The Value of Energy Efficiency: Past Successes and Future Strategies

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Introduction

For decades, energy efficiency programs have delivered significant environmental, economic, and societal value. They have transformed markets for efficient lighting and appliances, created green jobs, improved the health and safety of buildings, and reduced energy bills for consumers. Now, the value of energy efficiency is changing. This paper draws on VEIC's 35 years of expertise in designing and scaling solutions for clean energy, along with independent research we commissioned, to assess the value of energy efficiency, both past and future.

In 2017, VEIC commissioned Synapse Energy Economics, Inc. to undertake a two-part study that examined:

1. The utility costs and benefits of energy efficiency from 2010 to 2016
2. The projected utility costs and benefits from energy efficiency from 2016 through 2030

In estimating value for 2030, the study considered increasing marginal costs for efficiency resources. The findings indicate that maintaining or increasing levels of energy efficiency initiatives provides net benefits in every state and in every power system operator's electric balancing area, nationwide.

We also summarize future strategies for success, to ensure that energy efficiency continues to be a core element of clean-energy policy and portfolios.

Maintaining or increasing the level of energy efficiency provides net benefits in every state.

Energy efficiency at an inflection point

Each state that has modeled a pathway to achieve 100 percent clean-energy supply or deep decarbonization includes a significant contribution from energy efficiency. As David Olsen, former chair of the California Independent System Operator (ISO) has said, "low-carbon grids make energy efficiency more important than ever," by keeping costs down for the entire energy system.[1]

According to a Natural Resources Defense Council analysis of how to meet the global goal of limiting climate change to an increase of 2 degrees Celsius, energy efficiency makes an even larger contribution to emissions reductions than does renewable energy.[2] Efficiency helps to lower the cost and complexity of transitioning to systems powered by clean and renewable energy.

For many stakeholders in the clean-energy economy, the continued value of energy efficiency is clear. However, nationwide spending on energy efficiency programs has flattened since ramping up to about $6 billion per year in 2011. In some states, stakeholders are questioning whether energy efficiency has run its course.

Skeptics commonly cite three rationales when questioning whether it still makes sense to invest in energy efficiency.

Rationale 1	Rationale 2	Rationale 3
As load growth flattens from the increase of energy efficiency and distributed generation, and because beneficial electrification has not yet been widely adopted, utilities must spread costs across a smaller amount of retail electricity sales. This puts more pressure on rates, raising concerns among utilities, regulators, and consumer advocates about the cost of energy efficiency programs.	Sustained low natural gas prices are reducing the avoided cost of energy,[3] making it more difficult for some energy efficiency programs' measures to pass cost-effectiveness screening tests.	Energy efficiency has become widely adopted in the market, and much of the energy-saving "low-hanging fruit" has already been picked. Stricter energy codes for new buildings and energy standards for products and equipment, such as LED light bulbs, are leading some to argue that energy efficiency programs are no longer needed.

To assess the validity of these arguments, VEIC commissioned Synapse to conduct an independent analysis of the past value of energy efficiency and to project its future value as a utility system resource.

The Synapse study quantified costs and benefits of energy efficiency as a utility system resource, on a par with other sources of energy. Although energy efficiency also delivers significant added value in terms of carbon savings and non-energy benefits (such as building occupant health and comfort), the Synapse study did not quantify those value streams.

The analysis came to two clear conclusions:

- Energy efficiency has been the cheapest fuel for powering the United States.
- It will continue to be the best value for all energy users in the future.

The answer to the question of whether energy efficiency has run its course is a resounding "no."

Study methods

In analyzing the value of energy efficiency as a utility system resource, Synapse drew on publicly available data from the U.S. Energy Information Administration (EIA). The researchers aggregated energy sales, savings, and cost data for "utility-years" from 2010 through 2016, and subsequently excluded outliers. The resulting dataset constituted 3,007 utility-years. To calculate energy and capacity savings and to model future energy efficiency scenarios, Synapse used power-planning software, EnCompass.

