

# State Indicators for Advancing Demand Flexibility and Energy Efficiency in Buildings – Part II

## Traditional Energy Efficiency Indicators for Electricity and Gas

December 21, 2021

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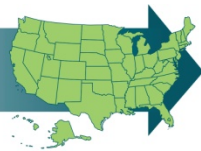
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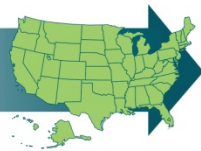
- [Energy Efficiency Programs Funded by Utility Customers](#)
- [Regulatory Mechanisms to Address Utility Disincentives](#)
- [Energy Savings Targets](#)
- [Energy Savings Performance Contracting](#)
- [Codes and Standards](#)
- [Financing Programs](#)
- [Combined Heat and Power](#)

***Also see Part I – Demand Response and Energy Efficiency Targeted to Reduce Peak Electricity Demand, as well as an infographic, at***

***<https://emp.lbl.gov/publications/state-indicators-advancing-demand>***



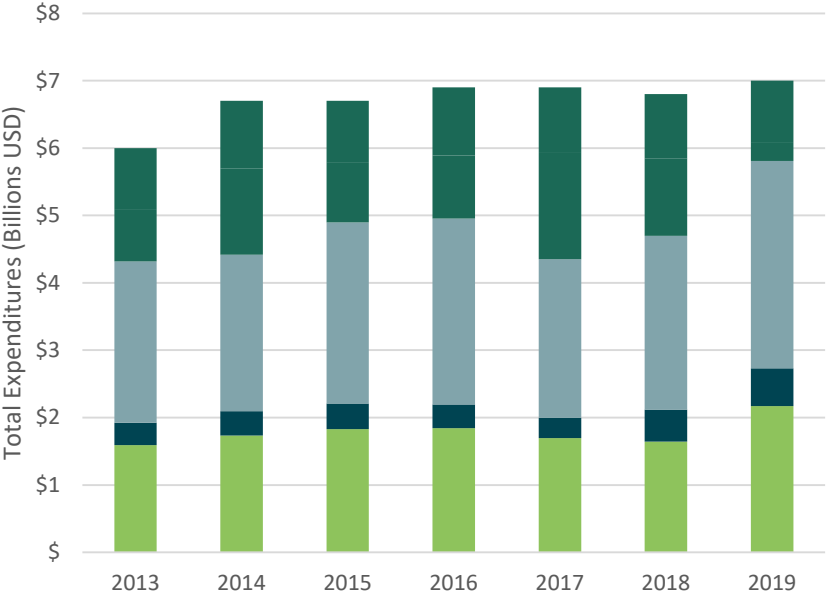
# ENERGY EFFICIENCY PROGRAMS FUNDED BY UTILITY CUSTOMERS



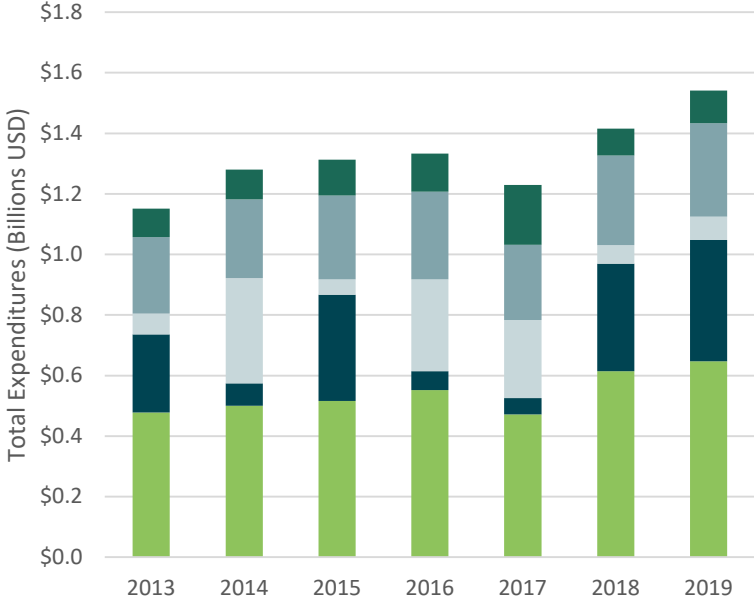
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# Utility Spending on Electric & Gas Efficiency Programs, Combined, Grew 22% Between 2013 and 2019

U.S. Electric Utility Efficiency Expenditures



U.S. Natural Gas Utility Efficiency Expenditures



■ Residential ■ Low Income ■ Multifamily ■ C&I ■ Other

Source: [Annual Industry Reports: 2013-2020](#). Consortium for Energy Efficiency. Accessed December 2021

**Projected future spending** on electricity efficiency programs, as a percent of utility retail revenues, for low, medium and high scenarios

Source: Goldman et al. 2018. [The Future of U.S. Electricity Efficiency Programs Funded by Utility Customers](#). Berkeley Lab

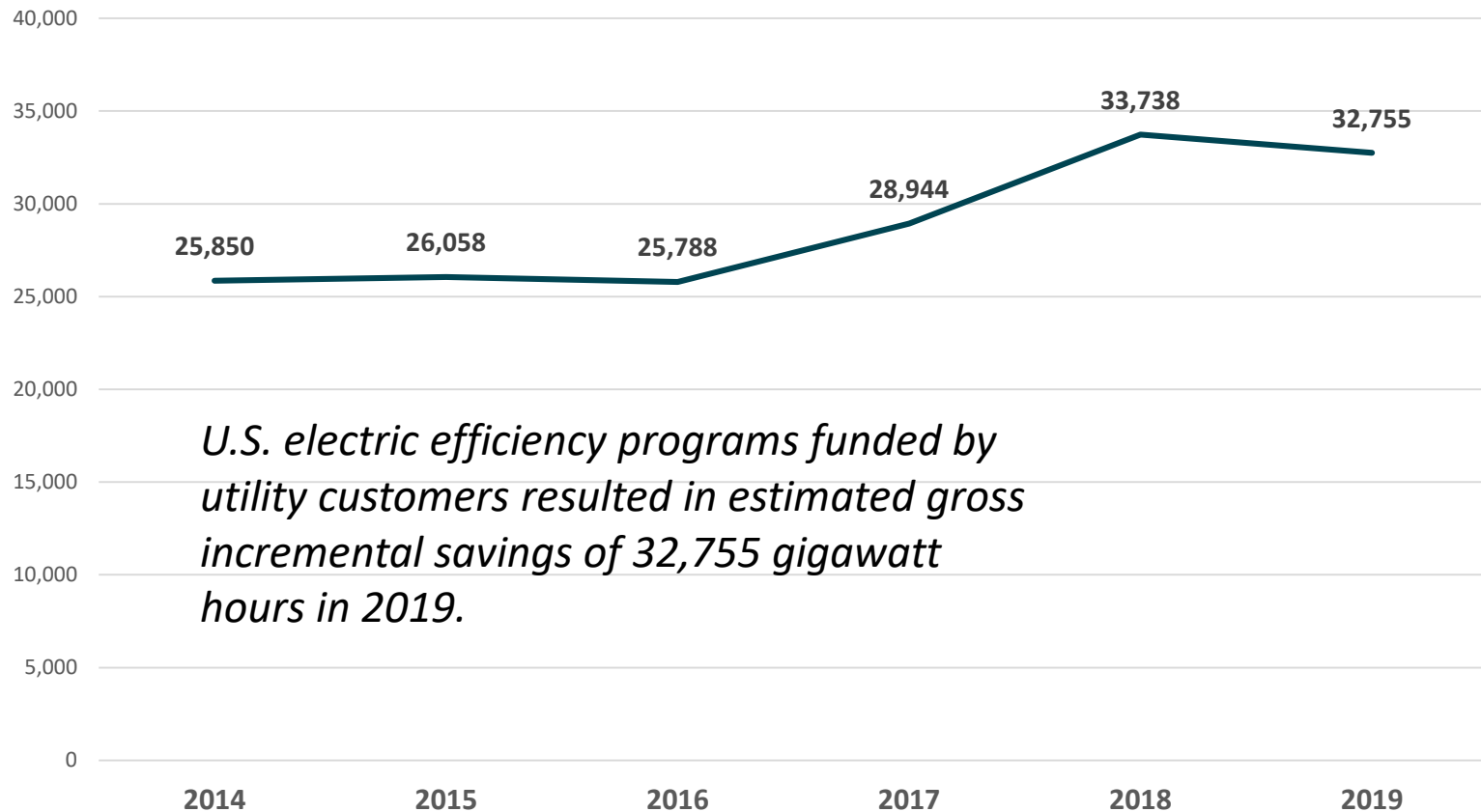
	2025	2030
Low	1.4%	1.2%
Medium	1.8%	1.6%
High	2.2%	2.1%



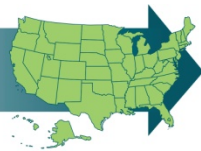
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# Electric Efficiency Savings: Utility Customer-Funded Programs

U.S. Gross Incremental Electric Efficiency Savings (GWh)\*



\*Based on estimated total of all energy savings that accumulated from new participants in existing programs and all participants in new programs in the reporting year.

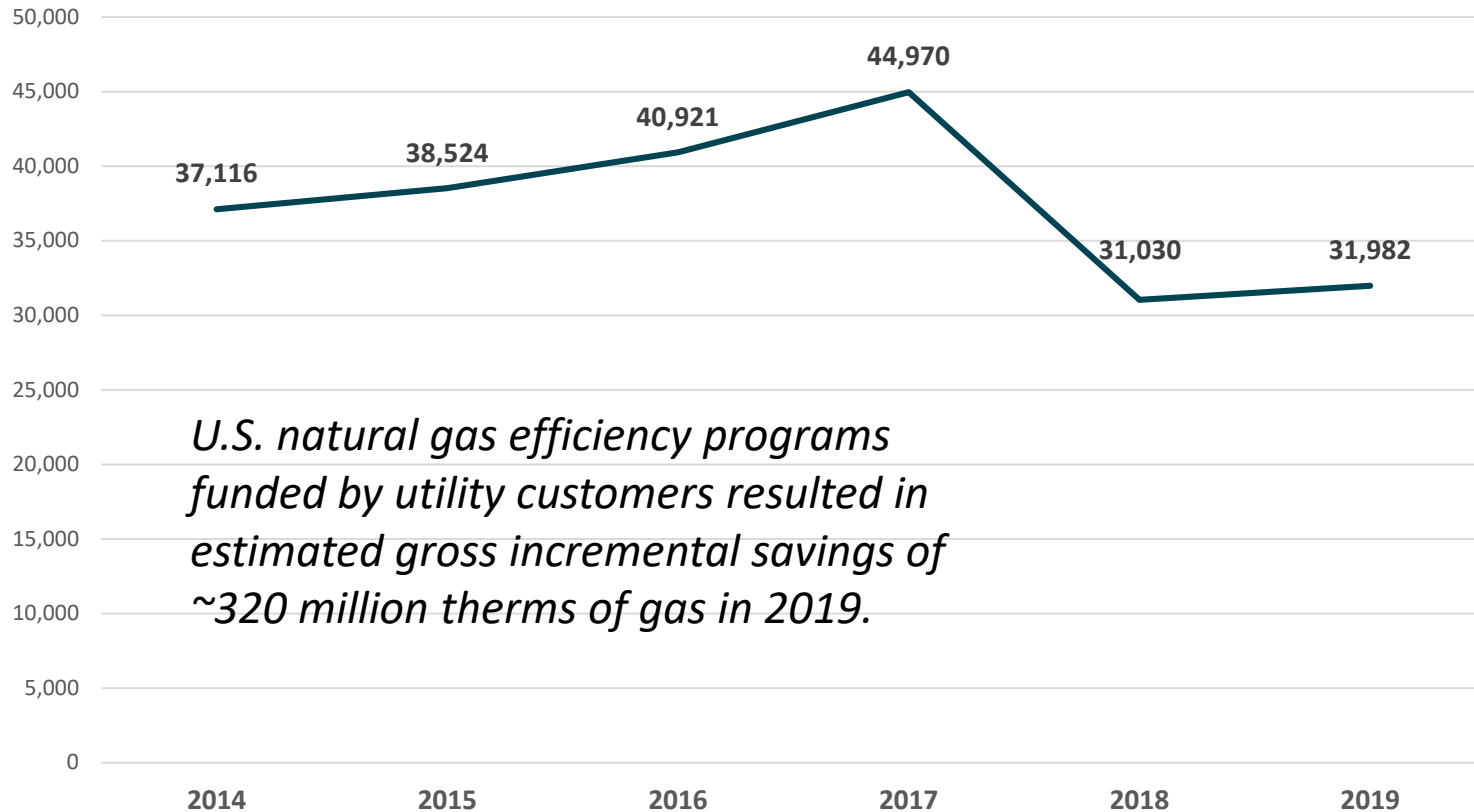


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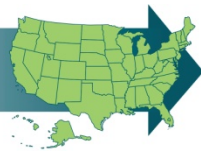
Source: [Annual Industry Reports: 2015-2020](#). Consortium for Energy Efficiency. Accessed December 2021

# Natural Gas Efficiency Savings: Utility Customer-Funded Programs

U.S. Gross Incremental Natural Gas Savings (MDth)\*



\*Based on estimated total of all energy savings that accumulated from new participants in existing programs and all participants in new programs in the reporting year.



