ENERGY EFFICIENCY COST CONSIDERATIONS FOR STATE COMPLIANCE PLANS

Barriers and Solutions: Strategies for Effectively Leveraging Energy Efficiency as an Environmental Compliance Tool

SEEA
SOUTHEAST ENERGY EFFICIENCY ALLIANCE

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About This Resource Paper Series

Energy efficiency is widely recognized as a cost-effective, rapidly-deployable resource for air pollution reductions from the electric sector. However, with the release of the U.S. Environmental Protection Agency's (EPA) proposed Clean Power Plan (CPP) in June 2014, southeastern states and utilities have voiced concerns regarding a number of barriers and challenges to using energy efficiency as a pollution control strategy within state compliance plans, both under existing air programs and forthcoming regulations, such as the CPP, once finalized (expected in August 2015). This SEEA Resource Paper Series identifies resources, strategies and solutions to help states and utilities address these barriers and effectively utilize energy efficiency as a compliance strategy, where appropriate and cost-effective.

Disclaimer

SEEA recognizes that the EPA is finalizing the CPP; many unknowns exist until the final guidelines are released. The materials provided on the SEEA 111(d) web portal, along with the resources and discussion contained in this Resource Paper are provided for informational purposes only, and do not constitute legal advice. Contact your attorney for advice with respect to any particular legal issue.

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I. Executive Summary

Since the publication of EPA's draft Clean Power Plan (CPP), a healthy dialogue has emerged on strategies for meeting compliance obligations at least cost. Often, energy efficiency is a part of these conversations as a potential pathway for minimizing costs.

Understanding costs and cost-effectiveness, as well as the value and shortcomings of different methods for characterizing it, is critical to designing policy that maximizes low-cost resources in state compliance plans. This paper provides a starting point for conversations on the costs of energy efficiency within the context of state strategies for complying with EPA's proposed CPP.

A. Tools for Evaluating Energy Efficiency Costs

The **levelized cost of energy (LCOE)** is the benchmark metric used by utilities to measure the cost of alternative sources of electricity generation on a comparable basis. In other words, it represents an "apples to apples" metric to compare electricity resources against one another, and provides a convenient summary measure of the overall competitiveness of different generating technologies.

A comparable metric for end-use energy efficiency–useful for comparing the relative costs of efficiency programs and for comparing an energy efficiency option to other demand and supply choices for serving energy needs—is the **"cost of saved energy"** or **"levelized cost of saved energy" (LCSE)** taken from a utility or program administrator perspective. Another frequently cited metric in evaluating the costs of energy efficiency is **"first year acquisition cost."** Essentially, this metric assesses the cost of acquiring a single year of annualized incremental energy savings.

In simple terms, ratepayer-funded **energy efficiency cost-effectiveness** is measured by comparing the benefits of an investment with its costs. This tool, unlike LCOE, LCSE and acquisition costs, uses utility-specific costs to determine if energy efficiency is the lowest cost resource for that utility in their jurisdiction. A robust benefit-cost measurement framework has developed over time, based largely on a number of "tests" established in the California Standard Practice Manual. Each cost-effectiveness test provides a different lens by which a regulator can better understand the impacts of energy efficiency.

Adding further complexity to conversations surrounding the costs of energy efficiency-driven compliance strategies, given the range of energy efficiency compliance opportunities available to states, there is no defined cost for implementing energy efficiency, but rather, a spectrum of costs. In addition, specific assumptions that impact the results of cost measurements may vary.

B. Empirical Measurements of Energy Efficiency Costs

In recent years, several national analyses of energy efficiency costs have been conducted to evaluate where the industry stands, as well as how energy efficiency measures stand up against traditional supply-side resources.

In 2014, Lawrence Berkeley National Laboratory conducted an extensive analysis of energy efficiency costs from programs administered in 31 states from 2009 to 2011. This analysis revealed a national average program administrator cost of saved energy of 2.1 cents/kWh (2012 dollars, gross savings). Also in 2014, the American Council for an Energy-Efficient Economy released a study analyzing programs from 2009 to 2012 in 20 states, and arrived at a similar value of 2.8 cents/kWh (2011 dollars, net savings). In general, national analyses have found little evidence to support the escalation of program costs over time.

