Still the One: Efficiency Remains a Cost-Effective Electricity Resource

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Berkeley Lab

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Agenda

- **Introduction**
- **Why the cost of saving electricity matters**
- **Berkeley Lab's cost of saving energy project**
- **Program administrator cost of saving electricity analysis results**
  - National, regional, market sector
  - Composite cost curve for energy savings from electric efficiency programs
  - Time trend analysis of program administrator cost of saving electricity
- **Program administrator cost of saving peak demand analysis results**
  - National, regional, market sector
  - Composite cost curve for energy savings from electric efficiency programs
  - Time trend analysis of the program administrator cost of saving peak demand
- **Key findings**
- **Moderated Q&A**

Webinar housekeeping items

- We're recording the webinar and will post it on our web site.
- Because of the large number of participants, everyone is in listen mode only.
- Please use the chat box to send us your questions and comments any time during the webinar.
- Moderated Q&A will follow our presentation. Report authors will respond to questions submitted through the chat box.
- The webinar slides are posted at https://emp.lbl.gov/publications/still-one-efficiency-remains-cost

Today's speakers

Sean Murphy

Cesca Miller

Margaret Pigman

Natalie Mims Frick

Why the Cost of Saving Electricity and Cost of Saving Peak Demand matter

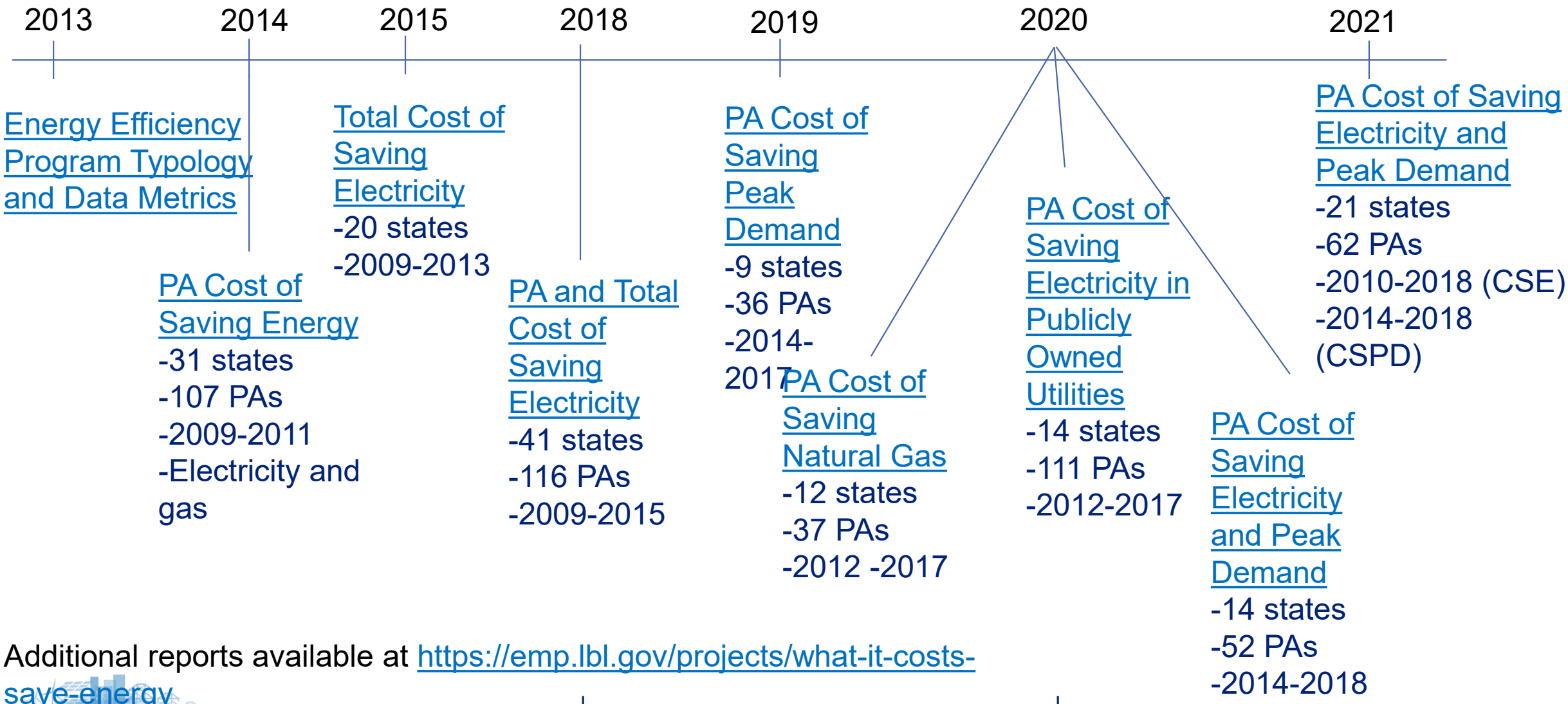
Program Administrator (PA) Cost of Saving Electricity (CSE) is expressed in dollars per kilowatt-hour ($/kWh)

PA Cost of Saving Peak Demand (CSPD) is expressed in dollars per kilowatt ($/kW)

The PA CSE and CSPD are **each** calculated based on the costs incurred by program administrators for individual programs. This means the results cannot be combined because it would double the program cost. Each metric must be considered separately.

- To help ensure electricity system reliability at the most affordable cost as part of resource adequacy planning and implementation activities
- To benchmark utility's program results with regional and national estimates
- For initial screening of electricity resource alternatives for meeting future demand
- To assess how program cost performance may change over time with funding levels and participation

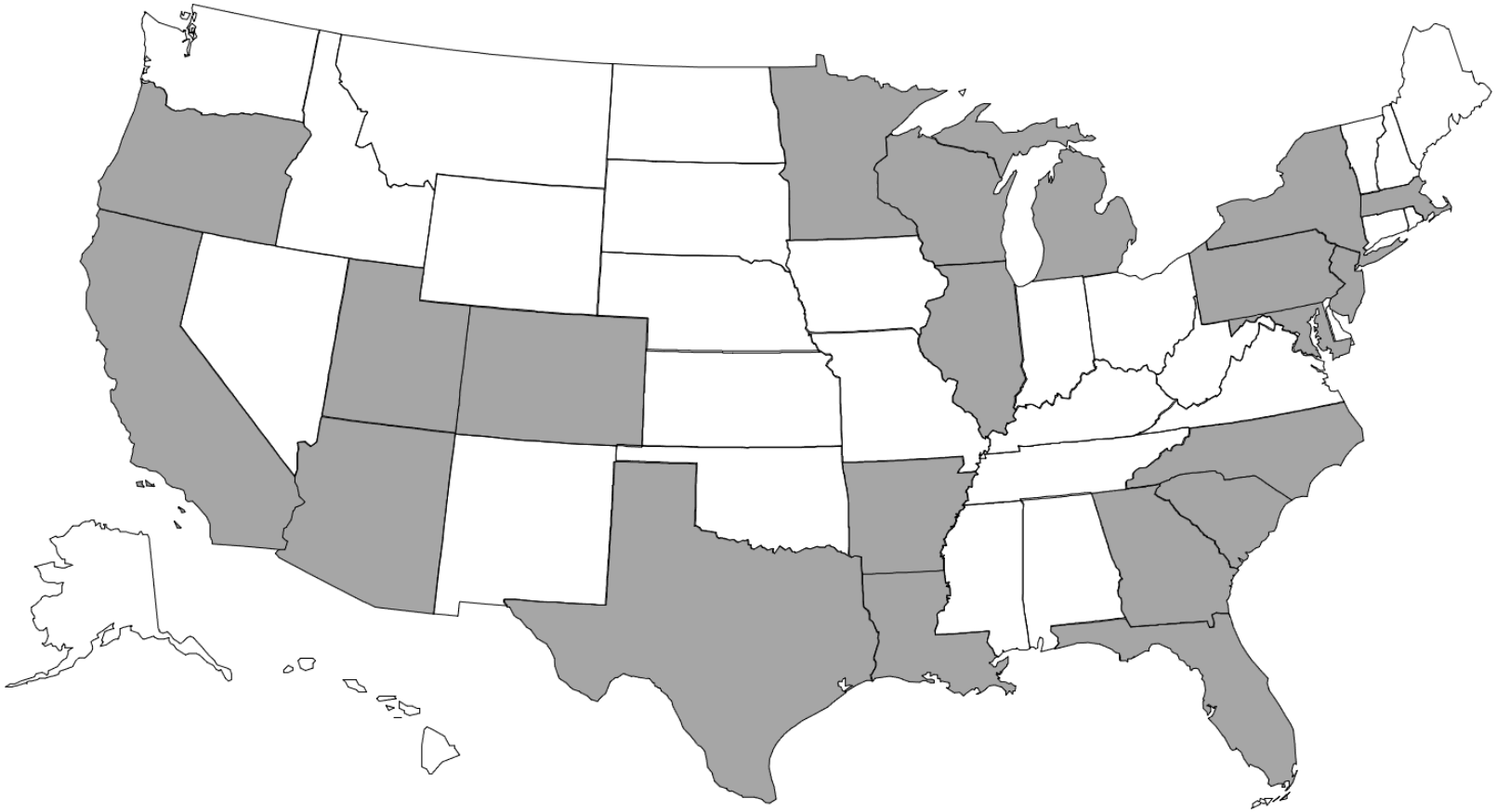
Select research from Berkeley Lab on the Cost of Saving Energy and Cost of Saving Peak Demand



Additional reports available at https://emp.lbl.gov/projects/what-it-costs-save-energy

Updated Cost of Saving Electricity and Cost of Saving Peak Demand analysis

- In 2018, data collection represents:
  - 67 program administrators in 21 states
  - 92% of reported efficiency spending
  - 84% of reported demand reductions
  - 90% of reported efficiency savings
- Cost of Saving Electricity
  - Analysis period 2010-2018
- Cost of Saving Peak Demand
  - Analysis period 2014-2018



Cost of Saving Electricity Analysis

Analysis approach

- Program administrator cost of saved electricity (PA CSE)
  - Levelized: amortizes costs over a program's lifetime, discounts to year of investment
- Calculated at program-level and in aggregate
  - e.g. sector-level PA CSE is calculated for all programs in a sector, not an average of individual programs