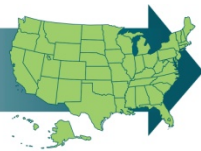
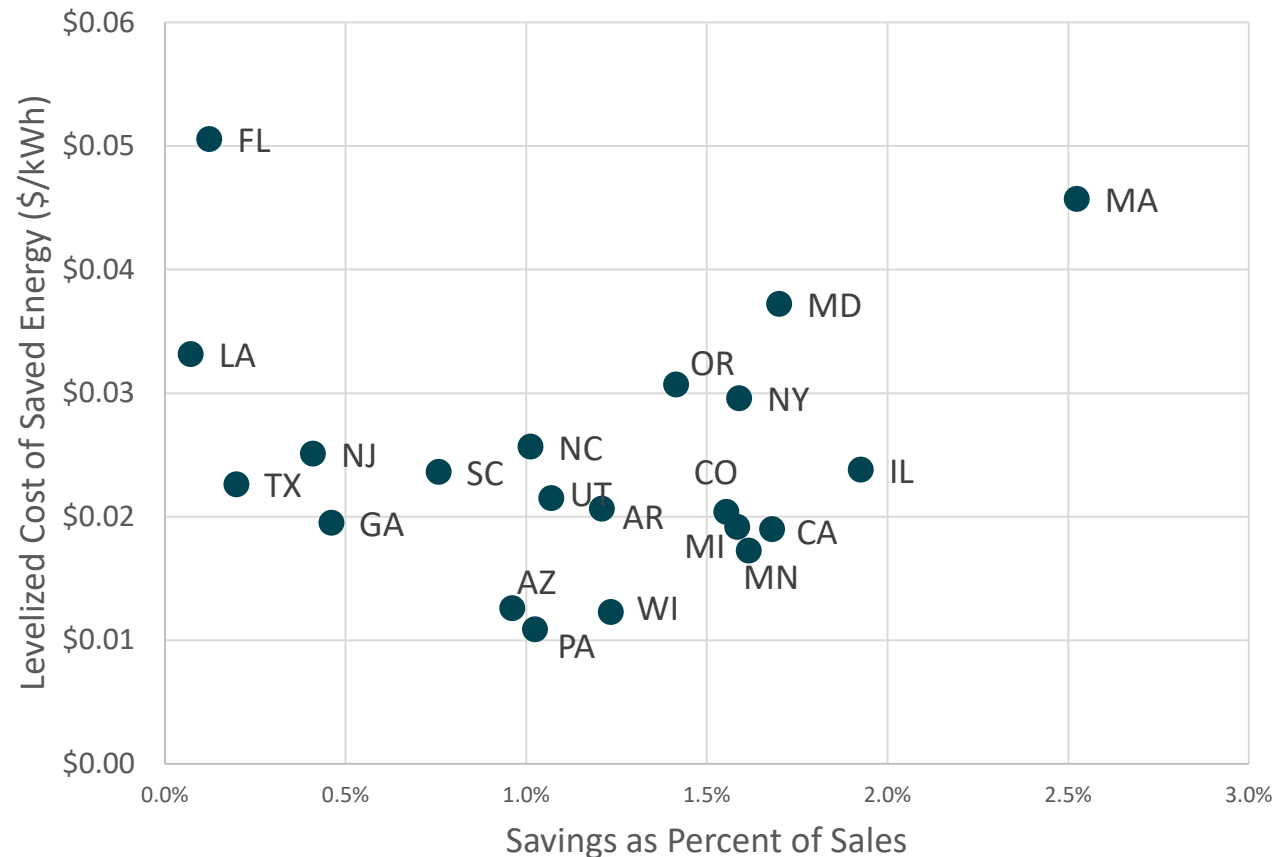
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Source. [Annual Industry Reports: 2015-2020](#). Consortium for Energy Efficiency. Accessed December 2021

# Electricity Savings and Costs: Investor-Owned Utilities (1)

- Investor-owned utilities (IOUs) and other program administrators (PAs) in 14 of the 21 states studied reported savings  $\geq 1\%$  of retail sales in 2018.
- PAs in 8 states reported savings  $>1.5\%$  of retail sales in 2018.
- High levels of savings were achieved without significant increases in the cost of saving electricity (CSE) — see next slide.

2018 CSE as a % of IOU Retail Sales in 2018 in 21 States

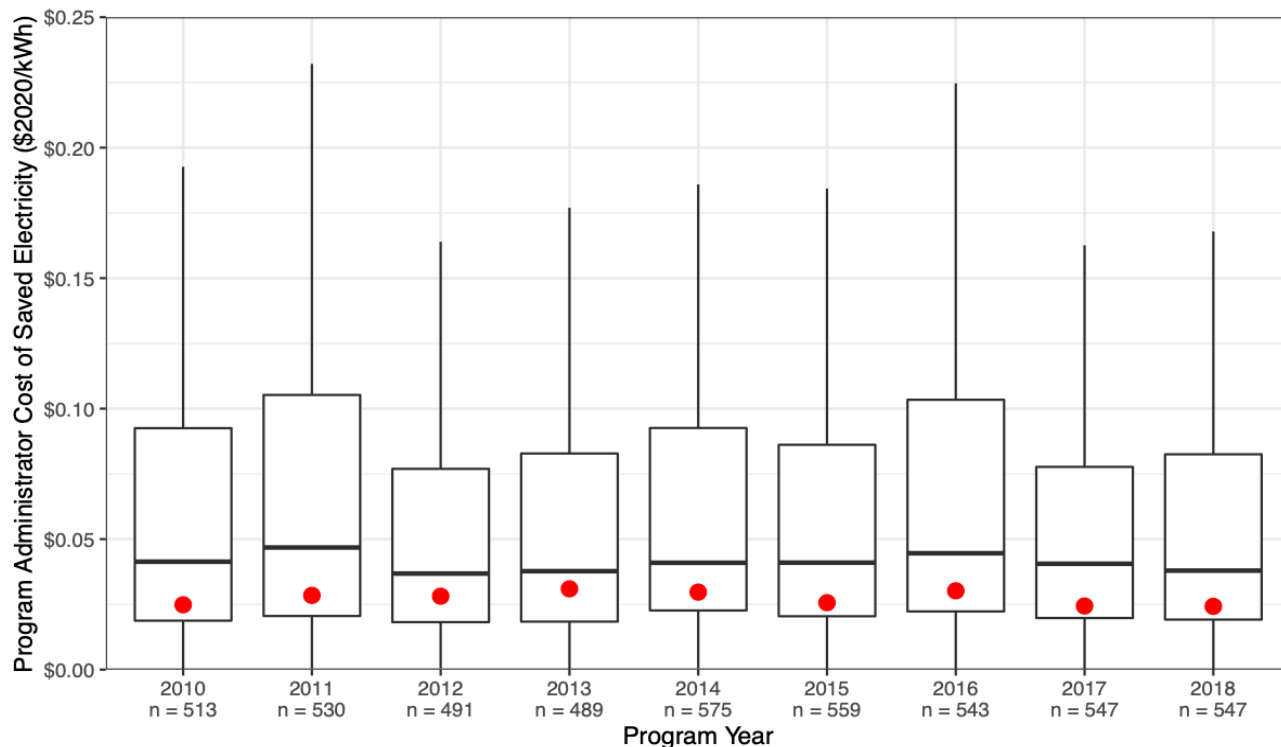




# Electricity Savings and Costs: Investor-Owned Utilities (2)

- The number of programs PAs offer each year varies. The number of programs in our sample ranged from 489 to 575 between 2010 and 2018.
- For the subset of programs with continuous data for all years, CSE varied more widely — from \$0.024 to \$0.031 per kWh during the study period.

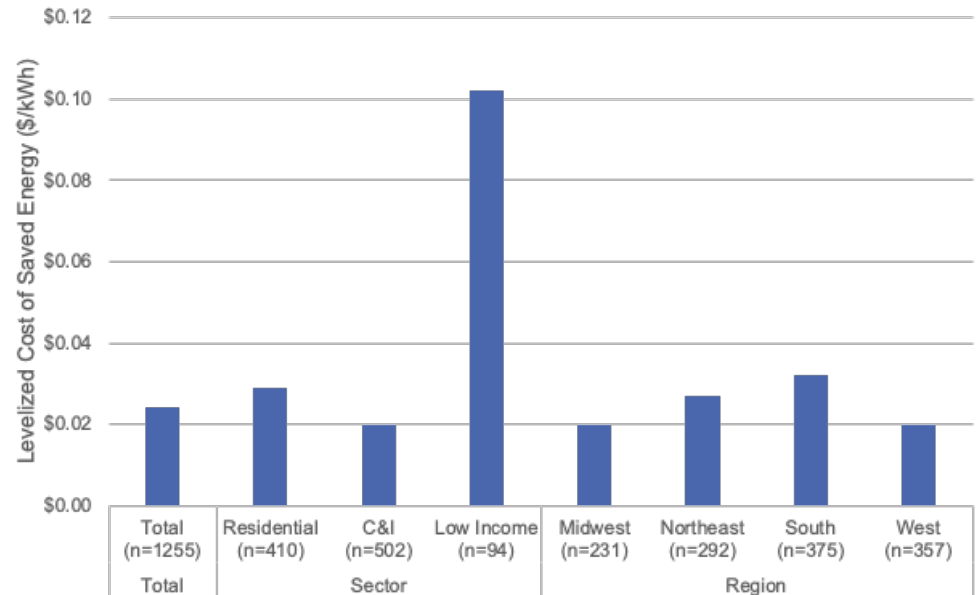
Trends in Program Administrator Cost of Saving Electricity Over Time



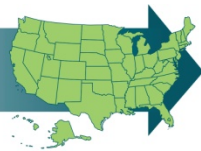
# Electricity Savings and Costs: Investor-Owned Utilities (3)

CSE by Market Sector and Region (2010-2018)		Levelized CSE (\$/kWh)	Sample Size (No. of Programs)
Total		\$0.026	11,796
Sector	C&I	\$0.023	4,579
	Low Income	\$0.091	983
	Residential	\$0.027	4,137
Region	Midwest	\$0.017	2,357
	Northeast	\$0.031	2,871
	South	\$0.030	3,098
	West	\$0.027	3,469

CSE and Savings as a Percent of Sales in 2018

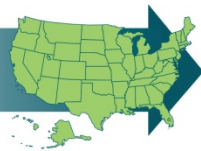
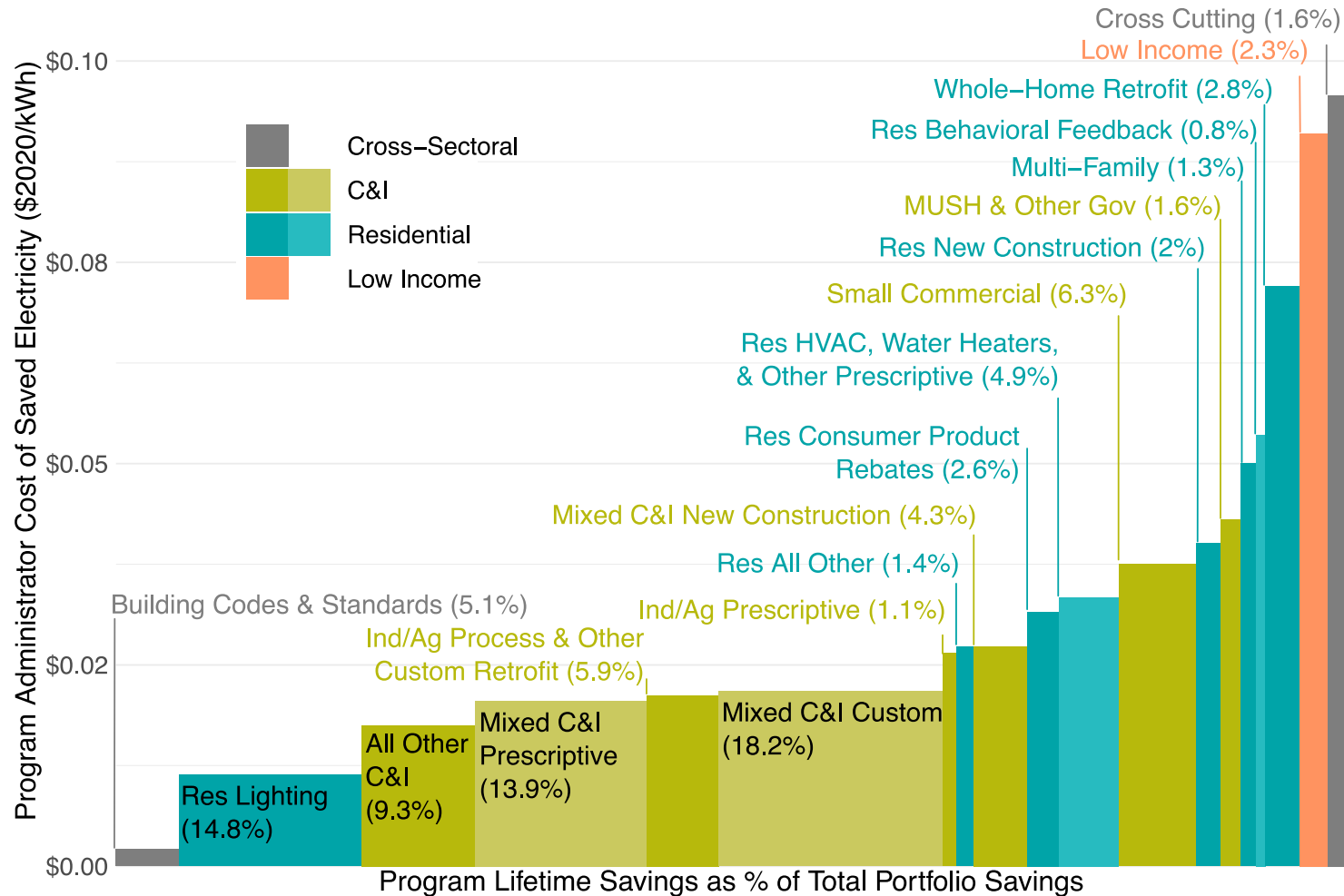


- Savings-weighted average PA CSE across all programs from 2010-2018: 2.6¢/kWh
- Levelized CSE for 2018 programs: 2.4¢/kWh
- Average cost of programs over the 2010-2018 study period by market sector: C&I - 2.3¢/kWh; low income - 9.1¢/kWh; residential - 2.6¢/kWh



# Electricity Savings and Costs: Investor-Owned Utilities (4)

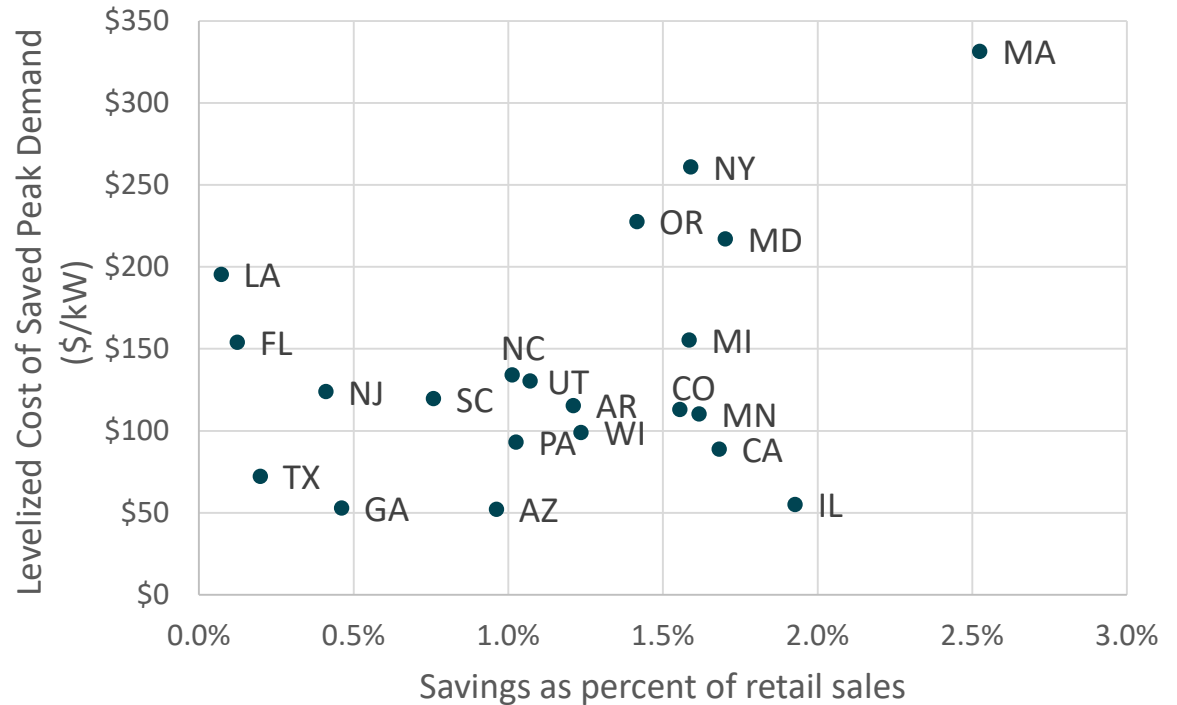
## Composite Cost Curve for Energy Savings From Electric Efficiency Programs: 2010-2018



# Peak Demand Savings: Investor-Owned Utilities (1)

- Saving electricity also can reduce peak demand.
- Most states in our analysis report peak demand savings at a cost less than \$200/kW.
- The cost of saving peak demand (CSPD) is highest in states with the greatest savings as a percent of retail sales.

