Regulatory Impact Analysis for the Proposed Federal Plan Requirements for Greenhouse Gas Emissions from Electric Utility Generating Units Constructed on or Before January 8, 2014; Model Trading Rules; Amendments to Framework Regulations

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Regulatory Impact Analysis for the for the Proposed Federal Plan Requirements for Greenhouse Gas Emissions from Electric Utility Generating Units Constructed on or Before January 8, 2014; Model Trading Rule

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CHAPTER 1: SUMMARY OF POTENTIAL REGULATORY IMPACTS

1.1 Introduction

This Regulatory Impact Analysis (RIA) discusses potential benefits, costs, and economic impacts of for the "Proposed Federal Plan Requirements for Greenhouse Gas Emissions from Electric Utility Generating Units Constructed on or Before January 8, 2014; Model Trading Rules; Amendments to Framework Regulations" (herein also referred to as "proposed federal plan and model trading rules"[1]). In this action, the Environmental Protection Agency (EPA) is proposing a federal plan to implement the emission guidelines for existing fossil fuel-fired EGUs under the Clean Air Act (CAA). The emission guidelines were proposed in June 2014 and finalized on August 3, 2015 as the Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units (also referred to as the Clean Power Plan or Emission Guidelines). The EPA is taking comment on many of the elements of this proposal.

This proposal presents two approaches to a federal plan (or model rule) for states and other jurisdictions that either chose to adopt a model rule or do not adopt and submit to the EPA in a timely manner an approvable state plan: a rate-based emission trading program and a mass-based emission trading program. The federal plan is an important measure to ensure that congressionally mandated emission standards under the authority of the CAA are implemented. The agency is also proposing a necessary or appropriate finding for the affected EGUs in several areas of Indian country and is proposing the federal plan for these affected EGUs.

The proposed federal plan is related to but separate from the final emission guidelines. The final emission guidelines establish the best system of emission reduction (BSER) for applicable fossil fuel-fired EGUs in the form of a carbon dioxide (CO_2) emission performance rate for steam-fired EGUs and a CO_2 emission performance rate for natural gas-fired combined cycle units, and provide guidance and criteria for the development of approvable state plans. The purpose of the proposed federal plan is to establish requirements directly applicable to a state's affected EGUs that meet the emission performance levels in order to achieve reductions in

[1] The proposed amendments to the framework regulations for section 111(d) are limited to enhancements in the procedure and timing of the EPA's action on state plans. *See* Section VII of the preamble. They do not modify requirements or obligations in the CPP or other substantive rules, or directly regulate any third parties. Therefore, the EPA has not included these changes in its analysis in this RIA and proposes to certify that these changes will not have a significant impact on a significant number of small entities pursuant to the Regulatory Flexibility Act (RFA).

carbon dioxide (CO_2) emissions in the case where a state or other jurisdiction does not submit an approvable plan. The stringency of the emission performance levels established in the final emission guidelines will be the same whether implemented through a state plan or a federal plan.

1.2 Legal, Scientific and Economic Basis for this Rulemaking

1.2.1 Statutory Requirement

Section 111(d)(2) of the Clean Air Act (CAA), 42 U.S.C. 7411(d)(2) provides the EPA the same authority to prescribe a plan for a state in cases where the state fails to submit a satisfactory plan as the Agency would have under CAA section 110(c) in the case of failure to submit a National Ambient Air Quality Standard implementation plan. In addition, the EPA has authority under CAA section 111(d)(1) to prescribe regulations that establish procedures similar to CAA section 110 with respect to the submission of state plans, and the EPA also has general rulemaking authority as necessary to implement the CAA under section 301. A federal Plan under CAA section 111(d) applies, implements and enforces standards of performance for affected EGUs. Under the Clean Power Plan Emission Guidelines, state plans will be due on September 6, 2016. States are also allowed to seek a two year extension for a final plan submittal, upon submitting a satisfactory initial submittal by the same deadline. If a state fails to submit a final state plan or initial submittal, or if either a final state plan or an initial submittal does not meet the requirements of the final emission guidelines, the Agency will take the appropriate steps to finalize and implement a federal plan.

States will remain free, and indeed are strongly encouraged, to submit an approvable state plan even after promulgation of the federal plan for their jurisdictions. Upon approval of the state plan by EPA, the federal plan will no longer apply to the affected EGUs covered by the approved state plan, starting at the initiation of the next compliance period with the limitations noted in the federal plan.

1.2.2 Health and Welfare Impacts from Climate Change

According to the National Research Council, "Emissions of CO_2 from the burning of fossil fuels have ushered in a new epoch where human activities will largely determine the evolution of Earth's climate. Because CO_2 in the atmosphere is long lived, it can effectively lock Earth and future generations into a range of impacts, some of which could become very severe.

Therefore, emission reduction choices made today matter in determining impacts experienced not just over the next few decades, but in the coming centuries and millennia."[2]

In 2009, based on a large body of robust and compelling scientific evidence, the EPA Administrator issued the Endangerment Finding under CAA section 202(a)(1).[3] In the Endangerment Finding, the Administrator found that the current, elevated concentrations of GHGs in the atmosphere—already at levels unprecedented in human history—may reasonably be anticipated to endanger public health and welfare of current and future generations in the United States.

Since the administrative record concerning the Endangerment Finding closed following the EPA's 2010 Reconsideration Denial, the climate has continued to change, with new records being set for a number of climate indicators such as global average surface temperatures, Arctic sea ice retreat, CO_2 concentrations, and sea level rise. Additionally, a number of major scientific assessments have been released that improve understanding of the climate system and strengthen the case that GHGs endanger public health and welfare both for current and future generations. These assessments are from the Intergovernmental Panel on Climate Change (IPCC), the U.S. Global Change Research Program (USGCRP), and the National Research Council (NRC). These and other assessments are discussed in more detail in the Final Clean Power Plan Emission Guidelines preamble and in Chapter 4 of the Clean Power Plan Final Rule Regulatory Impact Analysis (RIA).[4]

1.2.3 Market Failure

Many regulations are promulgated to correct market failures, which otherwise lead to a suboptimal allocation of resources within the free market. Air quality and pollution control regulations address "negative externalities" whereby the market does not internalize the full opportunity cost of production borne by society as public goods such as air quality are unpriced.

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[2] National Research Council, Climate Stabilization Targets, p.3.

[3] "Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act," 74 Fed. Reg. 66,496 (Dec. 15, 2009) ("Endangerment Finding").

[4] U.S. Environmental Protection Agency (U.S. EPA). 2015a. *Regulatory Impact Analysis for the Clean Power Plan Final Rule.* EPA-452/R-15-003. Office of Air Quality Planning and Standards, Health and Environmental Impacts Division, Research Triangle Park, NC.

GHG emissions impose costs on society, such as negative health and welfare impacts, that are not reflected in the market price of the goods produced through the polluting process. For this regulatory action the good produced is electricity. If a fossil fuel-fired electricity producer pollutes the atmosphere when it generates electricity, this cost will be borne not by the polluting firm but by society as a whole, thus imposing a negative externality. The equilibrium market price of electricity may fail to incorporate the full opportunity cost to society of generating electricity. All else equal, given this externality, the composition of EGUs used to generate electricity in a free market will not be socially optimal, and the quantity of electricity generated may not be at the socially optimal level. Fossil fuel-fired EGUs may produce more electricity than would occur if they had to account for the cost associated with this negative externality. Consequently, absent a regulation on emissions, the composition of the fleet of EGUs used to generate electricity may not be socially optimal, and the marginal social cost of the last unit of electricity produced may exceed its marginal social benefit. In the instances where the agency finalizes and implements a federal plan for a state's affected EGUs, this proposed regulation will work towards addressing this market failure by causing affected EGUs to begin to internalize the negative externality associated with CO_2 emissions.

1.3 Background for the Proposed Federal plan and model trading rules

1.3.1 Definition of Affected Sources

Existing fossil fuel-fired electric generating units subject to the final Clean Power Plan Emission Guidelines that are located in a state that does not have an EPA-approved state plan are potentially subject to this proposed action. Existing fossil fuel-fired EGUs are those that were in operation or had commenced construction on or before January 8, 2014.[5]

1.3.2 Trade in Compliance Instruments across States

The EPA intends to set up and administer a program to track trading programs – both rate-based and mass-based – that will be available for all states that choose it. The EPA proposes that affected EGUs in any state covered by a federal plan could trade compliance instruments

[5] An affected EGU is any fossil fuel-fired EGU that was in operation or had commenced construction as of January 8, 2014, and is therefore an ''existing source'' for purposes of CAA section 111, and that in all other respects would meet the applicability criteria for coverage under the proposed GHG standards for new fossil fuel-fired EGUs (79 FR 1430; January 8, 2014).

with affected EGUs in any other state covered by a federal plan or a state plan meeting the conditions for linkage to the federal plan. In the proposed mass-based federal-plan trading program, this would mean that affected EGUs in a state covered by the federal plan or a state meeting the conditions for linkage to the federal plan could use, as a compliance instrument, an allowance distributed in any other state covered by the federal plan or a state meeting the conditions for linkage to the federal plan. Similarly, in the proposed rate-based federal-plan trading program approach, this would mean that affected EGUs in a state covered by the federal plan or a state meeting the conditions for linkage to the federal plan could use, as a compliance instrument, an ERC issued in any other state covered by the federal plan or a state meeting the conditions for linkage to the federal plan. EPA is proposing that an affected EGU in a state covered by the mass-based trading federal plan must use allowances for compliance (not ERCs). Similarly, an affected EGU in a state covered by the rate-based trading federal plan must use ERCS for compliance (not allowances).

1.3.3 Model Trading Rule

A state program that adheres to the model trading rule provisions specified in this rulemaking would be presumptively approvable. States may submit means of meeting the emission guidelines requirements that differ from the model trading rule provisions, so long as the state demonstrates to the EPA's satisfaction in the state plan submittal that such alternative means of addressing requirements are at least as stringent as the presumptively approvable approach described here. Additionally, there are stand-alone portions of the model trading rules, such as the evaluation, measurement, and verification (EM&V) procedures that would be approvable even if a state adopted an approach that differs from the federal plan. The model trading rules serve as a mechanism to facilitate larger trading markets since consistency with the federal plan allows trading across both the state and federal programs. The EPA expects a larger trading region is likely to result in lower overall costs.

1.4 Summary of Regulatory Analysis

In accordance with Executive Order 12866, Executive Order 13563, OMB Circular A-4, and the EPA's "Guidelines for Preparing Economic Analyses," the EPA prepared this RIA for this "significant regulatory action." This action is an economically significant regulatory action because it may have an annual effect on the economy of $100 million or more or adversely affect

in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or state, local, or tribal governments or communities.[6]

This action proposes a federal plan under section 111(d) of the CAA for the control of CO_2, a greenhouse gas pollutant, from certain large emitting fossil-fuel fired power plants, in the event that some states do not adopt their own plans. Specifically, the EPA is proposing approaches in the form of mass- and rate-based trading options that provide flexibility in implementing emission standards for a state's affected EGUs. Both proposed approaches to the federal plan would require affected EGUs to meet emission standards set using the CO_2 emission performance rates in the emission guidelines. The federal plan will achieve the same levels of emissions performance as required of state plans under the emission guidelines.

However, at the time of this proposal, the EPA has no information on whether any or how many states will require a federal plan or adopt a model rule. Because of this lack of information, for this RIA, the EPA has chosen to examine two federal plan approach scenarios where all states of the contiguous U.S. will be regulated under a federal plan or a model rule. The first federal plan approach we examine in this RIA assumes all states in the contiguous U.S. are regulated under a rate-based federal plan or model rule. The second federal plan approach we examine assumes all contiguous states are regulated under a mass-based federal plan or model rule. These two approaches are a re-presentation of the modeling done for the Clean Power Plan Emission Guidelines RIA.

This approach is consistent with the analysis presented in the RIA for the final Clean Power Plan Emission Guidelines (U.S. EPA 2015). As a result, this RIA for the proposed federal plan and model trading rules re-presents the key results from the final Clean Power Plan Emission Guidelines RIA. These key results encompass the potential costs, emission reductions, and benefits of the proposed federal plan and model trading rules, as well as the potential impacts on electricity markets, employment, and markets outside the electricity sector.

The RIA also presents a discussion of limitations of the analysis and solicitations for public comments that will contribute to the analysis supporting the promulgation of final federal

[6] The analysis in this proposal RIA constitutes the economic assessment required by CAA section 317. In the EPA's judgment, the assessment is as extensive as practicable taking into account the EPA's time, resources, and other duties and authorities.

plans (as needed) and model trading rules. In evaluating the impacts of the proposed federal plan and model trading rules, we address a number of uncertainties.

It is important to note that the potential regulatory impacts presented in the Clean Power Plan Final Rule RIA and the RIA for this proposed rule are not additive. Both RIAs present estimates of the benefits and costs of achieving the emission performance rates of the Clean Power Plan emissions guidelines. In the case of the Clean Power Plan Final Rule RIA, the illustrative analysis assumes the performance rates are met under state plans. In the case of this RIA for the proposed federal plan and model trading rules, the same performance rates are accomplished but are assumed to be accomplished under the federal plan or model trading rules.

This RIA also presents in Chapter 2 the statutory and executive order analyses that accompany the proposal for this action, including the Initial Flexibility Regulatory Analysis (IRFA). The IRFA describes the economic impact of the proposed rule on small entities and any significant alternatives to the proposed rule that would accomplish the objectives of the rule while minimizing significant economic impacts on small entities. This IRFA has been prepared following EPA's guidance document for preparing initial and final regulatory flexibility analyses.[7]

1.4.1 Base Case and Years of Analysis

The base case for this analysis, which uses the Integrated Planning Model (IPM), includes state rules that have been finalized and/or approved by a state's legislature or environmental agencies, as well as final federal rules. The IPM Base Case v.5.15 includes the Cross-State Air Pollution Rule (CSAPR), the Mercury and Air Toxics Rule (MATS), the proposed Carbon Pollution Standards for New Power Plants, the Cooling Water Intakes (316(b)) Rule, the Combustion Residuals from Electric Utilities (CCR), and other state and Federal regulations to the extent that they contain measures, permits, or other air-related limitations or

[7] See "EPA's *Action Development Process*: Final Guidance for EPA Rulewriters: Regulatory Flexibility Act as amended by the Small Business Regulatory Enforcement Fairness Act." OPEI Regulatory Development Series. November 2006. Available at: <http://www.epa.gov/sbrefa/documents/Guidance-RegFlexAct.pdf>. Accessed July 21, 2015.

requirements. Additional legally binding and enforceable commitments for GHG reductions considered in the base case are discussed in the documentation for IPM.[8]

To present a complete picture of the potential costs and benefits of the proposed federal plan and model trading rules, this RIA presents results for the analysis years 2020, 2025, and 2030. While 2020 is before the first year of the interim compliance period (2022), the EPA expects states and affected EGUs to perform voluntary activities that will facilitate compliance with interim and final goals. These pre-compliance period activities might include investments in renewable energy or demand-side energy efficiency projects, for example, that produce emissions reductions in the compliance period. Activities might also include preparatory investments in transmission capacity or monitoring, reporting, and recordkeeping systems. As a result, there are likely to be benefits and costs in 2020, so these are reported in this RIA. Meanwhile, cost and benefits are estimated in this RIA for 2025, which is intended to represent a central period of the interim compliance time-frame as states are on glide paths toward fully meeting the final CO_2 emission performance goals. Lastly, the RIA presents costs and benefits for 2030, when the emission performance goals are fully achieved.

