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Energy Efficiency and Greenhouse Gas Limits for Existing Power Plants: Learning from EPA Precedent

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INTRODUCTION

In April 2012, the U.S. Environmental Protection Agency (EPA) proposed a new source performance standard (NSPS), limiting carbon dioxide (CO₂) emissions from new fossil fuel-fired electric generating units (EGUs). Under Section 111(d) of the Clean Air Act (CAA), the EPA and state governments will also have responsibility for regulating CO₂ emissions from existing EGUs. Regulators interpreting this provision face broad statutory language and limited precedent from past applications, providing the opportunity to consider flexible compliance strategies to reduce these emissions, but also presenting a degree of legal uncertainty regarding how a court would view the strategies.

Many stakeholders envision a role for flexible compliance mechanisms such as renewable power generation and end-use energy efficiency in existing-source regulations for CO₂.¹ End-use energy efficiency does not require large upfront capital investments, can be expanded as needed to comply with regulations, and can be deployed quickly. In addition, many states already have energy efficiency policies and programs in place that effectively reduce CO₂ emissions from the power sector. Recognizing state efforts to improve efficiency and crediting those measures can minimize administrative burdens and reduce the cost of reducing CO₂ emissions from existing EGUs.

There is a long history of incorporating energy efficiency under other CAA programs, and the EPA's guidance on such efforts provides lessons regarding the potential inclusion of energy efficiency as a 111(d) compliance option. This analysis identifies key issues regarding the role of end-use energy efficiency under Section 111(d) and explores the CAA rules and regulations that can inform the EPA and the states as they evaluate those issues.

BACKGROUND

Section 111(d) of the Clean Air Act

The EPA has proposed an NSPS that would set an emissions limit of 1,000 pounds of CO₂ per megawatt hour for new electric-utility steam-generating units (e.g., coal-fired facilities) and combined-cycle combustion turbines (e.g., natural gas--fired combined-cycle units).² The proposed rule defines this group of fossil fuel-fired EGUs as a single category of sources—identified as the “TTTT category.”³ The proposed NSPS does not apply to modifications, units with preconstruction permits approved by April 13, 2012 (provided that construction begins

¹ See, e.g., Natural Resources Defense Council, “Closing the Power Plant Carbon Pollution Loophole: Smart Ways the Clean Air Act Can Clean Up America’s Biggest Climate Polluters” (March 2013), <http://www.nrdc.org/air/pollution-standards/files/pollution-standards-report.pdf>; Jeremy Tarr et al., “Regulating CO₂ under Section 111(d): Options, Limits, and Impacts, Nicholas Institute for Environmental Policy Solutions, Duke University” (January 2013). Unless otherwise specified, the phrase “energy efficiency” in this paper refers to end-use energy efficiency.

² EPA Standards of Performance for Greenhouse Gas Emissions for New Stationary Sources: Electric Utility Generating Units, 77 *Fed. Reg.* 22,392.

³ This paper uses the “TTTT” source category to refer to existing power plants that meet the same criteria as the TTTT category that applies to new sources.

within 12 months of that date),⁴ units with a capacity of less than 25 MW, or single-cycle combustion turbines.⁵

CO₂ Performance Standards for Existing Fossil Fuel-Fired EGUs

Because power plants are a major source of greenhouse gas emissions, and because those emissions are not regulated as hazardous or criteria air pollutants, the CAA will require the EPA and the states to regulate CO₂ emissions from existing plants.⁶ Section 111(d) of the act applies to any existing source of an air pollutant, provided that (1) the air pollutant is neither regulated as a criteria pollutant under the National Ambient Air Quality Standards (NAAQS) program nor regulated as a hazardous air pollutant, and (2) an NSPS would apply if the existing source were a new source.⁷ CO₂ emissions from existing fossil fuel-fired power plants meet both criteria, thereby triggering Section 111(d).

Regulating under Section 111(d) involves a three-step process. First, the EPA releases “guideline documents” that identify the best system of emission reduction (BSER) for the covered pollutant (e.g., CO₂).⁸ The BSER must be adequately demonstrated, considering cost, energy requirements, and environmental impacts.⁹ EPA guideline documents also include an emission guideline that identifies the degree of emissions limitation achievable through application of the BSER.¹⁰

Under the second step, each state creates a plan that establishes a standard of performance and provides for its implementation and enforcement.¹¹ Section 111 defines this standard as “a standard for emissions of air pollutants which reflects the degree of emission limitation achievable through the application of the best system of emission reduction.”¹² Notably, states play a significant role under Section 111(d). Using EPA guidance, they establish standards of performance and determine how covered entities within their borders will meet those standards.

In the third and final step, each state submits to the EPA a Section 111(d) plan, which the Agency approves or denies based upon whether the plan satisfies the criteria identified in the EPA’s guidelines. If a state fails to submit a plan or submits a plan deemed unsatisfactory, the EPA may develop a federal plan for the state.¹³

Energy Efficiency under Section 111(d)

EPA action to allow end-use energy efficiency measures as a compliance option is untested in the 111(d) context. The EPA and state regulators will interpret the statutory language to determine the types of compliance strategies allowable for the existing source performance standards, considering factors such as environmental effectiveness, legal certainty, economic viability, and

⁴ *Id.* at 22,395, 22,421.

⁵ *Id.*

⁶ 42 U.S.C. § 7411(d) (2006). The U.S. Supreme Court recognized this mandate in *American Electric Power v. Connecticut*, 131 S. Ct. 2527, 2537 (2011) (noting that section 111(d) “requires regulation of existing sources” that, like power plants, are major sources of carbon pollution).

⁷ 42 U.S.C. § 7411(d)(1) (2006).

⁸ 40 C.F.R. § 60.22(b) (2011).

⁹ 42 U.S.C. § 7411(a)(1) (2006).

¹⁰ 40 CFR § 60.22(b)(5).

¹¹ 42 U.S.C. § 7411(d)(1).

¹² *Id.* at § 7411(a)(1).