Program Administrator Cost of Saving Electricity =

$$\frac{\text{Capital Recovery Factor} * (\text{Program Administrator Costs})}{\text{Annual Electricity Savings (kWh)}}$$

where the Capital Recovery Factor (CRF) is:

$$CRF = \frac{r(1+r)^N}{(1+r)^N - 1}.$$

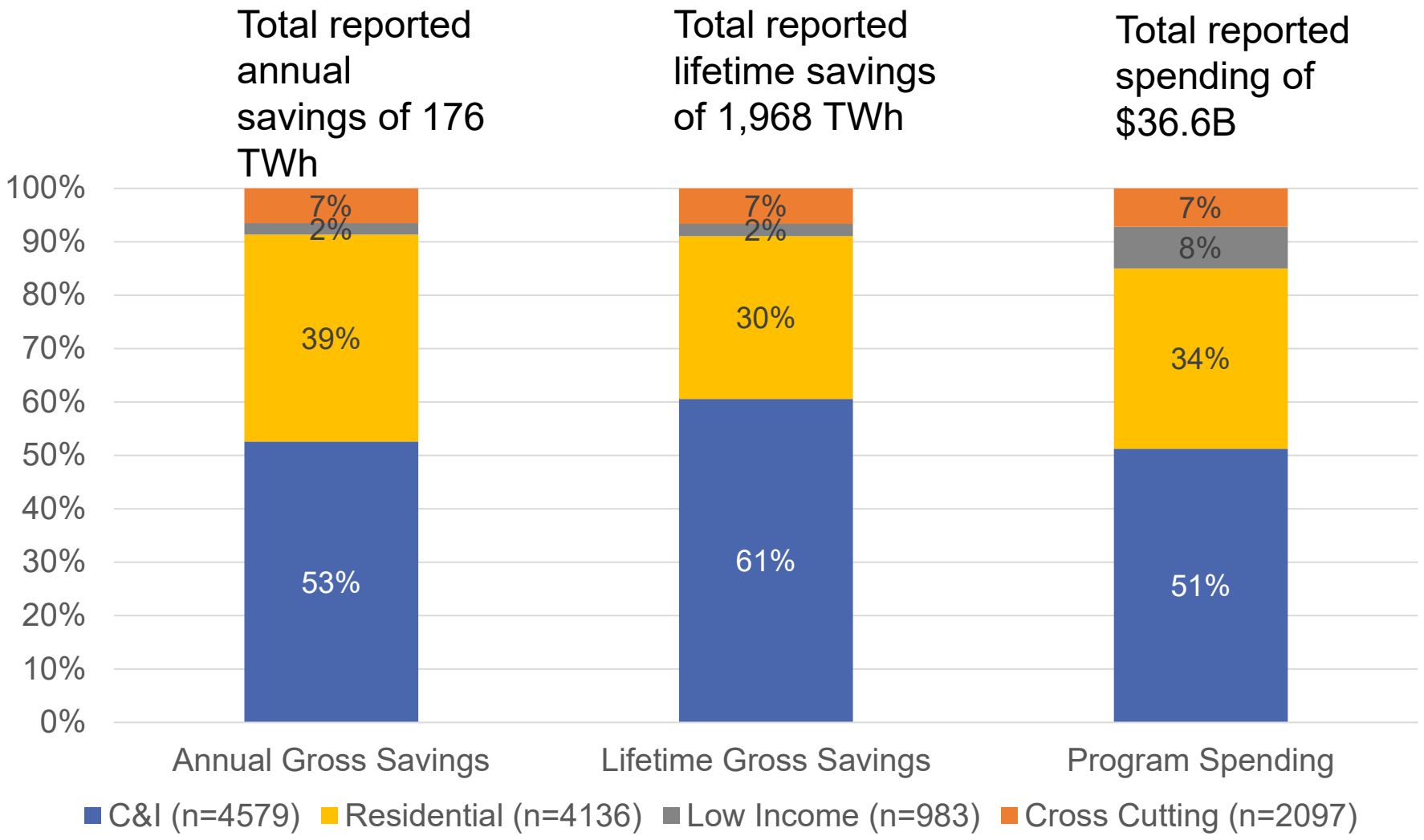
and

r = the discount rate
N = estimated program lifetime in years and calculated as the savings-weighted lifetime of measures or actions installed by participating customers in a program

Data collection: reported spending and savings by market sector for 118 program administrators (2010-2018)

C&I accounts for half of annual savings and spending.

Low income programs accounts for larger share of spending (8%) than annual savings (2%).



Program administrator Cost of Saving Electricity by market sector and region

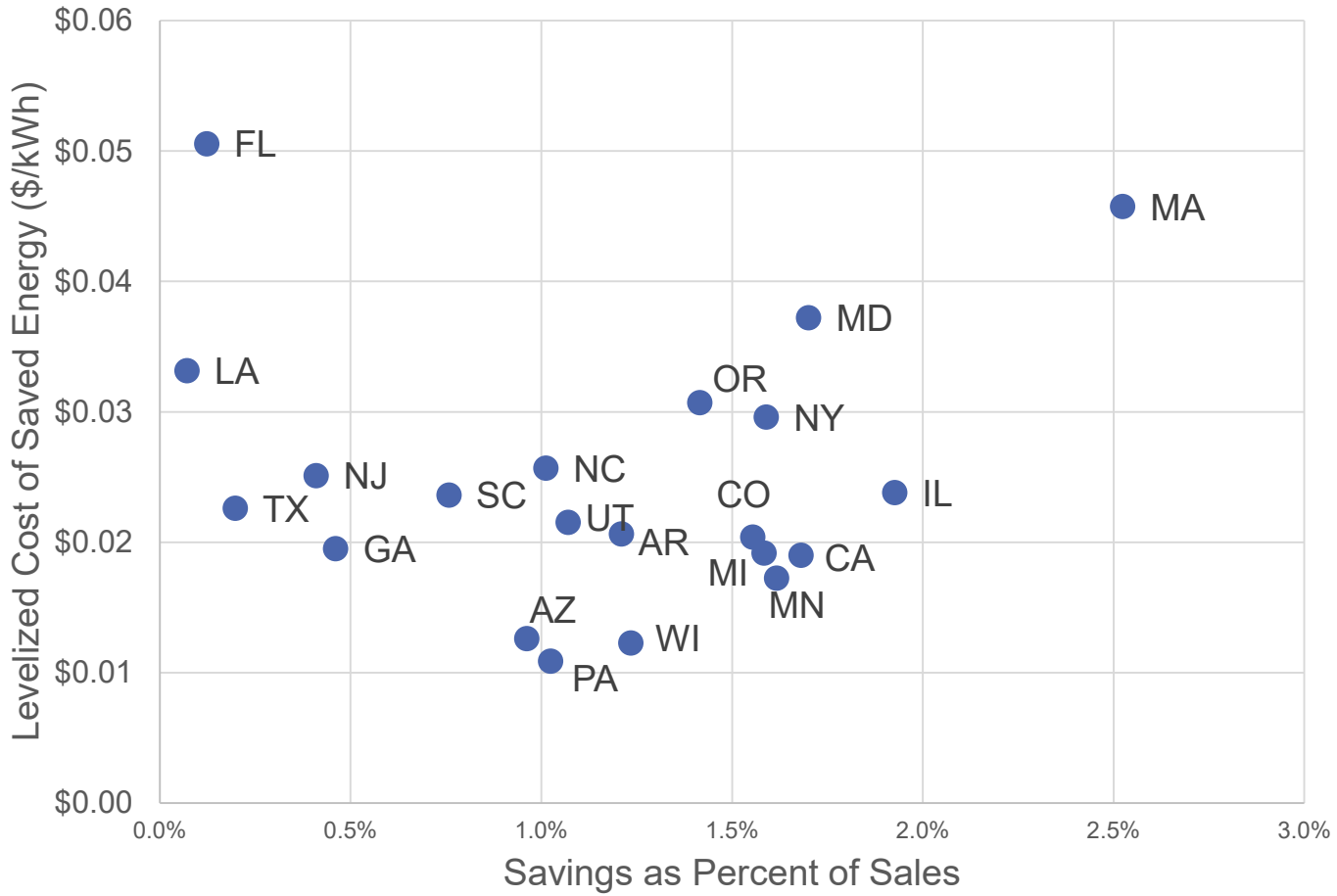
- The savings-weighted average PA cost of saving electricity across all programs was 2.6¢/kWh during the study period.
- The levelized CSE for 2018 programs was 2.4¢/kWh.
- Average cost of programs over the 2010-2018 study period by market sector:
  - C&I - 2.0¢/kWh
  - Low Income - 9.1¢/kWh
  - Residential - 2.7¢/kWh

		2010 - 2018		2018 Results	
		Levelized CSE ($/kWh)	Sample Size (Number of Programs)	Levelized CSE ($/kWh)	Sample Size (Number of Programs)
Total		0.026	11,796	0.024	1,255
Sector	**Residential**	0.027	4,137	0.029	410
	C&I	0.023	4,579	0.020	502
	Low Income	0.091	983	0.102	94
Region	**Midwest**	0.017	2,357	0.020	231
	Northeast	0.031	2,871	0.027	292
	South	0.030	3,098	0.028	375
	West	0.027	3,469	0.020	357

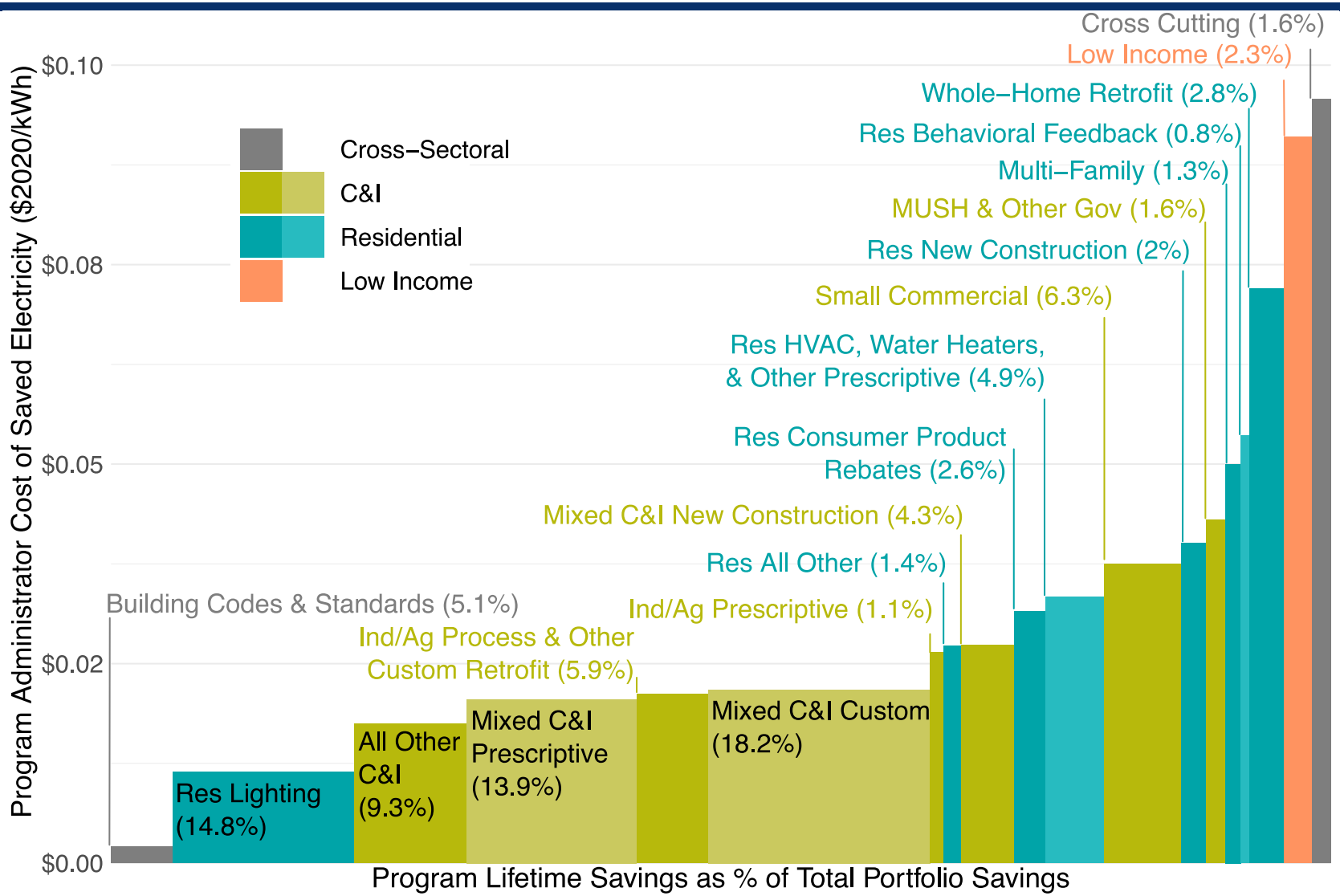
Program administrator Cost of Saving Electricity as a percent of retail sales in 2018

- Investor-owned utilities (IOUs) and other PAs in 14 of the 21 states studied reported saving ≥1% of their retail sales in 2018.
- IOUs and other PAs in 8 states reported saving >1.5% of their retail sales in 2018.
- High levels of savings were achieved without significant increases in the cost of saving electricity.
- Relationship between cost of saved energy and scale of programs differs by region.