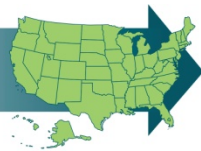
2018 CSPD as a % of IOU Retail Sales in 2018 in 21 States



# Peak Demand Savings: Investor-Owned Utilities (2)

PA Cost of Saved Peak Demand (\$2020/kW)  
Average levelized cost weighted by lifetime savings

Program year	All programs \$/kW	Time-trend analysis \$/kW
2014	\$179	\$187
2015	\$175	\$170
2016	\$160	\$162
2017	\$137	\$138
2018	\$125	\$151



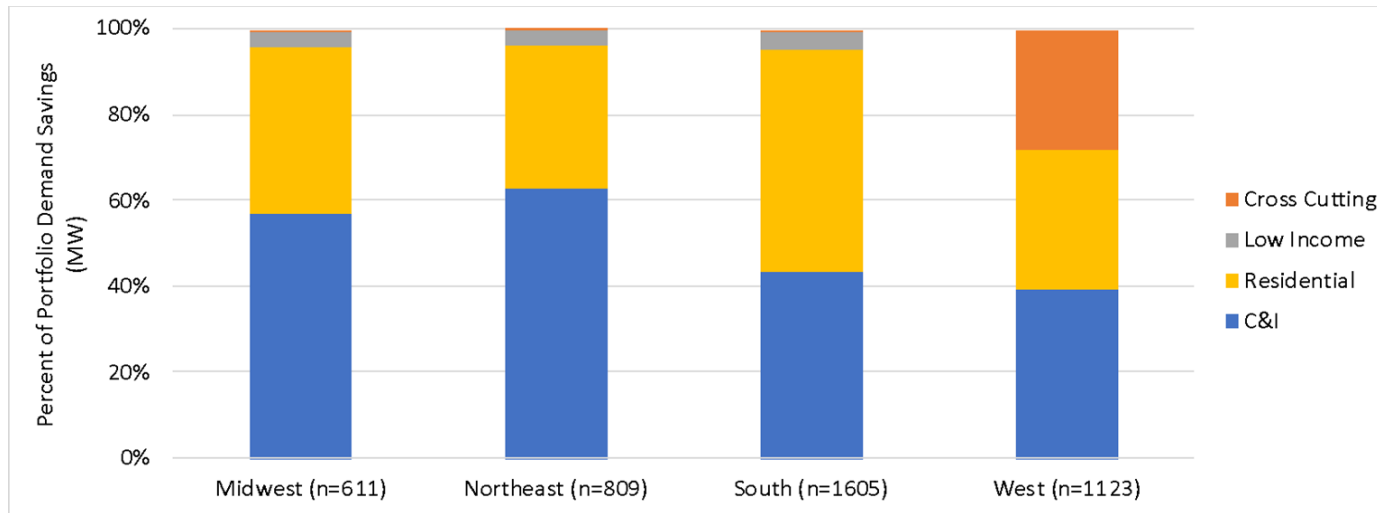
# Peak Demand Savings: Investor-Owned Utilities (3)

CSPD by Market Sector and Region

		2014 -2018		2018	
		Levelized CSPD (\$/kW)	Sample Size	Levelized CSPD (\$/kW)	Sample Size
Total		153	11,796	128	1,255
Sector	C&I	143	2,364	134	502
	Low Income	386	461	241	94
	Residential	152	1,951	117	410
Region	Midwest	105	895	76	231
	Northeast	201	1,308	223	292
	South	138	1,962	136	375
	West	151	1,666	99	357

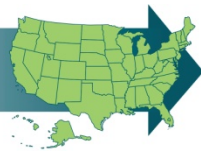


# Peak Demand Savings: Investor-Owned Utilities (4)



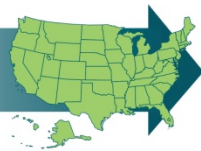
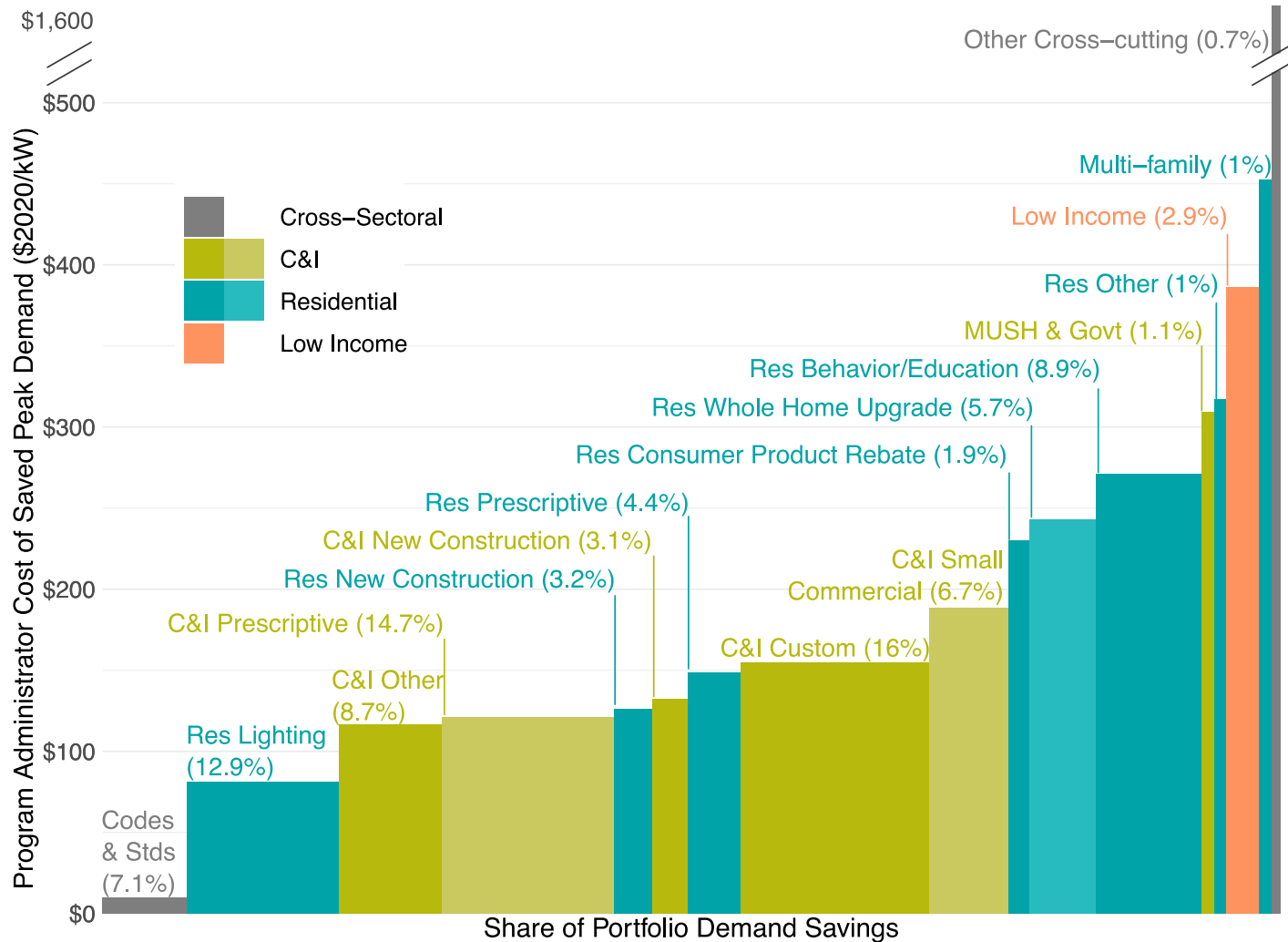
- The C&I sector provided 57% of peak demand savings across all programs in our 2014-2018 study period.
- Results varied by region. C&I provided the majority of savings in the Midwest (57%) and Northeast (63%). Residential provided the majority of savings in the South (55%).

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



# Peak Demand Savings: Investor-Owned Utilities (5)

Composite Cost Curve for Demand Savings From Electric Efficiency Programs: 2010-2018



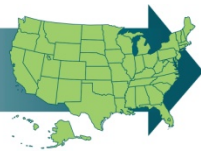
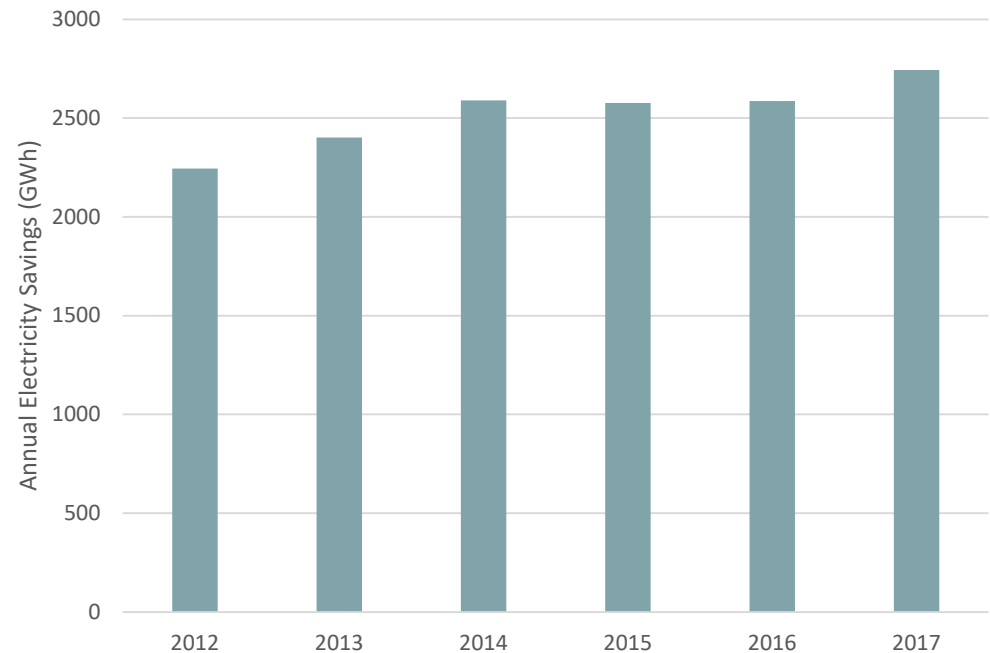
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Source: Mims Frick et al., Berkeley Lab, 2021. [“Still the One: Efficiency Remains a Cost-Effective Electricity Resource”](#)



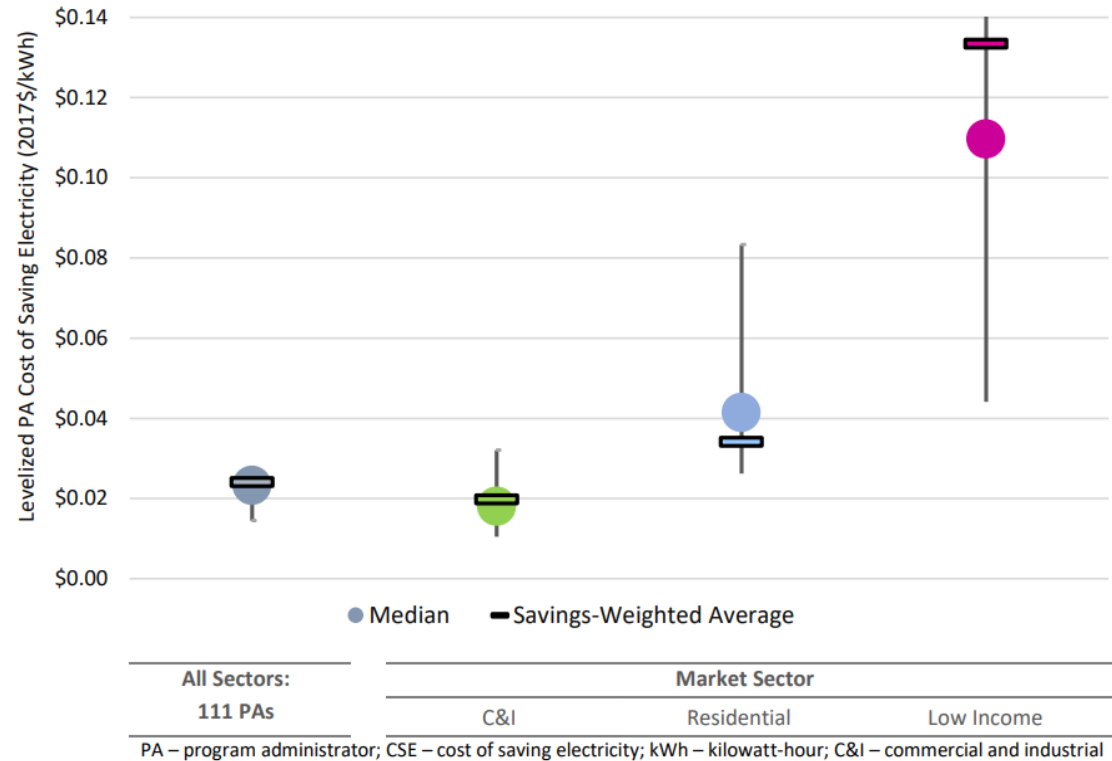
# Electricity Savings: Publicly Owned Utilities (1)

- Savings reported to EIA by municipal utilities and public utility districts grew ~22% from 2012-2017, representing ~1.2% of their retail sales over the period.
- Based on a sample representing the vast majority of all POU efficiency reporting to EIA, POU program savings increased slightly from 1.1% of retail sales in 2012 to 1.3% in 2017.
- C&I represents 59% of the electricity savings, while residential represents 35%.