¹³ *Id.* at § 7411(d)(2).

the state's energy mix. A key question for regulators is whether each regulated source must achieve emissions limits at that source, as opposed to permitting the use of flexible compliance mechanisms that allow compliance across the regulated sources within a state, potentially by crediting a source with emissions reductions occurring at another electricity generator or service (e.g., trading, averaging, reductions in utilization of regulated sources secured through end-use energy efficiency or renewable energy).¹⁴ The resolution of this question will have a significant impact on the options for energy efficiency in the 111(d) programs.

This paper does not speculate on how regulators will resolve this issue; rather, it focuses on how CAA precedent can inform regulators if they determine that Section 111(d) allows end-use energy efficiency as a compliance option. The paper explores the role of energy efficiency in each of the CAA programs described below, considering the lessons that may apply to the design of existing source performance standards.

Energy Efficiency Precedent under the Clean Air Act

Although recognition of energy efficiency as a compliance mechanism under section 111(d) is untested in court, there is a long history of incorporating energy efficiency under other CAA programs. Regulators in many states require electric utilities to implement end-use energy efficiency programs. These programs target energy demand in residential or commercial buildings (including measures such as upgraded insulation, energy-efficient appliances and lighting) and optimizing performance at industrial facilities. In general, efficiency programs rely on upgrades and improvements to existing systems as well as replacement of old technologies to improve operations and reduce energy consumption. The energy savings generated by an energy efficiency program or project are typically measured in kilowatt- or megawatt-hours of avoided generation.

Energy efficiency programs improve air quality by reducing energy consumption and, consequently, the burning of fossil fuels, such as coal and natural gas. Many of these programs can present low-cost options for achieving CO₂ emissions reductions and other air quality goals. Furthermore, productive investments in energy efficiency hold vast potential for energy savings in the United States. Recent analysis by ACEEE demonstrates that productive investments in energy efficiency can reduce U.S. energy consumption by up to 40–60% by 2050.¹⁵

Congress and the EPA have recognized the relationship between energy efficiency and pollution reduction for decades. Various sections of the Clean Air Act and a number of EPA rulemakings and guidance documents explicitly provide for the use of energy efficiency as a compliance mechanism. Key examples of air quality programs that could inform the treatment of energy efficiency under Section 111(d) include the National Ambient Air Quality Standards program (NAAQS), the Title IV Acid Rain Trading Program, the NO_x SIP Call, and New Source Review.

¹⁴ The EPA has determined that averaging emissions across facilities and allowing emissions trading are permissible systems of emissions control under Section 111(d). However, this determination has not been addressed in court decisions. See “Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam-Generating Units (Clean Air Mercury Rule),” 70 *Fed. Reg.* 28606 (July 18, 2005); Emission Guidelines for Municipal Waste Combustor Metals, Acid Gases, Organics, and Nitrogen Oxides, 40 C.F.R. §60.33b(d). Petitioners challenged the emissions trading program included in the Clean Air Mercury Rule. The D.C. Circuit Court overturned the rule on other grounds and did not address the question of emissions trading under Section 111(d).

¹⁵ John A. Laitner et al., “Long-Term Energy Efficiency Potential: What the Evidence Suggests,” (Research Report E121, American Council for an Energy-Efficient Economy, January 11, 2012).

NAAQS Program and EE/RE Roadmap

In July 2012, the EPA published the Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies and Programs into State and Tribal Implementation Plans (EE/RE Roadmap).¹⁶ The EE/RE Roadmap clarifies prior EPA guidance for jurisdictions incorporating energy efficiency and renewable energy policies and programs into state and tribal plans for achieving NAAQS. It also identifies pathways for building energy efficiency and renewable energy programs into state implementation plans for attaining national air quality standards and provides methods for estimating emissions impacts.

NAAQS Program

The Clean Air Act requires the EPA to establish and periodically update national ambient air quality standards (NAAQS) for six pollutants—NO_x, SO₂, ozone, PM, CO, and lead. Each state then submits to the EPA for approval a state implementation plan that details the state's strategy for attaining NAAQS.

Title IV Acid Rain Trading Program

The Title IV Acid Rain Trading Program included a “Conservation and Renewable Energy Reserve” (CRER) of 300,000 allowances that were set aside for utilities implementing efficiency or renewable energy measures.¹⁷ Utilities could earn CRER allowances by sponsoring energy efficiency programs and by measuring and verifying the energy savings in accordance with EPA guidance.¹⁸

Title IV of the Clean Air Act

In 1990, Congress added Title IV to the Clean Air Act to reduce acid rain through a market-based system. The Title IV Acid Rain Trading Program is an emissions trading program that targets sulfur dioxide (SO₂) emissions from coal-fired power plants.

¹⁶ U.S. EPA, “Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies and Programs into State and Tribal Implementation Plans” (EPA-465/D-12-001a, July 2012), 15.

¹⁷ 42 USCS § 7651c(f)(2)(A) (2012).

¹⁸ See David R. Wooley, “The Clean Air Act Amendments of 1990: Opportunities for Promoting Renewable Energy” (Technical Report NREL/SR-620-29448), prepared for the National Renewable Energy Laboratory (December 11, 2000).

NOx SIP Call

The EPA’s guidance on the NO_x SIP Call Model Rule outlines a set-aside mechanism for states to award allowances for emissions reductions achieved through end-use efficiency measures.¹⁹ In states that adopted this provision of the model rule, these set-aside credits were available for utilities or third parties that sponsored energy efficiency programs.²⁰ The savings from those programs could be converted into a “tons” of NO_x equivalent and traded or sold in the program. The EPA recommended a list of technologies that could potentially qualify for set-aside allowances, although it was up to each state to make the final determination of the actions that qualified.²¹

NOx SIP Call
In 2003, the EPA began to administer the NO _x SIP Call, a market-based cap-and-trade program created to reduce power plant emissions and the regional transport of nitrogen oxides in the eastern United States.

New Source Review

The New Source Review program limits pollution from a source if its potential to emit (PTE) exceeds the “major source threshold,” an annual limit on pollution emitted by a source.²² The major source threshold for different pollutants is determined by the EPA and may vary by location of the source. Sources wishing to avoid NSR requirements may opt to artificially limit their PTE by limiting their operating hours. By reducing its PTE below major levels, a source can qualify as a minor source and avoid triggering NSR. Although this aspect of NSR does not directly relate to efficiency, the precedent of satisfying pollution limits through permits that incorporate reduced operations could apply, as discussed below.