1.4.2 Federal Plan Approaches Examined in RIA

In the Final Clean Power Plan Emission Guidelines, the EPA translated the source category-specific CO_2 emission performance rates into equivalent state-level rate-based and mass-based CO_2 goals in order to maximize the range of choices that states will have in developing their plans.[9] As noted above, like the RIA for the Final Clean Power Plan Emission Guidelines, this RIA presents two scenarios designed to achieve these goals, which we term the rate-based federal plan approach and the mass-based federal plan approach.

It is very important to note that the differences between the analytical results for the rate-based and mass-based federal plan approaches presented in this RIA may not be indicative of likely differences between the approaches. In other words, if one approach performs differently

[8] Detailed documentation for IPM v.5.15 is available at: http://www.epa.gov/powersectormodeling.

[9] See the preamble of the final Clean Power Plan Emissions Guidelines for these state-level rate-based and mass-based CO_2 goals.

than the other on a given metric during a given time period, this does not imply this will apply in all instances in all time periods in all places.

In the rate-based approach modeled in the RIA for the final Clean Power Plan Emission Guidelines, avoided generation from demand-side energy efficiency is counted towards meeting the emission performance rates at affected EGUs. However, this federal plan and model trading rule proposal takes comment on whether EPA should allow demand-side energy efficiency to directly count toward the compliance rate of affected EGUs in a rate-based compliance approach. Because energy efficiency is not proposed to be eligible to generate ERCs that could be used to comply in the proposed rate-based federal plan, this RIA might be forecasting a different a generation mix and emissions levels than might occur from the proposed federal plan.[10] Compliance strategies under either approach to the federal plan (mass or rate) may be anticipated to rely on different abatement measures than those modeled for this RIA. The climate benefits and health co-benefits arising from these alternative strategies may be different those presented here. We will update this analysis as necessary to support the final rule.

Even without explicit incentives for energy efficiency under a rate-based federal plan, we believe that the increased focus that the Clean Power Plan Emission Guidelines will bring to considerations of CO_2 emissions from EGUs will encourage states to consider more aggressive demand-side energy policies. Furthermore, the EPA anticipates that many states will submit fully-approvable plans, and that demand side energy efficiency is likely to be either an explicit component of, or a complimentary policy to, many of those plans. The resulting lower electricity demand in states not subject to a federal plan surrounding a state that is subject to a federal plan will likely have an impact on fossil generation and thus the cost of reducing CO_2 emissions. The EPA takes comment on the appropriate way to factor such costs into the analysis of the final federal plan and model trading rules.

In the rate-based approach modeled in the RIA for the final Clean Power Plan Emission Guidelines, affected EGUs may not procure emission reductions from (e.g., by averaging their emissions with) affected EGUs located in other states (which may also have different emission

[10] However, as with states subject to the mass-based approach, energy efficiency activities may be adopted by states subject to the rate-based approach to lower demand, which in turn may reduce the compliance cost of achieving the performance rates.

standards) in order to demonstrate compliance. As described in Section 1.3.2, in the proposed rate-based federal plan affected EGUs may procure ERCs from affected EGUs in other rate-based states subject to the federal plan. Furthermore, the rate-based illustrative plan in the Final Clean Power Plan Emission Guidelines RIA assumes that the plan applies a state's blended rate-based goal as a requirement for affected EGUs in that state to achieve.[11] Alternatively, the proposed federal plan specifically establishes an emissions rate performance standard that is applied to affected steam-fired EGUs and an emission rate performance standard that is applied to affected natural gas-fired combined cycle EGUs. Applying the subcategory-specific rate goal may alter the incentives among affected EGUs and could lead to a different generation mix and emission levels. The EPA will further explore the impacts of subcategory-specific rate goals in the analysis supporting the final rule.

The mass-based plan approach requires affected sources in each state to limit their aggregate emissions not to exceed the mass goal for that state. The mass-based scenario presented in this chapter includes a 5 percent set-aside of allowances that would be allocated to recognize deployment of new renewable capacity, which is represented by lowering the capital cost of new renewable capacity in a compliance period by the estimated value of the allowances in the set-aside in that period.

The EPA is also proposing a set-aside approach referred to as output-based allocation (OBA), which provides targeted allocations of a limited portion of allowances to existing NGCC units as a means of mitigating leakage. The EPA believes that this proposed set-aside would address incentives for generation to shift away from EGUs covered under mass-based plans to new unaffected EGUs. OBA provides an incentive for eligible EGUs in mass-based states to increase their generation in order to increase their allocation of allowances. This approach helps align the generation incentives for eligible EGUs in mass-based states with new EGUs that are not subject to the mass-based limits, mitigating the potential for emissions leakage.

[11] In the rate-based scenario in the RIA for the final Clean Power Plan Emission Guidelines, the generation-weighted average emission rate from affected EGUs, in which generation is inclusive of their procurement of zero-emitting generation or demand-side EE savings, in a state must be less than or equal to the state goal. One way for a state to achieve this outcome would be to assign in its plan emission rate performance standards to affected EGUs that equal the state emission rate goal, the incentives of which would be consistent with the analysis and results reported in the RIA for the final Clean Power Plan Emission Guidelines.

While the mass-based scenario analyzed for this proposed rule included a representation of the set-aside for new renewable generation, it did not quantify the effects of the OBA as proposed in this rulemaking. Therefore, in Section 1.5.6, the EPA conducted additional analysis to approximate the potential emissions reductions if the OBA set-aside were included in that mass-based scenario. The EPA is inviting comment on its approach to approximating the impact of OBA. If appropriate, the EPA will further explore OBA as a means to mitigate leakage in the analysis supporting the final federal plan and model trading rules.

The EPA notes that, in this analysis, EGUs within each state comply with the applicable state goals without exchanging a compliance instrument with EGUs in other states. However, under the proposed federal plan and model trading rules if all states had a federal plan and the same type of goal (as they do in this analysis), then trading among EGUs in different states would be allowed and would lead to differences in the generation mix and emissions. The EPA is inviting comment on this approach to the modeling that will contribute to analysis supporting the final rule.

1.5 Summary of Regulatory Analysis

1.5.1 Emissions Reductions

Table 1-1 shows the emission reductions associated with the modeled rate-based federal plan approach.

Table 1-1. Climate and Air Pollutant Emission Reductions for the Rate-Based Federal Plan Approach[1]

	CO_2 (million short tons)	SO_2 (thousand short tons)	Annual NO_X (thousand short tons)
2020 Rate-Based Approach			
Base Case	2,155	1,311	1,333
Federal Plan Approach	2,085	1,297	1,282
Emissions Change	-69	-14	-50
2025 Rate-Based Approach			
Base Case	2,165	1,275	1,302
Federal Plan Approach	1,933	1,097	1,138
Emissions Change	-232	-178	-165
2030 Rate-Based Approach			
Base Case	2,227	1,314	1,293
Federal Plan Approach	1,812	996	1,011
Emission Change	-415	-318	-282

Source: Integrated Planning Model, 2015. Emissions change may not sum due to rounding.
[1] CO_2 emission reductions are used to estimate the climate benefits of the proposed rule. SO_2, and NO_X reductions are relevant for estimating air quality health co-benefits of the proposed rule. The proposed rule is also expected to achieve reductions in directly emitted $PM_{2.5}$, which we were not able to estimate for this RIA.

In 2020, the EPA estimates that CO_2 emissions will be reduced by 69 million short tons under the rate-based approach compared to base case levels. In 2025, the EPA estimates that CO_2 emissions will be reduced by 232 million short tons under the rate-based approach compared to base case levels. CO_2 emission reductions increase to 415 million short tons annually in 2030 when compared to the base case emissions. Table 1-1 also shows emission reductions for criteria air pollutants.

Table 1-2 shows the emission reductions associated with the modeled mass-based federal plan approach.

Table 1-2. Climate and Air Pollutant Emission Reductions for the Mass-Based Federal Plan Appproach[1]

	CO_2 (million short tons)	SO_2 (thousand short tons)	Annual NO_X (thousand short tons)
2020 Mass-Based Approach			
Base Case	2,155	1,311	1,333
Federal Plan Approach	2,073	1,257	1,272
Emissions Change	-81	-54	-60
2025 Mass-Based Approach			
Base Case	2,165	1,275	1,302
Federal Plan Approach	1,901	1,090	1,100
Emissions Change	-265	-185	-203
2030 Mass-Based Approach			
Base Case	2,227	1,314	1,293
Federal Plan Approach	1,814	1,034	1,015
Emission Change	-413	-280	-278

Source: Integrated Planning Model, 2015. Emissions change may not sum due to rounding.
[1] CO_2 emission reductions are used to estimate the climate benefits of the proposed rule. SO_2, and NO_X reductions are relevant for estimating air quality health co-benefits of the proposed rule. The proposed rule is also expected to achieve reductions in directly emitted $PM_{2.5}$, which we were not able to estimate for this RIA.

In 2020, the EPA estimates that CO_2 emissions will be reduced by 81 million short tons under the mass-based approach compared to base case levels. In 2025, the EPA estimates that CO_2 emissions will be reduced by 265 million short tons under the mass-based approach compared to base case levels. CO_2 emission reductions increase to 413 million short tons annually in 2030 when compared to the base case emissions. Table 1-2 also shows emission reductions for criteria air pollutants.

Table 1-3 presents CO_2 emission reductions relative to 2005 for the two federal plan approaches.

Table 1-3. Projected CO_2 Emission Reductions, Relative to 2005

	CO_2 Emissions (million short tons)	CO_2 Emissions: Change from 2005 (million short tons)			CO_2 Emissions Reductions: Percent Change from 2005		
	2005	2020	2025	2030	2020	2025	2030
Base Case	2,683	-528	-518	-456	-20%	-19%	-17%
Rate-based	-	-598	-750	-871	-22%	-28%	-32%
Mass-based	-	-610	-782	-869	-23%	-29%	-32%

Source: Integrated Planning Model, 2015.

In 2020, the EPA estimates that CO_2 emissions will be reduced by 598 million short tons (22 percent) under the rate-based approach compared to 2005 levels. In 2025, the EPA estimates that CO_2 emissions will be reduced by 750 million short tons (28 percent) under the rate-based approach compared to 2005 levels. Under the rate-based approach, CO_2 emission reductions increase to 871 million short tons (32 percent) in 2030 when compared to 2005 levels.

Under the mass-based approach in 2020, the EPA estimates that CO_2 emissions will be reduced by 610 million short tons (23 percent) under the rate-based approach compared to 2005 levels. In 2025, the EPA estimates that CO_2 emissions will be reduced by 782 million short tons (29 percent) under the mass-based approach compared to 2005 levels. Under the mass-based approach, CO_2 emission reductions increase to 869 million short tons (32 percent) in 2030 when compared to 2005 levels.

1.5.2 Costs

The compliance cost estimates in this analysis are the change in electric power generation costs between the base case and federal plan approach policy cases, including the cost of demand-side energy efficiency measures and costs associated with monitoring, reporting, and recordkeeping requirements (MR&R).[12] In the rate-based approach, energy efficiency activities are modeled as being used by EGUs as a low-cost method of demonstrating compliance with their rate-based emissions standards. In the mass-based approach, energy efficiency activities are assumed to be adopted by states to lower demand, which in turn reduces the cost of achieving the

[12] See Chapter 3 of the Clean Power Plan Final Rule RIA for a detailed discussion of the compliance cost estimates.

mass limitations. The level of energy efficiency measures is determined outside of IPM and is assumed to be the same in the two federal plan approaches.[13] The compliance assumptions, and therefore the projected "compliance costs" set forth in this analysis, are illustrative in nature.

The annual compliance cost is the projected additional cost of complying with the rule in the year analyzed and reflects the net difference in the sum of the annualized cost of capital investment in new generating sources and heat rate improvements at coal steam facilities, the change in the ongoing costs of operating pollution controls, shifts between or amongst various fuels, demand-side energy efficiency measures, and other actions associated with compliance. The costs for both federal plan approaches are reflected in Table 1-4 below. All dollar estimates are in 2011 dollars.

The EPA estimates the annual incremental compliance cost for the rate-based approach for the proposed federal plan and model trading rules to be $2.5 billion in 2020, $1.0 billion in 2025 and $8.4 billion in 2030. The EPA estimates the annual incremental compliance cost for the mass-based approach for the federal plan and model trading rules to be $1.4 billion in 2020, $3.0 billion in 2025 and $5.1 billion in 2030.

Table 1-4. Compliance Costs for the Federal Rate-Based and Mass-Based Plan Approaches

	Incremental Cost from Base Case (billions of 2011$)	
	Rate-based Approach	**Mass-based Approach**
2020	$2.5	$1.4
2025	$1.0	$3.0
2030	$8.4	$5.1

Source: Integrated Planning Model, 2015, with post-processing to account for exogenous demand-side management energy efficiency costs and monitoring, reporting, and recordkeeping costs. See Chapter 3 of the Clean Power Plan Final Rule RIA for a more complete explanation.

The costs reported in Table 1-4 represent the estimated incremental electric utility generating costs changes from the base case plus the estimates of demand-side energy efficiency program costs (which are paid by electric utilities), demand-side energy efficiency participant costs (which are paid by electricity consumers), and MR&R costs. For example, in 2030, under the rate-based approach, the incremental electric utility generating costs decline by about $18.0

[13] For more detailed information on demand-side energy efficiency, see U.S. EPA. 2015b. Technical Support Document (TSD) the Final Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units. Demand-Side Energy Efficiency.

billion from the base case. MR&R requirements in 2030 are estimated at $16.0 million, and demand-side energy efficiency costs in 2030 are estimated to be $26.3 billion, split equally between program and participants using a 3 percent discount rate (see Chapter 3 of this RIA for more details on these estimates). These cost estimates sum to the $8.4 billion shown in Table 1-4 and represent the total costs of the rate-based federal plan approach in 2030. The same approach applies in each year of analysis for the rate-based and the mass-based federal plan approaches.

The compliance costs reported in Table 1-4 are not social costs. These costs represent the estimated expenditures incurred by EGUs, the costs to participants in demand-side energy efficiency programs, and states to comply with the BSER goals for the Final Clean Power Plan Emission Guidelines. These compliance cost estimates are compared to estimates of social benefits to derive net benefits of the proposed federal plan and model trading rules, which are presented later in this Chapter.

