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Putting a Floor on Energy Savings: Comparing State Energy Efficiency Resource Standards

Karen Palmer, Samuel Grausz, Blair Beasley, and Tim Brennan

1616 P St. NW
Washington, DC 20036
202-328-5000 www.rff.org

RESOURCES FOR THE FUTURE

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Abstract

Energy efficiency resource standards (EERS) refer to policies that require utilities and other covered entities to achieve quantitative goals for reducing energy use by a certain year. EERS policies generally apply to electricity and natural gas sales and electricity peak demand, though they also cover other energy sources in Europe. Our study aggregates information about the requirements of existing EERS policies for electricity sales in the United States. We convert quantitative goals into comparable terms to compare the nominal stringency of EERS programs across states. EERS programs also differ in their nonquantitative requirements, including flexibility measures, measurement and verification programs, and penalties and positive incentives. We compare the U.S. policies to similar policies in the European Union and discuss important policy issues, including exogenous changes in fuel prices and issues with utility management of energy efficiency programs.

Key Words: energy efficiency, electricity, energy efficiency resource standards, state regulation

JEL Classification Numbers: L94, L95, L51

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Introduction

Out of concern for environmental harm, climate change, and the expense of generation and transmission capacity to meet peak demands, governments have been looking at a wide range of policies to change the amount of energy we use and the portfolio of fuels used to generate it. Among the policies that have been considered are carbon taxes, marketable emissions permit (cap-and-trade) programs, renewable portfolio standards (RPS) and clean energy standards (CES), real-time retail electricity pricing, demand response programs (such as critical peak period rebates or utility air conditioner controls), and programs to promote energy efficiency (i.e., the use of equipment and appliances that use less electricity or gas to provide a given level of service). One type of policy receiving increased attention, particularly at the state level in the United States but also in Europe, is the energy efficiency resource standard (EERS). We describe the individual standards in more detail below, but in general, EERS programs consist of mandates to reduce the use of electricity and natural gas by some prescribed percentage or amount, by some prescribed time (Nadel 2006). Twenty states have adopted EERS programs. Maryland's EmPower program, for example, envisions reducing electricity use per capita by 15 percent of 2007 levels by 2015 (Maryland Energy Administration 2008).

State statutes and public utility commission orders that establish or implement EERS policies cite a largely homogeneous list of reasons for enacting the standards. Common rationales include: environmental and public health benefits, green jobs creation, deferment of electricity infrastructure improvements, greenhouse gas reductions, energy savings, reduced

*Karen Palmer, Senior Fellow, Resources for the Future (palmer@rff.org); Sam Grausz, Research Assistant, Resources for the Future (grausz@rff.org); Blair Beasley, Research Assistant, Resources for the Future (beasley@rff.org); and Tim Brennan, Professor, Public Policy and Economics, University of Maryland, Baltimore County, and Senior Fellow, Resources for the Future (brennan@umbc.edu). The authors benefitted from some background research by Natasha Plotkin, who was a summer intern at Resources for the Future in 2010. We thank Fred Murphy and other attendees at the 5th Trans-Atlantic Infraday Conference on Advances in Electricity Operations, Planning, and Market Models for helpful comments. We also thank Steve Nadel, Michael Sciortino, Rodney Sobin, Thomas Simchak, Gaetan Giraudet, and Brian Lips for their comments on an earlier draft of this paper. All remaining errors are our own. This research was funded by the Center for Climate and Electricity Policy at Resources for the Future.

reliance on fossil fuels, and energy security. For example, the 2006 California Assembly Bill No. 2021[1] states that, "Expanding California's energy efficiency programs will promote lower energy bills, protect public health, improve environmental quality, stimulate sustainable economic development, create new employment opportunities, and reduce reliance on imported fuels."[2]

We take a close look at different features of the EERS policies for electricity that have been adopted in the states. We assess the relative stringency of different state policies; the role of different flexibility mechanisms; approaches to evaluation, measurement, and verification; and penalties for noncompliance. We also describe the differences in regulatory incentives for utility efficiency programs. To facilitate comparison of policy stringency across the states, we translate each state's nominal EERS policy goal into comparable annual energy savings and compare this goal to the state's covered and total energy sales. We also briefly survey similar policies in Europe, highlighting the ways in which they differ from U.S. policies. Further, we discuss a number of important implementation challenges, including interactions with other policies, effects of exogenous fuel and electricity price changes, and advantages and disadvantages of implementing the policy through utilities.[3]

States vary substantially in the stringency and flexibility of their EERS policies, but in general we found the EERS policies to be quite stringent. The policies require reductions on average equal to 12.7 percent of covered load and 11.5 percent of total state load. These values are well in excess of past energy efficiency requirements, though within the range of energy savings from energy efficiency programs expected over the next decade by experts in the field.[4]

States also vary in the flexibility of their policies. Currently, 13 states explicitly allow one or more of a broader set of efficiency investments beyond those that target reductions in

[1] Assembly Bill 2021, California Statutes of 2006, chapter 734.
[2] Many other states offer similar policy rationales. For example, New Mexico's Efficient Use of Energy Act states that, "cost-effective energy efficiency and load management programs undertaken by public utilities can provide significant reductions in greenhouse gas emissions, regulated air emissions, water consumption and natural resource depletion, and can avoid or delay the need for more expensive generation, transmission and distribution infrastructure."
[3] A companion paper (Brennan and Palmer 2012) compares EERS policies to policies that directly address the problems motivating them and analyzes conditions for when an EERS will achieve optimal outcomes in the face of changing demand—an issue arising because the typical EERS is a floor on energy efficiency, not a cap on energy use.
[4] Sciortino et al. (2011) also categorize and compare EERS policies across U.S. states. We have consulted extensively on our results with Sciortino et al in the preparation of this report and compare our results directly to theirs and discuss the reasons for differences in Appendix B.

customer use of electricity to be eligible for compliance, but only two states allow efficiency credit banking. Seven states have explicit penalties for noncompliance, and an additional ten states have financial rewards for compliance that create implicit penalties at the margin. In virtually all cases, EERS standards require the energy efficiency programs used to produce energy savings to pass a cost benefit test where the benefits of savings depend on the costs of producing electricity. As a result the effects of EERS policies are potentially sensitive—in unexpected ways—to changes in the underlying economics of electricity supply. Last, the role that regulated utilities should play in the provision of energy efficiency services is debatable. The current practice in many states of relying primarily on regulated utilities to deliver energy efficiency services may be more the result of political considerations than of economic efficiency.

Although we focus our empirical analysis on electricity use EERS policies, we expect that our methods will apply in the electricity peak demand and natural gas use settings. We hope that this exercise provides a basis for further research, particularly in testing the effectiveness of EERS policies and comparing them to other energy and environmental policies. These two challenges are particularly formidable as many of these programs are new. In addition, because states do not choose to adopt EERS policies at random, empirical testing of their effects becomes significantly more difficult. This review should be of interest, not just to other states that are considering the adoption of EERS programs, but also to the federal government, which might look to an EERS as an alternative to politically infeasible emissions tax or cap-and-trade programs.[5]

Overview of State EERS Policies

A number of states have adopted a variety of policies that seek to incentivize or mandate energy efficiency by setting broad-based goals or targets. For the purposes of this report, we define an EERS as a legally binding numeric target for energy use reduction stated in either percentage or quantity terms. Not every energy efficiency policy counts. For example, a state that has energy efficiency goals but no entity or group of entities that is legally obligated to meet

[5] In June 2009, the U.S. House of Representatives passed the American Clean Energy and Security Act (generally known as the Waxman–Markey bill), which included cap-and-trade provisions for carbon dioxide. This legislation did not pass the Senate, and prospects for passage of similar legislation in the current Congress appear minimal. Concern over deficit reduction and the desire to hold down or lower tax rates in other parts of the economy may spur consideration of carbon taxes.

those goals does not have an EERS. Similarly, any state that has defined an EERS but not provided funding nor required obligated entities to fund the projects, does not have a legally binding policy and thus is not included.[6] Also, we do not include states, such as Nevada, North Carolina, and Connecticut, that allow energy savings from efficiency investments to earn credit under the state RPS, but do not have a separate, multi-year energy efficiency policy. Sciortino et al. (2011) and other policy databases classify Maine, Oregon and Texas as having an EERS; however, because neither state has a legally binding energy savings goal, we exclude all three from our list.[7]

Based on this definition, 20 states have EERS policies for electricity. EERS policies are typically specified for energy (electricity and/or natural gas) use, and sometimes for reductions in peak electricity consumption; we focus on EERS policies targeting electricity use. A list of states with EERS policies for electricity use overall, with their adoption years, is shown in Table 1.[8]

[6] Wisconsin is the best example of this situation. The state passed a funding increase for EERS programs in December 2010. However, that increase was revoked in the 2011 Wisconsin Act 32 of the 2011-2013 Biennial Budget Act, effectively forcing utilities to only maintain existing programs.

[7] Texas has an EERS for peak electricity demand which requires utilities to report resulting reductions in electricity sales, but does not have a stand-alone binding standard for reductions in electricity sales.

[8] Washington State has an EERS, but we were not able to gather suffient information to calculate its stingency. As a result, Washington State is not included any of the remaining stringency calculations.

