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The Future of U.S. Electricity Efficiency Programs Funded by Utility Customers:

Program Spending and Savings Projections to 2030

Prepared for the
U.S. Department of Energy and U.S. Environmental Protection Agency

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All opinions, errors and omissions remain the responsibility of the authors. All reference URLs were accurate as of the date of publication.

Table of Contents

Table of Figures

List of Tables

Abbreviations

AEO	Annual Energy Outlook (EIA)
C&I	Commercial & industrial
Cooperative	Rural Electric Cooperative
DSM	Demand-side management
EE	Energy efficiency
EERS	Energy efficiency resource standard
EIA	Energy Information Administration
GWh	Gigawatt-hour
IOU	Investor-owned utility
IRP	Integrated resource plan
LBNL	Lawrence Berkeley National Laboratory
NEMS	National Energy Modeling System
PUC	Public utility commission
RPS	Renewable portfolio standard
TWh	Terawatt-hour

Executive Summary

Energy efficiency programs for utility customers are offered in every state. Spending on programs funded by electric utility customers grew by about 20 percent between 2011 and 2016, reaching ~$5.8 billion. Spending—and associated energy savings—have fluctuated over time with state goals, energy prices and market trends, among other factors. This study provides a forward-looking, bottom-up assessment of the potential impact of existing and likely policies and market conditions that promote or constrain future spending and savings for electricity efficiency programs funded by utility customers in all U.S. states.

We find that energy efficiency programs funded by utility customers have become a significant electricity resource in many states. This trend is expected to continue through 2030 and will have important implications for electricity system planning and operations. Electricity savings from these programs, and from complementary policies such as equipment standards and building energy codes, have contributed to modest or even no growth in electricity loads in many states in recent years. That affects the need for investment in new electricity infrastructure, across generation, transmission and distribution systems, and the impact of such investments on rates. Looking to the future, our analysis suggests that electricity efficiency programs funded by utility customers will continue to impact load growth at least through 2030.

Approach

The study includes three scenarios (low, medium and high cases) for 2030, with updated projections of spending and savings for interim years (2016, 2020 and 2025). The scenarios represent a range of potential outcomes given the current policy environment and uncertainties in the broader economic and state policy environment in each state. We reviewed relevant state statutes, regulatory commission decisions, and filings of electric utilities (investor-owned utilities, rural electric cooperatives and publicly owned utilities) and other efficiency program administrators. We also conducted more than 50 interviews with regulatory staff, energy efficiency experts, program administrators and other stakeholders to help inform scenarios and key assumptions.

Modeling future efficiency spending and savings

Our forecast of electricity efficiency program spending and savings to 2030 considers past and current performance of program administrators and key policy drivers in each state. These policy drivers include energy efficiency resource standards (EERS), statutory requirements that utilities acquire all cost-effective energy efficiency or include efficiency under state renewable portfolio standards, voluntary savings targets, public (or system) benefit charges that fund efficiency, integrated resource planning (IRP) requirements, demand-side management (DSM) plans and policies intended to reduce utilities' disincentives (e.g., decoupling) or provide a financial incentive to promote energy efficiency. Conversely, some states have adopted policies that effectively constrain the magnitude of available savings or spending on efficiency programs. We explicitly model policy constraints such as caps on program spending or rate impacts and statutes that allow large commercial and industrial (C&I) customers to opt out of efficiency charges and programs.

We distinguish among three timeframes: historical, policy period and post-policy period. In the historical period (2013-2016), we collect information on actual program spending and savings to establish an initial relationship between program costs and first-year electricity savings. The duration of the policy period (beginning in 2017) varies by state and depends on its specific policies.[1] In most states, the policy period does not include the entire study period. Thus, we define a post-policy period (from the time that key state policies expire to 2030) during which commitments have ended or are considerably less firm. For this period, we relied on interviews with state and regional experts and for the high scenario considered their view of best practices in the region to define a range of savings targets for each state.

Developing the Scenarios

The three scenarios represent alternative pathways for the evolution of electricity efficiency programs funded by utility customers during the post-policy period:

- The *medium scenario* largely represents a continuation of current practices and policies, subject to known policy and market constraints. We project that most states generally stay the course on policies and meet savings targets. Some states are expected to expand their commitment to efficiency based on recent legislation or regulatory commission decisions, while other states are expected to throttle back their commitment to efficiency.
- The *low scenario* represents a less prominent role for energy efficiency. States that are new to efficiency adopt a "go slow" approach; other states retreat from the current policy path—for example, EERS are not continued or are extended with lower savings targets, or states adopt new policies that constrain efficiency spending.
- The *high scenario* explores the possibility that states increase energy efficiency targets and budgets, driven by regional best practices that are adopted by other states in the area, and adopt favorable utility business models and savings targets set based on achievable energy efficiency potential.

Our study provides an analytically rigorous assessment of what we know and expect regarding the future of electricity efficiency programs funded by utility customers, based on current state policies and market drivers and constraints and a range of likely scenarios from the time these policies end through 2030. While this study does not envision or quantify the impact of potential new drivers and delivery mechanisms, we highlight emerging challenges faced by program administrators and policymakers and, in some cases, ways to address them (chapter 5).

[1] We compiled information on state policy drivers (e.g., DSM plan filings, IRPs, new legislation or major public utility commission decisions on electricity efficiency) through August 2018.

Key Findings

1. **Program Spending** - In the medium case, spending is projected to increase to $8.6 billion in 2030 compared to ~$5.8 billion in 2016, an increase of more than 45 percent (see Table ES-1). Projected growth in program spending tends to be front-loaded with increases concentrated in the first nine years (to 2025). This dynamic of front-loaded growth in spending is attributable to our methodological approach as well as our cautious assessment of efficiency market dynamics in the later years of our study period.[2] In the high case, annual spending increases to $11.1 billion in 2030, 90 percent higher than 2016 levels. In the low case, spending is projected to decrease in 19 states in 2030 compared to 2016 levels. National spending remains fairly flat, increasing to just $6.8 billion in 2030.[3]

Table ES - 1. Projected spending on electricity efficiency programs: Three scenarios

	Projected Spending ($ Billion)				Projected Spending as % of Retail Revenues			Average Annual Spending Growth		
	2016	2020	2025	2030	2020	2025	2030	2016-2020	2020-2025	2025-2030
Scenario										
Low		6.3	6.8	6.8	1.6%	1.4%	1.2%	2.2%	1.7%	0.1%
Medium	5.8	7.1	8.3	8.6	1.7%	1.8%	1.6%	4.3%	3.6%	0.6%
High		7.9	10.3	11.1	2.0%	2.2%	2.1%	7.1%	6.2%	1.4%

- **We project program spending as a share of electric utility retail revenues to be somewhat lower in 2030 than in 2016.** Electricity efficiency program spending in 2030 is projected to account for about 1.6 percent of retail revenues in the medium case, 2.1 percent in the high case, and 1.2 percent in the low case. Except for the high case, these levels are all lower than in 2016. Tracking spending as a percent of retail revenues provides an indication for the potential rate impacts of efficiency programs.
- **At the same time, total market activity leveraged by utility efficiency programs increases.** Projected spending by program administrators includes both administrative costs and incentives. Participating customers also typically pay for a portion of project costs—in some cases, a significant share. Thus, we also estimated total market activity leveraged by electricity

[2] For most states, we assume that when a binding EERS expires, savings targets will continue at levels consistent with the last year the standard is in effect. In addition, we have higher confidence in our modeling of spending (and savings targets) in the policy period compared to the post-policy period because we can typically rely on multi-year DSM plans. Finally, our modeling of the later years of our study period often relies on utility IRPs and their characterization of achievable potential for energy efficiency. Some utility IRPs are projecting reduced savings levels from 2025 on, which impacts our projections of spending from 2025 to 2030. Utility estimates of remaining achievable potential are often conservative. In their IRPs, some utilities have suggested that achievable potential for their efficiency programs is likely to be lower in the future due to tightening federal efficiency standards and transformation of certain end-use markets (e.g., increased market penetration of light-emitting diode (LED) lamps).

[3] Projected spending in 2030 ($6.8 billion) decreases in the low scenario if we account for the expected effects of inflation and report spending in real dollars.

efficiency programs, drawing upon results from the LBNL Cost of Saved Energy project.[4] For 2016, we estimated this value at about $11.6 billion. If we assume that the relationship between net participant costs and program administrator costs continues in the future, the total market size of electricity efficiency programs in 2030 would increase to $17.2 billion in the medium scenario and range from $13.6 billion in the low scenario to $22.2 billion in the high scenario.

- **Spending varies widely by region today, and regional shares of national spending are expected to shift over time.** The national results are driven by regional trends in program spending. In 2016, states in the West and Northeast accounted for 64 percent of national spending on electricity efficiency programs as energy efficiency services markets are relatively mature in these regions with many states implementing programs for decades, while states in the South and Midwest accounted for 36 percent. In 2030, these values represent the estimated shares of national spending in the low scenario. In contrast, in the high scenario, states in the South assume an increasingly prominent role, with spending projected to increase to $3 billion in 2030 compared to $1.0 billion in 2016 (see Figure ES-1). Thus, in 2030, the relative share of spending for states in the West and Northeast decreases to 55 percent of the national total, while states in the South and Midwest account for 45 percent.

[4] Projected spending by program administrators includes administrative costs and incentives. Total costs include costs incurred by participating customers. On a national basis, the total cost of saved electricity was double the program administrator cost of saved electricity between 2009 and 2015: $0.05/kWh vs. $0.025/kWh (Hoffman et al. 2018).

Figure ES - 1. Electricity efficiency program spending by region in 2016 vs. 2030 scenarios

- Midwest - Efficiency program spending in 2030 is driven primarily by four populous states (IL, MI, OH and MN) that have made long-term policy commitments in legislation. The future trajectory of efficiency spending in the region will be heavily influenced by policy constraints (e.g., opt-out policies, spending caps), long-term resource planning processes (e.g., MI and MN), and the extent to which utilities are motivated by business model policies to achieve higher savings goals.
- South - The range in spending in 2030 across the three scenarios is quite large ($1.3 to $3 billion) because utilities in many states have proposed savings goals in DSM plans or IRPs that are modest relative to the achievable potential. Thus, there is significant potential upside in the high scenario, as well as significant uncertainty regarding the extent to which policies that may constrain savings (e.g., large C&I customer opt-out) will spread to other states in the region.
- West - California accounts for more than 60 percent of spending in the region and we project that spending will increase by $330-480 million compared to 2016 levels, driven primarily by state legislation. Lower spending is projected in the Pacific Northwest states in all scenarios in 2030 compared to 2016, while we expect most Southwest states to sustain

long-term commitments to energy efficiency driven by state statute and favorable utility business models.[5]

- Northeast - Efficiency program spending is projected to increase under all three scenarios, ranging between $2.1, $2.6 and $3.2 billion in the low, medium and high scenarios compared to $1.7 billion in 2016. All nine states in the Northeast have made strong policy commitments to energy efficiency and recent legislation in several states (NY, NJ, NH) increased savings (or spending) goals. Several of the historic leaders in the region (MA, RI, VT, CT) are projected to maintain or somewhat reduce spending levels on utility customer-funded programs due to anticipated saturation of efficiency potential, greater emphasis on complementary strategies (e.g., equipment standards, financing), concern about potential retail rate impacts, or state budget constraints.

2. **Program Savings** - In 2016, efficiency programs funded by utility customers saved 27.5 terawatt-hours (TWh) of electricity per year, equal to 0.74 percent of retail sales. Efficiency programs funded by customers offset at least 1 percent of investor-owned utility load in 23 states, with four states exceeding savings of 2 percent of sales (Hoffman et al. 2018). In the medium case, we project incremental annual electricity savings to increase very modestly to 28 TWh in 2030. Savings rise through 2025, and then decrease by 1.6 TWh by 2030. Savings are projected to decrease in most regions (except the South). The anticipated decline in relative program savings after 2025 across all scenarios is driven primarily by forecasts and views of program administrators that the potential to acquire cost-effective savings from voluntary programs is relatively lower because of increased reliance on complementary efficiency policies (e.g., equipment standards) and transformation of certain end-use markets (e.g., increased penetration of LEDs).

   - **Projected electricity savings increase significantly in the South by 2030.** The results are particularly striking in the high scenario, with projected savings significantly greater compared to other regions: 12.9 TWh in the South vs. 7.2, 8.3 and 9.2 TWh in the Northeast, Midwest and West, respectively (see Figure ES-2). Savings in the 17 states in the South account for 34 percent of the national savings from electricity efficiency programs in 2030 in the high scenario (compared to 19 percent in 2016). These results are driven by our assumptions. Several large states (FL, TX, TN) significantly increase their efficiency savings targets to levels that are closer to the achievable potential, program administrators in several states increase their efforts motivated by attractive utility business models (e.g., OK, NC, SC) or targets set in EERS legislation (MD, VA). However, savings as a percent of electric utility retail sales in 2030 remain higher in the Northeast (1.6 percent), West (1.2 percent) and Midwest (1.1 percent) than the South (0.7 percent).

[5] Although several utilities propose de-emphasizing efficiency in the long-term in their IRPs.

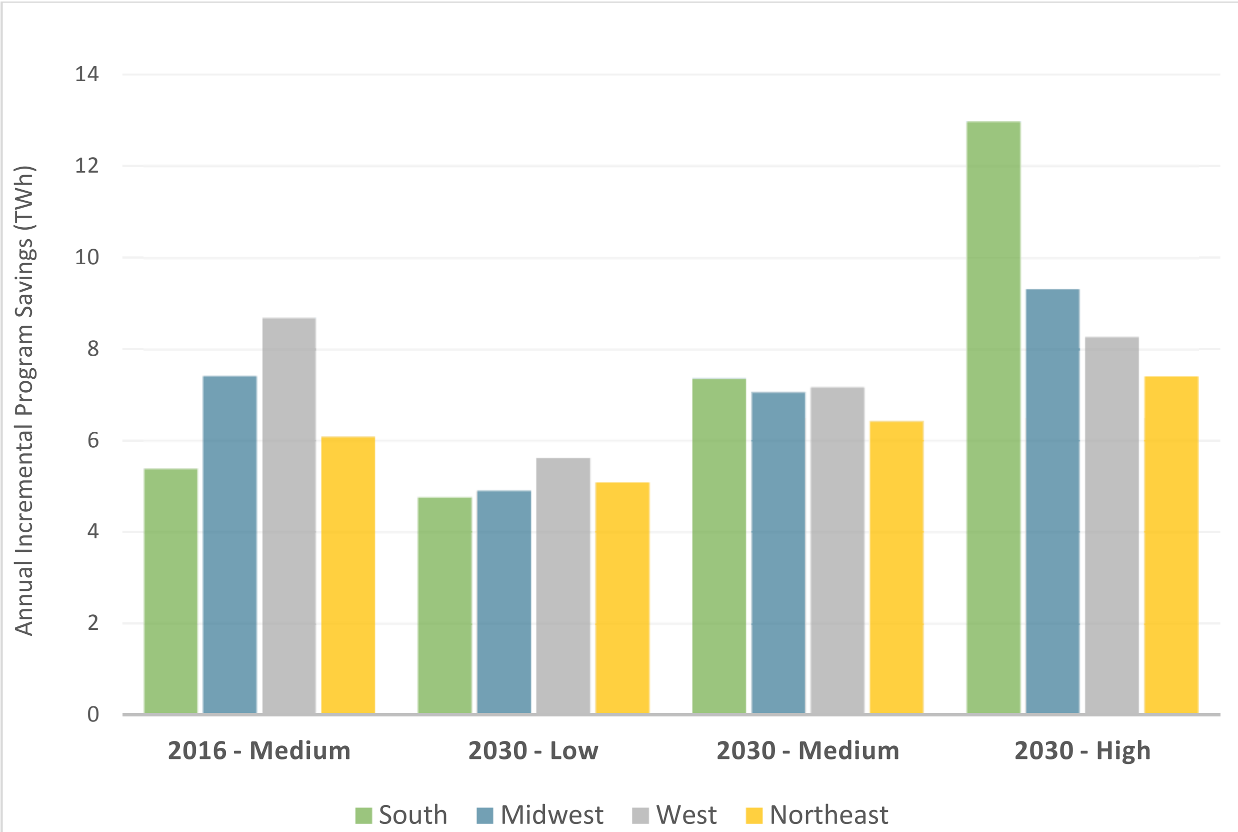

Figure ES - 2. Annual incremental program savings by region in 2016 vs. 2030 scenarios

- **Electricity savings from complementary strategies such as equipment standards will increasingly impact utility efficiency programs.** For the last decade, estimated annual savings from electricity efficiency programs were roughly comparable to annual savings from efficiency standards. However, for the 2017 to 2030 period, the average annual incremental savings from appliance, equipment and lighting standards may increase substantially compared to the previous period (e.g., 2002-2016). The increased savings from standards that take effect during the next five years means that it will be more challenging for efficiency program administrators to obtain cost-effective savings, particularly in the later years of our study period.

3. **Publicly Owned Utilities and Rural Electric Cooperatives** – For the first time, we explicitly model publicly owned utilities and cooperatives and project their future efficiency spending and savings. Spending by these types of utilities increases from $0.6 billion in 2016 to $0.8, $1.2 and $1.5 billion, respectively, by 2030 in our low, medium and high scenarios (see Table 4-4 in this report). Spending on electricity efficiency programs by publicly owned utilities and cooperatives accounts for 12 percent to 14 percent of national spending in the three scenarios and is concentrated in five states (CA, WA, TX, TN, MN), projected to account for 67 percent of efficiency spending by publicly owned utilities and cooperatives in 2030. Publicly owned utilities and cooperatives are projected to account for 14 percent to 19 percent of national savings in 2030 depending on the scenario.

Key Issues and Challenges

Key issues and challenges ahead for policymakers, regulatory commissions and efficiency program administrators that contribute to uncertainty in forecasting future pathways include largely external factors. At the same time, policy choices and regulatory and program practices also heavily influence efficiency pathways.

