ACEEE Policy Brief

American Council for an Energy-Efficient Economy

The Cost of Saving Electricity for the Largest U.S. Utilities: Ratepayer-Funded Efficiency Programs in 2018

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KEY FINDINGS

- Utility energy efficiency programs continue to be extremely cost effective. For program year 2018, the cost of saved energy remains as low or lower than it has been in past studies.
- The levelized program cost of saved energy was $0.024/kWh in program year 2018, based on data aggregated from the portfolios of 48 large investor-owned utilities and weighted based on overall portfolio savings.
- Low-income efficiency programs, which are pursued for customer equity objectives rather than least-cost resource planning, have a higher cost of saved energy than non-low-income programs. However, even considering the higher costs of low-income programs, the aggregate cost of saved energy remains comparable to the least-cost generation resources available to grid planners.
- A purely cost-based analysis does not capture the full benefits of efficiency. More robust cost-effectiveness testing is needed to fully evaluate energy efficiency investments, including emissions impacts, grid reliability and resiliency benefits, participant and societal benefits, and more.
- When compared to the levelized cost of supply-side energy, energy efficiency is comparable to the least-cost generation resources available on the grid today, and it is cheaper than the least expensive fossil fuel option.

Introduction

Energy efficiency has a long history of serving as an abundant, low-cost, carbon-free energy resource. Prior ACEEE research shows that energy efficiency currently provides approximately 18% of utilities' power supply needs.[1] Given transforming markets and technology in the energy efficiency industry, this brief evaluates whether energy efficiency remains as cost competitive today as it has been in the past. Over the last decade, evolving building codes, increased market saturation of efficient technologies such as LEDs, and decreasing avoided costs due to increasingly affordable renewable energy technology have led utility grid planners to question whether energy efficiency can continue to deliver the same consistent value as it has in the past. This policy brief updates past research on the cost of saved energy using data from the 2018 program year collected in the most recent *ACEEE Utility Energy Efficiency Scorecard*. Updating this research using the most current data available from our

[1] Molina, M. 2016. *Our new analysis finds energy efficiency is the 3rd largest resource in the US electric power sector*. Washington, DC: ACEEE. Blog Post. aceee.org/blog/2016/08/our-new-analysis-finds-energy.

scorecards creates a resource for understanding how the cost of saved energy is evolving over time and how it compares to alternatives, including new fossil generation and carbon-free resources.

Because energy efficiency has unique characteristics as a "demand-side" resource, grid planners rely on different methods for calculating its costs and benefits than they use with "supply-side" energy generation investments. One such heuristic is the levelized cost of saved energy (LCSE, sometimes referred to as "levelized CSE"), which refers to the cost per unit of energy saved over the lifetime of the efficiency measure, from the perspective of the utility.[2] These are often amortized at a 5% real discount rate over a utility portfolio's average measure life. Amortizing the costs in this way enables comparison to the levelized costs of supply-side generation in levelized cost of energy (LCOE) analyses.

Building on a body of research since 2004,[3] ACEEE most recently explored the cost of saved energy based on data from utility energy efficiency programs in 2015, finding an average LCSE of $0.031/kWh including low-income programs.[4] Using a slightly different approach, Lawrence Berkeley National Laboratory has also published a large body of research, with their most recent findings detailing a savings-weighted[5] average LCSE of $0.025/kWh based on investor-owned utility program data aggregated over the years 2009–2015.[6] Our research for program year 2018 finds a similar savings-weighted LCSE of $0.024/kWh, albeit using a different dataset (the 52 largest investor-owned utilities by sales volume), and data reported at the portfolio, rather than the program, level.

Methodology

Data Sources

Energy efficiency program spending and savings data for this analysis came from the utilities evaluated in ACEEE's 2020 *Utility Scorecard*.[7] These included the 52 largest electric utilities by sales volume in the United States. The *Utility Scorecard* does not include data from smaller investor-owned utilities, electric cooperatives, and most publicly owned utilities, so is not representative of all ratepayer-funded energy efficiency in the United States. We pulled ratepayer-funded energy efficiency

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[2] This calculation uses a first-year cost of saved energy, which reflects the total upfront cost to the utility and enables a swift comparison between various energy efficiency programs, and amortizes it over the life of those programs to get a levelized cost of saved energy. However, first-year costs are an impractical point of comparison for use in planning when compared to other energy resources. See Molina, M. 2014. *The Best Value for America's Energy Dollar: A National Review of the Cost of Utility Energy Efficiency Programs* for a full discussion of the applications of CSE from the perspective of a grid planner. aceee.org/research-report/u1402.