Table 1. States with EERS Policies and Adoption Years

State	Year
Florida	1980
Vermont	1999
California	2004
Rhode Island	2006
Washington	2006
Colorado	2007
Illinois	2007
Minnesota	2007
Iowa	2008
Maryland	2008
Massachusetts	2008
Michigan	2008
New Mexico	2008
New York	2008
Ohio	2008
Pennsylvania	2008
Arizona	2009
Hawaii	2009
Indiana	2009
Arkansas	2010

Among electricity use EERS policies, perhaps the most salient feature is the required reduction in electricity use. To understand and compare required reductions across EERS programs, we need to define some terms. The *reference case* is our estimate of the amount of electricity that would be used in a given year but for the EERS. The *basis* is the quantity from which a percentage reduction is calculated. Different terms are necessary because the percentage reduction is not calculated against the reference case. For example, in Maryland the goal is to reduce per-capita electricity use in 2015 by 15 percent of the amount of electricity used in 2007. In our terminology, the amount of electricity that would have been used in 2015 but for the EERS is the reference case, and the amount of electricity used in 2007 is the basis.

Table 2 summarizes the policy requirements of each state program in or by the final year specified in the policy. As that table shows, EERS policies characterize reductions in one of two different ways: annual or cumulative reductions. An annual reduction specifies the new energy savings required in a given year from investments made in that year, whereas a cumulative reduction sets the total amount of reductions to be achieved in a given year from all policies implemented up through that year. Each of these definitions of energy use reduction can be characterized as either quantity or percentage reductions. Policies with a quantity reduction specify the requirement in physical units, whereas policies with a percentage reduction specify the requirement as a percentage of the relevant basis.

Table 2. EERS Reduction Requirements in Final Year[9] of Policy

		Nominal Requirement	
State	**Year**	**Reduction Measure**	**Requirement**
Arizona	2020	Cumulative Percent	22.00%
Arkansas	2013	Annual Percent	0.75%
California	2020	Annual Quantity	1,788
Colorado	2020	Annual Quantity	549
Florida	2019	Annual Quantity	703
Hawaii	2030	Annual Quantity	195
Iowa	2020	Annual Percent	1.50%
Illinois	2020	Annual Percent	2.00%
Indiana	2020	Annual Percent	2.00%
Maryland	2015	Cumulative Percent	15.00%
Massachusetts	2012	Annual Quantity	1,103
Michigan	2020	Annual Percent	1.00%
Minnesota	2020	Annual Percent	1.50%
New Mexico	2020	Cumulative Percent	10.00%
New York	2015	Cumulative Quantity	24,927
Ohio	2025	Annual Percent	2.00%
Pennsylvania	2013	Cumulative Percent	3.00%
Rhode Island	2014	Annual Quantity	189
Vermont	2011	Annual Quantity	120

The quantity reductions shown in Table 2 are easy to compare across states. The percentage reductions, however, are not because they are defined relative to bases that vary across states. Thus, to compare the percentage reduction policies, we need to understand these bases. Table 3 classifies the bases into two major types—fixed and rolling. Fixed bases establish a single reference period, whether it’s a past year or a forecasted future year, and measure compliance relative to electricity usage in that period.[10] Rolling bases refer to a moving period that varies with the year of compliance, whether it’s the current year, the previous year, or an

[9] Final year refers to the last year in which the policy is defined in the legislation. For policies that have requirements extending indefinitely beyond their final year, we assumed a final year of 2020.

[10] A strict legal interpretation of fixed future bases (implemented in New York and Pennsylvania) might require utilities to keep energy consumption below a set level (an energy cap) rather than to prove a certain amount of reductions. However, this does not seem to be an issue for either state because New York translates its percentage goals into physical unit targets, and Pennsylvania’s initial forecast period now lies in the past, effectively creating a historical fixed-year basis going forward.

average of multiple previous years. States that specify their reductions in quantity reductions (physical units), as explained above, do not require a basis for measuring required energy savings.[11]

Table 3. Basis Definition for States with EERS Policies

State	Basis			
	Type	**Fixed Basis Year**	**Rolling Period (years)**	**Metric**
Arizona	Rolling		1	Sales
Arkansas	Fixed	2010		Sales
California	None			Sales
Colorado	None			Sales
Florida	None			Sales
Hawaii	None			Sales
Iowa	Rolling		3	Sales
Illinois	Rolling		1	Sales
Indiana	Rolling		3	Sales
Maryland	Fixed	2007		Per-Capita Sales
Massachusetts	None			Sales
Michigan	Rolling		1	Sales
Minnesota	Rolling		3	Sales
New Mexico	Fixed	2005		Sales
New York	None			Sales
Ohio	Rolling		3	Sales
Pennsylvania	Fixed	2009		Sales
Rhode Island	None			Sales
Vermont	None			Sales

Notes:
Policies with baseline type "Rolling" relate to requirements denominated in percentage of previous or current year(s) consumption.
Policies with baseline type "Fixed" relate to requirements denominated in percentage of consumption in a given year.
Policies with baseline type "None" relate to requirements denominated in physical units.
Rolling period refers to the number of years prior ot the compliance year that electricity use is averaged over to calculate the baseline.

[11] Both New York and Rhode Island initially specify their policy as a percentage reduction, but ultimately respecify the policy as a quantity reduction. As such, we present the policy as a quantity reduction because the quantity reductions are ultimately the binding requirement.

Unlike fixed bases, rolling bases are affected by the level of compliance in prior years. Higher levels of savings in a particular year reduce savings requirements in future years by reducing the basis from which percentage reductions are calculated. Rolling bases also introduce more uncertainty by linking required reductions to exogenous changes in energy sales resulting from the level of economic activity, weather, demographics, or other factors. How these factors might cause utilities to move forward or delay reductions is an open question. Except for Maryland, states define their bases in terms of total electricity sales for energy-related policies. Maryland uses per capita sales as a basis. Using per capita sales as a basis adds the uncertainty of population growth to the eventual policy requirements.

Bases also very in terms of how much and which sales are covered by the policy and, relatedly, which entities are responsible for complying with the policy, as shown in Table 4. States use a variety of terms to describe their energy sector participants, such as *utilities*, *public utilities*, and *electricity distribution companies*. In Table 4, we standardize these terms into three possibilities: *investor-owned utilities (IOUs), cooperative (co-op) utilities*, and *municipal utilities*. When a state obligates all three, we list that as “All.”

Table 4. Policy Coverage and Obligated Entities

	% of State Sales Covered			
State	**Description**	**Share**	**Obligated Entities**	**Notes**
Arizona	All except excluded	99%	All utilities	Excludes utilities < $5,000,000 in annual revenue and co-op utilities with less than 25% of customers in AZ, all co-op utilities comply with separate standard (75% of normal standard)
Arkansas	IOUs	61%	IOUs	
California	IOUs	74%	IOUs	
Colorado	IOUs	57%	IOUs	
Florida	All except excluded	84%	All utilities	Only utilties > 2000 GWH annual sales
Hawaii	All	100%	All utilities	
Iowa	IOUs	74%	IOUs	
Illinois	IOUs except excluded	89%	IOUs, DCEO	Only IOUs > 100,000 customers in IL, IOUs and Department of Commerce and Economic Opportunity (DCEO) responsible for 75% and 25% of obligation respectively
Indiana	All	100%	All utilities	
Maryland	All	100%	All utilities, other entities	
Massachusetts	IOUs	86%	IOUs	
Michigan	All	100%	All utilities	88.9% (IOUs), 7.8% (municipal utilities), and 3.4% (co-ops) of obligation
Minnesota	All	100%	All utilities	
New Mexico	IOUs	67%	IOUs	Co-op utilities outside the jurisdication of the Public Utility Commission (PUC) but required to develop voluntary targets
New York	All	100%	IOUs, NYSERDA, other entities	Obligation shared between multiple entities; share of observations determined by the Public Service Commission (PSC)
Ohio	IOUs	88%	IOUs	
Pennsylvania	IOUs except excluded	96%	IOUs	IOUs > 100,000 customers
Rhode Island	All	100%	All utilities	Excludes the Pascoag Utility District and Block Island Power Company
Vermont	All except excluded	94%	Efficiency Vermont	Excludes the City of Burlington

Notes:

Covered Sales Share is the percent of 2009 electricity sales covered under the EERS divided by the total state electricity sales.

Arizona requires co-op utilities to only achieve 75% of the standard. We do not include this in further calculations.

Arizona allows utilities to use peak demand reductions to meet up to 2 percentage points of their requirements in 2020. The equivalent load reduction is calculated by assuming a 50% load factor.

In roughly half of the states, the EERS policy covers all utilities and thus all load, and in the other half it covers only investor-owned utilities (IOUs), in some cases because of the limited jurisdiction of the state regulatory commission that typically oversees implementation of the policy. A few states also include explicit size limitations on obligated entities; for example, Illinois covers only IOUs with more than 100,000 customers. In some states, the choice of obligated entities significantly narrows the scope of the policy, such as in Colorado and New Mexico, where cooperatives (co-ops) and municipal utilities represent a large share of state sales but are not obligated to comply with the EERS. Obligation for compliance with the policy typically lies with the utilities, although a few states also place obligations on nonutility actors, including the Department of Commerce and Economic Opportunity in Illinois, the New York State Energy & Research Development Authority in New York, and Efficiency Vermont in Vermont.

Stringency

We compare the relative stringency of each policy by calculating the cumulative quantity of reductions—the reductions required from all policies implemented up to the compliance year measured in physical units—required by each policy in the last year of the policy. We also calculate the ratio of required savings to total sales of both covered entities and all electric retailers within each state.[12] To make these comparisons at particular points in time, we take projected population growth by state from Census Bureau projections (U.S. Census Bureau 2004) and assume that, in the absence of the EERS, electricity sales would grow at 0.9 percent per year.[13] We also assume that the relevant set of utilities within the state will fully comply with all EERS policy requirements and achieve the same level of annual reduction in each year after implementation. In reality, the viability of these conditions will depend on monitoring and measurement, which we discuss below. The converted requirements are shown in Table 5; the calculations underlying this conversion are described in Appendix A.