- **A changing economy and shifting policy objectives complicate forecasting of future electricity loads.** EIA projects that total retail electricity sales will increase at an annual growth rate of only 0.59 percent per year from 2016 to 2030. This projected growth rate is quite modest compared to historic growth rates for electricity sales (1.3 percent per year since 1990). This trend of slowly increasing or flat electric loads is driven in large part by the steady decline of energy intensity (i.e., the amount of energy used per unit of economic growth) for many years due to energy efficiency, structural changes in the economy and fuel economy improvements (EIA 2017).[6]

  However, several recent studies have explored the potential long-term impacts of "beneficial electrification" driven primarily by adoption of electric vehicles, heat pumps and select industrial applications on future electricity sales and peak demand. If states decide to promote electrification as a policy objective, then policymakers may have to reassess how they define energy efficiency policies and guidelines for efficiency programs, and utilities and other program administrators will have additional technical opportunities for investments in high efficiency technologies.

- **The cost of electricity supply options has declined.** In recent years, utilities and utility customers have benefitted from low natural gas prices and declining costs for natural gas-fired and renewable generation technologies. Going forward, low gas prices and increasing levels of renewable generation technologies with zero marginal cost translate into reduced efficiency program benefits (e.g., avoided energy and capacity costs), which may in turn constrain program budgets. Moreover, the evolving generation mix, current economics of supply-side options and evolving resource needs of utilities are changing the value proposition for energy efficiency resources. The result is a greater focus on time-varying value (e.g., to help meet peak system demand) and locational value (e.g., for load relief on distribution systems), more emphasis on controllable loads (e.g., to increase system flexibility), and more interest in bundling demand-side options such as energy efficiency, demand response, distributed generation and storage, and electric vehicles in order to provide various grid services.

- **State leadership drives institutional frameworks for energy efficiency.** Energy efficiency resources have distinctive characteristics that require state regulatory commissions to establish an institutional framework for effective oversight of utility customer-funded programs. These distinctive elements include: (1) the need for measurement and verification of savings; (2) program success dependent on customer acceptance and adoption, making stakeholder input

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[6] EIA estimates that U.S. energy intensity has decreased from 12,000 to 6,000 Btu per dollar from 1980 to 2015 and will be 4,000 Btu per dollar in 2040 (EIA 2017).

on program design crucial; and (3) the need to align the utility's financial interest in pursuing cost-effective efficiency with a state's policy goals, given the disincentives that exist under traditional utility regulation. Many leading states have successfully grappled with these institutional and regulatory policy issues and a variety of approaches have proven to be effective. Thus, our high scenario assumes that in states that are newer to efficiency, legislatures and regulatory commissions provide leadership in defining energy efficiency policy objectives, establish roles and responsibilities for program administrators, and devote sufficient staff (or technical consultant) resources to effectively oversee acquisition of large-scale energy efficiency portfolios.

- **Program portfolios will need to evolve to continue to capture cost-effective electricity savings.** During the timeframe of this study and particularly in the later years (2025-2030), we expect that utilities and other program administrators will grapple with several significant challenges in developing a cost-effective portfolio of efficiency programs.
  - **New programs** - Program administrators will have to look for additional technical opportunities for saving electricity to offset their historic reliance on lighting programs.
  - **Large customer opt-out** - Program administrators in states that allow large C&I customers to opt out of paying for and participating in efficiency programs are likely to develop program designs that focus more on smaller and mid-size C&I customers. The cost of saved electricity for programs that target smaller C&I customers has historically been higher than programs for larger customers, putting upward pressure on program costs. For large C&I customers, program administrators may also focus more attention on Strategic Energy Management and the ISO 50001 standard to systematically track, analyze and plan energy use to continually improve energy performance — reducing operating costs and increasing productivity and competitiveness (State and Local Energy Efficiency Action Network 2016).
  - **Achieving deeper savings** - In states with more stringent efficiency savings goals for future years, program administrators will need to design and implement programs that can achieve deeper savings for participating customers and have a broader reach in terms of market penetration. Achieving higher market penetration rates includes targeting and reaching traditionally underserved markets (e.g., small commercial, multifamily, rental housing, non-owner-occupied commercial buildings) in far greater numbers than current practice. Program administrators also will need to design new, innovative programs that offer different strategies and services that are attractive to customers. Examples may include strategic energy management programs for industrial customers, greater reliance on building and industrial controls, programs that focus more on upstream/midstream market interventions (e.g., incentives to retailers, vendors), competitive procurement processes to meet distribution system needs that are open to aggregators that offer bundles of demand-side services and technologies, behavior-based programs using advances in data-based technologies and strategies, programs that combine technical assistance with incentives and financing (e.g., green bank, on-bill financing), and programs that integrate delivery of electric and gas efficiency programs. Program administrators can

also consider leveraging efforts of state and local governments and private providers to advance efficiency such as building energy benchmarking (Mims et al. 2017b) and Property Assessed Clean Energy (PACE) financing programs. Performance-based regulation also may play a role in utilities achieving deeper savings in the future, building on current practice in some states today (e.g., New York).

We include these examples to highlight that the portfolio of efficiency programs is likely to evolve significantly over the time horizon of this study. Program administrators and state regulatory commissions face emerging challenges, such as the increased impact of complementary strategies (e.g., standards), the decreasing costs of some supply-side resource options, and adapting the value proposition for energy efficiency to reflect changing utility system needs. The degree to which program administrators and states address these challenges is likely to heavily influence the longer term pathway for spending and savings on efficiency programs.

1. Introduction

A diverse mix of policies and programs aim to overcome institutional and market barriers to acquiring cost-effective energy efficiency for the benefit of electricity systems, utility customers and society (Eto and Golove 1996; NAPEE 2006). Supporting and supplementing private investments by individuals and businesses, these approaches include building energy codes, appliance and equipment standards, labeling programs (e.g., the national ENERGY STAR® label), tax credits and grants, financing, and utility customer-funded programs that offer information, marketing and outreach, and financial incentives.

Spending on electricity efficiency programs funded by utility customers grew by about 20 percent between 2011 and 2016, reaching ~$5.8 billion. But spending for utility customer-funded programs—and associated energy savings—have fluctuated over time with state goals, energy prices and market trends, among other factors. Some of these shifts happen abruptly and are somewhat unpredictable.

In this context, Berkeley Lab conducted two earlier studies to project future spending and savings for these programs under low, medium and high scenarios. The studies covered all types of utilities—investor-owned electric and gas utilities, public power and rural electric cooperatives—as well as other program administrators. We examined energy efficiency policies in all states as well as historical spending and savings, funding mechanisms, efficiency potential studies, demand-side management plans and budgets, resource plans, ratemaking approaches and incentives for utilities, and state regulatory decisions in order to develop projections of future program spending and savings under multiple scenarios.

Our first report provided state-by-state projections through 2020 for both electricity and natural gas programs (Barbose, Goldman and Schlegel 2009).[7] In 2013, we updated and enhanced that analysis and published projections for these programs through 2025 (Barbose et al. 2013).[8] State, federal, and international agencies, utilities and others have used these projections for a variety of planning and analytical activities.

In addition to these future scenarios, Berkeley Lab has assessed *historical* spending and savings trends for electricity efficiency programs for the period 2009 to 2015 in a series of reports on the cost of saving energy (Billingsley et al. 2014, Hoffman et al. 2015, Hoffman et al. 2017, Hoffman et al. 2018). These reports provide detailed results down to the program level using information reported by utilities and other program administrators—most recently for 41 states. The Consortium for Energy Efficiency (CEE)[9]

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[7] In the first study, we explicitly modeled state energy efficiency policies in 31 states and used a simple, standardized approach to model the remaining 19 states (and publicly owned utilities and rural electric cooperatives) that were "uncommitted" in terms of efficiency policies.

[8] In the second study, we explicitly modeled state energy efficiency policies in 44 states and used a standardized approach for the remaining seven "uncommitted" jurisdictions that had little efficiency activity and no established policy framework at the time of that study. We also modeled publicly owned utilities and rural electric cooperatives using a standardized approach.

[9] See CEE Annual Industry Reports at https://www.cee1.org/annual-industry-reports and ACEEE State Energy Efficiency Scorecards at http://aceee.org/state-policy/scorecard.

and American Council for an Energy-Efficient Economy (ACEEE) also have reviewed spending and savings trends for customer-funded efficiency programs, on a less granular level (e.g., by market sector or state).

Other studies have estimated the potential savings that could be achieved through utility customer-funded efficiency programs, for individual utilities and states (e.g., Navigant 2017)[10] as well as at regional and national levels (e.g., Northwest Power and Conservation Council 2016, EPRI 2017).

This Berkeley Lab study builds on this earlier body of work by comprehensively estimating the impact of the full suite of policies and market conditions that promote or constrain utility customer-funded efficiency programs in the United States. The study reaches out to 2030, with updated projections for interim years, and focuses solely on the electricity sector.[11]

Using a bottom-up approach, we conducted a detailed review of efficiency policies, regulations, plans and programs for each state and program administrator and modeled low, medium, and high scenarios that represent a range of possible evolutionary paths and potential outcomes in each state. Scenario definitions and assumptions were informed by interviews with regional and national energy efficiency experts, utilities and other program administrators, state public utility commission (PUC) staff and industry stakeholders. None of the scenarios is intended to capture wholesale shifts in federal policies. Nor do our scenarios contemplate or quantify a major evolution in energy efficiency drivers or delivery mechanisms.

The medium case scenario is an extrapolation of recent program performance and the current policy and market environment to 2030. The medium scenario reflects a future in which states that have historically been leaders in energy efficiency continue their commitment, although the future path varies somewhat by state. Other states continue to ramp up or maintain their efficiency programs to meet legislative requirements and, where appropriate, we attempt to account for constraints that may limit the ability of program administrators to achieve savings targets.

The low scenario represents a less prominent role for energy efficiency. For example, the low case considers that efficiency targets and budgets may be flat or reduced in future years for various reasons. Examples include statutes (e.g., energy efficiency resource standards) that sunset during the study period and we assume are either not continued or are extended with lower savings targets, as well as adoption or expansion of policies that constrain efficiency spending (e.g., large commercial and industrial customers are allowed to opt out of paying for and participating in efficiency programs). Conversely, the high case considers the possibility that states increase efficiency savings targets and budgets to capture achievable economic potential, and/or states adopt regional best practices.

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[10] Also see U.S. Department of Energy's catalog of energy efficiency potential studies: https://www.energy.gov/eere/slsc/energy-efficiency-potential-studies-catalog.

[11] This new Berkeley Lab study features explicit modeling of the impact of electricity efficiency policies in 49 states, modeling of policy constraints (e.g., opt-out policies), and more in-depth assessment of projected spending and savings trends for publicly owned utilities and rural electric cooperatives over an extended time horizon (to 2030).

Based on our quantitative analysis of projected spending and savings under these three scenarios, we identify and discuss the broader themes and issues that will influence which of the potential projections are most likely to occur and the potential implications.

The findings are useful for a wide range of audiences, including utilities and other entities responsible for administering customer-funded efficiency programs; state PUCs responsible for overseeing program implementation for regulated utilities; state consumer advocates and other stakeholders in regulatory proceedings; state energy office and air quality agencies responsible for related policies and programs; policymakers, planners, and industry analysts seeking to understand the potential impact of these programs on broader electricity markets and implications for other policies; and the energy services industry seeking to understand market trends and opportunities.[12]

The remainder of this report is organized as follows:

- Chapter 2 summarizes recent trends in program spending on electricity efficiency.
- Chapter 3 describes our analytical approach, including the key drivers and constraints for projecting program spending as well as savings for the low, medium and high scenarios.
- Chapter 4 provides the results of our scenario modeling to develop spending and savings projections for 2020, 2025 and 2030 at the national and regional levels, including projected spending in 2020 and 2030 by primary policy driver.
- Chapter 5 discusses these results in the context of key issues, uncertainties and new challenges for electricity efficiency programs funded by utility customers.

A separate technical appendix describes the methodologies and assumptions we used to develop spending and savings projections for investor-owned utilities and publicly owned utilities and cooperatives (Appendix A) and state-by-state spending and savings projections for 2020, 2025 and 2030 (Appendix B). Table A-3 in Appendix A, organized by Census region, summarizes each state's policy and regulatory framework and our resulting assumptions for the low, medium and high scenarios.

[12] Berkeley Lab's 2013 study has been used by the U.S. Energy Information Administration in its inventory of efficiency program spending in support of energy modeling in the National Energy Modeling System; by EPA in support of rulemakings (e.g., Demand-Side Energy Efficiency Technical Support Document, August 2015); by utilities (e.g., PacifiCorp's Demand-Side Resource Potential Assessment: 2015-2034); by several national and regional energy efficiency organizations; by other national laboratories and consultants (Synapse Energy Economics, Analysis Group) in their publications; by trade publications (Affordable Housing Finance, May 2013; Energy Manager Today, January 2013); by state air regulators (National Association of Clean Air Agencies); and by academics (e.g., University of Texas, University of Delaware, University of Dayton, Rochester Institute of Technology, University of Florida, University of California-Berkeley, Oxford University, University of Malaysia).

2. Recent Trends in Electricity Efficiency Program Spending

In this chapter, we summarize recent trends in electricity efficiency spending by program administrators in order to provide a baseline for our projections of future activity. We also compare actual program spending trends in recent years with projections that LBNL made in a 2013 study on the future of energy efficiency programs funded by utility customers (Barbose et al. 2013).

Figure 2-1 shows historical spending on electricity efficiency programs as reported by the American Council for an Energy-Efficient Economy (ACEEE 2010, 2011, 2013, 2014, 2015) as well as projections from the 2013 LBNL study of future spending to 2025 under low, medium and high scenarios. We observe that reported spending on electricity efficiency programs funded by utility customers increased from $4.6 billion in 2010 to $6.3 billion in 2015.

At the time we conducted the analysis for our 2013 study, reported program spending was available through 2010. We anticipated significant growth in efficiency program spending driven primarily by legislation and regulatory policies (e.g., energy efficiency resource standards (EERS), energy efficiency eligibility under renewable portfolio standard (RPS) policies, and statutes requiring utilities to acquire all cost-effective efficiency). Actual spending since 2010 has increased to a level that is slightly below our projections in the medium scenario. In 2015, program administrators reported spending $6.3 billion on electricity efficiency programs, which is 97 percent of LBNL's medium scenario projection for 2015 ($6.5 billion) (Barbose et al. 2013). Actual spending in 2016 ($5.8 billion) fell within the range of the low and medium scenarios in the 2013 study.[13]

The study also projected that the geographic concentration of spending on electricity efficiency programs would become less concentrated and more dispersed across states. For example, LBNL forecasted that the Northeast and West would account for only 50 percent of national spending by 2025, down from 70 percent in 2010 (Barbose et al. 2013). Since 2010, actual spending in the Northeast and West declined as a percent of national spending to 64 percent. The share of spending in the 10 states with the highest expenditures on these electricity efficiency programs has decreased from 68 percent of total spending in 2010 (Barbose et al. 2013, Table 2) to 61 percent in 2016 (see Table 2-1).

[13] Values for actual spending for 2016 programs in most states are derived primarily from annual reports submitted by program administrators. In several states, LBNL used efficiency budgets proposed by program administrators in their demand-side management plans when actual spending data are unavailable.

Figure 2-1. Electricity efficiency programs: Actual spending (2010 to 2016) compared to projected spending in the 2013 LBNL study

Source: Barbose et al. (2013)

Table 2-1. Spending in 2016 on electricity efficiency programs

Rank	State	2016 Spending on Electricity Efficiency Programs ($ million)
1	CA	1,164
2	MA	521
3	NY	425
4	PA	238
5	WA	234
6	IL	219
7	CT	205
8	TX	200
9	MI	188
10	MD	184
	Top 10 States	**$3,579**
	% of U.S. spending	61%
	Remaining U.S. States	**$2,242**
	% of US spending	39%
	Total U.S.	**$5,823**

3. Analytical Approach: Key Drivers and Constraints for Projecting Future Program Spending and Savings

In this chapter, we describe our analytical approach for projecting future spending and savings from electricity efficiency that could be achieved by program administrators. The projections are based on three scenarios—low, medium and high cases—that reflect different pathways for the evolution of efficiency policies and market dynamics in each state. The scenarios are intended to represent a range of potential outcomes given the current policy environment, uncertainties in policy implementation and the broader economic and policy environment (e.g., utility business models, the level and longevity of policy commitment, concerns about rate impacts). Appendix A includes a more detailed description of our methodological approach used to develop spending and savings projections to 2030.

3.1 Analytical Approach

To forecast efficiency program spending and savings to 2030, LBNL engaged in an expansive and detailed data collection and analysis effort. Researchers collected historical spending and savings data at the program administrator level for investor-owned utilities (IOUs), publicly owned utilities and cooperatives.[14] Additional information collected included demand-side management (DSM) plans, integrated resource plans (IRPs), energy efficiency potential studies and public utility commission (PUC) decisions.[15] Researchers also reviewed relevant state statutes and conducted more than 50 interviews with regional and national energy efficiency experts, utilities and other program administrators, regulatory staff and other industry stakeholders to help inform scenario definitions and key assumptions.

3.1.1 General Factors Considered: Performance, Policy Drivers and Constraints

Utilities and other efficiency program administrators offer programs and pursue energy savings for multiple reasons (e.g., comply with state regulatory policy objectives, enhance customer service and satisfaction). The program administrator may be required to achieve a certain level of savings or meet a related objective, receive an incentive to reach or exceed a savings target, or pursue savings as a low-cost component of its resource mix. In states with strong and enduring support for efficiency, program administrators are typically motivated by a complementary array of carrots and sticks, as well as by resource optimization or customer service objectives, or both.

Program administrators also face constraints on program spending or savings. Some are a function of policy (e.g., limits on spending). Others are a function of the market environment (e.g., shifting baselines for the energy performance of standard equipment). Some are a hybrid (e.g., definition and

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[14] We supplemented data on publicly owned utilities and cooperatives available through EIA form 861 with additional analysis based on the share of load in the state that was currently covered by energy efficiency programs for these types of utilities. See Section A.5 of the Appendix for details.

[15] We compiled information on state policy drivers (e.g., DSM plan filings, IRPs, new legislation or major PUC decisions on electricity efficiency) through August 2018.

application of cost-benefit analyses, which are driven in part by the market cost of supply-side resources and in turn dictate what types of savings opportunities are cost-effective).

