Chapter 11. Establish Energy Savings Targets for Utilities

1. Profile

Energy efficiency refers to technologies, equipment, operational changes, and in some cases behavioral changes that enable our society to enjoy equal or better levels of energy services while reducing energy consumption.[1] Efforts to improve efficiency in the generation, transmission, or distribution of electricity are covered in Chapters 1 through 5 and in Chapter 10. In contrast, Chapters 11 through 15 address different policy options for making the end-user's consumption of electricity more efficient. This chapter focuses on policies that establish mandatory energy savings targets for electric utilities, the achievement of which is generally funded through revenues collected from customers themselves. Chapter 12 focuses on policies that create or expand the opportunities for voluntary, market-based transactions that promote energy efficiency as an alternative or supplement to government-mandated programs or regulatory requirements. Chapter 13 focuses on an emerging type of energy efficiency program, behavioral energy efficiency, that is worthy of separate treatment because it is sometimes included within the mandated programs described in this chapter (Chapter 11) and sometimes implemented as a voluntary effort outside of those programs. Chapter 14 covers mandatory appliance efficiency standards that are imposed on manufacturers, and Chapter 15 covers mandatory building energy codes that are imposed on builders and developers.

The efficient consumption of energy is already a critical driver of our economy. Although the US economy has tripled in size since 1970, three-quarters of the energy needed to fuel that growth has come from efficiency improvements rather than new electric generation resources.[2] Yet much more can be done. A 2009 study concluded that 86 percent of energy consumed in the United States is wasted.[3] Adopting a broad base of energy efficiency programs is a critical step in rectifying this problem. Recently, energy efficiency programs have grown in scope and quantity in many states, but significant savings can still be found in every state. For instance, McKinsey & Company concluded that non-transportation energy use across the country could be reduced by 23 percent from a business-as-usual scenario by 2020. As McKinsey put it, "Energy efficiency offers a vast, low-cost energy resource for the US economy – but only if the nation can craft a comprehensive and innovative approach to unlock it."[4]

Energy efficiency also holds a unique place among all the policies and technologies discussed in this report in that it provides the largest source of greenhouse gas (GHG) abatement at negative cost. That is, energy efficiency simultaneously reduces GHG emissions and cost. McKinsey attempted to quantify both the cost and GHG abatement potential of a host of technologies including energy efficiency in a 2007 report. As indicated in Figure 11-1, many electric efficiency measures from residential and commercial electronics to shell improvements in commercial buildings constituted the majority of the negative cost abatement opportunities.

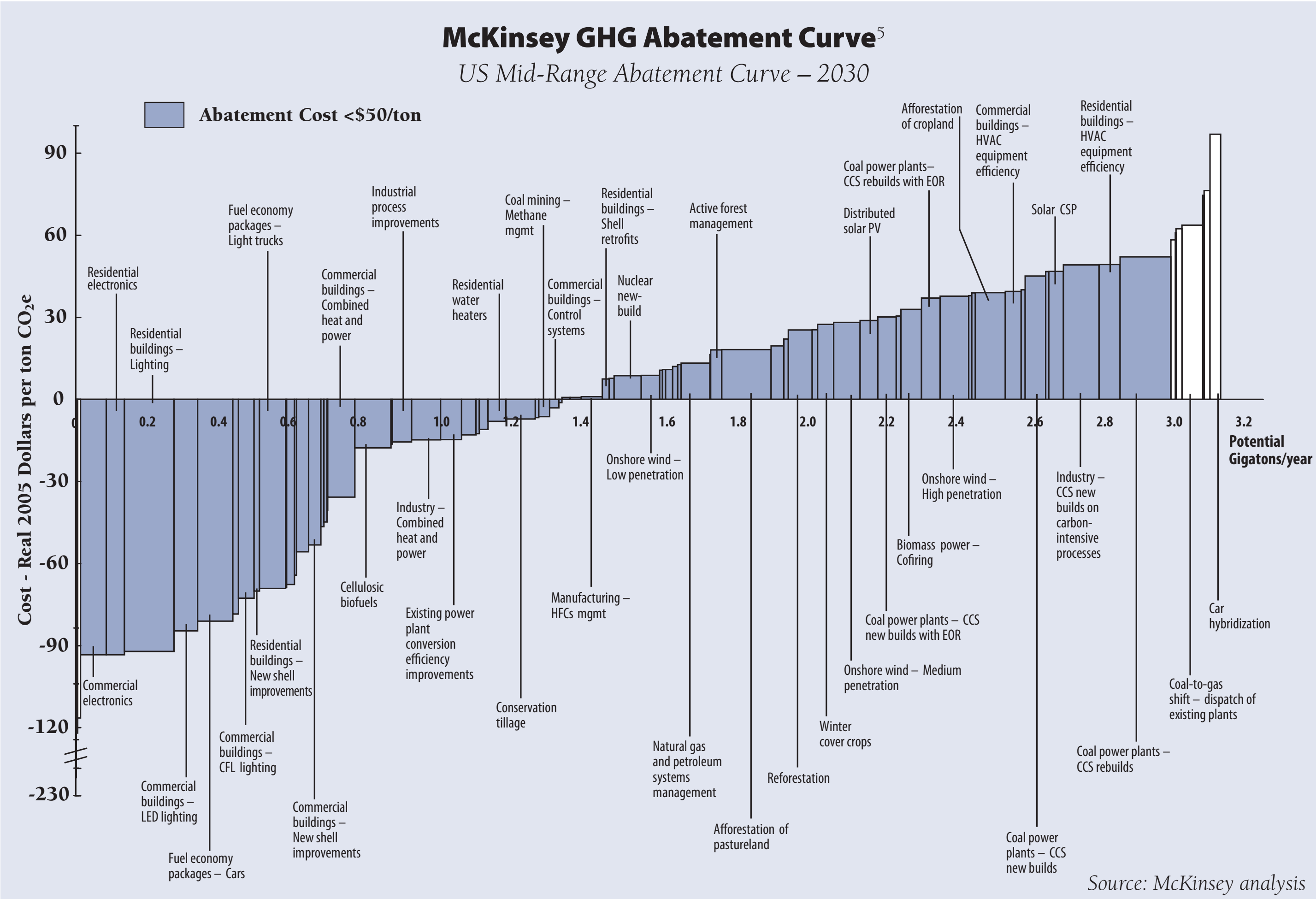
1 In contrast, some people use the term "energy conservation" to refer to actions that reduce energy consumption but at some loss of service. Neither term has a universally accepted definition and they are sometimes used interchangeably.

2 Laitner, J. A. S., Nadel, S., Elliott, R. N., Sachs, H., & Khan, A. S. (2012, January). *The Long-Term Efficiency Potential: What the Evidence Suggests*. ACEEE. Available at: http://www.aceee.org/sites/default/files/publications/researchreports/e121.pdf

3 Ibid.

4 Choi Granade, H., Creyts, J., Derkach, A., Farese, P., Nyquist, S., & Ostrowski, K. (2009, July). *Unlocking Energy Efficiency in the US Economy*. McKinsey & Company. Available at: http://www.greenbuildinglawblog.com/uploads/file/mckinseyUS_energy_efficiency_full_report.pdf

Figure 11-1



Source: McKinsey analysis

Ratepayer-Funded Energy Efficiency Programs and Mandatory Savings Targets

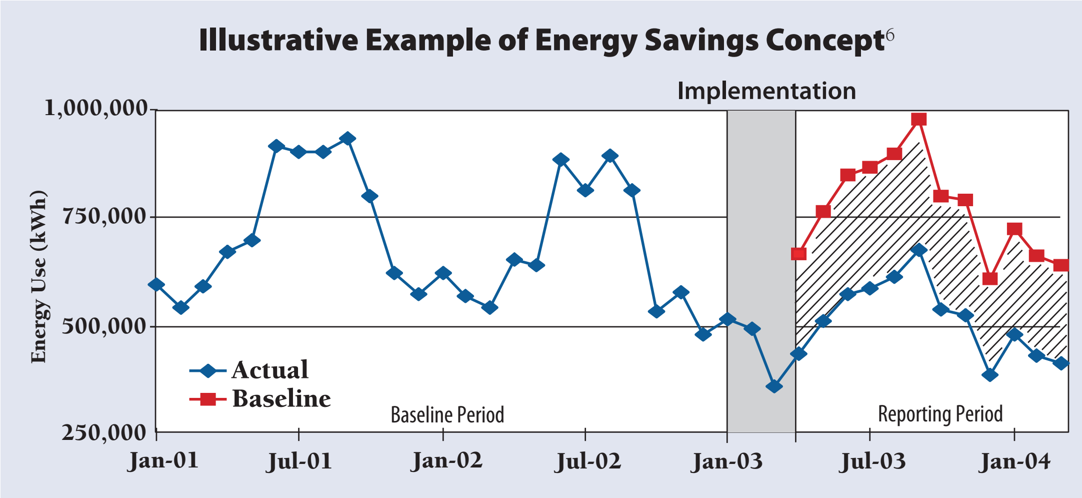
For decades, in jurisdictions across the United States, electric utilities have offered programs to help their customers use energy more efficiently. These programs are generally funded by the customers (a.k.a., "ratepayers") themselves; utilities set aside a portion of the revenues collected from customers and reinvest that money in energy efficiency programs. Although ratepayer-funded energy efficiency programs are generally administered by utilities, there are several examples from the United States where the programs are administered by a third party instead of the utility. For this reason, throughout this chapter we refer generically to energy efficiency "program administrators."

In most cases, ratepayer-funded energy efficiency programs were created in response to a state government policy that directly or indirectly obligated utilities to offer energy efficiency programs. Some of these jurisdictions also require utilities to achieve specified targets for energy savings. The reason these policies exist is that energy efficiency is a low-cost, low-risk resource. Evidence from energy efficiency policies implemented across the United States has consistently demonstrated that a suite of enabling policies, complemented with an effective implementation strategy and support mechanisms, leads to significant energy savings and emissions reductions while reducing total electric system costs.

"Energy savings" is an important but confusing concept that brings with it all of the difficulties of "measuring" something that did not happen – in this case, the consumption of energy that did not happen because a customer became more efficient. The process of quantifying

5 McKinsey & Company. (2007, December). *Reducing US Greenhouse Gas Emissions: How Much at What Cost?* US Greenhouse Gas Abatement Mapping Initiative. Executive Report. Available at: http://www.mckinsey.com/~/media/McKinsey/dotcom/client_service/Sustainability/cost%20curve%20PDFs/US_ghg_final_report.ashx.

Figure 11-2

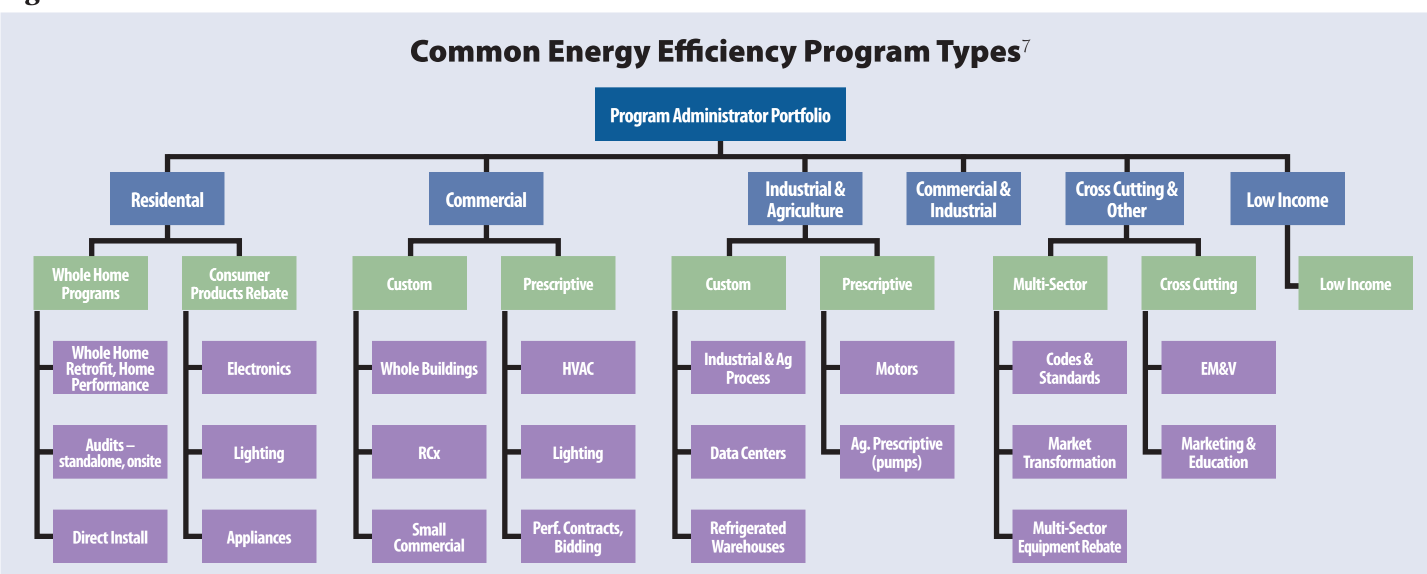


energy efficiency, programs can apply to all manner of fuels, from electricity to natural gas to heating oil. Energy efficiency programs can also target all end-uses of energy. There are programs to make commercial lighting more efficient, to reoptimize or replace an office building's heating, ventilation, cooling and lighting systems, to weatherize homes, to customize industrial processes to make them as efficient as possible, to replace or repair inefficient gas heating systems, among many, many others. In most jurisdictions, the energy efficiency program administrator offers a portfolio of energy efficiency programs targeting different energy end-uses by different classes of customers (e.g., residential, commercial, industrial). Figure 11-3 depicts the variety of energy efficiency program types that are often included within such a portfolio. Although the portfolio of any

energy savings necessarily requires a comparison between an actual outcome and an assumed "baseline" or business-as-usual outcome (i.e., one in which the customer did not take an action to become more efficient). This concept is illustrated in Figure 11-2, in which the hatched area represents the energy savings from implementing an energy efficiency measure.