EnCompass offers a single, fully integrated power system optimization model that allows for utility-scale electric power generation planning and operations analysis, including detailed generation dispatch and energy price results.

For the forward-looking analysis, Synapse entered estimates of future load, by state, under different future efficiency trajectories, and the EnCompass model output avoided energy, capacity, and production costs at the transmission area level by year. Synapse then processed the results to produce net dollar savings from efficiency, as well as bill impacts.

A history of success: The value of energy efficiency from 2010 through 2016

Energy efficiency has consistently been a successful method for reducing energy consumption and lowering demand. Synapse found that energy efficiency programs saved more than 160,000 GWh per year in 2016, resulting in nationwide net savings of more than $4.1 billion from reduced spending on electricity generation, transmission, and distribution. Despite the proliferation of energy-consuming products in daily American lives, energy efficiency has reduced total annual electricity sales by 4.1 percent, flattening load growth (Figure 1). The level of energy savings as a percentage of retail sales varies considerably by region. Cumulative energy savings from energy efficiency from 2010 through 2017 ranged from approximately 1 percent in the Southeast to approximately 10 percent in California and New England.[4]

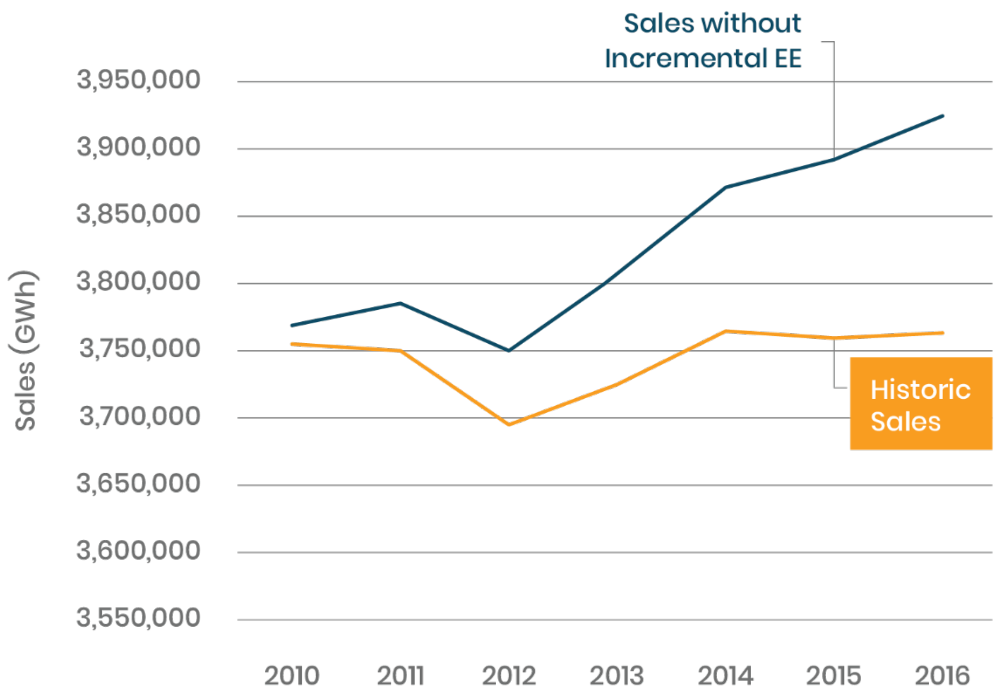

Figure 1: U.S. total annual energy sales, with and without energy efficiency.

Based on the analysis of EIA data, **the utility cost of saved energy (COSE) has averaged approximately 2.5 cents / kWh** (or $25 / MWh) on a levelized (lifetime) basis. This amount is significantly less than electricity supply alternatives. Figure 2 compares the unsubsidized levelized cost of energy of 18 alternative and conventional electricity supply options. Energy efficiency was a less expensive utility system resource than any of the renewable and conventional energy sources.