The projections reported here are based on drivers and constraints that are observable. LBNL analysts collected statutes, regulatory filings, rulings, reports and expert observations in order to understand the nature of these drivers and constraints: the manner in which policies were promulgated, the length of time over which they operate, the stringency of targets, or limits on savings opportunities or funding. None of the projections are premised on wholesale policy changes at the state or federal level or other more speculative influences.

Past and Current Performance of Program Administrators

We review the recent activity of efficiency program administrators and states in order to characterize their historic performance. For example, we use historic information on program spending and savings in each state to establish an initial relationship of the costs incurred by the program administrator to acquire first-year savings. We also assess the historic performance of program administrators (e.g., actual savings achieved compared to projected savings goals in recent years) in order to calibrate expectations of future performance. For example, a program administrator that consistently exceeds a mandatory savings target might be maximizing available shareholder incentives for energy efficiency and continue to perform at a high level even if EERS targets were to flatten or end.

Historic performance may also provide insights on the capability of program administrators (e.g., experience), capacity (sufficient resources and infrastructure) and market conditions. For example, a program administrator that is new to efficiency and has not yet developed the infrastructure for successful programs cannot be expected to ramp up to savings of 1 percent of retail electricity sales in one year. Conversely, an experienced program administrator operating in a mature efficiency services market is unlikely to sustain increasing saturations of typical efficiency measures as the pool of participants shrinks or baseline efficiency rises, although they may be better positioned to implement new measures.

Policy Drivers

Utilities and other efficiency program administrators work in the context of multiple policy drivers that vary in scope and stringency. Policies may establish targets—voluntary or mandatory—for energy savings. Some govern the collection, spending or magnitude of program funds. Others require integration of efficiency into electricity system planning. Some influence the utility’s motivation to acquire efficiency savings.

The following text box defines the policy drivers as used and defined in this study; Table 3-1 identifies states where these policy drivers apply.

Definitions of Policy Drivers as Used in This Study

Energy Efficiency Resource Standard – A state statute, executive order, or commission order or rule that specifies *binding* savings targets for program administrators over a period of three years or more. Savings targets may be annual or cumulative. An EERS may be expressed as required energy or demand reductions or in terms of a minimum or maximum spending requirement for program administrators (e.g., spend at least 2% of revenues; spend no more than 3% of revenues).

Energy efficiency eligibility under Renewable Portfolio Standard – Efficiency qualifies as an eligible resource for compliance with a state RPS or other clean energy standard. We project the extent to which utilities rely on efficiency as a RPS compliance strategy in the three scenarios.

Voluntary savings targets – A state sets non-binding efficiency targets, often stated as goals for program administrators (e.g., an EERS allows utilities to propose voluntary savings targets), or savings targets proposed by program administrators in a DSM plan to state regulatory commission.

All cost-effective energy efficiency mandate – A state statute requires that utilities or other program administrators acquire all cost-effective energy efficiency. A state regulatory commission or energy agency typically establishes a process to define savings levels, often based on the results of an energy efficiency potential study.

Regional Greenhouse Gas Initiative (RGGI) – A multi-state initiative to reduce power sector carbon dioxide (CO_2) emissions, participating states establish a regional cap on the amount of CO_2 emissions that power plants can emit by issuing a limited amount of tradeable CO_2 allowances. Each state has discretion over the investment of RGGI proceeds: energy efficiency, clean and renewable energy, direct bill assistance, and greenhouse gas abatement.

System benefit or public benefit charges – A statute or PUC decision authorizes and sets a dollar amount for energy efficiency programs (and often other public benefits) that appear on customers' electricity bills as a separate fee. The charge is typically fixed (in ¢/kWh) for a period of time (years). (Alternatively, efficiency program costs may be included in bundled retail electricity rates or as part of a procurement charge.)

Integrated Resource Plan – State legislation or commission rules require the utility to prepare a long-term plan that defines system requirements and identifies the combination of demand- and supply-side resources to meet those requirements considering least cost and risk and other policy objectives.

Demand-Side Management plan – The program administrator is required to submit a DSM program plan on a regular basis (e.g., single- or multi-year program cycle) that includes program description, design, savings goals and budget. A state commission or oversight body reviews and typically approves the plan.

Utility business model changes that support energy efficiency – The state has adopted and approved for its program administrator(s) one or more of the mechanisms to reduce disincentives to energy efficiency or provide an incentive for acquiring savings: decoupling, lost revenue adjustment, and earnings opportunities (e.g., shared savings, bonus) for exemplary performance.

Table 3-1. Policy drivers for spending and savings for electricity efficiency programs

Key Policy Drivers	States Where Applicable to Electricity Efficiency Programs
Energy efficiency resource standard	AZ, CA, CO, HI, IL, MD, MI, MN, NJ, NM, NV, NY, OH, PA, TX, VA, VT, WI
Energy efficiency eligibility under state renewable portfolio standards	MI, NC, NV, OH
Voluntary savings target	IA, IN, MN, MO, UT
Statutory requirement that utilities acquire all cost-effective energy efficiency	CA, CT, MA, ME, NH, OR, RI, VT, WA
System/public benefit charge	CA, CT, DC, HI, MA, MT, NH, NJ, NY, OH, OR, RI
Regional Greenhouse Gas Initiative	CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VT[16]
Integrated resource plan	28 states (primarily in the West and South)
Demand-side management plan, multi-year energy efficiency budget or both	46 states
Utility business model (e.g., decoupling, lost revenue adjustment, shareholder incentives for performance)	27 states

3.1.1.1 Policy Drivers: Near to Mid Term

In the near term, most administrators of efficiency programs funded by IOU customers file DSM program plans with state regulators every one to three years. DSM plans are among the more prevalent drivers of efficiency program spending and savings and are used in 46 states (see Table 3-1). Approved DSM plans (and budgets) often are coupled to DSM surcharges, riders or tariffs that are adjusted or "trued up"—typically annually—to reconcile revenue collections with actual spending.

DSM plans often operate in tandem with other policies such as savings targets that span longer time frames. Binding savings targets, or energy efficiency resource standards (EERS), spread rapidly in the last 15 years[17] and now are key policy drivers for efficiency programs in 18 states (see Table 3-1). An EERS requires the administrator to meet energy savings or minimum spending requirements (e.g., spend at least 2 percent of revenues), often for a long time frame such as five to 20 years (ACEEE 2017). In four states (MI, NC, NV, OH), electricity savings from efficiency programs are eligible for compliance with state renewable portfolio standards (RPS) or clean energy standards that likewise are longer term commitments to increasing development and deployment of clean resources.

Five states (IA, IN, MN, MO, UT) have voluntary (non-binding) savings targets in which utilities propose desired savings levels for review by state regulators.

[16] New Jersey and Pennsylvania have decided to join RGGI, which will provide revenues for efficiency program administrators in the future.
[17] For dates of EERS enactment, see https://aceee.org/sites/default/files/state-eers-0117.pdf. For LBNL's EERS definition, see text box.

Nine states in the New England and Mid-Atlantic regions currently are members of the Regional Greenhouse Gas Initiative (RGGI). In 2015, the nine states invested about 64 percent of the $410 million (or $264 million) from RGGI auctions in energy efficiency programs, which were typically managed by program administrators of utility customer-funded programs (RGGI 2017).[18]

3.1.1.2 Policy Drivers: Mid to Long Term

Some of the more enduring policy drivers for efficiency program spending and savings are rooted in states' efforts in the 1980s and 1990s to grapple with rising energy costs. States chiefly in the Northeast, West and Midwest began requiring utilities to conduct integrated resource planning (IRP). The objective was to foster more comprehensive evaluations of all potential energy sector resources—including demand-side options—to minimize the cost of service over the long term. Planning horizons for IRPs typically are 15 to 20 years, with some states requiring longer term analyses. The IRP process is mainly concentrated today in the South and West, with some Midwest states also requiring IRPs.

In the mid-1990s and early 2000s, many states restructured their electric utilities. To maintain energy efficiency and other public benefits (e.g., bill assistance for low-income customers) that might be lost, some states introduced a system or public benefits charge (SBC/PBC) as a dedicated funding source for efficiency programs. These charges are in place in at least 12 states (CA, CT, DC, HI, MA, MT, NH, NJ, NY, OH, OR, RI), setting a floor on program spending. Some states allow additional funding for energy efficiency programs to enable acquisition of additional cost-effective efficiency.

To ensure efficiency is fully considered and maximized, some states enacted legislation to require utilities to acquire all cost-effective energy savings—energy savings that are less costly than the likeliest next supply alternative. In translating this requirement into a specific savings target, state regulators and program administrators often use energy efficiency potential studies to screen measures for cost-effectiveness and integrate achievable potential values in annual or multi-year target setting and DSM portfolios and budgets. All cost-effective efficiency mandates are a driver of program spending and savings in nine states (CA, CT, MA, ME, NH, OR, RI, VT, WA).[19]

3.1.1.3 Policy Drivers: Business Models for Energy Efficiency

Utilities in all states recoup their direct cost of offering efficiency programs. Three policies are intended to reduce utilities' disincentive or provide a financial incentive to promote energy efficiency:[20]

1. *Decoupling* breaks the link between how much energy a utility sells and the revenue it collects to cover fixed costs. An accounting mechanism trues up the utility's revenues to cover the fixed costs authorized in the last rate case.

[18] Program administrators often combine several funding sources. For example, in RGGI states, energy efficiency funds come from system benefit charges or are collected in utility rates, as well as RGGI proceeds. These multiple funding sources are used to meet a state's policy objectives for energy efficiency (e.g., an EERS or an all cost-effective efficiency standard).

[19] In several other states, statutes or executive orders cite the acquisition of all cost-effective efficiency as a policy objective or goal. While those policies may animate the development of efficiency targets and efforts to acquire savings, they are non-binding and not modeled explicitly in this study.

[20] See https://emp.lbl.gov/publications/framework-organizing-current-and.

2. *Lost revenue adjustment mechanisms* compensate the utility only for reduced revenue associated with lost sales from specific demand-side programs.

3. *Shareholder incentives* provide an earnings opportunity for meeting or exceeding energy savings targets or other performance objectives.

Many states allow utilities to apply for one or more of these ratemaking mechanisms or business model incentives. However, our study considered these policies as influential in a state only when at least one electric utility with substantial load is *approved* for decoupling, lost revenue recovery or a performance incentive.

3.1.1.4 Policy Constraints

Some states have adopted policies that effectively constrain the magnitude of available savings (or spending) from efficiency programs. It is important to consider and account for the impact of policy constraints in exploring potential future pathways for electricity efficiency programs. Table 3-2 lists several policy constraints for efficiency program spending and savings with examples of states where they are an important feature of the policy environment.

Table 3-2. Key policy constraints on efficiency program savings and spending

Key Policy Constraints	Examples of States With Policy
Statutory or regulatory caps on rate impacts or program spending	MI, PA, TX, WI
Legislative or executive redirection of efficiency funding to other state purposes	CT, NJ
Large commercial and industrial opt out from efficiency charges and programs[21]	AR, IA, IL, IN, KY, ME, MO, NC, OH, OK, SC, VA, WV

Statutory or regulatory caps on rate impacts or program spending. Most states control spending on efficiency programs in two ways—by approving program budgets and by setting efficiency program charges to match program expenditures. Legislatures in some states impose additional limits on efficiency investment by capping the portion of rates or collections dedicated to efficiency or capping total dollars spent. In some cases, these caps are dynamic. For example, Texas links its statutory caps on efficiency-related charges to changes in the consumer price index for urban areas in the South. Pennsylvania has a statutory cap on efficiency (and demand response) that limits spending to 2 percent of revenues paid to utilities for generation, transmission and distribution services.

[21] Under opt-out provisions, qualifying large commercial and industrial customers avoid utility energy efficiency charges altogether. Some 15 other states have some provision for self-direction of efficiency charges. Under a self-direct paradigm, these customers can choose to spend the fees in their own facilities to achieve energy savings, or they can pay into an aggregated pool of funds the utility collects to fund all energy efficiency programs. See *Industrial Energy Efficiency: Designing Effective State Programs for the Industrial Sector,* at https://www4.eere.energy.gov/seeaction/system/files/documents/industrial_energy_efficiency.pdf.

Legislative or executive redirection of funding. In a small number of states, governors or legislatures have redirected customer funds slated for efficiency programs to the state general fund or specified non-energy-related purposes. These funding diversions increased in number and size during the 2008 recession as state tax revenues declined, but the diversions have persisted in a few states as the economy recovered. We project duration and severity of legislative redirection of funding designated for efficiency programs in our modeling of scenarios.

Large commercial and industrial opt out. Opt-out policies for large commercial and industrial (C&I) customers allow eligible customers, typically above a certain threshold of demand or energy consumption, to stop paying charges for funding energy efficiency programs. C&I opt-out policies may reduce available funding sources for efficiency programs for all types of customers,[22] and program administrators are not able to claim savings from customers that have opted out.

To build low, medium and high scenarios for states with opt-out policies, LBNL reviewed utility DSM plans and included information on the amount of retail load that had opted out of participating in utility efficiency programs. In some cases, we projected retail load that was eligible to opt out based upon customer size thresholds included in legislation or PUC decisions and varied assumptions regarding the number of customers (and their retail load) that may opt out and the impact on program spending and savings.

Federal and State Standards:
A Challenge for Future Utility Program Design

Standards activity has increased significantly during the last decade with new or updated federal standards (and test procedures) on dozens of product categories, ranging from light bulbs and ceiling fans to commercial chillers and electric transformers. As those federal standards take effect, along with more stringent standards adopted by some states, they increase the efficiency of new lighting products, appliances and equipment, resulting in reduced electricity consumption and bill savings for consumers.

These standards also capture some of the achievable efficiency potential and reduce savings opportunities for electricity efficiency programs funded by utility customers. When all products sold in a given product category are more efficient—have a higher minimum energy performance—voluntary efficiency programs have a smaller margin of energy and bill savings to promote to customers for that product type.

Federal and state standards for common residential lighting products, coupled with dramatic cost reductions and market adoption of LED (light-emitting diode) lamps, are expected to dramatically reduce the largest source of low-cost savings for efficiency programs. These lighting programs supplied about 45% of program-driven savings in the residential sector from 2009-2015 (Hofmann et al. 2018). We attempted to account for the impact of existing federal standards in our modeling of future scenarios for utility-customer funded efficiency programs, particularly in later years of our study period (2025-2030). For example, reductions in utility program savings for residential lighting would tend to adversely impact the cost-effectiveness of portfolios of programs in aggregate, raising total costs and reducing available savings opportunities.

Federal and state efficiency standards for appliances, equipment and lighting. Federal and state energy conservation standards are very effective at reducing energy demand by requiring certain products meet minimum efficiency or maximum energy use levels. Given these standards capture some of the

[22] Funding is pooled across customer classes to pay for a portfolio of cost-effective efficiency resources that serve all eligible customers and provide system-wide benefits.

achievable efficiency potential, opportunities for savings from voluntary electricity efficiency programs funded by utility customers are reduced when these standards require compliance. In effect, standards act as a complementary efficiency strategy but they do constrain (and reduce) the remaining achievable savings potential (see text box for a more detailed discussion).

3.1.2 Modeling Future Electricity Efficiency Spending and Savings

In developing our modeling approach to projecting spending and savings over the study time horizon (2017-2030) under alternative scenarios, we distinguished among three time frames (see Figure 3-1).

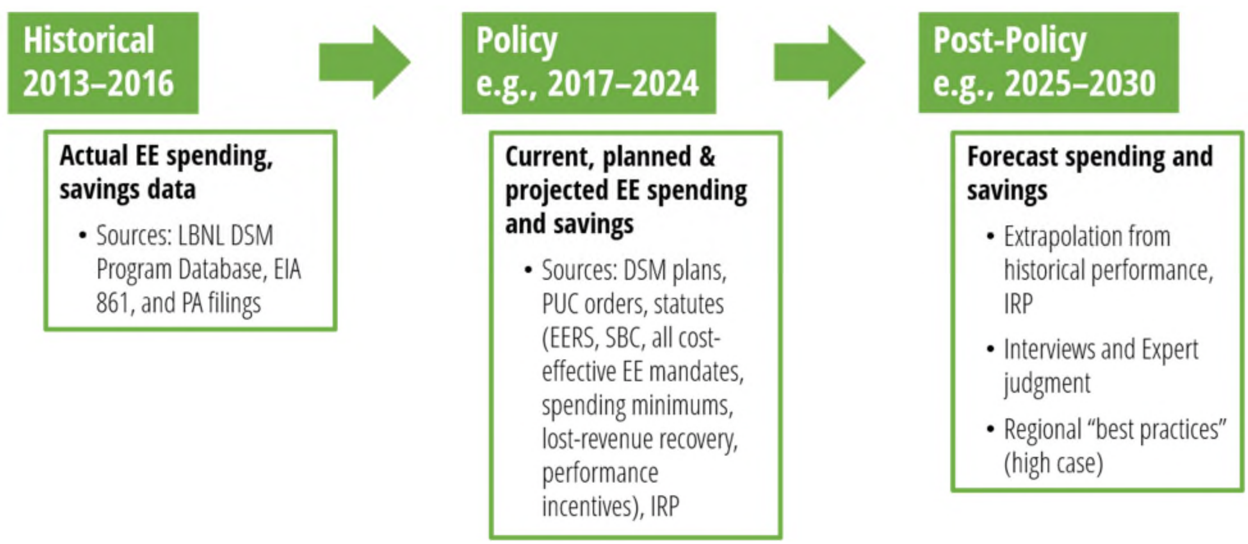

Figure 3-1. Modeling framework: Historical, policy and post-policy periods

In the first period ("Historical"), we collect information on actual program spending and savings for program administrators in each state in order to establish an initial relationship of costs incurred by the program administrator to obtain first-year savings. We then define a "Policy" period whose duration varies by state and depends on its specific policies. For this period, we estimate future savings and spending for efficiency programs funded by customers of IOUs that are driven by explicit state policies or plans: DSM plans, IRPs, PUC orders and statutes (e.g., EERS, utility shareholder performance incentives, SBC). In most states, the Policy period does not include the entire study period (to 2030). Thus, in many states, we define a "Post-policy" period during which policy commitments have ended or are considerably less firm. For this post-policy period, we relied on interviews with state and regional efficiency experts, regulators, and utilities and other program administrators and for the high scenario considered their view of "best practices" in each region to define a range of savings targets for each state.