Energy efficiency programs encompass a wide variety of activities. Although this chapter focuses only on electric

Figure 11-3



6 National Action Plan for Energy Efficiency. (2007, November). *Model Energy Efficiency Program Impact Evaluation Guide.* Available at: http://www.epa.gov/cleanenergy/documents/suca/evaluation_guide.pdf

7 Hoffman, I., Billingsley, M. A., Schiller, S. R., Goldman, C. A., & Stuart, E. (2013, August 28). *Energy Efficiency Program Typology and Data Metrics: Enabling Multi-State Analyses Through the Use of Common Terminology.* LBNL. Available at: http://emp.lbl.gov/sites/all/files/lbnl-6370e.pdf. In the figure, "HVAC" refers to heating, ventilation, and air conditioning; "RCx" refers to retro-commissioning of buildings; and "EM&V" refers to evaluation, measurement, and verification, a topic covered in more detail later in this chapter.

given program administrator may not include all of the program types shown in Figure 11-3, the key to unlocking significant savings is to offer a broad array of energy efficiency programs addressing multiple end-uses and targeting all classes of customers.

Figure 11-3 indicates that "Codes & Standards" are one type of energy efficiency program that may be included in a program administrator's portfolio. Although this is true, it is much more common for appliance efficiency standards and building energy codes to be addressed through separate policies, outside the context of ratepayer-funded energy efficiency programs. For that reason, this document describes appliance efficiency standards separately in Chapter 14 and building energy codes separately in Chapter 15. Behavioral efficiency programs, not shown in Figure 11-3, are another type of energy efficiency program that might appear in a program administrator's portfolio or might be offered as a separate, stand-alone program by another party. Because behavioral efficiency programs are a relatively new development, presenting some unique opportunities and issues, they are treated separately in Chapter 13.

The design of each energy efficiency program in the portfolio will vary across administrators but often includes actions such as auditing buildings to determine which systems are inefficient; providing rebates, discounts, or other financial incentives to influence consumer purchasing, design, and remodeling decisions;[8] installing or subsidizing the installation of more efficient equipment; and rating buildings for their energy performance. Examples of good energy efficiency program design have been featured in publications of the American Council for an Energy-Efficient Economy (ACEEE).[9] Typically these efficiency programs are funded through a charge to electric or gas customers per unit of energy consumption. The funds collected pay for everything from administrative costs to equipment incentives to the costs of marketing the program to potential participants.

Critics of mandatory energy efficiency programs often argue, based on economic principles, that people (and profit-making businesses, especially) will choose energy-saving options if they are truly cost-effective, without any incentives or subsidies or government-mandated energy efficiency programs. However, this common critique overlooks the fact that ratepayer-funded energy efficiency programs seek to address market failures that create barriers to more efficient consumption of electricity. These barriers could be as simple as the difference in up-front purchase cost between the most efficient and least efficient air conditioner. Or the barriers could be as complex as addressing a tenant-landlord situation in which the tenant pays all energy-related bills but would reap no other benefits from structural improvements to the leased property. Properly designed energy efficiency programs will find ways to correct these and other market failures for a wide range of participants.

2. Regulatory Backdrop

The enabling legislative and regulatory framework for establishing energy savings targets can take multiple and sometimes overlapping forms, including (1) as an obligation on energy service providers such as gas and electric utilities to achieve mandated levels of energy savings (known in the United States as an energy efficiency resource standard or EERS); (2) as part of an integrated resource planning framework that seeks to identify the least-cost means of meeting electric demand;[10] and (3) as part of a demand-side management (DSM) plan.[11]

In the past decade, there has been a noticeable trend in state policies toward establishing EERS policies. The most

8 In the past, rebates and other incentives have usually been offered to consumers to directly influence their decisions. For example, many energy efficiency programs will provide a rebate to customers who purchase an Energy Star appliance. An alternative approach that is increasingly included in energy efficiency portfolios and that may be prevalent in the future is to offer "mid-stream" financial incentives to retailers for stocking, promoting, and selling more efficient products than they would have otherwise. The theory behind this approach is that retailers can be motivated by even small changes in their profit margin, whereas many consumers will only change their purchasing decisions if they perceive a rebate to be "large" and worth the trouble of mailing it in.

9 Nowak, S., Kushler, M., White, P., & York, D. (2013, June). *Leaders of the Pack: ACEEE's Third National Review of Exemplary Energy Efficiency Programs*. ACEEE. Available at: http://www.aceee.org/sites/default/files/publications/researchreports/u132.pdf

10 Integrated resource planning encompasses much more than just energy efficiency; because of the breadth of the subject and its potential role in reducing power sector emissions, it is covered separately in Chapter 22.

11 DSM is often intended to mean the combination of end-use energy efficiency and demand response. Demand response programs are described in Chapter 23.

common formulation for an EERS obligation is one that requires a utility to achieve an amount of energy savings (in megawatt-hours [MWh]) in each year that equals a specified percentage (e.g., one percent) of the provider's retail sales in a previous year. Some EERS policies include two savings levels: a "first year" savings level, referring to the energy savings achieved by new energy efficiency measures in the compliance year, and a "cumulative" savings level that sums the "first year" savings and the persistent savings from energy efficiency measures installed in previous years that are still saving energy compared to what would have occurred if those measures had not been implemented.

An EERS is most likely to originate from state legislation or a public utility commission (PUC) order.[12] In addition to a target savings level, a good EERS policy will address the following:[13]

1. **Policy Objective.** Policymakers are likely to support an EERS because energy efficiency reduces consumer costs, but efficiency may also have many ancillary benefits, such as providing bill relief to low-income families or creating jobs. Achieving those benefits can also be an objective of an EERS and will help shape the ways in which the policy is implemented.
2. **Coverage.** Policymakers will need to determine if the EERS covers one or multiple fuels (e.g., electricity only or electricity, natural gas, and heating oil) or if certain sectors of the economy are excluded, for example, large industrial customers. The scope of coverage will impact how broadly energy efficiency's benefits are distributed. State policies also vary in terms of whether they apply to all utilities and service providers, or only a subset (e.g., only investor-owned electric utilities).
3. **Implementing Parties.** Service providers such as electric and natural gas utilities are frequently targeted to comply with an EERS because they have an existing relationship with customers as well as knowledge of their customers' energy consumption patterns. However, certain states have chosen a third-party administrator to handle energy efficiency program implementation. The reasons for establishing a separate third-party entity may vary, but include concern that utilities may lack effective financial motivation to design and implement energy efficiency programs (discussed further in Section 7). Another reason to select a third-party entity is that it can offer a comprehensive program across fuels and utility service territories.[14]
4. **Compliance Verification.** An EERS is unlikely to be supported by stakeholders if there is no structure to ensure that savings are measured and verifiable. There is no "one size fits all" approach to verifying compliance. Evaluation, measurement, and verification (EM&V) of energy savings is discussed further in the text box on page 11-6.

Neme and Wasserman concluded that an EERS is a critical policy in achieving aggressive energy efficiency savings.[15] A study of nine, mostly Midwestern states bears that out – it found that clear legislative or regulatory direction such as setting a specific savings goal through an EERS-type mechanism resulted in greater efficiency savings.[16]

The second framework for establishing energy savings targets, incorporating energy efficiency into resource planning, is discussed in detail in Chapter 22, but is briefly summarized here as it relates to energy savings targets. The purpose of utility resource planning is to look far into the future, estimate the future demand for energy, and devise a least-cost plan for meeting that demand while satisfying all other legal and public policy objectives. A resource plan is said to be an "integrated resource plan" (IRP) if the options for meeting demand include both supply-side options (e.g.,

12 Almost all aspects of the regulation of retail energy sales, including energy efficiency programs, fall within the jurisdiction of state rather than federal authorities.

13 The Regulatory Assistance Project. (2012, June). *Best Practices in Designing and Implementing Energy Efficiency Obligation Schemes.* Available at: http://www.raponline.org/document/download/id/5003

14 Nichols, D., Sommer, A., & Steinhurst, W. (2007, May). *Independent Administration of Energy Efficiency Programs: A Model for North Carolina.* Available at: http://ncsavesenergy.org/wp-content/uploads/IndependentAdminEfficiencyProgramsModelforNC.pdf.

15 Wasserman, N., & Neme, C. (2012, October). *Policies to Achieve Greater Energy Efficiency.* Montpelier, VT: The Regulatory Assistance Project. Available at: http://www.raponline.org/document/download/id/6161.

16 Gunn, R., Neumann, R., & Lysyuk, M. (2012). *Regulatory Regimes (Across Nine States) and Potential Improvement for Energy Efficiency Programs.* 2012 ACEEE Summer Study on Energy Efficiency in Buildings. Available at: http://www.aceee.org/files/proceedings/2012/start.htm

EM&V of Energy Savings

EM&V refers to a retrospective analysis of the impacts of energy efficiency programs that have already been implemented. The analysis typically estimates energy savings and peak demand reductions, as well as economic costs and benefits. Some evaluations also estimate avoided emissions. Energy efficiency program evaluations are most often done by a third-party contractor working for a utility, PUC, or state energy office.

Estimates of energy savings can be made based on actual onsite measurements, by formulas, or by statistical methods. Where formulas are used, results may be verified through onsite visits or audits. Technical reference manuals (TRMs) are a common tool used to promote high-quality EM&V. A TRM provides documentation of the standard values or formulas that are used to estimate energy savings attributable to specific energy efficiency measures and programs. For example, the TRM might provide a value or formula for estimating the energy savings from a program that promotes efficient clothes washers. Many (but not all) states with energy efficiency policies have formally adopted a TRM to bring consistency and predictability to the EM&V process. Air quality regulators might think of these manuals as analogous to the US Environmental Protection Agency's (EPA) AP-42 Emission Factor manuals. They provide a way to make consistent, credible estimates of energy savings without having to measure every single efficiency action taken by every individual. There is also a continual improvement aspect to these methods. As part of the larger EM&V process, data are adjusted in the TRM after audits are completed and methods become more accurate over time. However, one key distinction between TRMs and AP-42 must be noted. AP-42 is national in scope, whereas TRMs can vary significantly from one state to the next. Thus, the consistency promoted by a TRM is *intra*-state consistency, not *inter*-state consistency.

In most states, energy efficiency program administrators are required to aggregate the evaluation results from all of the energy efficiency programs they offer into annual energy savings reports. Many states require that these reports be scrutinized and verified by an independent evaluator and even, in some cases, by other parties in a docketed proceeding. These energy savings reports will normally be far more useful to the air regulator than individual program evaluations.

Energy efficiency program evaluation can be extremely complex, and it is generally undertaken by one of a relatively small number of companies and experts that specialize in this subject. Many states require evaluations to be done by a third-party EM&V contractor who answers directly to a state agency, not a utility, in order to ensure that the results are viewed as unbiased and legitimate. Any oversight of the process will normally fall to the PUC or state energy office, not the air regulator.

Although air regulators may not consider EM&V data to be as accurate or reliable as continuous emissions monitoring data, the estimates presented in evaluation reports and energy savings reports are not mere guesswork or wishful thinking. Program evaluations have been conducted for several decades and in nearly every state and municipality that has made a significant public investment in energy efficiency. In its 2011 survey of energy efficiency program administrators, the Consortium for Energy Efficiency found that 3.6 percent of total energy efficiency budgets (on average) were allocated to EM&V activities. This amounted to over $180 million budgeted for EM&V among the program administrators that responded to the survey.[17]

In general, air regulators may wish to become familiar with EM&V methods, but should not expect — and don't need — to become experts on this subject. What is more important is that the air regulator knows in a general way how evaluation is conducted and where to find the energy savings reports.[18] A variety of helpful resources and reference documents on this topic are listed in Section 8.