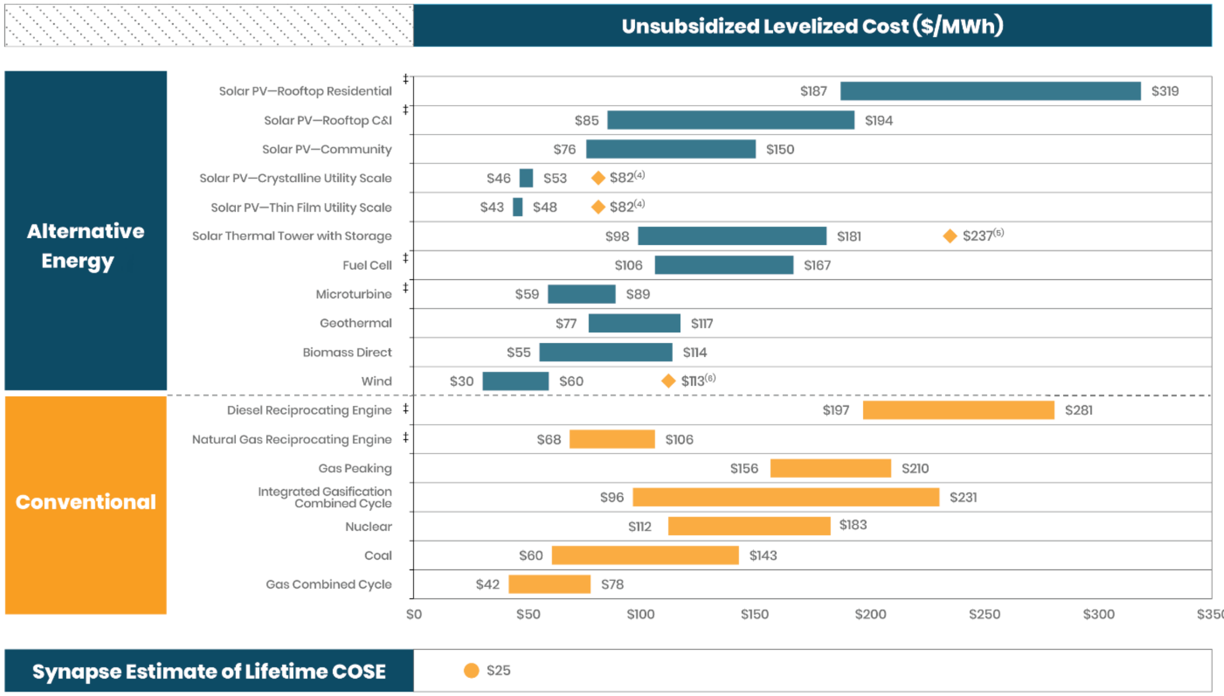

Figure 2. Energy efficiency programs, when levelized, cost less than electricity supply options. Source: Lazard 2017.[5]

Because energy efficiency is cheaper than supply, the net utility cost of efficiency in every state is lower than supply. Savings vary considerably by region. Regions with higher energy savings realize higher cost savings, as shown in Figure 3. States with higher energy savings also realize higher net annual residential bill savings—more than $100 per customer in states where annual bill savings from efficiency are high: Arizona, Vermont, Rhode Island, Connecticut, and Massachusetts, as shown in Figure 4.