[3] Past ACEEE reports on the cost of saved energy include Kushler, M. 2004. *Five Years In: An Examination of the First Half-Decade of Public Benefits Energy Efficiency Policies.* aceee.org/research-report/u042; Friedrich et al. 2009. *Saving Energy Cost-Effectively: A National Review of the Cost of Energy Saved Through Utility-Sector Energy Efficiency Programs.* aceee.org/research-report/u092 and Molina, M. and Relf, G. 2018. *Does Efficiency Still Deliver the Biggest Bang for Our Buck? A Review of Cost of Saved Energy for US Electric Utilities.* ACEEE Summer Study on Energy Efficiency in Buildings.

[4] See Molina and Relf 2018. This was a flat average across 50 utilities.

[5] The savings-weighted average was derived from each utility's energy savings in 2018, divided by the total savings across all utilities in the dataset. This results in weighting towards utilities with a larger amount of kWh savings compared with those with smaller savings.

[6] Schwartz, L. et al. 2018. *The Cost of Saving Electricity through Energy Efficiency Programs Funded by Utility Customers: 2009–2015.* Berkeley, CA: Lawrence Berkeley National Labs. emp.lbl.gov/publications/cost-saving-electricity-through.

[7] Relf et al. 2020. *The 2020 Utility Energy Efficiency Scorecard.* Washington, DC: ACEEE. aceee.org/utility-scorecard.

spending, savings, and measure life data from EIA 861 reports, public regulatory filings, and planning documents for the program year 2018, then submitted these data to the utilities for verification and correction. Low-income program spending and savings data were collected in the same way. In states where a third-party program administrator is responsible for implementing some or all energy efficiency programs, ACEEE worked with both utilities and third-party program administrators to allocate spending and savings appropriately. These costs are aggregated across residential, commercial, and industrial sectors. For utilities that have them, program costs include performance incentives.

Savings data are often reported at various levels by utilities. Many utilities report only gross savings, not accounting for impacts of market forces such as free riders, participant spill-over, and market effects.[8] Some utilities report savings only at the meter, which does not consider additional savings from avoided line losses on the transmission and distribution level. To account for this, energy savings were normalized to net savings at the generator by applying a net-to-gross ratio and line loss factor, where needed.[9]

Calculation Methods

To calculate first-year costs, we divided annual demand-side management (DSM) portfolio spending by total energy savings (in kWh) to generate $/kWh. To calculate levelized costs, we multiplied annual portfolio spending by a capital recovery factor (CRF) to determine the present value of the investment over its measure lifetime, which we then divided by annual electricity savings in kWh. We determined each utility's CRF based on the following formula:[10]

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

where r = the real discount rate (5%), and N = the weighted average measure life across the utility's portfolio. Measure lifetimes for each utility were included in the utility scorecard data based on either a) the weighted average based on utility public documents, or b) an average measure lifetime of 11.25 years, based on the mean of the average measure life data from utilities with reported measure lives in the dataset. All monetary values are in 2018 U.S. dollars.

While the *Utility Scorecard* data include spending on low-income programs, low-income savings and spending data were also collected separately. These spending and savings totals were subtracted from total program administrator spending and energy savings to determine levelized and first-year CSE excluding income-qualified programs. Such programs typically come at a higher cost per kWh saved since they are often offered at little to no cost to consumers or require additional upgrades such as weatherization and insulation to achieve the targeted level of savings. These programs often have policy, equity, and other benefits above and beyond the energy savings that they provide.

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[8] "Free riders" are utility customers that receive efficiency program incentives who would have installed measures themselves without the incentive. "Free drivers" are customers who adopt efficiency measures without receiving an incentive. "Market transformation" refers to the effect of wide-spread adoption of more efficient technologies leading to decreasing costs and expanded options for consumers. For more information on these terms, see www.aceee.org/topic/emv.

[9] If a utility uses its own net-to-gross ratio, this was applied; otherwise, an average NTGR of 0.83 was used. We took a similar approach to account for line losses, using either the utility's reported values or a national average of 5%.

[10] This is the same formula used by Lawrence Berkeley National Laboratory in their research on the cost of saving electricity. E.g., Schwartz, L. et al. 2019.