17 Forster, H. J., Wallace, P., & Dahlberg, N. (2013, March 28). *State of the Efficiency Program Industry: Budgets, Expenditures, and Impacts.* p 27. Consortium for Energy Efficiency. Available at: http://library.cee1.org/sites/default/files/library/10533/CEE_Annual_Industry_Report.pdf

18 For details on evaluation methods, including a 17-page chapter on methods for estimating avoided emissions, refer to: State and Local Energy Efficiency Action Network. (2012). *Energy Efficiency Program Impact Evaluation Guide.* Available at: https://www4.eere.energy.gov/seeaction/system/files/documents/emv_ee_program_impact_guide_0.pdf

building new power plants) and demand-side options, such as reducing the need for energy through energy efficiency programs. How those options are considered varies from one jurisdiction to the next. An IRP could include energy efficiency in a head-to-head comparison against supply-side resources, in which the least-cost means of meeting every MWh of demand is evaluated. More often, a single trajectory of "achievable" energy savings is simply assumed and incorporated as a decrement (reduction) to the forecast of future energy demand.

Good resource planning can convey important information about the need for and role of energy efficiency in a portfolio of resources. For instance, IRPs generally extend for 20 years or more, but energy efficiency program plans may only cover three to five years at a time, so incorporating energy efficiency into the IRP can signal the extent to which a utility plans to offer energy efficiency programs beyond the current energy efficiency program planning cycle. The IRP process can also be used to evaluate how long-term costs of supply-side resources are avoided or deferred by energy efficiency. And even in states that have an EERS policy, resource planning can still impact the level of savings a utility strives to achieve; IRPs can be used to assess the cost-effectiveness of going above and beyond the state's EERS requirements. However, simply having an IRP requirement does not ensure that energy efficiency will be properly evaluated. The details of each utility's IRP methodology matter, and a specific approach to considering energy efficiency is often not specified in the IRP requirements dictated by regulators.[19]

It is frequently through a third framework – DSM planning – that a utility's specific energy efficiency program offerings are determined. Some states require utilities to conduct short-term DSM plans, either as a step in complying with an EERS requirement or in the absence of such a requirement. In a DSM plan, energy efficiency is judged through a series of cost-effectiveness tests (discussed in Section 6) that include what is known as a utility's "avoided cost." The avoided cost is a projection of the costs of energy services that can be avoided by implementing an energy efficiency program.[20] The level of energy savings that is established through a DSM plan ultimately depends on the level of achievable, cost-effective savings that is identified through the planning process. Like an IRP, DSM planning normally comes within the regulatory purview of a PUC, because energy efficiency programs will necessarily affect customers' rates and bills. The PUC will typically choose the metrics used to judge the cost-effectiveness of energy efficiency as well as the level of savings to be achieved. As with an EERS policy, EM&V protocols are generally established by the PUC in order to ensure that targeted level of energy savings are actually achieved.

A fourth framework for implementation of energy efficiency requires no enabling legislation or commission order. Utilities can simply volunteer to provide energy efficiency programs. Certainly some investor-owned utilities do so, for example, in exchange for concessions by other parties in PUC-adjudicated cases. Principally, it is municipal utilities and cooperatives that take this route because they are frequently exempt from state regulation and requirements. Even so, public power utilities will take many of the same steps discussed previously, such as determining their policy objective and the program coverage, evaluating possible programs using cost-effectiveness metrics and then verifying their savings.

In addition to the regulatory frameworks summarized previously, the federal government and some state governments have adopted mandatory appliance efficiency standards. Those policies are described in Chapter 14. Most state governments have also adopted mandatory building energy codes, which are described in Chapter 15. In some jurisdictions, state regulators have allowed utilities to count some of the energy savings attributable to state appliance efficiency standards and state building energy codes toward their energy savings targets, if the utility supports and facilitates the adoption of such codes and standards. But to date that has been the exception rather than the norm, and codes and standards are usually excluded from mandated energy savings targets.

Although the federal government does not establish

19 For more information on IRPs, see Chapter 22 of this document, and see: State and Local Energy Efficiency Action Network. (2011, September). *Using Integrated Resource Planning to Encourage Investment in Cost-Effective Energy Efficiency Measures.* Available at: https://www4.eere.energy.gov/seeaction/publication/using-integrated-resource-planning-encourage-investment-cost-effective-energy-efficiency.

20 Utility planners don't always distinguish between DSM and integrated resource planning, perhaps because the avoided cost may be determined using IRP methodologies or because DSM planning is a step in developing a plan combining supply- and demand-side resources.

energy savings targets for utilities, energy efficiency programs play a prominent role in the emissions guidelines for carbon dioxide (CO_2) emissions from existing power plants that the EPA proposed in June 2014, citing its authority under section 111(d) of the Clean Air Act, as part of its "Clean Power Plan."[21] The EPA determined that the "best system of emission reduction" for existing power plants consists of four "building blocks," one of which is end-use energy efficiency. Although states will not be required to include energy efficiency in their 111(d) compliance plans, the emissions rate goals for each state are based on an assumption that a certain level of energy savings (and thus, emissions reduction) is achievable. The level of savings that the EPA used to set each state's emissions rate goals is based on the demonstrated performance of leading states with respect to ratepayer-funded energy efficiency programs and a meta-analysis of energy efficiency potential studies. Based on those factors, the EPA concluded that all states could ramp up their energy efficiency program efforts and achieve incremental "first year" energy savings equal to 1.5 percent of retail sales per year.[22] The EPA requested comments on whether this was an achievable level of energy savings for all states, and also requested comments on EM&V issues. The agency has indicated that additional guidance on EM&V issues and the use of energy savings in state compliance plans is forthcoming.

The Clean Power Plan is not the EPA's first venture into encouraging states to use energy efficiency to reduce power sector emissions. In 2004, the EPA offered guidance to states on how to incorporate electric-sector energy efficiency and renewable energy measures in state implementation plans (SIPs) for criteria pollutants.[23] Then in July 2012, the EPA followed up on the 2004 guidance with a new document called the Roadmap for Incorporating Energy Efficiency/Renewable Energy (EE/RE) Policies and Programs into State and Tribal Implementation Plans (SIPs/TIPs). The purpose of this Roadmap document, according to the EPA, is "to reduce the barriers for state, tribal and local agencies to incorporate energy efficiency/renewable energy policies and programs in SIPs/TIPs by clarifying existing EPA guidance and providing new and detailed information."[24] The Roadmap provides states with more options, better explanations, and fewer restrictions than previously existed in guidance documents. Of particular interest here is that the Roadmap offers greater clarity to states on the methods that can be used to quantify the emissions reductions that are associated with energy efficiency energy savings and renewable energy generation. States are not obligated to include energy efficiency or renewable energy in their SIPs, but they have the option of doing so.

3. State and Local Implementation Experiences

There are 24 states that have an active EERS or similar energy efficiency policy. Although 25 are shown in Figure 11-4, in June 2014 the Ohio legislature suspended that state's EERS for two years.

Two states, Nevada and North Carolina, combine their renewable energy and energy efficiency requirements into one standard. Texas was the first state to enact an EERS in 1999.[25]

In nearly all cases, EERS targets have been developed by the state legislature or by the PUC in response to a legislative mandate. Among early adopters, the target levels were set based on a combination of factors, including an assessment of the levels that had historically been achieved through ratepayer-funded energy efficiency programs,

21 Refer to: US EPA. (2014, June). *40 CFR Part 60 – Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units; Proposed Rule.* Federal Register Vol. 79, No. 117. Available at: http://www.gpo.gov/fdsys/pkg/FR-2014-06-18/pdf/2014-13726.pdf

22 Refer to: US EPA. (2014, June). *GHG Abatement Measures – Technical Support Document (TSD) for Carbon Pollution Guidelines for Existing Power Plants: Emission Guidelines for Greenhouse Gas Emissions from Existing Stationary Sources: Electric Utility Generating Units.* Docket ID No. EPA-HQ-OAR-2013-0602. Available at: http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-ghg-abatement-measures

23 US EPA. (2004.) *Guidance on SIP Credits for Emission Reductions from Electric-Sector Energy Efficiency and Renewable Energy Measures.* Available at: http://www.epa.gov/ttn/caaa/t1/memoranda/ereseerem_gd.pdf

24 US EPA. (2012.) *Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies and Programs into State and Tribal Implementation Plans.* EPA-456/D-12-001a. Available at: http://epa.gov/airquality/eere/pdfs/EEREmanual.pdf

25 ACEEE Policy Brief. (2014, April). *State Energy Efficiency Resource Standard (EERS) Activity.* Available at: http://www.aceee.org/policy-brief/state-energy-efficiency-resource-standard-activity

Figure 11-4

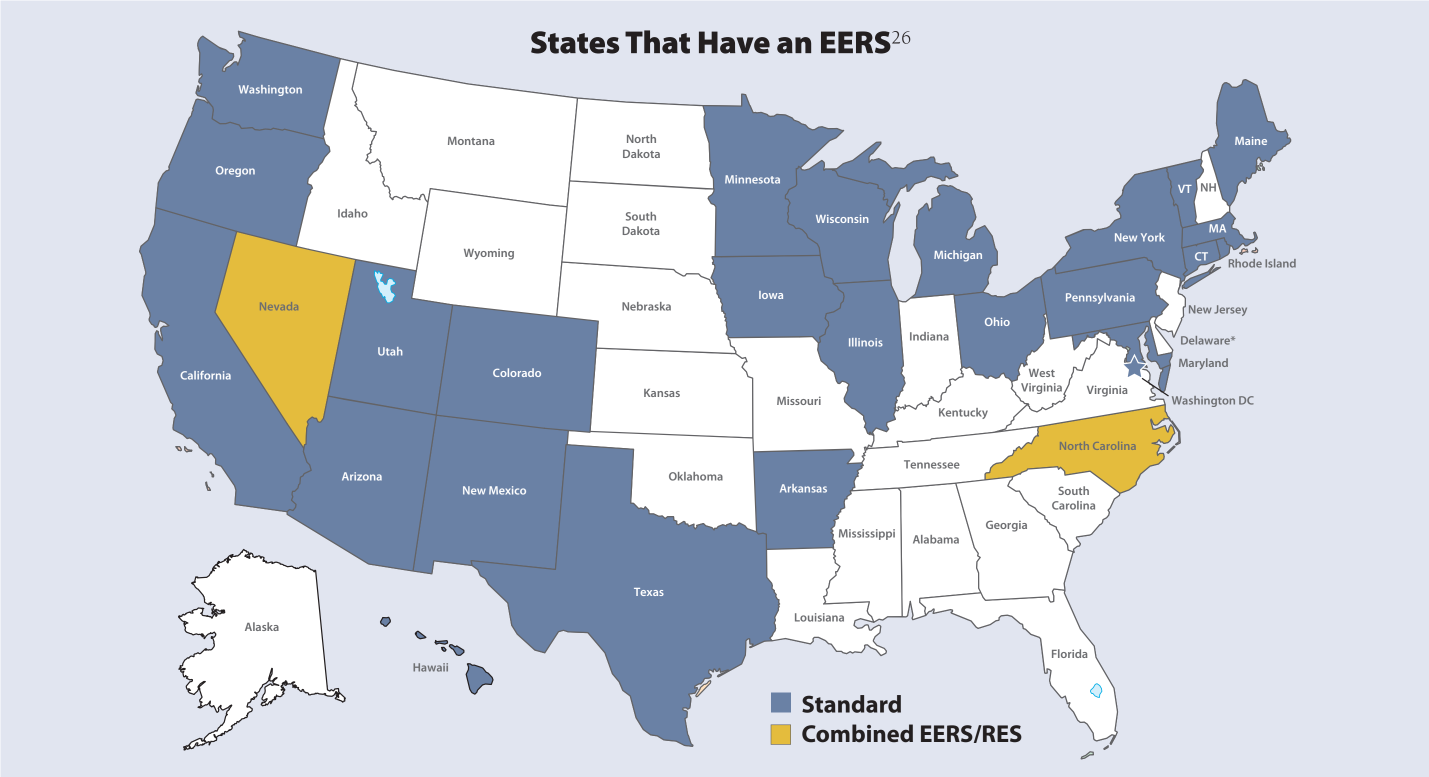
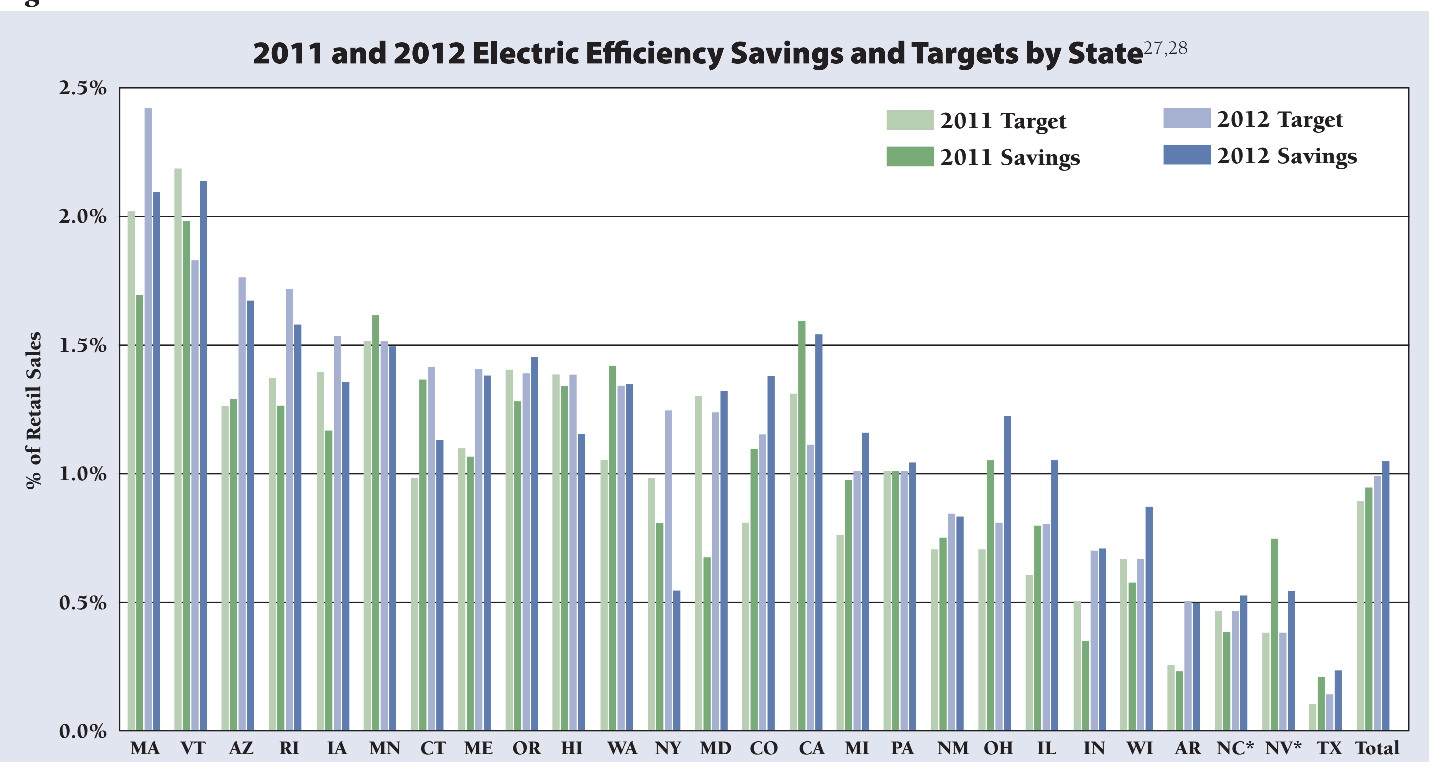