2018 Cost of Saving Electricity as a percent of IOU retail sales in 2018



Composite cost curve for energy savings from electric efficiency programs (2010-2018)



Cost of Saving Electricity Time Trend Analysis

Cost of Saving Electricity time trend analysis approach

- Calculated the Program Administrator Cost of Saving Electricity for each program in each year over nine years
  - Levelized: amortizes costs over a program's lifetime, discounts to year of investment
- Only consider PAs that have data from all years of a defined period
  - Offerings change, so the number and types of programs from each PA may vary from year to year
  - Used for assessing time trends
- Analysis covers 2010-2018

Program Administrator Cost of Saving Electricity =

$$\frac{\text{Capital Recovery Factor} * (\text{Program Administrator Costs})}{\text{Annual Electricity Savings (kWh)}}$$

where the Capital Recovery Factor (CRF) is:

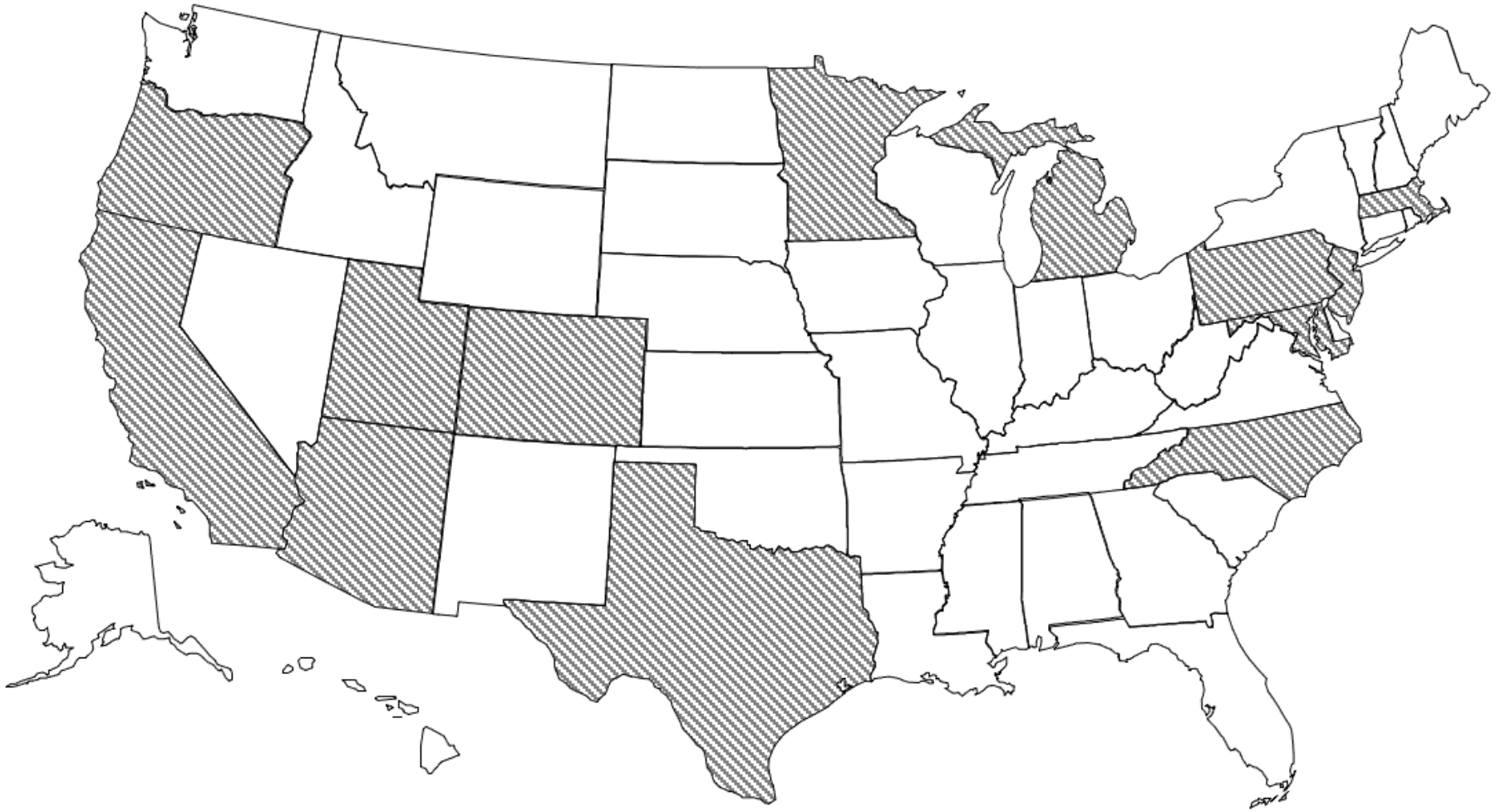
$$CRF = \frac{r(1+r)^N}{(1+r)^N - 1}.$$

and

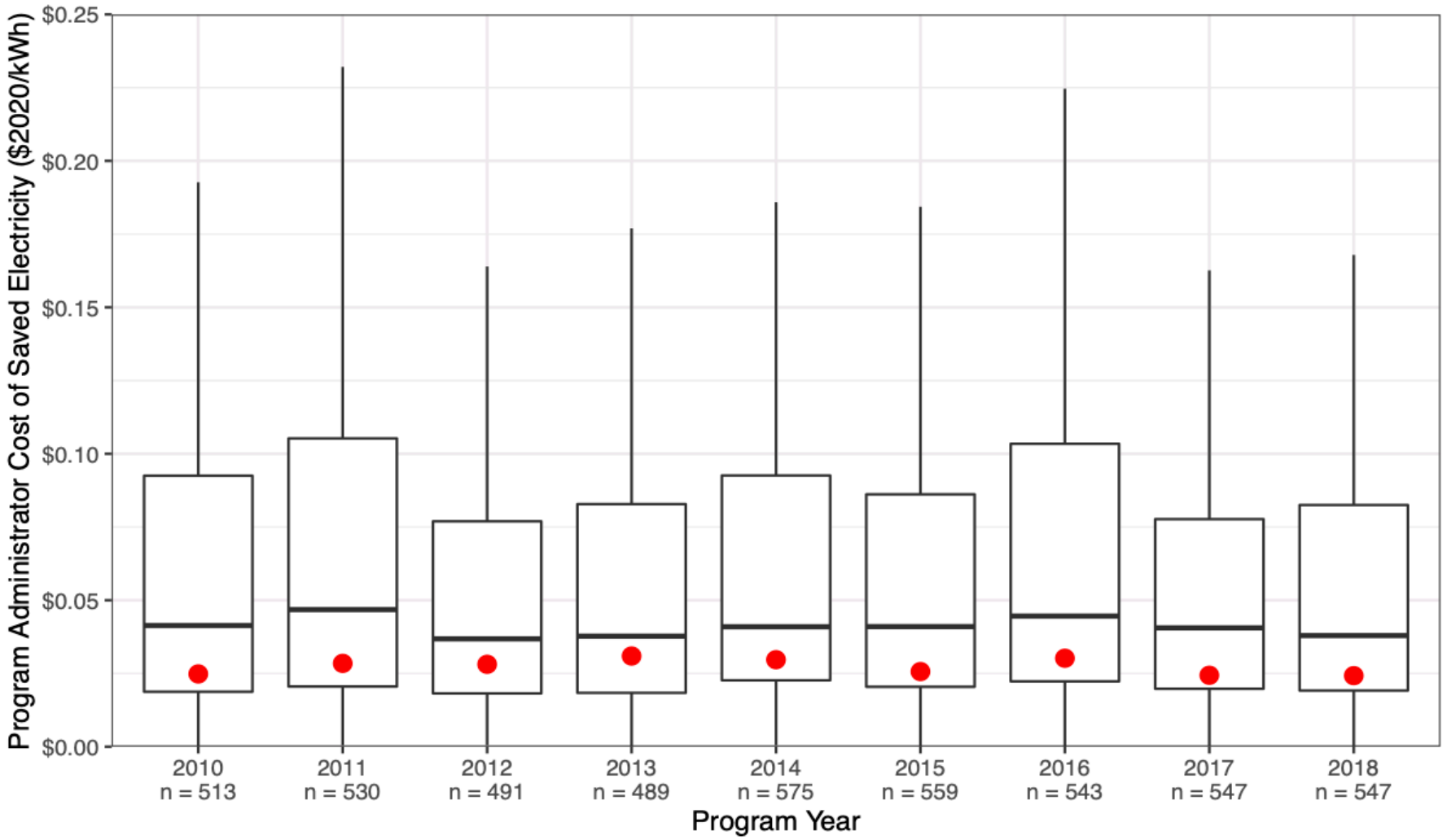
r = the discount rate
N = estimated program lifetime in years and calculated as the savings-weighted lifetime of measures or actions installed by participating customers in a program

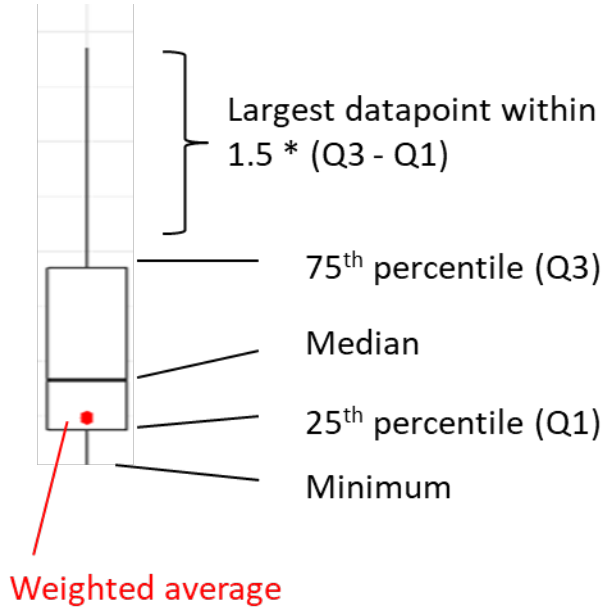
States in Cost of Saving Electricity time trend analysis

- Data used in the analysis is a subset of Cost of Saving Electricity data.
- In 2018, data represents
  - 13 states
  - 38 program administrators
- Collection years: 2010-2018