Outliers

Among the 52 utilities evaluated in the 2020 *Utility Scorecard*, there were 4 utilities that we identified as outliers, having LCSE values 5 to 28 times the standard deviation of the rest of the dataset: Dominion Energy (Dominion), Public Service Electric & Gas (PSE&G), Florida Power & Light (FP&L), and Jersey Central Power & Light (JCP&L).[11] For this reason they were excluded from the analysis of average savings across the dataset. All four utilities with high LCSE received low rankings in the 2020 *Utility Scorecard*, earning fewer than 24% of available points. This may indicate that utilities with more robust DSM portfolios and enabling regulatory policies can achieve lower costs of saved energy.

Results

Total Portfolio Costs

Table 1 shows the levelized and first-year CSE for each utility in the dataset, expressed in dollars per net kWh at the generator.

Table 1. Program administrator CSE for 2018 – net savings at generator ($/kWh)

Utility/program administrator	Levelized CSE (including LI)	First-year CSE (including LI)	Levelized CSE (excluding LI)	First-year CSE (excluding LI)
AEP OH[12]	$0.015	$0.135	$0.014	$0.123
AEP TC	$0.029	$0.243	$0.025	$0.211
AL Power	$0.044	$0.340	-[13]	-
Ameren IL	$0.041	$0.360	$0.033	$0.290
Ameren MO	$0.022	$0.183	$0.021	$0.174
APS	$0.015	$0.133	$0.014	$0.117
BGE	$0.023	$0.180	$0.020	$0.154
CenterPoint	$0.022	$0.184	$0.018	$0.156
ComEd	$0.022	$0.171	$0.021	$0.163
Con Ed	$0.032	$0.275	$0.033	$0.276
Consumers	$0.023	$0.201	$0.023	$0.196
CPS	$0.041	$0.350	$0.027	$0.229
DTE	$0.013	$0.137	$0.012	$0.124
Duke FL	$0.045	$0.304	$0.044	$0.301
Duke IN	$0.023	$0.142	$0.023	$0.141
Duke NC	$0.023	$0.150	$0.022	$0.143
Duke OH	$0.015	$0.120	$0.015	$0.118

[11] Data from JCP&L and PSE&G are primarily based on savings and costs from the state-run New Jersey Clean Energy Program. In program year 2018, the state's Board of Public Utilities had primary responsibility for administering energy efficiency programs, although the utilities were allowed to offer some programs.

[12] Utility names are abbreviated based on the format used in the 2020 *Utility Scorecard*. For a list of full utility names and locations, see: aceee.org/research-report/u2004 pp. 2–4.

[13] Program data did not include low-income program savings.

Utility/program administrator	Levelized CSE (including LI)	First-year CSE (including LI)	Levelized CSE (excluding LI)	First-year CSE (excluding LI)
Duke SC	$0.023	$0.149	$0.022	$0.143
Entergy AR	$0.019	$0.199	$0.019	$0.194
Entergy LA	$0.024	$0.275	$0.021	$0.236
Eversource CT	$0.037	$0.301	$0.035	$0.278
Eversource MA	$0.044	$0.374	$0.041	$0.343
GA Power	$0.012	$0.111	-	-
LADWP	$0.031	$0.342	$0.029	$0.320
LIPA	$0.032	$0.245	$0.031	$0.238
MidAm. IA	$0.020	$0.198	$0.020	$0.196
NG MA	$0.049	$0.340	$0.042	$0.295
NG NY	$0.025	$0.144	$0.025	$0.143
NPC	$0.016	$0.113	-	-
OG&E	$0.024	$0.194	$0.022	$0.179
OH Edison	$0.013	$0.107	-	-
Oncor	$0.019	$0.211	$0.016	$0.172
PacifiCorp UT	$0.021	$0.172	$0.020	$0.170
PECO	$0.029	$0.175	$0.026	$0.158
PG&E	$0.025	$0.218	$0.015	$0.132
PGE	$0.028	$0.282	-	-
PPL	$0.021	$0.163	$0.017	$0.137
Progress NC	$0.035	$0.191	$0.034	$0.187
PSE	$0.037	$0.348	$0.035	$0.331
SCE	$0.015	$0.139	$0.010	$0.095
SCE&G	$0.028	$0.232	$0.027	$0.224
SDG&E	$0.019	$0.177	$0.016	$0.151
SRP	$0.007	$0.060	-	-
TECO	$0.029	$0.367	$0.026	$0.327
We Energies	$0.027	$0.276	$0.018	$0.190
West Penn	$0.008	$0.062	$0.009	$0.064
Xcel CO	$0.019	$0.175	$0.018	$0.169
Xcel MN	$0.020	$0.190	$0.020	$0.187
Average	**$0.025**	**$0.211**	**$0.024**	**$0.196**
Savings-weighted Average	**$0.024**	**$0.198**	**$0.020**	**$0.165**