New Source Review
Created by Congress in 1977, New Source Review (NSR) is a permitting program limiting emissions from stationary sources of pollution. Once finalized, NSR requirements are incorporated into Title V operating permits issued by the state where the source is located.

Energy Efficiency Questions Addressed in this Paper

Regulators considering energy efficiency in the 111(d) context face at least three key issues. First, any energy efficiency program will presumably require compliance entities to demonstrate a link between the efficiency measure and CO₂ emissions at either an individual emissions source or a group of sources—a requirement that does not typically apply to energy efficiency programs

¹⁹ *Id.* The EPA issued a model rule to function as a set of guidelines for states to put the rule into law. See “40 CFR Parts 96 Finding of Significant Contribution and Rulemaking for Certain States in the Ozone Transport Assessment Group Region for Purposes of Reducing Regional Transport of Ozone; Rule,” 63 *Fed. Reg.* 57356 (October 27, 1998).

²⁰ U.S. EPA, “State Set-Aside Programs for Energy Efficiency and Renewable Energy Projects Under the NO_x Budget Trading Program: A Review of Programs in Indiana, Maryland, Massachusetts, Missouri, New Jersey, New York, and Ohio,” (draft report, EPA 430-R-03-005, September 16, 2005), http://www.epa.gov/statelocalclimate/documents/pdf/eere_rpt.pdf.

²¹ See U.S. EPA, “Guidance on Establishing an Energy Efficiency and Renewable Energy (EE/RE) Set-Aside in the NO_x Budget Trading Program,” (March 1999), http://www.epa.gov/statelocalclimate/documents/pdf/ee-re_set-asides_vol1.pdf.

²² See U.S. EPA, “Limiting Potential to Emit (PTE) in New Source Review (NSR) Permitting,” <http://www.epa.gov/reg3artd/permitting/limitPTEmmo.htm>.

or policies. Second, policy makers will need to determine how to accurately and reliably measure the energy savings that result from energy efficiency programs. The amount of electricity generation avoided by these programs can vary by type of program or policy, number of participants, and length of time the measure or program has been in place. Finally, once the energy savings are accurately measured, their emissions impacts must be quantified.

Key Issues for Energy Efficiency and Section 111(d)

1. How to tie energy savings to regulated sources
2. How to measure energy savings
3. How to quantify emissions

The following sections discuss each of these issues and identify potential paths forward under Section 111(d) by examining the EPA’s previous treatment of energy efficiency as an air quality compliance mechanism and CAA precedent. It is important to note that these existing CAA programs address specific air quality concerns, and their energy efficiency options are designed to achieve compliance with the programs’ respective mandates. The 111(d) performance standards for CO₂ emissions from power plants will aim to limit global concentrations of CO₂ emissions rather than achieve local or regional air quality standards.²³ Regulators may, therefore, determine that energy efficiency measures under Section 111(d) implementation may differ significantly from the approaches included in the EE/RE Roadmap, the Acid Rain Trading Program, the NO_x SIP Call, and New Source Review.

TYING ENERGY SAVINGS TO COVERED SOURCES

With regard to Section 111(d) regulations for CO₂ emissions, regulators might decide to credit only energy efficiency programs whose emissions impacts can be traced to a specific identifiable EGU. Alternatively, they might credit only reductions that occur in the TTTT category or only reductions within the power sector.²⁴ Under each of these scenarios, the challenge for regulators is how to determine or estimate where emission impacts occur. Because ensuring that energy efficiency reduces generation within the power sector is relatively straightforward, this discussion focuses on tying reductions to individual units and to the TTTT category.

²³ See generally, U.S. EPA, “Climate Change Indicators in the United States,” <http://www.epa.gov/climatechange/science/indicators/ghg/> (“[Greenhouse gas emissions] become globally mixed in the lower atmosphere, reflecting contributions from emissions sources worldwide.”).

²⁴ Crediting emissions reductions that occur outside the electricity sector presents a greater degree of legal uncertainty, as there is no direct nexus between the regulated sources and the emissions reductions. *See, e.g.*, Jeremy M. Tarr et al., “Regulating Carbon Dioxide under Section 111(d) of the Clean Air Act: Options, Limits, and Impacts” (NI R 13-01, Nicholas Institute for Environmental Policy Solutions, Duke University, January 2013), at 17; Gregory E. Wannier et al., “Prevailing Academic View on Compliance Flexibility under §111 of the Clean Air Act” (RFF DP 11-29, Resources for the Future, July 2011), at 9.

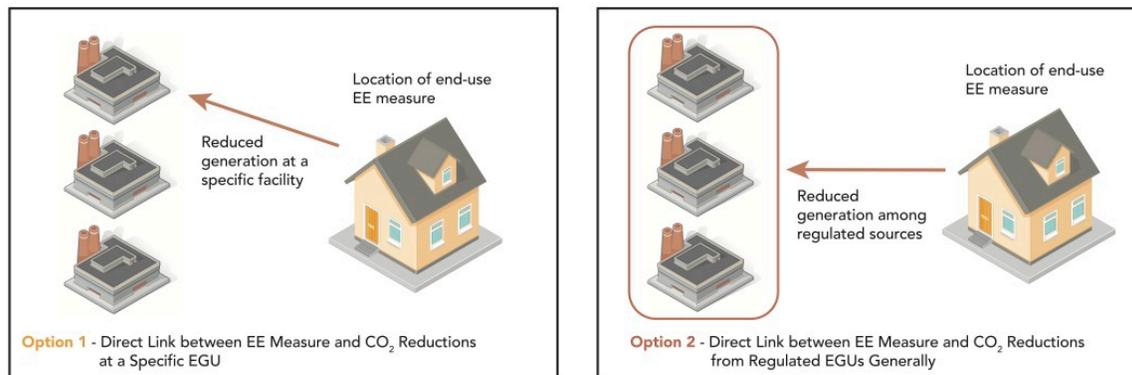


Fig. 1. Options for Incorporating Energy Efficiency into Sec. 111(d) Performance Standards

Tying Reductions to Individual Units

The EPA or state regulators may determine that Section 111(d) requires each covered unit to individually achieve the performance standard.²⁵ Under this approach, a TTTT unit would need to demonstrate that reduced electricity demand due to an energy efficiency program translates into a specific reduction in CO₂ emissions at that unit.

