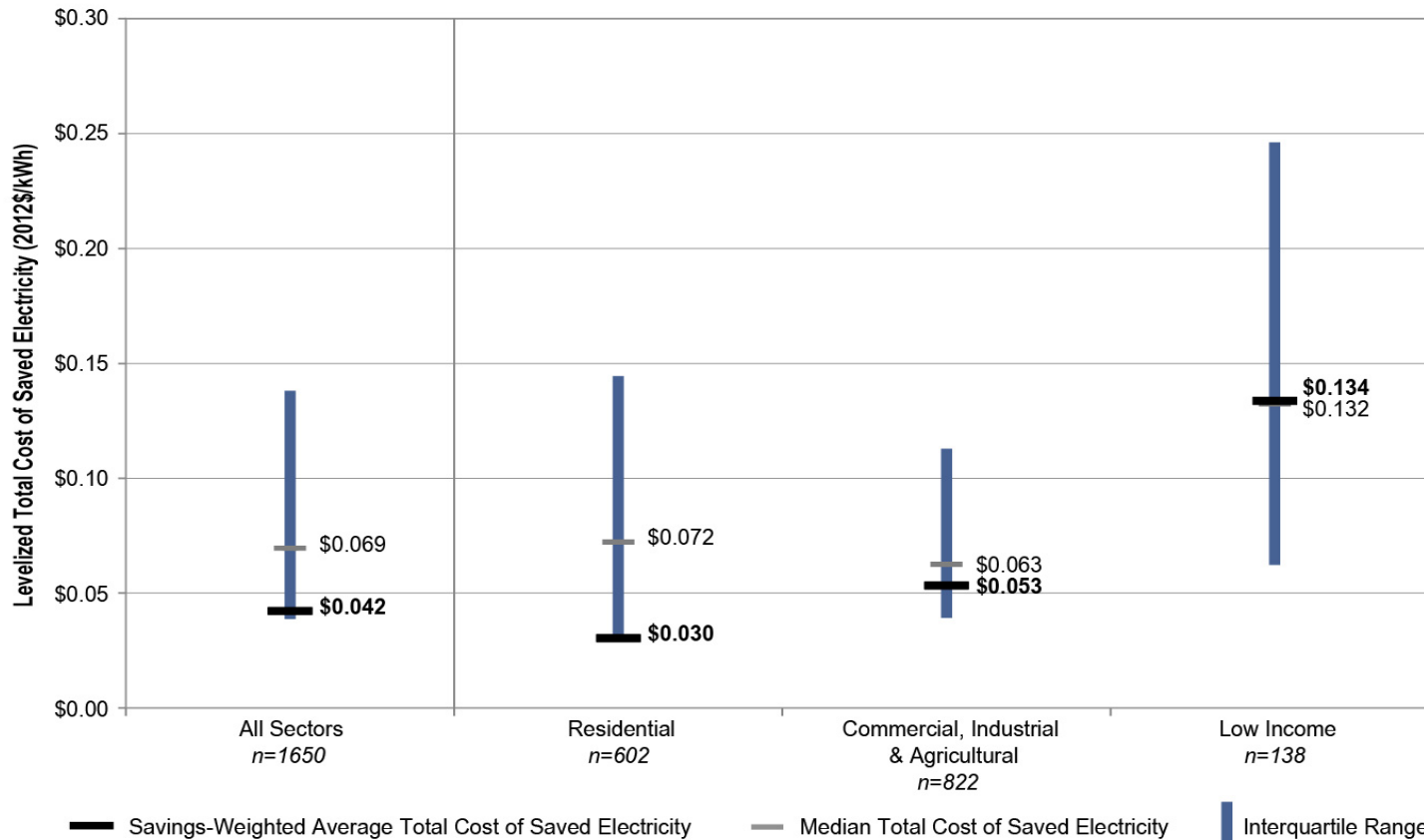
- Savings-weighted average **Total CSE (\$0.046/kWh)** was roughly twice the **PA CSE (\$0.023/kWh)**
- **Residential programs** had the lowest savings-weighted total CSE (**\$0.033/kWh**) followed by **C&I programs (\$0.055/kWh)**