Figure 11-5



26 Downs, A., & Cui, C. (2014, April). *Energy Efficiency Resource Standards: A New Progress Report on State Experience.* ACEEE. Available at: http://aceee.org/sites/default/files/publications/researchreports/u1403.pdf

27 Ibid.

28 Indiana is shown here because it had an EERS until the legislature eliminated it in March 2014.

economic potential studies, political considerations, and so on. As more and more states adopted EERS policies, the results achieved by early adopters have also influenced target-setting and the targets have generally become more ambitious.

Utilities and other program administrators have largely been able to meet their state's EERS targets to date, as shown in Figure 11-5. The figure shows "first year" energy savings.

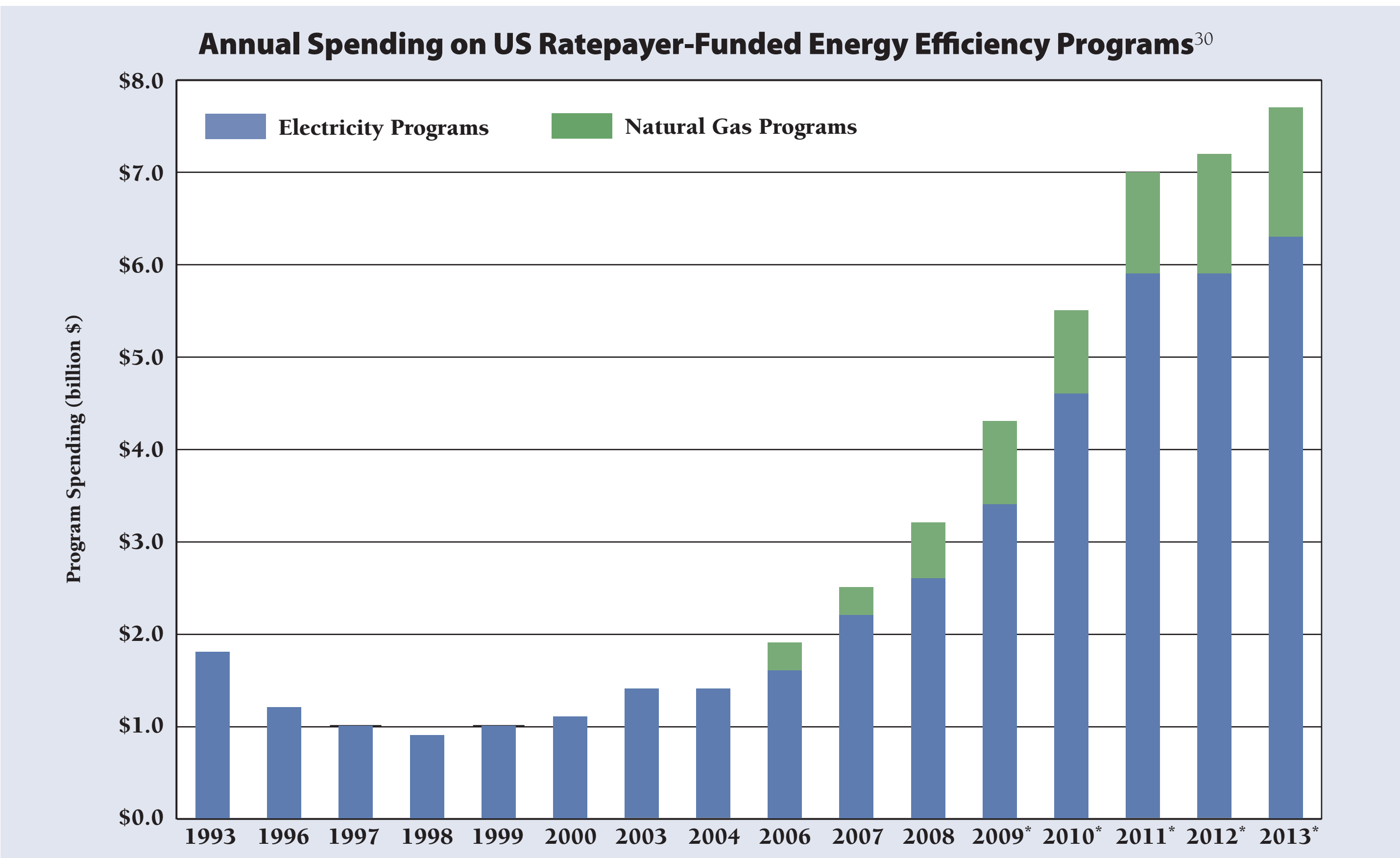
In 2012, 16 states met or exceeded their targets and another 6 came within 90 percent of meeting their targets. In 2012, states that had an EERS saved over 20 terawatt-hours, approximately 85 percent of the total energy savings realized in the United States.[29] Several of these states have already achieved a level of "first year" energy savings greater than the 1.5 percent of retail sales that the EPA included in its analysis of the "best system of emission reduction" for power sector CO_2 emissions as part of the proposed Clean Power Plan.

Not surprisingly, the trend toward an increase in achieved energy savings is consistent with a trend in increased spending on electric efficiency programs. Figure 11-6, developed by ACEEE, shows that trend.

Research and analysis by the Lawrence Berkeley National Laboratory (LBNL) predicts yet further increases in state energy efficiency program expenditures in the future, primarily owing to growth in electric energy efficiency programs. Upwards of $12 billion could be spent in 2025 on electric efficiency programs alone, as shown in Figure 11-7.

Nationwide, the additional expenditures forecasted by LBNL would be expected to translate into significant additional savings beyond what was actually achieved in 2010, as indicated in Figure 11-8. Twelve billion dollars of spending would save over 1.1 percent of US retail electric sales in 2025, with savings from most energy efficiency

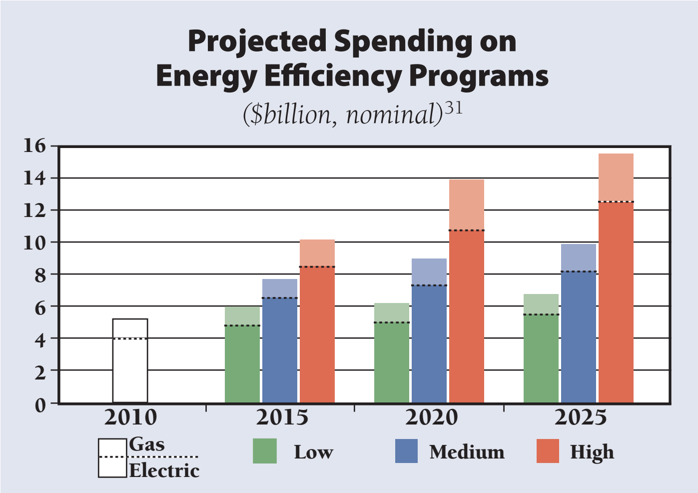
Figure 11-6



29 Supra footnote 26.

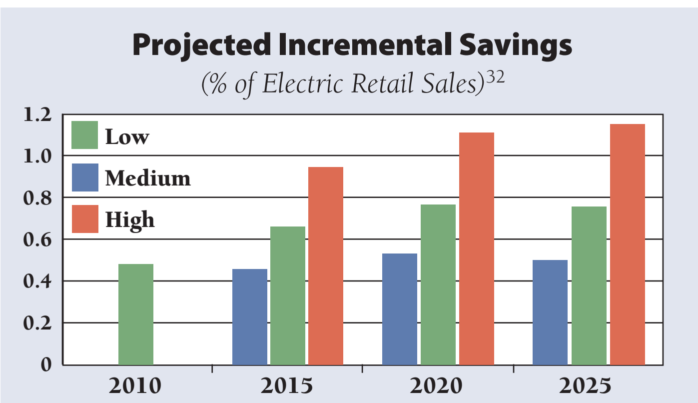
30 Values shown for 2009 and later years reflect program budgets rather than actual program expenditures. Source: Gilleo, A., Chittum, A., Farley, K., Neubauer, M., Nowak, S., Ribeiro, D. & Vaidyanathan, S. (2014, October). *The 2014 State Energy Efficiency Scorecard*. ACEEE. Available at: http://www.aceee.org/sites/default/files/publications/researchreports/u1408.pdf

Figure 11-7



measures persisting for years and adding to cumulative energy savings. The differences between the low, medium, and high scenarios are described in LBNL's report, but it is not assumed that each state will achieve similar "first year" savings (e.g., 1.5 percent of retail sales). States that have little experience implementing energy efficiency programs are projected by LBNL to achieve fewer savings than states that have more robust programs. This is why the nationwide level of projected energy savings in Figure 11-8

Figure 11-8



is lower than the level achieved by many states in 2011 and 2012 (see Figure 11-5), despite increased nationwide spending. If every state achieved the levels of energy savings that the EPA asserts are achievable in the proposed 111(d) rule, the national level of expenditures and energy savings would exceed what LBNL has forecast.

In many states, utilities were required to offer ratepayer-funded energy efficiency programs before an EERS policy with defined energy savings targets was adopted. Adopting an EERS policy simply strengthened the state's commitment to energy efficiency. Minnesota is one such state. Its EERS was established in 2007 by an act of the legislature and covers investor-owned, municipal, and cooperative gas and electric utilities. Up until passage of the Next Generation Energy Act, the state's utilities were required to commit a portion of their annual revenues toward energy efficiency measures, but there was no explicit energy savings goal. The spending requirement had ensured that energy efficiency programs were offered for several years prior to 2007. However, since the EERS was enacted, total energy savings by Minnesota utilities have increased significantly and, as shown in Figure 11-5, the state's utilities collectively exceeded their electric savings goal in 2011 and came close to meeting the goal in 2012. Every three years, the utilities file their plans for providing energy efficiency programs with the Minnesota Department of Commerce (DOC) Division of Energy Resources, the equivalent of the state energy office. There is no financial penalty for failure to achieve the EERS goal or failure to file a plan that complies with the goal. But there is a financial incentive available to rate-regulated utilities that achieve or exceed the 1.5-percent goal.[33] And although the DOC's role with regard to public power utilities is largely an advisory one,[34] the combination of the DOC, ratepayer advocates, and utility staff working together has helped to create quality program offerings by those utilities.[35]

31 Barbose, G., Goldman, C. A., Hoffman, I. M., & Billingsley, M. (2013, January). *The Future of Utility Customer-Funded Energy Efficiency Programs in the United States: Project Spending and Savings to 2025.* Available at: http://emp.lbl.gov/sites/all/files/lbnl-5803e.pdf

32 Ibid.

33 Minnesota Public Utilities Commissioner order in Docket No. E,G-999/CI-08-133 on December 20, 2012. Available at: https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={7B916D08-09C1-4084-8C13-852C2F8CC8E9}&documentTitle=201212-82007-01

34 Minnesota Department of Commerce, Office of Energy Security. (2009, January 15). *2006–2007 Minnesota Conservation Improvement Program Energy and CO_2 Savings Report.* Available at: http://archive.leg.state.mn.us/docs/2009/mandated/090117.pdf

35 Personal communication with Will Nissen, Fresh Energy. August 28, 2014.

Based on experience to date, some of the components of an EERS policy that appear to be conducive to high levels of energy savings and compliance include:[36]

- Clear statement of energy efficiency goal(s);
- Clear direction to the entity responsible for implementation and oversight;
- Complementary and supportive regulatory policies, such as revenue decoupling or another method to address lost contributions to utility fixed costs (a.k.a., "lost revenues");[37]
- "Collaborate vs. litigate" approach that engages stakeholder groups; and
- Rigorous, independent EM&V.