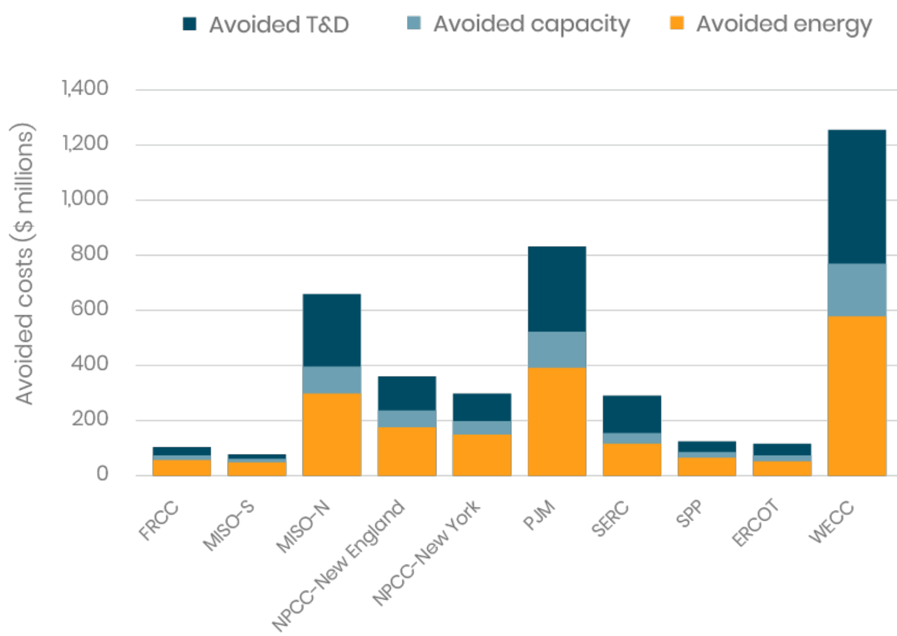

Figure 3. Savings by North American Electric Reliability Corporation (NERC) regions. Regions with higher energy savings realized higher overall cost savings.

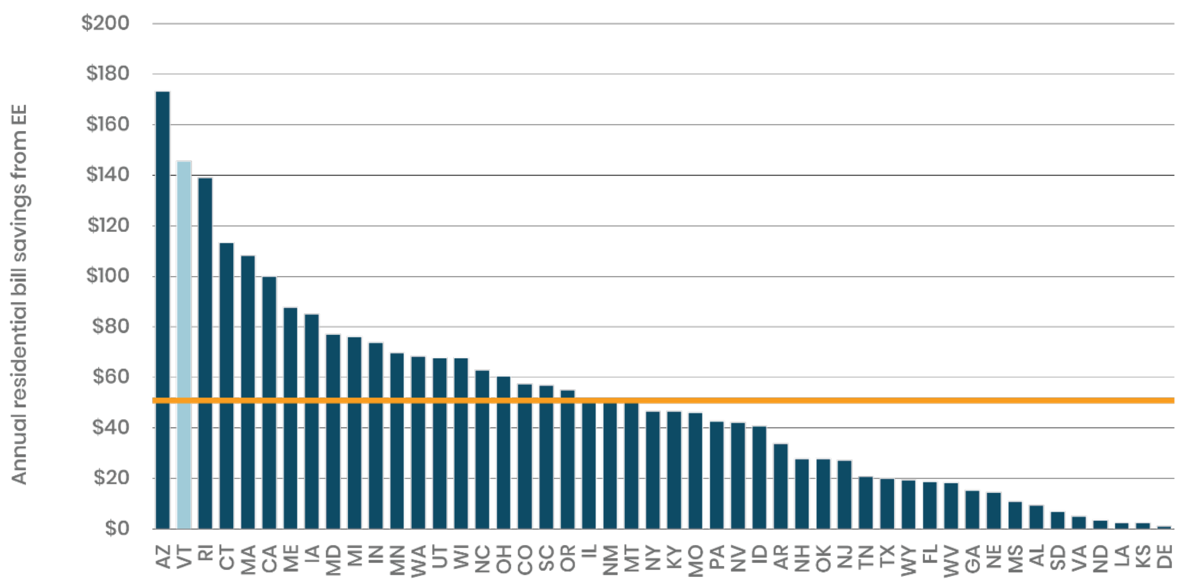

Figure 4. States' realized net annual residential bill savings; orange line is the average of about $50 per utility customer. The top six states show average annual residential savings of $100 or more.

Outlook: The value of energy efficiency through 2030

To quantify the value of energy efficiency to the nation's utility system through 2030, Synapse used EnCompass to model three different energy efficiency scenarios.