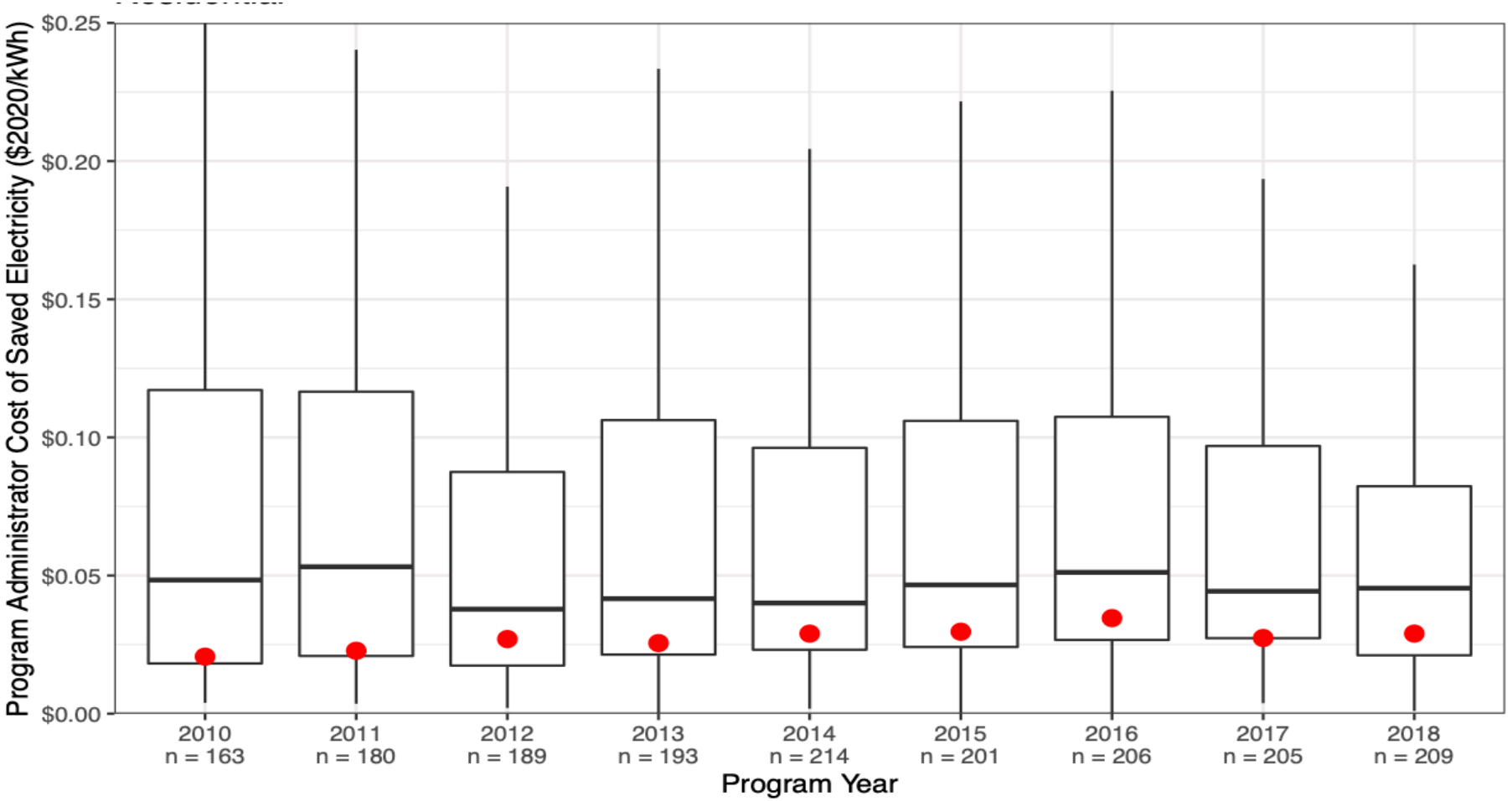


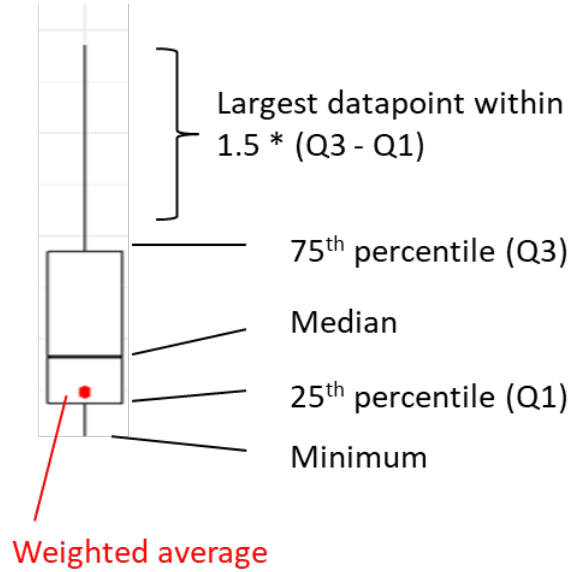
Trends in program administrator Cost of Saving Electricity over time
All Programs



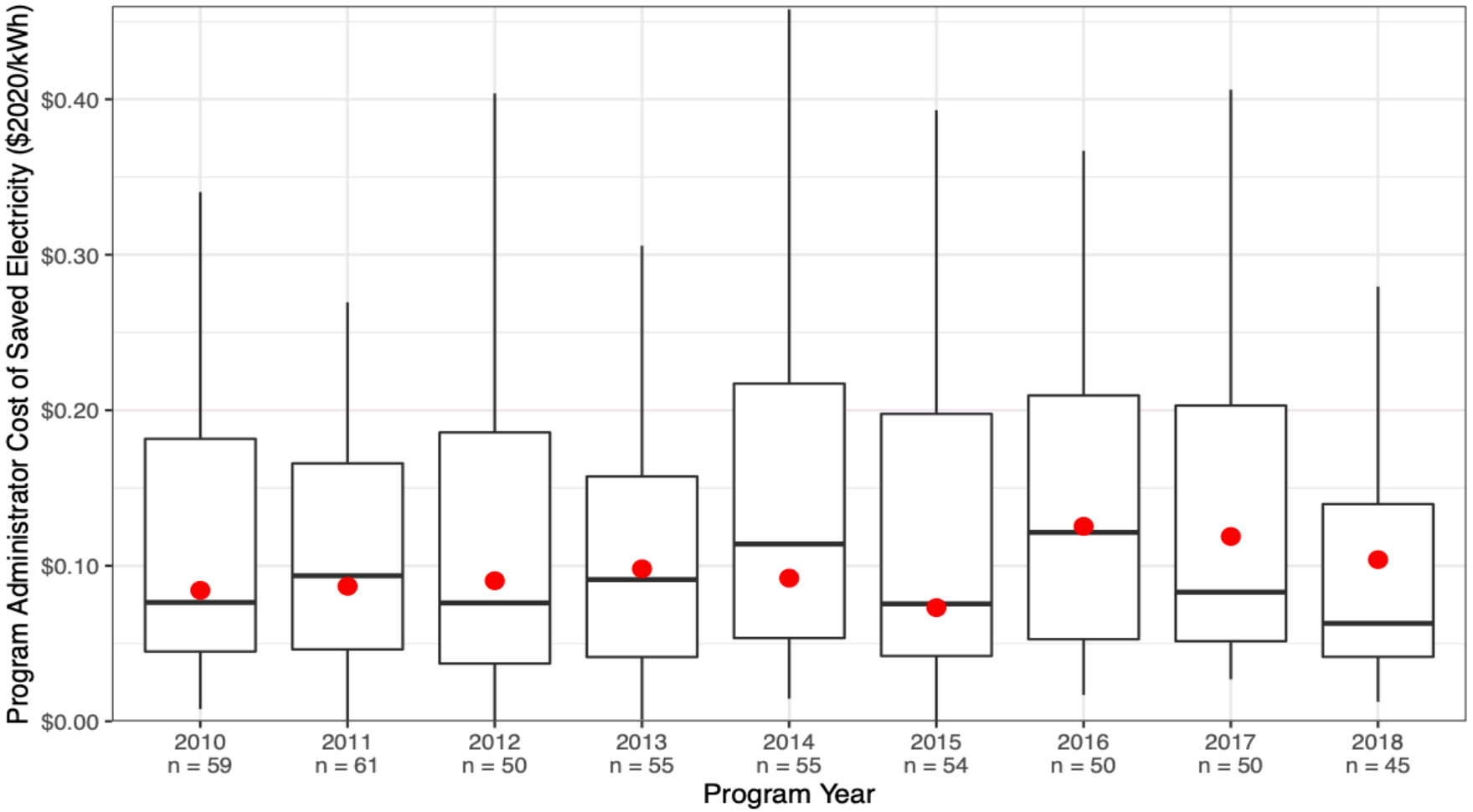


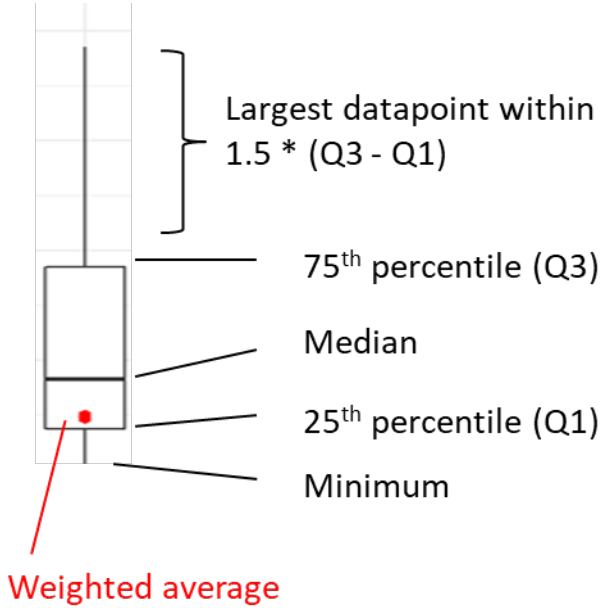
Trends in program administrator Cost of Saving Electricity over time
Residential Programs