Minnesota exemplifies many of these components, although it has a limited form of revenue decoupling. This likely contributes to a tendency to view the EERS targets as a ceiling for energy savings rather than a floor that is lower than the level that could be achieved by implementing all cost-effective energy efficiency measures.

Just as there are critical elements in an EERS policy that are conducive to high levels of energy savings, there are also provisions that can limit or deter end-user savings. These provisions can include:

- Stop and start (i.e., unpredictable) funding for energy efficiency programs;
- Provisions allowing industrial customers to opt out of ratepayer-funded energy efficiency programs;
- Allowing the program administrator to count savings that result from activities upon which it had no influence toward its savings targets;
- Allowing the program administrator to count savings that result from infrastructure improvements such as those described in Chapters 5 and 10 toward its savings targets;[38] and
- Overcompensating the utility either through excessive shared savings incentives or lost revenue adjustments that are not based on realistic assessments of sales and fixed costs.

Many of the states that have an EERS policy also have IRP requirements, and again the IRP requirements tend to pre-date the EERS policy. An IRP requirement by itself has generally not been sufficient in most jurisdictions to stimulate large-scale investment in energy efficiency.[39] One exception to this general rule is found in the IRPs of the Northwest Power and Conservation Council. The Council conducts resource planning on behalf of the Bonneville Power Administration and its customer utilities. Its most recent plan recommended that energy efficiency be used to meet 85 percent of new demand over the 20-year period from 2010 to 2030.[40] IRP requirements are treated in more detail in Chapter 22.

There are many examples of states that have DSM planning requirements, at least 28 on the electrical side.[41] As an example, Connecticut's electric and gas utilities jointly file periodic plans to achieve "all cost-effective" energy efficiency. The 2013–2015 plan was filed after the Connecticut Department of Energy and Environmental Protection created a statewide IRP and concluded that annual "first year" electric savings could be cost-effectively achieved at a level equal to two percent of retail sales.[42]

Mandatory energy efficiency policies like an EERS are not the only way to save energy. Austin Energy, the municipal utility serving the city of Austin, Texas, is an example of one utility that voluntarily chooses to administer efficiency programs. Although it is exempt from its state's EERS, in 2011 Austin Energy saved energy at a level equal to 0.92 percent of retail sales and devoted 1.28 percent of its revenues to energy efficiency programs.[43] In

36 See, for example, a study produced for the New Hampshire Energy Efficiency & Sustainable Energy Board at: http://www.puc.nh.gov/EESE%20Board/Meetings/2013/20131108Mtg/NH%20EESE%20Board%2011-8-13%20Final.pdf

37 See Section 7 of this chapter for a discussion of lost contributions to fixed costs.

38 As noted in Chapters 5 and 10, these kinds of improvements can reduce electric system costs and reduce GHG emissions. The point is not that those improvements are undesirable (the opposite is true), rather that allowing utilities to use those energy savings to meet mandatory EERS targets reduces the savings that will be achieved through end-user energy efficiency.

39 Supra footnote 26.

40 6th Power Plan Energy Efficiency Two-Pager. Available at: https://www.nwcouncil.org/energy/powerplan/6/2010-08/

41 Supra footnote 31.

42 *2013–2015 Electric and Natural Gas Conservation and Load Management Plan.* (2012, November). Available at: http://energizect.com/sites/default/files/2013_2015_CLM%20PLAN_11_01_12_FINAL.pdf

43 Mackres, E., Johnson, K., Downs, A., Cluett, R., Vaidyanathan, S., & Schultz, K. (2013, September). *The 2013 City Energy Efficiency Scorecard.* ACEEE. Available at: http://www.aceee.org/sites/default/files/publications/researchreports/e13g.pdf

contrast, Texas as a whole saved 0.20 percent of retail sales and spent 0.46 percent of revenue.[44]

Finally, returning to the topic of air pollution regulation, it should be noted that the guidance the EPA issued in 2004 for including energy efficiency in SIPs had only a very limited impact. Based on that guidance, energy efficiency measures were subsequently included in ozone SIPs prepared by Texas, Louisiana, Connecticut, and the District of Columbia region.[45] The EPA's publication of the Roadmap in 2012 appears to be sparking renewed interest among air pollution regulators in the possibility of using energy efficiency to improve air quality. For example, the Northeast States for Coordinated Air Use Management (NESCAUM) worked with the EPA, the Massachusetts Department of Environmental Protection, the New York State Department of Environmental Conservation, and the Maryland Department of the Environment to test the usability of the new "pathways" for including energy efficiency in SIPs that are described in the Roadmap. Massachusetts tested the new "baseline pathway," New York tested the "control strategy" pathway, and Maryland tested the "weight of evidence" pathway. NESCAUM and the three states then provided the EPA with a summary of their perspectives and suggestions on key policy issues, including some of the potential implications for using energy efficiency to comply with 111(d) requirements.[46]

4. GHG Emissions Reductions

Most of the generation that serves load in the United States burns fossil fuels and emits CO_2 and other GHGs. When consumers reduce their electricity use, somewhere on the grid one or more electric generating units (EGUs) will produce less electricity than they otherwise would. If those EGUs are fossil-fueled, less fuel is burned and less CO_2 is emitted. Thus, the immediate impact of energy efficiency programs is that they indirectly result in GHG emissions reductions from existing EGUs.[47] Over the longer term, energy efficiency programs can also defer or avoid the deployment of new EGUs. The longer-term avoided emissions will depend not so much on the characteristics of existing EGUs, but on the costs and development potential for new EGUs.[48]

The magnitude of emissions reductions attributable to energy efficiency programs will depend first and foremost on the amount of energy saved. EM&V protocols, discussed previously, provide the means of retrospectively assessing the amount of energy saved by any energy efficiency program or portfolio of programs. Similar methods can be applied prospectively to forecast the expected energy savings from energy efficiency programs yet to be implemented. However, we would note that the magnitude of emissions reductions that result from those energy savings also depends on when energy was (or will be) saved, and which marginal EGUs reduced (or will reduce) their output at those times.

In general, when customers reduce electricity use, the grid operator will reduce the output of the most expensive generating unit(s) currently operating with manual or automatic load control capability (i.e., the "marginal" unit[s]) to match customer load. One caveat is that the grid operator also must consider transmission constraints that

44 Downs, A., Chittum, A., Hayes, S., Neubauer, M., Nowak, S., Vaidyanathan, S., Farley, K., & Cui, C. (2013, November). *The 2013 State Energy Efficiency Scorecard.* ACEEE. Available at: http://www.aceee.org/sites/default/files/publications/researchreports/e13k.pdf

45 Refer to Appendix K of the *Roadmap* document. Supra footnote 24.

46 Guerette, A., & Weiss, L. (2014, May). *States' Perspectives on EPA's Roadmap to Incorporate Energy Efficiency/Renewable Energy in NAAQS State Implementation Plans: Three Case Studies.* NESCAUM. Available at: http://www.nescaum.org/initiatives/ee-re-in-sips/states2019-perspectives-on-epa2019s-roadmap-to-incorporate-energy-efficiency-renewable-energy-in-state-implementation-plans-three-case-studies

47 Some energy efficiency programs reduce onsite natural gas combustion (e.g., for space heating purposes), and thus directly reduce emissions. Such programs are noteworthy but beyond the power sector focus of this document.

48 The fact that energy efficiency programs can defer the need for new generating capacity means that they can also potentially extend the life of existing EGUs. New EGUs will tend to be lower-emitting than the existing EGUs most prone to retirement, and the developers of new EGUs often size the units not only to meet load growth but also to replace an existing EGU. For example, they might develop a 200-MW EGU in anticipation of 150 MW of load growth, and thus some of the existing EGUs would run less or might choose to retire. Air regulators should be cognizant of this possibility, but not view it as a certainty or as an argument against using energy efficiency to reduce emissions. Older, less-efficient, higher-emitting EGUs will generally be dispatched less often (not more often) as a result of demand reductions, and the economic pressures that lead to a retirement decision will generally arise sooner (rather than later) as a result of energy efficiency programs.

affect the deliverability of electric power from generators to customers. So the true reduction in system emissions associated with a given unit of energy savings depends on which of the generators capable of delivering power to that location is operating on the economic margin at the specific time that the customer reduces energy consumption. The GHG emissions rates of marginal generating units can vary substantially in different parts of the country and at different times of year. In one region of the country, coal plants might be on the margin in one hour and natural gas the next, whereas in a different region of the country, gas plants might be on the margin in both hours. Thus, an energy efficiency program that reduces annual energy consumption by one percent, for example, could conceivably reduce GHG emissions by more than or less than one percent, depending on whether the marginal EGUs have higher-than-average or lower-than-average emissions rates.

Historically, the specific timing and locations of energy savings have typically not been assessed by standard EM&V protocols, and this has posed a considerable challenge for accurately estimating avoided emissions. EM&V practices are evolving, however, with more specificity about the timing of energy savings and much greater consideration for quantifying avoided emissions. Guidance and technical assistance for energy efficiency program evaluators and air pollution regulators are increasingly available on this topic. For example, the State and Local Energy Efficiency Action Network included a 17-page chapter on methods for estimating avoided emissions in its Energy Efficiency Program Impact Evaluation Guide and the Regulatory Assistance Project published a paper dedicated entirely to this topic.[49,50] In some states, energy efficiency program evaluations now routinely include estimates of avoided emissions. A brief explanation of the common methods for estimating avoided emissions follows.

Methods and Tools for Estimating Avoided Emissions from Energy Efficiency Programs

To quantify the air quality impacts of an energy efficiency program or portfolio, one begins with an assessment of energy savings. Standard EM&V protocols can be used for this step. Where possible, it is also helpful to estimate the timing of energy savings in each hour of the year and estimate the location of energy savings with respect to electricity markets or balancing areas. Any one of three common methods can then be used to estimate the avoided emissions associated with those energy savings.

Average Emissions Method

The first method for estimating avoided emissions is to use an emissions factor approach based on the average emissions resulting from one unit of energy consumption. For this simple method, the annual emissions of all of the generators operating within a defined geographic area are divided by the aggregated annual net generation within the same area to get "system average" emissions rates. For example, one could use the average emissions rate of non-baseload generating units operating in a given area. This approach would be equivalent to assuming that all baseload generators are unaffected by energy efficiency, but all non-baseload generators will reduce their output by an equal percentage when system load is reduced. This simple approach is informative but may not be suitable for regulatory purposes.

The EPA's Emissions & Generation Resource Integrated Database, available at www.epa.gov/egrid/, compiles emissions rate data (in pounds per MWh) for nitrogen oxides (NO_X), sulfur dioxide (SO_2), mercury, and GHGs for every power plant in the United States. Power-plant level data are aggregated to develop average emissions rates for 26 subregions of the country.

Marginal Emissions Method

With marginal emissions methods, one attempts to apportion energy savings only to those generating units that are likely to be operating on the margin when the energy savings occur. Some system operators now routinely provide information about the fuel type of the marginal generating units through their websites and smart phone applications. The actual marginal units are not identified, but merely knowing the fuel type of the marginal units can lead to much more accurate emissions analyses than using system averages. In addition, the EPA has published an Avoided Generation and Emissions Tool (dubbed AVERT, and available at http://epa.gov/avert/) that is based on a marginal emissions methodology. Users can enter the amount of energy saved in each hour of the year in a specified location, and AVERT will produce estimates of avoided emissions at the unit, county, state, and regional

49 Supra footnote 18.

50 Shenot, J. (2013, August). *Quantifying the Air Quality Impacts of Energy Efficiency Policies and Programs.* Montpelier, VT: The Regulatory Assistance Program. Available at: http://www.raponline.org/document/download/id/6680%20

levels. This enables analysts to estimate not just the amount but also the expected locations of avoided emissions, which can be difficult or impossible to do with average emissions rate methods.