Source: LBNL DSM Program Database

# Total Cost of Saved Energy by Sector

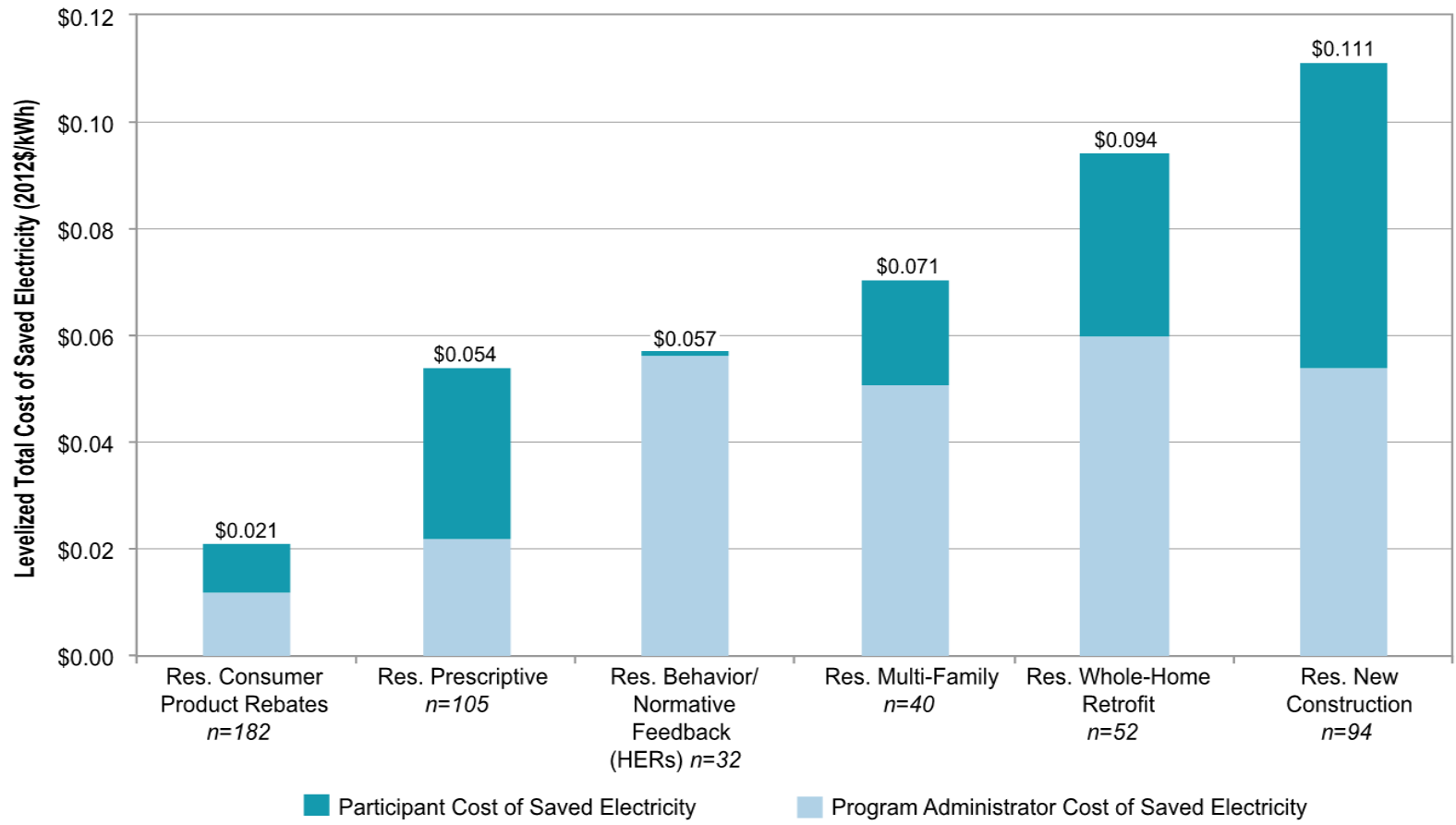
- Median across all sectors is **\$0.069/kWh**
- Ranges are narrowest in the C&I sector, widest for low income