Tying energy efficiency initiatives to individual units is challenging, as the nature of the electricity grid makes it difficult to determine exactly where energy savings on the consumer side will “show up” among the various generation resources serving a given market. Stated generally, electric-generating units supply electricity to the power grid at levels necessary to satisfy energy demand in real time. When demand increases above base load needs, electricity from additional units comes onto the grid, though at a higher price. When electricity demand recedes, electricity from units last in the dispatch order is no longer needed, and those marginal units back off of the grid. It is not possible to precisely determine, however, which particular unit adjusted operations for a specific reason. For example, on a mild summer day, some people will turn off their air conditioners. At any given moment it is very difficult to tell which specific marginal units reduced their generation due to the weather and which reduced their operation due to energy savings from an individual energy efficiency program.²⁶

The New Source Review program in the Clean Air Act may offer some precedent that could address this issue. Currently, sources in the electricity generation sector that wish to avoid NSR may instead implement artificial limitations on their potential to emit through permits that limit the total number of hours a facility may operate in a year. These commitments are incorporated into the sources’ Title V operating permits. Under Section 111(d), regulators could consider a similar approach whereby regulated sources accept operational limitations reflective of an amount of generation that is offset by the energy efficiency programs run by the facility. For example, a system cannot simply require a coal-fired EGU to reduce its emissions, because some other unit in the system would be dispatched to meet that demand. Instead, a system could allow regulated

²⁵ See, e.g., Final Opening Brief of *Envtl. Petitioners, New Jersey v. Env'tl. Prot. Agency*, 517 F.3d 574, 583 (D.C. Cir. 2008), 2007 WL 3193050 at *25–26.

²⁶ Sara Hayes & Rachel Young, “Energy Efficiency: The Slip Switch to a New Track Toward Compliance with Federal Air Regulations,” (Research Report E122, American Council for an Energy-Efficient Economy, January 31, 2012), at 19; U.S. EPA, Roadmap, Appendix B-7 to B-11.

sources to subsidize an energy efficiency program. If that program saves 1,000 MWh of electricity, the source would demonstrate that the reduced demand translates into emissions reductions at that facility by agreeing to reduce its generation by 1,000 MWh relative to a baseline period. This strategy would ensure that the efficiency savings were realized by that specific facility. It would also enable regulators to accurately determine the amount of pollution reduced. Using this approach the reduction in generation that is created by the energy efficiency program would be linked directly to a specific source, allowing energy efficiency to function as a compliance mechanism under a conservative interpretation of the flexibility permitted by Section 111(d).

Tying Reductions to TTTT Units Generally

The EPA and state regulators may determine that Section 111(d) does not require tying emissions reductions to each individual source, but rather allows compliance credit for reductions as long as they occur within the TTTT sector. A challenge with linking EEenergy efficiency reductions to the TTTT sector is that energy savings may occur at sources that are both in and out of the regulated group. For example, the proposed definition of TTTT sources excludes single-cycle power plants (typically plants providing power during times of peak demand). Furthermore, efficiency measures may offset renewable and nuclear power plants—facilities not included in the proposed TTTT category. An appliance efficiency program or policy likely would reduce electricity demand during peak and nonpeak hours and consequently affect generation at TTTT sources and non-TTTT sources. As explained above,²⁷ the nature of electricity transmission on the grid makes it difficult to identify with certainty which unit experienced emissions reductions because of energy efficiency measures. As a result, determining whether affected units are in the TTTT category is challenging.

The EPA’s EE/RE Roadmap and NO_x SIP Call include strategies that might apply to the question of tying energy savings to TTTT sources. While acknowledging uncertainty about where energy savings from efficiency will show up as reduced power plant emissions, the EPA does not view this uncertainty as insurmountable. In the EE/RE Roadmap, the agency identifies three methods for quantifying emissions reductions that involve estimating these reductions at individual units: the

Capacity Factor: The capacity factor approach assumes there is a correlation between the amount of time a power plant operates and the likelihood that its operation will be displaced due to energy efficiency. The approach estimates displaced MWhs at particular units assuming those with lower capacity factors will be displaced first. The emissions rate of a displaced unit is used to project emissions reductions from that unit.

Historical Hourly Data: This method uses data about historical generation to project dispatch order and estimate marginal units. Having determined generation impacts at individual units, the method uses their emissions rates to estimate emissions reductions.

Energy Modeling: The most sophisticated of the methods outlined in the EPA’s EE/RE Roadmap is energy modeling (dispatch or capacity modeling), which can estimate the location of avoided emissions while accounting for variables such as electricity imports and exports, seasonal demand variability, and hourly demand variability.

²⁷ See *supra* Part II.A.

capacity factor approach, historical hourly data, and energy modeling. The unit-specific emissions impacts are then used to forecast air quality in nonattainment areas.

These methods are not used to determine with certainty the source that reduced its emissions. Rather, the EPA allows estimations of the sources most likely to be impacted for purposes of more accurately quantifying emissions impacts of efficiency measures. These emissions quantification methods may provide some insight into how the EPA could tackle the challenge of linking energy efficiency impacts to the TTTT category under 111(d).²⁸ Under this approach, the unit with estimated emission reductions would not necessarily receive credit for those reductions. Instead, the identified unit would be used only to indicate whether the emissions reductions came from a TTTT source. For instance, if energy modeling projected that energy efficiency programs reduced generation at a single-cycle peaking unit (a non-TTTT source), the associated emissions reductions would not count toward 111(d) compliance. If emissions reductions were linked to a combined-cycle natural gas plant, the reductions would be credited to the regulated category.