The marginal emissions rate method will generally produce more accurate results than an average emissions rate method, and it may be appropriate in some circumstances to use the results of this method for regulatory and planning purposes. However, like the average emissions rate method, the marginal emissions rate method assumes that future system operation will mirror past system operation. As the system changes and as fuel prices and other variables change with time, that assumption becomes increasingly suspect. Consequently, it may be inappropriate to use this method to estimate avoided emissions many years into the future. In fact, on the AVERT website, the EPA says that the tool "should not be used to examine the emission impacts of major fleet adjustments or changes extending further than five years from the baseline year."

Dispatch Modeling Method

Analysts in the electric power sector use sophisticated economic dispatch models, and somewhat less sophisticated capacity expansion models, to predict how the system will react to different scenarios — that is, which generating units will be dispatched by the system operator to meet any given future load. Instead of assuming that future behavior will match past behavior, these models are driven by the input data, in particular price and operating cost assumptions. Because these models can forecast the output of each generator on the system, and each generator's emissions rates are known, they can also be used to project emissions. By modeling two scenarios — one including the impacts of energy efficiency policies and programs, and one without those impacts — the analyst can develop values for avoided emissions.

Most of the dispatch models that might be useful for estimating avoided emissions are proprietary software products that must be purchased from a private sector vendor. Some notable examples of chronologic dispatch models include PROSYM, PROMOD, and PLEXOS. Other models that approximate dispatch decisions but also evaluate the energy system more broadly include the National Energy Modeling System (used by the US Energy Information Administration), the Integrated Planning Model (used by the EPA for various regulatory purposes), ENERGY 2020 (used by California Air Resources Board for modeling impacts of GHG regulations), and MARKAL (used by several Northeast states for assessing avoided emissions). Most air quality regulators at the state level will not have licenses for dispatch model software or the training on how to use the models. However, they may be able to work in partnership with utilities, consultants, or PUC staff to use these models.

Estimates of the GHG Reduction Potential of Energy Efficiency

Whichever methodology is used to make estimates, the potential to reduce CO_2 emissions by establishing energy savings targets for utilities is very real. ACEEE estimated that a national EERS policy that was proposed in 2009 would have saved 15 percent of forecasted electricity sales by 2020, had it been enacted.[51] That percentage, which reflects cumulative energy savings, is comparable to the cumulative effect of the existing EERS requirements in Illinois and Iowa, but falls short of the more stringent existing EERS policies in states like Vermont, Massachusetts, and Hawaii.[52] The proposed national EERS was projected to result in 260 million tons of cumulative CO_2 reductions by 2020, an amount equal to five percent of the 5.4 Gt of CO_2 that was emitted in the United States in 2013.

Northeast Energy Efficiency Partnerships (NEEP) compiles energy efficiency program impact data from nine Northeastern and Mid-Atlantic states and the District of Columbia in its Regional Energy Efficiency Database (REED). In the most recent REED annual report, NEEP estimates (using average emissions factors provided by the region's system operators) that the first-year energy savings from energy efficiency programs in those ten jurisdictions avoided over 3.5 billion pounds (1.75 million tons) of CO_2 emissions in the year 2012.[53]

51 ACEEE. (2009, March 17). *Energy Efficiency Resource Standard (EERS) Retail Electricity and Natural Gas Distributors: Fact Sheet.* Available at: http://www.aceee.org/files/pdf/fact-sheet/FederalEERSfactsheet_Mar09.pdf

52 US Energy Information Administration. (2014, June 25). *Monthly Energy Review.* Available at: http://www.eia.gov/totalenergy/data/monthly/previous.cfm

53 Northeast Energy Efficiency Partnerships. (2014, August). *Regional Energy Efficiency Database: Program Year 2012 Annual Report.* Available at: http://www.neep.org/sites/default/files/resources/2012%20REED%20Annual%20Report.pdf

According to an EPA analysis of states that currently have mandatory GHG reduction targets, energy efficiency programs are expected to be a major contributor to total emissions reductions:

> "Demand-side energy efficiency is considered a central part of climate change mitigation in states that currently have mandatory GHG targets, accounting for roughly 35 percent to 70 percent of expected reductions of state's power sector emissions. For example, California expects to achieve reductions of 21.9 $MMTCO_2e$ in 2020 from energy efficiency programs targeting electricity reductions... [E]nergy efficiency makes up 48 percent of power sector reductions based on California's Climate Change Scoping Plan. Another state, Washington, expects to reduce 9.7 $MMTCO_2e$ from energy efficiency measures in 2020… [E]nergy efficiency makes up 70 percent of expected emission reductions from stationary energy within the state."[54]

Treatment of Energy Efficiency and Avoided CO_2 Emissions in the Proposed 111(d) Rule

In the proposed 111(d) rule, the EPA recognized the significant potential to reduce CO_2 emissions through energy efficiency programs by including energy efficiency as one of the four "building blocks" that comprise the best system of emissions reduction for the power sector. As noted previously, the EPA established target emissions rates for each state based in part on an assumption that each state could achieve annual first-year energy savings equal to 1.5 percent of retail sales, although states are not obligated to use energy efficiency as a means of achieving their assigned emissions rate goals.

However, it should also be noted that in the proposed 111(d) rule, the EPA took a simple and direct approach to the treatment of avoided emissions. Rather than using one of the three methods described previously for quantifying the avoided emissions resulting from energy savings, the EPA proposed to give states the option of merely adding the quantity of energy savings (in MWh) to the denominator of the emissions rate formula when determining compliance. The "adjusted" emissions rate is thus the actual pounds of CO_2 emissions from regulated sources, divided by the sum of the actual MWh of generation from those regulated sources plus the MWh of energy savings from energy efficiency programs.[55] The EPA does not, in the proposed 111(d) rule, require states to convert MWh of energy savings into pounds of CO_2 emissions reductions, as is the case for SIPs.[56] This proposed methodology should lessen the analytical burden on state air regulators who choose to include energy efficiency programs in their state compliance plans.

5. Co-Benefits

Energy efficiency programs can provide the broadest number of co-benefits of any policy or technology discussed in this document. Because of the diversity of types of programs that can be included in an energy efficiency portfolio, essentially every type of co-benefit imaginable is possible. However, quantifying those benefits is not always straightforward and is not consistently done across jurisdictions.

Virtually all energy efficiency program evaluations will attempt to quantify the economic benefits associated with avoided or deferred utility system costs. Those costs will include energy costs, capacity costs (including generating capacity, and in some cases transmission and distribution capacity), and operation and maintenance (O&M) costs.[57] These avoided utility system costs, rather than environmental benefits, are the primary justification for most ratepayer-funded energy efficiency investments.

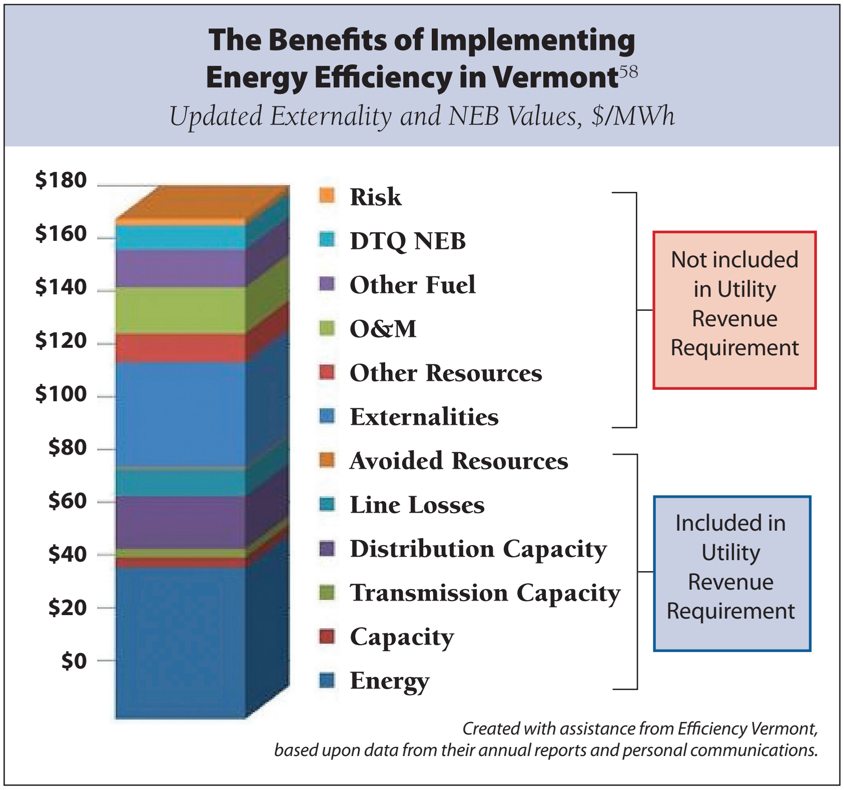
54 US EPA. (2014, June). *State Plan Considerations – Technical Support Document (TSD) for Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units.* Pages 112-113. Docket ID No. EPA-HQ-OAR-2013-0602. Available at: http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-state-plan-considerations

55 The EPA also proposes that states could make similar adjustments for MWh of generation from nuclear and renewable EGUs.

56 The 111(d) rule is not a final rule. The EPA has requested comments on whether an approach similar to the SIP approach should be required, in which the emissions reductions must be quantified in pounds and subtracted from the numerator of the compliance formula.

57 The potential to avoid transmission and distribution capacity costs generally receives less attention than other avoided utility system costs, and frequently is unappreciated and undervalued. For more information on this topic, refer to: Neme, C., & Sedano, R. (2012, February). *US Experience with Efficiency As a Transmission and Distribution System Resource.* Montpelier, VT: The Regulatory Assistance Project. Available at: http://www.raponline.org/document/download/id/4765

Figure 11-9



The magnitude of the benefits illustrated in Figure 11-9 will vary across jurisdictions, but the Vermont example is reinforced by evidence from other states. Program evaluations in Wisconsin, for example, indicate that the economic benefit of avoided emissions can form a large portion of the total societal benefits of energy efficiency programs. A recent evaluation report for Wisconsin's Focus on Energy program found that over 20 percent of the total economic benefits of this statewide energy efficiency program were attributable to avoided emissions.[59] What is clear from both the Vermont and Wisconsin examples is that a failure to assess all of the benefit categories for energy efficiency programs will likely lead to a lower estimate of the net benefits, and thus in turn a lower level of efficiency investment than is optimal for customers and society as a whole.

The environmental benefits of energy efficiency, in particular the air quality benefits, can be substantial. In nearly all regions of the country, energy efficiency will displace fossil-fueled generation. As a result, criteria and hazardous air pollutant emissions, notably including emissions of NO_X, SO_2, and mercury, will be reduced when energy efficiency is implemented. As was explained for GHG emissions, the magnitude of that co-benefit will depend on the amount of energy savings, as well as the timing and location of those savings. The same tools and methods described previously for estimating avoided CO_2 emissions are applicable to other air pollutants.

However, even though other categories of economic benefits are frequently excluded from energy efficiency program evaluations, those co-benefits can also be substantial. An example demonstrating this fact is provided in Figure 11-9, based on evaluation data from the state of Vermont.

In Vermont's estimation, energy efficiency avoids significant externality costs, primarily those associated with the damage from climate change. It also reduces O&M expenses incurred by program participants, in addition to the utility's avoided O&M costs. And an adder is included for "difficult-to-quantify" benefits, which include such things as the assumed value of increased participant comfort and productivity. Nearly half of the total benefit of the energy efficiency programs comes from categories of benefits that are typically excluded from program evaluations in other jurisdictions.

As an example of the potential scale of air quality co-benefits, ACEEE found that if all 12 Southeastern states adopted an annual energy efficiency savings goal equal to one percent of retail sales, they would avoid 52,000 tons of NO_X emissions, 160,000 tons of SO_2, and 4500 pounds of mercury through 2025.[60] ACEEE further asserts that it would cost over $12 billion to achieve the same

58 Lazar, J., & Colburn, K. (2013, September). *Recognizing the Full Value of Energy Efficiency (What's Under the Feel-Good Frosting of the World's Most Valuable Layer Cake of Benefits).* Montpelier, VT: The Regulatory Assistance Project. Available at: www.raponline.org/document/download/id/6739.

59 Cadmus Group. (2013). *Focus on Energy Calendar Year 2012 Evaluation Report: Volume I.* Madison, WI: Public Service Commission of Wisconsin. Pages 49-52. Available at: https://focusonenergy.com/sites/default/files/FOC_XC_CY%2012%20Report%20Volume%20I%20Final_05-3-2013.pdf

60 Hayes, S. (2013, September 23). *Energy Efficiency: A Resource for Meeting Air Quality Goals While Keeping the Lights On.* ACEEE. Available at: http://aceee.org/files/pdf/conferences/eer/2013/1B-Hayes.pdf

results using traditional air pollution control devices. In fact, this is what sets energy efficiency apart from most other GHG reduction options: energy efficiency is a power sector investment that simultaneously reduces emissions of multiple air pollutants while lowering system costs, rather than a "control measure" that achieves emissions reductions at some incremental system cost.