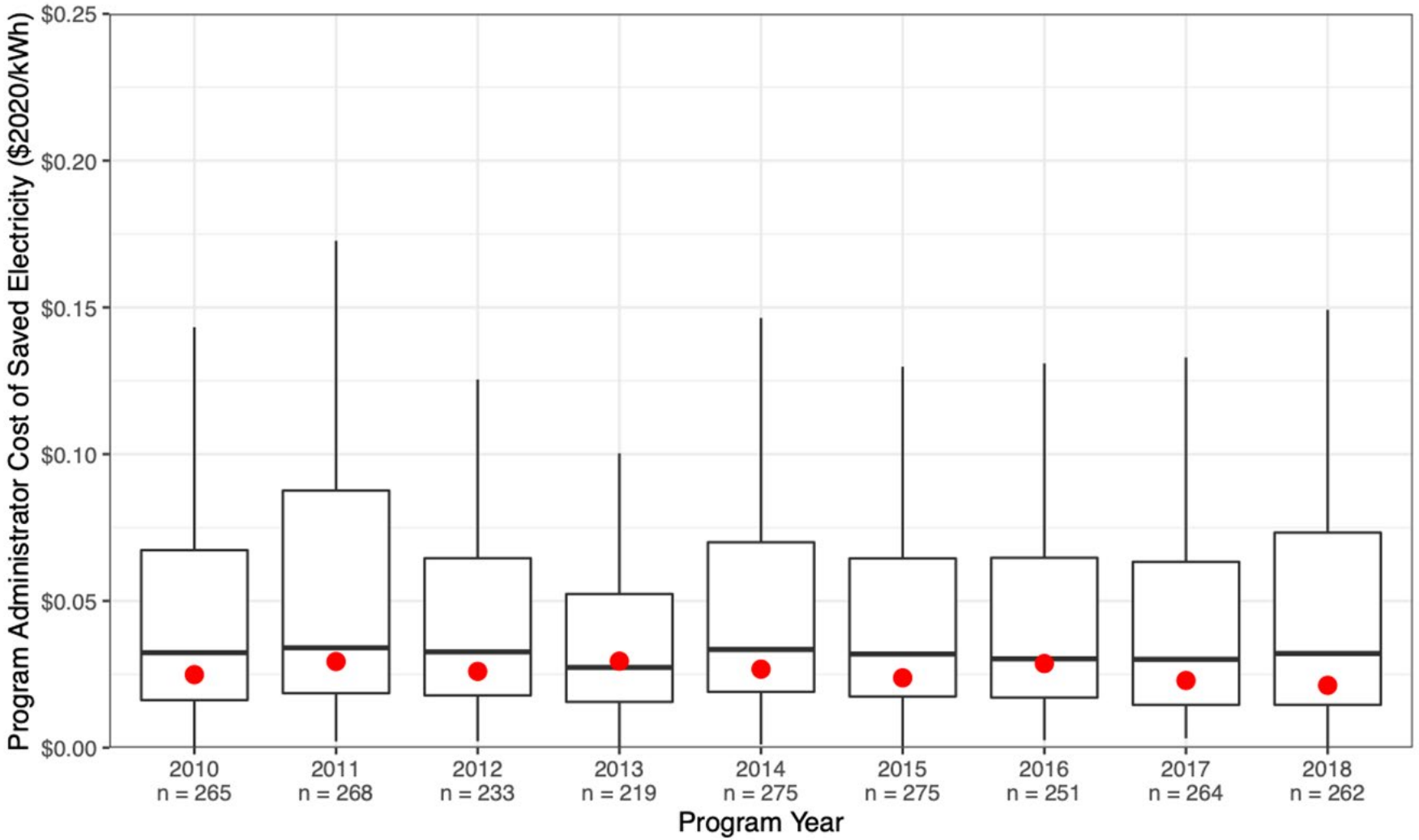


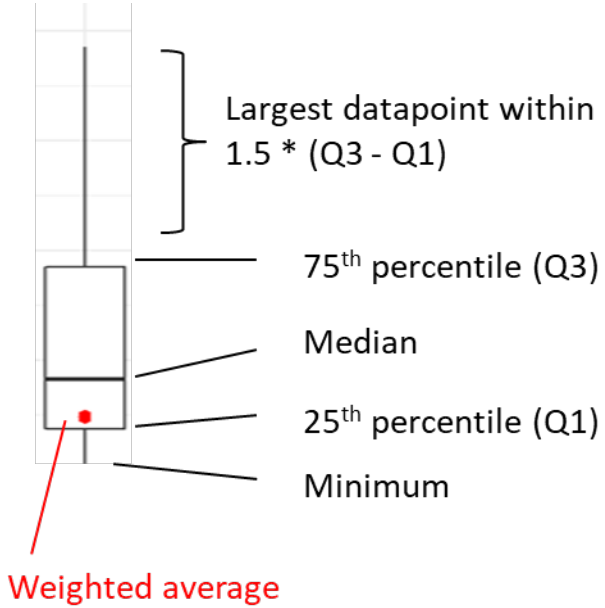
Trends in program administrator Cost of Saving Electricity over time
Low-Income Programs





Trends in program administrator Cost of Saving Electricity over time
Commercial and Industrial Programs





Cost of Saving Peak Demand Analysis

Cost of Saving Peak Demand analysis approach

- Program administrator cost of saving peak demand (PA CSPD)
  - Levelized: amortizes costs over a program's lifetime, discounts to year of investment
  - First-year annual gross peak demand (kW) instead of annual electricity savings (kWh)
- Calculated at program-level and in aggregate by sector
  - e.g. sector-level PA CSPD is calculated for all programs in a sector using a savings-weighted sector lifetime, not an average of individual programs

Program Administrator Cost of Saving Peak Demand =

$$\frac{\text{Capital Recovery Factor} * (\text{Program Administrator Costs})}{\text{Annual Peak Demand Savings (kW)}}$$

where the Capital Recovery Factor (CRF) is:

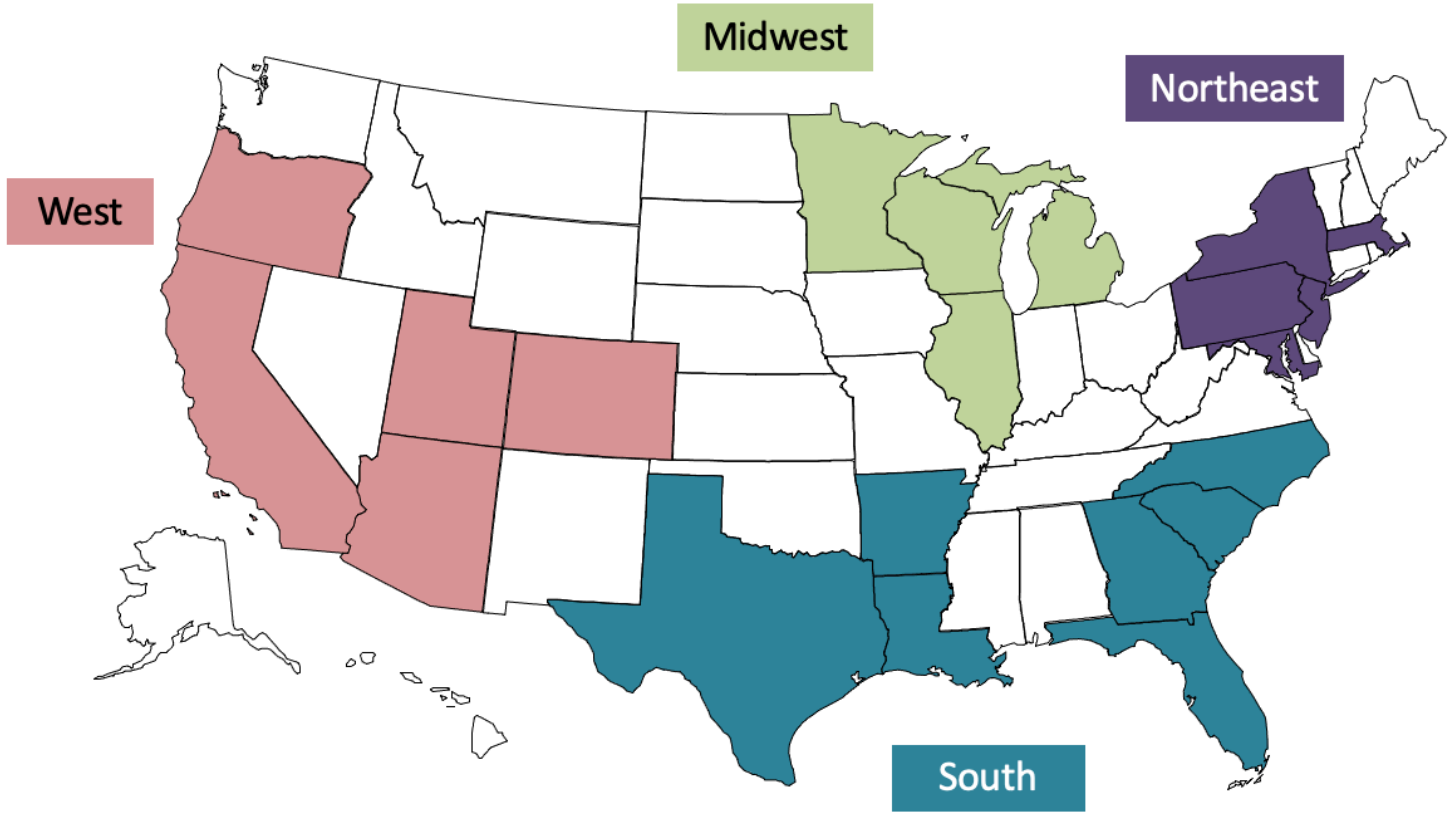
$$CRF = \frac{r(1+r)^N}{(1+r)^N - 1}.$$

and

r = the discount rate
N = estimated program lifetime in years and calculated as the savings-weighted lifetime of measures or actions installed by participating customers in a program

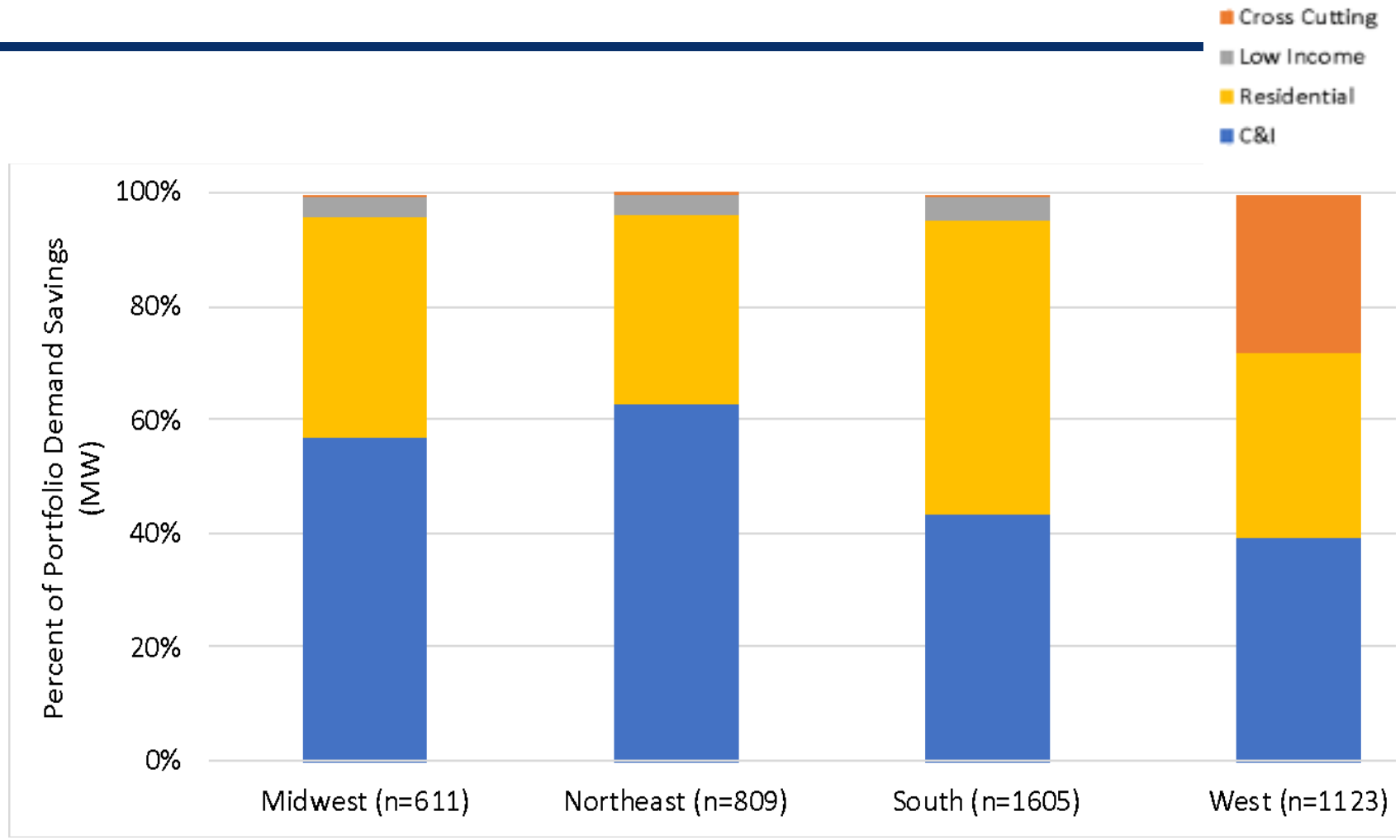
States in Cost of Saving Peak Demand analysis