Based on data from program year 2018 across 48 utilities, the average utility LCSE is $0.025/kWh while the average first-year cost per kWh is $0.211. When weighted based on total portfolio savings (i.e., utilities with more energy savings through energy efficiency were weighted more heavily than those with less energy savings), the average savings-weighted LCSE is $0.024/kWh. This indicates that utilities with larger energy efficiency portfolios tend to have a lower cost per kWh saved than utilities with more modest portfolios, suggesting economies of scale.

As noted above, there were four utilities among the 52 scored in the *Utility Scorecard* that reported a cost of saved energy that was more than five times the standard deviation of the rest of the dataset. Those utilities were excluded from the dataset in table 1, and their costs are listed in table 2.

Table 2. Outliers

Utility/program administrator	Levelized CSE (including LI)	First-year CSE (including LI)	Levelized CSE (excluding LI)	First-year CSE (excluding LI)
FP&L	$0.137	$1.163	$0.139	$1.180
Dominion	$0.096	$0.771	$0.096	$0.776
PSE&G	$0.078	$0.780	$0.078	$0.780
JCP&L	$0.751	$6.376	-	-

The distribution of levelized CSE is represented in figure 1 below, which shows the distribution of data in quartiles with the savings-weighted average indicated for the data including and excluding income-eligible (low- or moderate-income (LMI)) programs. It allows for an easily understood summary of the range of variation in cost of saved energy among the utilities whose data are included in this set, as well as how the median and savings-weighted average compare.

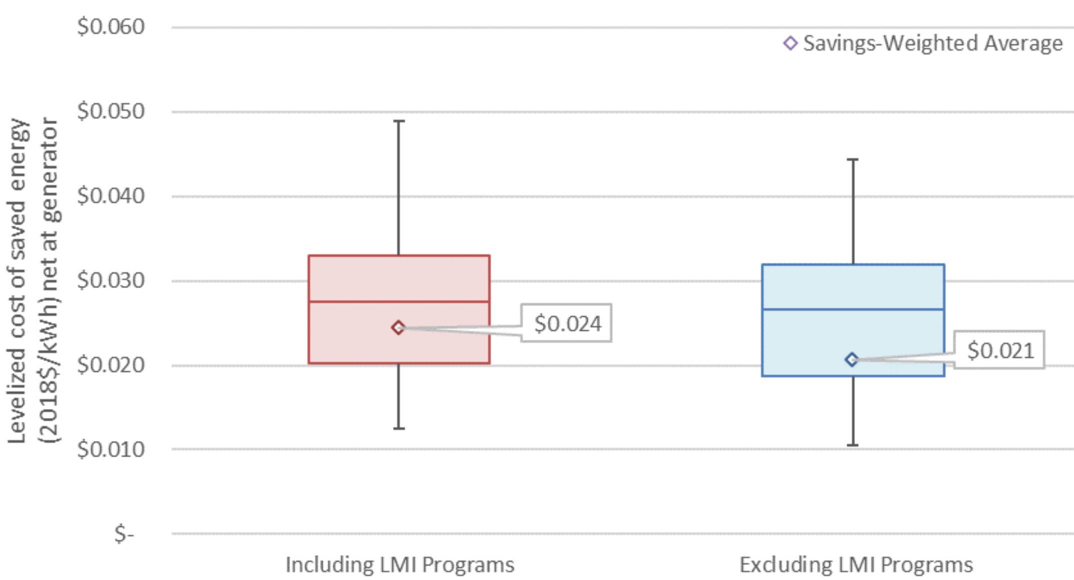

Figure 1. Savings-weighted levelized cost of saved energy including and excluding LMI programs (net savings at generator)

Based on the data, we can see that the average levelized CSE is approximately $0.02–0.03/kWh. This compares favorably with some of the least-cost generation resources available on the grid today, such as wind and utility-scale solar, which typically range from $0.025–0.05, and combined-cycle natural gas, which costs between $0.04–0.07/kWh, per Lazard (2020).[14] Additionally, the savings-weighted average is slightly lower than the median in both datasets, indicating that utilities with larger energy efficiency portfolios tend to spend slightly less per saved kWh than those with smaller portfolios.