Similarly, the EPA's guidance on energy efficiency projects eligible for credits under the NO_x SIP Call does not attempt to determine with certainty the power plant that reduced its emissions. Instead, the EPA lists criteria for eligible projects, including that a project "[r]educes/displaces electricity load from core source EGUs in the SIP Call region."²⁹ There is no process for linking reductions directly to those units. Instead, this criteria is considered satisfied once regulators approve the project. In the same guidance document, the EPA suggests potentially eligible technologies and activities as well as identifies technologies that are not recommended for credit.³⁰ Though the NO_x SIP Call regulates a subset of the power sector, the EPA determined that it was not necessary to link emissions reductions due to energy efficiency programs to specific sources as long as those programs were decreasing electricity consumption. Although the language in Section 111(d) is different from that relied on for the NO_x SIP Call rulemaking, this experience suggests that the EPA may allow the use of energy efficiency as a compliance mechanism in the power sector without a direct link to individual units.

MEASUREMENT OF ENERGY SAVINGS

Measuring actual energy savings resulting from an efficiency program or policy is a critical task when relying on those savings to satisfy CAA requirements. This task requires (1) defining the energy efficiency policies and programs that "count" and (2) totaling the kilowatt- or megawatt-hours of energy saved by the policy or program. Measurement of energy efficiency savings occur at the site of the project. Accurate measurement of savings must address a number of variables that may affect up-front savings estimates, such as improper execution of a project and failure to achieve critical project goals.

The approaches for measuring energy savings currently vary by state and have been developed over decades, largely in the context of regulatory proceedings of a state public utility

²⁸ This model could also be used to determine whether emissions reductions came from within a particular state, that is, to tie energy savings to a particular unit for the purpose of determining whether emissions reductions from an energy efficiency program will occur in state or out of state.

²⁹ See U.S. EPA, "Creating an Energy Efficiency and Renewable Energy Set-Aside in the NO_x Budget Trading Program: Designing the Administrative and Quantitative Elements," (EPA-430-K-00-004, April 2000), at 9, http://www.epa.gov/statelocalclimate/documents/pdf/ee-re_set-asides_vol2.pdf.

³⁰ *Id.* at 10 and 11 (Table 4).

commissions.³¹ However, the EPA's recent EE/RE Roadmap guidance as well as earlier cap-and-trade regulations make a number of recommendations for measuring energy efficiency in the context of federal air quality regulations. The following section gives a description of the EPA's guidance on the issue. The section concludes with some observations about how this guidance might inform energy efficiency measurement under section 111(d).

Because there is no standard national protocol for measuring energy savings from energy efficiency measures efficiency for air quality purposes, the EPA could

- Allow states to use the evaluation, measurement, and verification (EM&V) requirements they have in place,
- Require states to select from EPA-approved standard protocols,
- Require states to use a particular protocol, or
- Outline protocol principles, and allow states to develop EM&V practices consistent with those principles.

Given the broad range of possibilities, EPA precedent on the treatment of energy efficiency crediting in other air regulations may help indicate a path forward. With Title IV, the NO_x SIP Call, and the EE/RE Roadmap, the EPA has addressed measurement in a variety of ways but has tended to allow states to determine standards for measuring energy efficiency.

Title IV Acid Rain Trading Program

The Title IV Acid Rain Trading Program credited energy efficiency programs that met state standards or an EPA protocol. Title IV set aside 300,000 allowances in the Conservation and Renewable Energy Reserve for utilities implementing efficiency or renewable energy measures.³² The EPA provided a list of qualifying energy efficiency measures implemented in the residence or facility of a utility customer; however, efficiency measures not included in the list could qualify if they were cost-effective demand-side measures consistent with an applicable least-cost plan or least-cost planning process that increased the efficiency of the customer's electricity use.³³ The regulation allowed a state public utility commission to verify measurement of energy savings from energy efficiency using state protocols.³⁴ Otherwise, applicants submitted documentation of savings directly to EPA using the EPA Conservation Verification Protocols.³⁵ These verification options describe the types of efficiency measures that can qualify for credit, as well as the methods that must be used to measure the total energy savings from the qualifying efficiency measures.

³¹ More than half of all U.S. states have efficiency targets, and most states are measuring savings from energy efficiency programs. The California Public Utilities Commission (CPUC) established energy efficiency valuation protocols to guide evaluations of California's energy efficiency programs. The CPUC has developed separate protocols for impact evaluation, measurement and verification, market effects evaluation, codes and standards program evaluation, effective useful life determination, and sampling and uncertainty protocols. The Efficiency Valuation Organization maintains the International Performance Measurement and Verification Protocol, which includes best practices for verifying results of energy efficiency and renewable energy projects in commercial and industrial facilities.

³² 42 USCS § 7651c(f)(2)(A) (2012).

³³ See Sulfur Dioxide Allowance System, 40 C.F.R. § 73, Subpt. F, App. A (2012).

³⁴ See 40 CFR Part 73.82(c).

³⁵ U.S. EPA, "Conservation Verification Protocols," (EPA 430/B-95-012, June 1995).

NO_x SIP Call

The EPA's guidance on the NO_x SIP Call Model Rule outlines a set-aside mechanism for states to award allowances for emissions reductions achieved through end-use efficiency measures.³⁶ The EPA recommended technologies that could potentially qualify for set-aside allowances, although it was up to each state to determine which actions qualified.³⁷ The EPA's recommended eligible technologies fell into three groups: (1) lighting; (2) heating, ventilation, and air conditioning (HVAC) and refrigeration; and (3) motors and other technologies.³⁸ The EPA guidance recommended that efficiency projects receive set-aside allowances for at least three years and that verification of energy savings from projects occur annually.³⁹

The guidance allowed states to choose their own measurement and verification approach and lists the International Performance Measurement and Verification Protocol (IPMVP) (maintained by the Efficiency Valuation Organization) as an available tool.⁴⁰ The EPA recommended awarding set-aside allowances for efficiency to actors outside of the regulated sector, giving sponsors of end-use energy efficiency projects the opportunity to earn a return on their investments.⁴¹

Several states, including Indiana, Maryland, Massachusetts, New Jersey, New York, and Ohio, created "set-aside" pools of 1–5% of the allowances in their budgets that were earmarked for efficiency (and renewables).⁴² In some states, the transaction costs and administrative burdens of measuring and verifying energy savings were barriers.⁴³

³⁶ *Id.*

³⁷ See U.S. EPA, "Guidance on Establishing an Energy Efficiency and Renewable Energy (EE/RE) Set-Aside in the NO_x Budget Trading Program," (March 1999), at 17, http://www.epa.gov/statelocalclimate/documents/pdf/ee-re_set-asides_voll.pdf.