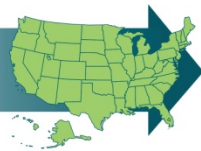
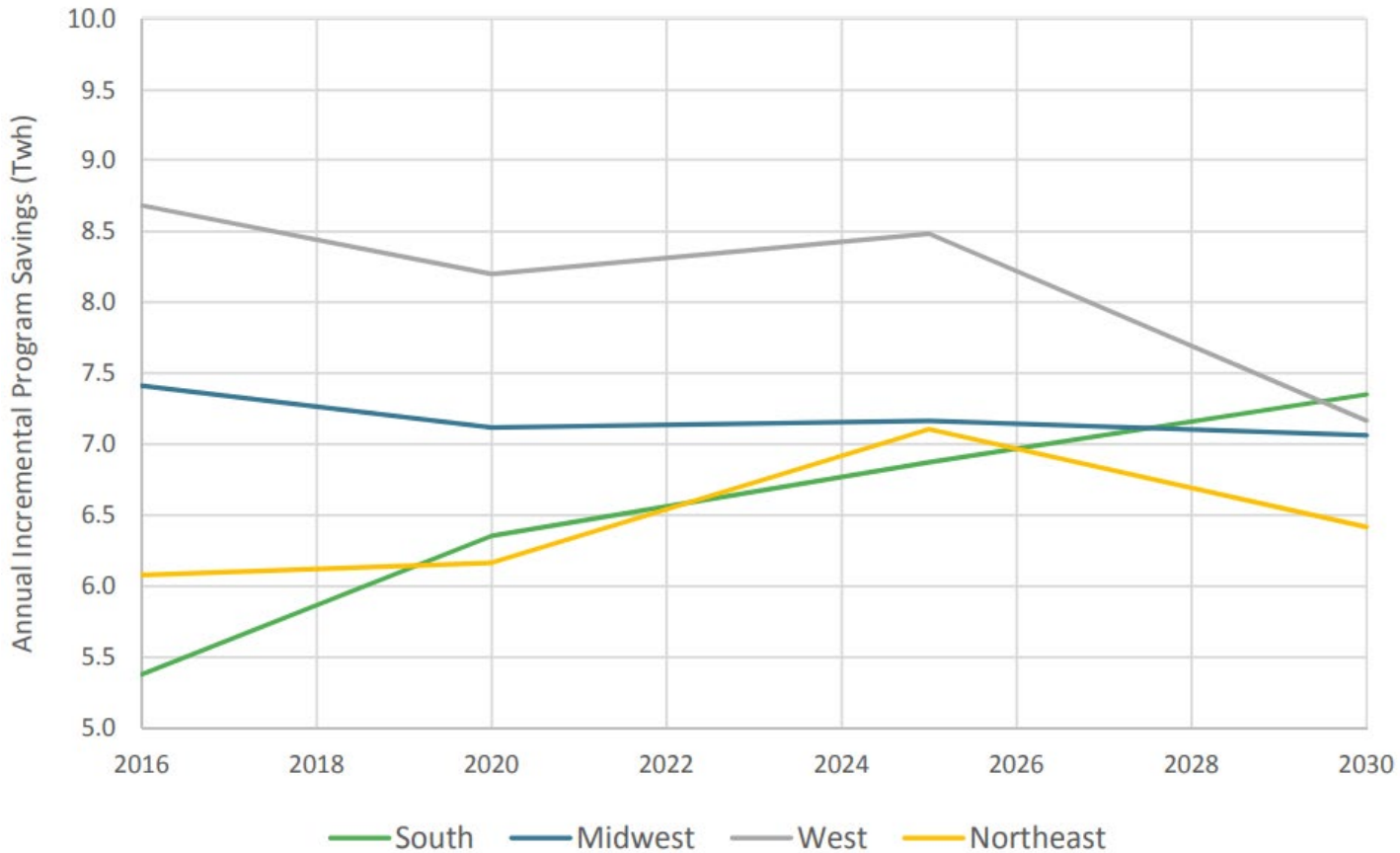


# Cost of Saving Electricity: Publicly Owned Utilities (2)

- The average PA cost of saving electricity was 2.4¢/kWh during the study period.
- The C&I sector accounted for ~60% of savings reported by municipal utilities.
- The C&I sector also had the lowest average PA cost — 2.0¢/kWh.
- The cost for the residential sector was 3.4¢/kWh.



# Electricity Savings from Utility Efficiency Programs Are Projected to Increase Modestly by 2030 (Investor-owned and publicly owned utilities)

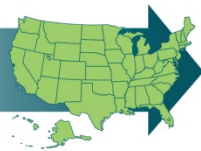
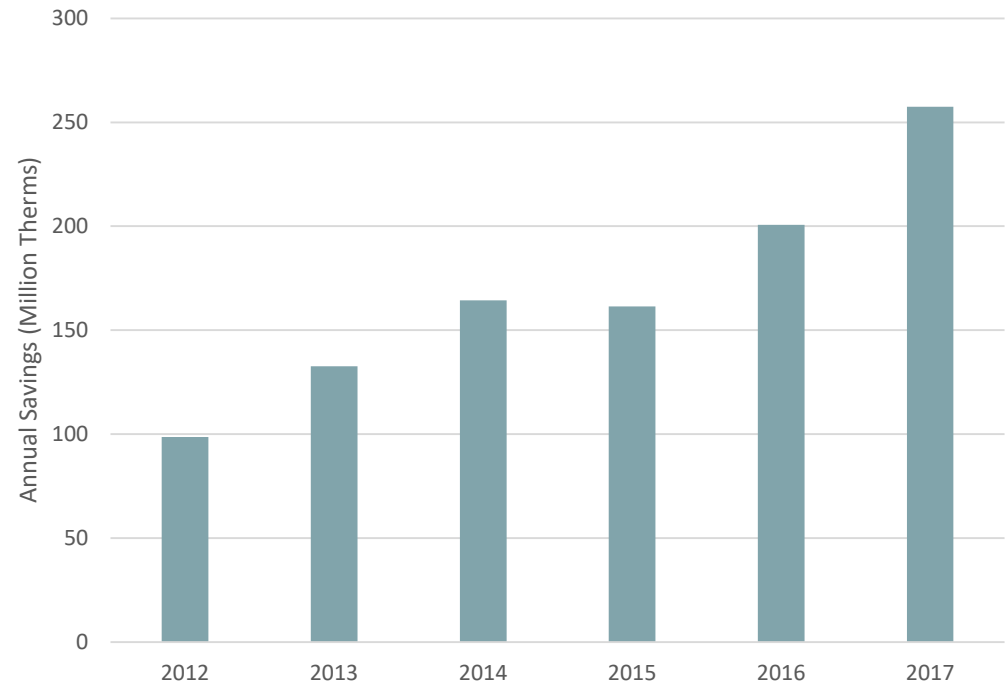


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Source: Goldman et al. 2018. [The Future of U.S. Electricity Efficiency Programs Funded by Utility Customers](#). Berkeley Lab

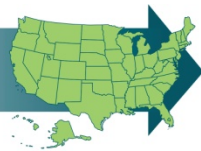
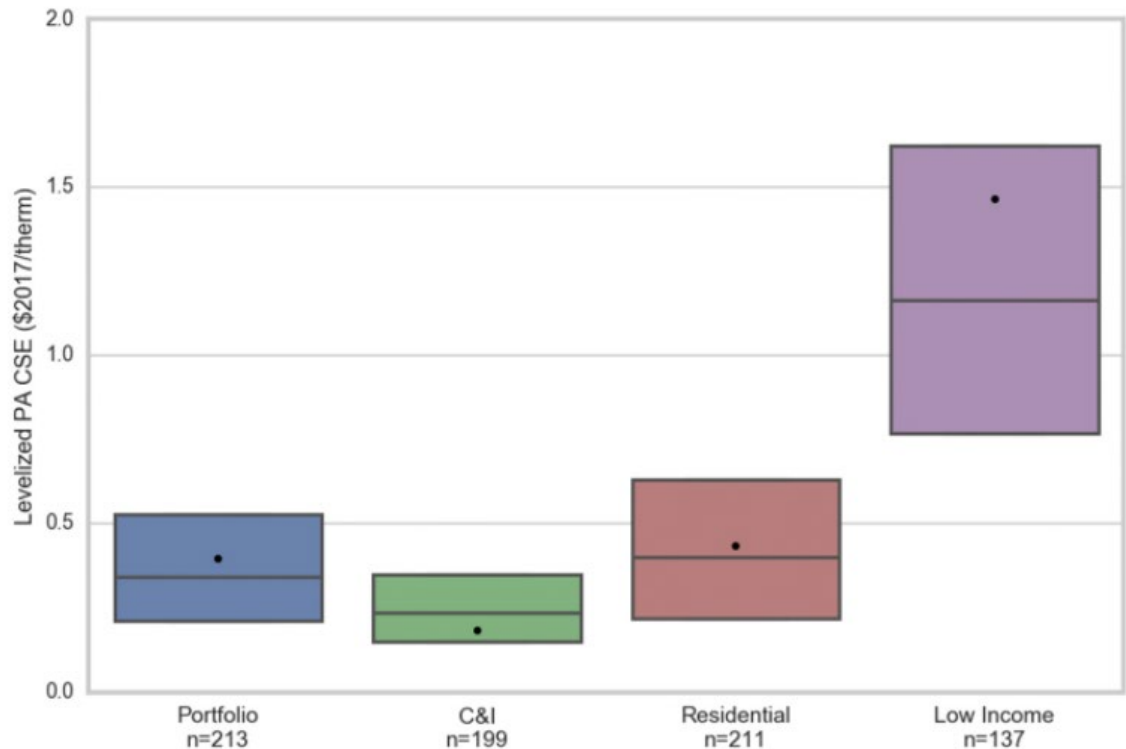
# Natural Gas Utility Programs: Savings

- Natural gas utility savings increased 119% between 2012 and 2017 for the utilities studied.
- C&I represented 44% of electricity savings in the sample, while residential represented 43%.

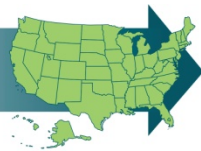


# Natural Gas Utility Programs: Costs

- The average savings-weighted PA cost of saving gas for the 2012-2017 period was 40¢/therm.
- C&I programs provided the lowest cost savings (18¢/therm), but represented only ~20% of spending.
- The cost of saving gas for the residential sector was 43¢/therm. About half of program spending was in the residential sector (not including low-income).