No future efficiency	Steady efficiency	Progressive efficiency
Incremental energy efficiency savings end in 2017, but states continue to see the benefit of previous efficiency investments (2011 through 2016) until those measures expire.	Incremental energy efficiency continues at the average of the previous three years, but states do not increase ambition for more energy efficiency measures over time.	All states match the ambition of the leading states by ramping up to a 2.15% annual incremental savings level. States that already exceed that level maintain their 2016 level of incremental savings, while other states ramp up their incremental savings targets by 0.2% per year.

Synapse also factored in a higher cost of delivering energy efficiency after assuming that much of the low-hanging fruit, particularly lighting, has been picked. The data are limited on the impact of the lighting transition on the cost of energy efficiency. According to a 2014 report from the Lawrence Berkeley National Laboratory, the cost of residential non-lighting measures can be from two to six times greater than that of residential lighting measures.[6] In 2018, ISO New England found that the cost of saved energy in Connecticut would have increased by 65 percent without energy-efficient lighting measures.[7] At the same time, most energy efficiency programs will continue to support some residential lighting measures through 2021—and well beyond that in the commercial market. Based on these trends, Synapse assumed a cost of saved energy of 4.3 cents / kWh between 2016 and 2030. This was significantly higher than the average of 2.5 cents / kWh from 2010 through 2016.

Synapse found that energy efficiency will continue to result in substantial value to the utility system through 2030, even if it costs more to deliver.

National net benefits of energy efficiency in 2030 are $5.5 billion under the Steady Efficiency scenario, and $9.7 billion under the Progressive Efficiency scenario.

Notably, customers in every state are expected to experience bill savings from energy efficiency in 2030: average annual bill savings will be $64 for residential customers in 2030, under the

Steady Efficiency scenario; under the Progressive Efficiency scenario, the annual savings will be $147 for residential customers.

The results vary by region. For example, in ISO New England territory, energy efficiency is projected to reduce regional annual energy needs by 17 percent by 2030, under the Steady Efficiency scenario; under the Progressive Efficiency scenario, it will be 20 percent by 2030 (Figure 5). **The model shows that there will be 34 percent less generation of natural gas, compared to 2017, under the Progressive Efficiency case.**