Another example of the magnitude of air pollution co-benefits can be found in the previously cited REED annual report for program year 2012. NEEP estimates (using average emissions factors provided by the region's system operators) that the first-year energy savings from energy efficiency programs in those ten jurisdictions avoided over 2.7 million pounds (1350 tons) of NO_X emissions and 7 million pounds (3500 tons) of SO_2 emissions in the year 2012.[61]

Energy efficiency programs can also lead to economic co-benefits outside of the power sector. To give another example of how far-reaching energy efficiency's benefits can be, the authors of a study examining higher investment in energy efficiency in New England found that gross state product would increase multiple times above the efficiency program cost and induce significant job growth. For example, raising New England region-wide electric program spending to $16.8 billion over 15 years (to capture all cost-effective electricity energy efficiency investments) would increase total gross state product in the region by $99 billion and raise employment equivalent to 767,000 job years.[62]

Although quantifying all these benefits may seem daunting, this is not uncharted territory. For instance, the Regulatory Assistance Project offers some best practices in calculating the benefits of energy efficiency, including:

- Count all the benefits you can quantify except when measures pass easily with readily quantifiable benefits;
- Use partners such as equipment vendors and advocates to obtain data; and
- Use a discount rate appropriate to the source of funding.[63]

The full range of societal and utility system co-benefits that can be realized through energy efficiency is summarized in Table 11-1. Although not shown in the table, energy efficiency programs can also produce substantial benefits for the participants (i.e., the customers that improve their efficiency), including reduced future energy bills, other resource savings (e.g., septic, well pumping), reduced O&M costs, positive health impacts, increased employee productivity, higher property values, and more comfortable indoor environments. Low-income consumers may see additional benefits unique to their circumstances.

Table 11-1

Types of Co-Benefits Potentially Associated with Energy Efficiency

Type of Co-Benefit	Provided by This Policy or Technology?
Benefits to Society	
Non-GHG Air Quality Impacts	Yes
Nitrogen Oxides	Yes
Sulfur Dioxide	Yes
Particulate Matter	Yes
Mercury	Yes
Other	Yes
Water Quantity and Quality Impacts	Yes
Coal Ash Ponds and Coal Combustion Residuals	Yes
Employment Impacts	Yes
Economic Development	Yes
Other Economic Considerations	Yes
Societal Risk and Energy Security	Yes
Reduction of Effects of Termination of Service	Yes
Avoidance of Uncollectible Bills for Utilities	Yes
Benefits to the Utility System	
Avoided Production Capacity Costs	Yes
Avoided Production Energy Costs	Yes
Avoided Costs of Existing Environmental Regulations	Yes
Avoided Costs of Future Environmental Regulations	Yes
Avoided Transmission Capacity Costs	Yes
Avoided Distribution Capacity Costs	Yes
Avoided Line Losses	Yes
Avoided Reserves	Yes
Avoided Risk	Yes
Increased Reliability	Yes
Displacement of Renewable Resource Obligation	Yes
Reduced Credit and Collection Costs	Yes
Demand Response-Induced Price Effect	Yes
Other	Yes

61 Supra footnote 53.

62 Howland, J., Murrow, D., Petraglia, L., & Comings, T. (2009, October). *Energy Efficiency: Engine of Economic Growth.* Environment Northeast. Available at: http://www.ctenergy.org/pdf/DSMESERPT.pdf

63 Supra footnote 58.

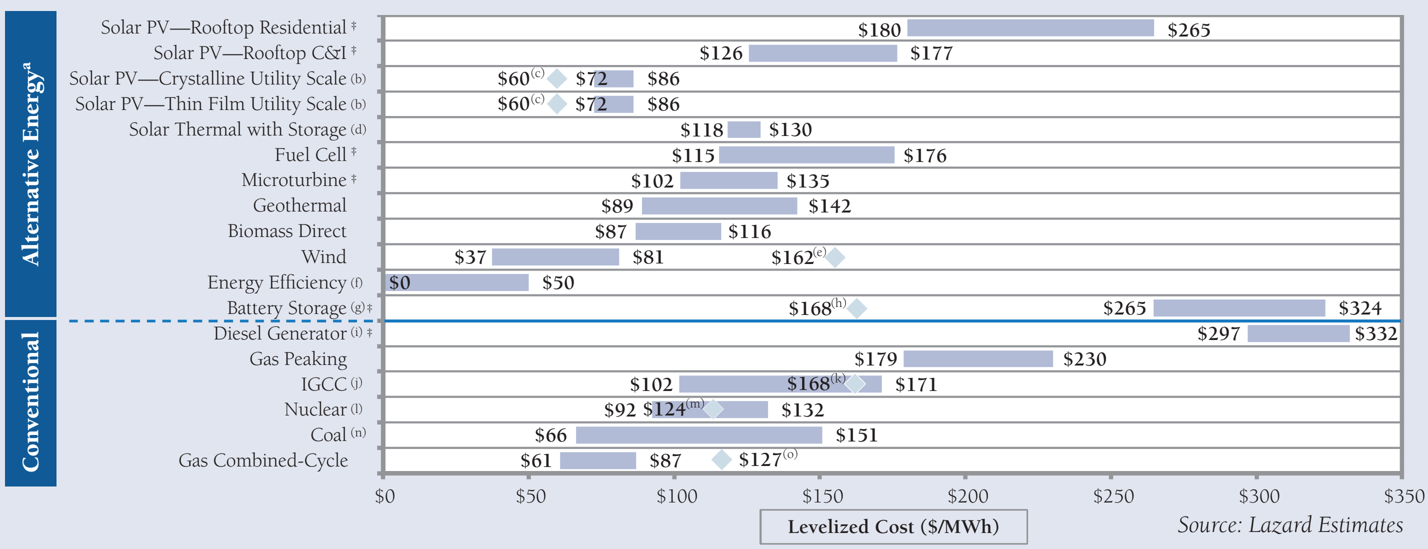
6. Costs and Cost-Effectiveness

Well-designed and implemented energy efficiency programs routinely deliver MWh savings at costs to the utility that are below the cost of producing the same number of MWh with supply-side resources. On an "all-in" basis, energy efficiency is estimated by the management firm Lazard to cost in the range of $0 to $50 per MWh. As summarized in Figure 11-10, energy efficiency is cheaper on a levelized cost of energy basis than all resources except some wind projects. In many cases, it is significantly cheaper than other resources.

Analyses by LBNL and ACEEE support Lazard's estimate. LBNL collected data from over 100 program administrators in 31 states from 2009 to 2011. Collectively these programs cost utilities an average of $21 per MWh saved.[65] ACEEE

Figure 11-10

Lazard's Estimates of Unsubsidized Levelized Cost of Energy (Dollars per MWh)[64]



Note: Here and throughout this presentation, unless otherwise indicated, analysis assumes 60% debt at 8% interest rate and 40% equity at 12% cost for conventional and Alternative Energy generation technologies. Assumes Powder River Basin coal price of $1.99 per MMBtu and natural gas price of $4.50 per MMBtu. Analysis does not reflect potential impact of recent draft rule to regulate carbon emissions under Section 111(d).

‡ Denotes distributed generation technology.

a. Analysis excludes integration costs for intermittent technologies. A variety of studies suggest integration costs ranging from 2.00 to $10.00 per MWh.

b. Low end represents single-axis tracking. High end represents fixed-tilt installation. Assumes 10 MW system in high insolation jurisdiction (e.g., Southwest US). Not directly comparable for baseload. Does not account for differences in heat coefficients, balance-of-system costs or other potential factors which may differ across solar technologies.

c. Diamond represents estimated implied levelized cost of energy in 2017, assuming $1.25 per watt for a single-axis tracking system.

d. Low end represents concentrating solar tower with 18-hour storage capability. High end represents concentrating solar tower with 10-hour storage capability.

e. Represents estimated implied midpoint of levelized cost of energy for offshore wind, assuming a capital cost range of $3.10 – $5.50 per watt.

f. Estimates per National Action Plan for Energy Efficiency; actual cost for various initiatives varies widely. Estimates involving demand response may fail to account for opportunity cost of foregone consumption.

g. Indicative range based on current stationary storage technologies; assumes capital costs of $500 – $750/KWh for 6 hours of storage capacity, $60/MWh cost to charge, one full cycle per day (full charge and discharge), efficiency of 75% – 85% and fixed O&M costs of $22.00 to $27.50 per KWh installed per year.

h. Diamond represents estimated implied levelized cost for "next generation" storage in 2017; assumes capital costs of $300/KWh for six hours of storage capacity, $60/MWh cost to charge, one full cycle per day (full charge and discharge), efficiency of 75% and fixed O&M costs of $5.00 per KWh installed per year.

i. Low end represents continuous operation. High end represents intermittent operation. Assumes diesel price of $4.00 per gallon.

j. High end incorporates 90% carbon capture and compression. Does not include cost of transportation and storage.

k. Represents estimate of current US new IGCC construction with carbon capture and compression. Does not include cost of transportation and storage.

l. Does not reflect decommissioning costs or potential economic impact of federal loan guarantees or other subsidies.

m. Represents estimate of current US new nuclear construction.

n. Based on advanced supercritical pulverized coal. High end incorporates 90% carbon capture and compression. Does not include cost of transportation and storage.

o. Incorporates 90% carbon capture and compression. Does not include cost of transportation and storage.

64 Lazard Ltd. (2014, September). *Lazard's Levelized Cost of Energy Analysis – Version 8.0.* Available at: http://www.lazard.com/PDF/Levelized%20Cost%20of%20Energy%20-%20Version%208.0.pdf

65 Billingsley, M. A., Hoffman, I. M., Stuart, E., Schiller, S. R., Goldman, C. A., & LaCommare, K. (2014, March). *The Program Administrator Cost of Energy Saved for Utility Customer-Funded Energy Efficiency Programs.* LBNL. Available at: http://emp.lbl.gov/sites/all/files/lbnl-6595e.pdf

estimated an average cost of $28 per MWh saved over the period 2009 to 2012 for a total of 20 states.[66]

The numbers cited previously reflect the cost that utilities and ratepayers pay per MWh of saved energy. This is the appropriate metric for comparing energy efficiency program investments to other investments the utility might make to meet customer demand. However, those numbers do not reflect additional costs paid by energy efficiency program participants. Because energy efficiency program participants gain the most from implementing energy efficiency, they are willing to invest their own money to save energy, in addition to any money invested by the utility and its ratepayers. Air regulators may see estimates of the cost of saved energy that are significantly higher than those cited previously, if the estimates include the total societal costs including the utility's costs and the participant's costs. For example, in the regulatory impact analysis it conducted for the proposed 111(d) rule, the EPA cites a levelized cost of saved energy approaching $85 per MWh saved in the year 2020 and $90 per MWh in the year 2030.[67] But even at those costs,

Cost-Effectiveness Tests for Energy Efficiency Programs

In 1983, the California PUC adopted a Standard Practice for Cost-Benefit Analysis of Conservation and Load Management Programs. This "Standard Practice Manual" described five different "tests" that could be used to determine whether an energy efficiency program was (or will be) cost-effective.[68] Each test considers the question from a different perspective (i.e., a different definition of what it means for a program to be "cost-effective"):

- **Participant Test.** Accounts for the benefits and costs of energy efficiency programs from the perspective of the customer implementing the measure;
- **Rate Impact Measure (RIM) Test.** Includes the benefits and costs affecting utility rates;
- **Utility Cost Test.** Includes the benefits and costs accruing to the program administrator, excluding revenues lost because of reduced sales;
- **Total Resource Cost (TRC) Test.** Includes the benefits and costs from both the utility and participant perspectives as well as those of non-participating customers; and
- **Societal Cost Test.** Includes the benefits and costs affecting all members of society.

Because each test considers different categories of costs and benefits, each test will yield a different calculation of cost-effectiveness for the same energy efficiency program. This is critically important to understand because the results of these tests will often dictate whether a particular energy efficiency program will be offered. Air pollution regulators need to understand that regulatory compliance costs are considered a utility cost that should be included in all of the tests except the participant test. Externality costs, such as public health costs associated with air pollution, are not a utility cost and are only included in the societal cost test.