Many state policies on energy efficiency allow us to estimate electricity savings in future years (e.g., EERS, IRPs), but do not include information on projected spending. Thus, we developed an analytic method that models and projects future spending for efficiency programs, given estimates of future program savings. Specifically, we created a cost of electricity savings function that translated first-year program savings by state into annual program spending, grouping program administrators in states by our four census regions. This cost function is based on the assumption that the cost of electricity savings is associated with the level of savings achieved by the program administrator relative to their retail sales (see Appendix A).

3.1.3 Developing the Scenarios

Deciding which policy and market factors are the most salient influences in a state—and how best to represent them in future scenarios—is a judgment. We modeled three scenarios for each state to represent alternative pathways for the evolution of electricity efficiency program spending and savings given the current policies and broader environment in which programs operate. The medium case largely represents a continuation of current policies and practices, subject to known policy and market constraints. While scenarios are tailored by state, they can be characterized broadly (see Figure 3-2).

Low Case	Medium Case	High Case
• Retrenchment or retreat from current policy context and path • States that have been leaders in efficiency markets have greater saturation of "low-hanging fruit" technical opportunities and greater emphasis on strategies such as financing that increase customer cost contribution • "Go slow" approach in states newer to efficiency • Publicly owned utilities and cooperatives with programs continue at historic spending levels and those without programs today do not launch them • Cost-effectiveness of efficiency compared to supply-side alternatives declines • Efficiency product and equipment standards significantly reduce savings opportunities for voluntary programs in most states	• Extension of current policy context and performance – States generally stay the course on policies and meet savings targets – Some states throttle back commitments to efficiency (e.g., IA, OH); others reinforce expand their commitments (e.g., NY, NJ, IL, MI) • Financing augments, not replaces, rebates • Publicly owned utilities and cooperatives with existing efficiency programs expand somewhat to 2030 (see Appendix A) • Consider policy and market constraints – Rate and spending caps are binding – Large C&I opt-outs remain • Standards significantly impact efficiency markets in later years, particularly in New England, Pacific NW, CA	• Policymakers view efficiency as a low-cost, low-risk resource option – Accept short-term rate impacts • Current policies ramp higher (e.g., toward achievable potential or savings levels of highest performer in region) – Rate and spending caps are eased • Publicly owned utilities and cooperatives with existing programs treated same as Medium scenario. Publicly owned utilities and cooperatives without programs start and ramp them up moderately • Regulators support and more utilities (and other program administrators) perceive business model for efficiency to be attractive

Figure 3-2. Summary of general assumptions in low, medium and high scenarios

Figure 3-3 illustrates one example of how changes in policy and performance by program administrators are reflected in the three scenarios. In this example, the state has an EERS that expires during the study time frame. In the medium case, we assume that the utility meets its saving targets as specified in the EERS and that the state legislature or PUC decides to extend the EERS to 2030. In the low case, the utility petitions the PUC with a waiver request to lower its EERS savings target in later years and also reflects its views on efficiency in its IRP. In the high case, a state has put in place an attractive business model for efficiency, and we assume that the utility outperforms its planned savings target in order to maximize its performance incentives during later years of the study period.

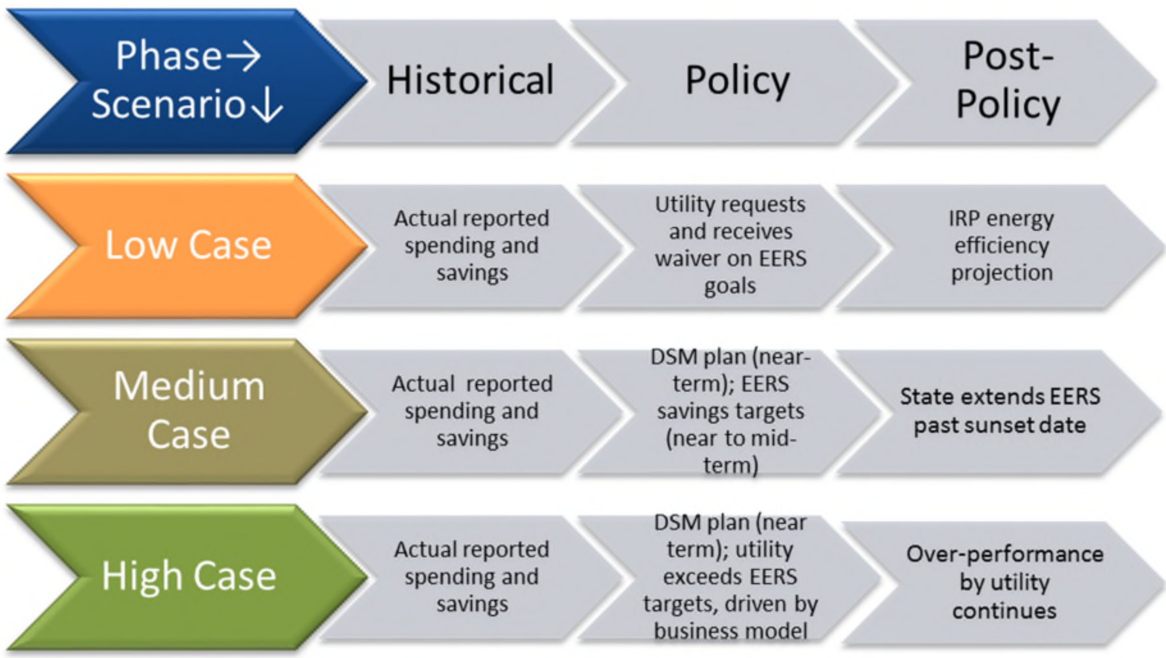

Figure 3-3. Illustrative example of policy modeling approach

The projections of electricity efficiency program spending and savings are based on state-specific assumptions, which are summarized by Census region in Table 3-3. In each region, we describe key assumptions for several of the states, including larger states or states with significant policy changes (e.g., higher goals in NY, erosion of support in IA), in order to illustrate the bottom-up approach. Projected IOU savings in each scenario are described using a common metric—annual savings as a percent of retail sales. Appendix A (see Table A-3) summarizes the policy context and regulatory framework in more detail in each state, including the key assumptions used in each scenario to model IOU spending and savings and how that translates into projected savings over time using this metric.

Table 3-3. Key scenario assumptions for projecting future electricity efficiency spending and savings

Region	Scenario	Representative Assumptions
South	Low	• Arkansas - Same as medium scenario. • Florida - Same as medium scenario. • North Carolina - IOUs achieve 2018 target, then savings are lower to 2030 based on IRP base case and more C&I customer opt-out (0.6%).
	Medium	• Arkansas - IOUs meet EERS targets through 2019 (1.5%), then goals set based on achievable potential (1%) in 2030, subject to C&I opt-out (~18% of load). • Florida - State-regulated utilities achieve very modest savings goals set in 2014 Florida Energy Efficiency and Conservation Act proceeding (0.07%) to 2024. • North Carolina - IOUs achieve targets through 2018 (1.3%), then savings decline to the maximum allowable for efficiency under the state RPS (0.75%).
	High	• Arkansas - IOUs meet EERS targets through 2019 and sustain 1.5% savings through 2030. • Florida- State-regulated utilities achieve savings goals to 2019, then increase savings by 0.15% per year to a maximum of 0.5% savings as % of retail sales based on achievable potential. • North Carolina - IOUs meet 2018 targets (1.3%) and continue to perform at that level to 2030.
Midwest	Low	• Illinois – See medium case for new law provisions; assume IOUs meet DSM plan targets to 2021, then savings decrease (0.9%) as C&I opt-out excludes 10-30% of load with efficiency opportunities. • Iowa – See medium case for new law and 2019-2023 proposed DSM plan savings and spending. From 2024 on, assume DSM plan does not pass the ratepayer impact measure (RIM) test and customers representing 65% of revenues opt out by 2030, with savings decreasing to 0.35%. • Michigan – Assume EERS is not extended after 2021; IOUs meet their near-term DSM targets to 2021 but reduce their efforts somewhat after that (0.8% in 2030).
	Medium	• Illinois – A 2017 law includes EERS with aggressive cumulative savings goals and excludes large customers (>10 MW peak demand). Assume IOUs meet DSM plan targets to 2021, then savings decline modestly to 2030 given favorable energy efficiency business model (1.2%). • Iowa – A 2018 law allows all customers to opt out of participating in any five-year efficiency plan if the plan fails to pass the RIM test. The new law caps efficiency spending at 2% based on revenues of remaining customers that do not request exemption. Assume IOUs meet near-term spending and savings goals in their proposed DSM plans (2019-2023). From 2024 on, assume that DSM plan does not pass the RIM test and customers representing 45% of revenues opt out by 2030, with savings decreasing to 0.5% (from 1.2% in 2017). • Michigan – EERS sunsets in 2021; utilities submit DSM plan and have attractive efficiency business model; assume IOUs meet near-term DSM savings goals (1.5% in 2021) and sustain targets to 2030, motivated by opportunities for shareholder earnings.
	High	• Illinois – See medium case for new law provisions; assume IOUs meet DSM plan targets to 2021 and sustain those savings to 2030 given attractive business model (1.4%). • Iowa – See medium case for new law provisions. From 2024 on, assume that DSM plan does not pass the RIM test and customers representing 35% of revenues opt out by 2030, with savings decreasing to 0.58% by 2030. • Michigan – IOUs achieve higher savings target (1.7%) based on achievable market potential, driven by attractive performance incentives.

West	Low	• California – See medium case for policy framework; assume difficulties in IOU transition to 3rd-party program managers, but savings recover somewhat after 2020. Publicly owned utilities reduce their efforts somewhat (0.9%). • Washington - See medium scenario for policy framework; assume IOU savings targets decrease from current levels (1.1% in 2018 to 0.5% in 2030) due to as low wholesale prices which erode cost-effectiveness and impact of appliance and equipment standards. • Arizona - IOUs fall short of EERS; savings after 2020 fall to IRP level; Salt River Project savings decline slightly.
	Medium	• California – Extensive policy support for efficiency with savings targets based on potential studies and aggressive state policies; assume IOUs meet current targets (1.7%), which decrease somewhat over time (1.4% in 2030); low-income savings decline somewhat. Publicly owned utilities meet targets (1.1% in 2030). • Washington – All-cost effective efficiency statute and Northwest Power and Conservation Council estimates efficiency potential. Assume IOUs maintain aggressive savings levels through mid-2020s (1.8% in 2025), but savings decline in later years of study period primarily due to impact of appliance and equipment efficiency standards (0.6% in 2030). • Arizona – EERS sunsets in 2020; after that, assume IOUs savings decrease from current levels for IOUs (1.7% in 2017 to 1.0% in 2030).
	High	• California – See medium case for policy framework; assume IOU savings rise to higher tier of achievable market potential (1.7% in 2030); low-income savings sustained. Publicly owned utilities meet targets. • Washington - See medium scenario for policy framework; assume IOUs, publicly owned utilities and cooperatives achieve savings that are close to achievable potential (2% in 2025), but savings decline in later years due primarily to impact of efficiency standards. • Arizona – See medium scenario for policy framework; assume EERS requirements remain largely in place with IOU savings at 1.5% in 2030; Salt River Project maintains current savings (2.0%).

Northeast	Low	• Massachusetts - IOUs attain 90% of achievable savings potential through 2021 (3.4%), then savings decline due to efficiency standards and lighting market transformation (1.75% in 2030). • New York – Same as medium scenario to 2025. Then assume savings decline to 1.6% in 2030, consistent with low scenario of other regional leaders. • Connecticut - Assume state budget challenges continue to adversely impact efficiency program budgets and savings continue to decline (0.8% in 2030).
	Medium	• Massachusetts – All cost-effective efficiency mandate and business model. Assume strong policy support for efficiency continues and IOUs meet near-term savings goals (3.9% in 2021), but savings decline in later years in response to efficiency standards and lighting market transformation (2.2% in 2030). • New York – Governor announced higher statewide savings target for energy efficiency in 2018 (30,000 GWh for the period between 2015 and 2025). Assume IOUs achieve near-term savings goals (1.4%) to 2020 and then IOU and NYSERDA programs ramp up to 2% savings per year by 2025 to help achieve Governor's energy goals along with NYPA and LIPA programs. After 2025, assume savings decline slighting to 1.9% in 2030. • Connecticut – Strong efficiency policy framework (acquire all cost-effective efficiency with business model), but state budgetary problems result in lower spending and savings; IOU savings decrease from 1.7% in 2017 to 1.0% in 2030.

High	• Massachusetts - IOUs achieve potential through 2021 and, given strong policy support, continue to achieve high savings targets by adapting efficiency programs (2.5% in 2030). • New York – Same as medium scenario to 2025 (2%) and after 2025, assume savings remain at 2% per year through 2030. • Connecticut – Assume state budget challenges are resolved in several years and historic policy support for efficiency translates into increased program budgets (savings increase to 2017 levels in 2030 at 1.7%).

4. Results

In this chapter, we present our projections of future spending and savings for electricity efficiency programs to 2030 in the low, medium and high scenarios. We first provide a national overview of projected program spending, then focus on regional spending trends and discuss policies that appear to be primary drivers. We then summarize results for program savings nationally and by region for the three scenarios. Appendix B provides state-by-state details on program spending and savings.

4.1 Electricity Efficiency Program Spending: National Overview

Spending on electricity efficiency programs (in nominal $) is expected to increase in all three scenarios between 2016 and 2030. In the medium case, spending is expected to rise to $8.6 billion in 2030 compared to $5.8 billion in 2016, an increase of more than 45 percent. In the high case, annual spending increases by 90 percent compared to 2016 levels, reaching $11.1 billion in 2030 (see Figure 4-1).

Spending in the low case remains fairly flat, increasing only to $6.8 billion in 2030, which is a decrease if we account for the expected effects of inflation and report spending in real dollars. At a state level, spending in this case is projected to decrease in 19 states in 2030 compared to 2016 levels.

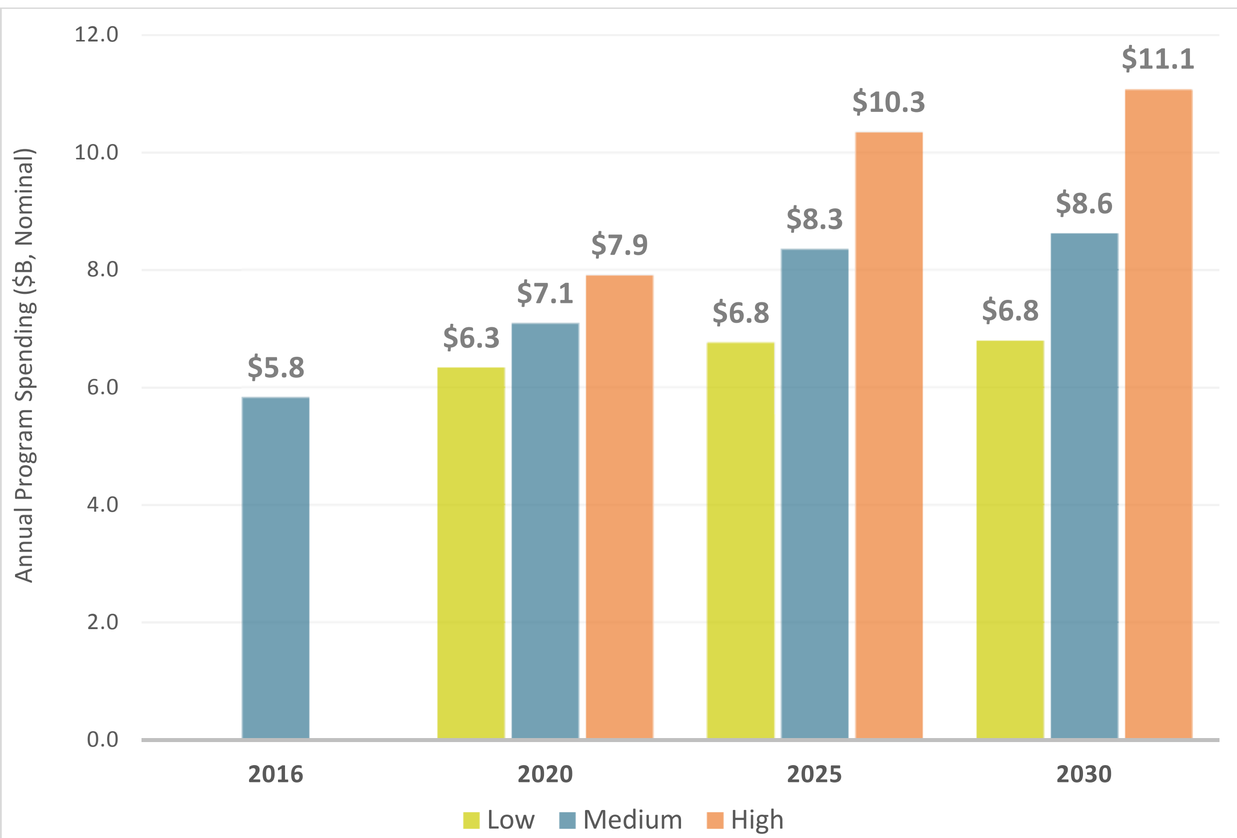

Figure 4-1. Projected electricity efficiency program spending to 2030 under three scenarios

These projections correspond to compound annual growth rates of ~1.1 percent per year (low case), 2.8 percent per year (medium case) and 4.7 percent (high case). To place these results in context, historical spending patterns for electricity efficiency programs in the United States have been somewhat volatile over the last two decades. From 1997 to 2005, electricity program spending increased by less than 5 percent per year. However, between 2006 and 2010, electricity efficiency program spending accelerated at an average rate of 30 percent per year.[23] More recently, between 2011 and 2015, spending for electricity efficiency programs increased at an average rate of only 2 percent per year.[24] Thus, the projected growth rates in spending between 2016 and 2030 in our medium case (2.8 percent per year) are quite consistent with trends between 2011 and 2015 (2 percent per year). Projected growth rates in spending in our high case (4.7 percent per year) are relatively conservative compared to previous periods.