In general, southeastern experience has reflected national trends, and in many cases, southeastern utilities have saved energy at a lower cost than their national peers. In general, most southeastern states have begun ramp up of energy efficiency programming in recent years, meaning that there is less information on longer-term program performance; however, at a high level, it appears that southeastern utilities are saving energy at an equal or lesser cost than their national peers. The results of a high-level analysis conducted by SEEA show that, of a sampling of select southeastern utilities, program administrator costs of saved energy fell between 1 and 4 cents/kWh (2011 dollars, net savings), with most in the 1 to 3 cent range.

C. Conclusions

Understanding costs and cost-effectiveness, as well as the value and shortcomings of different methods for characterizing them, is critical to designing policy that maximizes low cost resources in state compliance plans. Given the spectrum of approaches for evaluating energy efficiency costs, as well as the context and assumptions that often accompany them, states must carefully consider the implications of each approach, and how it informs policy choices.

II. Introduction

Since the publication of EPA's draft Clean Power Plan (CPP), a healthy dialogue has emerged on strategies for meeting compliance obligations at least cost.[1] Often, energy efficiency is a part of these conversations as a potential pathway for minimizing costs.

Southeastern stakeholders directly and indirectly impacted by the proposed rule have voiced a variety of preferences and concerns around both the cost of implementing the rule and the characterization of energy efficiency costs used in determining the best system of emission reduction (BSER). SEEA's survey of southeastern comments uncovered the following key themes regarding the costs of energy efficiency within a compliance framework:[2]

- Recognition of unique cost-effectiveness frameworks in place in states;
- Concern regarding the extrapolation of the amount of cost-effective savings from one state to another; and
- Critiques of EPA's annualized cost figures and assumed escalation rate.

A. This Paper Provides a Starting Point for Conversations on the Costs of Energy Efficiency Within a Compliance Framework

The purpose of the paper is to assist states in understanding the various methods used to quantify the costs and cost-effectiveness of energy efficiency measures that might be evaluated for inclusion in state compliance plans under the final CPP. Understanding cost and cost-effectiveness, as well as the value and shortcomings of different methods for characterizing it, is critical to designing policy that maximizes low-cost resources in state compliance plans.

After explaining the most commonly used tools to evaluate the benefits and costs of energy efficiency, this paper will provide specific examples of southeastern utility results from using these tools to provide context to the reader. Finally, this paper will offer conclusions and takeaways that may be useful to states assessing cost considerations for compliance with the proposed CPP.

III. Tools to Evaluate Energy Efficiency Costs

A. Energy Efficiency Costs Are Assessed in a Variety of Ways

There are a variety of approaches commonly used for evaluating the impacts of energy efficiency costs and cost-effectiveness. Different measurements may be appropriate in different contexts, and this paper seeks to provide information on a range of approaches, as well as the advantages and disadvantages of each. Below, the four most commonly used tools for evaluating the cost and cost-effectiveness or energy efficiency are explained: levelized cost of energy, levelized cost of saved energy, acquisition cost and cost-effectiveness tests.

Table 1. The Role of Cost Assessment Tools in EPA's Proposed Clean Power Plan

Assessment Tool	Description	Discussed in CPP?	Output
Levelized Cost of Energy (LCOE)	Annual levelized cost	No	$/kWh over lifetime of measure
Levelized Cost of Saved Energy (LCSE)	Annual levelized cost	No	$/kWh over lifetime of measure
Acquisition Cost	"Overnight" cost of one year of energy efficiency savings	Yes	$/kWh in first year of measure
Cost-effectiveness Tests	Five standard tests used to evaluate if a measure is cost-effective for a specific utility	Yes	Cost-benefit score

1. Levelized Cost of Energy

The levelized cost of electricity (LCOE) is the benchmark metric used by utilities to measure the cost of alternative sources of electricity generation on a comparable basis.[3] In other words, it represents an "apples to apples" metric to compare electricity resources against one another, and provides a convenient summary measure of the overall competiveness of different generating technologies. More recently, it has also gained credibility as a measure of the cost of energy efficiency (see the following section). By approaching energy efficiency and supply-side technologies similarly, LCOE allows utility planners to comprehensively evaluate their resource options.