[12] We perform this comparison for electricity sales policies but not for electricity peak policies as we could not find projections of peak electricity by state.

[13] We assume a 0.9 percent rate of annual growth in demand in the absence of the EERS policies because this is the annual growth rate in electricity consumption found by the U.S. Energy Information Administration (EIA) in its *Annual Energy Outlook 2011* (U.S. Energy Information Administration 2011). We chose to make this latter assumption rather than use state-level projections from another source as those projections might include the anticipated effects of state EERS policies on energy sales.

Table 5. Comparison of Nominal Required Reductions and Converted Stringency in the Final Year of the Policy

State	Year	Nominal Requirement		Standardized Requirement		
		Measure	Requirement	Requirement	Percent of Reference (covered)	Percent of Reference (state)
Arizona	2020	Cumulative Percent	22.00%	14,635	18.2%	18.1%
Arkansas	2013	Annual Percent	0.75%	401	1.5%	0.9%
California	2020	Annual Quantity	1,788	34,303	16.2%	12.0%
Colorado	2020	Annual Quantity	549	4,793	14.9%	8.5%
Florida	2019	Annual Quantity	703	7,843	3.8%	3.2%
Hawaii	2030	Annual Quantity	195	4,300	35.2%	35.2%
Iowa	2020	Annual Percent	1.50%	4,777	13.4%	9.9%
Illinois	2020	Annual Percent	2.00%	21,562	16.1%	14.3%
Indiana	2020	Annual Percent	2.00%	13,853	12.6%	12.6%
Maryland	2015	Cumulative Percent	15.00%	10,641	16.1%	16.1%
Massachusetts	2012	Annual Quantity	1,103	2,625	5.5%	4.7%
Michigan	2020	Annual Percent	1.00%	10,373	9.6%	9.6%
Minnesota	2020	Annual Percent	1.50%	10,377	14.7%	14.7%
New Mexico	2020	Cumulative Percent	10.00%	1,393	8.7%	5.8%
New York	2015	Cumulative Quantity	24,927	24,927	16.9%	16.9%
Ohio	2025	Annual Percent	2.00%	28,399	19.1%	16.8%
Pennsylvania	2013	Cumulative Percent	3.00%	4,152	2.9%	2.8%
Rhode Island	2014	Annual Quantity	189	796	10.0%	10.0%
Vermont	2011	Annual Quantity	120	360	6.9%	6.4%

Notes:

Policies defined with last year requirements prior to 2020 continuing each year after their final specified year are shown with a final year of 2020.

All non-standardized non-percent electricity requirements denominated in million KWhs.

All standardized requirements denominated in million KWhs.

Converting and comparing the stringencies of the policies provides a number of important insights about the policies' relative requirements. The mean of the requirements as a percent of covered load in the reference case is 12.7 percent and the median is 13.4 percent. The majority of policies are clustered relatively narrowly around the means, with the first quartile at 7.8 percent and the third quartile at 16.2 percent. The most stringent policy is Hawaii's, requiring energy efficiency equal to 35.2 percent by 2030 of covered load, and the least stringent is Arkansas's, requiring only 1.5 percent by 2013. Other high requirement states include Ohio (19.1 percent in 2025), Arizona (18.2 percent in 2020), and New York (16.9 percent in 2015).

These results remain largely the same when we look at energy efficiency as a percent of total state demand. Average requirements decrease to 11.5 percent and the median to 10 percent, with the first and third quartiles decreasing to 6.1 percent and 15.4 percent. The largest changes occur in Colorado, Arkansas, and New Mexico, where the low percentage of total state load covered results in the EERS policies requiring a significantly smaller percentage of total state load than percentage of covered state load.

These EERS goals significantly exceed historical energy efficiency savings. According to the U.S. Energy Information Administration (EIA (2011), utilities report total cumulative energy savings in 2010 from ratepayer-funded energy efficiency programs equal to 2.3 percent of total electricity sales in that year. These findings are echoed by Arimura et al. (2011), who estimate that between the early 1990s and 2006, ratepayer-funded energy efficiency programs saved an average of 1.8 percent of electricity sales per year. The relationship between the EERS goals and these estimates of past savings suggest that the EERS requirements will likely be binding as they require utilities to achieve more energy savings than they have achieved historically as a result of normal behavior and pre-existing policies.

The EERS goals are broadly in line, however, with the level of savings that energy efficiency experts expect future policies to achieve. Farugui and Mitarotonda (2011) surveyed energy efficiency experts to determine how much energy savings they expected U.S. energy efficiency policies to produce by 2020. These experts believe that energy use will fall between 5 and 15 percent relative to a world without energy efficiency policies. These expectations are consistent with the goals of the majority of state EERS policies.

Generally, these results reveal that the nominal policy goals can often mask the stringency of the ultimate requirement. Small requirements phrased in terms of annual reductions, requiring energy efficiency from projects initiated in that year, can quickly build up into significant cumulative requirements. Assuming that states require utilities to continue projects once started and that customers continue to realize energy savings from projects in the years after initiation, these cumulative requirements would generate energy savings equal to a significant percentage of reference utility load. Hawaii is a prime example of this situation. Hawaii's annual requirement of between 195 and 197 GWhs of energy efficiency each year from 2009 to 2030 adds up to a cumulative requirement of 35.2 percent of covered load in 2030.[14]

These measures of stringency indicate the requirements of the policy in physical units, but do not indicate the expenditures associated with encouraging the adoption of efficient appliances and equipment or building retrofits or the economic cost of meeting those requirements. Both of these measures could vary substantially across states. Expenditures by utilities or other responsible parties are of interest in part because they affect electricity rates, which are highly visible politically.[15] Expenditures also play a role in assessments of which energy efficiency measures could be used to achieve the goals of an EERS and pass traditional regulatory cost–benefit tests, as discussed below. Economic costs—measured by the value of what is given up to achieve the energy use reduction goals of the EERS and attain the associated environmental or other benefits—should ideally be a consideration when setting the stringency of the EERS policy. Both economic costs and expenditures may be an increasing function of the energy savings target or the stringency of the policy.

Both expenditures and economic costs will also depend on the flexibility of the EERS policy, which we address further in the next section.[16] In general, flexibility mechanisms enable

[14] This calculation assumes that savings from investments made early in the time horizon persist until the end with no errosion of performance and thus of savings.

[15] Note that EIA (2011) collects data each year from utilties about their expenditures on energy efficiency programs in their Form 861 survey, and the Consortium for Energy Efficiency (2010) collects information from utilities and other entities that administer efficiency programs regarding their expenditures in past years and their budgets in current years for these activities.

[16] We also do not examine compliance to date with these standards, but this issue is addressed by Sciortino et al. (2011). These authors interviewed state officials connected with each of the EERS policies that had been in place for at least two years as of 2010. They collected information on relevant energy savings, as measured by the relevant body in each state, and compared these to their calculations of targets. Of the 17 states that they consider, only six (Vermont, Massachusetts, Minnesota, Maryland, New York, and Pennsylvania) failed to meet their electricity savings goals for 2010 (or, in the case of a couple of states, 2009). The two states that saw the biggest gap between targeted savings and realized savings, Maryland and New York, are among those with the most stringent targets, although the deadlines for meeting those targets are well into the future. Because Sciortino et al. use publicly available measures of energy savings, in many cases these estimates may not be verifiable. They also may be gross savings, as opposed to net savings measures that focus on installations that are clearly the result of an efficiency measure or program rather than savings that would have occurred in the baseline. They also acknowledge that they have not accounted for differences in evaluation methods across the states that could affect savings estimates.

obligated entities to engage in energy efficiency projects when such projects have the least cost or pay other entities with lower costs to implement the reductions.

Flexibility

EERS policies are made more flexible by including a more expansive definition of an energy efficiency resource or by allowing trading of energy efficiency savings across different obligated entities within the state. States generally allow a broad range of end-use efficiency programs to count toward energy efficiency requirements, including home weatherization; light bulb and appliance replacement; improvements in industrial heating, ventilation, and air conditioning systems; and many others. They differ, however, on whether to include combined heat and power (CHP) applications of otherwise wasted heat in electricity generation (or using waste heat from other industrial or commercial processes to generate electricity), reduced transmission/distribution line losses, and generator efficiency upgrades. Table 6 shows which states identify investments in each of these various additional resources as eligible for compliance with the EERS.