³⁸ See 63 *Fed. Reg.* 57356.

³⁹ *Id.*

⁴⁰ See also International Performance Measurement and Verification Protocol Committee, U.S. Dept. of Energy, "International Performance Measurement and Verification Protocol: Concepts and Options for Determining Energy and Water Savings" (DOE/GO-102002-1554, March 2002), <http://www.nrel.gov/docs/fy02osti/31505.pdf>.

⁴¹ 63 *Fed. Reg.* 57356.

⁴² U.S. EPA, "State Set-Aside Programs for Energy Efficiency and Renewable Energy Projects under the NO_x Budget Trading Program: A Review of Programs in Indiana, Maryland, Massachusetts, Missouri, New Jersey, New York, and Ohio" (draft report, EPA 430-R-03-005, 2005), at 3. http://www.epa.gov/statelocalclimate/documents/pdf/eere_rpt.pdf; U.S. EPA, State Clean Energy-Environment Technical Forum Roundtable on State NO_x Allowance EE/RE Set-Aside Programs, June 6, 2006 Call Summary (2006), <http://www.epatechforum.org/documents/2005-2006/2006-06-06/2006-06-06-Summary.pdf>.

⁴³ U.S. EPA, "State Set-Aside Programs for Energy Efficiency and Renewable Energy Projects under the NO_x Budget Trading Program: A Review of Programs in Indiana, Maryland, Massachusetts, Missouri, New Jersey, New York, and Ohio."

EE/RE Roadmap

The EE/RE Roadmap is the EPA’s most recent guidance affirming the value of energy efficiency as an air quality compliance mechanism. This guidance details how states might incorporate energy efficiency as an air quality compliance mechanism in state implementation plans (SIPs) developed to comply with National Ambient Air Quality Standards (NAAQS). The requirements and goals of NAAQS differ in many ways from the goals and requirements of 111(d), but because the EE/RE Roadmap is the EPA’s most recent and comprehensive guidance on how energy efficiency can be considered in the air quality context, it may be indicative of EPA’s current views on EM&V issues.

The options for measurement in the EE/RE Roadmap vary in required degree of specificity and level of documentation and process. States may use estimates of the energy savings of statewide policies (as opposed to individual programs or measures) in the “baseline” pathway; the “control strategy” pathway requires submission of more detailed documentation to demonstrate compliance with requirements outlined in the guidance. The “emerging/voluntary measures” pathway and “weight of evidence” pathway both lean toward allowing states to estimate the energy savings from efficiency programs and policies with less oversight. All but the control strategies pathway allow states autonomy in determining which types of energy efficiency programs will count and broad flexibility in determining how to measure the energy savings from those policies and programs. The control strategies pathway has some added requirements (quantifiable, surplus, permanent and enforceable)⁴⁴ that may limit the types of efficiency measures that can qualify, though states retain quite a bit of flexibility to design programs within these parameters.

It is unclear which, if any, of the measurement approaches included in the EE/RE Roadmap might be permissible in the context of 111(d), but in its guidance on the most rigorous of the options (the “control strategy”), the EPA defers to state efforts.

If an air agency wants to incorporate EE policies as a control measure, the agency should conduct evaluation, measurement, and verification (EM&V) of the EE impacts over time, as savings accrue. In jurisdictions with significant levels of EE investment in place, a

Baseline Emissions Projection

Pathway: Agencies that have already adopted energy efficiency policies and programs can incorporate the impact of those measures in the air quality forecasts used in their SIPs.

Control Strategies Pathway:

States can use this option to incorporate new energy efficiency measures as one of the suite of control measures that are used to show they will attain air quality standards in a SIP.

Emerging/Voluntary Measures

Pathway: This path allows additional flexibility so that measures that are difficult to enforce, quantify, or both can receive a limited amount of SIP credit.

Weight of Evidence Pathway:

States that are close to meeting their air quality goals can use this path to show that efficiency measures that are difficult to measure and verify will have an impact on a nonattainment area.

⁴⁴ For more detailed discussion of these four elements see U.S. EPA, EE/RE Roadmap, Appendix F F-6, <http://www.epa.gov/airquality/eere/pdfs/appendixF.pdf>. These criteria must also be met as part of the emerging/voluntary measures pathway, though there is added flexibility for meeting the quantifiable and enforceable criterion.

robust EM&V framework likely already exists and is overseen by the PUC. Communications with these officials can reveal the frequency, rigor, and scope of the EM&V effort needed, as well as the timing for impacts reporting.

Air officials can then use these data to document and validate the effectiveness of the EE policy for SIP purposes.⁴⁵

The EPA has long exhibited (and recently reaffirmed) a willingness to allow states to take the lead in determining the appropriate protocols for measuring energy savings. Furthermore, Section 111(d) appears to permit flexibility in allowing states to determine many of the aspects of a compliance approach. These factors suggest that in the context of 111(d), the EPA could defer, at least to some extent, to states to define the appropriate methods for measuring energy savings.

The limited use of energy efficiency under the NO_x SIP Call and Acid Rain Trading Program suggest that there is a potential tension between encouraging the use of energy efficiency to maximize CO₂ reductions and using the most stringent protocols for measuring and verifying the impacts of those efficiency measures. In its development of 111(d) guidance, the EPA may have to consider a balance between achieving the right level of stringency in terms of measurement and verification and adopting a simple and straightforward compliance path that encourages the use of energy efficiency as a compliance tool.