Source: LBNL DSM Program Database

# Residential Total CSE: Program Weighted Averages

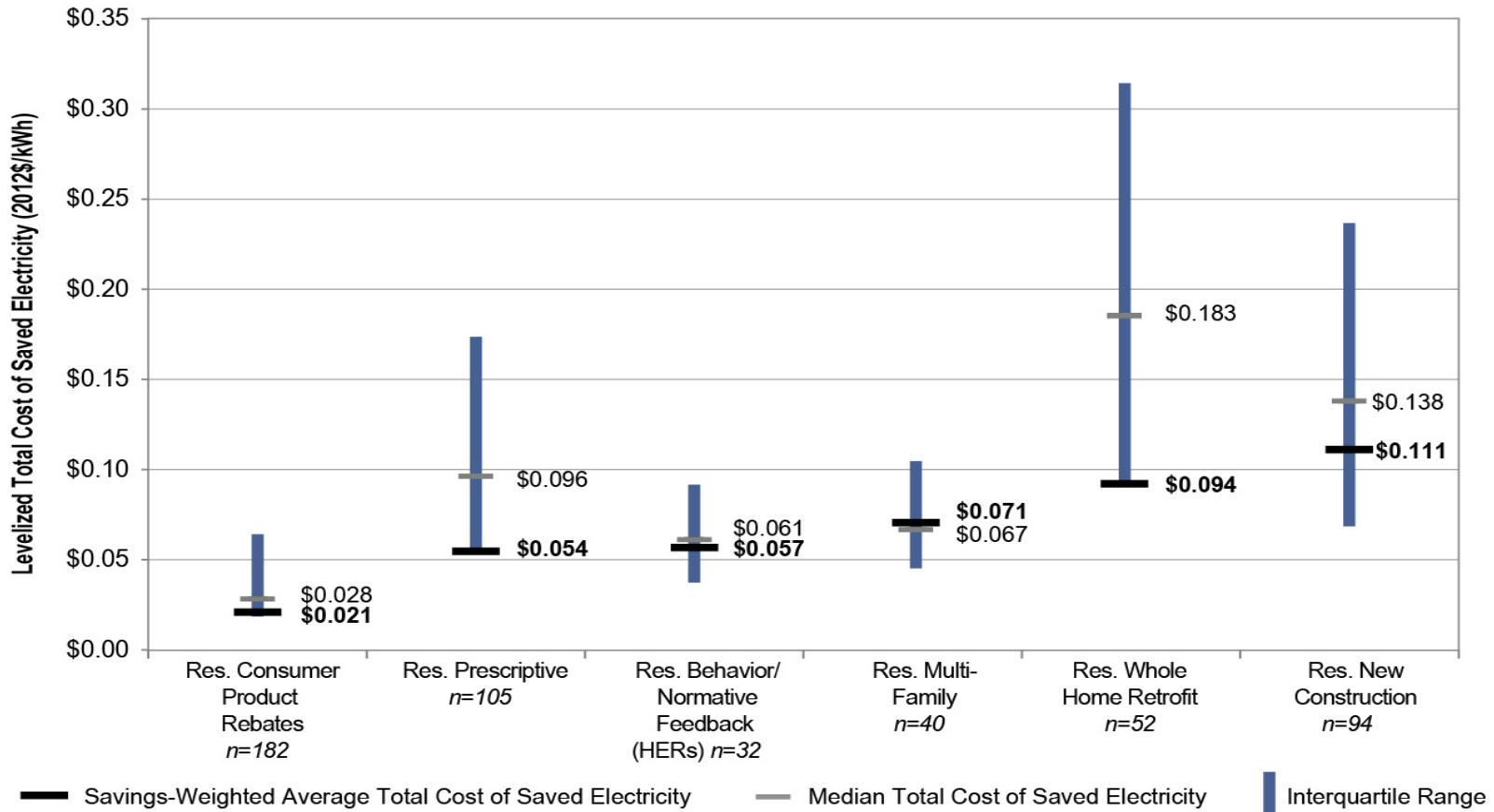
- Low residential total CSE driven by **lighting programs** (60% of sector savings at **\$0.018/kWh**)
- **Behavioral feedback programs** were **\$0.057/kWh** – with 1-year lifetime for savings
- Many multi-measure programs – **MF/SF retrofits and new homes**– were **\$0.07-\$0.11/kWh**