Table 6. Additional Eligible Resources for States with EERS

	Elibile Resources		
State	CHP	Transmission / Distribution Savings	Generator Efficiency Savings
Arizona	X		
Arkansas		X	X
California			
Colorado			
Florida		X	X
Hawaii	X		
Iowa	X	X	X
Illinois			
Indiana			
Massachusetts	X	X	X
Maryland	X	X	
Michigan	X		
Minnesota	X	X	X
New Mexico			
New York	X	X	
Ohio		X	
Pennsylvania			
Rhode Island	X		
Vermont	X	X	
Washington			

Another way to introduce flexibility to an EERS is to allow credit trading and banking, features of several European EERS programs that we discuss below. Most states do not allow trading, banking, or borrowing of energy efficiency credits to meet EERS goals. The two exceptions are Michigan and Minnesota.[17] The Michigan EERS allows banking of Energy Optimization Credits. Utilities earn credits from the Michigan Public Service Commission for each MWh of annual incremental energy savings achieved through energy efficiency. If the utility exceeds its savings requirements for a particular year, it can apply its Energy Optimization Credits toward meeting the next year's standard; credits cannot be banked for more than one year and cannot be sold to another utility. The state does not allow credits generated in the past to comprise more than one-third of a future year's compliance. Energy Optimization Credits can also be used to help meet renewable energy goals.[18] Starting in 2013, the state will allow additional flexibility by enabling electric providers to use credits generated from renewable energy production or "advanced cleaner energy," such as plasma arc gasification, to meet up to 10 percent of the energy optimization standard. Similarly, in Minnesota, state law allows a utility or co-op to bank energy savings that exceed the annual savings goal. These electricity providers can carry forward the savings for up to three years. The state increases the banking period for savings accrued from electric utility infrastructure projects, allowing those savings to be carried forward for up to five years.[19]

Measurement and Verification Practices

The objective of an EERS is to reduce energy use below an amount that would have occurred but for its presence. To assess whether or not the policy objective is being achieved, utilities need to identify and measure the energy savings attributed to policies adopted to meet the EERS. Many states have their own standards or protocols, or are in the process of developing standards or protocols, for evaluating, measuring, and verifying the energy savings that obligated entities report. Measurement and verification practices vary substantially state by state, including differences in the legal framework of the programs, the methodologies for evaluations, and the assumptions used in savings calculations (Kushler et al. 2012). The reliability of these

[17] Other studies, such as Loper et al. (2010), include a broader definition of EERS policies, and therefore include additional states with energy efficiency trading or banking programs. The most common is the inclusion of Connecticut, which allows credit trading as part of its Class III RPS program.
[18] Michigan Clean, Renewable and Efficient Energy Act of 2008.
[19] Minnesota Next Generation Energy Act of 2007.

measurements is central to ensuring that obligated entities comply with mandated energy reduction targets and that performance-based incentives and noncompliance penalties are tied to actual savings.[20] Without accurate measurement and verification, exaggerated attributions of savings or inflated estimates of what business-as-usual energy use would have been absent the policy, make an EERS appear more effective than it actually was.

Evaluation, measurement, and verification (EM&V), can be classified into three main types: impact evaluation, process evaluation, and market effects evaluation. Impact evaluations are primarily meant to verify the installation of energy efficiency programs and measure the energy savings attributable to the programs. Process evaluations study the efficacy of efficiency program administration, and market effects evaluations assess how energy efficiency programs influence markets for energy and energy-efficient products.

Our focus is on the first of these. Impact evaluations typically focus on two measures of energy savings: gross energy savings and net energy savings. Gross savings is the amount of energy saved by consumers who participate in an energy efficiency program by, for example, purchasing a subsidized compact fluorescent light bulb. To calculate gross savings, evaluators may undertake engineering analyses of the reduced energy consumed by equipment supported by the program or directly measure energy consumption before and after the implementation of efficiency programs for a sample of participants. Various techniques are employed to control for year-to-year variations in external factors, such as weather. Net savings, on the other hand, is gross savings minus the savings that consumers would have achieved absent the policy.[21] Ideally, net savings also account for rebound effects—that is, increases in demand for energy as a result of a lower cost of energy services following an efficiency upgrade (NMR Group 2010), although the extent to which this effect is accounted for in practice is unclear.

Messenger et al. (2010) finds that states differ significantly in their approaches to translating gross savings into net savings and the resulting *net-to-gross* ratio. First, states vary in

[20] Verifying savings is also important to calculating the carbon dioxide emissions reductions associated with an EERS, which is a common practice in many states.

[21] The difference between the two is what an economist might call the inframarginal savings, and the consumers who would have undertaken energy efficiency investments on their own are often "free riders." Such free riders are likely to be consumers who either are already aware of the financial benefits to them of energy efficiency, or who are willing to make sacrifices to promote the environmental and social benefits from reduced energy use. They are not free riders in the conventional sense of selfishly exploiting the willingness of others to provide for collective benefits; if anything, they are the exact opposite.

what they assume about energy savings in the absence of the program, such as the treatment of savings resulting from evolving state and federal product efficiency standards. In addition, some states consider spillover effects when calculating net savings. Spillover accounts for the impact of an energy efficiency program beyond the impact on direct beneficiaries. For example, if a neighbor of a program participant saw the energy savings from the participant's high-efficiency air conditioner and decided to purchase one not supported by the program, those spillover energy savings could be attributed to the program. The extent to which this is done varies across the states.

States also have different rules about whether to count changes in energy consumption outside the state—the so-called *leakage* that occurs when a portion of incentive products move across state lines. Of the 14 states Messenger et al. reviews, 10 required free-ridership effects to be part of the net savings estimation. In addition, eight states required spillover and/or broader market effects to be considered. California was the only state analyzed that attempted to account for leakage in selected energy efficiency programs. The uncertainties associated with estimating net savings has led some states to question whether a focus exclusively on gross savings might be the most defensible (NMR Group 2010).

States take a variety of different approaches to other aspects of the measurement of energy savings. Many efficiency programs rely heavily on ex ante estimates of savings, based on engineering calculations and assumptions about product use, combined with the verification of installations as the primary approach to assessing program effect. For some types of efficiency measures, utilities use "deemed savings" which are savings calculated based on assumptions about baseline energy use, product lifetimes and future use and applied generally to particular programs or investments. States also produce very different estimates of savings for the same investment. Loper et al. (2010) provide an example of how estimates of lifetime energy savings for compact fluorescent light bulb replacements in a living room differ by a factor of 4 between California (lowest) and Vermont (highest), with several state estimates lying in between. The differences in estimates stem from different assumptions about, for example, bulb lifetimes, hours of operation, free-riders and spillovers and wattage differences.

Ex post estimates of costs and energy savings are generally more accurate, particularly when these savings are evaluated by an independent third party, (Schiller et al. 2011), but they are also more expensive. Ex post assessments that look at actual energy use among participants before and after an energy efficiency intervention and compare these changes to a control group—while controlling for changes in weather, building occupancy, and other relevant factors—is perhaps the only way to capture the effects of a potential rebound in energy use resulting from a particular efficiency measure, but this approach is rarely used. In addition, states invest varying amounts of their EERS budgets in measurement and verification efforts. Messenger et al. (2010) reported that for programs funded by utility customers, measurement and verification comprises between less than 1 percent and 5 percent of program budgets. Interviews of energy efficiency and evaluation experts, administrators, and managers showed that respondents chose how and whether to conduct impact evaluations, process evaluations, or market effects evaluations based largely on the size of their budgets and their beliefs about the uncertainty of existing estimates of program savings and costs. Messenger et al. also find that very few states require an assessment of the uncertainty associated with measuring energy savings, which is particularly important for net savings.

States also differ regarding whether they require evaluations to be conducted by independent entities not responsible for the success of the program. The use of independent evaluators can have a significant effect on the quality of evaluations. Kaufman and Palmer (forthcoming) find that the MWh savings results of third-party evaluations of California energy efficiency programs from 2004 to 2005 were systematically about 30 percent lower than energy savings reported by the program administrators. An important role of third-party evaluators is to confirm whether the reported energy efficiency technologies or upgrades were implemented, whether they met reasonable quality standards, and that the technologies or upgrades were operating correctly and had the potential to generate the predicted savings. In the more recent round of third-party evaluations covering the California utility energy efficiency programs spanning 2006–2009, evaluators confirmed electricity savings that were equal to about 93 percent of the savings reported by utilities to the California Public Utilities Commission (CPUC).[22]

Table 7 summarizes some of the key differences in the sample of states with an EERS. It highlights whether the measurement and verification program is mandated by law or regulation, whether results of ex post efficiency program evaluations are used to adjust deemed savings estimates for completed projects retrospectively or to adjust the deemed savings measures applied to future projects, and whether states are required to report net or gross savings or both.

[22] These calculations include electricity savings achieved in 2006–2009 as a result of prior utility energy efficiency programs, inlcluding pre-2005 efforts to assist in the development of appliance and equipment standards and building codes. The underlying energy savings numbers reflect estimates of net savings for 2006–2008 and gross savings for 2009.

Table 7. State-Level Measurement and Verification Practices

State	Requirement for Evaluation		Adjustments to Deemed Savings Based on Ex Post Evaluations		Reporting Requirements		
	Legislative	Regulatory	Future Efficiency Programs	Past Efficiency Programs	Net Savings	Gross Savings	Both
Arizona		x	x			x	
Arkansas		x	x		x		
California		x	x				x
Colorado		x	x		x		
Florida	x	x	x		x		
Hawaii	x		x		x		
Iowa		x	x			x	
Illinois	x	x	x		x		
Indiana		x					x
Massachussetts	x	x		x			x
Maryland	x	x	x			x	
Michigan	x		x			x	
Minnesota	x		x			x	
New Mexico	x			x	x		
New York		x	x		x		
Ohio		x	x			x	
Pennsylvania	x	x	x			x	
Rhode Island		x	x		x		
Vermont	x	x	x				x
Washington		x	x			x	

Source: Kushler, M., S. Nowak and P. White. 2012. A National Survey of State Policies and Practices for the Evaluation of Ratepayer-Funded Energy Efficiency Programs, Washington, DC: American Council for an Energy-Efficient Economy. U112.

As a result of the state-by-state differences, some regional groups are beginning to work toward standardized EM&V protocols. These groups include the Northeast Energy Efficiency Partnerships (NEEP) Evaluation, Measurement and Verification Forum, the State Energy Efficiency Action Network, ISO New England, and PJM (Schiller et al. 2011). However, many of these efforts at standardization focus more on reporting and transparency about approaches used and thus fall short of establishing a common approach for measuring savings. For example, in December 2010, NEEP released its Common Statewide Energy Efficiency Reporting Guidelines as a model for its member states. The guidelines establish consistent definitions and reporting requirements for energy and demand savings, associated costs, emissions reductions, and jobs impacts. The guidelines would require states to report how they measured and verified energy savings but do not advocate for any specific measurement and verification process (Northeast Energy Efficiency Partnerships 2010). Were the federal government to adopt an EERS, particularly one that allowed interstate trading, it would likely lead to uniform EM&V procedures across the country. However, requiring uniformity in EM&V procedures could make it harder to impose a federal EERS.