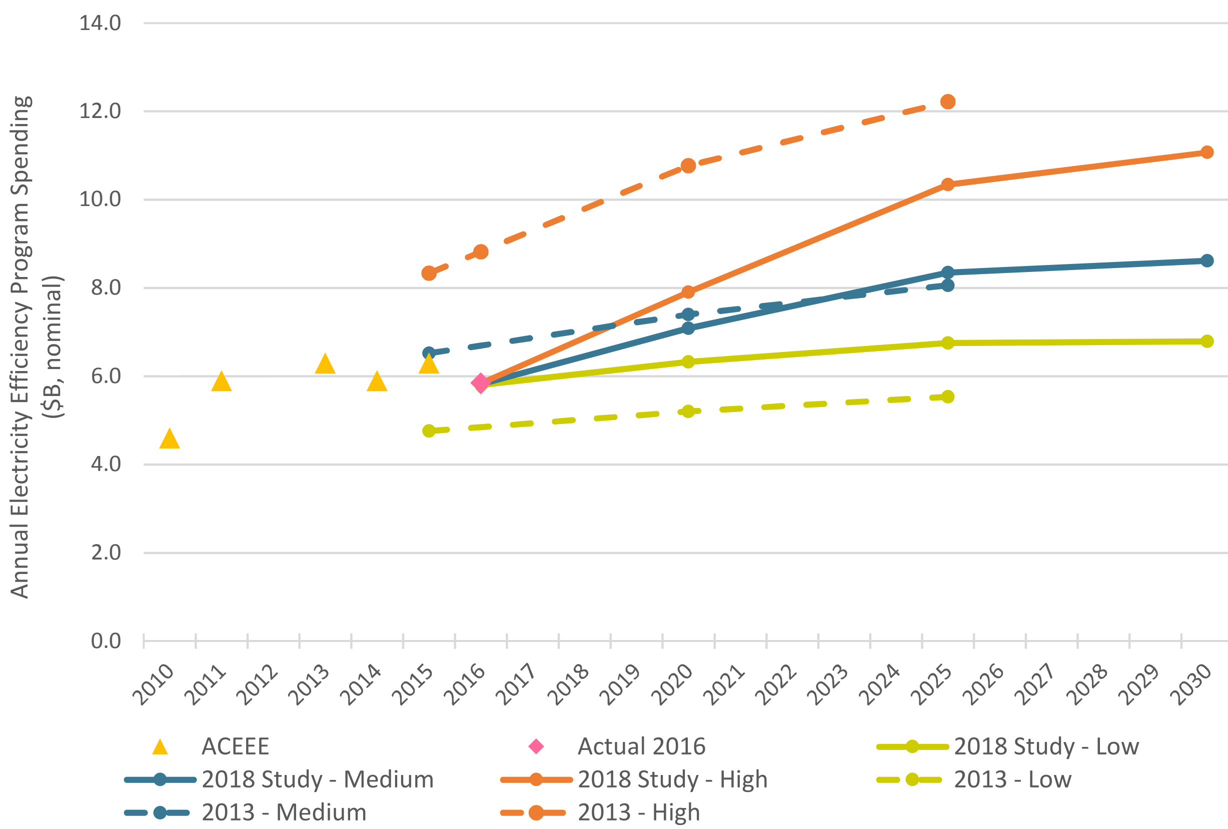

Figure 4-2. Reported spending on electricity efficiency programs (2010 to 2016) compared to projected spending in 2013 LBNL study and current (2018) LBNL study for low, medium and high scenarios[25]

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[23] Spending increased from $1.59 billion in 2006 to $4.6 billion in 2010; 12 states accounted for 75% of that increase (CA, NY, MA, MN, OH, FL, IL, NJ, MI, MD, CT, WA). Source: ACEEE (2011)

[24] Based on ACEEE Scorecards for these years, http://aceee.org/state-policy/scorecard.

[25] ACEEE Scorecard reports provide historical spending data on electricity efficiency programs from 2010 to 2015. Actual 2016 spending is based on program data compiled by LBNL for this report from various sources (e.g., EIA 861, annual reports filed by program administrators).

Figure 4-2 compares our projections of future program spending in this study with the scenario projections from the 2013 LBNL study. The figure updates Figure 2-1 in this report (which shows actual spending in 2010-2016 and the 2013 LBNL study scenario results) and adds projected spending for our low, medium and high scenarios to 2030.

We offer three observations on this comparison. First, our current projections of the “upside” for electricity efficiency program spending (the high scenario) are significantly lower compared to the 2013 study (for 2025, $10.3 billion vs. $12.2 billion). Second, our projection of spending in the medium case in 2025 is slightly higher than the 2013 LBNL study. Third, the projected range in spending in our current study is much narrower across the three scenarios compared to the 2013 LBNL study, driven primarily by our higher spending projections in the low scenario.

In addition, projected growth in program spending in the current study tends to be “front-loaded,” with increases concentrated in the first 10 years (to 2025). For example, in the medium scenario, annual spending increases by 4.3 percent and 3.6 percent per year between 2016-2020 and 2021-2025, respectively, but only 0.6 percent per year in 2026-2030 (see Table 4-1). We observe a similar pattern in the high case. Spending increases by more than 6 percent per year from 2016-2025 and by only 1.4 percent per year from 2026-2030.

This dynamic of front-loaded growth in spending is attributable to our methodological approach as well as our cautious assessment of efficiency market dynamics beyond the near term (see section 5.1). First, EERSs expire in some states over the next three to seven years and typically reach their savings targets prior to the sunset date. In the medium scenario, we typically take a business as usual approach and assume that in states with a binding EERS, savings targets will continue at levels that are consistent with the last year of the EERS. Second, we have higher confidence in our modeling of spending (and savings targets) in the near-term policy period as we can often rely on multi-year DSM plans prepared by program administrators (e.g., for 2018-2020). Third, in some states our modeling of the 2025-2030 period relies on utility IRPs and their characterization of achievable potential for energy efficiency. For example, in some states with an EERS (or an all cost-effective efficiency policy), utilities are projecting reduced savings levels in their IRPs from 2025 on, which impacts our projections of spending in 2025-2030. Often, utility estimates of remaining achievable potential are conservative (compared to previous periods), and some utility IRPs have suggested that achievable potential for their programs is likely to be lower in the future due to tightening federal efficiency standards and changes in certain end use markets (e.g., reduced cost and increased market penetration of LEDs).

It is useful to calibrate efficiency program spending relative to projected retail utility revenue. Electricity efficiency program spending in 2030 is projected to account for about 1.6 percent of retail revenues in the medium case, 2.1 percent in the high case, and 1.2 percent in the low case (see Table 4-1 and Figure 4-3). Policymakers often consider multiple indicators in making trade-offs regarding the costs, benefits and impacts of efficiency programs. Tracking spending as a percent of retail revenues provides an indication for the potential rate impacts of efficiency programs.

Table 4-1. Projected spending on efficiency programs: Growth rates over time and as a percent of electric utility retail revenues

	Projected Spending ($ Billion)				Projected Spending as % of Retail Revenues			Average Annual Spending Growth		
	2016	2020	2025	2030	2020	2025	2030	2016-2020	2020-2025	2025-2030
Low		6.3	6.8	6.8	1.6%	1.4%	1.2%	2.2%	1.7%	0.1%
Medium	5.8	7.1	8.3	8.6	1.7%	1.8%	1.6%	4.3%	3.6%	0.6%
High		7.9	10.3	11.1	2.0%	2.2%	2.1%	7.1%	6.2%	1.4%

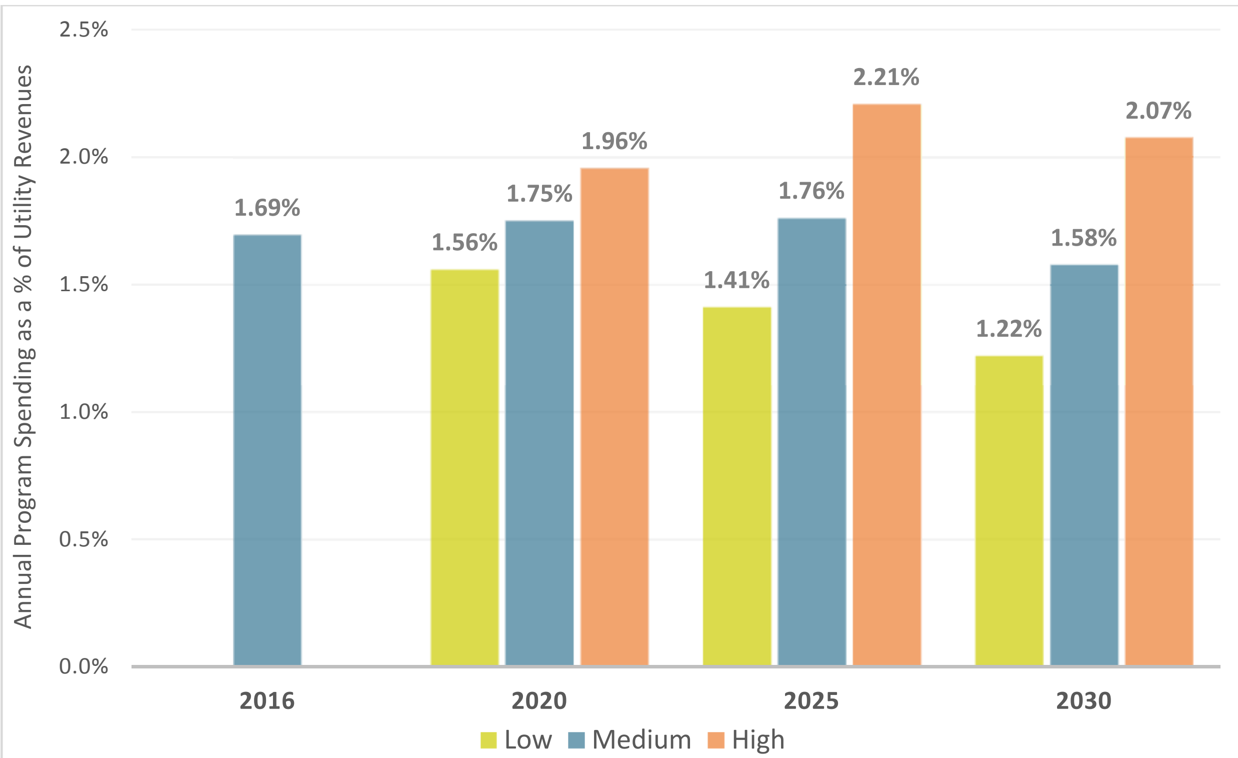

Figure 4-3. Electricity efficiency program spending as a percent of retail electric utility revenues in three scenarios

Projected spending by program administrators includes administrative costs and incentives. Participating customers also typically pay for a portion of project costs—in some cases, a significant share of the total costs. On a national basis, the total cost of saved electricity was double the program administrator cost of saved electricity between 2009 and 2015: $0.05/kWh vs. $0.025/kWh (Hoffman et al. 2018). Thus, we estimate that total market activity leveraged by electricity efficiency programs is about $11.6 billion in 2016. If we assume that the relationship between net participant cost and program administrator costs continues in the future, then the total market size of electricity efficiency programs in 2030 would increase to $17.2 billion in the medium scenario and range from $13.6 billion to $22.2 billion in the low and high scenarios, respectively.

4.2 Primary Policy Drivers for Electricity Efficiency Program Spending

In Chapter 3, we described and discussed policy drivers for electricity efficiency spending and savings and listed states where these policies are in place. As Table 3-1 shows, states often adopt multiple policy drivers that provide the overall framework under which program administrators design, manage and implement programs. We attempted to identify the primary policy driver in each state for programs funded by customers of IOUs in 2020 and 2030, using our judgment.

For example, assume that a state adopted an EERS with binding savings targets as well as utility business model mechanisms (e.g., shareholder incentives, decoupling). If the state's IOUs significantly exceeded EERs targets for several years and indicated that their business model for efficiency was an important driver for their activities, we concluded that the utility business model was the primary driver. We came to the same conclusion if the state adopted a voluntary savings target (e.g., utilities are free to propose non-binding multi-year savings targets) and the PUC had approved business model mechanisms which appeared to drive savings targets proposed by utilities. Conversely, if a state authorized PUCs to develop mechanisms to overcome disincentives to efficiency (e.g., decoupling, lost revenue mechanism) or provided an opportunity for additional earnings, but these mechanisms had either not been approved by the PUC for any IOU or were not widely adopted among IOUs in that state, then we typically did not list utility business model as the primary driver. As another example, if state statute requires utilities to acquire all cost-effective efficiency, which the PUC uses to set binding savings targets, then we typically decided that the statute was the primary policy driver for efficiency. For other states, if the only regulatory policy that impacts efficiency is a requirement for program administrators to file a DSM plan that includes program designs and budgets for PUC approval, then we listed that as a primary policy driver.

Projected trends in national spending on electricity efficiency programs are driven by efforts and activities in each state. After deciding on the primary driver in each state, we assigned projected spending in that state to the primary policy driver and calculated the share of total national electricity efficiency spending driven by each policy driver in 2020 under the medium case.

Figure 4-4 summarizes the results of this effort. Based on our analysis, EERS policies are the primary driver in 12 states and all cost-effective efficiency statutes are the primary driver in five states, accounting for 34 percent and 13 percent respectively of national efficiency spending in 2020. Utility business models are the primary driver in 15 states, accounting for about 40 percent of projected spending in 2020, and DSM plans are the primary driver in 12 states, accounting for about 9 percent of projected national spending in 2020.

We used the same methodological approach to assess the primary policy driver in 2030 for all states (Figure 4-5). The biggest change, compared to 2020, is a projected increase in spending in those nine states where a statutory requirement for utilities to acquire all cost-effective efficiency is the primary driver for efficiency program spending (nine states, accounting for 31 percent of projected national spending). The number of states where IRPs are the dominant driver also increased (seven states, accounting for 6 percent of projected national spending). These increases are in part due to expiration of authorizations for other policy drivers. For example, we project that the number of states where utility business models are the primary driver declines (10 states, accounting for 18 percent of national spending). Business model mechanisms in some states are more near term (e.g., product of a general rate case settlement) or more uncertain farther out in the future.

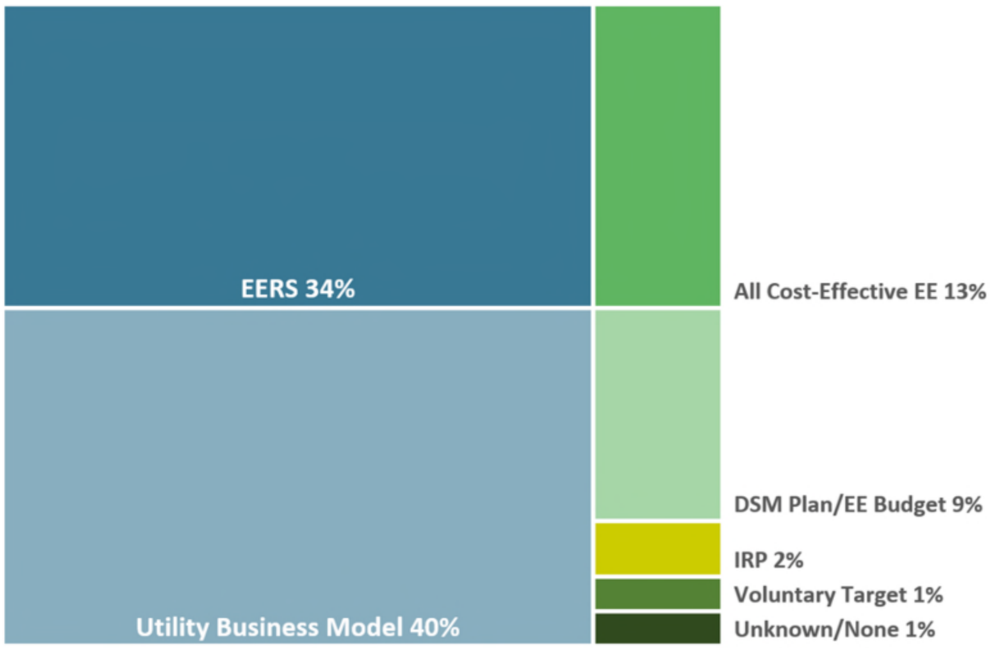

Figure 4-4. Primary policy driver for electricity efficiency program spending in medium case in 2020

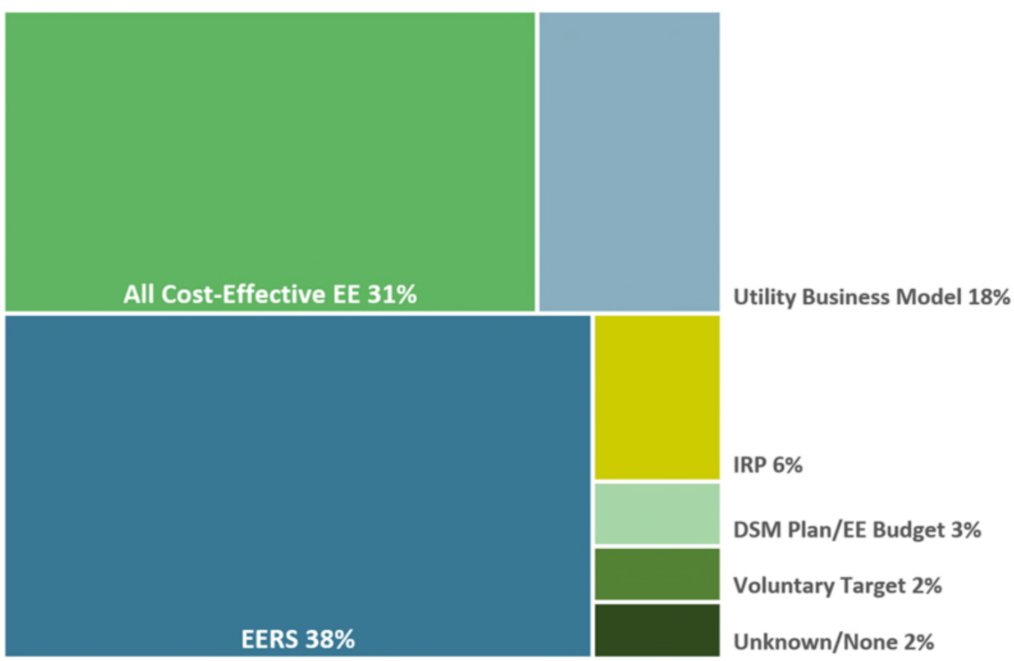

Figure 4-5. Primary policy drivers for electricity efficiency program spending in medium case in 2030

4.3 Regional Trends in Electricity Efficiency Program Spending

We also characterized trends in four regions based on activities in each state. Figure 4-6 summarizes spending on electricity efficiency programs in 2030 compared to 2016 in the low, medium and high scenarios. In 2016, states in the West and Northeast accounted for 64 percent of national spending on electricity efficiency programs. Energy efficiency services markets in these regions are relatively mature as many states have been implementing programs for decades.