- Cost of Saving Peak Demand is a subset of Cost of Saving Electricity data.
  - Collection period: 2014-2018
- Data in 2018 represents
  - 67 program administrators in 21 states
  - 92% of reported efficiency spending
  - 84% of reported demand reductions
- For regional analysis, states are categorized into four regions shown by color on the map



Peak demand savings by region for 67 program administrators (2014-2018)

- The C&I sector provided 57% of peak demand savings across all programs in our 2014-2018 study period.
- Results varied by region. C&I provided the majority of savings in the Midwest (57%) and Northeast (63%). Residential provided the majority of savings in the South (55%).



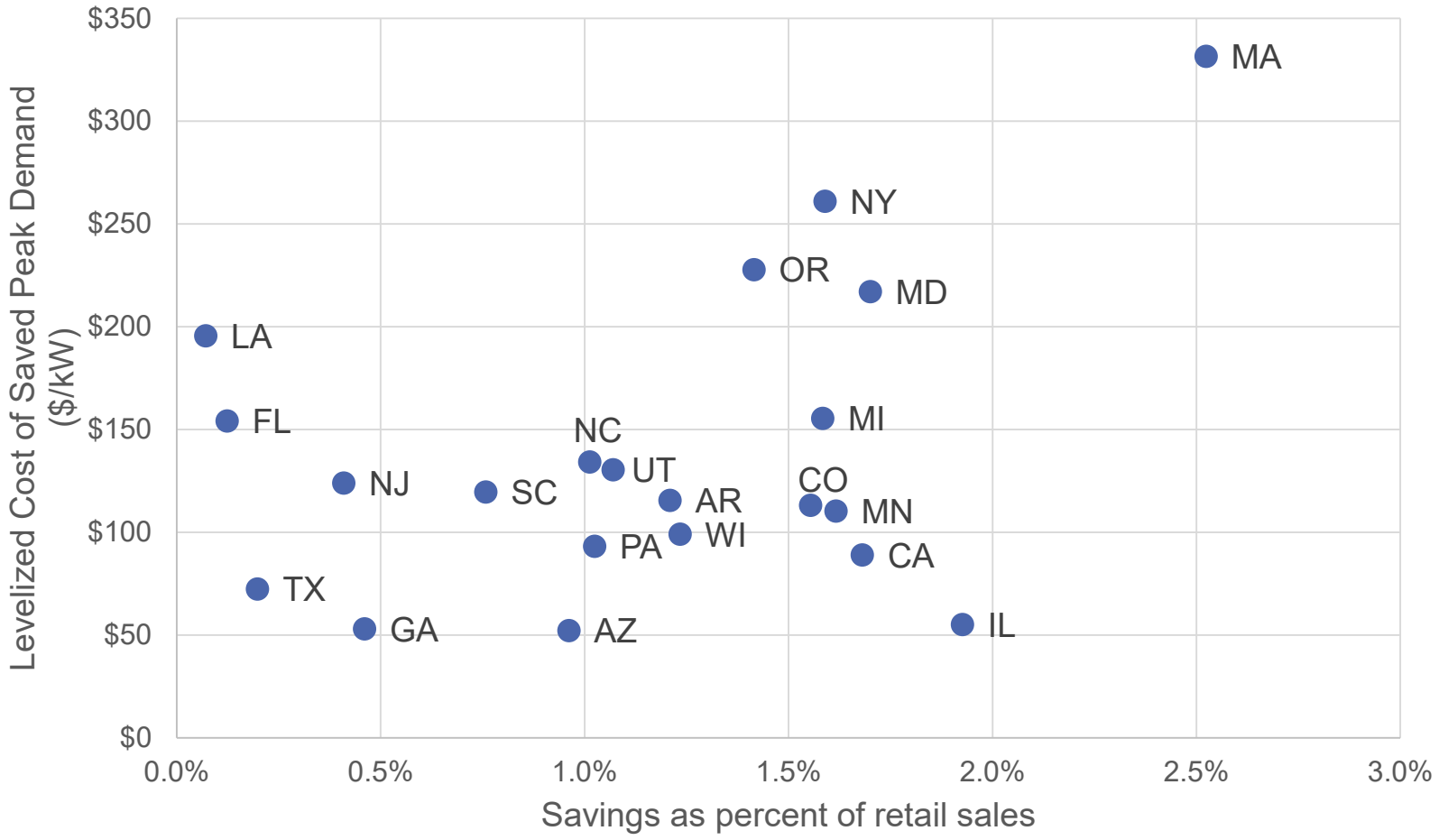
Cross cutting programs apply to all market sectors. They include multi-sector rebates, codes and standards, education, outreach, workforce development and R&D.

Program administrator Cost of Saving Peak Demand by market sector and region

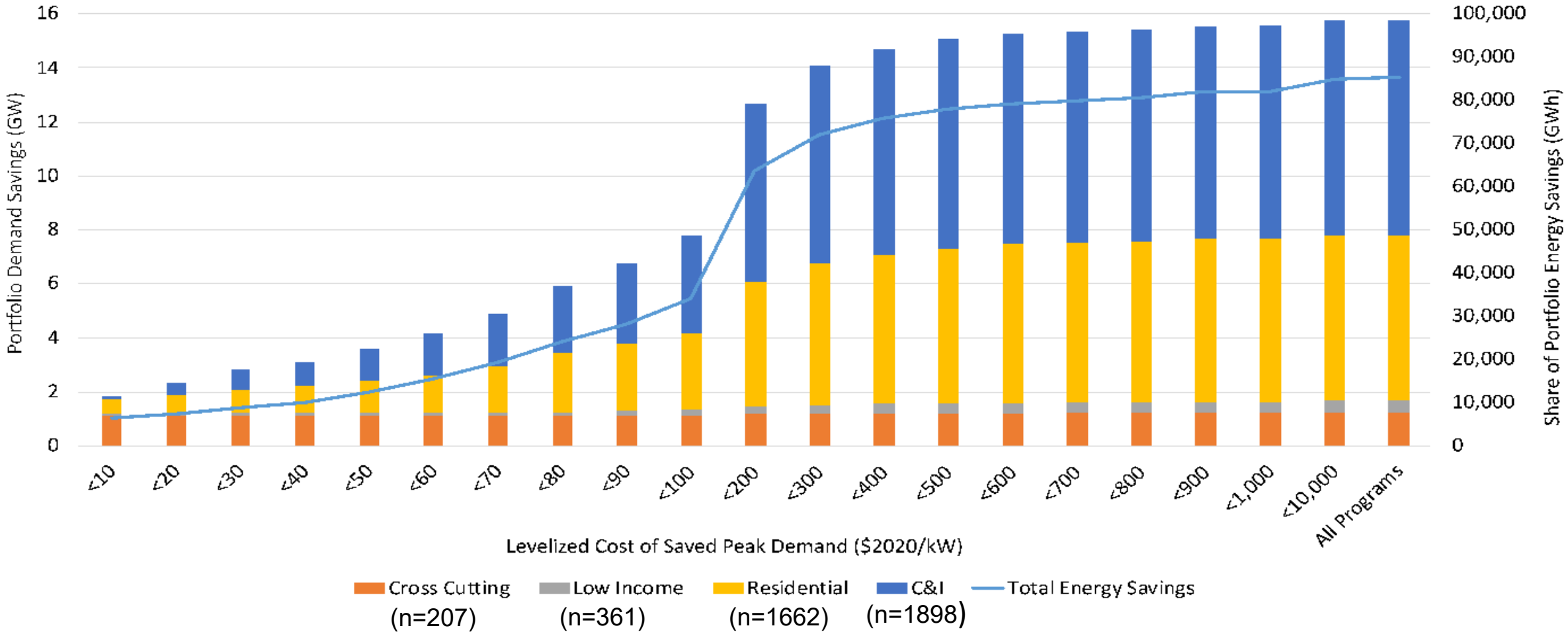
		2014 -2018		2018	
		Levelized CSPD ($/kW)	Sample Size	Levelized CSPD ($/kW)	Sample Size
Total		153	5,831	128	1,255
Sector	C&I	145	2,364	134	502
	Low Income	386	461	241	94
	Residential	147	1,951	108	410
Region	Midwest	105	895	76	231
	Northeast	201	1,308	223	292
	South	132	1,962	119	375
	West	151	1,666	99	357

Program administrator Cost of Saving Peak Demand as a percent of retail sales in 2018