Financial Consequences of Noncomplaince

The effectiveness of an EERS policy will likely depend on the consequences of noncompliance for obligated entities. States impose costs for noncompliance in several ways. First, utilities face political pressure to meet public utility commission orders. Utilities interact repeatedly with public utility commissioners, such as for periodic ratemaking hearings. Because of this "repeated game," utilities have an incentive to comply with the public utility commission to maintain good working relationships. Our focus is on explicit financial consequences of noncompliance. This includes the imposition of monetary penalties on obligated entities that fail to reach the minimum energy savings requirements and the use of positive monetary incentives for utilities that meet or exceed EERS standards, which effectively imposes a cost on utilities that fail to meet the standard. Table 8 summarizes the differences among state policies in the use of these two approaches.

Table 8. EERS Penalties and Positive Incentives for Obligated Entities

State	Penalties	Positive Incentives
Arizona		X
Arkansas		X
California	X	X
Colorado		X
Florida	X	X
Hawaii		X
Iowa		
Illinois	X	
Indiana		X
Maryland		
Massachusetts		X
Michigan		X
Minnesota		X
New Mexico		
New York	X	X
Ohio	X	
Pennsylvania	X	
Rhode Island		X
Vermont	*	X
Washington	X	

* Penalty applied to adminstrator, not utilities

Eight states impose a monetary penalty on obligated entities that fail to meet EERS goals. The level of these penalties varies across states, and sometimes within states, depending on the size of the utility. The Illinois Power Agency Act (2007) establishes penalties in years two and three of noncompliance. Large utilities that serve more than 2 million customers are fined $665,000, whereas medium-sized utilities that serve between 100,000 and 2 million customers are fined $335,000. If the utility is still in noncompliance after three years, the Illinois Power Agency will assume control over the utilities' energy efficiency incentive programs and implement a competitive procurement program to raise the money needed to meet the energy efficiency standards.

Thirteen states offer a variety of performance-based incentives to utilities to encourage compliance. These incentives are typically structured as bonuses for utilities that meet or exceed energy savings goals. The CPUC adopted its Risk/Reward Incentive Mechanism in September

2007.[23] For the 2006–2008 time period, the mechanism allowed for performance-based incentives if utilities met, on average, 85 percent or more of the CPUC's savings goals for electricity use, peak electricity demand, and natural gas use savings, with no individual metric falling below 80 percent of CPUC's goal. Reaching this benchmark allowed utilities to earn 9 percent of the Performance Earnings Basis, which is a monetary estimate of the benefits created by the utility's energy savings minus the cost of the utility portfolio. If a utility reached an average of 100 percent of CPUC's goals for electricity use, peak electricity demand, and natural gas use, with no individual metric falling below 95 percent of the goal, the incentive increased to 12 percent of the Performance Earnings Basis. Earnings from these incentives are capped at $450 million for all four IOUs. (CPUC 2010).

The state of Vermont created a hybrid policy that combines penalties and incentives. The nonprofit Vermont Energy Investment Corporation (VEIC) administers the state's EERS through Efficiency Vermont, a ratepayer-funded state energy efficiency utility. Under the terms of its contract, VEIC submits a three-year budget. The Vermont Public Service Board, the state's electricity regulator, withholds a portion of VEIC's budget unless efficiency goals are met (Vermont Public Service Board 2009).[24] For 2009–2011, the Public Service Board agreed to set aside 4.1 percent of Efficiency Vermont's budget, with 60 percent of that money allocated for a performance-based incentive. The total set aside is estimated to be about $4.9 million over the three years, leaving about $2.9 million for a performance-based incentive (Vermont Public Service Board 2011).

Other Regulatory Incentives

Under traditional regulation, the distribution companies that bring electricity to customers collect a positive fee per kilowatt-hour (kWh) used, whereas the cost of distributing an additional kWh is negligible. Such a utility may lack an incentive to inform customers about opportunities to reduce energy use or subsidize more energy-efficient appliances or programs to reduce energy

[23] California PUC decision 07-09-043 created the Risk/Reward Incentive Mechanism on September 20, 2007.

[24] Florida also has a combined penalty-and-incentive EERS scheme for its two major utilities, Florida Power & Light Company and Progress Energy Florida. Because of high projected costs for consumers, the Florida Public Service Commission (FPSC) passed orders in 2011 that allowed both utilities to continue to operate their existing energy efficiency programs instead of switching to an updated plan passed by the FPSC in 2009. As part of those orders, the FPSC ruled that the utilities will receive a performance-based incentive only if they exceed the new goals established in 2009. Penalties will be issued only for failing to achieve projected savings from the utilities' current energy efficiency programs, not the more stringent 2009 standards.

use (Brennan 2010a). On the other hand, distribution utilities that sell electricity as well as distribution to customers will want to supply information or technologies (such as cycling off air conditioners) to discourage use at peak demand periods when wholesale prices exceed retail rates in the absence of real-time pricing.

Although utilities may act to reduce peak uses, the concern that distribution utilities would do too little to reduce electricity use overall has led some to advocate “decoupling” distribution utility revenues from electricity used. Under a decoupling policy, a utility’s revenues from electricity distribution are insulated from variations resulting from sales reductions attributable to savings from energy efficiency programs. Of the 20 states with EERS policies, 10 allow electric utilities to apply for decoupling. Three of the four states with the most stringent EERS policies—Hawaii, Ohio, and New York—all allow decoupling, as do California, Maryland, Massachusetts, Michigan, Minnesota, Vermont, and Washington. Other states, such as Pennsylvania, employ additional regulatory provisions to recover part of the revenues lost as a result of energy efficiency programs. If utilities earn the same revenues regardless of how much electricity they use, they no longer have an incentive to withhold information regarding how to get a given amount of lighting, heating, or cooling with less electricity or to implement subsidies that encourage the adoption of more energy-efficient technologies.

Decoupling is no panacea, as guaranteeing a given amount of revenue regardless of use provides no incentive to promote efficiency; at most, it eliminates any bias in subsidies or information provision. In addition, information regarding energy efficiency is available from numerous public agencies, conservation advocates, and media outlets; utilities have no special advantage in that regard. Finally, eliminating links between revenues and energy supplied could, at least in theory, attenuate the incentives of utilities to prevent outages and to quickly restore power following outages. The main benefit of decoupling is probably not in its direct economic incentives, but rather that it defuses utility opposition to energy efficiency programs by keeping them whole.

Policies in the European Union

EERS policies have also been adopted in a few other countries. In Europe, the United Kingdom, France, and Italy all have EERS policies with penalties for noncompliance; all of these policies allow trading and banking of credits, referred to as *white certificates*.[25] The United Kingdom adopted its white certificates scheme in 2002, followed by Italy in 2005 and France in 2006. Each scheme includes an energy savings obligation, typically defined over a number of years as a specific quantity of cumulative or annual energy savings, which is apportioned to obligated entities (typically retail energy suppliers) in proportion to their share of the household retail energy market (Giraudet et al. 2011b).

Different countries include different types of energy under their EERS programs. In Great Britain and Italy, the scheme originally was limited to electricity and natural gas, whereas in France it included all forms of energy except gasoline.[26] In Great Britain, the obligation is placed solely on retail sales to households, whereas in the other countries all end-use sectors are covered, with the exception, in France, of those sectors included in the E.U. Emissions Trading System for carbon dioxide emissions (Giraudet et al. 2011a). Different countries also set different targets for different reasons. In France, for example, the target is based on a goal of reducing energy intensity by 2 percent per year until 2015, and then by 2.5 percent per year until 2030 (Hamilton 2010).

In all of these countries, the white certificates—the units of trade under these programs—are created when an investment in an energy-efficient technology is made. The determination of the number of white certificates associated with that investment is typically calculated based on deemed savings. Countries differ, however, in the mechanisms for creating the certificates. In Great Britain, only obligated parties are allowed to create white certificates, whereas in Italy and France third parties can make investments that lead to the creation of white certificates. In Italy, savings are credited as they are realized, whereas in the other countries savings are credited up front when the initial investment is made (Pavan 2008). Italy also explicitly allows for savings to come from investment in CHP (Bertoldi and Rezessy 2007).

Further, the total credits awarded for a particular type of investment vary across the three countries as savings are measured over different time horizons and different discount rates are assumed. For example, in Italy, savings for most options are counted only for the first 5 years (8

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[25] Two other countries have policies that are similar to an EERS. The state of New South Wales in Australia allows for the creation of greenhouse gas reduction certificates as the result of investments in energy efficiency; these certificates can be used for compliance with state-level greenhouse gas targets (Crossly 2008). Denmark also has an energy efficiency target that is sometimes described as an obligation, but is more of a voluntary standard (Hamilton 2010).
[26] In 2010, gasoline distributors were added to the schemes in Italy and France.

years for building insulation), but in the other two countries, lifetimes of in excess of 20 years are assumed for investments that last that long (Pavan 2008, Giraudet et al. 2011). Moreover, countries differ in terms of the reference case energy use for particular energy services, such as heating, existing building technologies and assumptions about technological performance.

As a result of these differences, the types of investments that are undertaken to create white certificates have varied substantially across the different countries, with most of the investment being in insulation in Great Britain, heating equipment in France, and lighting in Italy. Part of the reason for the popularity of lighting in the Italian program may be because, in the early years of the Italian program, credits were awarded for merely giving away coupons that offered a discount on compact fluorescent light bulbs or water savers, without any confirmation that the items had actually been purchased (Giraudet et al. 2011a). The United Kingdom has no ex post measurement of savings. Deemed savings measures or engineering model predictions are the main approaches to measuring savings in Italy, where only about 10 percent of the savings are evaluated ex post (Bertoldi and Rezessy 2007).