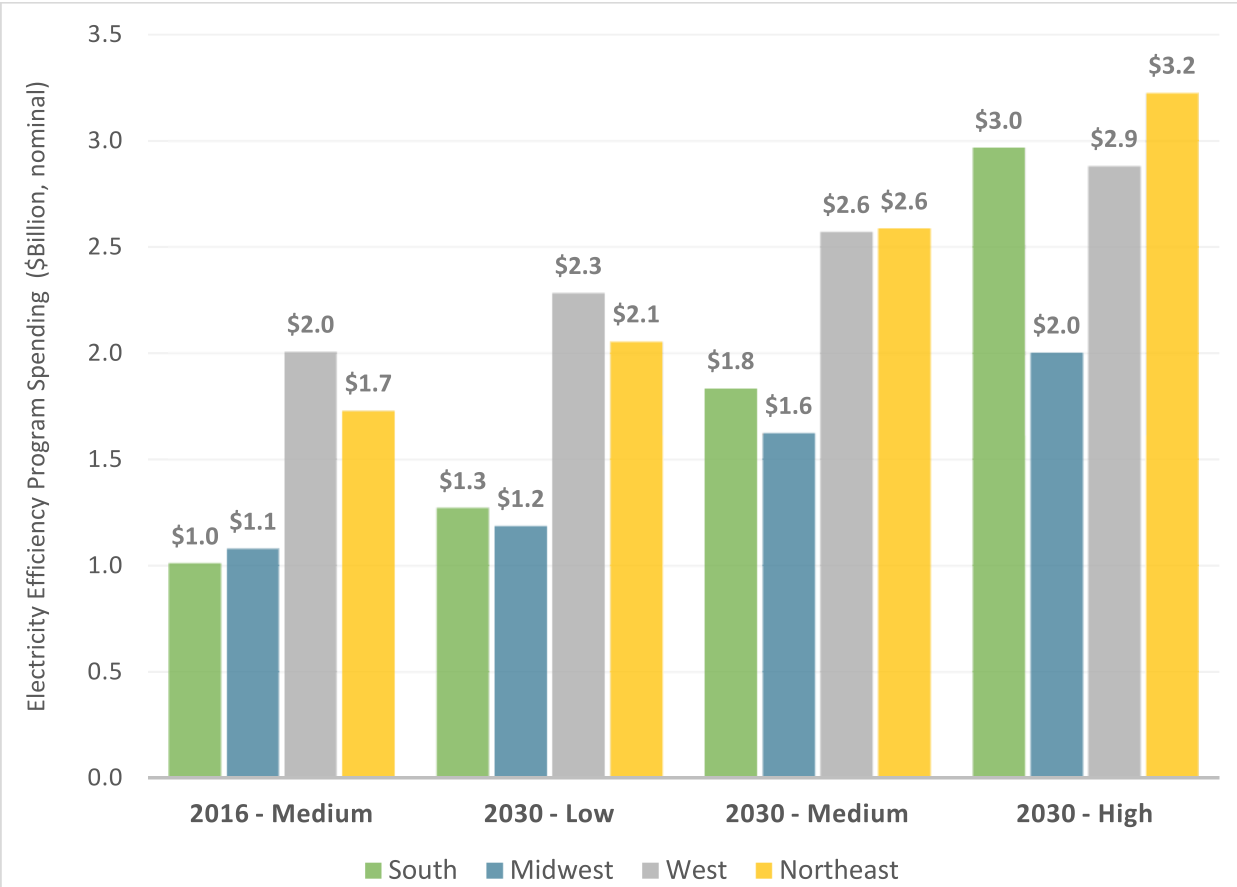

Figure 4-6. Electricity efficiency program spending by region in 2016 vs. 2030 scenarios

In 2030, the relative contribution of each region to national efficiency spending varies significantly among the three scenarios. For example, in the low scenario, spending in West and Northeast states is 64 percent of the national total, while states in the South and Midwest account for 36 percent. In contrast, in the high scenario, states in the South assume an increasingly prominent role as spending is projected to increase to $3 billion in 2030 (compared to $1.0 billion in 2016). As a result, the relative share of spending for states in the South and Midwest account for 45 percent of the national total while states in the West and Northeast decrease to 55 percent of the national total.

Midwest - Efficiency program spending in 2030 is driven primarily by four populous states (IL, MI, OH and MN) that have made long-term policy commitments in legislation. Spending in the 12 Midwest states is projected to range between 1.2 and 2.0 billion in 2030. The future trajectory of efficiency spending (and savings) in the region will be heavily influenced by policy constraints (e.g., opt-out policies, spending caps), long-term resource planning processes (e.g., MI and MN), and the extent to which utilities are motivated by business model policies to achieve higher savings goals.

South - The range in spending in 2030 across the three scenarios is quite large ($1.3 to $3 billion), primarily a byproduct of several factors: (1) only two jurisdictions (MD, DC) have adopted stringent savings goals to date, (2) a number of states have adopted savings goals in DSM or IRP plans that are modest relative to the achievable potential so there is a lot of potential upside in terms of savings (and spending), and (3) there is significant uncertainty regarding the extent to which policies that may constrain savings, such as large C&I customer opt-out, will spread to other states in the region.

West - Regional spending trends are dominated by California, which accounts for more than 60 percent of spending in the West. We project that by 2030, spending in the state will increase by $330-$480 million compared to 2016 levels, driven primarily by state legislation (e.g., SB 350 which requires the California Energy Commission to establish annual targets to achieve a cumulative doubling of statewide efficiency savings at the end use by 2030). Elsewhere in the West, we project: (1) lower projected spending in states in the Pacific Northwest (WA, OR, ID) in all scenarios in 2030 compared to 2016 and (2) sustained long-term commitments to energy efficiency in most states in the Southwest, driven by state statute and favorable utility business models, although several utilities propose de-emphasizing efficiency in the long-term in their IRPs.

Northeast - Efficiency program spending is projected to increase under all three scenarios, ranging between $2.1, $2.6 and $3.2 billion in the low, medium and high scenarios, respectively, compared to $1.7 billion in 2016. All nine states in the Northeast have made strong policy commitments to energy efficiency and recent legislation in several states (NY, NJ, NH) increased savings (or spending) goals. Several of the historic leaders in the region (MA, RI, VT, CT) are projected to maintain or somewhat reduce spending levels on utility customer-funded programs due to anticipated saturation of efficiency potential, greater emphasis on complementary strategies (e.g., standards, financing), concern about potential retail rate impacts, or state budget constraints.

Figure 4-7 shows estimated electricity efficiency program spending in each region relative to the projected retail revenues of regulated electric utilities in 2016 and 2030 (see Appendix A). We make several observations. First, retail revenues for the utilities are influenced by their organizational structure and extent of vertical integration. Thus, spending on electricity efficiency programs represents a higher share of retail revenues in the Northeast (e.g., 3.1 to 5.0 percent of 2030 retail revenues) compared to the other three regions (0.5 to 2.4 percent of 2030 retail revenues). That's because many states in the Northeast have restructured their IOUs so that they are only distribution utilities and do not collect commodity costs for customers that have selected retail service providers. Second, efficiency spending as a percent of retail revenues in 2030 is increasing only in the high scenario in most regions (except the West) compared to 2016. Third, although there is greater regional balance in *absolute* dollar spending in 2030, the South is projected to lag well behind the West and Midwest regions in 2030 in all three scenarios in terms of *relative* spending levels, expressed as a percentage of electric utility revenues (0.5 to 1.2 percent in the South compared to 1.8 to 2.4 percent in the West and 1.1 to 1.9 percent in the Midwest). In 2030, efficiency spending in the South as a percentage of electric utility revenues is one-fourth to one-half the spending levels projected in the West and Midwest.

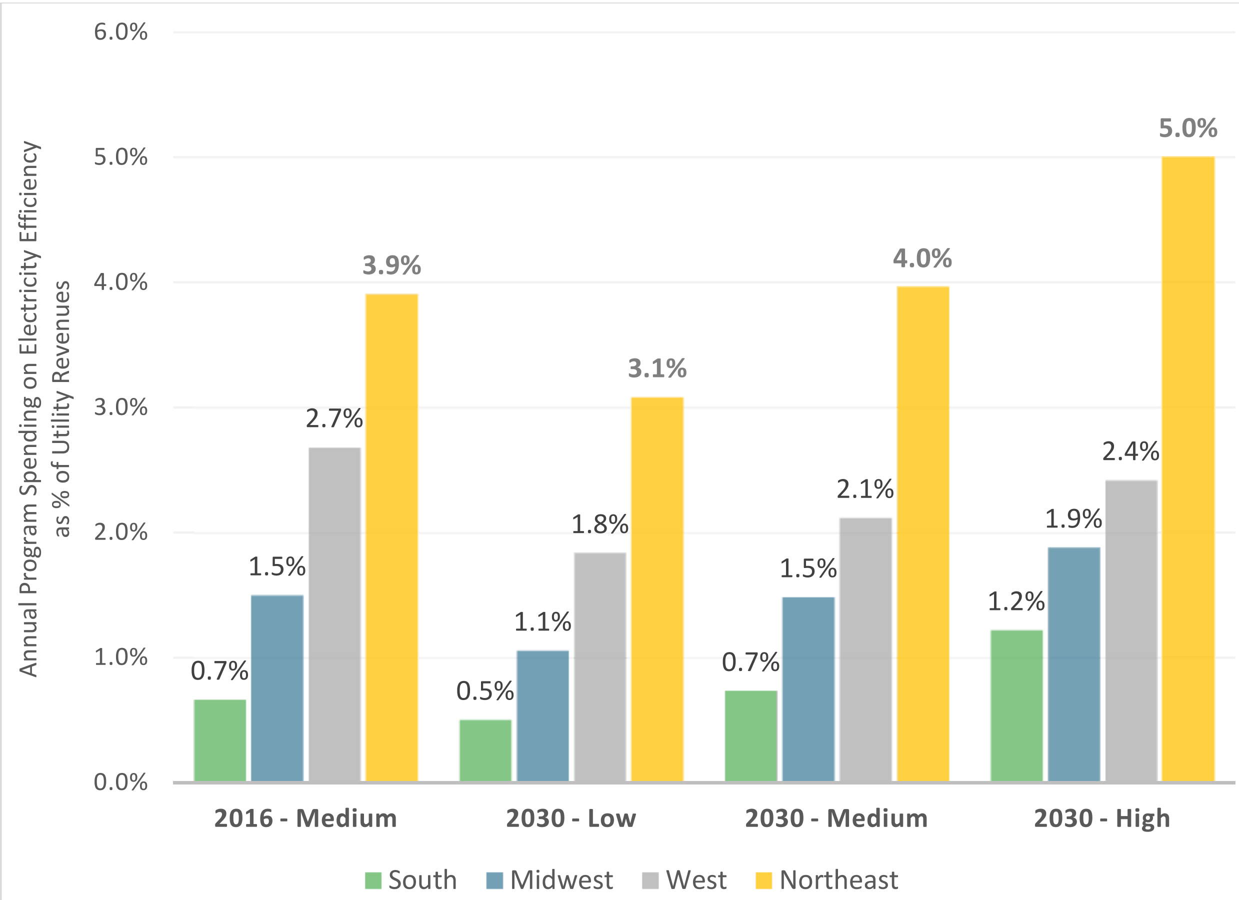

Figure 4-7. Annual efficiency program spending as a percent of retail electric utility revenues in 2030

Table 4-2 shows the 10 states with the highest investment in electricity efficiency programs funded by utility customers in 2016, compared with our medium and high cases in 2030. While we anticipate that most of the top 10 states will remain highly ranked, we expect some shifts within these ranked jurisdictions, as well as replacements. In the medium case, WA and CT are replaced by NJ and OH. In the high case, FL replaces OH. Spending on electricity efficiency programs is projected to remain relatively concentrated in the top 10 states in 2030 in the medium and high scenarios (66 and 62 percent of national spending, respectively).

Table 4-2. Spending ($ million) on electricity efficiency programs in 2016 (actual) and 2030 (projected)

	2016		2030 Medium Scenario		2030 High Scenario	
Rank	**State**	**Spending**	**State**	**Spending**	**State**	**Spending**
1	CA	1,164	CA	1,605	CA	1,650
2	NY	425	NY	894	NY	1,067
3	MA	521	MA	523	NJ	676
4	PA	238	NJ	489	TX	625
5	WA	234	MD	484	MA	589
6	IL	219	IL	464	MD	543
7	CT	205	TX	382	IL	540
8	TX	200	MI	316	FL	504
9	MI	188	PA	269	PA	360
10	MD	184	OH	227	MI	344
Top 10 States		**$3,579**		**$5,654**		**$6,897**
% of U.S. spending		61%		66%		62%
Remaining U.S. States		**$2,244**		**$2,961**		**$4,175**
% of US spending		39%		34%		38%
Total U.S.		**$5,823**		**$8,614**		**$11,072**

4.4 Electricity Efficiency Program Savings

4.4.1 National Overview

In 2016, we estimate that efficiency programs funded by utility customers saved 27.5 terawatt-hours (TWh) of electricity, equal to 0.74 percent of retail sales. This value is comparable to national estimates of first-year electricity savings that average 0.68 percent between 2013 and 2016 as reported by ACEEE.[26]

In 2010, nine states (CA, CT, HI, MA, MN, NV, OR, RI, VT) with decades of policy commitments to efficiency programs were achieving savings of at least 1 percent of retail electricity sales (Barbose et al. 2013). By 2015, efficiency programs funded by customers offset at least 1 percent of IOU load in 23 states, with four states exceeding savings of 2 percent of sales (Hoffman et al. 2018). Policy supports for efficiency programs funded by IOU customers drove much of this expansion in program-driven savings. Given these savings from electricity efficiency programs and complementary policies such as equipment standards and building energy codes, many states have experienced modest or no growth in electricity loads in recent years. That impacts the need for investments in new electricity infrastructure across generation, transmission and distribution systems.

Looking to the future, our analysis suggests that electricity efficiency programs funded by utility customers will continue to impact load growth at least through 2030. Specifically, in the medium case,

[26] ACEEE's Scorecard report (http://aceee.org/state-policy/scorecard) estimates annual net incremental savings each year. LBNL used these estimates for 2013-2016, and a net to gross ratio of 0.86, to convert these figures to gross savings. Annual incremental savings are new savings from programs in that year.

we project incremental annual electricity savings to increase very modestly between 2016 and 2030 (27.5 TWh in 2016 vs. 28 TWh in 2030). Savings rise through 2025, and then decrease by 1.6 GWh by 2030 (see Table 4-3). In the high case, annual savings increase to 38.0 TWh by 2030, 38 percent higher than savings achieved in 2016. In the low scenario, first-year savings are 20.3 TWh in 2030, a decline of more than 27 percent compared to 2016 levels. Savings decline between 2025 and 2030 in all three scenarios, by 0.9 to 2.2 TWh.

Table 4-3. Current and projected annual incremental electricity savings from utility customer-funded programs (TWh)

	Annual Electricity Savings (TWh)			
Scenario	2016	2020	2025	2030
Low		23.6	22.5	20.3
Medium	27.5	27.8	29.6	28.0
High		31.7	38.9	38.0

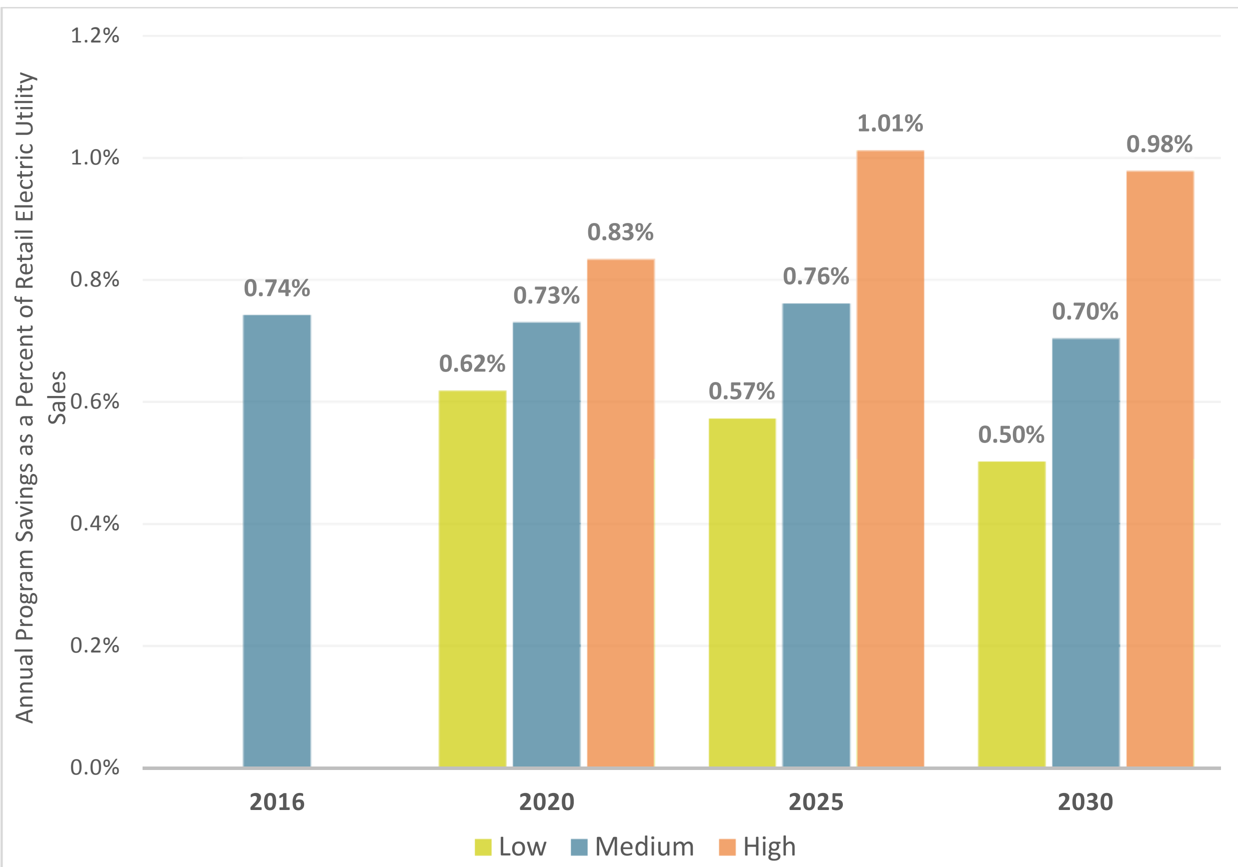

Figure 4-8. Projected electricity savings from utility customer-funded efficiency programs as a percent of retail electric utility sales

It is also useful to examine savings relative to trends in retail electric utility sales (see Figure 4-8). In our medium case, savings as a percent of retail sales vary little between 2016 and 2030, ranging from 0.74 percent to 0.70 percent. In the high scenario, electricity savings increase to 1 percent of retail sales in 2025, declining slightly to 0.98 percent of sales in 2030, with program administrators in 24 states projected to save more than 1 percent of retail sales. In the low scenario, savings decrease to 0.50 percent of retail sales by 2030, with program administrators in only 11 states projected to save more than 1 percent of retail electric sales.