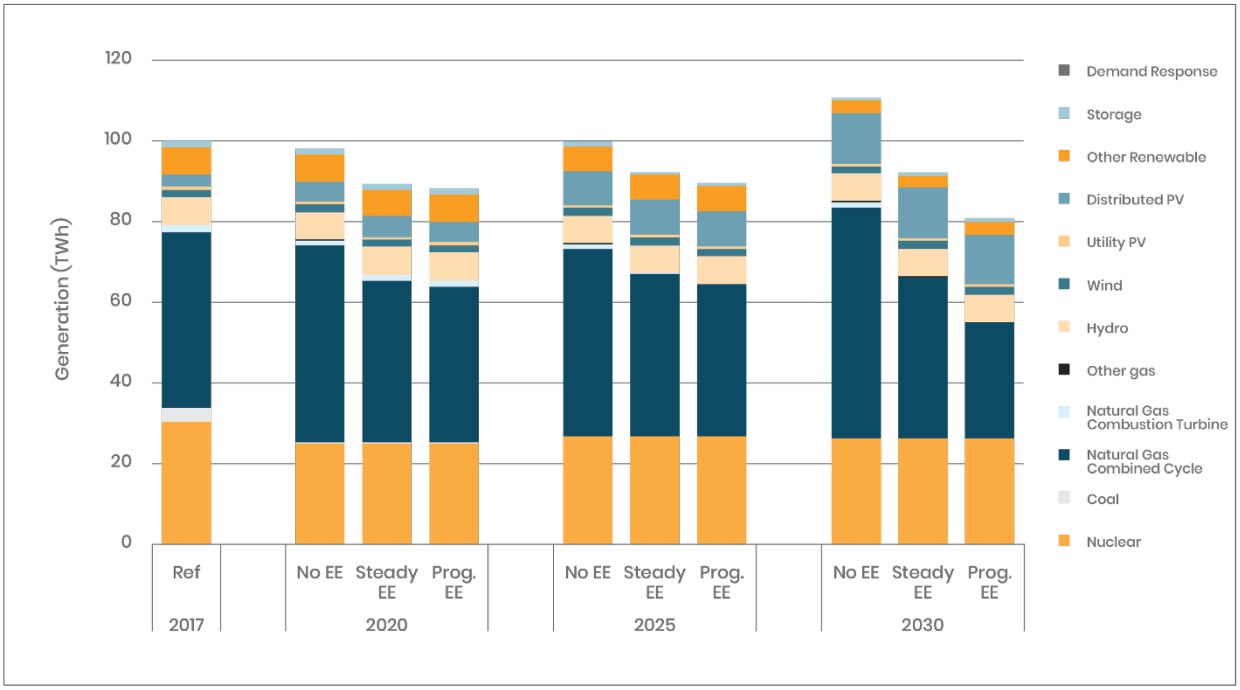

Figure 5. Future energy generation in ISO-New England region.

Energy efficiency's continued value

The Synapse analysis tells us that energy efficiency should continue to be the "first fuel," as the nation transitions to a cleaner energy system.

> **Although efficiency will be more expensive to deliver, it will still be cheaper than most other energy generation sources. And that's before factoring in the significant value of energy efficiency in terms of carbon reduction, health, and other non-energy benefits.**

Quantifying those non-energy benefits could open up significant new value streams for energy efficiency programs and services. VEIC has explored the possibility of valuing carbon savings through an economy-wide "cap-and-invest" initiative. It has also investigated valuing health benefits (that is, reduced rates of asthma and chronic obstructive pulmonary disorder [COPD]), through **partnerships in the health care sector**.

Next-generation strategies for continuing the success of energy efficiency

The future delivery of energy efficiency will not look like past energy efficiency delivery. As VEIC works with utilities, program administrators, regulators, and national and international partners, it has identified four strategies for creating next-generation energy efficiency portfolios and supporting the clean-energy system of the future:

1. **Diversify sources of energy savings**. **VEIC has previously shared strategies for program administrators navigating the lighting transition**. One strategy is to diversify energy efficiency portfolios so that we can scale up adoption of non-lighting measures. Significant efficiency remains untapped from measures such as high-efficiency HVAC equipment and controls, refrigeration, motors and pumps, and industrial process improvements. Efficiency programs are also shifting HVAC and appliance measures to a midstream program design (with incentives offered at the retail or distribution level, rather than at the customer level). This tactic takes advantage of cost efficiencies and uses the supply chain to accelerate the adoption of new, appropriate technology.

2. **Advance networked and connected strategies**. Advances in real-time data access and big-data analytics are encouraging programs to add new data-driven lighting and HVAC controls, building energy management systems, and connected devices. Such measures **make it easier to measure** savings**, confirmed by metered data,** in real time. This has allowed programs to scale up data-driven retro-commissioning, pay-for-performance, and strategic energy management**—all of** which **can** capture savings from behavioral and operational changes**. I**ntegrated, whole-building approaches**—what the Rocky Mountain Institute's** Amory Lovins calls "integrative design"**—can also capture savings.** According to Lovins,

    > … the efficiency resource far exceeds the sum of savings by individual technologies because artfully choosing, combining, sequencing, and timing fewer and simpler technologies can save more energy at lower cost than deploying more and fancier but dis-integrated and randomly timed technologies.[8]

3. **Coordinate design and delivery of demand-side decarbonization: energy efficiency, demand flexibility, and beneficial electrification**. Leading energy efficiency programs are coordinating the delivery of energy efficiency, electrification, and demand flexibility (primarily demand response and load shifting) to maximize benefits for both customers and utilities. The American Council for an Energy-Efficient Economy (ACEEE) has termed these strategies *climate-forward efficiency*.[9] VEIC refers to them as *demand-side decarbonization*. Integrated delivery of demand-side decarbonization services offers several benefits:
    a. Weatherized buildings are more grid-responsive for pre-heating and pre-cooling, and customers can realize cost savings from right-sizing solar and HVAC installations.
    b. Utilities can also support electrification of vehicles and buildings in ways that build load without exacerbating peaks. This can be accomplished by managed charging, rate structures, and supported installation of grid-interactive devices such as controllable heat pump water heaters.