LCOE represents the per-kilowatt-hour cost of resource options over an assumed financial life and activity level.[4] LCOE is calculated by dividing the present value of the resource costs over the life of the facility or program by the discounted quantity of total electricity generated or saved. Analysts generally follow the methodology described by the National Renewable Energy Laboratory (NREL) and the Electric Power Research Institute.[5] For electricity generation, costs typically include:

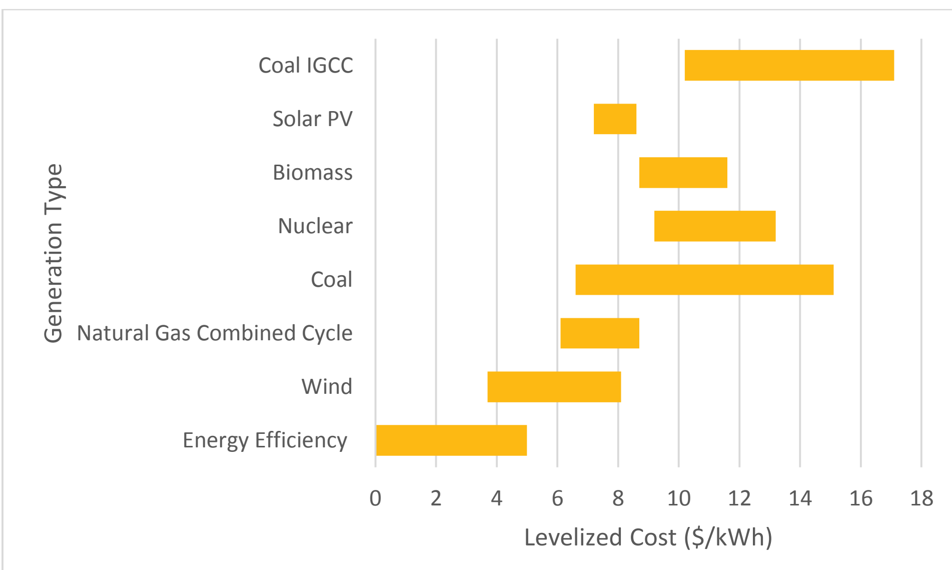
- Generating equipment, its installation and its operation and maintenance;
- Fuel and costs associated with any environmental requirements; and
- The cost of connecting to the transmission system, and the cost of capital.

For energy-efficiency programs, costs include:

- Any financial incentives such as subsidies and low-interest loans, which is sometime estimated as the “energy-efficiency premium;” in other words, the cost of the added increment of energy efficiency;[6]
- The costs of providing information and technical assistance or promulgating the regulation;
- Program administration costs; and
- The cost of capital.

Since 2008, Lazard has published an annual levelized cost analysis of various generation resources. The results for the most recent analysis are provided below, demonstrated that, on a levelized basis, energy efficiency is significantly less costly than the other generation resources analyzed.[7]

Figure 1. Unsubsidized Levelized Cost of Energy Comparison



Adapted from Lazard 2014.

As noted previously, LCOE is a useful metric for "comparing apples to apples;" however, from a policy perspective, it is important to note that resource options may have inherent differences in their overall value and role within the power system, based on site-specific and regulatory factors. In addition, levelized cost figures assume that generation resources can be brought online essentially overnight, and may not account for financing costs. In some states, the levelized cost of electricity savings is compared to wholesale electricity costs, while in others the value of energy efficiency is compared to retail electricity costs. Comparisons of current levelized costs for new electricity resource options provide useful context, but typically do not consider all factors related to cost-effectiveness. For example, the benefits to all customers from energy efficiency programs through avoided transmission and distribution (T&D) costs, peak demand reduction benefits, and reduced pollution may not be considered. Additionally, energy efficiency programs tend to result in reinvestment of local dollars in local jobs and industries, a benefit that is typically excluded from LCOE calculations. While LCOE assumes a future trajectory of energy costs, which can be avoided by improving energy efficiency, it usually does not include the cost of future price fluctuations.

As shown in the table above, energy efficiency has one of the lowest LCOE of any resource evaluated by Lazard, with a cost range of $0/MWh to $50/MWh; or $0.00/kWh to $0.05/kWh.

2. Levelized Cost of Saved Energy

A comparable metric for end-use energy efficiency–useful for comparing the relative costs of efficiency programs and for comparing an energy efficiency option to other demand and supply choices for serving energy needs—is the "cost of saved energy" or "levelized cost of saved energy" (LCSE) taken from a utility or program administrator perspective.[8] National reports that evaluate the LCSE estimate that energy efficiency costs somewhere between $0.02 and $0.03/kWh.[9] The primary difference between LCOE and LCSE is that the costs are measured at the implementation level, accounting for the cost of creating and designing a program. This paper specifically focuses on the LCSE.