QUANTIFICATION OF EMISSIONS REDUCTIONS

Utility and Challenge of Quantifying Emissions Reductions under 111(d)

After measuring energy savings from a qualifying efficiency policy or program, the savings would need to be converted into an amount of avoided CO₂ emissions, or “quantified.” The quantification process comes into play for states wishing to encourage energy efficiency for Section 111(d) compliance when demonstrating that a plan (a “SIP”) complies with EPA guidance or that a state’s approach is otherwise adequate to quantify emission reductions (under an equivalency plan⁴⁶). The EPA’s approval of a state’s implementation plan may depend, in part, upon the state’s proposed methods for quantifying emission savings.⁴⁷

The EPA recognizes that quantifying the emission impacts of energy efficiency policies and programs can be challenging.⁴⁸ Nevertheless, multiple methods for quantifying emissions reductions from energy savings are currently in use.⁴⁹ The following section discusses several such methods outlined by the EPA that may be useful in the context of a 111(d) rulemaking.

⁴⁵ *Id.* at F-7, <http://www.epa.gov/airquality/eere/pdfs/appendixF.pdf>.

⁴⁶ For more on state equivalency determinations, see Jonas Monast et al., “Greenhouse Gas Emissions from Existing Sources: Section 111(d) and State Equivalency,” 42 *Env. Law Reporter* 10,206 (2012).

⁴⁷ Other considerations may include the characteristics of particular energy efficiency programs (e.g., educational programs) and the method used for measuring energy savings.

⁴⁸ See U.S. EPA, Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies and Programs into State and Tribal Implementation Plans, 15.

⁴⁹ Chris Ann Dickerson and Mike McCormick, “Securing the Link Between Energy Efficiency Savings and Greenhouse Gas Reductions: How Will Energy Efficiency Evaluation Protocols Measure Up,” (International Energy Program Evaluation Conference, New York, 2005), <http://iepec.org/abstracts/abstracts2005/papers/071.pdf>.

Emissions Quantification Methods under the CAA

According to EPA guidance, the process of converting energy savings to emissions reductions can consist of two steps: (1) “estimate which facilities will likely reduce their energy output as a result of the measure” and (2) “determine the emission rate in pounds per kilowatt-hour of those facilities.”⁵⁰ Emissions reductions are then calculated by multiplying the reduction of a facility’s generation by that facility’s emissions rate. Although the degree of emissions reduction depends on the emissions rate of the displaced unit, it may not be possible to determine exactly the generation impacts at an individual unit.⁵¹ As a result, “surrogate approaches,” such as dispatch models or methods based on historical or projected information, may be necessary to estimate the electric generation units (EGUs) most likely to experience generation impacts.⁵² Because the EPA recognizes that states may not have the resources to conduct sophisticated dispatch modeling, it sometimes considers other approaches that rely on simplified assumptions, including use of capacity factor and historical generation data, to be adequate.

Energy Modeling

In the EE/RE Roadmap and the NO_x SIP Call guidance, the EPA discusses energy modeling as the most accurate of its suggested methods for estimating emissions impacts. Energy models, such as dispatch and capacity expansion models, can “capture the complex interactions within the electricity market and simulate what might happen given a set of assumptions.”⁵³ Models, for instance, can optimize dispatch from EGUs across different regions and appreciate variables such as “transmission constraints, forced outages, environmental regulations, plant retirements, new generation, and limitations on specific power plants.”⁵⁴ A dispatch model estimates the marginal units on an hourly basis and the amount of energy displacement at those units. A capacity expansion model is used for large-scale programs that may dramatically change electrical system operations.⁵⁵

The EE/RE Roadmap identifies energy modeling as the most sophisticated emissions quantification approach because of its ability to take into accounts for electricity imports, exports, fuel prices, and unit availability.⁵⁶ The EPA explains that energy modeling can provide “detailed, geographically specific hourly emission data at the EGU level.”⁵⁷ In the NO_x SIP Call guidance, the agency recognized the capacity of dispatch models to “capture a high level of detail on the specific electric generation units (EGU) displaced by EE/RE projects or programs.”⁵⁸ The guidance also explains that when energy efficiency programs reduce electricity demand, “the model calculates how this would affect dispatch and then calculates resulting emission and

⁵⁰ U.S. EPA, Guidance on State Implementation Plan (SIP) Credits for Emission Reductions from Electric-Sector Energy Efficiency and Renewable Energy Measures (2004), 14. [hereinafter “2004 EE/SIP Guidance”]

⁵¹ U.S. EPA, 2004 EE/SIP Guidance, 14–15.

⁵² *Id.* at 4.

⁵³ U.S. EPA, EE/RE Roadmap, Appendix I, I–28..

⁵⁴ *Id.*

⁵⁵ *Id.* at I–29..

⁵⁶ *Id.* at I–18.

⁵⁷ U.S. EPA, EE/RE Roadmap, Appendix I, I–29, I–30 .

⁵⁸ U.S. EPA, “Creating and Energy Efficiency and Renewable Energy Set-Aside in the NO_x Budget Trading Program: Evaluation, Measurement, and Verification of Electricity Savings for Determining Emission Reductions from Energy Efficiency and Renewable Energy Actions,” (2007), at 8.4.2 (2007) [hereinafter “EPA NO_x Budget Trading Program vol. 3”].

prices.”⁵⁹ Despite these advantages, modeling can be expensive and data intensive. Moreover, it requires modeling expertise, and the quality of results depends on assumptions.

Historical Generation and Emissions Data

The EE/RE Roadmap and the NO_x SIP Call guidance also provide for a less resource-intensive approach to calculating emissions reductions. In the EE/RE Roadmap’s historical hourly emissions rate approach, data about historical generation are used to estimate dispatch order and corresponding marginal emissions rates.⁶⁰ Comparing these data to estimated hourly impacts of an energy efficiency policy can reveal “which EGUs within the dispatch order will be affected by the policies” for each hour, day, and month of the time period being analyzed.⁶¹ The NO_x SIP Call guidance outlines a similar approach, whereby an estimated hourly dispatch order is compared to a load curve that accounts for energy efficiency measures in order to estimate marginal units on an hourly basis. Characteristic emissions rates for the marginal units can be used to quantify emissions savings.⁶²

Capacity Factor Emissions Rates

This approach, put forward in the EE/RE Roadmap, operates on the assumption that a unit’s capacity factor⁶³ can indicate the amount of its generation that an energy efficiency program will displace.⁶⁴ Marginal units cycle up and down according to demand and tend to have a low capacity factor. Base load units, by contrast, run continuously and have a capacity factor close to 1. By assuming that energy efficiency programs are more likely to displace marginal rather than base load units, this method uses capacity factor data to determine the “relative dispatch order” of EGUs in a region, and to identify “which power plants are on the margin,” allowing for the use of the “emission rates of those plants”⁶⁵ to quantify emissions.