4. **Update efficiency portfolio goals and metrics**. Most regulated efficiency program administrators have performance goals tied to electric (MWh) and gas (therm) savings. Under the "least-cost procurement" policies that served leading states well for the past two decades, performance targets have been tied to the value that energy efficiency provides as a least-cost utility system resource. However, in the context of the transition to a clean-energy economy, other values pertaining to energy efficiency are becoming more important.

    For example, many states have set ambitious greenhouse gas (GHG) reduction goals, but "the benefits and costs of energy efficiency are generally valued in terms of electricity and natural gas systems, not in the larger context of avoiding or reducing carbon dioxide or even other pollutant emissions."[10] Regulators in California, Massachusetts, New York, Vermont, and the District of Columbia are now beginning to update performance targets and incentives for energy efficiency portfolios, placing a greater emphasis on GHG reduction, peak demand reduction, heat pump adoption, and other metrics that align with policy goals.[11]

Building on energy efficiency's strong foundation

Regulators, states, utilities, and program administrators can harness the customer-centered strategies and infrastructure of efficiency programs to deliver demand-side decarbonization services. These strategies involve:

Program design. Demand-side decarbonization programs can build on efficiency programs' strong customer relationships, market knowledge, and technology expertise to drive customer adoption. Efficiency programs know how to overcome customer barriers through incentives, technical assistance, and marketing. This combined expertise is needed now, more than ever.

Data management, analysis, and tracking. Efficiency programs have data management systems to track energy savings, pay incentives, and support analysis that relies on advanced metering infrastructure (AMI) and connected devices. Utilities can apply these systems to collect and analyze the data needed to inform decarbonization programs.

Cost-effectiveness testing. Utilities, regulators, and consumer advocates are adept at cost-effectiveness analysis and can extend these methods to guide investments in demand response, energy storage, and other distributed energy resources to maximize customer, system, and societal benefits.

Consumer protection. Third-party advisors who offer technology- and vendor-neutral advice can be one-stop resources for comprehensive energy projects. This type of advice will become increasingly important as utility customers navigate the complex landscape of emerging energy and demand management technologies and services.

Trade ally networks. Networks of manufacturers, wholesale distributors, contractors, installers, retailers, electricians, and builders are well positioned to expand their demand-side decarbonization services, such as installation of heat pumps and electric vehicle (EV) charging systems.

Customer engagement and marketing. Efficiency programs have well-honed strategies for effective customer engagement. These typically range in scope from mass marketing to community outreach. Such strategies can be appropriately applied to promotional campaigns for heat pumps, storage, EVs, and other high-value decarbonization technologies.

Technical standards. Efficiency programs have been instrumental in transforming the market for energy-efficient products and building practices by adopting voluntary performance standards. Efficiency programs can now help to advance building codes, equipment standards, and communication protocols to promote grid-interactive and controllable devices and equipment.

Opportunity awaits

It's clear that energy efficiency is an essential component and driving force for a clean-energy future. The evolution to this future is already under way. We see a substantial opportunity to continue applying efficiency not only to avoid energy use, but to optimize the way it is distributed and consumed. VEIC is now working with program administrators to embrace next-generation strategies: diversifying new sources of savings; advancing networked and connected strategies; coordinating delivery of efficiency, flexibility, and electrification; and updating goals and metrics for efficiency portfolios.

> **Contact us at info@veic.org to talk about how to pursue demand-side decarbonization.**

Endnotes

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