The LCSE measures the monetized value of energy efficiency, but it is not a cost-benefit measure and therefore is not a direct test of cost-effectiveness. Standard cost-benefit tests are covered in detail in a later section, and are useful in providing greater context for the overall net impacts of energy efficiency programs.

LCSE is generally evaluated from the utility or program administrator perspective, which is due in part to limited data availability; however, it is also a useful metric for comparing the relative costs of efficiency programs against one another, and for comparing an energy efficiency option to other demand and supply choices for serving energy needs. Program administrator costs include administrative, education, marketing, outreach and evaluation, measurement and verification (EM&V) costs, in addition to financial incentives paid to customers or contractors.[10]

3. Acquisition Cost

Another frequently cited metric in evaluating the costs of energy efficiency is "first year acquisition cost." Essentially, this metric assesses the cost of acquiring a single year of annualized incremental energy savings.[11] This value is inclusive of the full costs, including administration, incentive payments, marketing and other expenses incurred by a program administrator in a given year resulting in measures that were put in place that year, but does not take into account the savings that occur from the efficiency measure over time. While this metric is more focused on short-term considerations than the LCSE, it may be useful for program design or budgeting to meet incremental annual savings targets.

In its calculation of the BSER, EPA assumes a national average program acquisition cost of $0.275/kWh (in 2011 dollars, net kWh at the meter), a figure that is higher than those calculated in national cost analyses. A number of the stakeholder comments SEEA surveyed from energy efficiency trade associations and NGOs specifically highlighted this concern for EPA. Specifically, LBNL and ACEEE both published studies in 2014 that defined this metric; LBNL found an average acquisition cost of $0.163 (2012$, while ACEEE found an average acquisition cost of $0.23 (2011$).[12]

4. Cost-Effectiveness Testing

In simple terms, ratepayer-funded energy efficiency cost-effectiveness is measured by comparing the benefits of an investment with the costs. This tool, unlike LCOE, LCSE and acquisition costs, uses utility-specific costs to determine if energy efficiency is the lowest cost resource for that utility in their jurisdiction. States enact energy efficiency programs to meet a number of policy objectives beyond least-cost resource acquisition, many of which are not directly reflected in levelized cost analyses. These may include reducing customer electricity bills, lowering costs of meeting electricity supply needs, supporting improved public health and catalyzing local economic development and job creation.[13] States may want to consider such additional benefits in their evaluation of compliance options under the final CPP.

Each cost-effectiveness test provides a different lens by which a regulator can better understand the impacts of energy efficiency. A robust benefit-cost measurement framework has developed over time, based largely on a number of "tests" established in the California Standard Practice Manual. Each test adopts a different perspective from which to measure both costs and benefits, as seen on the following page: [14]

Table 2. Standard Cost-Effectiveness Tests

Test	Acronym	Key Question Answered	Summary Approach
Participant cost test	**PCT**	Will the participants benefit over the measure life?	Comparison of costs and benefits of the customer installing the measure.
Program administrator cost test	**PACT**	Will utility bills increase?	Comparison of program administrator costs to supply-side resource costs.
Ratepayer impact measure	**RIM**	Will utility rates increase?[15]	Comparison of program administrator and customer costs to utility resource savings.
Total resource cost	**TRC**	Will the total costs of energy in the utility service territory decrease?	Comparison of program administrator and customer costs to utility resource savings.[16]
Societal cost test	**SCT**	Is the utility, state or nation better off as a whole?	Comparison of society's costs of energy resource savings and non-cash costs and benefits.

Source: U.S. EPA and U.S. DOE, National Action Plan for Energy Efficiency.

The results of these benefit-cost tests are used differently across the Southeast. Some states require all of the tests, some require no specific tests and others designate a primary test. While the tests are designed to be standardized, there are several modifications to the tests that can impact the results: at what level the test is applied (measure, program or portfolio); what discount rate is used; if savings are reported as net or gross and if a net-to-gross ratio (NTG) is being applied; if non-energy benefits (NEBs) are accounted for; and if greenhouse gas emissions assumptions are included.