1.5.3 Monetized Climate Benefits and Health Co-benefits

The climate benefits estimates have been calculated using the estimated values of marginal climate impacts presented in the *Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866 (May 2013, Revised July 2015)*, henceforth denoted as the current SC-CO_2 TSD.[14] Additionally, this analysis takes into account the social benefits of changes in emissions of non-CO_2 pollutants from the electricity sector. The range of combined benefits reflects different concentration-response functions for the air quality health co-benefits, but it does not capture the full range of uncertainty inherent in the health co-benefits estimates. Furthermore, we were unable to quantify or monetize all of the climate benefits and health and environmental co-benefits associated with the proposed federal plan and model trading rules, including reductions in directly emitted $PM_{2.5}$, reduced exposure to SO_2, NO_X, and hazardous air pollutants (e.g., mercury), as well as ecosystem effects and visibility improvement. The omission of these endpoints from the

[14] Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, Interagency Working Group on Social Cost of Carbon, with participation by Council of Economic Advisers, Council on Environmental Quality, Department of Agriculture, Department of Commerce, Department of Energy, Department of Transportation, Domestic Policy Council, Environmental Protection Agency, National Economic Council, Office of Management and Budget, Office of Science and Technology Policy, and Department of Treasury (May 2013, Revised July 2015). Available at: <https://www.whitehouse.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf> Accessed 7/11/2015.

monetized results should not imply that the impacts are small or unimportant. Table 1-5 provides the list of the quantified and unquantified health and environmental benefits in this analysis.

Table 1-5. Quantified and Unquantified Benefits

Benefits Category	Specific Effect	Effect Has Been Quantified	Effect Has Been Monetized	More Information
Improved Environment				
Reduced climate effects	Global climate impacts from CO_2	—[1]	✓	SC-CO_2 TSD
	Climate impacts from ozone and black carbon (directly emitted PM)	—	—	Ozone ISA, PM ISA[2]
	Other climate impacts (e.g., other GHGs such as methane, aerosols, other impacts)	—	—	IPCC[2]
Improved Human Health (co-benefits)				
Reduced incidence of premature mortality from exposure to $PM_{2.5}$	Adult premature mortality based on cohort study estimates and expert elicitation estimates (age >25 or age >30)	✓	✓	PM ISA
	Infant mortality (age <1)	✓	✓	PM ISA
Reduced incidence of morbidity from exposure to $PM_{2.5}$	Non-fatal heart attacks (age > 18)	✓	✓	PM ISA
	Hospital admissions—respiratory (all ages)	✓	✓	PM ISA
	Hospital admissions—cardiovascular (age >20)	✓	✓	PM ISA
	Emergency room visits for asthma (all ages)	✓	✓	PM ISA
	Acute bronchitis (age 8-12)	✓	✓	PM ISA
	Lower respiratory symptoms (age 7-14)	✓	✓	PM ISA
	Upper respiratory symptoms (asthmatics age 9-11)	✓	✓	PM ISA
	Asthma exacerbation (asthmatics age 6-18)	✓	✓	PM ISA
	Lost work days (age 18-65)	✓	✓	PM ISA
	Minor restricted-activity days (age 18-65)	✓	✓	PM ISA
	Chronic Bronchitis (age >26)	—	—	PM ISA[2]
	Emergency room visits for cardiovascular effects (all ages)	—	—	PM ISA[2]
	Strokes and cerebrovascular disease (age 50-79)	—	—	PM ISA[2]
	Other cardiovascular effects (e.g., other ages)	—	—	PM ISA[3]
	Other respiratory effects (e.g., pulmonary function, non-asthma ER visits, non-bronchitis chronic diseases, other ages and populations)	—	—	PM ISA[3]
	Reproductive and developmental effects (e.g., low birth weight, pre-term births, etc)	—	—	PM ISA[3,4]
	Cancer, mutagenicity, and genotoxicity effects	—	—	PM ISA[3,4]
Reduced incidence of mortality from exposure to ozone	Premature mortality based on short-term study estimates (all ages)	✓	✓	Ozone ISA
	Premature mortality based on long-term study estimates (age 30–99)	—	—	Ozone ISA[2]
Reduced incidence of morbidity from exposure to ozone	Hospital admissions—respiratory causes (age > 65)	✓	✓	Ozone ISA
	Hospital admissions—respiratory causes (age <2)	✓	✓	Ozone ISA
	Emergency department visits for asthma (all ages)	✓	✓	Ozone ISA
	Minor restricted-activity days (age 18–65)	✓	✓	Ozone ISA
	School absence days (age 5–17)	✓	✓	Ozone ISA
	Decreased outdoor worker productivity (age 18–65)	—	—	Ozone ISA[2]
	Other respiratory effects (e.g., premature aging of lungs)	—	—	Ozone ISA[3]
	Cardiovascular and nervous system effects	—	—	Ozone ISA[3]
	Reproductive and developmental effects	—	—	Ozone ISA[3,4]

Table 1-5. Continued

Reduced incidence of morbidity from exposure to NO_2	Asthma hospital admissions (all ages)	—	—	NO_2 ISA[2]
	Chronic lung disease hospital admissions (age > 65)	—	—	NO_2 ISA[2]
	Respiratory emergency department visits (all ages)	—	—	NO_2 ISA[2]
	Asthma exacerbation (asthmatics age 4–18)	—	—	NO_2 ISA[2]
	Acute respiratory symptoms (age 7–14)	—	—	NO_2 ISA[2]
	Premature mortality	—	—	NO_2 ISA[2,3,4]
	Other respiratory effects (e.g., airway hyperresponsiveness and inflammation, lung function, other ages and populations)	—	—	NO_2 ISA[3,4]
Reduced incidence of morbidity from exposure to SO_2	Respiratory hospital admissions (age > 65)	—	—	SO_2 ISA[2]
	Asthma emergency department visits (all ages)	—	—	SO_2 ISA[2]
	Asthma exacerbation (asthmatics age 4–12)	—	—	SO_2 ISA[2]
	Acute respiratory symptoms (age 7–14)	—	—	SO_2 ISA[2]
	Premature mortality	—	—	SO_2 ISA[2,3,4]
	Other respiratory effects (e.g., airway hyperresponsiveness and inflammation, lung function, other ages and populations)	—	—	SO_2 ISA[2,3]
Reduced incidence of morbidity from exposure to methylmercury	Neurologic effects—IQ loss	—	—	IRIS; NRC, 2000[2]
	Other neurologic effects (e.g., developmental delays, memory, behavior)	—	—	IRIS; NRC, 2000[3]
	Cardiovascular effects	—	—	IRIS; NRC, 2000[3,4]
	Genotoxic, immunologic, and other toxic effects	—	—	IRIS; NRC, 2000[3,4]
Improved Environment (co-benefits)				
Reduced visibility impairment	Visibility in Class 1 areas	—	—	PM ISA[2]
	Visibility in residential areas	—	—	PM ISA[2]
Reduced effects on materials	Household soiling	—	—	PM ISA[2,3]
	Materials damage (e.g., corrosion, increased wear)	—	—	PM ISA[3]
Reduced PM deposition (metals and organics)	Effects on individual organisms and ecosystems	—	—	PM ISA[3]
Reduced vegetation and ecosystem effects from exposure to ozone	Visible foliar injury on vegetation	—	—	Ozone ISA[2]
	Reduced vegetation growth and reproduction	—	—	Ozone ISA[2]
	Yield and quality of commercial forest products and crops	—	—	Ozone ISA[2]
	Damage to urban ornamental plants	—	—	Ozone ISA[3]
	Carbon sequestration in terrestrial ecosystems	—	—	Ozone ISA[2]
	Recreational demand associated with forest aesthetics	—	—	Ozone ISA[3]
	Other non-use effects			Ozone ISA[3]
	Ecosystem functions (e.g., water cycling, biogeochemical cycles, net primary productivity, leaf-gas exchange, community composition)	—	—	Ozone ISA[3]
Reduced effects from acid deposition	Recreational fishing	—	—	NO_x SO_x ISA[2]
	Tree mortality and decline	—	—	NO_x SO_x ISA[3]
	Commercial fishing and forestry effects	—	—	NO_x SO_x ISA[3]
	Recreational demand in terrestrial and aquatic ecosystems	—	—	NO_x SO_x ISA[3]
	Other non-use effects			NO_x SO_x ISA[3]
	Ecosystem functions (e.g., biogeochemical cycles)	—	—	NO_x SO_x ISA[3]

Table 1-5. Continued

Reduced effects from nutrient enrichment	Species composition and biodiversity in terrestrial and estuarine ecosystems	—	—	NO_x SO_x ISA[3]
	Coastal eutrophication	—	—	NO_x SO_x ISA[3]
	Recreational demand in terrestrial and estuarine ecosystems	—	—	NO_x SO_x ISA[3]
	Other non-use effects			NO_x SO_x ISA[3]
	Ecosystem functions (e.g., biogeochemical cycles, fire regulation)	—	—	NO_x SO_x ISA[3]
Reduced vegetation effects from exposure to SO_2 and NO_x	Injury to vegetation from SO_2 exposure	—	—	NO_x SO_x ISA[3]
	Injury to vegetation from NO_x exposure	—	—	NO_x SO_x ISA[3]
Reduced ecosystem effects from exposure to methylmercury	Effects on fish, birds, and mammals (e.g., reproductive effects)	—	—	Mercury Study RTC[3]
	Commercial, subsistence and recreational fishing	—	—	Mercury Study RTC[2]

[1] The global climate and related impacts of CO_2 emissions changes, such as sea level rise, are estimated within each integrated assessment model as part of the calculation of the SC-CO_2. The resulting monetized damages, which are relevant for conducting the benefit-cost analysis, are used in this RIA to estimate the welfare effects of quantified changes in CO_2 emissions.

[2] We assess these co-benefits qualitatively, as reported in the Chapter 4 of the Clean Power Plan Final Rule RIA, due to data and resource limitations for this analysis.

[3] We assess these co-benefits qualitatively, as reported in the Chapter 4 of the Clean Power Plan Final Rule RIA, because we do not have sufficient confidence in available data or methods.

[4] We assess these co-benefits qualitatively, as reported in the Chapter 4 of the Clean Power Plan Final Rule RIA, because current evidence is only suggestive of causality or there are other significant concerns over the strength of the association.

1.5.3.1 Estimating Global Climate Benefits

We estimate the global social benefits of CO_2 emission reductions expected from this rulemaking using the SC-CO_2 estimates presented in the current SC-CO_2 TSD.[15] We refer to these estimates, which were developed by the U.S. government, as "SC-CO_2 estimates" for the remainder of this document. The SC-CO_2 is a metric that estimates the monetary value of impacts associated with marginal changes in CO_2 emissions in a given year. It includes a wide range of anticipated climate impacts, such as net changes in agricultural productivity and human health, property damage from increased flood risk, and changes in energy system costs, such as reduced costs for heating and increased costs for air conditioning. It is typically used to assess

[15] Also see Chapter 4 of the Clean Power Plan Final Rule RIA for more details on this assessment of climate benefits.

the avoided damages as a result of regulatory actions (i.e., benefits of rulemakings that lead to an incremental reduction in cumulative global CO_2 emissions).

The SC-CO_2 estimates used in this analysis have been developed over many years, using the best science available, and with input from the public. The EPA and other federal agencies have considered the extensive public comments on ways to improve SC-CO_2 estimation received via the notice and comment period that was part of numerous rulemakings. In addition, OMB's Office of Information and Regulatory Affairs recently issued a response to the public comments it sought through a separate comment period on the approach used to develop the SC-CO_2 estimates.[16]

An interagency working group (IWG) that included the EPA and other executive branch entities used three integrated assessment models (IAMs) to develop SC-CO_2 estimates and recommended four global values for use in regulatory analyses. The SC-CO_2 estimates represent global measures because of the distinctive nature of the climate change problem. Emissions of greenhouse gases contribute to damages around the world, even when they are released in the United States, and the world's economies are now highly interconnected. Therefore, the SC-CO_2 estimates incorporate the worldwide damages caused by carbon dioxide emissions in order to reflect the global nature of the problem, and we expect other governments to consider the global consequences of their greenhouse gas emissions when setting their own domestic policies. See Chapter 4 of the final Clean Power Plan Emission Guidelines RIA for more discussion.

The IWG first released the estimates in February 2010 and updated them in 2013 using new versions of each IAM. The SC-CO_2 values was estimated using three integrated assessment models (DICE, FUND, and PAGE)[17], which the IWG harmonized across three key inputs: the probability distribution for equilibrium climate sensitivity; five scenarios for economic, population, and emissions growth; and three constant discount rates. The 2010 SC-CO_2 Technical Support Document (2010 SC-CO_2 TSD) provides a complete discussion of the methodology and the current SC-CO_2 TSD[18] presents and discusses the updated estimates. The

[16] See https://www.whitehouse.gov/sites/default/files/omb/inforeg/scc-response-to-comments-final-july-2015.pdf

[17] The full models names are as follows: Dynamic Integrated Climate and Economy (DICE); Climate Framework for Uncertainty, Negotiation, and Distribution (FUND); and Policy Analysis of the Greenhouse Gas Effect (PAGE).

[18] The IWG published the updated TSD in 2013, then issued two minor corrections to it in July 2015.

four SC-CO_2 estimates are as follows: $12, $40, $60, and $120 per short ton of CO_2 emissions in the year 2020 (2011$), and each estimate increases over time.[19] These SC-CO_2 estimates are associated with different discount rates. The first three estimates are the model average at 5 percent discount rate, 3 percent, and 2.5 percent, respectively, and the fourth estimate is the 95th percentile at 3 percent.

The 2010 SC-CO_2 TSD noted a number of limitations to the SC-CO_2 analysis, including the incomplete way in which the IAMs capture catastrophic and non-catastrophic impacts, their incomplete treatment of adaptation and technological change, uncertainty in the extrapolation of damages to high temperatures, and assumptions regarding risk aversion. Currently integrated assessment models do not assign value to all of the important physical, ecological, and economic impacts of climate change recognized in the climate change literature because of a lack of precise information on the nature of damages and because the science incorporated into these models understandably lags behind the most recent research.[20] In particular, the IPCC Fourth Assessment Report concluded that "It is very likely that [SC-CO_2 estimates] underestimate the damage costs because they cannot include many non-quantifiable impacts." Nonetheless, these estimates and the discussion of their limitations represent the best available information about the social benefits of CO_2 emission reductions to inform the benefit-cost analysis.

In addition, after careful evaluation of the full range of comments submitted to OMB's Office of Information and Regulatory Affairs, the IWG continues to recommend the use of these SC-CO_2 estimates in regulatory impact analysis. With the release of the response to comments, the IWG announced plans to obtain expert independent advice from the National Academies of Sciences, Engineering, and Medicine (Academies) to ensure that the SC-CO_2 estimates continue to reflect the best available scientific and economic information on climate change.[21] The

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[19] The 2010 and 2013 TSDs present SC-CO_2 in 2007$ per metric ton. The unrounded estimates from the current TSD were adjusted to (1) 2011$ using GDP Implicit Price Deflator (1.061374), http://www.bea.gov/iTable/index_nipa.cfm and (2) short tons using the conversion factor of 0.90718474 metric tons in a short ton. These estimates were rounded to two significant digits.