Source: LBNL DSM Program Database

# Residential Total CSE: Program Medians and Ranges

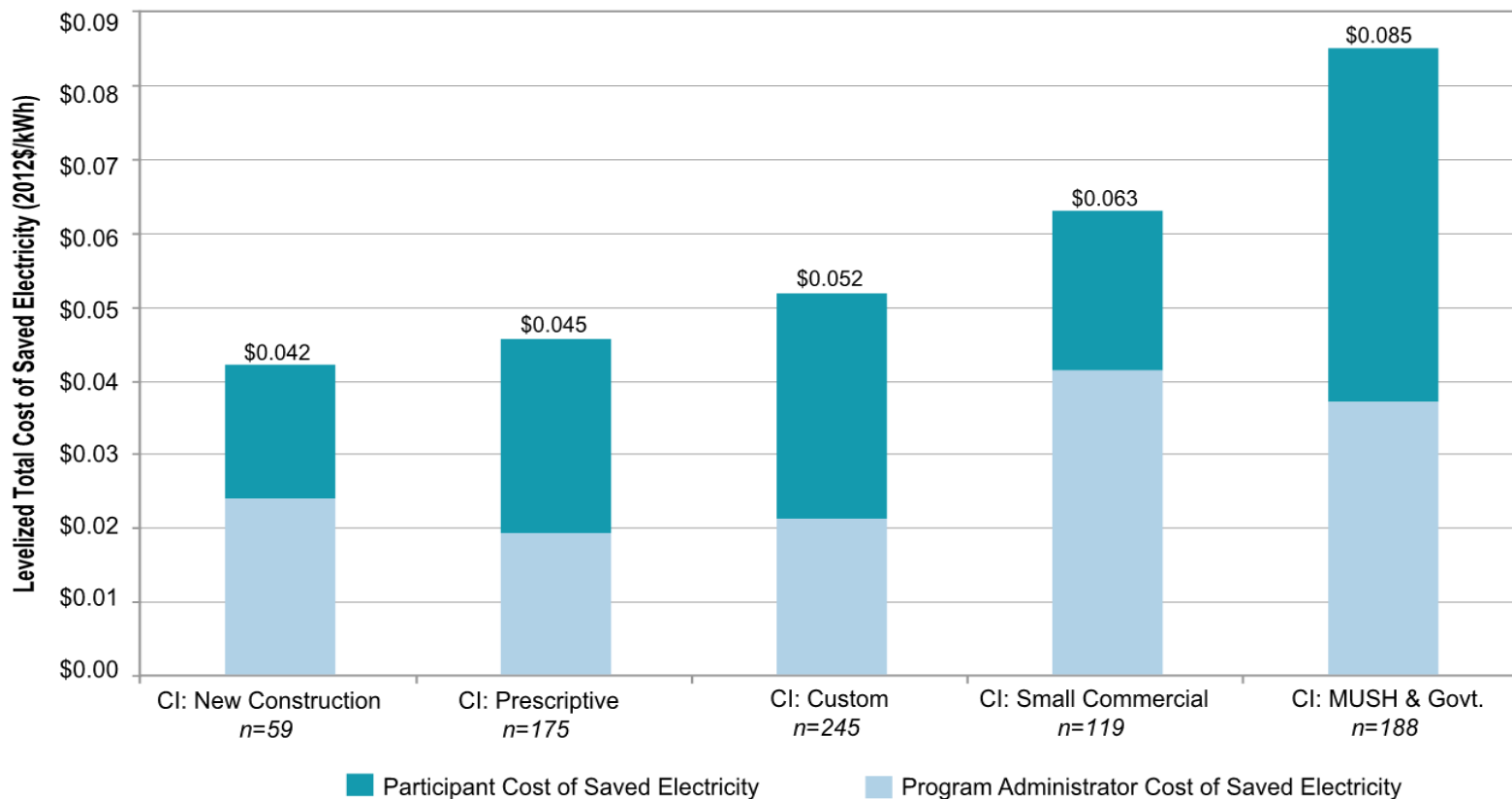
- Sector median is \$0.07/kWh, with the average for most programs at \$0.05-\$0.07/kWh
- Cost performance ranges 3x-5x among residential program types
- Variability in measure mix, maturity, state of the market and program design