4.4.2 Regional Trends in Program Savings

Trends in first-year savings at the national level are driven by the underlying patterns in efficiency program activity at the regional and state level (see Figure 4-9). The South is the largest Census region, with 16 states and the District of Columbia, comprising more than 40 percent of national electricity load. In the medium scenario, we observe a consistent upward savings trajectory in the South to 2030 (green line in Figure 4-9), driven primarily by large projected increases in several states (MD, TX and VA) and modest increases in 10 other states.[27] Savings as a percent of sales increase very modestly in the South region overall in the medium scenario: from 0.3 percent in 2016 to 0.4 percent in 2030. However, because of its relative size and underlying load growth projected to increase in the South more than in other regions, the magnitude of regional savings in the South exceeds other regions in 2030.

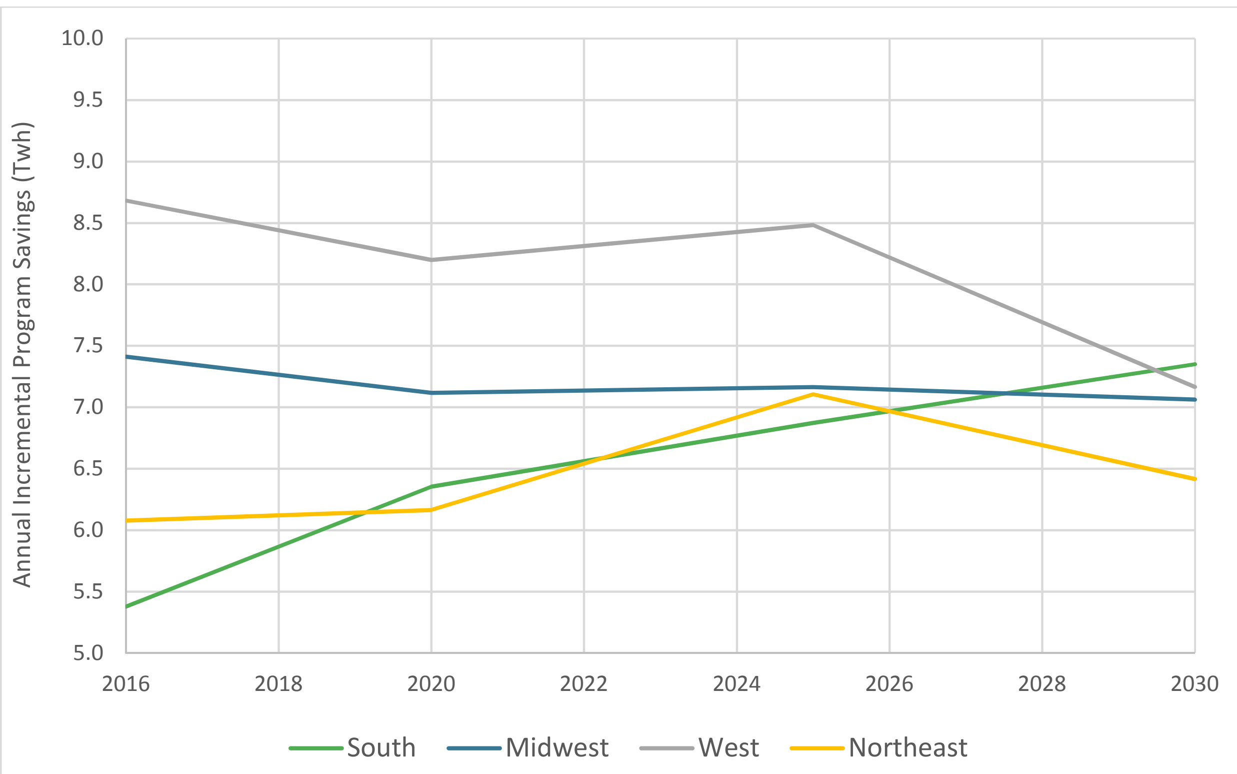

Figure 4-9. Annual program savings by region: Medium scenario to 2030

[27] Compared to 2016 activity, modest increases in savings are projected by 2030 in AL, DC, DE, FL, GL, KY, LA, MS, OK and WV.

In contrast, savings decrease by 5 percent in the Midwest region in the medium scenario between 2016 and 2030. A few Midwest states are projected to increase their savings targets (e.g., MI) or are projected to maintain current levels of savings between 2016 and 2030 (e.g., MN, IN). However, these are offset by other states (e.g., IA, OH) where savings are projected to decrease in 2030 compared to 2016.

We project a 17 percent decrease in first-year savings between 2016 and 2030 in the West region in the medium case, driven primarily by lower savings levels in CA, AZ, WA, OR and UT. We project a 6 percent increase in first-year savings between 2016 and 2030 in the Northeast region, driven primarily by large projected increases in efficiency activity in NY and NJ, which offsets projected decreases in MA, CT, RI and VT.

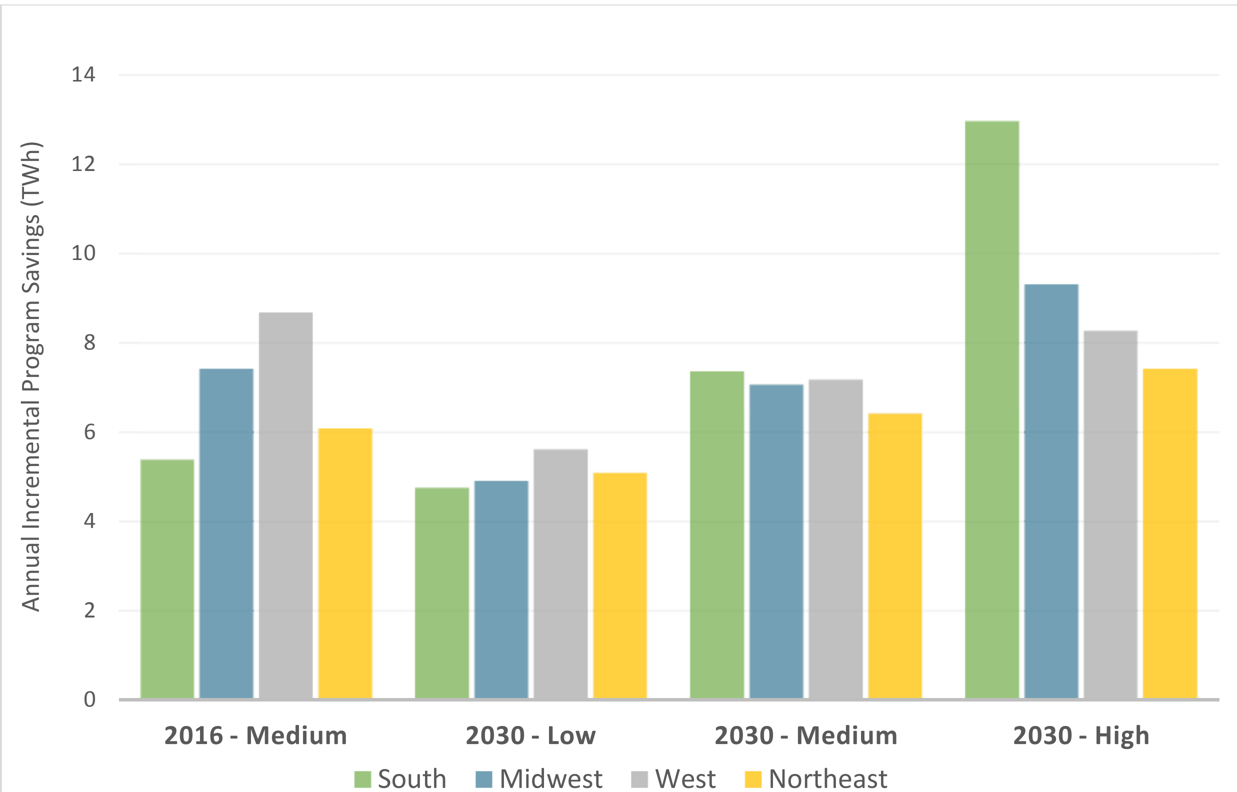

Figure 4-10. Annual incremental program savings by region in 2016 vs. 2030 scenarios

Figure 4-10 highlights regional trends in program savings over time in the low, medium and high scenarios. The results are particularly striking in the high scenario. Savings as a percent of retail sales in 2030 remain higher in the Northeast (1.7 percent), West (1.2 percent) and Midwest (1.1 percent) than the South (0.7 percent). However, because the South accounts for 40 percent of national electricity load, absolute savings levels in 2030 in the high scenario are significantly greater in the South compared to the other three regions (12.9 TWh in the South vs. 7.4, 8.3 and 9.3 TWh in the Northeast, Midwest and West, respectively). Savings in the South account for 34 percent of the national savings from electricity efficiency programs in 2030 in the high scenario (compared to 19 percent in 2016). These results in the South are driven by our assumptions in the high scenario that savings increase in all 17 states in the region: several large states (FL, TX, TN) significantly increase their efficiency savings targets to levels that are closer to the achievable potential, and program administrators in other states increase their efforts motivated by attractive utility business models (e.g., OK, NC, SC) or other policy drivers such as EERS legislation (MD, VA).

As noted earlier, savings are projected to decrease in most regions (except the South) between 2025 and 2030 in all scenarios. The anticipated decline in relative program savings after 2025 across all scenarios is driven largely by the forecasts and views of program administrators, key stakeholders and efficiency experts that the potential to acquire cost-effective savings from voluntary programs is relatively lower because of increased reliance on savings that occur because of complementary efficiency policies (e.g., equipment, appliance and lighting standards). In planning studies conducted by program administrators or states (e.g., IRPs, DSM plans, efficiency potential studies), a number of program administrators indicated that they were planning for lower savings targets for electricity efficiency programs in the 2025-2030 time frame because of the impact of standards and transformation of certain end uses markets (e.g., increased penetration of LEDs) (see text box on next page).

Impact of standards and transformation of the lighting market on potential savings from electricity efficiency programs

Energy Trust of Oregon (2017): *"Codes and standards will require much higher efficiency.... Measures that have made up the majority of residential savings in recent history, such as lighting and water flow, have already deeply penetrated their markets due in part to our success. Current indicators suggest that we are already experiencing the impact of deeper penetration in some markets…. Staff does not believe these factors are likely to be fully offset by new technologies."*

Ameren Missouri DSM Plan: *"The largest single factor contributing to the decline in residential energy efficiency potential is the enactment of federal appliance efficiency standards. The largest part of that effect comes from a single standard; that is, the lighting standard that sets efficiency ratings for standard medium screw base light bulbs that was promulgated as a part of the Energy Independence and Security Act of 2007 (EISA)."*

Sierra Power Integrated Resource Plan: *"While the economy is improving, improvements in end-use efficiency, new appliance and commercial end-use standards, photovoltaic market penetration, and DSM programs will continue to put downward pressure on long-term projections of customer usage… New residential lighting standards have had the largest impact on use per customer."*

Wisconsin's 2019-2030 Potential Study (completed 2017): "*Residential LEDs were assigned a more aggressive ramp rate of their own due to (1) a relatively high rate of saturation, (2) recent program success with these products, (3) their rapidly declining prices, and (4) the expectation that the Energy Independence and Security Act of 2007 (EISA) backstop in 2020—requiring all general service lamps and most specialty lamps meet a minimum federal standard of 45 lumens per watt—will reduce the available technical, economic, and achievable potential after that point in the study."*

Florida Power and Light: *"The incremental impacts of these energy efficiency codes and standards are projected to reduce both FPL's forecasted summer peak load by approximately 2,041 MW, and its annual energy consumption by more than 8,000 GWh, by 2026. In addition, energy efficiency codes and standards significantly reduce the potential for cost-effective energy efficiency that might otherwise have been obtained through FPL's DSM programs."*

Ameren's 2016 Potential Study: *The study identifies that a majority of potential savings are in the commercial and industrial sectors. This reflects the effectiveness of federal appliance standards in the residential space.*

California PUC (2018): *"Overall (program) potential ramps up significantly towards 2024 and then gradually begins to taper off… This is due to the model simulating an increasingly saturated market over time as more customers begin adopting efficient equipment with limited remaining low efficiency equipment to convert. This behavior is primarily driven by lighting measures, which turn over at a fast rate than other equipment."*

4.4.3 Impact of Projected Program Savings on EIA AEO National Load Growth Forecast

Savings from electricity efficiency programs impact forecasts of future load growth and ultimately influence the supply-side resource needs of utilities. Electricity retail sales forecasts usually reflect the amount of electricity expected to be purchased by end users after accounting for energy efficiency; that is, the load forecast is lower than it would be in the absence of efficiency programs and other energy-saving initiatives.

In order to understand the impact of program savings projections on retail sales, it is necessary to adjust the sales forecast to restore program-related savings and then compare this adjusted forecast to the modeled projections of program savings.

The Energy Information Administration (EIA) produces the Annual Energy Outlook (AEO), which provides a multi-decade forecast of power-sector generation, consumption and prices. The 2018 AEO projects that total retail electricity sales will increase at a compound annual growth rate of 0.59 percent from 2016 to 2030. This growth rate in sales is less than half of the actual long-term average compound growth of about 1.3 percent since 1990, but is consistent with EIA's load growth projections since the 2008 recession.

In its National Energy Modeling System (NEMS), EIA produces a reference case load forecast that is based on a methodology that implicitly assumes that savings from efficiency programs continue at roughly historical levels.[28] EIA staff indicated that program savings in the 2013 to 2015 period would provide the best approximation of program-related savings that are implicitly captured in its calibration of demand and consumption to actual sales.[29] As discussed above, we estimate average annual savings in 2013-2015 at 0.68 percent of retail sales.

In a hypothetical case where EIA was forecasting a future where efficiency programs did not exist, the forecast of future load growth would be 1.27 percent per year between 2016 and 2030 (i.e., 0.59 percent forecast growth plus 0.68 percent historical savings).

In the medium case, we project annual savings of 0.70 percent of retail sales in 2030. Thus, if realized, those projected savings would curb forecasted load growth by roughly the same amount as is already implicitly reflected in the sales forecast (resulting in 0.57 percent adjusted load growth vs. 0.59 percent in the AEO forecast). In the high case, annual savings is projected to be 0.98 percent of retail sales in 2030. If this high efficiency scenario accurately depicts the future, forecasted load growth would be reduced to 0.29 percent per year between 2016 and 2030 (compared to 0.59 percent per year of in the AEO forecast).[30] In the absence of efficiency programs, substantially greater investments in power plants and transmission and distribution infrastructure would be needed to serve the offset load.

4.5 Publicly Owned Utilities and Cooperatives: Projected Spending and Savings

Section A.5 of the Appendix describes the analytical approach that we used to develop projections of future spending and savings for publicly owned utilities and cooperatives in all states. Based on our analysis, spending for these types of utilities on electricity efficiency increases from $0.6 billion in 2016 to $0.83, $1.2 and $1.5 billion, respectively, by 2030 in our low, medium and high scenarios (see Table 4-3). Spending on electricity efficiency programs by publicly owned utilities and cooperatives accounts for 12 percent to 14 percent of national spending in the three scenarios. Spending is concentrated in a relatively small number of states: five states (CA, WA, TX, TN, MN) account for 70 percent of total spending in 2016 by publicly owned utilities and cooperatives and 67 percent in 2030. Publicly owned

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[28] Appendix A provides more details on the implicit underlying assumptions in NEMS regarding the impacts of energy efficiency programs.

[29] Personal communication, Erin Boedecker Feb. 2, 2018.

[30] The estimates of program savings implicitly embedded in the AEO load forecast are inherently inexact. Thus, these comparisons of future program impacts for future loads should be regarded as approximations.

utilities in California alone account for 32 percent of total national spending on efficiency by publicly owned utilities and cooperatives in 2030 in our medium scenario.

Savings from electricity efficiency programs administered by publicly owned utilities and cooperatives are projected to increase from 3.8 TWh in 2016 to 5.4- 7.1 TWh in our medium and high scenarios, respectively, by 2030 (Table 4-4). Our projections of savings in 2030 represent 14 percent to 19 percent of national savings depending on the scenario.