[20] Climate change impacts and SCC modeling is an area of active research. For example, see: (1) Howard, Peter, "Omitted Damages: What's Missing from the Social Cost of Carbon." March 13, 2014, http://costofcarbon.org/files/Omitted_Damages_Whats_Missing_From_the_Social_Cost_of_Carbon.pdf; and (2) Electric Power Research Institute, "Understanding the Social Cost of Carbon: A Technical Assessment," October 2014, www.epri.com.

[21] See <https://www.whitehouse.gov/blog/2015/07/02/estimating-benefits-carbon-dioxide-emissions-reductions>.

Academies' process will be informed by the public comments received and focus on the technical merits and challenges of potential approaches to improving the SC-CO_2 estimates in future updates.

1.5.3.2 Estimating Air Quality Health Co-Benefits

The proposed federal plan and model trading rules would reduce emissions of precursor pollutants (e.g., SO_2, NO_X, and directly emitted particles), which in turn would lower ambient concentrations of $PM_{2.5}$ and ozone. This co-benefits analysis quantifies the monetized benefits associated with the reduced exposure to these two pollutants.[22] Unlike the global SC-CO_2 estimates, the air quality health co-benefits are only estimated for the contiguous U.S. The estimates of monetized $PM_{2.5}$ co-benefits include avoided premature deaths (derived from effect coefficients in two cohort studies [Krewski *et al.* 2009 and Lepeule *et al.* 2012] for adults and one for infants [Woodruff *et al.* 1997]), as well as avoided morbidity effects for ten non-fatal endpoints ranging in severity from lower respiratory symptoms to heart attacks[23] (U.S. EPA, 2012). The estimates of monetized ozone co-benefits include avoided premature deaths (derived from the range of effect coefficients represented by two short-term epidemiology studies [Bell *et al.* (2004) and Levy *et al.* (2005)]), as well as avoided morbidity effects for five non-fatal endpoints ranging in severity from school absence days to hospital admissions (U.S. EPA, 2008, 2011).

We use a "benefit-per-ton" approach to estimate the $PM_{2.5}$ and ozone co-benefits in this RIA. Benefit-per-ton approaches apply an average benefit per ton derived from modeling of benefits of specific air quality scenarios to estimates of emissions reductions for scenarios where no air quality modeling is available. The benefit-per-ton approach we use in this RIA relies on estimates of human health responses to exposure to PM and ozone obtained from the peer-reviewed scientific literature. These estimates are used in conjunction with population data,

[22] We did not estimate the co-benefits associated with reducing direct exposure to SO_2 and NO_X. For this RIA, we did not estimate changes in emissions of directly emitted particles. As a result, quantified $PM_{2.5}$ related benefits are underestimated by a relatively small amount. In the proposal RIA, the benefits from reductions in directly emitted $PM_{2.5}$ were less than 10 percent of total monetized health co-benefits across all scenarios and years.

[23] See Chapter 4 and Appendix 4A of the Clean Power Plan Final Rule for details on this assessment of health co-benefits.

baseline health information, air quality data and economic valuation information to conduct health impact and economic benefits assessments.

Specifically, in this analysis, we multiplied the benefit-per-ton estimates by the corresponding emission reductions that were generated from air quality modeling of the proposed Clean Power Plan Emission Guidelines. Similar to the co-benefits analysis conducted for the final Clean Power Plan Emission Guidelines RIA, we generated regional benefit-per-ton estimates by aggregating the impacts in BenMAP[24] to the region (i.e., East, West, and California) rather than aggregating to the nation. The benefit-per-ton for SO_2 and NO_x emissions used in this proposed rule were calculated using air quality modeling of the base case and the proposed Clean Power Plan (Option 1 State) scenario for 2025 as described in Appendix 4A of the final Clean Power Plan Emission Guidelines RIA. The benefit-per-ton values for 2020 and 2030 are based on applying the air quality modeling from 2025 to population and health information from 2020 and 2030.

To calculate the co-benefits for this proposed rule, we then multiplied the regional benefit-per-ton estimates for the EGU sector by the corresponding emission reductions. All benefit-per-ton estimates reflect the geographic distribution of the modeled emissions, which may not exactly match the emission reductions in this rulemaking, and thus they may not reflect the local variability in population density, meteorology, exposure, baseline health incidence rates, or other local factors for any specific location.

Our estimate of the monetized co-benefits is based on the EPA's interpretation of the best available scientific literature (U.S. EPA, 2009) and methods and supported by the EPA's Science Advisory Board and the NAS (NRC, 2002). Below are key assumptions underlying the estimates for $PM_{2.5}$-related premature mortality, which accounts for 98 percent of the monetized $PM_{2.5}$ health co-benefits.

1. We assume that all fine particles, regardless of their chemical composition, are equally potent in causing premature mortality. This is an important assumption,

[24] BenMAP is a computer program developed by the EPA that calculates the number and economic value of air pollution-related deaths and illnesses. The software incorporates a database that includes many of the concentration-response relationships, population files, and health and economic data needed to quantify these impacts.

because $PM_{2.5}$ varies considerably in composition across sources, but the scientific evidence is not yet sufficient to allow differentiation of effect estimates by particle type. The PM ISA concluded that "many constituents of $PM_{2.5}$ can be linked with multiple health effects, and the evidence is not yet sufficient to allow differentiation of those constituents or sources that are more closely related to specific outcomes" (U.S. EPA, 2009b).

2. We assume that the health impact function for fine particles is log-linear without a threshold in this analysis. Thus, the estimates include health co-benefits from reducing fine particles in areas with varied concentrations of $PM_{2.5}$, including both areas that do not meet the National Ambient Air Quality Standard for fine particles and those areas that are in attainment, down to the lowest modeled concentrations.

3. We assume that there is a "cessation" lag between the change in PM exposures and the total realization of changes in mortality effects. Specifically, we assume that some of the incidences of premature mortality related to $PM_{2.5}$ exposures occur in a distributed fashion over the 20 years following exposure based on the advice of the SAB-H1 (U.S. EPA-SAB, 2004c), which affects the valuation of mortality co-benefits at different discount rates.

Every benefits analysis examining the potential effects of a change in environmental protection requirements is limited, to some extent, by data gaps, model capabilities (such as geographic coverage) and uncertainties in the underlying scientific and economic studies used to configure the benefit and cost models. Despite these uncertainties, we believe this analysis provides a reasonable indication of the expected health co-benefits of the air quality emission reductions for the proposed rule under a set of reasonable assumptions. This analysis does not include the type of detailed uncertainty assessment found in the 2012 $PM_{2.5}$ National Ambient Air Quality Standard (NAAQS) RIA (U.S. EPA, 2012) because we lack the necessary air quality input and monitoring data to conduct a complete benefits assessment. In addition, using a benefit-per-ton approach adds another important source of uncertainty to the benefits estimates.

1.5.3.3 Combined Benefits Estimates

The EPA has evaluated the range of potential impacts by combining all four SC-CO_2 values with health co-benefits values at the 3 percent and 7 percent discount rates. Different

discount rates are applied to SC-CO_2 than to the health co-benefit estimates because CO_2 emissions are long-lived and subsequent damages occur over many years. Moreover, several discount rates are applied to SC-CO_2 because the literature shows that the estimate of SC-CO_2 is sensitive to assumptions about discount rate and because no consensus exists on the appropriate rate to use in an intergenerational context. The IWG centered its attention on the average SC-CO_2 at a 3 percent discount rate but emphasized the importance of considering all four SC-CO_2 estimates. Table 1-6 (rate-based federal plan approach) and Table 1-7 (mass-based federal plan approach) provide the combined climate benefits and health co-benefits for the proposed federal plan model trading rules estimated for 2020, 2025, and 2030 for each discount rate combination. All dollar estimates are in 2011 dollars.

Table 1-6. Combined Estimates of Climate Benefits and Health Co-Benefits for Rate-Based Approach (billions of 2011$)*

SC-CO_2 Discount Rate and Statistic**	Climate Benefits Only	Climate Benefits plus Health Co-benefits (Discount Rate Applied to Health Co-benefits)					
		3%			7%		
In 2020	69	million short tons CO_2					
5%	$0.80	$1.5	to	$2.6	$1.4	to	$2.5
3%	$2.8	$3.5	to	$4.6	$3.5	to	$4.5
2.5%	$4.1	$4.9	to	$6.0	$4.8	to	$5.9
3% (95th percentile)	$8.2	$8.9	to	$10	$8.9	to	$9.9
In 2025	232	million short tons CO_2					
5%	$3.1	$11	to	$21	$9.9	to	$19
3%	$10	$18	to	$28	$17	to	$26
2.5%	$15	$23	to	$33	$22	to	$31
3% (95th percentile)	$31	$38	to	$49	$38	to	$47
In 2030	415	million short tons CO_2					
5%	$6.4	$21	to	$40	$19	to	$37
3%	$20	$34	to	$54	$33	to	$51
2.5%	$29	$43	to	$63	$42	to	$60
3% (95th percentile)	$61	$75	to	$95	$74	to	$92

*All benefit estimates are rounded to two significant figures. Climate benefits are based on reductions in CO_2 emissions. Co-benefits are based on regional benefit-per-ton estimates. Ozone co-benefits occur in analysis year, so they are the same for all discount rates. The health co-benefits reflect the sum of the $PM_{2.5}$ and ozone co-benefits and reflect the range based on adult mortality functions (e.g., from Krewski *et al.* (2009) with Bell *et al.* (2004) to Lepeule *et al.* (2012) with Levy *et al.* (2005)). The monetized health co-benefits do not include reduced health effects from reductions in directly emitted $PM_{2.5}$, direct exposure to NO_X, SO_2, and HAP; ecosystem effects; or visibility impairment. See Chapter 4 of the Clean Power Plan Final Rule RIA for more information about these estimates and for more information regarding the uncertainty in these estimates.

**Unless otherwise specified, the row reflects the average SC-CO_2 estimate for the specified discount rate.

Table 1-7. Combined Estimates of Climate Benefits and Health Co-benefits for Mass-Based Approach (billions of 2011$)*

SC-CO_2 Discount Rate and Statistic**	Climate Benefits Only	Climate Benefits plus Health Co-benefits (Discount Rate Applied to Health Co-benefits)	
		3%	7%
In 2020	82	million short tons CO_2	
5%	$0.94	$2.9 to $5.7	$2.8 to $5.3
3%	$3.3	$5.3 to $8.1	$5.1 to $7.7
2.5%	$4.9	$6.9 to $9.7	$6.7 to $9.3
3% (95th percentile)	$9.7	$12 to $14	$11 to $14
In 2025	264	million short tons CO_2	
5%	$3.6	$11 to $21	$10 to $19
3%	$12	$19 to $29	$18 to $27
2.5%	$17	$24 to $35	$24 to $33
3% (95th percentile)	$35	$42 to $52	$42 to $51
In 2030	413	million short tons CO_2	
5%	$6.4	$18 to $34	$17 to $32
3%	$20	$32 to $48	$31 to $46
2.5%	$29	$41 to $57	$40 to $55
3% (95th percentile)	$60	$72 to $89	$71 to $86

*All benefit estimates are rounded to two significant figures. Climate benefits are based on reductions in CO_2 emissions. Co-benefits are based on regional benefit-per-ton estimates. Ozone co-benefits occur in analysis year, so they are the same for all discount rates. The health co-benefits reflect the sum of the $PM_{2.5}$ and ozone co-benefits and reflect the range based on adult mortality functions (e.g., from Krewski *et al.* (2009) with Bell *et al.* (2004) to Lepeule *et al.* (2012) with Levy *et al.* (2005)). The monetized health co-benefits do not include reduced health effects from reductions in directly emitted $PM_{2.5}$, direct exposure to NO_X, SO_2, and HAP; ecosystem effects; or visibility impairment. See Chapter 4 of the Clean Power Plan Final Rule RIA for more information about these estimates and for more information regarding the uncertainty in these estimates.

**Unless otherwise specified, the row reflects the average SC-CO_2 estimate for the specified discount rate.

1.5.4 Net Benefits

Table 1-8 and 1-9 provide the estimates of the climate benefits, health co-benefits, compliance costs and net benefits of the proposed federal plan and model trading rules for rate-based and mass-based approaches, respectively. There are additional important benefits that the EPA could not monetize. Due to current data and modeling limitations, our estimates of the benefits from reducing CO_2 emissions do not include important impacts like ocean acidification or potential tipping points in natural or managed ecosystems. Unquantified benefits also include climate benefits from reducing emissions of non-CO_2 greenhouse gases and co-benefits from reducing exposure to SO_2, NO_X, and hazardous air pollutants (e.g., mercury), as well as ecosystem effects and visibility impairment. Upon considering these limitations and uncertainties, it remains clear that the benefits of this proposed rule are substantial and far outweigh the costs.

Table 1-8. Monetized Benefits, Compliance Costs, and Net Benefits Under the Rate-based Federal Plan Approach (billions of 2011$) [a]

	Rate-Based Approach					
	2020		2025		2030	
Climate Benefits [b]						
5% discount rate	$0.80		$3.1		$6.4	
3% discount rate	$2.8		$10		$20	
2.5% discount rate	$4.1		$15		$29	
95th percentile at 3% discount rate	$8.2		$31		$61	
	Air Quality Co-benefits Discount Rate					
	3%	7%	3%	7%	3%	7%
Air Quality Health Co-benefits [c]	$0.70 to $1.8	$0.64 to $1.7	$7.4 to $18	$6.7 to $16	$14 to $34	$13 to $31
Compliance Costs [d]	$2.5		$1.0		$8.4	
Net Benefits [e]	$1.0 to $2.1	$1.0 to $2.0	$17 to $27	$16 to $25	$26 to $45	$25 to $43
Non-Monetized Benefits	Non-monetized climate benefits Reductions in exposure to ambient NO_2 and SO_2 Reductions in mercury deposition Ecosystem benefits associated with reductions in emissions of NO_X, SO_2, PM, and mercury Visibility impairment					

[a] All are rounded to two significant figures, so figures may not sum.

[b] The climate benefit estimate in this summary table reflects global impacts from CO_2 emission changes and does not account for changes in non-CO_2 GHG emissions. Also, different discount rates are applied to SC-CO_2 than to the other estimates because CO_2 emissions are long-lived and subsequent damages occur over many years. The net benefit estimates in this table are based on the average SC-CO_2 estimated for a 3 percent discount rate, however we emphasize the importance and value of considering the full range of SC-CO_2 values. As shown in this table, climate benefits are also estimated using the other three SC-CO_2 estimates (model average at 2.5 percent discount rate, 3 percent, and 5 percent; 95th percentile at 3 percent). The SC-CO_2 estimates are year-specific and increase over time.