In the years since the Standard Practice Manual was first published, it has been revised and adapted for use by PUCs across the country. In most cases, PUCs have ordered utilities and energy efficiency program evaluators to consider more than one of the five tests, but often with one test designated as the primary test for determining cost-effectiveness. States have differed in substantial ways in which tests they favor, and in whether and how they consider environmental compliance costs and externalities. Best practices with regard to those factors continue to evolve.[69]

66 Molina, M. (2014, March). *The Best Value for America's Energy Dollar: A National Review of the Cost of Utility Energy Efficiency Programs.* Available at: http://www.aceee.org/sites/default/files/publications/researchreports/u1402.pdf

67 US EPA. (2014, June). *Regulatory Impact Analysis for the Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants.* pp. 3-17 to 3-18. Available at: http://www2.epa.gov/sites/production/files/2014-06/documents/20140602ria-clean-power-plan.pdf

68 The manual was revised and updated in 1987-1988, and again in 2001, and corrections were made in 2007. The current version is available at: http://www.cpuc.ca.gov/NR/rdonlyres/004ABF9D-027C-4BE1-9AE1-CE56ADF8DADC/0/CPUC_STANDARD_PRACTICE_MANUAL.pdf

69 See, for example: Woolf, T., Steinhurst, W., Malone, E., & Takahashi, K. (2013, November). *Energy Efficiency Cost-Effectiveness Screening: How to Properly Account for 'Other Program Impacts' and Environmental Compliance Costs.* Montpelier, VT: The Regulatory Assistance Project. Available at: http://www.raponline.org/document/download/id/6149

energy efficiency is cheaper to society than most supply-side resources, and much of that cost is borne by participants rather than utilities or ratepayers.

Some might argue that even if energy efficiency currently costs $50 per MWh or less, states with a history of administering programs will see their costs rise as the stock of available, low-cost energy efficiency is used up. However, evidence points to the opposite being true, that is, as savings increase the cost of obtaining those savings goes down.[70] The reasons for this are not clear but could include economies of scale and scope as programs grow and greater experience is gained, leading to greater efficiency in program administration.[71] In any event, despite its low cost, there are many states that have left a large amount of potential efficiency savings on the table. Two of the most significant reasons for this are described in Section 7.

Cost-effectiveness, as distinguished from the cost of saved energy, requires consideration of the benefits of energy efficiency programs, primarily in the form of avoided utility system costs. The cost-effectiveness of energy efficiency programs is generally expressed as a ratio of benefits to costs, or in terms of net benefits (i.e., benefits minus costs). Energy regulators, utilities, and energy efficiency program evaluators have developed very robust methods for gauging the cost-effectiveness of energy efficiency programs, and all parties work together to ensure that the portfolio of ratepayer-funded energy efficiency programs is cost-effective. Although this topic of cost-effectiveness is generally beyond the scope of this chapter, a brief summary of methods is provided in the text box on page 11-20.

Finally, from the perspective of a participant in a ratepayer-funded program, energy efficiency represents a potentially valuable investment opportunity. As noted in testimony made by ACEEE's Executive Director to the US House of Representatives, energy efficiency investments typically provide a 25-percent return on investment, well above the returns of any other category of investment, and are associated with job creation and economic development.[72]

7. Other Considerations

One objection often raised against energy efficiency focuses on its impact on rates, because energy efficiency is largely funded through ratepayer charges. Related to this is a concern about equity — although a customer who participates in an energy efficiency program will see his or her bill *decrease,* often dramatically, there is likely to be a small bill *increase* for those who do not participate in any program offering. The underlying assumption within this criticism is that participation rates in these programs will be low and therefore only a subset or even a small minority of customers will directly benefit. Certainly PUCs have to be concerned about consumers' rates, bills, and the equity of charging all customers for energy efficiency programs. However, these concerns can be largely remedied so as to not overshadow the substantial benefits of pursuing a robust efficiency program.

It is the rare utility that has no foreseeable need for additional energy resources. In the case of electric utilities, energy efficiency is nearly always cheaper than supply-side investments as demonstrated in Section 6. However, this fact can be obscured by the methodology used to evaluate new resources. When energy efficiency and supply-side investments are evaluated differently, a utility may conclude that it is advantageous to pursue the supply-side investment. This situation arises frequently whenever energy efficiency is judged by its impact on rates, whereas supply-side investments are judged on the basis of *total system cost.* Total system cost can be thought of as the sum of payments by ratepayers to meet future needs. Because customers ultimately judge cost based on their bills, total system cost (rather than the impact on rates) is a better measure by which to select between energy efficiency and supply-side investments.

For example, in its Sixth Power Plan, the Northwest Power & Conservation Council looked at the average rates and bills for a variety of different planning scenarios. Removing energy efficiency as a possible future resource lowered the average system rate from $69.49 per MWh to $66.52 per MWh, but raised average residential bills from $77.91 per month to $82.24 per month.[73] If lower rates

70 Takahashi, K., & Nichols, D. A. (2008, August 20). *The Sustainability and Costs of Increasing Efficiency Impacts: Evidence from Experience to Date.* The 2008 ACEEE Summer Study. Available at: http://www.synapse-energy.com/Downloads/SynapsePresentation.2008-08.0.Sustainability-and-Costs-of-Efficiency-Impacts.S0051.pdf

71 Ibid.

72 Nadel, S. (2014, July 24). *Economic Impacts of State Energy Policy.* ACEEE. Available at: http://www.aceee.org/files/pdf/testimony/nadel-house-072414.pdf

73 Sixth Northwest Conservation and Electric Power Plan. Appendix O: Calculation of Revenue Requirements and Customer Bills. Available at: https://www.nwcouncil.org/media/6335/SixthPowerPlan_Appendix_O.pdf

had guided the Council's plan, consumers would ultimately pay more for electric service.

With regard to equity and returning to the Northwest Power & Conservation Council example, the appropriate question becomes, "How does one ensure that as many ratepayers as possible see their bills go down?" The answer lies in offering a broad portfolio of programs that addresses all end-uses and customer types, and is sufficiently funded so that any customer who desires to do so can participate.[74] Often programs that have a higher level of savings will have higher participation rates and therefore fewer equity issues.[75]

Another barrier to energy efficiency is utilities' financial disincentive to offer energy efficiency programs. Energy efficiency reduces the utility's sales of electricity below what would otherwise occur. When a utility's sales are reduced, the utility experiences: (1) "lost revenues" or a "lost contribution to fixed costs," meaning that the utility has less revenue than it expected to have when it incurred debt to make capital investments in the electric system; and (2) a reduction in its shareholders' return on equity, because money that would have gone to shareholders under business as usual instead is used to replace the lost revenues. These are serious issues for shareholders but fortunately they can be addressed to varying degrees through two mechanisms: lost revenue recovery or decoupling. As Moskovitz et al explains:

> At first blush, the lost-base revenue approach appears simple and straightforward. One simply calculates how many dollars a utility has lost due to its DSM programs and increases revenues by that amount. For example, suppose a utility has a program to replace existing electric motors with more efficient ones, and that it estimates that, as a result, its electricity sales are 100 million kilowatts lower as a result. If each kilowatt-hour produced, say two cents in revenue net of fuel and any other variable costs, then the utility would lose $2 million in net revenue to this program, which would be recovered under a lost-base revenue adjustment.
>
> A decoupling approach operates differently. Here, one determines during a normal rate case how much revenue a utility requires to cover its expenses and sets an electric rate which is expected to produce that level. Later, perhaps at the end of a year, we return to see whether, in fact, that revenue has been generated or whether, due to fluctuations in sales from the expected level, some greater or lesser amount has been realized. To the extent that the utility has, in fact, received too little (too much) the error is corrected through a surcharge (rebate).[76]

Energy efficiency does offer several ancillary benefits that may be attractive to utilities. Energy efficiency measures can be targeted toward reducing system peak load or reducing congestion.[77] Energy efficiency is also relatively quick to deploy. The planning cycles for new supply resources can vary from two years to ten years, whereas new energy efficiency programs and initiatives can be implemented in a matter of months. And because energy efficiency programs typically target a portfolio of measures and projects, the impacts on the system are predictable and can be shaped to match the load characteristics of a baseload generator.[78]

8. For More Information

Interested readers may wish to consult the following reference documents for more information on end-use energy efficiency:

- Crossley, D. (2013, January). *Effective Mechanisms to Increase the Use of Demand-Side Resources*. Montpelier, VT: The Regulatory Assistance Project. Available at: http://www.raponline.org/document/download/id/6135

74 Woolf, T. (2013, September 24). *Energy Efficiency: Rate, Bill and Participation Impacts*. A presentation at the ACEEE Energy Efficiency as a Resource Conference. Available at: http://www.aceee.org/files/pdf/conferences/eer/2013/5C-Woolf.pdf

75 Ibid.

76 Moskovitz, D., Harrington, C., & Austin, T. (1992, May). *Decoupling vs. Lost Revenues: Regulatory Considerations*. Available at: http://www.epa.gov/statelocalclimate/documents/pdf/5_19decoupling_lost_revs_compariso_RAP.pdf. The authors further note: "The phrase lost-base revenues is used to distinguish fuel revenues from base revenues. Fuel revenues comprise nearly all of a utility's variable costs. In most states, fuel revenues are fully recovered on a reconciled basis in fuel adjustment factors. Fuel revenues are not lost as a result of energy efficiency investments."

77 See: https://www.efficiencyvermont.com/About-Us/Energy-Efficiency-Initiatives/Geographic-Targeting

78 Crossley, D. (2012, September). *The Efficiency Power Plant Model*. Montpelier, VT: The Regulatory Assistance Project. Available at: http://www.raponline.org/document/download/id/6135

- Downs, A., & Cui, C. (2014, April). *Energy Efficiency Resource Standards: A New Progress Report on State Experience.* Available at: http://aceee.org/sites/default/files/publications/researchreports/u1403.pdf
- Lazar, J., & Colburn, K. (2013, September). *Recognizing the Full Value of Energy Efficiency (What's Under the Feel-Good Frosting of the World's Most Valuable Layer Cake of Benefits).* Montpelier, VT: The Regulatory Assistance Project. Available at: Available at: www.raponline.org/document/download/id/6739
- NEEP. *Regional Energy Efficiency Database.* Database and supporting documentation available at: http://neep-reed.org/
- Nowak, S., Kushler, M., White, P., & York, D. (2013, June). *Leaders of the Pack: ACEEE's Third National Review of Exemplary Energy Efficiency Programs.* Available at: http://www.aceee.org/sites/default/files/publications/researchreports/u132.pdf
- Regional Technical Forum. (2014, June). *Roadmap for the Assessment of Energy Efficiency Measures.* Available at: http://rtf.nwcouncil.org/subcommittees/Guidelines/RTF%20Guidelines%20(revised%206-17-2014).pdf
- Sciortino, M., Young, R., & Nadel, S. (2012, May). *Opportunity Knocks: Examining Low-Ranking States in the State Energy Efficiency Scorecard.* Available at: http://www.aceee.org/sites/default/files/publications/researchreports/e126.pdf
- Shenot, J. (2013, August). *Quantifying the Air Quality Impacts of Energy Efficiency Policies and Programs.* Montpelier, VT: The Regulatory Assistance Project. Available at: http://www.raponline.org/document/download/id/6680%20
- Slote, S., Sherman, M., & Crossley, D. (2014, March). *Energy Efficiency Evaluation, Measurement, and Verification.* Montpelier, VT: The Regulatory Assistance Project. Available at: http://www.raponline.org/document/download/id/7064
- State and Local Energy Efficiency Action Network. (2012). *Energy Efficiency Program Impact Evaluation Guide.* Available at: http://www1.eere.energy.gov/seeaction/pdfs/emv_ee_program_impact_guide.pdf
- State and Local Energy Efficiency Action Network. Numerous other publications and resources are available at: http://seeaction.energy.gov/
- US Department of Energy. (2013, April). *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* Available at: http://energy.gov/eere/downloads/uniform-methods-project-methods-determining-energy-efficiency-savings-specific
- US EPA. (2014, June). *GHG Abatement Measures – Technical Support Document (TSD) for Carbon Pollution Guidelines for Existing Power Plants: Emission Guidelines for Greenhouse Gas Emissions from Existing Stationary Sources:* Electric Utility Generating Units. Docket ID No. EPA-HQ-OAR-2013-0602. Available at: http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-ghg-abatement-measures
- US EPA. 2012. *Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies and Programs into State and Tribal Implementation Plans.* EPA-456/D-12-001a. Available at: http://epa.gov/airquality/eere/pdfs/EEREmanual.pdf
- Wasserman, N., & Neme, C. (2012, October). *Policies to Achieve Greater Energy Efficiency.* Montpelier, VT: The Regulatory Assistance Project. Available at: www.raponline.org/document/download/id/6161

9. Summary

Ratepayer-funded energy efficiency programs have expanded significantly over the past decade or so, yielding significant economic and environmental benefits. Nevertheless, the potential to achieve even greater energy savings exists across the country, perhaps even more so in states that have a shorter history with energy efficiency programs or have historically invested less money in energy efficiency.

Recent evidence suggests that states that have established mandatory energy savings targets for utilities see the highest levels of achieved energy savings. This revelation has led to a proliferation of EERS policies, which now exist in half of all states.

Energy efficiency is a low-cost, low-risk resource that compares favorably to all supply-side alternatives. It is also a proven and effective means of reducing air emissions, increasingly recognized and encouraged by the EPA and state air regulators. By leveraging several policy mechanisms, chiefly an EERS, states can make significant reductions in CO_2 emissions while stimulating job growth and their economies.