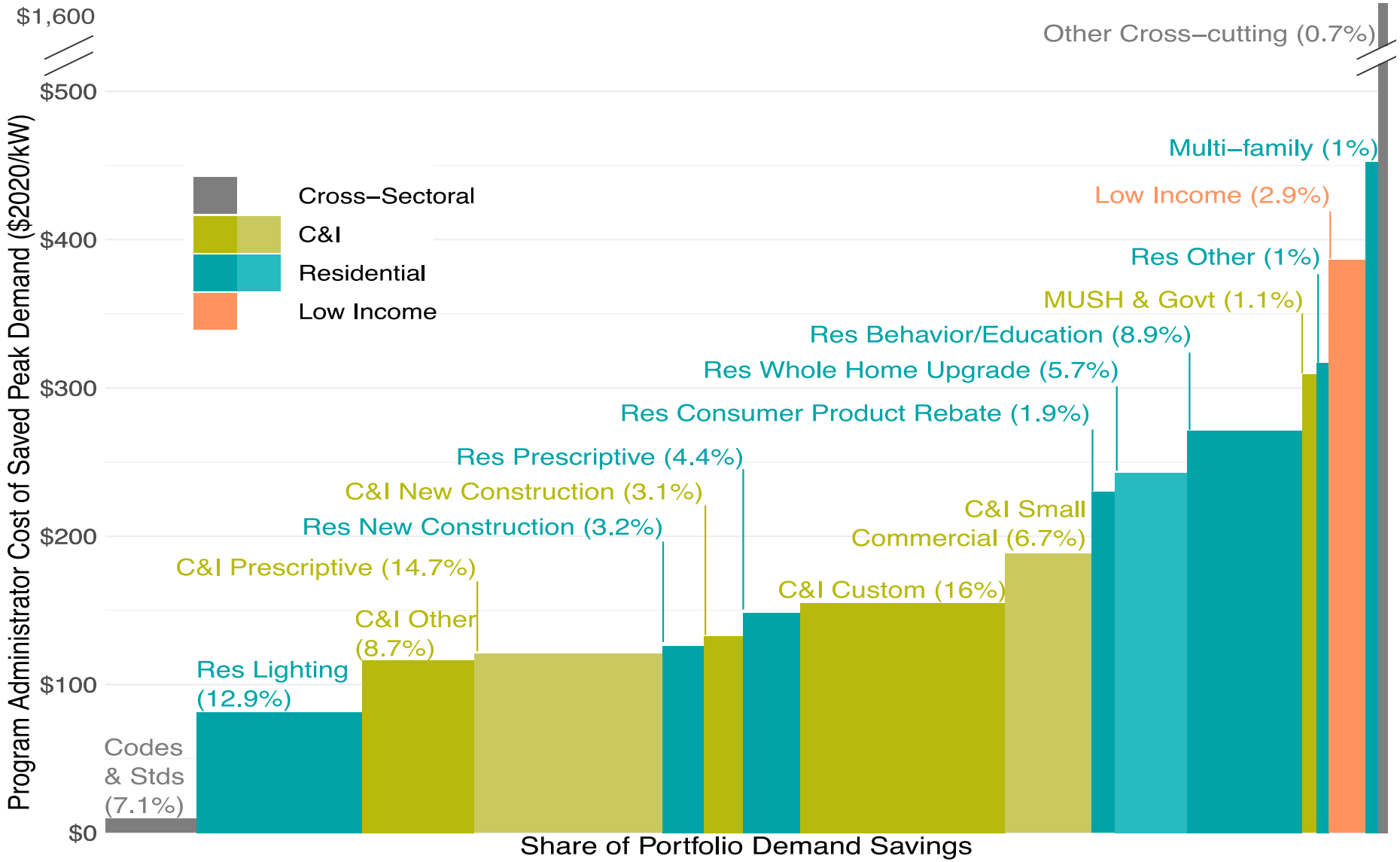
- Data is from 21 states.
- Saving electricity can also reduce demand.
- CSPD is highest in states with greatest savings as percent of sales.
- Most states in our analysis report peak demand savings at less than $200/kW.



Distribution of peak demand and energy savings, by Cost of Saving Peak Demand bin and market sector (2014-2018)



Composite cost curve for demand savings from electric efficiency programs (2014-2018)

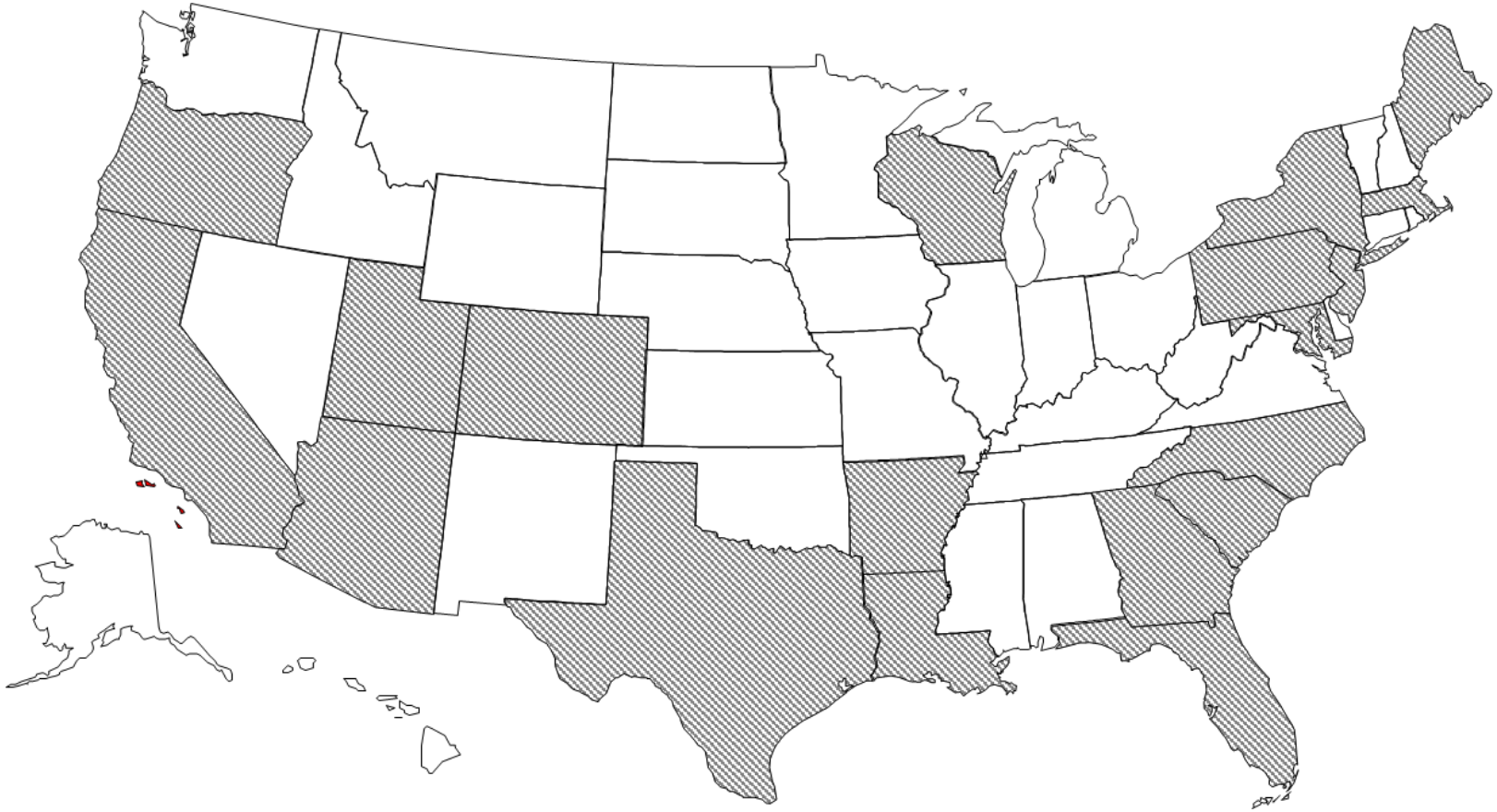


Cost of Saving Peak Demand:
Time Trend Analysis

States in Cost of Saving Peak Demand time trends analysis and approach

- Data used in the analysis is a subset of Cost of Saving Electricity data.
- In 2018, the data represents:
  - 19 states
  - 59 program administrators

- Collection years: 2014-2018



Trends in the program administrator Cost of Saving Peak Demand over time

	All programs		Time trend analysis	
Program year	Levelized CSPD $/kW	Sample size	Time trend $/kW	Sample size
2014	179	1,036	187	1,008
2015	175	1,058	170	994
2016	160	1,265	162	1,150
2017	137	1,216	138	1,150
2018	125	1,255	151	1,130

Key Findings

Cost of Saving Electricity findings

- The cost of saving electricity analysis spans a 9 year period (2010-2018). Findings include:
  - Investor-owned utilities and other program administrators in 14 of the 21 states studied reported savings ≥1% of retail sales in 2018.
  - The program administrator cost of saving electricity for all programs ranged from $0.024 to $0.028 per kWh over the course of the study period. The range was greater for our time trend dataset, which is a subset of all of the programs that we have data on.
  - The program administrator cost of saving energy remained low over the study period. Average cost of programs over the 2010-2018 study period by market sector: C&I - 2.0¢/kWh, Low Income - 9.0¢/kWh, and Residential - 3.0¢/kWh
  - The aggregate program savings "cost curve" for the actual electricity efficiency resource during the study period provides insights into the relative costs of various types of efficiency programs and the savings contribution of each program type to the efficiency resource for our sample.
- The cost of saving electricity time trend analysis covers the same time period, but data from 13 states. Findings include:
  - The program administrator cost of saving electricity remained stable over time for all 3 market sectors.
  - In most cases, the programs with the highest lifetime savings tended to have lower cost of saving electricity than the smaller programs.

Cost of Saving Peak Demand findings

- The cost of saving peak demand analysis spans a 5 year period (2014-2018). Findings include:
  - The program administrator cost of saving peak demand for all programs ranged from $59 to $449 per kW over the course of the study period. The range was greater for our time trend dataset, which is a subset of all of the programs that we have data on.
  - The program administrator cost of saving peak demand decreased over time during the study period. Average cost of programs over the 2014-2018 study period by market sector: C&I - $145/kW, Low Income - $386/kW, and Residential - $147/kW.
  - Four programs contribute more than 40% of the portfolio demand savings for the period studied: residential consumer products, C&I custom, C&I prescriptive, and C&I All Other Programs
  - The comparison of COSE and CSPD “cost curves” for program categories demonstrate the similar relative costs of various types of efficiency programs and the savings contribution of each program type.
- The cost of saving peak demand time trend analysis covers the same time period, but data from 19 states. Findings include:
  - The program administrator cost of saving peak demand declined over the period 2014 to 2018

The cost of saved electricity has remained relatively constant over 8 years and is a low-cost energy resource.

	2010 - 2018	2018 Results
	Levelized CSE ($/kWh)	Levelized CSE ($/kWh)
Residential	0.027	0.029
C&I	0.023	0.020
Low Income	0.091	0.102
Midwest	0.017	0.020
Northeast	0.031	0.027
South	0.030	0.028
West	0.027	0.020

Dispatchable technologies	$/kWh
Ultra-supercritical coal	0.073
Combined cycle	0.037
Combustion turbine	0.107
Advanced nuclear	0.063
Geothermal	0.345
Biomass	0.089
Battery storage	0.119

Non-dispatchable technologies	$/kWh
Wind, onshore	0.037
Wind, offshore	0.121
Solar, standalone	0.030
Solar, hybrid	0.045
Hydroelectric	0.055

Excerpt from EIA, Estimated unweighted levelized cost of electricity and levelized cost of storage for new resources entering service in 2026 (2020 dollars per kWh). Full table found here (table 1b).

In some cases, efficiency resources do not provide the same services as power generating technologies, making comparisons complex. Adding controls enables active management of efficiency resources, offering additional grid services.