[c] The air quality health co-benefits reflect reduced exposure to $PM_{2.5}$ and ozone associated with emission reductions of SO_2 and NO_X. The co-benefits do not include the benefits of reductions in directly emitted $PM_{2.5}$. These additional benefits would increase overall benefits by a few percent based on the analyses conducted for the proposed rule. The range reflects the use of concentration-response functions from different epidemiology studies. The reduction in premature fatalities each year accounts for over 98 percent of total monetized co-benefits from $PM_{2.5}$ and ozone. These models assume that all fine particles, regardless of their chemical composition, are equally potent in causing premature mortality because the scientific evidence is not yet sufficient to allow differentiation of effect estimates by particle type. Estimates in the table are presented for three analytical years with air quality co-benefits calculated using two discount rates. The estimates of co-benefits are annual estimates in each of the analytical years, reflecting discounting of mortality benefits over the cessation lag between changes in $PM_{2.5}$ concentrations and changes in risks of premature death (see Chapter 4 of the Clean Power Plan Final Rule RIA for more details), and discounting of morbidity benefits due to the multiple years of costs associated with some illnesses. The estimates are not the present value of the benefits of the rule over the full compliance period.

[d] Compliance costs are the compliance costs estimated using the Integrated Planning Model and a discount rate of approximately 5 percent. It also includes monitoring, recordkeeping, and reporting costs and demand-side energy efficiency program and participant costs.

[e] The estimates of net benefits in this summary table are calculated using the global SC-CO_2 at a 3 percent discount rate (model average). The Clean Power Plan Final Rule RIA includes combined climate and health estimates based on additional discount rates.

Table 1-9. Monetized Benefits, Compliance Costs, and Net Benefits under the Mass-based Federal Plan Approach (billions of 2011$) [a]

	Mass-Based Approach					
	2020		2025		2030	
Climate Benefits [b]						
5% discount rate	$0.94		$3.6		$6.4	
3% discount rate	$3.3		$12		$20	
2.5% discount rate	$4.9		$17		$29	
95th percentile at 3% discount rate	$9.7		$35		$60	
	Air Quality Co-benefits Discount Rate					
	3%	7%	3%	7%	3%	7%
Air Quality Health Co-benefits [c]	$2.0 to $4.8	$1.8 to $4.4	$7.1 to $17	$6.5 to $16	$12 to $28	$11 to $26
Compliance Costs [d]	$1.4		$3.0		$5.1	
Net Benefits [e]	$3.9 to $6.7	$3.7 to $6.3	$16 to $26	$15 to $24	$26 to $43	$25 to $40
Non-Monetized Benefits	Non-monetized climate benefits Reductions in exposure to ambient NO_2 and SO_2 Reductions in mercury deposition Ecosystem benefits associated with reductions in emissions of NO_X, SO_2, PM, and mercury Visibility improvement					

[a] All are rounded to two significant figures, so figures may not sum.

[b] The climate benefit estimate in this summary table reflects global impacts from CO_2 emission changes and does not account for changes in non-CO_2 GHG emissions. Also, different discount rates are applied to SC-CO_2 than to the other estimates because CO_2 emissions are long-lived and subsequent damages occur over many years. The net benefit estimates in this table are based on the average SC-CO_2 estimated for a 3 percent discount rate, however we emphasize the importance and value of considering the full range of SC-CO_2 values. As shown in this table, climate benefits are also estimated using the other three SC-CO_2 estimates (model average at 2.5 percent discount rate, 3 percent, and 5 percent; 95th percentile at 3 percent). The SC-CO_2 estimates are year-specific and increase over time.

[c] The air quality health co-benefits reflect reduced exposure to $PM_{2.5}$ and ozone associated with emission reductions of SO_2 and NO_X. The co-benefits do not include the benefits of reductions in directly emitted $PM_{2.5}$. These additional benefits would increase overall benefits by a few percent based on the analyses conducted for the proposed rule. The range reflects the use of concentration-response functions from different epidemiology studies. The reduction in premature fatalities each year accounts for over 98 percent of total monetized co-benefits from $PM_{2.5}$ and ozone. These models assume that all fine particles, regardless of their chemical composition, are equally potent in causing premature mortality because the scientific evidence is not yet sufficient to allow differentiation of effect estimates by particle type. Estimates in the table are presented for three analytical years with air quality co-benefits calculated using two discount rates. The estimates of co-benefits are annual estimates in each of the analytical years, reflecting discounting of mortality benefits over the cessation lag between changes in $PM_{2.5}$ concentrations and changes in risks of premature death (see Chapter 4 of the Clean Power Plan Final Rule RIA for more details), and discounting of morbidity benefits due to the multiple years of costs associated with some illnesses. The estimates are not the present value of the benefits of the rule over the full compliance period.

[d] Compliance costs are the compliance costs estimated using the Integrated Planning Model and a discount rate of approximately 5 percent. It also includes monitoring, recordkeeping, and reporting costs and demand-side energy efficiency program and participant costs.

[e] The estimates of net benefits in this summary table are calculated using the global SC-CO_2 at a 3 percent discount rate (model average). The Clean Power Plan Final Rule RIA includes combined climate and health estimates based on additional discount rates.

1.5.5 Economic Impacts

The federal plan approaches analyzed in this RIA indicate that the proposed federal plan and model trading rules may have important energy market implications. Table 1-10 presents a variety of important energy market impacts for 2020, 2025, and 2030 for both the rate-based and mass-based federal plan approaches.

Table 1-10. Summary Table of Important Energy Market Impacts (Percent Change from Base Case)

	Rate-Based			Mass-Based		
	2020	**2025**	**2030**	**2020**	**2025**	**2030**
Retail electricity prices	3%	1%	1%	3%	2%	0%
Average electricity bills	3%	-4%	-7%	2%	-3%	-8%
Price of coal at minemouth	-1%	-5%	-4%	-1%	-5%	-3%
Coal production for power sector use	-5%	-14%	-25%	-7%	-17%	-24%
Price of natural gas delivered to power sector	5%	-8%	2%	4%	-3%	-2%
Natural gas use for electricity generation	3%	-1%	-1%	5%	0%	-4%

Energy market impacts are discussed more extensively in Chapter 3 of the final Clean Power Plan Emission Guidelines RIA. As well as the above energy market impacts, Chapter 3 of the final Clean Power Plan Emission Guidelines RIA presents projections of power sector generation and capacity changes by fuel type.

Additionally, changes in supply or demand for electricity, natural gas, and coal can impact markets for goods and services produced by sectors that use these energy inputs in the production process or that supply those sectors. Changes in cost of production may result in changes in price and/or quantity produced by these sectors and these market changes may affect the profitability of firms and the economic welfare of their consumers. Similarly, demand for new generation or energy efficiency, for example, can result in changes in production and profitability for firms that supply those goods and services. The EPA recognizes that states subject to the federal plan may choose to mitigate impacts to some markets outside the EGU sector, perhaps by implementing the guidelines through a state plan.

1.5.6 Employment Impacts

Executive Order 13563 directs federal agencies to consider the effect of regulations on job creation and employment. According to the Executive Order, “our regulatory system must

protect public health, welfare, safety, and our environment while promoting economic growth, innovation, competitiveness, and job creation. It must be based on the best available science" (Executive Order 13563, 2011). Although standard benefit-cost analyses have not typically included a separate analysis of regulation-induced employment impacts, we typically conduct employment analyses.[25] While the economy continues moving toward full-employment, employment impacts are of particular concern and questions may arise about their existence and magnitude.

Given the wide range of approaches that may be used to meet the requirements of the proposed federal plan and model trading rules, quantifying the associated employment impacts is difficult. The EPA's illustrative employment analysis includes an estimate of projected employment impacts for the utility power sector, coal and natural gas production, and demand-side energy efficiency activities. These projections are derived, in part, from the detailed model of the utility power sector used for this regulatory analysis, and U.S government data on employment and labor productivity.

In the electricity, coal, and natural gas sectors, the EPA uses the IPM estimates of the changes in generation and fuel use of the proposed rule to estimate there could be a net decrease of approximately 25,000 job-years[26] in 2025 for the proposed rule under the rate-based federal plan approach and approximately 26,000 job-years in 2025 under the mass-based approach. For 2030 the estimates of the net decrease in job-years is 30,900 under the rate-based plan, and 33,700 under the mass-based plan. The Agency is also offering an illustrative calculation of potential employment effects due to demand-side energy efficiency programs. Employment impacts from demand-side energy efficiency programs in 2030 could range from approximately 52,000 to 83,000 jobs created under proposed federal plan and model trading rules. The IPM-derived job-year numbers for the electricity, coal and natural gas sectors should not be added to the demand-side efficiency job impacts, since the former are reported in full-time equivalent job-years, whereas the latter do not distinguish between full- and part-time employment. More detail

[25] The employment analysis in this RIA is part of EPA's ongoing effort to "conduct continuing evaluations of potential loss or shifts of employment which may result from the administration or enforcement of [the Act]" pursuant to CAA section 321(a).

[26] Job-years are not individual jobs, but rather the amount of work performed by the equivalent of one full-time individual for one year. For example, 20 job-years in 2020 may represent 20 full-time jobs or 40 half-time jobs in that year.

about these analyses can be found in Chapter 6 of the final Clean Power Plan Emission Guidelines RIA.

1.5.7 Additional Analysis of Output-Based Allocation as a Means of Mitigating Leakage

The application of OBA will provide an incentive to increase generation at existing NGCC EGUs in place of generation at new NGCC EGUs and existing fossil steam EGUs. To approximate the effect of this incentive in the mass-based scenario, the EPA used IPM model plant results from the mass-based scenario to construct the average dispatch order for model plants in each IPM region. Then, based on the allowance prices for the state in which each model plant resides, the EPA adjusted the dispatch order in the case where existing NGCC units were allocated allowances at a rate of 1,030 lbs/MWh for each MWh generated above a 50 percent capacity factor as proposed. In cases where an existing NGCC plant moved ahead of an existing fossil steam plant in the dispatch order, the NGCC plant's generation was increased while the existing fossil plant's generation was reduced. The NGCC plant's generation was increased to the maximum capacity factor assumed feasible within IPM while the amount of reduced generation at the fossil steam plant is determined by the amount that would keep the overall covered sources' emissions in the region constant, so as to respect compliance with the mass-based standards represented in the modeling scenario. Since the existing NGCC plant has a lower emissions rate than the existing fossil steam plant, the increase in generation at the NGCC plant is greater than the reduction in generation (because more generation is now possible from both plants together at the same given level of emissions). This net increase in generation from existing EGUs is then subtracted from new NGCC generation in the region, consistent with the total generation needed to meet the load assumed in the IPM modeling of the mass-based scenario.

When applying this algorithm to the results from the mass-based scenario analyzed in this RIA, it forecasts nationally in 2030 a 10 percent increase in generation at existing NGCC EGUs, a 4 percent reduction in generation at existing fossil steam EGUs, and a 29 percent decrease in generation at new NGCC EGUs compared to the modeling scenario results presented above. The result of this reduction in new NGCC EGU generation is a reduction in CO_2 emissions of 23 million short tons (an amount equal to 1.3 percent of 2030 forecast emissions in mass-based

scenario). We do not quantify the effect of these changes in generation on SO_2 and NO_x emissions, although on net additional co-benefits are expected.

The incentives portrayed in this analysis are consistent with the incentives that would be realized under the OBA set-aside, and the general direction and magnitude of the results are likely consistent with those that would be observed had the mass-based scenario been modeled with the OBA set-aside. However, the results should be viewed as approximate given that analysis does not consider important aspects of power markets included in IPM. For example, the analysis does not consider any potential changes in relative fuel and allowance prices as a result of the OBA set-aside. The application of the OBA set-aside will place upward pressure on the allowance prices and therefore further incentivize a shift away from existing fossil steam generation. The OBA set-aside may also place upward pressure on the price of natural gas which would reduce the effectiveness of the set-aside at encouraging increased utilization of existing NGCC EGUs, but the OBA set-aside would be effective in increasing existing NGCC generation, the analysis does not consider the fact that electricity is traded across many IPM regions. The application of OBA in one state may impact the generation at EGUs in another state.

1.5.8 Uncertainty Analysis

The Office of Management and Budget's circular *Regulatory Analysis* (Circular A-4) provides guidance on the preparation of regulatory analyses required under E.O. 12866, and requires an uncertainty analysis for rules with annual benefits or costs of $1 billion or more.[27] This proposed rulemaking potentially surpasses that threshold for both benefits and costs. Throughout this RIA and the referenced final Clean Power Plan Emission Guidelines RIA, we considered a number of sources of uncertainty, both quantitatively and qualitatively, on benefits and costs. We summarize three key elements of our analysis of uncertainty here:

[27] Office of Management and Budget (OMB), 2003, *Circular A-4*, http://www.whitehouse.gov/omb/circulars_a004_a-4 and OMB, 2011. *Regulatory Impact Analysis: A Primer.* http://www.whitehouse.gov/sites/default/files/omb/*inforeg*/regpol/circular-a-4_regulatory-impact-analysis-a-primer.pdf

- Assess uncertainty in the methods used to calculate the health co-benefits associated with the reduction in $PM_{2.5}$ and ozone and the use of a benefits-per-ton approach in estimating these co-benefits.
- Characterizing uncertainty in monetizing climate-related benefits.

Some of these elements are evaluated using probabilistic techniques, whereas for others the underlying likelihoods of certain outcomes are unknown and we use scenario analysis to evaluate their potential effect on the benefits and costs of this rulemaking.

1.5.8.1 Uncertainty in Costs

Our best estimates of the costs of these illustrative scenarios are reported within the cost analysis of the final Clean Power Plan Emission Guidelines and are included in the cost modeling in this RIA for both the proposed rate-based and mass-based approaches. A source of uncertainty under this regulation is the ultimate approach states that are not subject to the federal plan or adopt the model rule will adopt in response to the guidelines, which will affect both the costs and benefits of this rule. For this reason we modeled the two proposed federal plan approaches assuming they applied to all of the states.

1.5.8.2 Uncertainty Associated with Estimating the Social Cost of Carbon

The 2010 SC-CO_2 TSD noted a number of limitations to the SC-CO_2 analysis, including the incomplete way in which the integrated assessment models (IAM) capture catastrophic and non-catastrophic impacts, their incomplete treatment of adaptation and technological change, uncertainty in the extrapolation of damages to high temperatures, and assumptions regarding risk aversion.[28] Currently integrated assessment models do not assign value to all of the important physical, ecological, and economic impacts of climate change recognized in the climate change literature due to a lack of precise information on the nature of damages and because the science incorporated into these models understandably lags behind the most recent research. These individual limitations do not all work in the same direction in terms of their influence on the SC-

[28] *Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866*, Interagency Working Group on Social Cost of Carbon, with participation by the Council of Economic Advisers, Council on Environmental Quality, Department of Agriculture, Department of Commerce, Department of Energy, Department of Transportation, Environmental Protection Agency, National Economic Council, Office of Energy and Climate Change, Office of Management and Budget, Office of Science and Technology Policy, and Department of Treasury (February 2010). Available at: <http://www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf>.