Discussion

This analysis of data from utility portfolios shows that energy efficiency remains among the cheapest ways for utilities to meet their consumers' energy demand, even when considering the higher cost of saved energy for low-income energy efficiency programs. ACEEE's 2018 analysis reported an average levelized CSE of $0.033/kWh, and an average first-year CSE of $0.27 (net savings at generator) for the 2015 program year. This analysis, for the 2018 program year, finds an average levelized CSE of $0.025/kWh and first-year CSE of $0.21. These values are lower than ACEEE's previous findings by 15%. This may be due to a 20% increase in first-year energy savings from program year 2015 to 2018, as noted in the 2020 *Scorecard*. In addition, for the first time this analysis includes a savings-weighted average LCSE of $0.024 and first-year CSE of $0.20. The lower values in the savings-weighted average imply that portfolios with a high level of energy savings tend to spend less per kWh than utilities with smaller portfolios, suggesting some economies of scale.

Further research on the cost of energy efficiency would incorporate a larger pool of utility programs, including those run by municipal and cooperative utilities in addition to large investor-owned utilities. This would allow for comparison between costs across utilities of different sizes and ownership structures. More program-year data would also allow for creation of a more robust average, as well as the ability to monitor changes in energy efficiency costs over time. Additionally, while this analysis aggregates data at the portfolio level, it is not broken out by customer sector. Examining the costs of saving electricity across residential, commercial, and industrial sectors might reveal trends in the costs of savings by sectors or program types. In particular, codes and standards programs, which are low cost and have long measure lives, could have an outsized impact on lowering the cost of saved energy. Lawrence Berkeley National Laboratory published such a sectoral analysis in 2018, using data at the program rather than the portfolio level. [15]

A common concern with energy efficiency is whether there is an increasing marginal cost per saved unit of energy. Utilities have protested efforts to scale up energy efficiency programs based on the assumption that higher energy savings will lead to higher costs of saved energy. Figure 2 shows the relationship between LCSE and annual energy savings as a percentage of sales. The data show little to no correlation between the level of savings and the cost of saved energy for utilities (r-squared = 0.09). This indicates that it may be possible for utilities to achieve high savings goals and still have cost-effective portfolios.

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[14] Lazard. 2020. *Lazard's Levelized Cost of Energy Analysis, Version 14.0.* www.lazard.com/perspective/levelized-cost-of-energy-and-levelized-cost-of-storage-2020/.

[15] Hoffman et al. 2018. *The Cost of Saving Electricity through Energy Efficiency Programs Funded by Utility Customers: 2009–2015.* Berkeley, CA: LBNL. emp.lbl.gov/publications/cost-saving-electricity-through.