For reasons related or unrelated to the policy characteristics listed above, all of the programs have exceeded their goals every year in the aggregate, and no penalty payments have been made. The excess energy savings are being banked for future use because the targets are becoming more stringent over time. The amount of credit trading varies across the different countries, with virtually no trading in Great Britain, trading of less than 5 percent of total credits generated in France, and trading of more than 75 percent of the issued credits in Italy. Certificate trading has been limited in the United Kingdom because only obligated parties are allowed to undertake activities that lead to savings. In Italy, trading is essential because the obligated entities are the distribution companies and they rely on others with stronger commercial relationships with end users to supply the credits they need. Currently, white certificates are not traded across country borders. Estimates of the cost per unit of energy saved to obligated parties differ by a factor of two across the countries, whereas estimates of average social cost differ across the countries by a factor of four (Giraudet et al. 2011a).

Implementation Issues

Changes in Energy Costs

In evaluating an EERS, the simple fact that a program reduces energy use will not be enough. In most states, regulators require utilities or other obligated entities to employ one or more cost–benefit tests to evaluate the programs they adopt to achieve the energy savings called for in their EERS. With some variation, five major tests, which were originally proposed in the *California Standard Practice Manual* (California Governor's Office 2001) are used: (a) the *program administrator cost test,* which focuses on the costs of running the program compared with the avoided resource costs of the electricity displaced by the program; (b) the *participant test*, which evaluates net revenue benefits to consumers who participate in utility-sponsored programs by taking advantage of subsidies for various efficiency measures; (c) the *ratepayer impact test*, which measures effects on the utility bills of all customers and not just those who participate in the program; (d) the *total resource cost test*, which measures net costs to ratepayers and utilities; and (e) the *societal cost test*, which expands the total resource cost test to include externality costs.[27]

Although these tests differ significantly, the energy efficiency investments that each certifies as eligible for use in an EERS depends on the avoided resource cost of the electricity that no longer needs to be produced as a result of the program. The eligible set of energy efficiency investments will depend on the price of electricity and thus its generation cost. Exogenous disruptions to fuel supply for generation (storms that take out natural gas pipelines or large transmission lines) or environmental regulations that raise the cost of electricity generation could increase the set of energy efficiency investments that would pass these cost–benefit tests. Alternatively, technology developments that lower the cost of fuel, such as advances in horizontal drilling and the development of natural gas fracking technology, will lower the benefits of avoided energy production and potentially reduce the set of energy efficiency measures that pass these tests.

Changes in fuel costs or electricity supply costs also can affect an EERS policy calculated as a percentage of a denominator that changes over time. Recent innovations that have lowered

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[27] Brennan (2010b) shows that, in part because they fail to focus on marginal conditions, none of these tests incorporates conditions for economic optimality. Moreover, the rationale for subsidizing energy efficiency generally requires that electricity prices be too low, which may be the case at peak periods or because of negative environmental externalities. None of the tests focuses on peak use, and only the societal cost tests incorporate the benefits of reducing environmental harms. The primary underlying principle behind these tests is that consumers are failing to invest in energy efficiency when such investment would benefit them. Using these or any other tests requires that one identify a means of assessing program benefits when the usual information on willingness to pay is presumptively invalid because of consumer choice failures. Some of these tests are more likely to make sense if one presumes that energy efficiency programs increase consumer willingness to pay for energy efficiency because they somehow lead consumers to value benefits they did not previously value. Whether this is the appropriate principle for evaluating these or any other policies in the face of consumer choice failure remains an unsettled question.

the price of natural gas translate into lower electricity prices to customers, particularly in those regions of the country where electricity prices are set in competitive markets. All else being equal, these lower prices will result in higher electricity demand.[28] The lower prices in a given year make fewer energy efficiency programs cost-effective. The lower prices will also, however, increase the quantity by which electricity use needs to be reduced under the EERS in the current and potentially future years, when those reductions are calculated on the basis of a percentage of use in the current year or a rolling average of current or past years.

How these conflicting effects play out depends on electricity price regulation and fuel mix for generation. States in which electricity prices are set by the cost of service regulation may be slow to respond to changes in fuel prices, and these changes will tend to have a smaller effect on the average cost of service prices than on market-determined prices that reflect swings in marginal cost more closely.[29] Electricity price effects will also depend on the mix of fuels and technologies used to supply electricity in each state or region and, in competitive regions, on which fuel is the marginal fuel for producing electricity.

Utility Involvement

A second implementation issue involves having distribution utilities serve as the sole or lead entities in managing, implementing, and in some cases designing programs to meet an EERS. They are attractive candidates, as they already play a large and crucial role in the supply of electricity. The Obama administration's President's Economic Recovery Advisory Board (2009) has viewed utilities as "engines of economic recovery" because of the potential effects of their involvement in energy efficiency. An immediate issue is corporate culture—enterprises that have been created under, motivated by, and subject to in many cases a century of regulation designed to supply energy are now being asked to cut back that output and transform themselves into "energy services" companies (Fox-Penner 2010). However, our focus is on the status of utilities as regulated monopolies and whether they should be involved in energy efficiency at all (Brennan 2011).[30]

[28] In a recent modeling exercise, Burtraw et al. (November 2011) show that changes in natural gas supply forecasts by EIA between 2009 and 2011 resulting from new shale gas supplies led, ceteris paribus, to a roughly 3 percent increase in electricity demand forecasts for the next 20 years.

[29] Fuel adjustment clauses that allow regulated prices to reflect variation in fuel costs may help pass the effects of natural gas price savings on in prices.

[30] Note that in Europe, the obligaed entity under a white certificate program is often the unregulated retail electricity provider and not the regulated local distributor.

A leading development in regulatory economics and policy in the last four decades has been the elimination or reduction of linkages between regulated monopolies and operations in competitive sectors. A leading example was the breakup of AT&T in the 1980s, settling an eight-year-old antitrust case. AT&T was required to divest its regulated local telephone monopolies to keep them out of competitive long-distance and information services markets.[31] The move to open wholesale electricity markets to competition was accompanied by Federal Energy Regulatory Commission Order 888 in 1996 and Order 2000 in 1999 to set rules limiting the ability of competing generators to control operations of and access to regulated monopoly transmission grids (Brennan et al. 2002).

The arguments for keeping regulated monopolies out of competitive markets rest on the premise that corporate affiliations spanning the regulated–unregulated boundary create the ability to exercise the market power that the regulation was intended to control. A regulated firm that owns an unregulated input supplier could charge a price above the competitive level to itself, passing along the higher cost to its captive ratepayers. A second potential tactic is cross-subsidization, in which the regulated firm is able to designate costs of providing unregulated service as incurred on the regulated side, again leading regulated rates to increase and potentially establishing a credible threat of charging predatory prices in the unregulated market (Brennan and Palmer 1994). In electricity, the most important concern has been discrimination: a generator that can operate or control access to a transmission or distribution grid might be able to provide lower-quality or delayed services to its rivals in the generation market. The resulting competitive advantage allows the firm to raise its price for generation, exploiting its control over the monopoly grid to profit from the exercise of market power the regulation would otherwise stem.

A striking facet of energy efficiency is that it seems particularly inviting to free entry by competing entrepreneurs who can offer numerous technological and service design solutions for reducing energy use. The vitality of this entrepreneurial response makes even more pressing the question of why utilities should play a central role in managing energy efficiency. A speculation, applicable at least at the state level in the United States, is that having utilities play a lead role allows state legislatures to propose and endorse energy conservation policies but to shift to state regulatory commissions the responsibility for funding them through electricity rate increases. This allows the legislature to avoid the political fallout from raising general taxes to pay for these

[31] United States v. American Telephone and Telegraph Company, 552 F. Supp. 131 (1982).

programs. The political economy of energy policy also suggests that the motive for decoupling is not so much to improve economic efficiency as it is to reduce or eliminate utility opposition to conservation programs (Brennan 2010a).

Though having utilities play a lead role in energy efficiency policy raises questions of economic efficiency and political accountability, it may yet have some advantages. If electricity use is itself undesirable, which would be the most appropriate rationale for an EERS, raising electricity prices may be a step in the right direction, so political convenience and economic efficiency may go hand-in-hand. One may be able to design EERS programs in which the utility provides the funds, but disperses them through arms-length peer-reviewed competitions that minimize the chance for abuses. In addition—at least if one is not using market-based instruments such as taxes or permit programs to meet an EERS or to address its underlying rationales, particularly mitigating pollution—some public or publicly-designated agency will be in charge of managing these programs, as is the case in several states. In doing so, one needs to recognize that public management may bring its own failures (Wolf 1993).

Conclusions

EERS policies have been adopted in 20 U.S. states and in three European countries. They can take numerous forms, varying by which energy sources they include, whether targeted reductions are specific amounts or a percentage of use in a specific past year or change over time, and whether the targeted reductions have to be achieved in the last year of the EERS or accumulated over the lifetime of the EERS. In general, we find these policies to be very stringent, with an average required reduction of 12.7 percent of covered load and 11.5 percent of total state load. Only two states allow credit banking, but several allow energy savings resulting from investments to reduce transmission and distribution losses, CHP systems, and other improvements in generation efficiency to qualify for EERS credits. Most states have an explicit or implicit penalty for noncompliance with savings targets, although measuring energy savings typically is a matter of verifying installations and using engineering methods to assign savings instead of a true empirically based comparison of energy use before and after a measure has been installed. Such measures need to account for the possibilities that some energy users would have made energy efficiency investments absent the EERS-supported programs and that, following such investments, consumers may increase their use of more efficient equipment, reducing the actual energy savings.