CO_2 estimates, though taken together they suggest that the SC-CO_2 estimates are likely conservative. In particular, the IPCC Fourth Assessment Report (2007) concluded that "It is very likely that [SC-CO_2 estimates] underestimate the damage costs because they cannot include many non-quantifiable impacts" and the IPCC Fifth Assessment report observed that SC-CO_2 estimates continue to omit various impacts that would likely increase damages. The 95th percentile estimate was included in the recommended range for regulatory impact analysis, in part, to address these concerns.

The modeling underlying the development of the SC-CO_2 estimates addressed uncertainty in several ways. An ensemble of three IAMs were used to generate the SC-CO_2 estimates to capture differences in model structures that, in part, reflect uncertainty in the scientific literature about these relationships. Parametric uncertainty was explicitly addressed in each IAM, though to differing degrees, through Monte Carlo simulations in which explicit probability distributions for key parameters were specified, including the equilibrium climate sensitivity, which represents the long-run responsiveness of the climate to increasing GHG concentrations. Furthermore, the analysis considered five different socioeconomic and emissions forecasts to capture the sensitivity of the SC-CO_2 estimates to key exogenous projections used in the modeling. Finally, the results were calculated for three discount rates, which were selected, in part, to reflect uncertainty about how interest rates may change over time and the possibility that climate damages are positively correlated with uncertain future economic activity. This analysis produced 45 different distributions of the SC-CO_2 estimates for each emissions year. To produce a range of plausible estimates that are manageable in regulatory analysis but still reflects the uncertainty in the results four point estimates were recommended. The use of this range of point estimates in this rulemaking helps to reflect the uncertainty in the SC-CO_2 estimates. Chapter 4 of the final Clean Power Plan Emission Guidelines RIA provides a comprehensive discussion about the methodology and application of the SC-CO_2; see both the 2010 TSD and current SC-CO_2 TSD for a full description.

In addition, OMB's Office of Information and Regulatory Affairs received comments regarding uncertainty and the SC-CO_2 estimates in response to a separate request for public comment on the approach used to develop the estimates. Commenters discussed the analyses and presentation of uncertainty in the TSD as well as the implications of uncertainty for use of the SC-CO_2 estimates in regulatory impact analysis. In their response, the interagency working

group (IWG) acknowledged uncertainty in the SC-CO_2 estimates but disagreed with commenters that suggested the uncertainty undermines use of the SC-CO_2 estimates in regulatory impact analysis. The IWG went on to note that the uncertainty in the SC-CO_2 estimates is fully acknowledged and comprehensively discussed in the TSDs and supporting academic literature, and that while all regulatory impact analysis involves uncertainty, these analyses can provide useful information to decision makers and the public. See the IWG Response to Comments for the complete response.[29]

1.5.8.3 Uncertainty Associated with $PM_{2.5}$ and Ozone Health Co-Benefits Assessment

EPA provides information on the relative uncertainty in the benefits estimates based on the 95th percentile confidence interval for avoided PM-related premature deaths and the associated economic valuation estimated in the benefits analysis for the recent PM NAAQS RIA (U.S. EPA, 2012).. In general, the 95th percentile confidence interval for monetized $PM_{2.5}$ benefits ranges from approximately -90 percent to +180 percent of the central estimates based on the two key PM mortality studies. To further explore uncertainty in the premature mortality benefits, EPA provides the PM-related results using concentration-response functions from two key epidemiology studies, as well as alternate concentration-response relationship provided by an expert elicitation and alternative ozone-related results using concentration-response relationships provided by alternative epidemiology studies. In addition, we include an assessment of the distribution of population exposure in the modeling underlying the benefit-per-ton estimates.

In addition to the uncertainties in the underlying concentration-response and valuation functions, all benefit-per-ton approaches have inherent limitations, including that the estimates reflect the geographic distribution of the modeled sector emissions, which may not match the emission reductions anticipated by this proposed rule, and they may not reflect local variability in population density, meteorology, exposure, baseline health incidence rates, or other local factors for any specific location. In addition, these estimates reflect the regional average benefit-per-ton for each ambient $PM_{2.5}$ precursor emitted from EGUs, which assumes a linear atmospheric response to emission reductions. The regional benefit-per-ton estimates, although

[29] See https://www.whitehouse.gov/sites/default/files/omb/inforeg/scc-response-to-comments-final-july-2015.pdf

less subject to these types of uncertainties than national estimates, still should be interpreted with caution. Even though we assume that all fine particles have equivalent health effects, the benefit-per-ton estimates vary between precursors depending on the location and magnitude of their impact on $PM_{2.5}$ levels, which drive population exposure.

1.6 References

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CHAPTER 2: STATUTORY AND EXECUTIVE ORDER REVIEWS

2.1 Executive Order 12866: Regulatory Planning and Review and Executive Order 13563: Improving Regulation and Regulatory Review

This proposed action is an economically significant regulatory action that was submitted to the OMB for review. Any changes made in response to OMB recommendations have been documented in the docket. The EPA prepared an analysis of the potential costs and benefits associated with this action. This analysis, which is presented in this RIA, is also available in the docket and is briefly summarized in section VIII of the preamble.

Consistent with Executive Order 12866 and Executive Order 13563, the EPA estimated the costs and benefits for two alternative federal plan approaches to implementing the proposed federal plan and model trading rules. The proposed action will achieve the same levels of emissions performance as required of state plans under the CAA section 111(d) EGs for the control of CO_2. Actions taken to comply with the guidelines will also reduce the emissions of directly-emitted $PM_{2.5}$, SO_2 and NO_X. The benefits associated with these $PM_{2.5}$, SO_2 and NO_X reductions are referred to as co-benefits, as these reductions are not the primary objective of this rule.

The RIA for this proposal analyzed two implementation scenarios, which we term the "rate-based federal plan approach" and the "mass-based federal plan approach". It is very important to note that the differences between the analytical results for the rate-based and mass-based federal plan approaches presented in this RIA may not be indicative of likely differences between the approaches if implemented by states and affected EGUs in response to the proposed rule. In other words, if one approach performs differently than the other on a given metric during a given time period, this does not imply this will apply in all instances.

It is important to note that the potential regulatory impacts presented in the Clean Power Plan Final Rule RIA and this RIA are not additive. Both RIAs present estimates of the benefits and costs of achieving the emission performance rates of the Clean Power Plan EGs. In the case of the Clean Power Plan Final Rule RIA, the illustrative analysis assumes the performance rates are met under state plans. In the case of this RIA for the proposed federal plan and model trading

rules, the same performance rates are accomplished but are assumed to be achieved under the federal plan or model trading rules.

The EPA has used the social cost of carbon estimates presented in the *Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866 (May 2013, Revised July 2015)* ("current TSD") to analyze CO_2 climate impacts of this rulemaking. We refer to these estimates, which were developed by the U.S. government, as "SC-CO_2 estimates." The SC-CO_2 is an estimate of the monetary value of impacts associated with a marginal change in CO_2 emissions in a given year. The four SC-CO_2 estimates are associated with different discount rates (model average at 2.5 percent discount rate, 3 percent, and 5 percent; 95th percentile at 3 percent), and each increases over time. In this summary, the EPA provides the estimate of climate benefits associated with the SC-CO_2 value deemed to be central in the current TSD: the model average at 3 percent discount rate.

The EPA estimates that, in 2020, the proposal will yield monetized climate benefits (in 2011$) of approximately $2.8 billion for the rate-based approach and $3.3 billion for the mass-based approach (3 percent model average). For the rate-based approach, the air pollution health co-benefits in 2020 are estimated to be $0.7 billion to $1.8 billion (2011$) for a 3 percent discount rate and $0.64 billion to $1.7 billion (2011$) for a 7 percent discount rate. For the mass-based approach, the air pollution health co-benefits in 2020 are estimated to be $2.0 billion to $4.8 billion (2011$) for a 3 percent discount rate and $1.8 billion to $4.4 billion (2011$) for a 7 percent discount rate. The annual compliance costs estimated by IPM and inclusive of DS-EE program and participant costs and MRR costs in 2020, are approximately $2.5 billion for the rate-based approach and $1.4 billion for the mass-based approach (2011$). The quantified net benefits (the difference between monetized benefits and compliance costs) in 2020 are estimated to range from $1.0 billion to $2.1 billion (2011$) for the rate-based approach and from $3.9 billion to 6.7 billion (2011$) for the mass-based approach, using a 3 percent discount rate (model average).

The EPA estimates that, in 2025, the proposal will yield monetized climate benefits (in 2011$) of approximately $10 billion for the rate-based approach and $12 billion for the mass-based approach (3 percent model average). For the rate-based approach, the air pollution health co-benefits in 2025 are estimated to be $7.4 billion to $18 billion (2011$) for a 3 percent

discount rate and $6.7 billion to $16 billion (2011$) for a 7 percent discount rate. For the mass-based approach, the air pollution health co-benefits in 2025 are estimated to be $7.1 billion to $17 billion (2011$) for a 3 percent discount rate and $6.5 billion to $16 billion (2011$) for a 7 percent discount rate. The annual compliance costs estimated by IPM and inclusive of DS-EE program and participant costs and MRR costs in 2025, are approximately $1.0 billion for the rate-based approach and $3.0 billion for the mass-based approach (2011$). The quantified net benefits (the difference between monetized benefits and compliance costs) in 2025 are estimated to range from $17 billion to $27 billion (2011$) for the rate-based approach and $16 billion to $26 billion (2011$) for the mass-based approach, using a 3 percent discount rate (model average).

The EPA estimates that, in 2030, the proposal will yield monetized climate benefits (in 2011$) of approximately $20 billion for the rate-based approach and $20 billion for the mass-based approach (3 percent model average). For the rate-based approach, the air pollution health co-benefits in 2030 are estimated to be $14 billion to $34 billion (2011$) for a 3 percent discount rate and $13 billion to $31 billion (2011$) for a 7 percent discount rate. For the mass-based approach, the air pollution health co-benefits in 2030 are estimated to be $12 billion to $28 billion (2011$) for a 3 percent discount rate and $11 billion to $26 billion (2011$) for a 7 percent discount rate. The annual compliance costs estimated by IPM and inclusive of DS-EE program and participant costs and MRR costs in 2030, are approximately $8.4 billion for the rate-based approach and $5.1 billion for the mass-based approach (2011$). The quantified net benefits (the difference between monetized benefits and compliance costs) in 2030 are estimated to range from $26 billion to $45 billion (2011$) for the rate-based approach and from $26 billion to $43 billion (2011$) for the mass-based approach, using a 3 percent discount rate (model average). Table 1-8 and Table 1-9 of this RIA provides the estimates of the climate benefits, health co-benefits, compliance costs and net benefits of the proposal for rate-based and mass-based federal plan approaches, respectively.

There are additional important benefits that the EPA could not monetize. Due to current data and modeling limitations, our estimates of the benefits from reducing CO_2 emissions do not include important impacts like ocean acidification or potential tipping points in natural or managed ecosystems. Unquantified benefits also include climate benefits from reducing emissions of non-CO_2 GHGs (*e.g.*, nitrous oxide and methane) and co-benefits from reducing

direct exposure to SO_2, NO_X, and HAP (*e.g.*, mercury), as well as from reducing ecosystem effects and visibility impairment. Based upon the foregoing discussion, it remains clear that the benefits of this proposed action are substantial, and far exceed the costs. Additional details on benefits, costs, and net benefits estimates are provided in this RIA.

2.2 Paperwork Reduction Act

The information collection requirements in this rule have been submitted for approval to OMB under the PRA. The Information Collection Request (ICR) document prepared by the EPA has been assigned EPA ICR number *2526.01*. You can find a copy of the ICR in the docket for this rule, and it is briefly summarized here. The information collection requirements are not enforceable until approved by OMB.

This rule does not directly impose specific requirements on state and U.S. territory governments with affected EGUs. The rule also does not impose specific requirements on tribal governments that have affected EGUs located in their area of Indian country. This rule does impose specific requirements on EGUs located in states, U.S. territories or areas of Indian country.

The information collection activities in this proposed rule are consistent with those activities defined under the Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units finalized on August 3, 2015. The information collection requirements in this proposed rule have been submitted for approval to the Office of Management and Budget (OMB) under the Paperwork Reduction Act, 44 U.S.C. 3501 et seq. The ICR document prepared by the EPA has been assigned EPA ICR number 2526.01. You can find a copy of the ICR in the docket for this rule, and it is briefly summarized here.

Aside from reading and understanding the rule, this proposed action would impose minimal new information collection burden on affected EGUs beyond what those affected EGUs would already be subject to under the authorities of CAA parts 75 and 98. OMB has previously approved the information collection requirements contained in the existing part 75 and 98 regulations (40 CFR part 75 and 40 CFR part 98) under the provisions of the Paperwork Reduction Act, 44 U.S.C. 3501 et seq. and has assigned OMB control numbers 2060–0626 and 2060– 0629, respectively. Apart from certain reporting costs based on requirements in the NSPS General Provisions (40 CFR part 60, subpart A), which are mandatory for all owners/operators

subject to CAA section 111 national emission standards, there are no new information collection costs, as the information required by this proposed rule is already collected and reported by other regulatory programs. The recordkeeping and reporting requirements are specifically authorized by CAA section 114 (42 U.S.C. 7414). All information submitted to the EPA pursuant to the recordkeeping and reporting requirements for which a claim of confidentiality is made is safeguarded according to agency policies set forth in 40 CFR part 2, subpart B.

Although EPA cannot determine at this time how many affected EGU respondents will submit information under the federal plan, EPA has estimated an "upper bound" burden estimate for this ICR that estimates burden should every affected EGU read and understand the rule. This is the only potential respondent activity that would be required under the 3-year period following publication of the final federal plan, so there are no obligations to respond in this period. The results of this "upper bound" estimate of federal plan burden are presented below:

Respondents/affected entities: 1,028

Respondents' obligation to respond: Not applicable, no responses are required during the period covered by the ICR.

Estimated number of respondents: Unknown at this time, but have assumed all affected entities are respondents for an upper bound estimate.

Frequency of response: None, no responses are required during the period covered by the ICR.

Total estimated burden: 17,133 hours (per year). Burden is defined at 5 CFR 1320.3(b).

Total estimated cost: $1,706,501 (per year)

An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. The OMB control numbers for the EPA's regulations in 40 CFR are listed in 40 CFR part 9.

Submit your comments on the agency's need for this information, the accuracy of the provided burden estimates and any suggested methods for minimizing respondent burden to the EPA using the docket identified at the beginning of this rule. You may also send your ICR-related comments to OMB's Office of Information and Regulatory Affairs via email to *oria_submissions@omb.eop.gov*, Attention: Desk Officer for the EPA. Since OMB is required to

make a decision concerning the ICR between 30 and 60 days after receipt, OMB must receive comments no later than 30 days after the date of publication in the Federal Register. The EPA will respond to any ICR-related comments in the final rule.