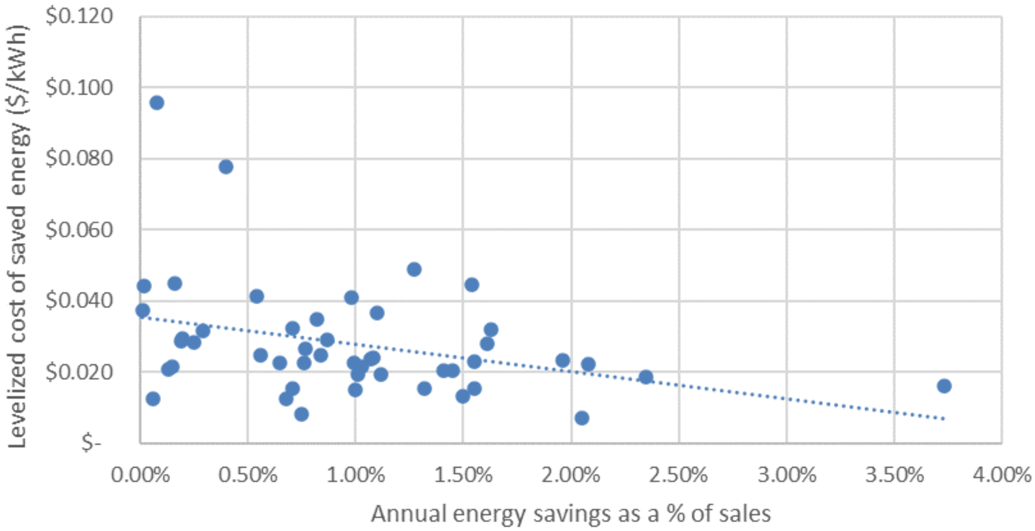

Figure 2. Cost of saved energy in relation to annual energy savings

Income-qualified programs tend to have a much higher cost per saved kWh than programs targeted toward other customer sectors. The data show that on average, utility portfolio LCSE was 12.5% lower when excluding low-income programs. This is likely because programs targeting this sector come at little to no cost to the participant, so the utility must bear a larger percentage of overall measure and installation costs.

However, there are multiple policy and equity benefits to income-qualified programs. ACEEE research finds that low-income households are more likely to face high energy burdens than the average customer, so targeted efficiency programs will typically have a greater impact for individual participant customers.[16] By providing an important service to overburdened households, low-income programs allow for more equitable access to clean and affordable energy. Demand-side programs such as weatherization can help address unequal access to (1) quality housing and to (2) energy-saving measures and upgrades that are a consequence of systemic inequities. For these reasons, many jurisdictions exclude low-income programs from cost-effectiveness testing, or apply a different test, such as the Societal Cost Test, that can capture the full benefits of delivering energy efficiency to low-income customers.

A benefit of developing a levelized cost of saved energy is that energy efficiency can be compared with other supply-side resources in utility resource planning and policy making. Energy consulting firm Lazard publishes a levelized cost of energy analysis that compares the various cost ranges of supply-side resources.[17] Figure 3 demonstrates Lazard's 2020 levelized cost values (in MWh), compared with the range of LCSE from this analysis.

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[16] ACEEE's energy burden research finds that low-income customers pay a higher proportion of their monthly income toward energy costs, on average, compared with the average utility customer. This burden is even more pronounced across marginalized groups, such as Blacks, Hispanics, and Native Americans. aceee.org/energy-burden.

[17] Lazard. 2020. *Lazard's Levelized Cost of Energy Analysis, Version 14.0*. www.lazard.com/perspective/levelized-cost-of-energy-and-levelized-cost-of-storage-2020/.