Recent years have seen calls for reform in cost-effectiveness testing, in order to bring greater symmetry and transparency to the benefit-cost evaluation process. The National Efficiency Screening Project, housed by the Home Performance Coalition, has spearheaded many of the national efforts in this space.[17]

EPA does not calculate cost-effectiveness values for the levels of energy efficiency included within the energy efficiency "building block" for each state for practical purposes, such as the lack of utility-specific avoided cost values and the variation in cost-effectiveness testing protocols from state to state; however, EPA mentions cost-effectiveness testing in both the proposed rule and technical support documents, and evaluates the net impact of the rule in its regulatory impact assessment. Ratepayer-funded energy efficiency programs implemented as part of a compliance strategy may be subject to some level of cost-effectiveness screening, which will vary from state-to-state absent a coordinated approach.

B. Inconsistencies in the Application of Energy Efficiency Cost Tools and Cost-Effectiveness Tests

Adding further complexity to conversations surrounding the costs of energy efficiency-driven compliance strategies, given the range of energy efficiency compliance opportunities available to states, there is no defined cost for implementing energy efficiency, but rather, a spectrum of costs. In addition, specific assumptions that impact the results of cost measurements may vary.

1. Costs Vary by Measure Type

Costs for implementation of utility-administered energy efficiency programs are better known due to the high level of regulatory oversight and review; costs for energy efficiency measures typically implemented outside the scope of utility programs are often less well-defined. Given the limited availability of data on non-utility program costs, this paper focuses on programs typically delivered by utilities in the Southeast. Similarly, EPA's cost analysis does not cover non-utility programs, which were not considered in setting emission-reduction targets for states. For additional detail on non-utility programs, see the previous paper in this series, *Non-Utility Energy Efficiency Programs*.[18]

2. Assumptions Regarding Cost Escalation over Time Differ

The escalation of energy efficiency program costs over time is an issue that has garnered much attention of late. Essentially, some argue that costs increase over time as "low-hanging fruit" are picked. However, empirically, in many cases this assumption has not proven out, as programs have evolved to incorporate new technologies and innovation that have stabilized program costs and grown energy efficiency impacts.[19]

EPA chose to apply an energy efficiency cost escalation rate, or increase over time, to annual program costs, resulting in very conservative (overly high) energy efficiency compliance costs. The EPA has applied an escalation rate to costs as follows:

- First-year savings as a percent of sales less than 0.5%: No escalation rate
- First-year savings between 0.5% and 1.0%: A 20% escalation rate
- First-year savings as a percent of sales above 1.0%: A 40% escalation rate.

National analyses generally do not support these assumptions, as described in the following section.

IV. Empirical Measurements of Energy Efficiency Costs

A. National Analyses

In recent years, several national analyses of energy efficiency costs have been conducted to evaluate where the industry stands, as well as how energy efficiency measures stand up against traditional supply-side resources. In general, these analyses have produced fairly consistent results.

1. Levelized Cost of Saved Energy and Acquisition Cost

In 2014, Lawrence Berkeley National Laboratory conducted an extensive analysis of energy efficiency costs from programs administered in 31 states from 2009 to 2011. This analysis revealed a national average program administrator cost of saved energy of 2.1 cents/kWh (2012 dollars, gross savings). Also in 2014, the American Council for an Energy-Efficient Economy released a study analyzing programs from 2009 to 2012 in 20 states, and arrived at a similar value of 2.8 cents/kWh (2011 dollars, net savings).

Table 3. LCSE and Acquisition Costs Reported in National Analyses

Study	Levelized Cost of Saved Energy	Acquisition Costs
LBNL (2014)	$0.021 (2012$)	$0.16 (2012$)
ACEEE (2014)	$0.028 (2011$)	$0.23 (2011$)

2. Escalation Rates

EPA's calculation of energy efficiency program impacts assumes a cost escalation rate as a highly conservative approach, given that "the level of EE program impacts represented in the state EE goals are substantial and represent a scenario that has not previously been achieved and sustained at a national level in the U.S."[20]

In general, national analyses have found little evidence to support the escalation of program costs over time. In its 2014 report, ACEEE conducted an initial correlation analysis and found a very weak correlation between LCSE values and energy savings, in the words of the authors, "cast[ing] doubt on the claim that higher savings levels are associated with higher costs."[21]