2.3 Initial Regulatory Flexibility Analysis

The Regulatory Flexibility Act (RFA; 5 U.S.C.§ 601 et seq.), as amended by the Small Business Regulatory Enforcement Fairness Act (Public Law No. 104-121), provides that whenever an agency is required to publish a general notice of proposed rulemaking, it must prepare and make available an initial regulatory flexibility analysis (IRFA), unless it certifies that the proposed rule, if promulgated, will not have a significant economic impact on a substantial number of small entities (5 U.S.C. § 605[b]). Small entities include small businesses, small organizations, and small governmental jurisdictions. An IRFA describes the economic impact of the proposed rule on small entities and any significant alternatives to the proposed rule that would accomplish the objectives of the rule while minimizing significant economic impacts on small entities. Pursuant to section 603 of the RFA, the EPA prepared an initial regulatory flexibility analysis (IRFA) that examines the impact of the proposed rule on small entities along with regulatory alternatives that could minimize that impact.

2.3.1 Reasons why Action is Being Considered

On August 3, 2015, the EPA finalized the Clean Power Plan EGs for existing fossil-fuel fired EGUs (40 CFR part 60, subpart UUUU) under authority of section 111 of the CAA. The Guidelines apply to existing fossil-fuel fired EGUs, *i.e.,* those that were in operation or had commenced construction before January 8, 2014. States with existing EGUs subject to the guidelines are required to submit to the EPA by September 6, 2016, a state plan that implements the EGs. States may also make initial plan submittals in lieu of a complete state plan, in which case extensions will be granted until September 6, 2018 (40 CFR &&&).[30] As discussed in section VI.D of the preamble, Indian Tribes may, but are not required to, submit tribal plans. Once the EPA finds that a state has failed to submit a plan, or disapproves a state plan,[31] section

[30] See Section VII of the preamble for additional information on proposed changes to 40 CFR 60.27 to provide enhancements and flexibilities to the agency's process for review and action on state plans and promulgation of federal plans.

[31] If a state has submitted a complete plan, then the EPA will go through a public notice and comment process to fully or partially approve or disapprove the state plan.

111 of the CAA and 40 CFR 60.27 require the EPA to develop, implement, and enforce a federal plan for existing EGUs located in that state. In addition, CAA section 301(d)(2) authorizes the Administrator to treat an Indian Tribe in the same manner as a state for this EGU requirement. *See* 40 CFR 49.3; *see also* "Indian Tribes: Air Quality Planning and Management," hereafter "Tribal Authority Rule," (63 FR 7254, February 12, 1998). As discussed in section VI.D of the preamble, the agency in this action is proposing a necessary or appropriate finding for the affected EGUs in several areas of Indian country and is proposing the federal plan for these affected EGUs.

The agency believes it is appropriate to propose the federal plan at this time for any states that may ultimately be found to have failed to submit a plan, or had their plan disapproved by the EPA. For some states in this situation, the federal plan may be no more than an interim measure to ensure that congressionally mandated emission standards under authority of section 111 of the CAA are implemented until they can get an approved plan in place. Other states may choose to rely on the federal plan and would not need to develop their own plan. This proposal also serves as two proposed model trading rules which states can adopt or tailor for adoption as their state plan.

2.3.2 Statement of Objectives and Legal Basis for Proposed Rules

The EPA is proposing this rulemaking for a federal plan to implement greenhouse gas Emission Guidelines for existing fossil fuel-fired electric generating units (EGUs). The emission guidelines were proposed in June 2014 as the Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units (79 FR 34830; the Clean Power Plan). This plan is part of the President's Climate Action Plan announced in June of 2013 to reduce carbon emissions from the power sector by 30 percent below 2005 levels. This federal plan serves to: 1) provide a model rule that states can tailor for implementation, and 2) set in place a plan that EPA can implement for states that do not develop an approvable state plan. The EPA sees this federal plan as an interim measure to ensure that congressionally mandated emission standards under authority of section 111 of the CAA are implemented until states assume their role as the preferred implementers of the emission guidelines.

The final Clean Power Plan Emission Guidelines are related to but separate from the proposed federal plan. The final Emission Guidelines will detail the carbon dioxide (CO_2)

reduction goals for sources by state. The purpose of the proposed federal plan is to lay out mechanisms to achieve reductions in CO_2 emissions from affected EGUs that are not covered by an EPA-approved state plan. The EPA is considering a range of options and approaches through which affected EGUs would meet a rate-based goal or a mass-based equivalent. The EPA intends to incorporate flexibility to the extent possible into the proposed federal plan so affected units can achieve these reductions in a cost-effective way.

2.3.3 Description and Estimate of Affected Small Entities

EPA conducted this regulatory flexibility analysis at the ultimate (i.e., highest) level of ownership, evaluating parent entities with the largest share of ownership in at least one potentially-affected EGU included in EPA's Base Case using the Integrated Planning Model (IPM) v.5.15, used in this RIA.[32] This analysis draws on the "parsed" unit-level estimates using IPM results for 2030, as well as ownership, employment, and financial information for the potentially affected small entities drawn from other resources described in more detail below. EPA chose to examine potential impacts in 2030 because that is when the emission performance goals are required to be fully achieved. Also, as presented in this RIA, 2030 is the year where the estimated annual compliance costs for the contiguous U.S. are at their highest.[33]

This action proposes a federal plan under section 111(d) of the CAA for the control of CO_2, a greenhouse gas pollutant, from certain large emitting fossil-fuel fired power plants, in the event that some states do not adopt their own plans. Specifically, the EPA is proposing approaches in the form of mass- and rate-based trading options that provide flexibility in implementing emission standards for a state's affected EGUs. Both proposed approaches to the federal plan would require affected EGUs to meet emission standards set using the CO_2 emission performance rates in the emission guidelines. The federal plan will achieve the same levels of emissions performance as required of state plans under the emission guidelines.

However, at the time of this proposal, the EPA has no information on whether any or how many states will require a federal plan or adopt a model rule. Because of this lack of information, for this RIA, the EPA has chosen to examine two federal plan approach scenarios where all

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[32] See 1.4.1 of this RIA for more detail on the IPM base case used for this analysis. Detailed documentation for IPM v.5.15 is available at: http://www.epa.gov/powersectormodeling.

[33] See Section 1.5.2 of this RIA.

states of the contiguous U.S. will be regulated under a federal plan or a model rule. The first federal plan approach we examine in this RIA assumes all states in the contiguous U.S. are regulated under a rate-based federal plan or model rule. The second federal plan approach we examine assumes all contiguous states are regulated under a mass-based federal plan or model rule. We use these scenarios to inform this IRFA.

As with the analysis in this RIA, the IRFA proceeds by examining potential costs to small entities under both the rate-based and mass-based approach, again under the strong assumption that all affected EGUs are regulated under a federal plan. The parsed unit-level estimates used in this IRFA are consistent with the analysis presented elsewhere in this RIA. These 2030 year IPM files can also be found in the docket for the rulemaking.

EPA identified the size of ultimate parent entities by using the Small Business Administration (SBA) size threshold guidelines.[34] The criteria for size determination vary by the organization/operation category of the ultimate parent entity, as follows:

- Privately-owned (non-government) entities (see Table 2-1)
    - Privately-owned entities include investor-owned utilities, non-utility entities, and entities with a primary business other than electric power generation.
    - For entities with electric power generation as a primary business, small entities are those with less than the threshold number of employees specified by SBA for each of the relevant North American Industry Classification System (NAICS) sectors (NAICS 2211).
    - For entities with a primary business other than electric power generation, the relevant size criteria are based on revenue, assets, or number of employees by NAICS sector.[35]
- Publicly-owned entities

[34] U.S. Small Business Administration (SBA). 2014. Small Business Size Standards. Effective as of July 14, 2014. See: http://www.sba.gov/sites/default/files/Size_Standards_Table.pdf.

[35] Certain affected EGUs are owned by ultimate parent entities whose primary business is not electric power generation.

- Publicly-owned entities include federal, state, municipal, and other political subdivision entities.
- The federal and state governments were considered to be large. Municipalities and other political units with population fewer than 50,000 were considered to be small.

- Rural Electric Cooperatives
  - Small entities are those with fewer than the threshold level of employees or revenue specified by SBA for each of the relevant NAICS sectors.

EPA examined affected EGUs included in EPA's 2030 projections and identified the associated power plants. Next, we determined power plant ownership information, including the name of associated owning entities, ownership shares, and each entity's type of ownership. EPA primarily used data from SNL and Ventyx, supplemented by limited research using publicly available data.[36] Majority owners of power plants with affected EGUs were categorized as one of the seven ownership types.[37] These ownership types are:

1. **Investor-Owned Utility (IOU):** Investor-owned assets (e.g., a marketer, independent power producer, financial entity) and electric companies owned by stockholders, etc.
2. **Cooperative (Co-Op):** Non-profit, customer-owned electric companies that generate and/or distribute electric power.
3. **Municipal:** A municipal utility, responsible for power supply and distribution in a small region, such as a city.
4. **Sub-division:** Political subdivision utility is a county, municipality, school district, hospital district, or any other political subdivision that is not classified as a municipality under state law.
5. **Private:** Similar to an investor-owned utility, however, ownership shares are not openly traded on the stock markets.
6. **State:** Utility owned by the state.

[36] SNL Financial data covers the energy market and other industries. For more information, see: www.snl.com. The Ventyx database consists of detailed ownership and corporate affiliation information at the EGU level. For more information, see: www.ventyx.com.

[37] Throughout this analysis, EPA refers to the owner with the largest ownership share as the "majority owner" even when the ownership share is less than 51 percent.

7. **Federal:** Utility owned by the federal government.

Required ownership information could not be determined for two committed units that are represented in the IPM base case modeling for this proposed rule, preventing their inclusion in this analysis.[38]

Next, EPA used the Hoover's online database to identify the ultimate owners of power plant owners identified in the SNL and Ventyx databases. This was necessary, as many majority owners of power plants (listed in SNL or Ventyx) are themselves owned by other ultimate parent entities (listed in Hoover's).[39] In these cases, the ultimate parent entity was identified via Hoover's, whether domestically or internationally owned.

EPA followed SBA size standards to determine which non-government ultimate parent entities should be considered small entities in this analysis. These SBA size standards are specific to each industry, each having a threshold level of either employees, revenue, or assets below which an entity is considered small. SBA guidelines list all industries, along with their associated NAICS code and SBA size standard. Therefore, it was necessary to identify the specific NAICS code associated with each ultimate parent entity in order to understand the appropriate size standard to apply. Data from Hoover's was used to identify the NAICS codes for most of the ultimate parent entities.[40] In many cases, an entity that is a majority owner of a power plant is itself owned by an ultimate parent entity with a primary business other than electric power generation. Therefore, it was necessary to consider SBA entity size guidelines for the range of NAICS codes listed in Table 2-1. This table represents the range of NAICS codes and areas of primary business of ultimate parent entities which are majority owners of potentially affected EGUs in EPA's IPM base case.

[38] The ORIS codes of these two units are 83609 and 83921. Without knowledge of entity type and size, it was not possible to accurately estimate revenue or costs impacts. An ORIS code is an identifying number assigned by the U.S. Energy Information Administration to power plants owned by utilities.

[39] The Hoover's Inc. online platform includes company records that can contain NAICS codes, number of employees, revenues, and assets. For more information, see: http://www.hoovers.com.

[40] In the case of two entities, NAICS codes could not be located in Hoover's, so publicly available information was used to determine the primary area of business for the ultimate parent entities.

Table 2-1. SBA Size Standards by NAICS Code

NAICS Code	NAICS Description	SBA Size Standard
211111	Crude Petroleum and Natural Gas Extraction	500 employees
211112	Natural Gas Liquid Extraction	500 employees
212111	Bituminous Coal and Lignite Surface Mining	500 employees
212221	Gold Ore Mining	500 employees
213112	Support Activities for Oil and Gas Operations	$38.5 million in revenue
221111	Hydroelectric Power Generation	500 employees
221112	Fossil Fuel Electric Power Generation	750 employees
221113	Nuclear Electric Power Generation	750 employees
221118	Other Electric Power Generation	250 employees
221121	Electric Bulk Power Transmission and Control	500 employees
221122	Electric Power Distribution	1,000 employees
221210	Natural Gas Distribution	500 employees
238210	Electrical Contractors and Other Wiring Installation Contractors	$15 million in revenue
238290	Other Building Equipment Contractors	$15 million in revenue
324110	Petroleum Refineries	1,500 employees
325120	Industrial Gas Manufacturing	1,000 employees
325211	Plastics Material and Resin Manufacturing	750 employees
325320	Pesticide and Other Agricultural Chemical Manufacturing	500 employees
331110	Iron and Steel Mills and Ferroalloy Manufacturing	1,000 employees
331313	Alumina Refining and Primary Aluminum Production	1,000 employees
333613	Mechanical Power Transmission Equipment Manufacturing	500 employees
333999	All Other Miscellaneous General Purpose Machinery Manufacturing	500 employees
335312	Motor and Generator Manufacturing	1,000 employees
335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing	500 employees
423610	Electrical Apparatus and Equipment, Wiring Supplies, and Related Equipment Merchant Wholesalers	100 employees
424720	Petroleum and Petroleum Products Merchant Wholesalers (except Bulk Stations and Terminals)	100 employees
454310	Fuel Dealers	50 employees
486210	Pipeline Transportation of Natural Gas	$27.5 million in revenue
522110	Commercial Banking	$550 million in assets
522220	Sales Financing	$38.5 million in revenue
522320	Financial Transactions Processing, Reserve, and Clearinghouse Activities	$38.5 million in revenue
523120	Securities Brokerage	$38.5 million in revenue
523910	Miscellaneous Intermediation	$38.5 million in revenue
523920	Portfolio Management	$38.5 million in revenue
523930	Investment Advice	$38.5 million in revenue
524113	Direct Life Insurance Carriers	$38.5 million in revenue
524126	Direct Property and Casualty Insurance Carriers	1,500 employees
524210	Insurance Agencies and Brokerages	$7.5 million in revenue
525110	Pension Funds	$32.5 million in revenue
525120	Health and Welfare Funds	$32.5 million in revenue
525990	Other Financial Vehicles	$32.5 million in revenue
541611	Administrative Management and General Management Consulting Services	$15 million in revenue
551112	Offices of Other Holding Companies	$20.5 million in revenue
561110	Office Administrative Services	$7.5 million in revenue
813910	Business Associations	$7.5 million in revenue
921110	Public Administration	750 employees

Notes: 1) Based on size standards effective at the time EPA conducted this analysis (SBA size standards, effective July 14, 2014) 2) Small business size standards are not established for the Public Administration industry (NAICS code 921110). It is assumed that a comparable NAICS private sector industry is Fossil Fuel Electric Power Generation (NAICS code 221112). Therefore, for this analysis, the NAICS code 921110 is assumed to have a size standard of 750 employees.
Source: SBA, 2014

EPA compared the relevant entity size criterion for each ultimate parent entity to the SBA threshold value noted in Table 2-1. We used the following data sources and methodology to estimate the relevant size criterion values for each ultimate parent entity:

1. **Employment, Revenue, and Assets:** EPA used the Hoover's database as the primary source for information on ultimate parent entity employee numbers, revenue, and assets.[41] In parallel, EPA also considered estimated revenues from affected EGUs based on analysis of parsed-file estimates for 2030.[42] EPA assumed that the ultimate parent entity revenue was the larger of the two revenue estimates. In limited instances, supplemental research was also conducted to estimate an ultimate parent entity's number of employees, revenue, or assets.