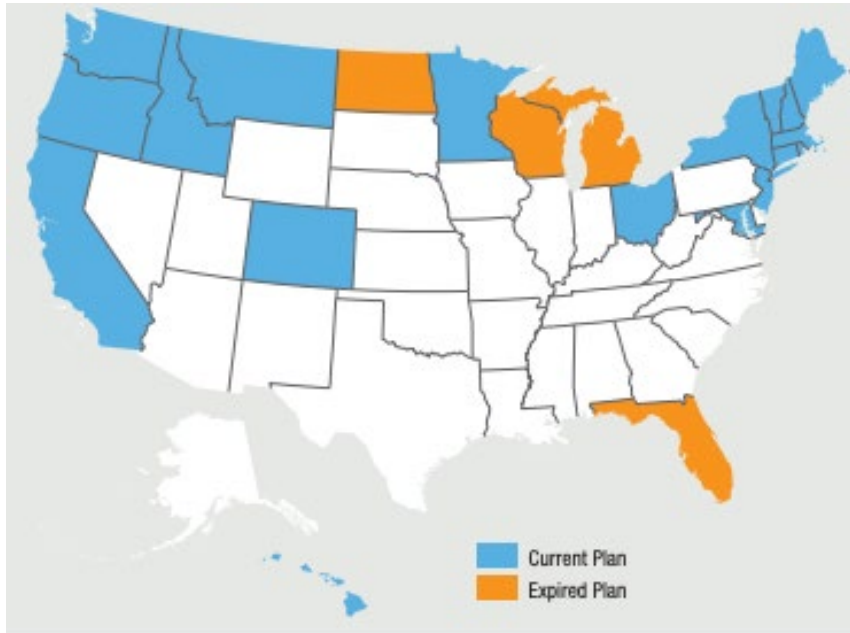


# REGULATORY MECHANISMS TO ADDRESS UTILITY DISINCENTIVES

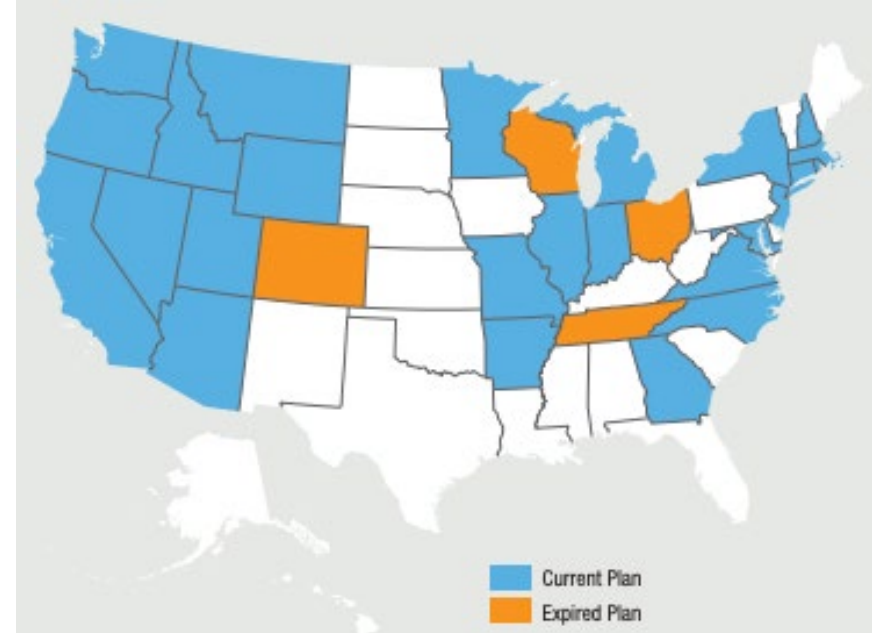


# In Most States, Decoupling Is in Place for at Least One Utility

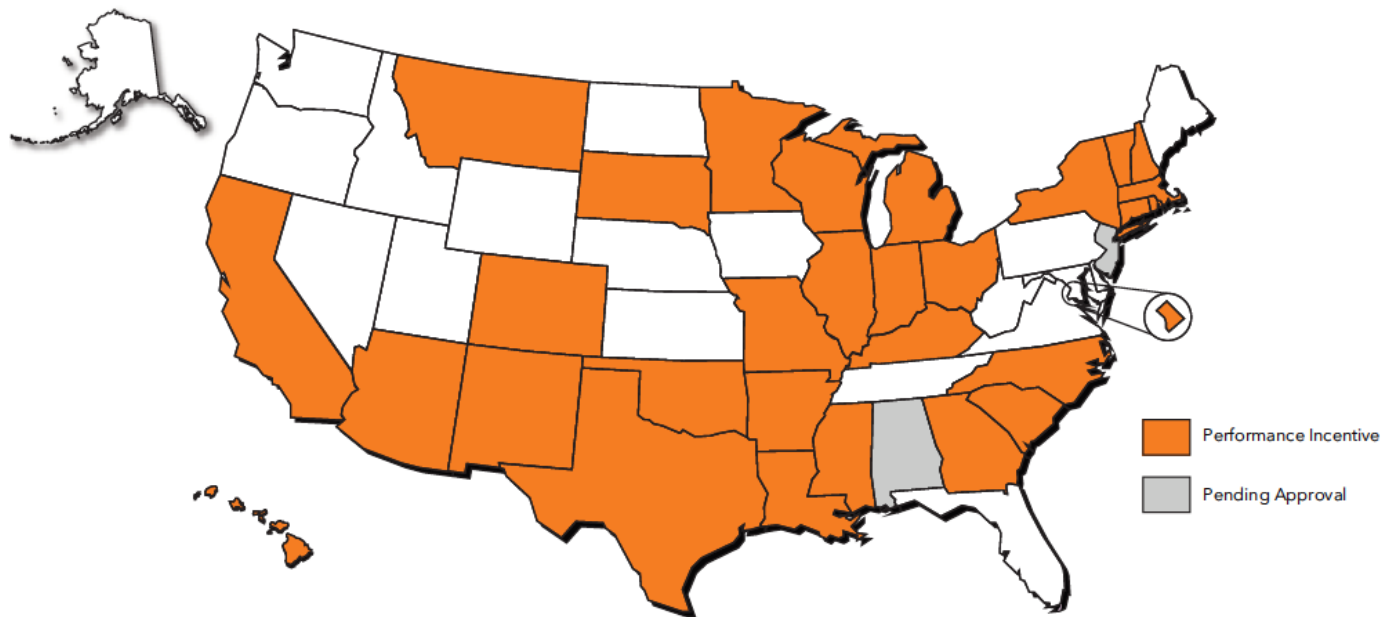
## Electric Utility Revenue Decoupling



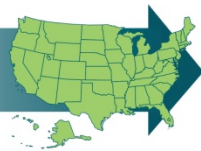
## Natural Gas Utility Revenue Decoupling



# Energy Efficiency Performance Incentives

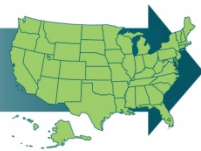


- As of 2018, electric companies in 29 states were eligible for energy efficiency performance incentives, with approval pending in two other states.

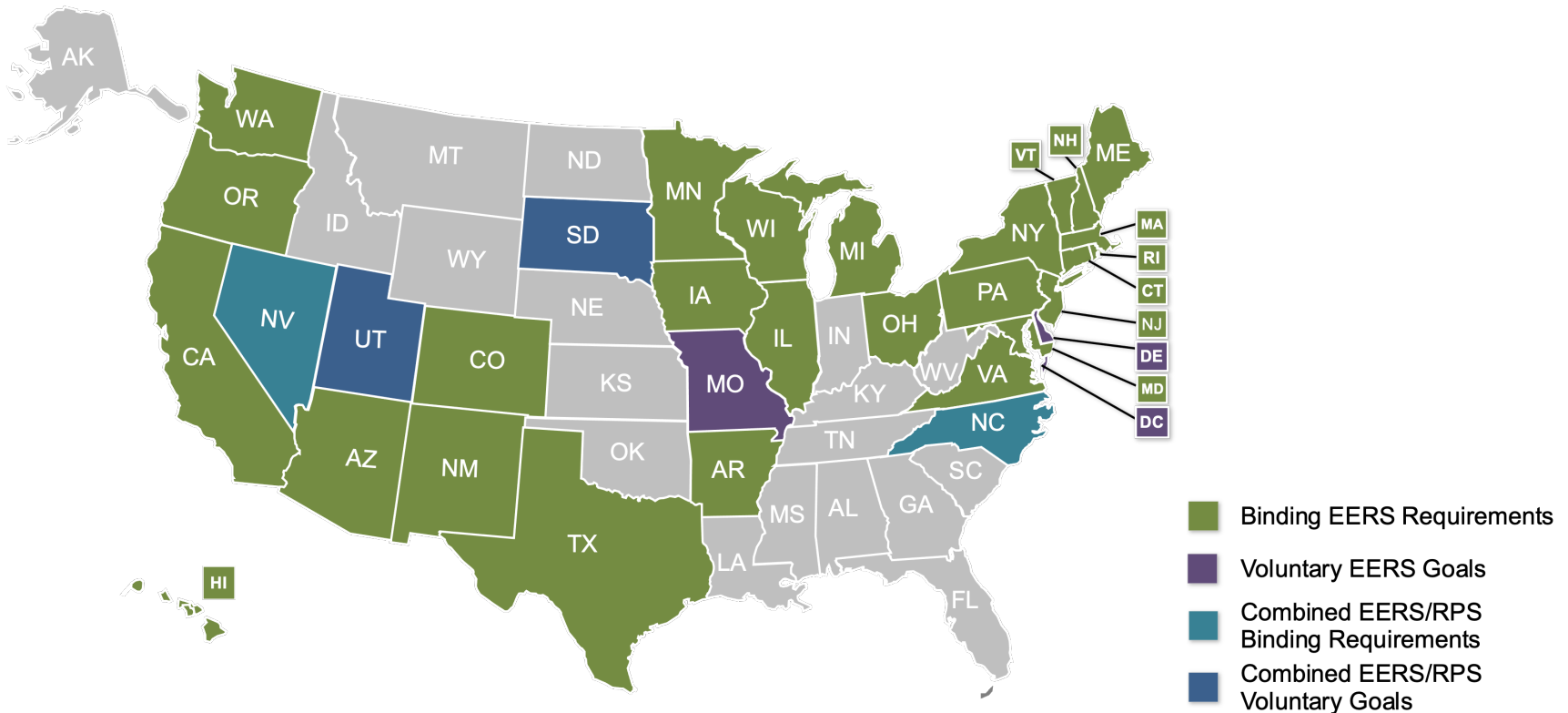




# ENERGY SAVINGS TARGETS



# 32 States Have Energy Savings Targets

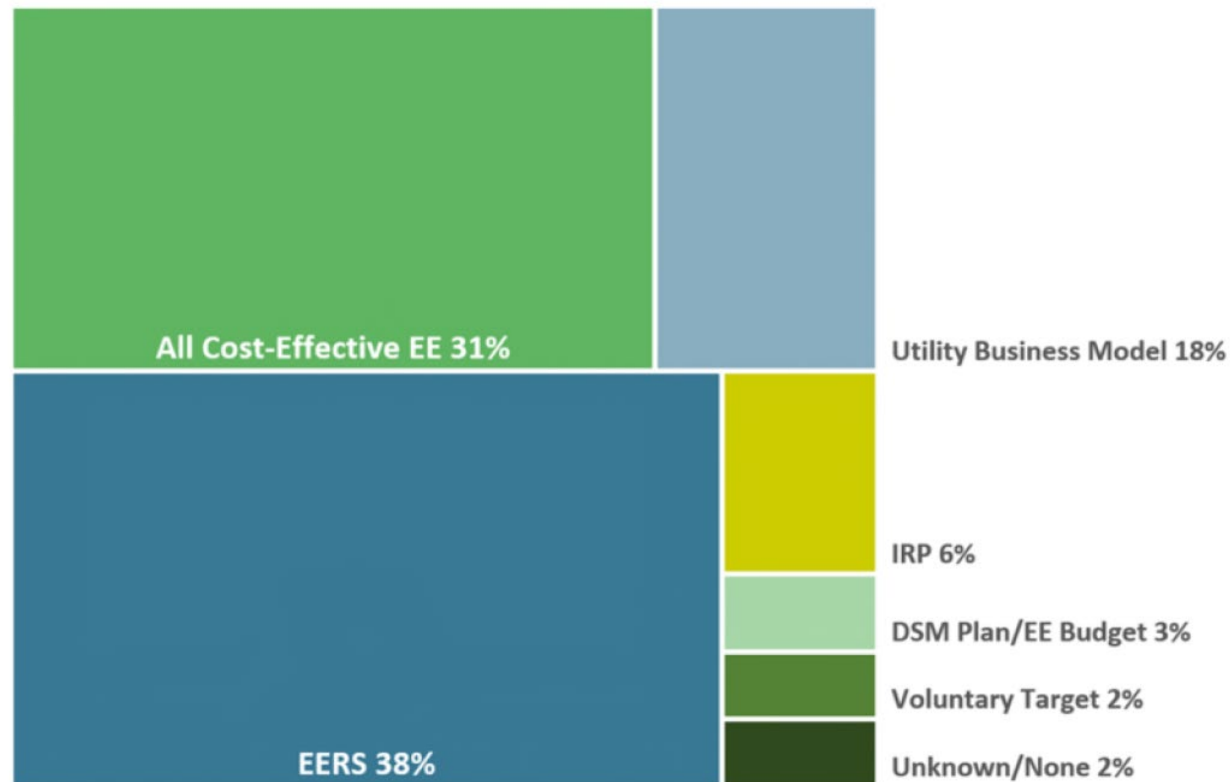


*While most recent state actions have updated or expanded EERS policies, a few states—including FL, IN, OH—enacted policies that effectively eliminated their EERS.*

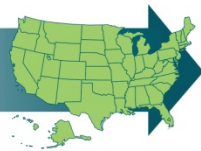


# Energy Savings Targets (EERS) Are Likely to Significantly Impact Utility Program Spending

Primary Policy Drivers for Electricity Efficiency Program Spending  
Medium Case - 2030



# ENERGY SAVINGS PERFORMANCE CONTRACTING

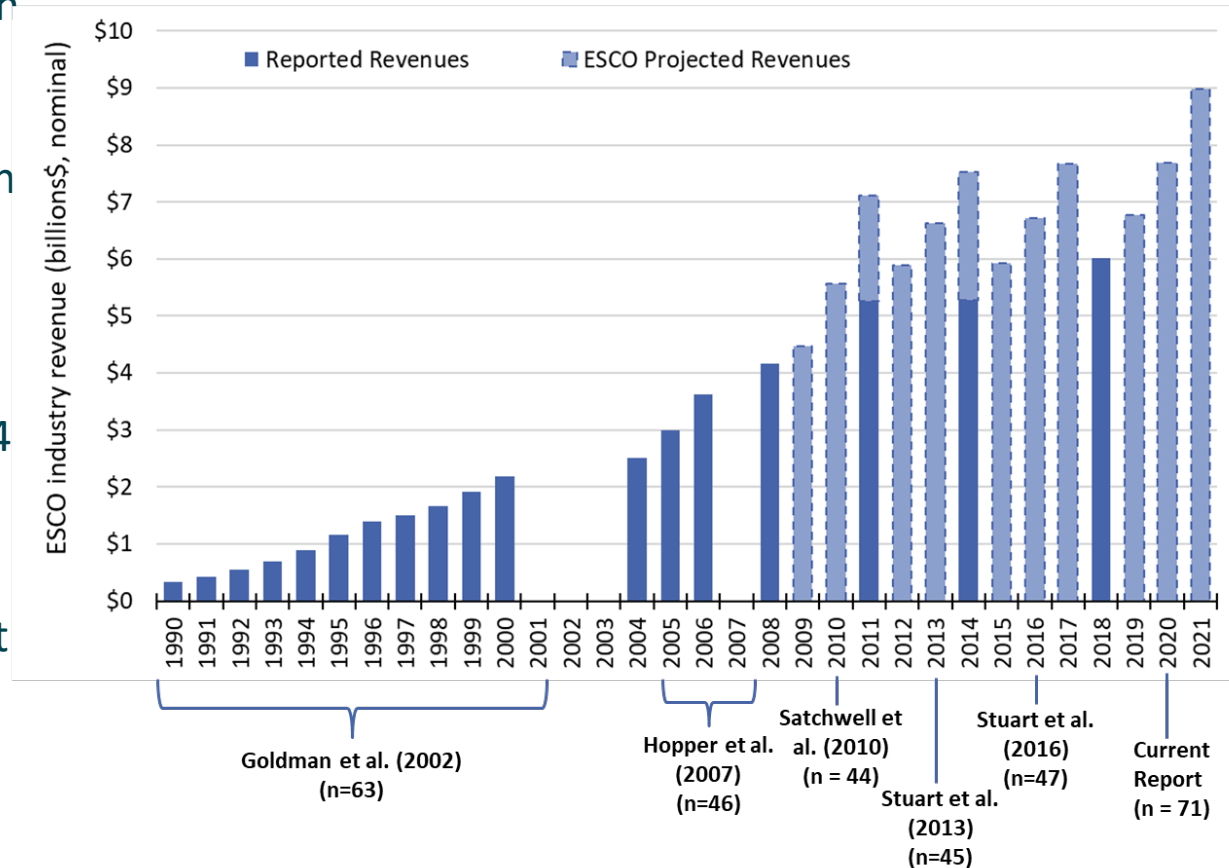


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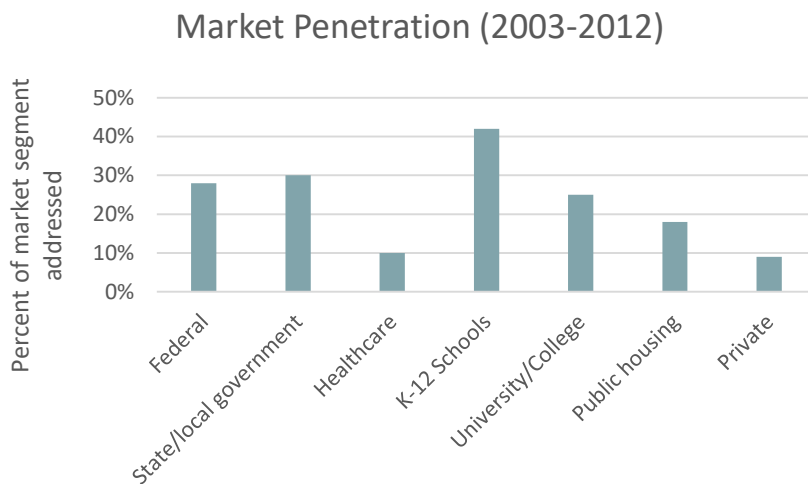
# Energy Service Companies: State of the Industry

- After a period of little growth from 2011-2014, U.S. ESCO industry revenues increased to approximately \$6 billion in 2018.
- These results represent an industry annual growth rate of about 3.4% between 2014 and 2018.
- ESCOs anticipate annual revenues of \$9B in 2021, but ESCOs have tended to be overly optimistic in past projections.