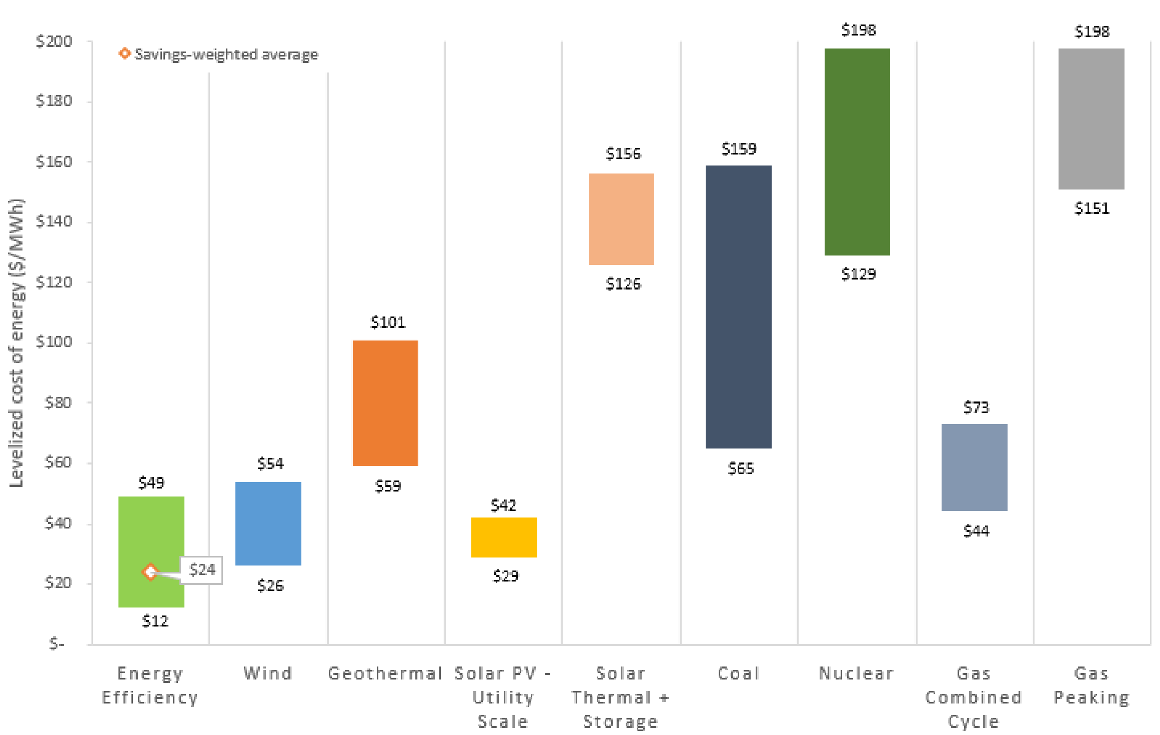

Figure 3. Levelized cost of energy efficiency compared with unsubsidized supply-side resources[18]

The cost of utility-scale renewable energy resources has fallen dramatically over recent decades, due to technology improvements and market transformation, with wind and solar costs declining from 70–90% between 2009 and 2019.[19] This makes an attractive set of options for grid planners seeking to decarbonize their power generation fleets. However, a comparison between the levelized cost of energy efficiency and the cost of supply-side resources reveals that energy efficiency is still as cheap or cheaper than most if not all types of generation currently available on the power grid (before subsidies).

Lastly, although the LCSE makes for a useful comparison with other supply-side resources, it does not fully capture the value of energy efficiency, nor all the factors that contribute to actual investment decisions. As a result, direct comparisons of LCOE and LCSE are insufficient for fully understanding the economics of alternatives. To compare the costs and benefits of efficiency, utilities must conduct cost-benefit testing that fairly considers all relevant, material, energy, and non-energy impacts, including both costs and benefits.[20]

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[18] Data from Lazard. 2020. *Lazard's Levelized Cost of Energy Analysis, Version 14.0.* www.lazard.com/perspective/levelized-cost-of-energy-and-levelized-cost-of-storage-2020/.

[19] From Lazard. 2019. "Levelized Cost of Energy – Historical Utility-Scale Generation Comparison." www.lazard.com/media/451086/lazards-levelized-cost-of-energy-version-130-vf.pdf.

[20] See NESP. 2020. *The National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources.* www.nationalenergyscreeningproject.org/national-standard-practice-manual/.

One major benefit from energy efficiency is peak demand reduction, but the comparative costs and benefits of reducing system peaks are not captured in a purely energy-based metric.[21] Another critical benefit is the time and locational value of energy. By delivering targeted demand-side programs, utilities can relieve congestion in otherwise constrained regions of the grid, thereby deferring the need to invest in large-scale transmission and distribution infrastructure. Another benefit is improving grid reliability and resiliency in extreme weather. ACEEE research finds that energy efficiency can help support reliability and resilience through reducing demand and providing predictable, long-term capacity relief.[22] A full accounting of the value of efficiency must also consider these impacts.

Conclusions and Further Research

The results of this analysis show that energy efficiency remains the lowest-cost resource available for grid planners to meet customers' energy needs. The average utility-led energy efficiency program has a levelized cost between $0.02–0.03 per kWh, making it much cheaper than any fossil or nuclear generation option, and cost competitive with the least expensive renewable energy options for new generation available on the grid today. The low cost and relative ease of implementation of energy efficiency, compared with the higher costs and extensive planning required to construct new supply-side generation, makes it a valuable and necessary resource as a part of any utility's energy portfolio.

Energy efficiency also encourages peak demand reduction and grid resilience, resulting in deferred infrastructure investment and lower operating costs. In addition, energy efficiency reduces direct greenhouse gas emissions and delivers many non-energy benefits, such as improved health and safety, comfort, productivity, and job growth, which are not always reflected in a cost-based framework.

Although the costs of renewable generation have fallen dramatically over the last decade to become some of the most affordable sources of energy available on the grid today, the low cost of energy efficiency proves that it should be an essential part of any least-cost infrastructure plan. Investor-owned utilities should seek to expand their efficiency portfolios in order to achieve both electricity resource and decarbonization goals.

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[21] For an analysis of the cost of saving peak demand, see Mims Frick et al. 2019, *Peak Demand Impacts from Electricity Efficiency Programs*. emp.lbl.gov/publications/peak-demand-impacts-electricity.

[22] From Relf et al. 2018. *Keeping the Lights On: Energy Efficiency and Electric System Reliability.* aceee.org/research-report/u1809.