B. Southeastern Analyses

In general, southeastern experience has reflected national trends, and in many cases, southeastern utilities have saved energy at a lower cost than their national peers. In general, most southeastern states have begun ramp up of energy efficiency programming in recent years; meaning that there is less information on longer-term program performance; however, at a high level, it appears that southeastern utilities are saving energy at an equal or lesser cost than their national peers. [22]

For this paper, SEEA conducted a high-level analysis of southeastern utility spending and savings data reported in energy efficiency dockets filed with the state Public Service Commissions. SEEA used the following equations, also used by LBNL and ACEEE in their analyses, to determine LCSE for five southeastern utilities. For consistency, SEEA reviewed a sampling of southeastern utilities, which were referenced as case studies in a previous SEEA resource paper, *Energy Efficiency Ramp-up Rates*.

1. Levelized Costs of Saved Energy

SEEA utilized the standard cost of saved energy calculation, also used by ACEEE and LBNL, which is as follows:

LCSE in $/kWh = C x (capital recovery factor)/D
where
A = Real discount rate (assumed 5%)
B = Estimated measure life in years (assumed 10 years)
C = Total annual program costs (in constant dollars)
D = Incremental net annual energy (kWh or therms) saved by energy efficiency programs
Capital recovery factor = [A*(1+A)^B]/[(1+A)^B-1]

Due to limited time and resources, SEEA used an assumed real discount rate of 5% as a simplifying assumption. All other values, including incremental annual savings, costs and measure lives, were taken directly from data reported to EIA. Demand response costs and savings are not included in this analysis. Results are provided below.

Table 4. LCSE for Select Southeastern Utilities, 2011-2013 (2011$)

Utility	Levelized Cost of Saved Energy		
	2011	2012	2013
Entergy Arkansas	$0.03	$0.03	$0.03
LG&E/KU (projected)	$0.02	$0.02	$0.03
Tennessee Valley Authority	$0.02	$0.02	$0.02
Duke Energy Carolinas	$0.01	$0.01	$0.01
Gulf Power	$0.04	$0.03	$0.02

2. Acquisition Costs

The accepted methodology for calculating first-year acquisition costs is simply dividing program costs for a given year by the energy saved by measures implemented in that year.

First-year cost in $/kWh = C / D
where
C = Total annual program cost
D = Incremental annual energy (kWh) saved by energy efficiency programs

Table 5. Acquisition Costs for Select Southeastern Utilities, 2011-2013 (2011$)

Utility	Acquisition Costs		
	2011	2012	2013
Entergy Arkansas	$0.21	$0.20	$0.23
LG&E/KU	$0.18	$0.19	$0.19
Tennessee Valley Authority	$0.15	$0.12	N/A
Duke Energy Carolinas	$0.08	$0.10	$0.11
Gulf Power	$0.30	$0.23	$0.14

3. Cost-Effectiveness

To determine a rough approximate of the cost effectiveness of individual utility energy efficiency portfolios, SEEA found the **as-filed** cost-effectiveness testing results for the portfolio of programs in operation between 2011 and 2013. Portfolio-level results were only available for two of the utilities analyzed, as follows.

Table 6. As-Filed Portfolio Cost-Effectiveness Scores for Select Southeastern Utilities

Program Administrator	Cost-Effectiveness Testing Results	
	PACT/UCT	TRC
Entergy Arkansas	2.89	1.89
LG&E/KU	3.39	3.01

V. Conclusions

Energy efficiency costs can be valued and measured using a variety of tools, and from a variety of perspectives. These tools further characterize and support the role of energy efficiency in delivering savings to meet energy demand, allowing planners to comprehensively evaluate their resource options.

Understanding costs and cost-effectiveness, as well as the value and shortcomings of different methods for characterizing them, is critical to designing policy that maximizes low cost resources in state compliance plans. Given the spectrum of approaches for evaluating energy efficiency costs, as well as the context and assumptions that often accompany them, states must carefully consider the implications of each approach, and how it informs policy choices.

Robust analysis of energy efficiency costs has enabled its deployment as a competitive resource nationally, and has supported recent deployment and ramp up in the Southeast. Continued analysis of the costs and benefits of energy efficiency is important in supporting its role within the southeastern energy landscape and facilitating least-cost compliance pathways with new and pending environmental regulations, including EPA's proposed Clean Power Plan.

End Notes

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