Source: LBNL DSM Program Database

# C&I Total CSE: Program Weighted Averages

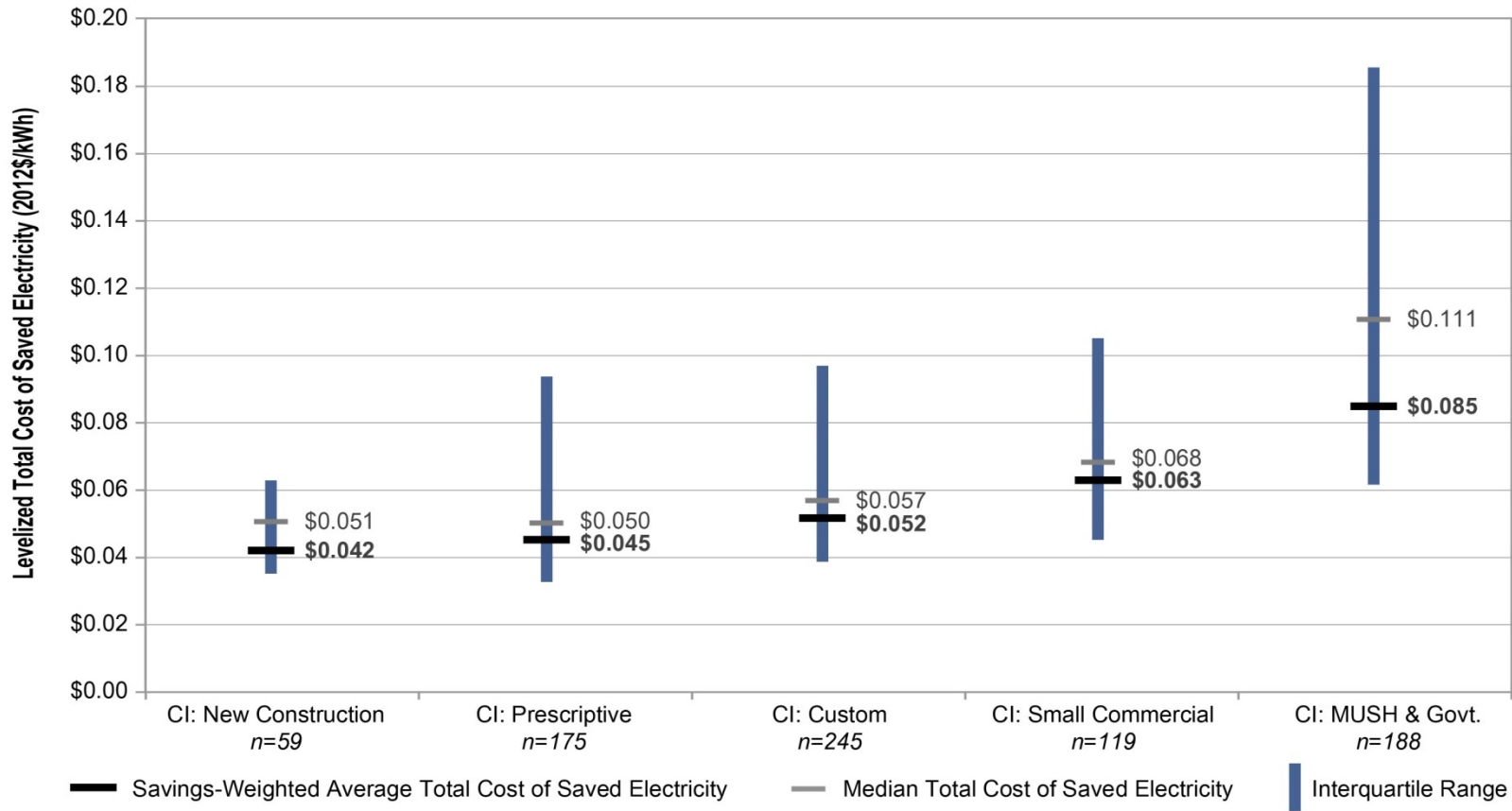
- Average values for **most C&I sector programs** are **\$0.04-\$0.06/kWh**
- C&I programs garner **more participant investment** than residential programs, particularly in **custom and prescriptive programs**