System Average Emissions Rate

A simple method used in CAA programs is to multiply energy savings by an average emissions rate of units in a specified geographic region. In the NO_x SIP Call guidance, for example, the EPA explains that the average rate is the total emissions output of a group of units divided by the total energy output of those units.⁶⁶ The group of units could be a single region or a power system,⁶⁷ and the agency notes a variety of sources for average emissions rates calculated by utility, state, and region.⁶⁸ The EPA’s guidance also suggests a similar but more accurate method

⁵⁹ *Id.* at 8.4.2.

⁶⁰ U.S. EPA, EE/RE Roadmap, Appendix I, I–25.

⁶¹ *Id.* at I–26.

⁶² U.S. EPA, NO_x Budget Trading Program Vol. 3, at NO_x Budget Trading Program vol. 3, at 8.4.3.

⁶³ “Capacity factor” refers to the ratio of the electricity produced by an EGU to the electricity the unit could have produced if operating at continuous full power. See U.S. EPA, EE/RE Roadmap, Appendix I, I–22.

⁶⁴ *Id.*

⁶⁵ *Id.* at I–23.

⁶⁶ U.S. EPA, NO_x Budget Trading Program vol. 3, *supra* note ___, at 8.4.1.

⁶⁷ *Id.*

⁶⁸ *Id.* at 8.4.1 (listing sources as the Ozone Transport Commission’s “OTC Workbook,” the Clean Air-Climate Protection Software (CACPS), and the EPA’s eGRID database).

whereby states use the average emissions rates of marginal EGUs. This method uses “regional or state average rates that exclude the base load EGUs not ‘backed off’ by EE/RE projects” in order to better estimate “the impact on the marginal EGUs that are most likely to be displaced.”⁶⁹ In the EE/RE Roadmap, the EPA describes essentially the same approach, where regulators estimate total avoided emissions by multiplying the total estimated avoided generation by a non–base load emissions rate provided by eGRID.⁷⁰

An average emissions rate for marginal units is simple to use but suffers from inaccuracy, because it roughly estimates affected marginal EGUs and does not fully capture the variations in emissions rates at individual facilities.⁷¹ The inherent imprecision of this approach may be incompatible with Section 111(d) regulations, depending on the level of accuracy required in emissions reductions estimates.

The quantification approaches used in the EE/RE Roadmap demonstrate compliance with the NAAQS and are part of a larger modeling effort to predict the ambient air quality of nonattainment regions. Less precise quantification approaches may be more tolerable for complying with NAAQS because estimated emissions reductions are used merely for forecasting air quality, which is ultimately measured with monitoring devices. In Section 111(d), by contrast, the quantification measures would be used to determine total tons of achieved emissions reductions because there is no air quality measurement as the final regulatory compliance metric. On the other hand, CO₂ is unique from the pollutants regulated under NAAQS in that it has no localized health impacts, suggesting that accurately identifying the location of CO₂ emissions reductions is less important than identifying the location of the pollutants contemplated in the EE/RE Roadmap. Though the roadmap focuses on ambient air quality and Section 111(d) focuses on performance standards, the EPA’s recent guidance on emissions quantification methods applied to energy efficiency may still be an informative precedent. It remains to be seen which approaches might be permissible under 111(d), but the range of options in the EE/RE Roadmap provides some context for the range of options air regulators could apply.

⁶⁹ *Id.* at 8.4.3. In its second guidance document for energy-efficiency set-asides under the NO_x Budget Trading Program, the EPA recommended that states use a uniform emissions rate of 0.0015 lbs/kWh. U.S. EPA, “Creating an Energy Efficiency and Renewable Energy Set-Aside in the NO_x Budget Trading Program: Designing the Administrative and Quantitative Elements,” vol. 2 (2000), 18 (“EPA recommends that states use a single SIP Call region-wide NO_x emissions rate of 0.0015 lbs/kWh.”). The agency’s 2007 guidance document did not identify use of this uniform rate as acceptable for quantifying emissions reductions. U.S. EPA, NO_x Budget Trading Program Vol. 3, 8.4 (listing system average emission rate, dispatch models, and medium effort calculation approaches as options). The agency did endorse use of this rate as an allocation rate—the number of kWh savings a state requires for a project to qualify for one NO_x set-aside allowance. *Id.* at 8.2. The allocation rate can differ from the emissions rate used to quantify emissions reductions. *Id.* at 8.1 (“States may choose a conservative allocation rate or a high allocation rate, i.e., an ‘incentive rate,’ if they believe it will encourage additional EE/RE projects. Another option is to adopt an allowance allocation rate based on the estimated rate at which EE/RE projects displace pollution from electric generation units (EGUs).”).

⁷⁰ The Emissions & Generation Resource Integrated Database (eGRID) is a comprehensive source of data on the environmental characteristics of almost all electric power generated in the United States.

⁷¹ U.S. EPA, NO_x Budget Trading Program vol. 3, at 8.4.3.

CONCLUSION

End-use energy efficiency measures have a long track record of achieving meaningful, cost-effective CO₂ emissions reductions from the electric power sector. The forthcoming performance standards limiting CO₂ emissions from existing coal-fired EGUs and natural gas-fired combined-cycle units present the opportunity to expand the use of energy efficiency as a compliance option for Clean Air Act programs. While there is limited history with Section 111(d), the Acid Rain Trading Program, the NO_x SIP Call, New Source Review, and the recently issued EE/RE Roadmap each provide useful lessons to guide the EPA and the states as they consider whether and how to incorporate energy efficiency into CO₂ performance standards for existing fossil fuel-fired EGUs. In particular, precedents from these established programs and guidance documents can help regulators determine how to tie energy savings to the sources subject to the performance standards, how to measure the energy savings, and how to quantify the impacts on CO₂ emissions of a given energy efficiency program.