Reported and projected ESCO industry revenues (nominal): 1990-2021

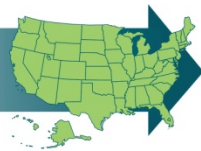


# Large Market Potential Remains for Energy Savings Performance Contracting



- As of 2017, the remaining investment potential for facilities typically addressed by ESCOs ranged from \$92 billion to \$333 billion.
- Compared to 2013, the low estimate of remaining investment potential increased by 30% and the high estimate increased by 150%.
- Market penetration, as of 2012, ranged from 9% for private commercial facilities to 42% for K-12 schools.

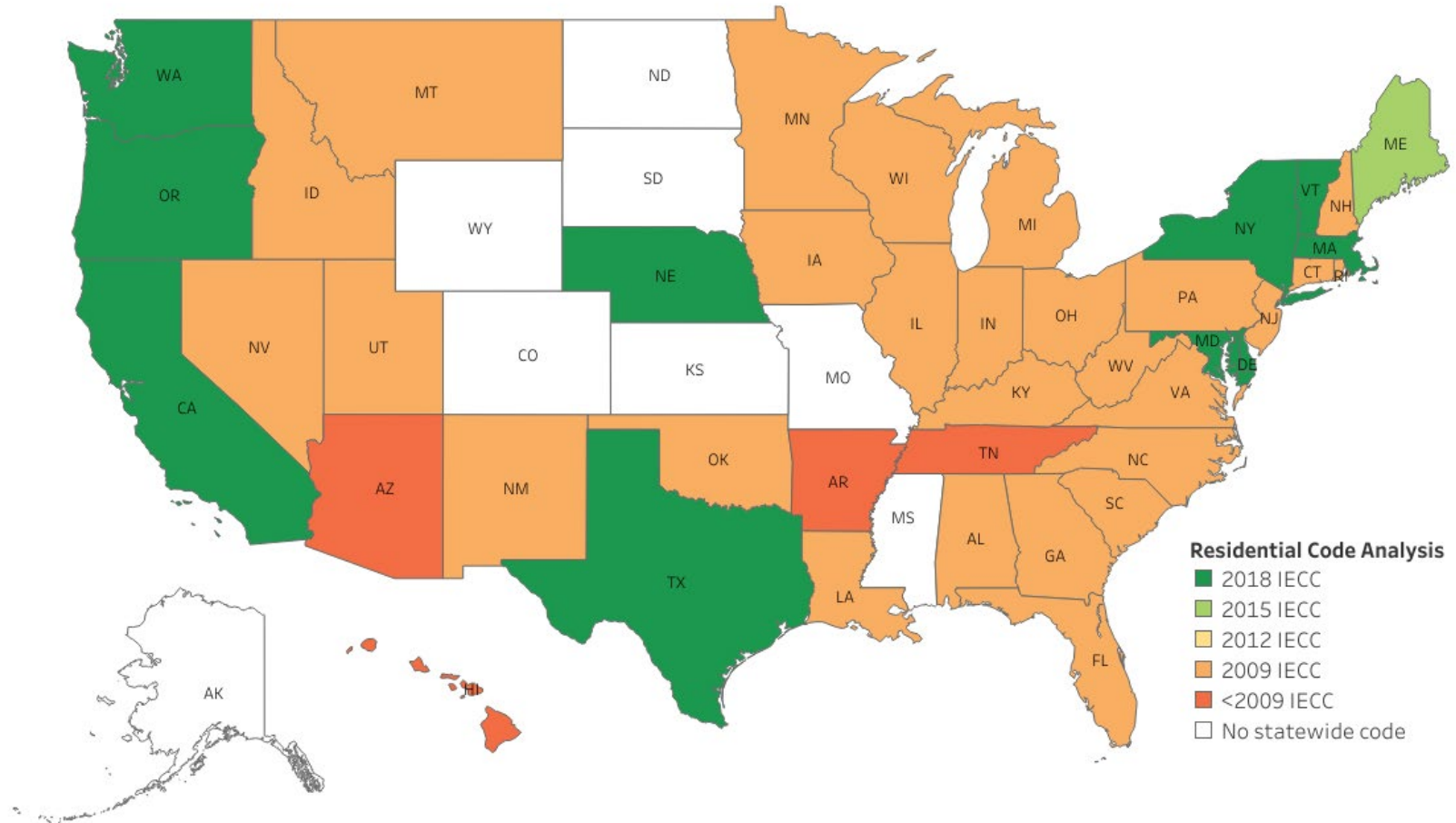
Sources: Larsen et al. 2017. [Updated Estimates of the Remaining Market Potential of the U.S. ESCO Industry](#), Berkeley Lab; Stuart et al. 2014. [A method to estimate the size and remaining market potential of the U.S. ESCO \(energy service company\) industry.](#) *Energy* Vol. 77, Pages 362-371



# CODES AND STANDARDS



# 75% of States Have Adopted Residential Codes Issued in 2009 or Later



*Compared to 66% of states in 2014*

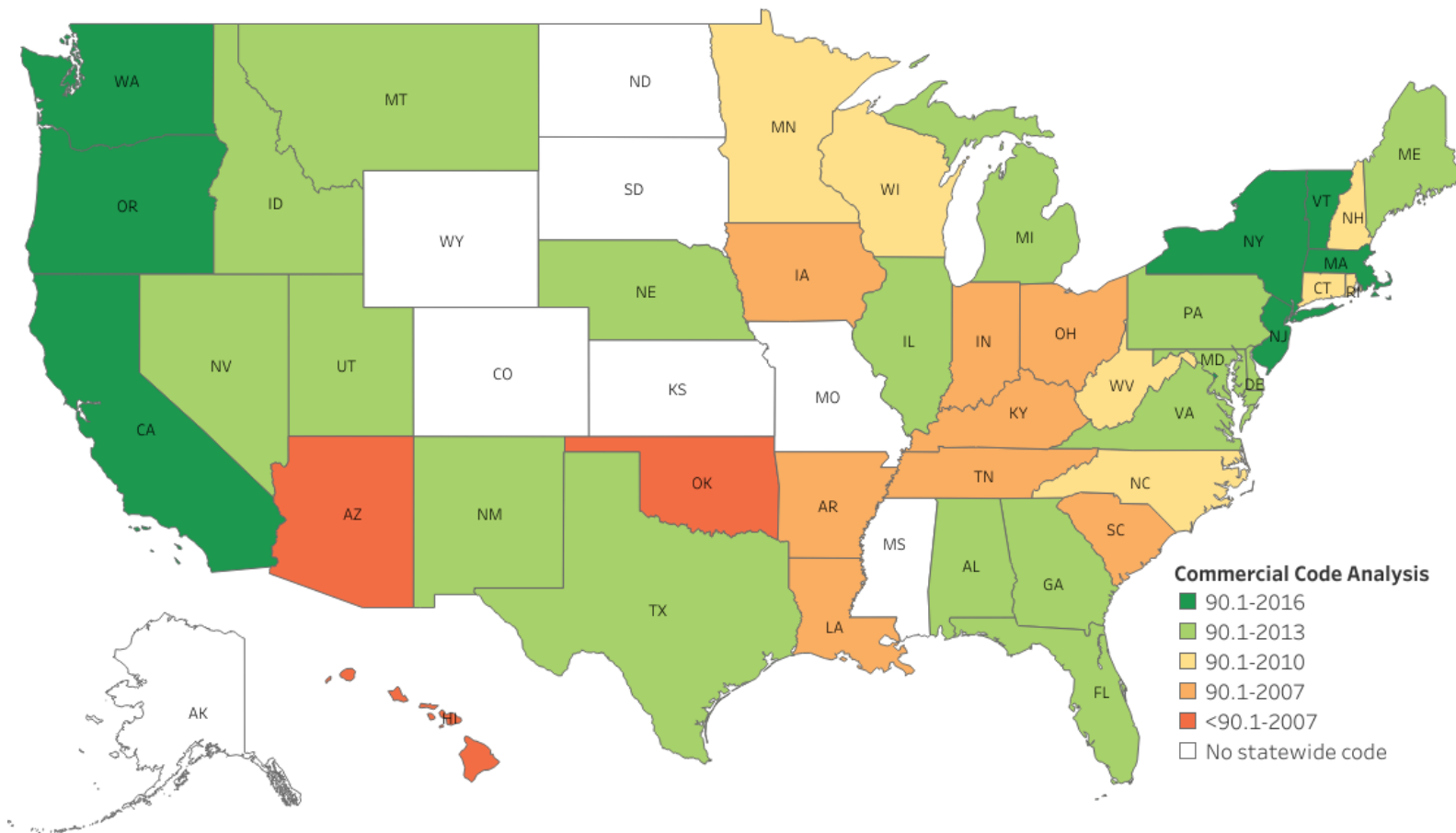


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Source: DOE. [“Status of State Energy Code Adoption - Residential.”](#) Accessed December 2021



# 80% of States Have Adopted Commercial Codes Issued in 2007 or Later

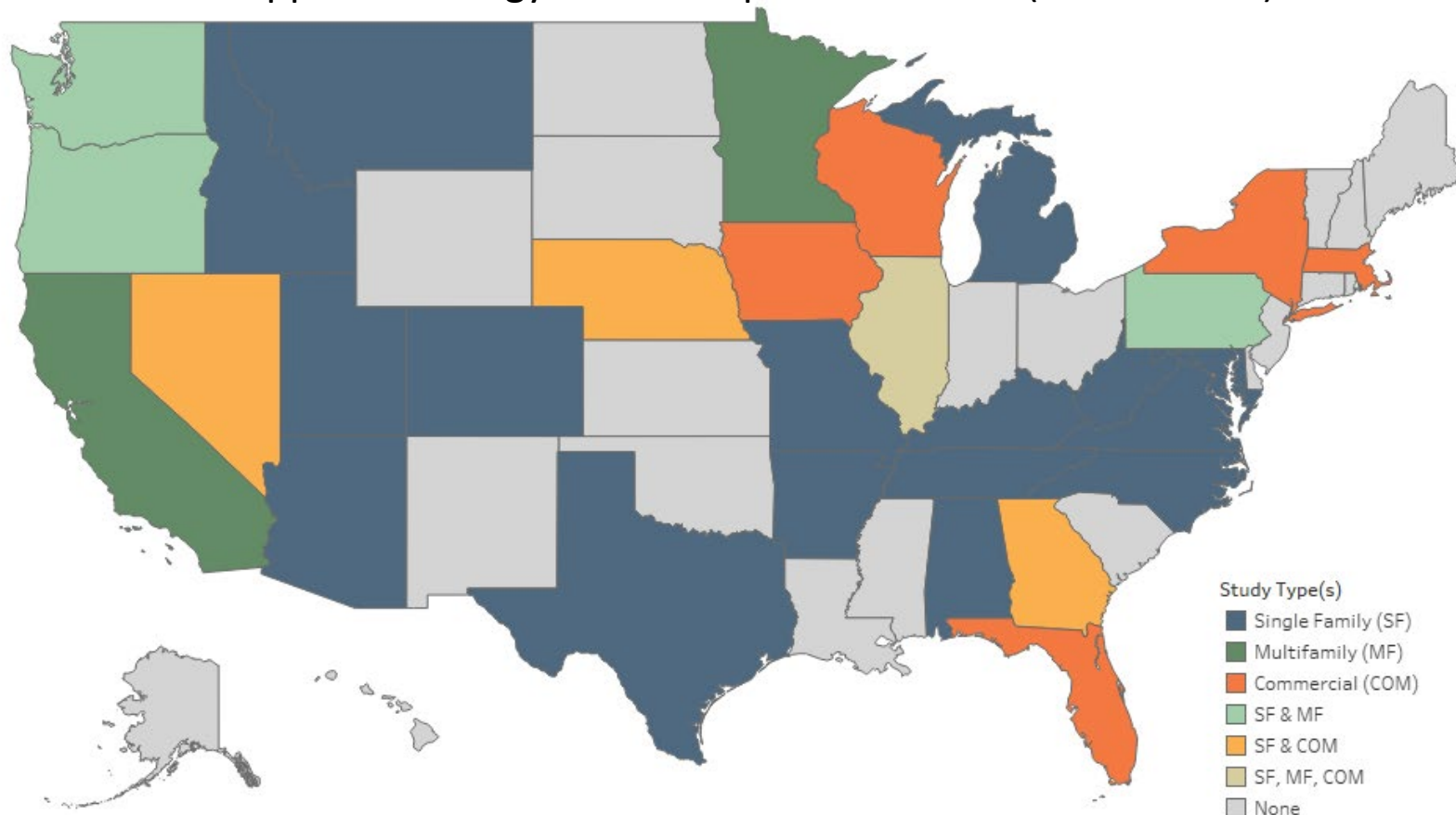


*Compared to 75% in 2014*

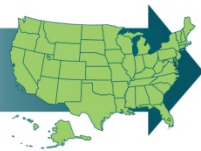


# Two-thirds of States Are Engaged in Some Form of Compliance Enhancement

DOE-Supported Energy Code Compliance Studies (2014 – 2020)