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

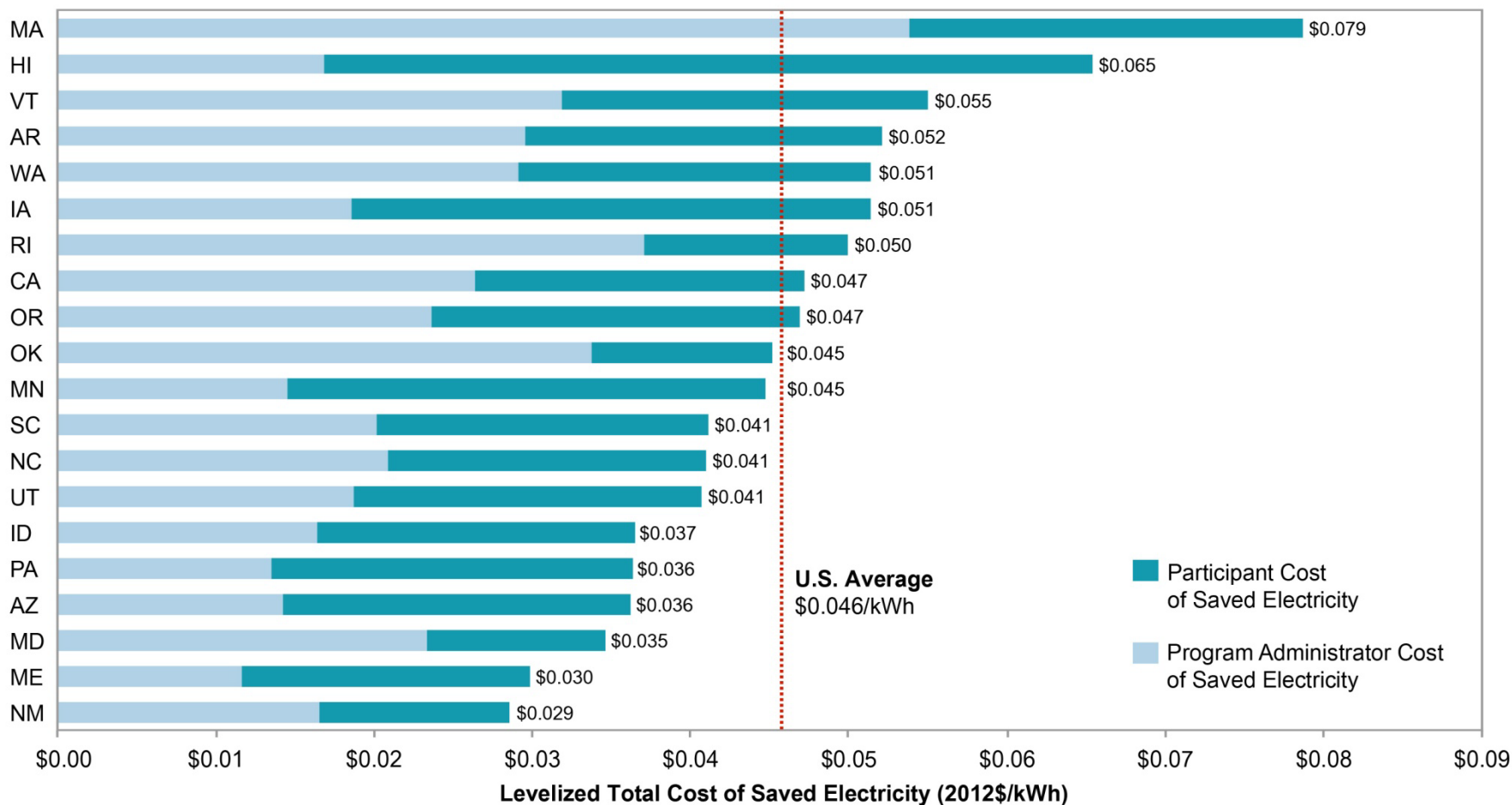


Source: LBNL DSM Program Database