An EERS policy, which is typically one of a suite of policies affecting the electricity sector, may interact with other policies. Depending on how the EERS policy is specified, changes in fuel supplies, such as the recent increase in natural gas production associated with the exploitation of shale deposits, could have important consequences for EERS stringency and ease of compliance that may work at cross purposes, particularly when only "cost-effective" energy efficiency programs qualify for meeting EERS goals. Having utilities serve as the main provider of energy efficiency results in potentially efficiency-enhancing increases in electricity prices but may also unduly limit innovation and other benefits that could result from greater competition in the supply of efficiency-enhancing investments. Our hope is that describing EERS programs and examining these issues will be useful as policymakers in other states, the U.S government, and countries around the world consider whether and how to include an EERS in their portfolios of energy policies.

References

Arimura, T., S. Li, R. Newell and K. Palmer. 2011. Cost-Effectiveness of Electricity Energy Efficiency Programs, RFF DP 09-48. Washington, DC: Resources for the Future.

Bertoldi, P. and S. Rezessy. 2007. Assessment of White Certificate Schemes and their Energy Savings Evaluation Methods. International Energy Program Evaluation Conference. 2007, Chicago, IL.

Brennan, T. 2010a. Decoupling in Electric Utilities. *Journal of Regulatory Economics* 38: 49-69.

Brennan, T. 2010b. Optimal Energy Efficiency Policies and Regulatory Demand Side Management: How Well Do They Match? *Energy Policy* 38: 3874-3885.

Brennan, T. 2011. Energy Efficiency Policy: Surveying the Puzzles, RFF DP 11-27. Washington, DC: Resources for the Future.

Brennan, T. and K. Palmer. 1994. Comparing the Costs and Benefits of Diversification by Regulated Firms. *Journal of Regulatory Economics* 6: 115-136.

Brennan, T. and K. Palmer. 2012. Energy Efficiency Resource Standards: Economics and Policy, RFF DP 12-10. Washington, DC: Resources for the Future.

Brennan, T., K. Palmer and S. Martinez. 2002. *Alternating Currents: Electricity Markets and Public Policy*. Washington, DC, RFF Press.

Burtraw, D., K. Palmer, A. Paul and M. Woerman. November 2011. Electricity System Reliability: Environmental Regulation and Secular Trends. Association for Public Policy Analysis and Management conference. Washington, DC.

California Governor's Office of Planning and Research. 2001. California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Policies. Sacramento, CA.

CPUC (California Public Utilities Commission). 2010. 2006-2008 Energy Division Scenario Analysis Report.

Crossly, D. 2008. Tradable Energy Efficiency Certificates in Australia. *Energy Efficiency* 1: 267-281.

Consortium for Energy Efficiency. 2010. State of the Efficiency Program Industry: 2009 Expenditures, Impacts & 2010 Budgets.

Farugui, A. and D. Mitarotonda. 2011. Energy Efficiency and Depand Response in 2020 - A Survey of Expert Opinion. *The Brattle Group*

Fox-Penner, P. 2010. *Smart Power: Climate Change, the Smart Grid and the Future of Electric Utilities*. Washington, DC, Island Press.

Giraudet, L.-G., L. Bordineau and D. Finon. 2011a. The Costs and Benefits of White Certificate Schemes. *Energy Efficiency*, Published Online.

Giraudet, L.-G., L. Bordineau and D. Finon. 2011b. White Certificate Schemes: The Static and Dynamic Efficiency of a Multifunctional Policy Instrument, Working Paper. Nogent-sur-Marne, France: Centre international de recherché sur l'environement et le developpement (CIRED).

Hamilton, B. 2010. A Comparison of Energy Efficiency Programs for Existing Homes in Eleven Countries, A report by the Regulatory Assistance Project prepared for the Department of Energy and Climate Change of the United Kingdom.

Illinois General Assembly. 2007. Illinois Power Agency Act, 20 ILCS 5/8-103.

Kaufman, N. and K. Palmer. Energy Efficiency Program Evaluations: Opportunities for Learning and Inputs to Incentive Mechanisms. *Energy Efficiency*, forthcoming.

Kushler, M., S. Nowak and P. White. 2012. A National Survey of State Policies and Practices for the Evaluation of Ratepayer-Funded Energy Efficiency Programs, Washington, DC: American Council for an Energy-Efficient Economy. U112.

Loper, J., S. Capanna, R. Sobin and T. Simchak. 2010. Energy Savings Credits: Are Potential Benefits Being Realized, Alliance to Save Energy.

MEA (Maryland Energy Administration). 2008. Maryland Strategic Electricity Plan. Annapolis, MD.

Messenger, M., R. Bharvirkar, B. Golemboski, C. A. Goldman and S. R. Schiller. 2010. Review of Evaluation, Measurement and Verification Approaches Used to Estimate the Load Impacts and Effectiveness of Energy Efficiency Programs, Lawrence Berkeley National Laboratory Report LBNL-3277E.

Nadel, S. 2006. Energy Efficiency Resource Standards: Experience and Recommendations, American Council for an Energy-Efficient Economy. ACEEE Report E063.

NMR Group Inc. 2010. Net Savings Scoping Paper, report submitted to Northeast Energy Efficiency Partnership: Evaluation, Measurement and Verification Forum.

Northeast Energy Efficiency Partnerships. 2010. Common Statewide Energy Efficiency Reporting Guidelines. Version 1.0.

Pavan, M. 2008. Tradable Energy Efficiency Certificates: The Italian Experience. *Energy Efficiency* 1: 257-266.

Schiller, S. R., C. Goldman and E. Galawish. 2011. National Energy Efficiency Evaluation, Measurement and Verification (EM&V) Standard: Scoping Study of Issues and Implementation Requirements, Lawrence Berkeley National Laboratory. LBNL-4265E.

Sciortino, M., S. Nowak, P. White, D. York and M. Kushler. 2011. Energy Efficiency Resource Standards: A Progress Report on State Experience, American Council for an Energy Efficient Economy. Report Number U112.

U.S. Census Bureau. 2004. State Interim Population Projections by Age and Sex: 2004-2030. http://www.census.gov/population/www/projections/projectionsagesex.html.

U.S. Energy Information Administration. 2011. Electric Power Annual 2009.

Vermont Public Service Board. 2009. Order Approving Change in EEU Structure and Scheduling Status Conference.

Vermont Public Service Board. 2011. Energy Efficiency Utility Electic Budgets for Demand Resources Plan.

Wolf, C. 1993. *Markets or Government: Choosing between Imperfect Alternatives*. Cambridge, MA, MIT Press.

Appendix A. EERS Stringency Calculation Method

This appendix describes the method employed to calculate the stringency of each state's EERS by converting the policy's requirements into cumulative quantity reductions, or physical units of energy savings in a particular year from all programs implemented up through that year. This method was used to produce the tables shown in the report. It can further be used to calculate the stringency of each EERS in each year in which it applies, both historically and in the future. Such a calculation would enable researchers to calculate total energy use reductions required by the EERS, a more complete measure of the stringency of the policy.

Data

We use historical electricity deliveries by retail electricity provider from EIA Form 861 (http://www.eia.gov/cneaf/electricity/page/eia861.html) for 1999–2009, and aggregate these data by state and utility type. These data are referred to as the observed sales. We develop a forecast of future electricity consumption in the absence of energy efficiency policies by assuming a 0.9 percent annual increase in electricity consumption in each state. This projection is referred to as the forecasted sales. For Maryland, the one state that denominates its policy in energy use per capita, we used population growth projections from the U.S. census (http://www.census.gov/population/www/projections/projectionsagesex.html).

Calculating Stringency

As mentioned above, we seek to convert the requirements of each policy, whether initially specified in annual quantity, cumulative quantity, annual percent, or cumulative percent reductions, into cumulative quantity reductions, enabling comparison across the policies. Cumulative quantity policies are already denominated in physical units per year and thus require no further conversion. Annual quantity policies are converted to cumulative quantities by adding up the required energy savings in each year prior to the compliance year, on the assumption described previously that all energy efficiency programs are required at the same level of energy use reductions each year after they are implemented.

Cumulative percent policies are converted to cumulative quantity policies by multiplying the percent reduction by the relevant basis. The relevant basis is a more complex function of observed sales, forecasted sales, and required energy efficiency in previous years, population, the basis year for fixed basis policies, and the rolling period for rolling basis policies. The formula for the basis varies depending on the type and units of each basis. Annual percent policies are converted to cumulative quantity policies by first multiplying the annual percent by the relevant basis and then adding up the required energy savings in each year prior to the compliance year.

Examples

A few examples should help clarify the set of calculations. Arizona denominates its policy as a cumulative percent reduction in energy use with a one year rolling basis. In other words, Arizona requires covered utilities to achieve energy efficiency equal to a certain percent of the previous year's energy use from all programs implemented up to that year. Arizona's policy covers all utilities except those specifically excluded, namely utilities with less than $5,000,000 in annual revenue and co-op utilities with less than 25 percent of customers in Arizona. These exclusions cover less than 1 percent of Arizona's load. We convert Arizona's required reductions into cumulative quantity reductions by multiplying the cumulative percent reduction by the relevant basis in each year.

A similar, but slightly different policy is found in Illinois. Illinois denominates its policy as an annual percent reduction in energy use with a one year rolling basis. In other words, Illinois requires covered utilities to achieve energy efficiency equal to a certain percent of the previous year's energy use from only programs implemented in the compliance year. Illinois's policy covers only IOUs and excludes IOU's with less than 100,000 customers in Illinois, resulting in the policy covering approximately 89 percent of state load. We covert Illinois's required reductions into cumulative quantity reductions by multiplying the annual percent reductions by the relevant basis in each year and summing the required reductions over all previous years.