*Compared to 75% of states before 2014*

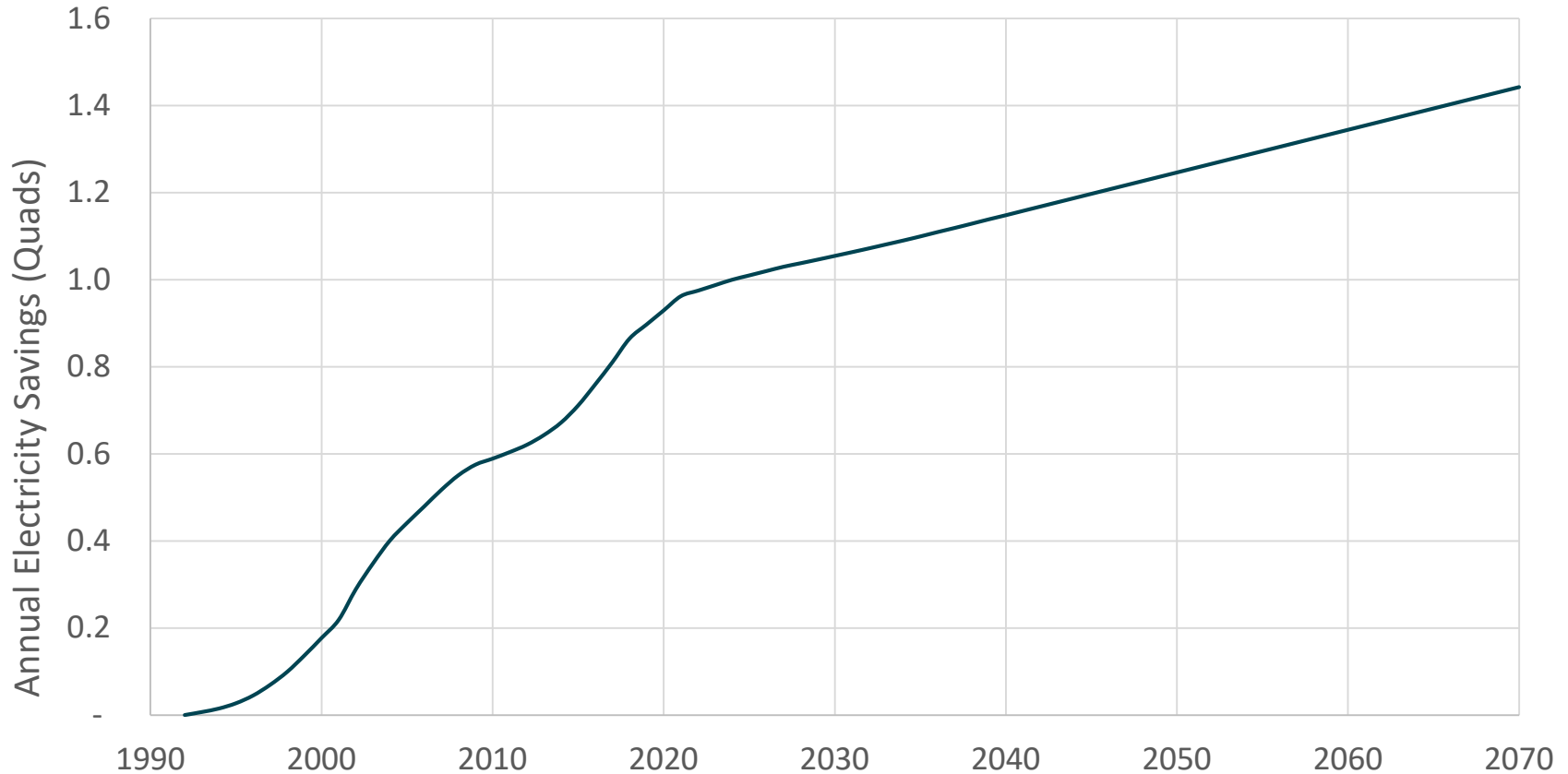


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Map provided by PNNL based on "DOE Building Energy Codes Program: Energy Efficiency Field Studies." 2020.

# Total Electricity Savings from Building Energy Codes Has Risen Considerably

Annual Primary Electricity Savings from Building Energy Codes

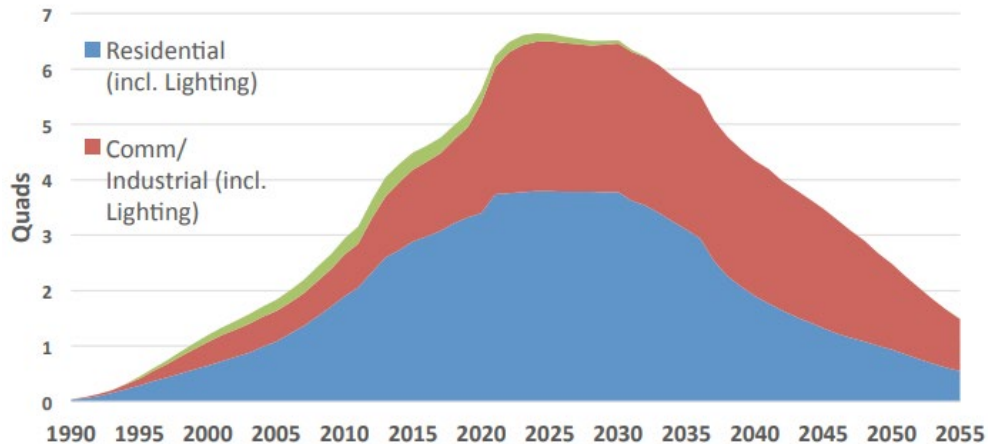


*Electricity savings from building energy codes increased 38% between 2014 and 2020.*



# Savings Rose Sharply As New Appliance and Equipment Standards Took Effect

Annual total energy savings by sector for national appliance and equipment energy efficiency standards adopted in 1987-2015



The impacts peak in the 2025-2030 period as purchases of products subject to standards increase. The decline in impacts reflects the analytical convention of counting impacts for 25-30 years of shipments for each standard. As current standards are revised and new standards are adopted, the impacts from all standards will likely not decline.

Compared to 2012, energy savings in 2015 increased by 24%.



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## In 2015

- Energy savings: 4.49 quads, equal to 5% of total U.S. energy consumption
- CO<sub>2</sub> emissions reduction: 238 million tons

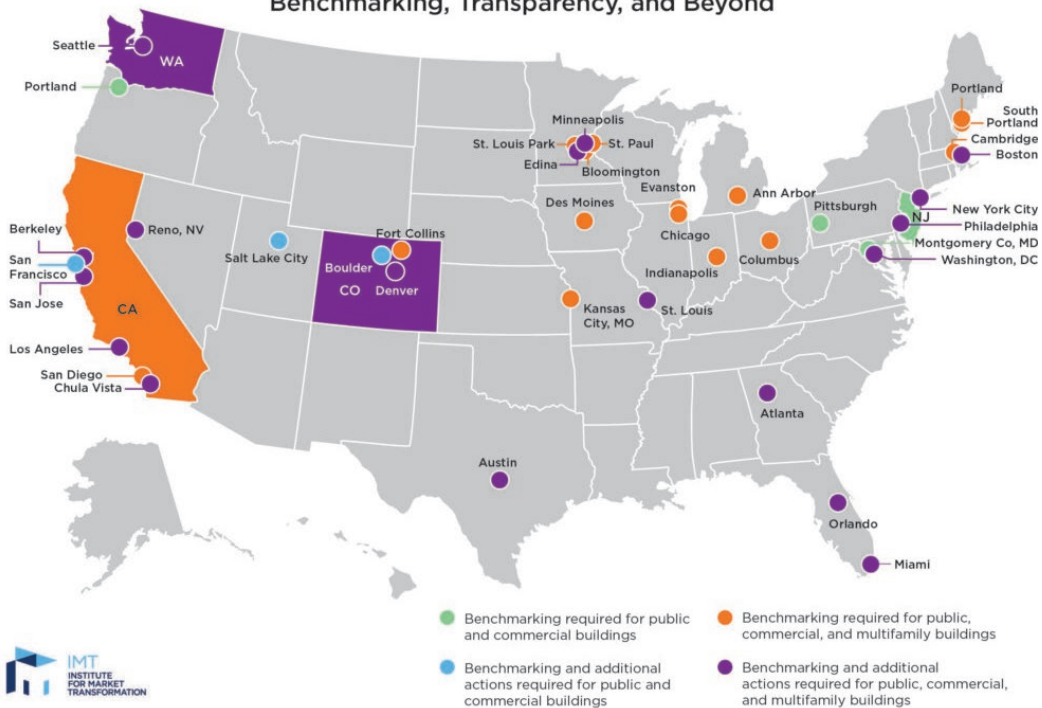
## Projected Cumulative Total

- Energy savings: 216.9 quads (through 2090)
- Consumer benefits: \$1.23 trillion to \$1.56 trillion (net present value through 2090)
- CO<sub>2</sub> emissions reduction: ~10 billion tons (through 2050)

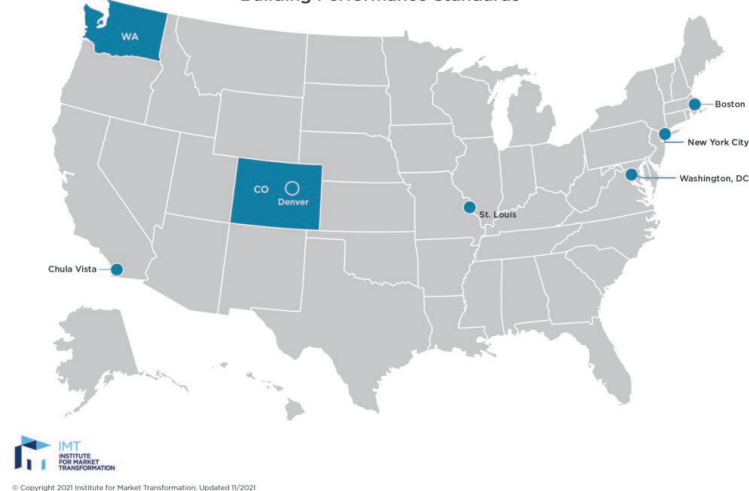
Source: Meyers et al. 2016. [Energy and Economic Impacts of U.S. Federal Energy and Water Conservation Standards Adopted From 1987 Through 2015](#). Berkeley Lab

# Benchmarking, Transparency, and Building Performance Policies Have Spread Across the Country

U.S. City, County, and State Policies for Existing Buildings: Benchmarking, Transparency, and Beyond



U.S. City and State Policies for Existing Buildings: Building Performance Standards



*Among recent additions are a statewide benchmarking policy in California and statewide building performance standards in Washington state.*



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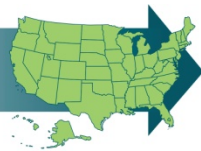
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Source: Institute for Market Transformation. [“Building Performance Policies at a Glance.”](#) Accessed December 2021

# FINANCING PROGRAMS



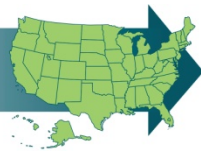
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# On-Bill Financing Programs Continue to Grow

Sector	2014 annual loan volume <sup>1</sup>	2018 annual loan volume <sup>2</sup>
Residential	\$76M	\$97M
Non-residential	\$89M	\$86M
<b>Total</b>	<b>\$179M</b>	<b>\$183M</b>

- As of 2018, at least 110 utilities were operating on-bill financing programs.
- The 2018 annual loan volume includes 40 programs that publicly reported program information or provided it on request. Among these are 15 programs operated by rural electric cooperatives.
- Four California investor-owned utilities accounted for nearly 37% of the 2018 loan volume.

*Annual loan volume grew an estimated 2% between 2014 and 2018 and the number of programs grew by 11.*



Sources:

1. Deason et al. 2016. [Energy Efficiency Program Financing: Where it comes from, where it goes, and how it gets there](#). Berkeley Lab
2. Nick Henner. 2020. [Energy Efficiency Program Financing: Size of the Markets](#). American Council for an Energy-Efficient Economy

# On-Bill Programs: Statutory and Funding Support for Rural Efficiency Financing

## Rural Energy Savings Plan

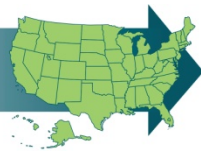
- Passed into law as part of the February 2014 Farm Bill, the program provides zero interest loans for up to 20 years to rural electric co-ops and municipal utilities to operate on-bill financing programs. As of April 2020, [\\$120M in loan capital](#) was available.

## Energy Efficiency and Conservation Loan Program

- The program provides 15-year Treasury-rate federal loans to support energy efficiency programs operated by co-ops and public power authorities serving rural areas (<20,000 population). It can access USDA loan authority of more than \$6 billion/year to support on-bill financing programs, as well as a range of projects including demand-side management and renewable energy investments.

## Rural Energy for America Program

- The program provides funding to farmers, ranchers, and small business owners. Qualifying renewable energy and energy efficiency measures are eligible for loan guarantees up to 75%, and grants up to 25%, of project costs. REAP is now part of the [OneRD Guarantee Loan Initiative](#).

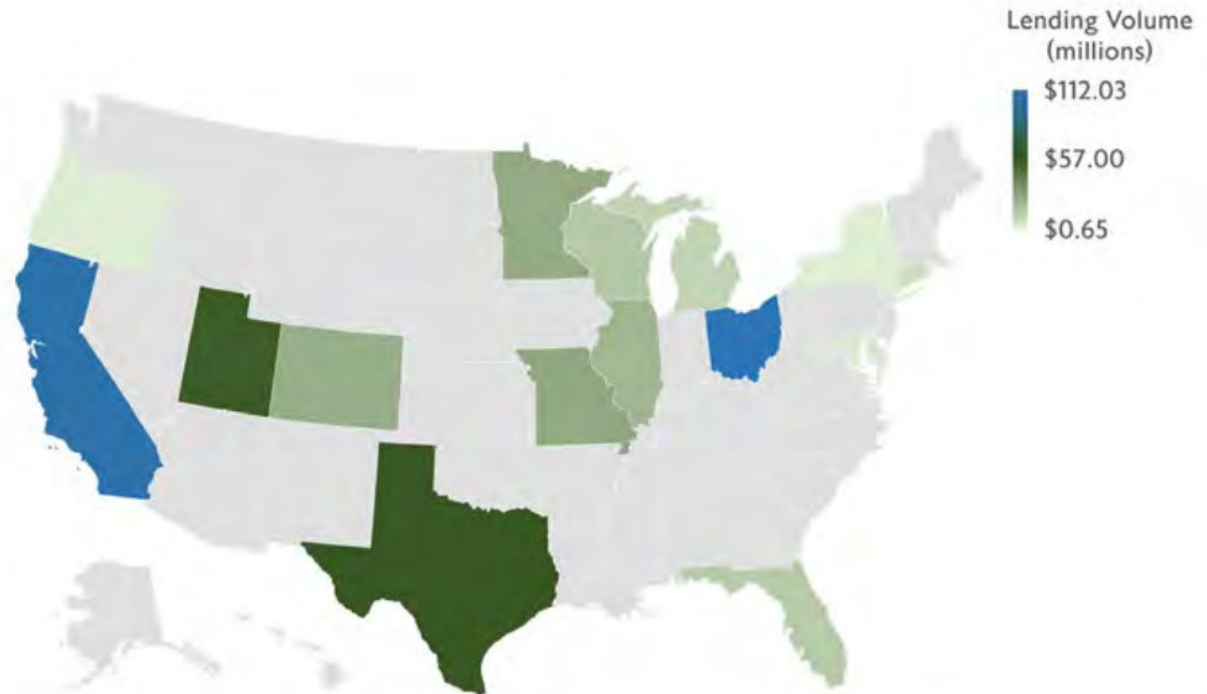




# Commercial Property Assessed Clean Energy Programs Picked Up a Fast PACE

- 37 states and D.C. have enabled C-PACE.
- 18 states have active C-PACE programs.
- An estimated \$855M in C-PACE financing in 2019 was used for energy efficiency upgrades.
- Between 2014 and 2019, annual energy efficiency financing through C-PACE grew by 2,500%.