# Total CSE by State

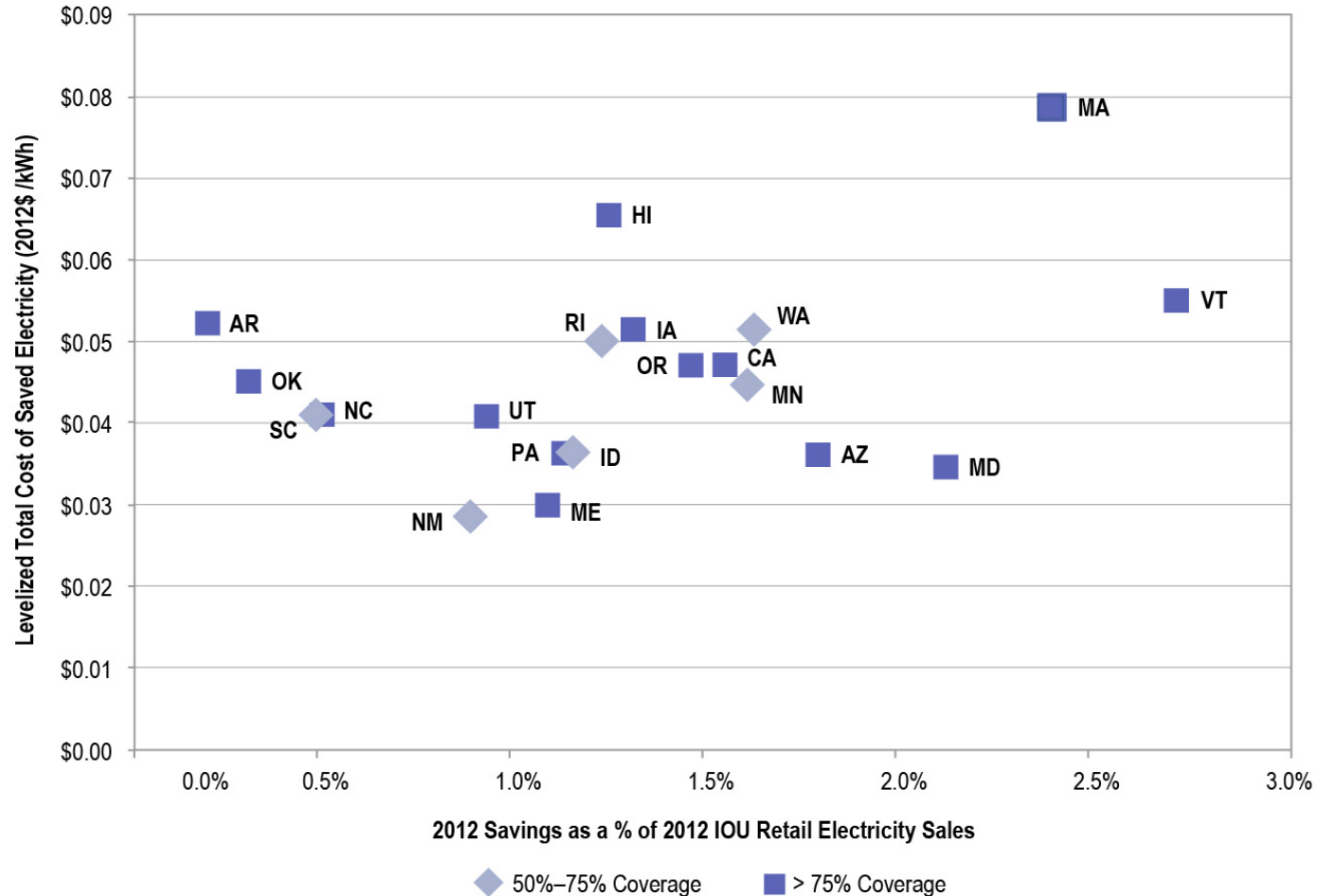
Large variability in the relationship of program costs to participant costs from state to state