Questions

Contact

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Acknowledgements

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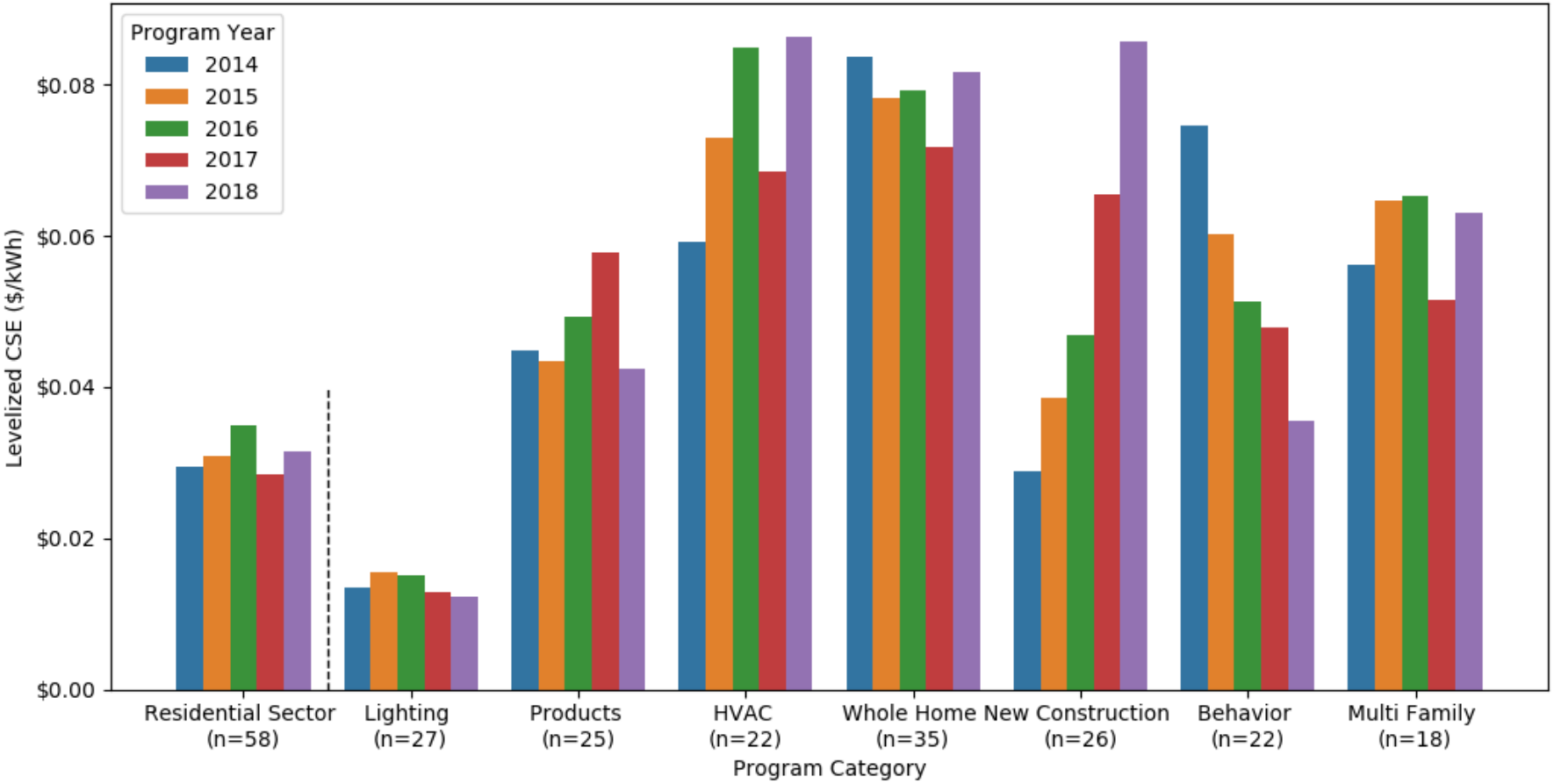
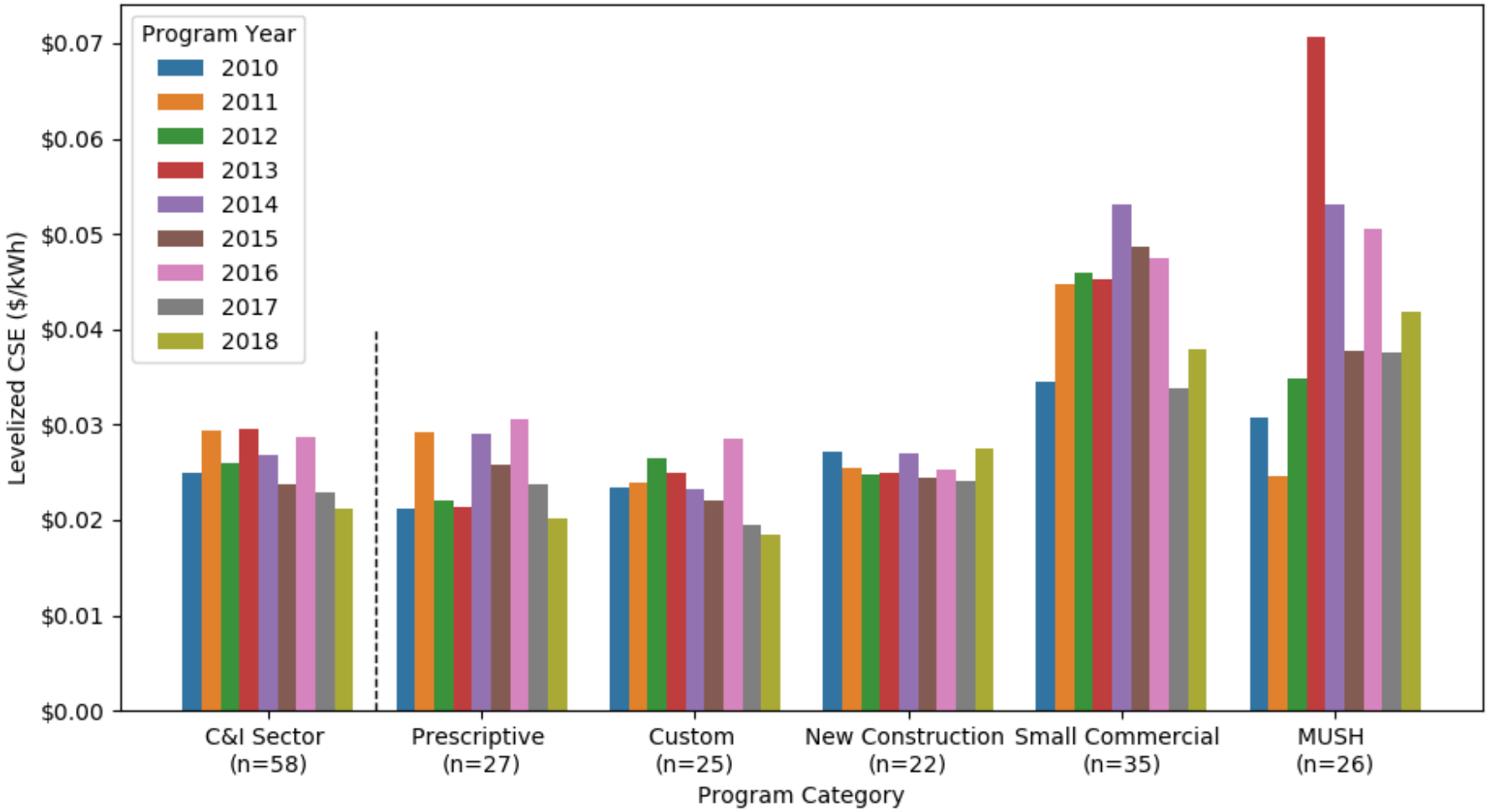
Appendix

Cost of Saving Electricity time trends by program type
Residential Cost of Saved Energy (2010-2018)



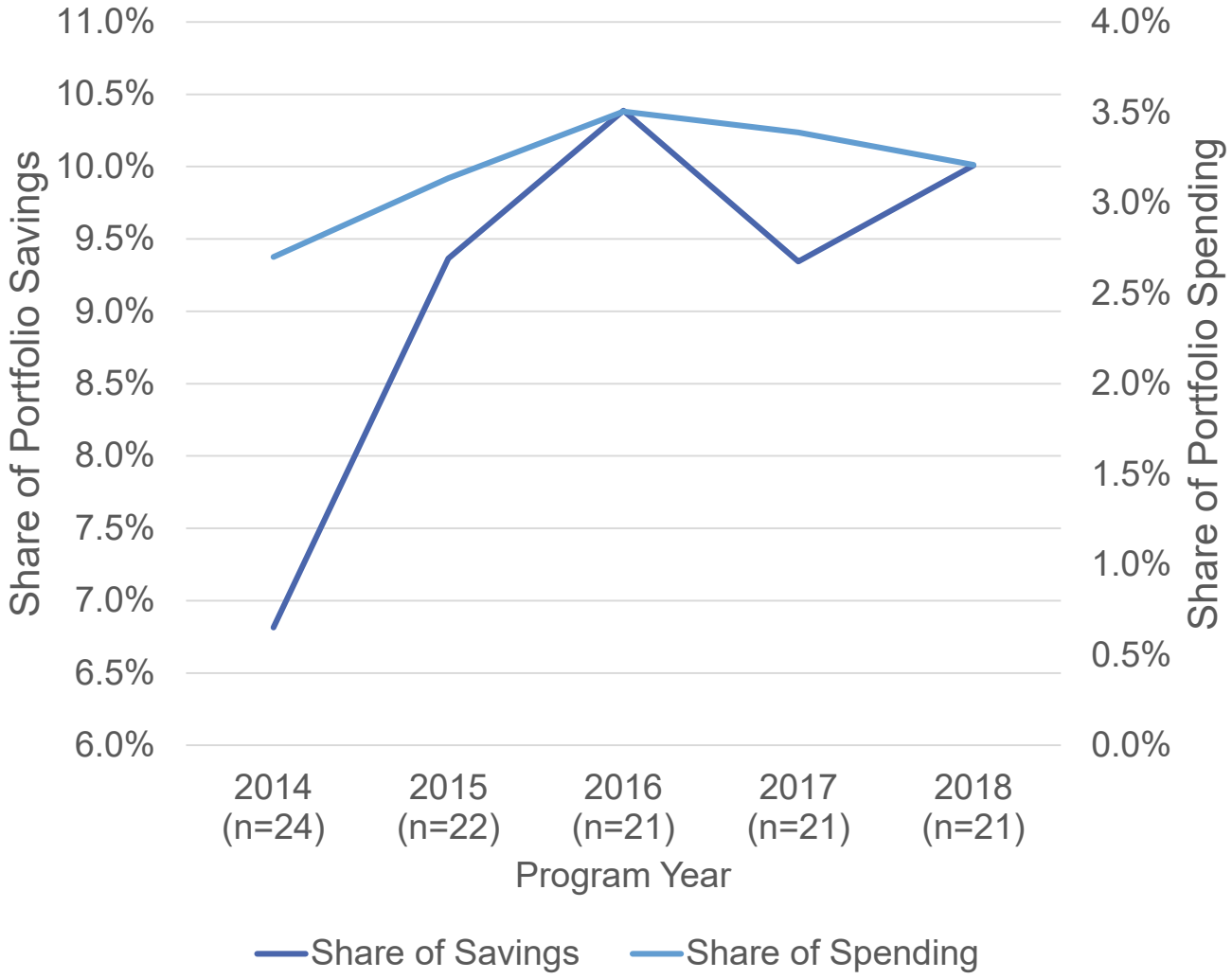
- Significant cost declines in behavioral programs
- Increases in cost of new construction and HVAC programs

Cost of Saving Electricity time trends by program type
Commercial and Industrial (2010-2018)



- Cost of saved energy generally stable across major program types

Growth of residential behavioral programs



- Scale of behavioral programs increased from 2014 to 2018 to provide 10% of first year savings across all PAs in our analysis
- Share of savings increased significantly with small increases in share of costs

Program average measure lifetime (2010-2018)