C-PACE energy efficiency lending volume in 2019



*Compared to 2014, 6 additional states have enabled C-PACE programs.*





# Residential PACE Programs

Estimated R-PACE program first-year and lifetime savings

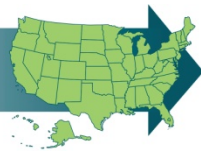
Average percentage household first-year electricity savings	Average absolute household first-year electricity savings (kWh)	Total first-year electricity savings (GWh)	Total lifetime electricity savings (TWh)	Average percentage household first-year gas savings	Average absolute household first-year gas savings (therms)	Total first-year gas savings (million therms)	Total lifetime gas savings (million therms)
2.9%	245	35	0.7	3.5%	16	2.3	44

- From July 2016 through June 2017, California R-PACE programs served about 60,000 households, of which ~43,000 conducted energy efficiency projects.
- 14 R-PACE programs are active in California, Florida and Missouri.
- Nationwide, 53% of R-PACE financing in 2019 was for projects in California.

*Compared to 2014, 7 additional R-PACE programs are available.*

Sources:

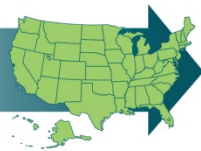
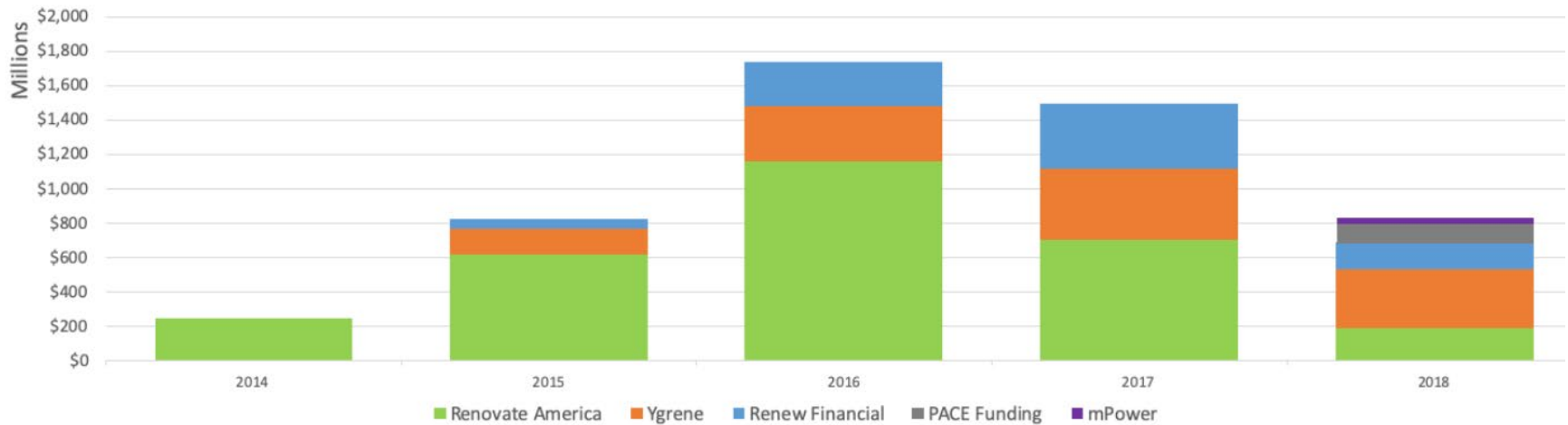
1. Deason, J.; Murphy, S.; Goldman, C.A. Empirical Estimation of the Energy Impacts of Projects Installed through Residential Property Assessed Clean Energy Financing Programs in California. *Energies* 2021, 14, 8060. <https://doi.org/10.3390/en14238060>
2. PACENation. "PACE Programs." Accessed December 2020
3. PACE Loss Reserve Program. "PACE Loss Reserve Program Enrollment Activity." Accessed December 2020.



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# R-PACE Lenders Are Using Secondary Markets to Replenish Funds

## R-PACE Securitization

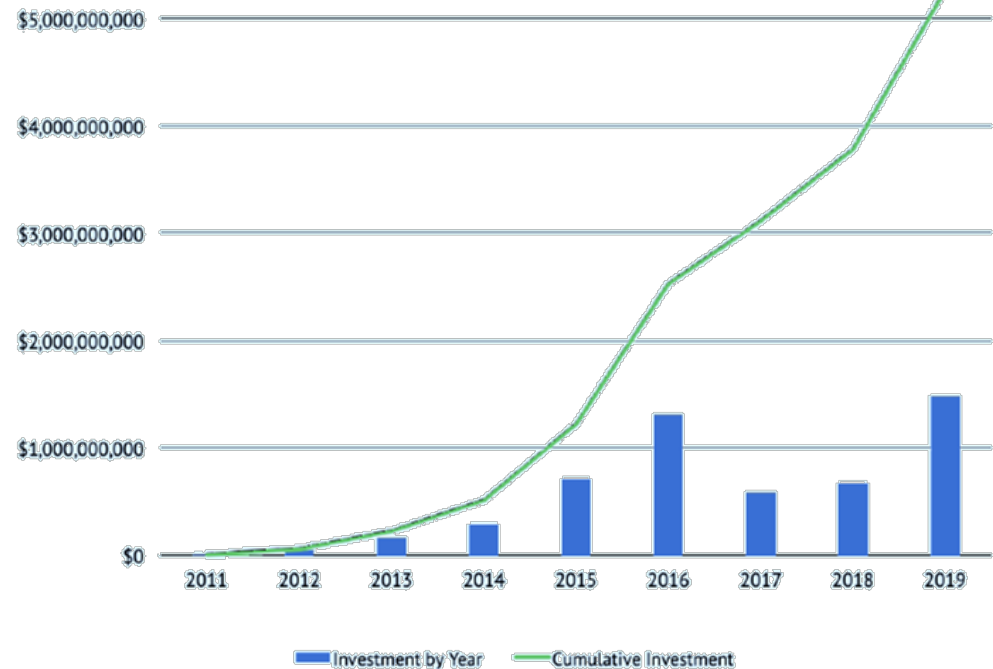




# Green Banks Are Enabling Significant Investments With Private Co-Investment

- Green Banks co-funded \$5 billion in investments between 2011 and 2019.
- Private co-investment accounted for \$3.8 billion of that amount.
- Some \$675M was invested in publicly profiled projects.
  - 19% for public and nonprofit energy efficiency projects
  - 6% for multi-family energy efficiency projects
  - 4% for commercial energy efficiency projects
- Low- and moderate-income household lending is expected to grow.

**Investment Caused by Green Banks**

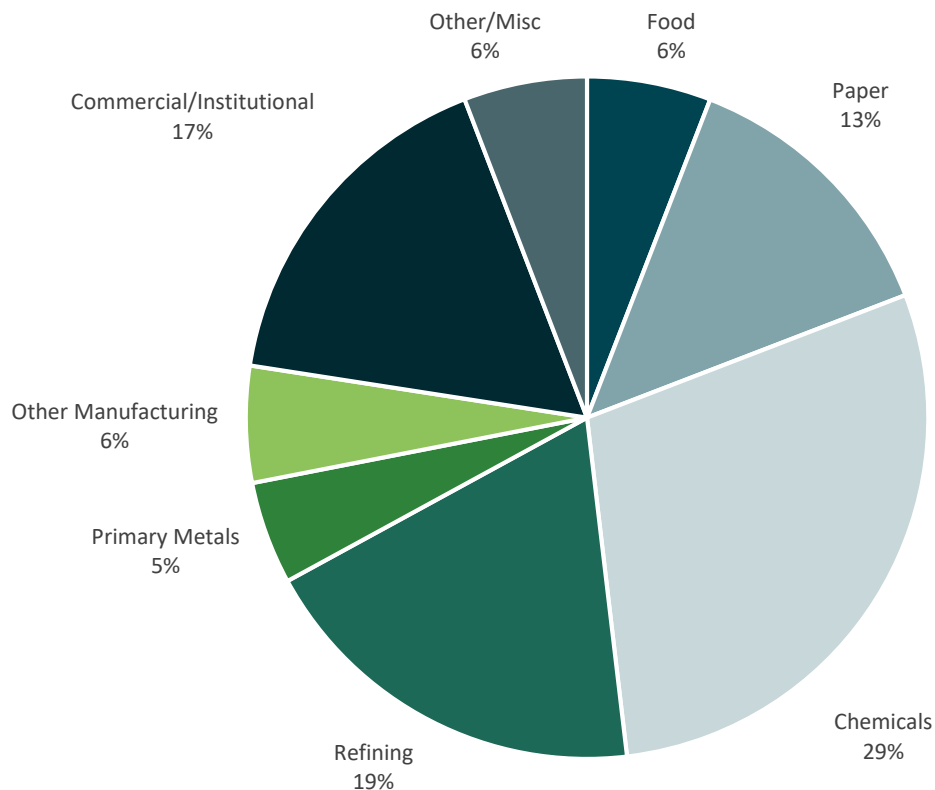


# COMBINED HEAT AND POWER



# Combined Heat and Power Installations

- As of 2019, 80.7 GW of CHP was installed at more than 4,600 C&I facilities.
- 77% of capacity is for industrial applications.
- 72% of capacity is natural gas-fired.



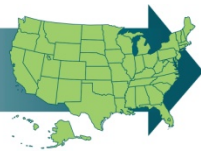
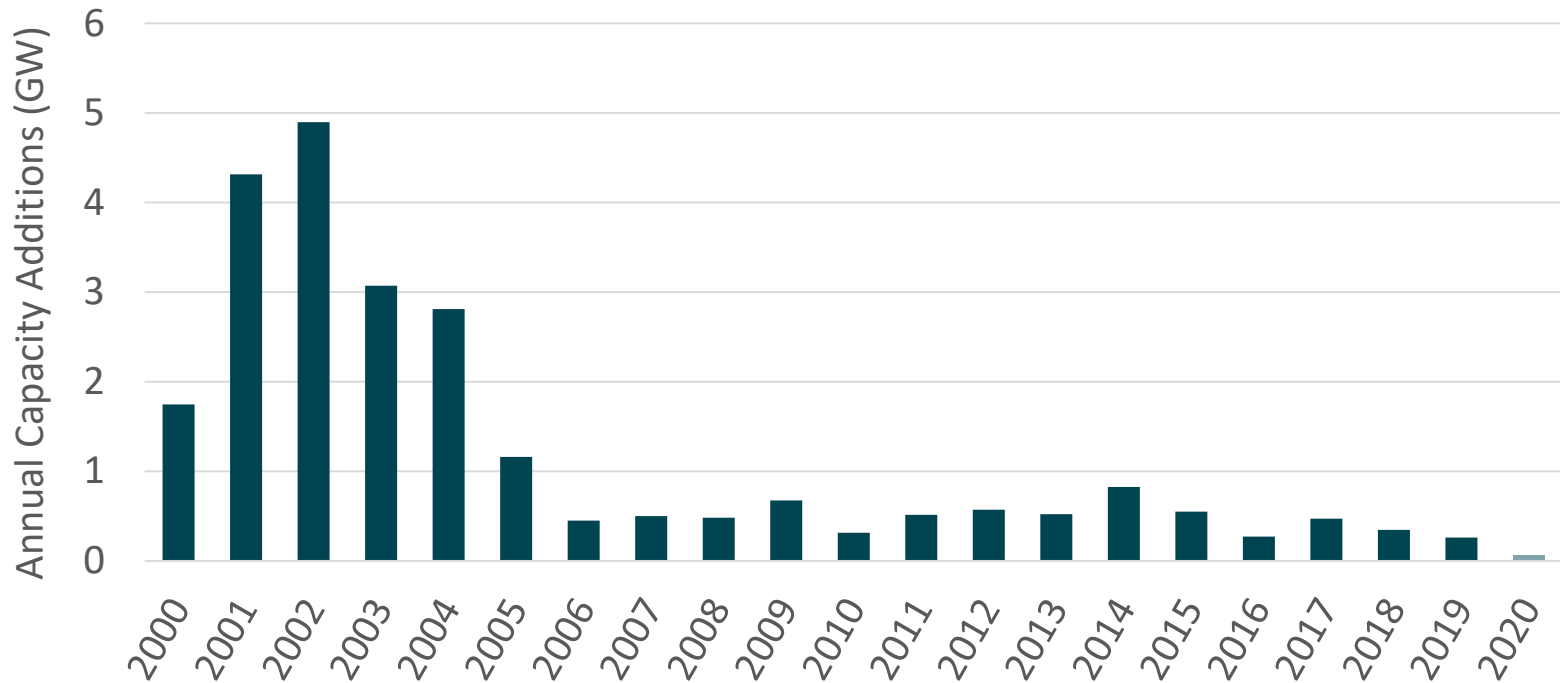
*300 new CHP facilities were installed between 2014 and 2019.*





# Growth of CHP in Recent Years Has Been Limited

- Additional capacity installed since 2014: 2.8 GW
- 70 GW of CHP capacity verified as operational



## Contact

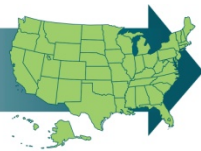
**Lisa Schwartz:** [lcschwartz@lbl.gov](mailto:lcschwartz@lbl.gov), (510) 486-6315

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