Table 4-4. Spending and savings from electricity efficiency programs administered by publicly owned utilities and cooperatives

		Spending on electricity efficiency programs administered by publicly owned utilities and cooperatives ($B)				**Savings from electricity efficiency programs administered by publicly owned utilities and cooperatives (TWh)**		
	2016	**2020**	**2025**	**2030**	**2016**	**2020**	**2025**	**2030**
Low		0.7	0.8	0.8		3.2	3.0	2.9
Medium	0.6	1.0	1.1	1.2	3.8	4.9	5.3	5.4
High		1.1	1.3	1.5		5.8	6.6	7.1

5. Discussion: Key Issues and Challenges

Our estimates of projected spending and savings under a low, medium and high scenario suggest a wide range of potential trajectories for electricity efficiency going forward in the United States. In this chapter, we identify key issues and challenges ahead for efficiency program administrators and policymakers that contribute to the uncertainty in forecasting future pathways. These issues and challenges include factors that are largely external to program administrators and state regulators, such as broader market forces and conditions and interactions with other policies, as well as factors that are more under their control, such as program implementation and regulatory oversight of efficiency programs.

5.1 Broader Market and Policy Context

Several key factors that relate to the broader market and policy context may be critical to the future trajectory of customer-funded efficiency programs: (1) the economy and forecasting of future electricity loads, (2) cost of electricity supply options, (3) federal and state minimum efficiency standards and building codes and (4) market transformation for energy efficiency products and services.

The Economy and Forecasting Future Electricity Loads

In our two previous studies on the future of customer-funded efficiency programs, we highlighted the potential impact of the economic recession (Barbose et al. 2009) and the timing and extent of the economic recovery (Barbose et al. 2013) as factors that were likely to constrain expansion of energy efficiency programs and customer investment in efficiency (e.g., reduced rate of stock turnover, increased risk that policymakers will redirect dedicated funding for energy efficiency, customer reluctance to make significant new investments). At present, the United States is in the midst of a lengthy economic expansion that features low unemployment, increasing economic growth rates, lower tax rates and low energy prices. These factors all contribute to an attractive investment climate, which should lead to higher turnover of building and equipment stock and investments in industrial plant.

In the midst of this economic expansion, EIA projects that total retail electricity sales will increase at an annual growth rate of only 0.59 percent per year from 2016 to 2030. This projected growth rate is quite modest compared to historic growth rates for electricity sales (1.3 percent per year since 1990). This trend of slowly increasing or flat electric loads is driven in large part by the fact that energy intensity (i.e., the amount of energy used per unit of economic growth) has declined steadily for many years due to energy efficiency, structural changes in the economy and fuel economy improvements (EIA 2017).[31] The EIA load forecast illustrates the progress that has been made in reducing energy use (and energy intensity) in the United States as a result of complementary efficiency policies and strategies (e.g., standards, building codes, financing programs and tax credits), as well efficiency investments made by customers on their own given declining costs and increasing customer acceptance of new technologies.

[31] EIA estimates that U.S. energy intensity has decreased from 12,000 to 6,000 Btu per dollar from 1980 to 2015 and will be 4,000 Btu per dollar in 2040 (EIA 2017).

The EIA load forecast highlights success in many regions of the United States in implementing efficiency policies.

Several recent studies have explored the potential impacts of "beneficial electrification" driven primarily by adoption of electric vehicles, heat pumps and select industrial applications on electricity sales and peak demand over the long term.[32] For example, NREL (2018) found that electricity sales could increase by 1.2 percent per year during the 2015-2050 period in a medium scenario characterized by widespread electrification compared to load growth of 0.65 percent per year in a reference scenario that is more consistent with EIA's 2017 Annual Energy Outlook forecast. The transportation sector accounts for most of the growth in electricity consumption in the medium scenario in the NREL study. The NREL study also found that, with widespread electrification, winter peaks will be more likely in some regions (e.g., the northeast and southeast). If states decide to promote electrification as a policy objective, then policymakers may have to reassess how they define energy efficiency policies and guidelines for efficiency programs, and utilities and other program administrators will have additional technical opportunities for investments in high efficiency technologies (Dennis 2018; Dennis et al. 2016).

Cost of Electricity Supply Options

Utilities and other program administrators adopt electricity efficiency programs that are cost-effective compared to supply-side resource alternatives. For much of the last two to three decades, it was relatively easy to maintain that electricity efficiency was the lowest cost resource alternative compared to supply-side resources. However, in recent years, utilities and customers have benefitted from low gas prices and declining costs for gas-fired and renewable generation technologies. Going forward, for electricity efficiency program administrators, low gas prices and increasing levels of zero marginal cost resources translate into reduced program benefits (e.g., avoided energy and capacity costs), which in turn may constrain program budgets. Given these trends, going forward program administrators face ongoing challenges in designing a cost-effective portfolio of efficiency programs.

Moreover, the evolving generation mix (e.g., more variable generation), current economics of supply-side options and evolving resource needs of utilities are changing the value proposition that efficiency resources face. The result is a greater focus on time-varying value (Mims et al. 2017a; Mims et al. 2018) and locational value (ICF 2018), more emphasis on controllable loads (Alstone et al. 2017), and more interest in bundling demand-side options such as energy efficiency, demand response, distributed generation and storage, and electric vehicles (Mims and Schwartz 2018) in order to provide various grid services.

[32] The NREL (2018) study by Mai, et al. defines electrification as the shift from any non-electric source of energy to electricity at the point of final consumption. Beneficial electrification is a term for replacing direct fossil fuel use (e.g., propane, heating oil, gasoline) with electricity in a way that reduces overall emissions and energy costs. https://www.eesi.org/projects/electrification. EPRI (2018) refers to "efficient electrification" as opportunities for electrification that lowers costs, lower energy use and reduces air emissions. https://www.epri.com/#/pages/sa/efficientelectrification?lang=en

Federal and State Standards and Building Codes

In recent years, many states have adopted more stringent building codes while federal and state minimum efficiency standards for appliances and end-use equipment have been tightened for many products. These policies affect utility customer-funded programs by essentially raising the baseline against which savings are measured, thereby influencing both the size of the remaining potential that can be harvested through those programs and the mix of technologies targeted.

For the last decade, estimated annual savings from electricity efficiency programs were roughly comparable to annual savings from efficiency standards.[33] To illustrate, in its 2016 scorecard report, ACEEE (2016) estimates that savings (gross) for utility customer-funded electricity efficiency programs averaged 27 TWh per year between 2013 and 2016 (and 21.5 TWh per year between 2006 and 2016). For appliance, lighting and equipment standards that took effect between 2002 and 2016, the LBNL Energy Efficiency Standards Group projected annual savings to be 27 per TWh per year.

Table 5-1 provides a partial list of residential and commercial equipment, lighting and appliances with updated, finalized standards that are scheduled to take effect between 2018 and 2023.

Table 5-1. Sample of finalized efficiency standards that take effect between 2018 and 2023

Standard	Effective Year for Compliance
General Service Fluorescent Lamps and Incandescent Reflector Lamps	2018
Commercial Air-Cooled Air Conditioners and Heat Pumps	2018 and 2023
Furnace Fans	2019
Miscellaneous Refrigeration	2019
Ceiling Fans	2021
Pool Pumps	2021
Central Air Conditioners and Heat Pumps	2023

However, for the 2017 to 2030 period, the average annual incremental savings from appliance, equipment and lighting standards may increase substantially compared to the previous period (2002-2016). The Energy Independence and Security Act (EISA) of 2007 established minimum efficiency standards for lighting, reducing over time the operating power (Watts, or W) required to meet light output (lumens) for some of the most commonly used light bulbs (e.g., screw-type). EISA included the potential for a backstop requirement stating that if DOE failed to complete a rulemaking on light bulbs by January 1, 2017, a new efficiency standard of 45 lumens per watt (lm/W) would be effective January

[33] The LBNL Energy Efficiency Standards Group publishes a biennial estimate of energy, water and economic impacts of current federal efficiency standards for DOE (Meyers et al. 2016). We extracted annual savings estimates for each minimum efficiency standard through 2030 using data from the LBNL Energy Efficiency Standards Group.

1, 2020, and cover a broader set of general service lamps. Legal challenges to this requirement are ongoing.[34]

This lighting requirement would substantially raise the efficiency of the most common types of lighting equipment and significantly increase annual electricity savings for standards in the 2017 to 2030 time frame compared to historical levels. The potential increase in savings from standards that take effect during the next five years (40-50 TWh per year) means that it will be more challenging for program administrators to obtain cost-effective savings, particularly in the later years of our study period.

Market transformation: Energy efficiency products and services

In analyzing the decreasing energy intensity of the U.S. economy, economists often cite technological innovation (e.g., declining costs, higher quality products) that leads electricity end users to invest in higher efficiency products and services on their own (e.g., "naturally occurring" efficiency). But it also is important to recognize that the marketplace for certain products and services can be strongly influenced by the indirect market effects of efficiency programs and imminent efficiency standards.[35] A good example is general service lamps, most of which are common, screw-type light bulbs (known as A-line lamps). In 2020, general-service lamps must meet a minimum standard of illumination efficacy (known as the 45 lumen per watt backstop) and the definition of general service lamps was extended to include a broad array of common lighting types.

However, the residential lighting market is already changing rapidly. The National Electrical Manufacturers Association (NEMA) reports that shipments of LEDs have grown rapidly in recent years (see Figure 5-1). By the end of 2017, LEDs accounted for 36 percent of A-line lamp sales compared to less than 1 percent in 2011, while the share of incandescent lamps and CFLs shipped decreased to 7.8 percent and 8.4 percent, respectively (NEMA 2018).[36]

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[34] Various interpretations involve whether the EISA backstop has been triggered. One interpretation is the backstop date has passed, the backstop was triggered, and light bulbs will have minimum efficiency of 45 lm/W beginning January 1, 2020. Another interpretation is that the efficiency standard of bulbs will continue to be the current standard in the market because DOE is proceeding with a rulemaking process for light bulbs. The outcome of the rulemaking will be announced in the months ahead, determining any new efficiency standard for light bulbs with an accompanying effective date (Doby and Molander 2018).

[35] It is difficult to show the relative contribution of factors that contribute to decreases in energy intensity. However, we believe that it is important to recognize the impact of voluntary efficiency programs and standards in accelerating investments by customers in higher efficiency products and services.

[36] NEMA does not publish absolute counts for shipments but rather indices. Sales for each lamp technology start in 2011 with an index value of 100. Values for subsequent years are keyed to that index value.

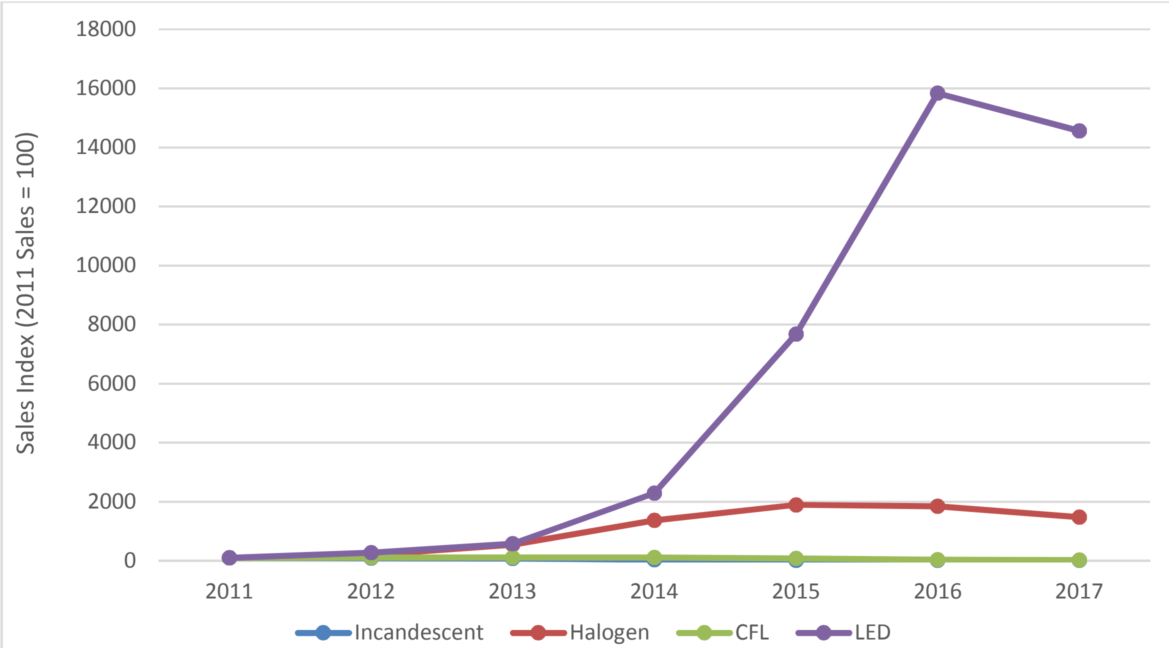

Figure 5-1. Indexed shipments of A-line lamps by technology (NEMA 2018). 2011 sales are indexed at 100.

5.2 Energy Efficiency Program Policies and Implementation Issues

The future pathway for electricity efficiency programs will also of course be heavily influenced by the policy choices and practices of state policymakers, regulators and program administrators. These include the institutional framework for energy efficiency and evolution of the program administrators' portfolio of efficiency programs.

Institutional Framework for Energy Efficiency

Energy efficiency resources have distinctive characteristics that require state PUCs to establish an institutional framework for effective regulatory oversight of ratepayer-funded energy efficiency programs. These distinctive elements include: (1) the need for measurement and verification of savings, (2) the fact that program success depends on customer acceptance and adoption, so input by stakeholders (e.g., product and service providers, customer groups) on program design is crucial; and (3) given utility disincentives to efficiency under traditional regulation, states with efficiency policy goals can consider aligning the utility's financial interests with a state's policy goals (see chapter 3). Many leading states have successfully grappled with these institutional and regulatory policy issues and a variety of approaches have proven to be effective. Thus, in states that are newer to efficiency, our high scenario assumes that state PUCs provide leadership in defining energy efficiency policy objectives, establish roles and responsibilities for program administrators, and devote sufficient staff (or technical consultant) resources to effectively oversee acquisition of large-scale energy efficiency resources.

Evolution of program administrators' portfolio of efficiency programs

Historically, in many states the portfolio of efficiency programs managed by program administrators has generally been regarded as a very cost-effective resource option and an integral part of a utility's resource plan. Even though efficiency was attractive from a technology cost perspective, policymakers, regulators and program administrators have always had to grapple with institutional barriers (e.g., compatibility with a utility's business model under cost of service regulation), market barriers and equity issues regarding allocation of program benefits. The extent of policy support for efficiency among states often hinged on the ability to develop strategies that overcome perceived institutional and market barriers and develop a workable, effective regulatory oversight framework so that stakeholders were convinced that estimated savings could be verified and trusted.

In projecting future spending by state to 2030, we used statistical analysis of historical data on the relationship between program spending and savings to develop a cost of electricity savings function that translated first-year program savings into program spending and vice versa (see Appendix A). The cost of savings function was then applied to each state by scaling the historic state-specific cost of saving electricity value (2013-2015) to anchor the values used in future years.

During the time frame of interest in this study and particularly in the "Post-policy" period (2025-2030), we expect that program administrators will have to grapple with several significant challenges in developing their portfolio of efficiency programs that may impact this relationship of the cost to acquire savings:

- First, as noted above, program administrators will have to look for additional technical opportunities for saving electricity to offset their recent reliance on residential lighting programs.
- Second, we have attempted to model the impact on future spending of policies that allow large C&I customers to opt-out of paying for and participating in efficiency programs.[37] As a practical matter, program administrators in states that adopt this policy approach are likely to develop program designs that focus more on smaller and mid-size commercial and industrial customers. Historically, the cost of saved electricity is higher for programs that target small C&I customers, compared to programs that target large C&I customers, so this will tend to put upward pressure on program costs.[38] For large C&I customers, program administrators may also focus more attention on Strategic Energy Management, which systematically tracks, analyzes and plans energy use to continually improve energy performance — reducing operating costs and increasing productivity and competitiveness (State and Local Energy Efficiency Action Network 2016).[39]

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[37] Among those states that have adopted C&I opt-out policies, customers representing 10% to 30% of a utility's load have elected not to participate in efficiency programs, based on our research for this study.
[38] Programs that target small C&I customers had an average levelized cost of saved electricity value of $0.038/kWh compared to $0.025/kWh for custom rebate programs that target large C&I customers (Hoffman et al. 2018).
[39] These programs use third-party verification bodies to certify facilities that implement an energy management system that conforms to the global ISO 50001 standard.

- Third, for those states that have established stringent efficiency savings goals for future years, program administrators will need to design and implement programs that can achieve deeper savings for participating customers and have a broader reach in terms of market penetration. Achieving higher market penetration rates includes targeting and reaching traditionally under-served markets (e.g., small commercial, multi-family, rental housing, non-owner-occupied commercial buildings) in far greater numbers than current practice. Program administrators also will have to design new, innovative programs that offer different strategies and services that are attractive to customers. Examples may include strategic energy management programs for industrial customers (SEE Action 2014; SEE Action 2016), greater reliance on building and industrial controls, programs that focus more on midstream/upstream market interventions (e.g., incentives to retailers, vendors) which can increase participation rates for some products, competitive procurement processes to meet distribution system needs that are open to aggregators that offer bundles of demand-side services and technologies, behavior-based programs using advances in data-based technologies and strategies, programs that combine technical assistance with incentives and financing (e.g., green bank, on-bill financing), and programs that integrate delivery of electric and gas efficiency programs. Program administrators also should consider leveraging efforts of state and local governments and private providers to advance efficiency such as building energy benchmarking (Mims et al. 2017b) and Property Assessed Clean Energy financing programs. Performance-based regulation also may play a role in utilities achieving deeper savings in the future, building on current practice in some states today (e.g., New York).

We include these examples to highlight the fact that the portfolio of efficiency programs is likely to evolve significantly over the time horizon of this study.[40] Program administrators and state regulators face emerging challenges, such as the increased impact of complementary strategies (e.g., standards), the decreasing costs of supply-side resource options, and adapting the value proposition for energy efficiency to reflect changing utility system needs (e.g., integrating variable generation, time-varying value of efficiency, offsetting local distribution system investments). The degree to which program administrators and state regulators address these challenges is likely to heavily influence the longer term pathway for spending and savings on efficiency programs.

[40] In those states that adopt policies that promote electrification of the power sector (e.g., electric heat pump water and space heating, industrial applications), program administrators may also benefit from increased savings potential opportunities offered by these new loads.

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