Arkansas presents a similar policy to Illinois with a different basis. Arkansas denominates its policy as an annual percent reduction in energy use with a fixed basis in 2010. In other words, Arkansas requires covered utilities to achieve energy efficiency equal to a certain percent of 2010 energy use from only programs implemented in the compliance year. Arkansas's policy covers only IOUs, resulting in the policy covering only approximately 61 percent of state load. We convert Arkansas's required reductions into cumulative quantity reductions by multiplying the annual percent reductions by the relevant basis in each year and summing the required reductions over all previous years.

A more dissimilar policy is provided by Maryland. Maryland denominates its policy as a cumulative percent reduction in per-capita energy use with a fixed basis in 2007. In other words, Maryland requires covered utilities to achieve energy efficiency equal to a certain percent of 2007 per-capita energy use from all programs implemented up to that year. Maryland's policy covers all utilities and thus 100 percent of state load. We convert Maryland's required reductions into cumulative quantity reductions by multiplying the cumulative percent reduction by the relevant basis in each year.

Challenges for Future Calculations

We were able to perform the above calculations for electricity use under EERS policies because historical data on electricity use by utility and by state are readily available. Performing a similar calculation for electricity peak demand and natural gas policies would require finding similar data for those sectors; this, most likely, would pose no small challenge, especially for electricity peak demand.

Algorithm

The notation below represents the mathematical algorithm we used to calculate the stringency of the different state EERS policies at particular points in time. After defining the notation, we show that cumulative quantity reductions can be calculated given what we know about the policy design, what we observe about the past, and what we assume about future electricity demand growth (and, in the case of Maryland, population growth) in the absence of the policy.

i = state

t = year

$x_{i,t}$ = Energy efficiency (EE) required in cumulative quantity

$z_{i,t}^{T}$ = total observed energy sales

$z_{i,t}^{C}$ = observed energy sales covered by the EERS

$\beta_{i,t}$ = EE required in the units denominated in the EERS

$s_{i,t}^{C}$ = population served by utilities covered by the EERS

α = annual percent increase in electricity sales = 0.9%

$$y_{i,t}^{T} = \begin{cases} z_{i,t}^{T} \;\; if \;\; t \le 2009 \\ z_{i,2009}^{T}(1+\alpha)^{t-2009} \;\; if \;\; t > 2009 \end{cases}$$

$$y_{i,t}^{C} = \begin{cases} z_{i,t}^{C} \;\; if \;\; t \le 2009 \\ z_{i,2009}^{C}(1+\alpha)^{t-2009} \;\; if \;\; t > 2009 \end{cases}$$

A_i = denomination of type of EERS requirement

$$A_i = \begin{cases} 0 \text{ if policy denominated as cumulative} \\ 1 \text{ if policy denominated as annual} \end{cases}$$

B_i = demoniation of units of EERS requirement

$$B_i = \begin{cases} 0 \text{ if policy denominated as quantity} \\ 1 \text{ if policy denominated as percentage} \end{cases}$$

C_i = type of basis of EERS requirement

$$C_i = \begin{cases} 1 \text{ if basis is rolling (only when } B_i = 1) \\ 2 \text{ if basis is fixed (only when } B_i = 1) \\ 3 \text{ if no basis (only when } B_i = 0) \end{cases}$$

γ_i = year of fixed basis, if $B_i = 1$

λ_i = length (years) of averaging period for rolling basis, if $B_i = 2$

D_i = units of basis of EERS requirement

$$D_i = \begin{cases} 1 \text{ if policy measured in energy sales} \\ 2 \text{ if policy measured in per-capita energy sales} \end{cases}$$

$$x_{i,t} = \beta_{i,t} * G(C_i, D_i)^{B_i} - A_i * x_{i,t-1}$$

$$r_{i,t} = \begin{cases} y_{i,t}^c \text{ if } t \leq 2009 \\ y_{i,t}^c - x_{i,t} \text{ if } t > 2009 \end{cases}$$

$$G(C_i, D_i) = \begin{cases} (1/\lambda_i) \sum_{j=t-\lambda_i-1}^{t-1} r_{i,j} & \text{if } C_i = 1, D_i = 1 \\ r_{i,\gamma_i} & \text{if } C_i = 2, D_i = 1 \\ r_{i,\gamma_i} * s_{i,t}^c / s_{i,\gamma_i}^c & \text{if } C_i = 2, D_i = 2 \end{cases}$$

Appendix B. Comparison to Sciortino et al (2011)

The conversion in this paper enables a comparison to the other major study that has calculated standardized EERS stringency, Sciortino et al (2011). In their study, under the auspices of the American Council for an Energy Efficient Economy (ACEEE), Sciortino et al calculate the cumulative percent reductions required by each EERS in 2020. We assume that the reductions in Sciortino et al (2011) are a percent of covered electricity use. In Table B1, we compare our calculated percent reductions relative to covered electricity use in 2020. To enable this comparison, we had to extrapolate the current policies to future years; the details of that extrapolation are described below.

Table B1. Comparison of Percent Requirements with ACEEE

	Percent Requirement		
State	**Standarized**	**ACEEE 2011**	**Difference**
Arizona	18.2%	22.0%	-3.8%
Arkansas	6.2%	6.8%	-0.6%
California	16.2%	12.9%	3.3%
Colorado	14.9%	14.9%	0.0%
Florida	4.1%	4.1%	0.0%
Hawaii	21.0%	18.0%	3.0%
Iowa	13.4%	16.1%	-2.7%
Illinois	16.1%	18.0%	-1.9%
Indiana	12.6%	13.8%	-1.2%
Maryland	26.9%	26.7%	0.2%
Massachusetts	22.3%	26.1%	-3.8%
Michigan	9.6%	10.6%	-1.0%
Minnesota	14.7%	16.5%	-1.8%
New Mexico	8.7%	8.1%	0.6%
New York	27.3%	26.5%	0.8%
Ohio	11.1%	12.1%	-1.0%
Pennsylvania	8.2%	10.0%	-1.8%
Rhode Island	23.0%	25.3%	-2.3%
Vermont	25.3%	27.0%	-1.7%

In order to develop this comparison, we needed to project the requirements for a number of states out to 2020. In general, we attempted to develop projections that followed the previously existing pattern of required savings. Specifically, we assumed that all states with annual percent or quantity requirements would require the same annual reduction in every year after the last year defined in the policy. For states with cumulative reduction requirements, we assumed that the cumulative requirements would continue to increase at the same rate as they had in previous years.

The table shows that the differences in the projections of the two studies are significant, but not huge and not systematically in one direction or the other. The precise causes of these differences are unclear, but likely culprits include different methodology for projecting required savings out to 2020 and different baselines for covered load in future years.

Appendix C. Method for Assessing EERS Policy Features

We researched key policy characteristics of state-level EERS by reviewing state laws and utility commission orders and by interviewing state program administrators. Policy characteristics include: eligible resources; trading, banking, and borrowing; measurement and verification protocols; and penalties and/or incentives. For example, we determined whether an EERS allows CHP, transmission/distribution savings, or generator efficiency savings to be used for compliance. In reviewing the documents, we labeled an EERS as including the resource if we found an explicit mention of that resource being usable for compliance. In the case where we did not find explicit mention of the eligible resources in the documents, but a program administrator stated that the resource was eligible, we labeled the resource as eligible. Similarly, we only labeled a state as having penalties and/or incentives or as having trading, banking, or borrowing schemes if we could locate specific language confirming these policy attributes or if a program administrator confirmed that these actions were allowed. Finally, we reviewed state-level measurement and verification protocols, focusing on states that have created their own protocols, such as California and Minnesota.

Appendix D. Sources for the EERS Database

The database of EERS policies used to produce the analysis for this paper is based on a wide variety of sources. The most heavily used sources were the Database of State Incentives for Renewables & Efficiency, managed by North Carolina State University, and the State Energy Efficiency Policy Database, created by the American Council for an Energy-Efficient Economy. We are very grateful to these organizations for their work in gathering the necessary information.

We also collected information from a wide variety of primary source documents, including documents from the National Renewable Energy Laboratory, Center for Climate and Energy Solutions (formerly the Pew Center on Global Climate Change), Northwest Power and Conservation Council, Arizona Corporations Commission, Arkansas Public Service

Commission, California Public Utilities Commission, State of Colorado, Colorado Public Utilities Commission, State of Connecticut, Connecticut Public Utilities Regulatory Authority, State of Delaware, State of Florida, Florida Public Service Commission, State of Hawaii, Hawaii Public Utilities Commission, State of Illinois, Illinois Commerce Commission, Indiana Utility Regulatory Commission, Iowa Legislature, Iowa Utilities Board, State of Maine, Efficiency Maine Trust, State of Maryland, Maryland Energy Administration, State of Massachusetts, Massachusetts Department of Public Utilities, State of Michigan, Michigan Public Service Commission, State of Minnesota, Minnesota Division of Energy Resources, Minnesota Public Utilities Commission, State of New Jersey, New Jersey Board of Public Utilities, State of New Mexico, New York Department of Public Service, New York Public Service Commission, State of Ohio, Energy Trust Oregon, State of Pennsylvania, Pennsylvania Public Utilities Commission, Rhode Island Public Utilities Commission, State of Texas, Texas Public Utilities Commission, State of Utah, State of Vermont, Efficiency Vermont, Vermont Public Service Board, Virginia State Corporation Commission, State of Washington, Washington Utilities and Transportation Commission, State of Wisconsin, and Wisconsin Public Service Commission.

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