Source: LBNL DSM Program Database

# Total CSE and Relative Savings by State

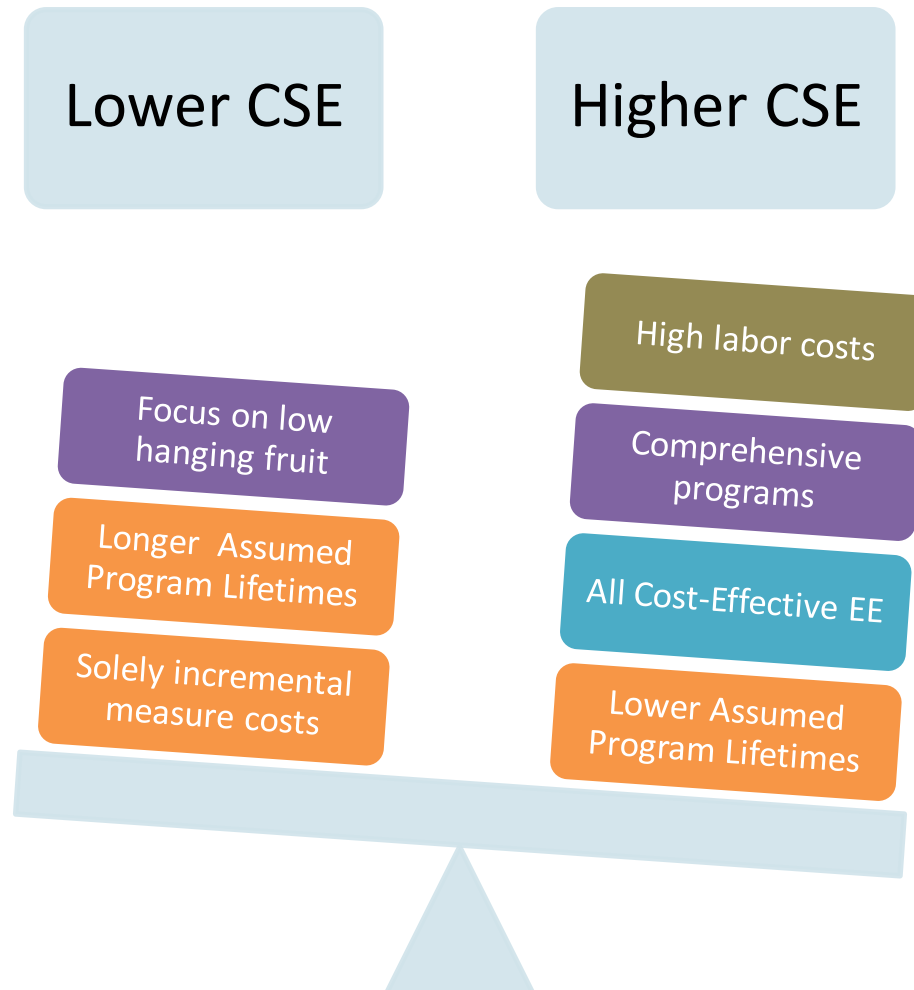
- Greater savings moves states up the efficiency supply curve
- Coverage is percent of IOU retail sales in each state



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



- 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

- **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.

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