State Indicators for Advancing Demand Flexibility and Energy Efficiency in Buildings – Part II
Traditional Energy Efficiency Indicators for Electricity and Gas

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

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

<table>
<thead>
<tr>
<th>Scenario</th>
<th>2025</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>1.4%</td>
<td>1.2%</td>
</tr>
<tr>
<td>Medium</td>
<td>1.8%</td>
<td>1.6%</td>
</tr>
<tr>
<td>High</td>
<td>2.2%</td>
<td>2.1%</td>
</tr>
</tbody>
</table>


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.

**U.S. electric efficiency programs funded by utility customers resulted in estimated gross incremental savings of 32,755 gigawatt hours in 2019.**

Utility Customer-Funded Programs

Natural Gas Efficiency Savings:

U.S. natural gas efficiency programs funded by utility customers resulted in estimated gross incremental savings of ~320 million therms of gas in 2019.

*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.

Investor-owned utilities (IOUs) and other program administrators (PAs) in 14 of the 21 states studied reported savings ≥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.
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.

Source: Mims Frick et al., Berkeley Lab, 2021. “Still the One: Efficiency Remains a Cost-Effective Electricity Resource”
Electricity Savings and Costs: Investor-Owned Utilities (3)

CSE by Market Sector and Region (2010-2018)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Levelized CSE ($/kWh)</th>
<th>Sample Size (No. of Programs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>$0.026</td>
<td>11,796</td>
</tr>
<tr>
<td>C&amp;I</td>
<td>$0.023</td>
<td>4,579</td>
</tr>
<tr>
<td>Low Income</td>
<td>$0.091</td>
<td>983</td>
</tr>
<tr>
<td>Residential</td>
<td>$0.027</td>
<td>4,137</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Region</th>
<th>Levelized CSE ($/kWh)</th>
<th>Sample Size (No. of Programs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midwest</td>
<td>$0.017</td>
<td>2,357</td>
</tr>
<tr>
<td>Northeast</td>
<td>$0.031</td>
<td>2,871</td>
</tr>
<tr>
<td>South</td>
<td>$0.030</td>
<td>3,098</td>
</tr>
<tr>
<td>West</td>
<td>$0.027</td>
<td>3,469</td>
</tr>
</tbody>
</table>

- 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

Source: Mims Frick et al., Berkeley Lab, 2021. “Still the One: Efficiency Remains a Cost-Effective Electricity Resource”
Electricity Savings and Costs: Investor-Owned Utilities (4)

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

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

Levelized Cost of Saved Peak Demand ($/kW) vs. Savings as percent of retail sales

Source: Mims Frick et al., Berkeley Lab, 2021. “Still the One: Efficiency Remains a Cost-Effective Electricity Resource”
Peak Demand Savings: Investor-Owned Utilities (2)

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

<table>
<thead>
<tr>
<th>Program year</th>
<th>All programs $/kW</th>
<th>Time-trend analysis $/kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>$179</td>
<td>$187</td>
</tr>
<tr>
<td>2015</td>
<td>$175</td>
<td>$170</td>
</tr>
<tr>
<td>2016</td>
<td>$160</td>
<td>$162</td>
</tr>
<tr>
<td>2017</td>
<td>$137</td>
<td>$138</td>
</tr>
<tr>
<td>2018</td>
<td>$125</td>
<td>$151</td>
</tr>
</tbody>
</table>

Source: Mims Frick et al., Berkeley Lab, 2021. "Still the One: Efficiency Remains a Cost-Effective Electricity Resource"
Peak Demand Savings: Investor-Owned Utilities (3)

CSPD by Market Sector and Region

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

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

Source: Mims Frick et al., Berkeley Lab, 2021. “Still the One: Efficiency Remains a Cost-Effective Electricity Resource”
Peak Demand Savings: Investor-Owned Utilities (5)

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

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%.

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)

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

Source: Mark Newton Lowry and Matt Makos, "Revenue Decoupling at 40," Public Utilities Fortnightly, April 2021
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
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
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.

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.

CODES AND STANDARDS
75% of States Have Adopted Residential Codes Issued in 2009 or Later

Compared to 66% of states in 2014

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
Total Electricity Savings from Building Energy Codes Has Risen Considerably

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.

In 2015
- Energy savings: 4.49 quads, equal to 5% of total U.S. energy consumption
- CO₂ 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)
- CO₂ emissions reduction: ~10 billion tons (through 2050)

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

Among recent additions are a statewide benchmarking policy in California and statewide building performance standards in Washington state.
FINANCING PROGRAMS
On-Bill Financing Programs Continue to Grow

<table>
<thead>
<tr>
<th>Sector</th>
<th>2014 annual loan volume&lt;sup&gt;1&lt;/sup&gt;</th>
<th>2018 annual loan volume&lt;sup&gt;2&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>$76M</td>
<td>$97M</td>
</tr>
<tr>
<td>Non-residential</td>
<td>$89M</td>
<td>$86M</td>
</tr>
<tr>
<td>Total</td>
<td>$179M</td>
<td>$183M</td>
</tr>
</tbody>
</table>

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

Remote 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%.

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

States with C-PACE Enabling Legislation

Residential PACE Programs

Estimated R-PACE program first-year and lifetime savings

<table>
<thead>
<tr>
<th>Average percentage household first-year electricity savings</th>
<th>Average absolute household first-year electricity savings (kWh)</th>
<th>Total first-year electricity savings (GWh)</th>
<th>Total lifetime electricity savings (TWh)</th>
<th>Average percentage household first-year gas savings</th>
<th>Average absolute household first-year gas savings (therms)</th>
<th>Total first-year gas savings (million therms)</th>
<th>Total lifetime gas savings (million therms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.9%</td>
<td>245</td>
<td>35</td>
<td>0.7</td>
<td>3.5%</td>
<td>16</td>
<td>2.3</td>
<td>44</td>
</tr>
</tbody>
</table>

- 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:
2. PACENation. “PACE Programs.” Accessed December 2020
R-PACE Lenders Are Using Secondary Markets to Replenish Funds

R-PACE Securitization

As of 2021, 36 states provided access to an RLF, with $1.65B available in financing for energy efficiency and renewable energy projects.¹

In 2018, 20 RLF programs in 17 states funded $146M of efficiency projects. Compared to 2014, loan volumes grew by an estimated 97% (from $74M), and 8 new programs were established.²

¹ NASEO. 2021. Personal communication

https://www.naseo.org/issues/energy-financing/revolving-loan-funds
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.

COMBINED HEAT AND POWER
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

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