2. **Population:** Municipal entities are defined as small if they serve populations of less than 50,000. EPA primarily relied on data from the Ventyx database and the U.S. Census Bureau to inform this determination. Supplemental research of individual municipalities was also conducted in some instances.

Ultimate parent entities for which the relevant measure is less than the SBA size criterion were identified as small entities and carried forward in this analysis. In the case of six entities, data limitations prevented the comparison of entities against their appropriate SBA size standards. For the purposes of this analysis, EPA assumed that these six entities are small entities.[43]

EPA identified 223 potentially affected EGUs owned by 74 small entities included in EPA's 2030 projections. Fifty-nine of these potentially affected EGUs are projected to no longer be operating by 2030 in the Base Case of EPA's version of IPM v.5.15.[44] Twenty-four small

[41] Estimates of sales were used in lieu of revenue estimates when revenue data was unavailable.

[42] The methodology for the analysis of IPM results is detailed later in this IRFA.

[43] Generation from potentially affected EGUs owned by these six entities represents less than two percent of total generation from potentially affected EGUs owned by small entities under EPA's base case projections.

[44] Detailed documentation for IPM v.5.15 is available at: http://www.epa.gov/powersectormodeling.

entities are projected to have all of their potentially affected EGUs cease operation by 2030 in this Base Case.

2.3.4 Compliance Cost Impact Estimates

2.3.4.1 Methodology for Estimating Impacts on Small Entities

This section presents the methodology used in this analysis for estimating the compliance costs of this proposed rule for small entities. For the purposes of this IRFA, EPA estimated net compliance costs for individual EGUs of the proposed rule using the following equation:

$$C_{\text{net compliance cost}} = \Delta C_{\text{operating + annualized capital}} + \Delta C_{\text{fuel}} + \Delta C_{\text{demand-side energy efficiency}} + \Delta R$$

where C represents the components of cost as labeled, R represents revenue, and Δ indicates the calculation of difference between the base case and the federal plan approach under examination. The specific meaning of these variables is discussed below.

This approach to estimate net compliance costs is consistent with previous proposed power sector regulations that required IRFAs, such as the proposed Mercury and Air Toxics Rule.[45] However, there is an additional component in the net compliance cost equation: the change in the program costs of demand-side energy efficiency programs. Investment in demand-side energy efficiency results in lower electricity demand, and consequently fewer emissions as production is reduced to meet the lower demand, an important emission-reduction strategy modelled in the rate-based and mass-based federal plan approaches.

Because this analysis evaluates the net compliance costs as a sum of the costs changes associated with compliance choices as well as changes in electricity revenues, it captures potential net compliance cost increases or decreases. For example, if under the proposed rule entities increase revenue more than costs, the net compliance costs will be negative. As a result, the approach used here to estimate net compliance costs is well-equipped to evaluate the potential distributional consequences of the proposed regulation.

For this analysis, EPA used the parsed unit-level estimates mentioned before to estimate three of the four components of the net compliance cost equation above: the change in operating

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[45] U.S. Environmental Protection Agency (U.S. EPA). 2011. *Regulatory Impact Analysis of the Proposed Toxics Rule: Final Report*. Office of Air Quality Planning and Standards, Health and Environmental Impacts Division, Research Triangle Park, NC. Available at: http://www.epa.gov/ttnecas1/regdata/RIAs/ToxicsRuleRIA.pdf.

and annualized capital costs, the change in fuel costs, and the change in revenue, where all changes are estimated as the difference between the base case and federal plan scenario. These impacts were then summed for each small entity, adjusting for ownership share.[46] As described momentarily, additional analysis was performed to estimate the change in costs of demand-side energy efficiency that factors in IPM-projected outputs but is not directly an output of the model. These individual components of compliance cost were estimated as follows:

1. **Operating and capital costs:** Using the IPM parsed estimates for the base case and the rate-based and mass-based federal plan approaches, EPA evaluated changes in operating and capital costs at the EGU level. The equations for calculating operating and capital costs were adopted from technology assumptions used in EPA's version of IPM version 5.15. The model calculates the capital cost (in $/MW); the fixed operation and maintenance (O&M) cost (in $/MW-year); and the variable O&M cost (in $/MWh).

2. **Fuel costs:** Using the IPM parsed estimates for the base case and the rate-based and mass-based federal plan approaches, EPA evaluated projected changes in fuel cost at the EGU level. These projected fuel costs are based on estimated EGU-level fuel input (in million British thermal units, MMBtu) and delivered fuel prices ($/MMBtu).

3. **Demand-side energy efficiency program costs:** Demand-side energy efficiency program costs are estimated and allocated to affected EGUs outside of IPM in this analysis. For this analysis, we assumed that IOUs, Co-Ops, Municipals, and Sub-Divisions are utilities that receive revenues on the basis of retail electricity rates. Retail electricity in this and related EPA analyses contain an energy efficiency surcharge. The surcharge reflects the standard mechanism by which utilities collect revenue from their customers to pay for energy efficiency programs. Such surcharges are approved for inclusion in rates by state utility commission for IOUs or the equivalent authority (e.g., municipal or cooperative utility board of directors) for other utility types. To be consistent, EPA assumes that these utilities will incur an energy efficiency surcharge as a cost in this analysis. The demand-side energy efficiency surcharge is state specific, being

[46] Unit-level cost impacts are adjusted for ownership shares for individual small entities, so as not to overestimate burden on each entity.

the estimated state demand-side energy efficiency program costs[47] divided by projected total state sales. The cost in this analysis is the surcharge multiplied by projected sales from affected EGUs.[48] In contrast, entities of the type Private are not assessed demand-side energy efficiency program costs in this analysis.[49] This distinction is made because EPA assumes that Private entities own non-utility EGUs that will earn wholesale electricity rates. Wholesale electricity rates do not include a demand-side energy efficiency surcharge in this or related EPA analyses.

4. **Revenues:** EPA estimated the value of electricity generated by multiplying the projected electricity generation from EPA's IPM modeling results with the regional retail electricity price estimates ($/MWh), for all entities except those categorized as Private in Ventyx. For private entities, EPA used projected wholesale electricity price instead of retail electricity price estimates because most of the private entities are independent power producers (IPP). Since IPPs sell their electricity to wholesale purchasers and do not own transmission facilities, their revenue was estimated with wholesale electricity prices.

2.3.4.2 Results

This section presents the estimated net compliance cost impacts of the proposed rule on small entities in 2030 based on the following endpoints:

- net compliance costs estimated for the proposed rule for potentially affected small entities, and

[47] In practice, the costs of demand-side energy efficiency programs include the costs to the utilities that are funding the programs (known as the program costs) and the additional cost to the end-user purchasing a more energy efficient technology (known as the participant costs). Based upon a literature review, the analysis supporting this proposed rule and the Clean Power Plan Final Rule, total costs are assumed to be divided evenly, 50 percent each, between program costs and participant costs. This IRFA includes only the program costs expected to be incurred by utilities. For more detail on how the demand-side energy efficiency costs are estimated, see U.S. EPA. 2015. Technical Support Document (TSD) the Final Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units. Demand-Side Energy Efficiency.

[48] For these entity types (i.e., IOUs, Co-Ops, Municipals, and Sub-Divisions), projected sales is estimated to be 7.5 percent less than generation. This 7.5 percent reduction is added to account for estimated transmission losses.

[49] Note that in this context, "Private" is one of seven distinct ownership types introduced earlier in this chapter.

- the ratio of small entity compliance cost impacts to revenues from electricity generation at affected EGUs

It is worth noting again that the results in this section are based on the assumption made for this analysis that all affected EGUs owned by small entities are subject to this proposed rule. EPA chose to examine this scenario because, at the time of this proposal, the EPA has no information on whether any or how many states will require a federal plan.

The number of affected small entities by ownership type and the potential impact of the federal plan approaches are summarized in Tables 2-2 through 2-5. These tables are specific to either the rate-based federal plan approach (i.e., rate-based), or mass-based federal plan approach (i.e., mass-based). All costs are presented in 2011 dollars.

EPA estimated the annualized net compliance cost to potentially affected small entities in 2030 to be approximately $364 million under the rate-based approach, and $404 million under the mass-based approach. Results for small entities discussed here do not fully account for the reality that electricity markets are regulated in parts of the country. Entities operating in regulated or cost-of-service markets are likely able to recover compliance costs through rate adjustments; as a result these costs can be viewed as likely being over-estimates for this set of utilities.[50]

[50]This is similarly discussed in previous EPA analyses. For example, see section 7.4.5.2 within the Regulatory Impact Analysis for the Final Mercury and Air Toxics Standards. Available at: http://www.epa.gov/ttnecas1/regdata/RIAs/matsriafinal.pdf.

Table 2-2. Number of Affected Small Entities in the Base Case, and Projected Impact under the Rate-Based Federal Plan Approach in 2030

EGU Ownership Type	Number of Potentially Affected Entities	Number of Entities Projected to Withdraw all Affected Units in Base Case	Additional Entities Projected to Withdraw all Affected Units under Rate-Based Approach
Co-Op	17	3	1
IOU	8	3	1
Municipal	24	13	1
Private	19	5	2
Sub-Division	6	0	2
Grand Total	**74**	**24**	**7**

Notes: 1) The number of potentially affected entities reflects those with affected EGUs that are modeled within IPM in 2030. 2) In this context, the term withdraw signifies that EGUs are represented in the 2030 IPM results but do not generate electricity.
Source: U.S. EPA analysis, based on EPA's IPM v.5.15 modeling results.

Table 2-3. Projected Impact on Small Entities in 2030 under Rate-Based Federal Plan Approach

EGU Ownership Type	Total Net Compliance Costs (2011$ millions)	Number of Small Entities with Net Compliance Costs > 1% of Generation Revenues	Number of Small Entities with Net Compliance Costs > 3% of Generation Revenues
Co-Op	109	8	3
IOU	186	4	4
Municipal	17	7	5
Private	34	11	9
Sub-Division	18	6	2
Grand Total	**364**	**36**	**23**

Notes: 1) The total number of entities with costs greater than 1 or 3 percent of revenues includes only entities experiencing positive net compliance costs. 2) Costs are compared to generation revenues from affected EGUs, and do not consider additional revenues some entities may earn from other sources. 3) Nine small entities are estimated to have net compliance cost savings greater than 3 percent of generation revenues from affected sources.
Source: U.S. EPA analysis, based on EPA's IPM v.5.15 modeling results.

Table 2-4. Number of Affected Small Entities in the Base Case, and Projected Impact under the Mass-Based Federal Plan Approach in 2030

EGU Ownership Type	Number of Potentially Affected Entities	Number of Entities Projected to Withdraw all Affected Units in Base Case	Additional Entities Projected to Withdraw all Affected Units under Mass-Based Approach
Co-Op	17	3	1
IOU	8	3	1
Municipal	24	13	1
Private	19	5	2
Sub-Division	6	0	0
Grand Total	**74**	**24**	**5**

Notes: 1) The number of potentially affected entities reflects those with affected EGUs that are modeled within IPM in 2030. 2) In this context, the term withdraw signifies that EGUs are represented in the 2030 IPM results but do not generate electricity.
Source: U.S. EPA analysis, based on IPM modeling results.

Table 2-5. Projected Impact on Small Entities in 2030 under Mass-Based Federal Plan Approach

EGU Ownership Type	Total Net Compliance Costs (2011$ millions)	Number of Small Entities with Net Compliance Costs > 1% of Generation Revenues	Number of Small Entities with Net Compliance Costs > 3% of Generation Revenues
Co-Op	133	10	4
IOU	179	3	3
Municipal	50	5	5
Private	36	8	7
Sub-Division	7	4	2
Grand Total	**404**	**30**	**21**

Notes: 1) The total number of entities with costs greater than 1 or 3 percent of revenues includes only entities experiencing positive net compliance costs. 2) Costs are compared to generation revenues from affected EGUs, and do not consider additional revenues some entities may earn from other sources. 3) Eleven small entities are estimated to have net compliance cost savings greater than 3 percent of generation revenues from affected sources.
Source: U.S. EPA analysis, based on EPA's IPM v.5.15 modeling results.

As noted earlier, there are 74 small entities with potentially affected EGUs that are modeled in the IPM base case in 2030. Of these, 24 small entities are projected to withdraw all of their potentially affected EGUs from operation under base case conditions. This leaves 50 small entities with potentially affected EGUs that are projected to be generating electricity in 2030. Under the rate-based federal plan approach, 7 of these 50 small entities are projected to withdraw all of their potentially affected EGUs from operation by 2030. Under the mass-based federal plan

approach, 5 of these 50 small entities are projected withdraw all of their potentially affected EGUs from operation by 2030.

Under the rate-based federal plan approach, 23 small entities are projected to incur net compliance costs greater than 3 percent of generation revenues from their potentially affected EGUs. In contrast, 9 entities are estimated to have net compliance cost savings greater than 3 percent of their generation revenues from affected EGUs. Under the mass-based federal plan approach, 21 small entities are projected to incur net compliance costs greater than 3 percent of generation revenues from their potentially affected EGUs. In contrast, 11 entities are estimated to have net compliance cost savings greater than 3 percent of generation revenues from their affected EGUs.

The separate components of the net compliance costs for small entities under the proposed rule are summarized in Table 2-6 and Table 2-7.

Table 2-6. Incremental Costs in 2030 under the Rate-based Federal Plan Approach Summarized by Ownership Group and Cost Category in 2030 (2011$ millions)

EGU Ownership Type	Capital + Operating + Fuel Costs ($MM)	Energy Efficiency Program Costs ($MM)	Change in Electricity Revenue ($MM)	Total Net Compliance Costs
	A	*B*	*C*	*=A+B-C*
Co-Op	(79)	87	(102)	109
IOU	78	93	(15)	186
Municipal	(26)	25	(19)	17
Private	(7)	0	(40)	34
Sub-Division	(68)	16	(70)	18
Grand Total	**(102)**	**221**	**(246)**	**364**

Note: Totals may not add due to rounding.
Source: U.S. EPA analysis, based on EPA's IPM v.5.15 modeling results.

Table 2-7. Incremental Costs in 2030 under the Mass-based Federal Plan Approach Summarized by Ownership Group and Cost Category in 2030 (2011$ millions)

EGU Ownership Type	Capital + Operating + Fuel Costs ($MM)	Energy Efficiency Program Costs ($MM)	Change in Electricity Revenue ($MM)	Total Net Compliance Costs
	A	*B*	*C*	*=A+B-C*
Co-Op	(178)	84	(228)	133
IOU	(17)	91	(104)	179
Municipal	(64)	23	(91)	50
Private	(2)	0	(38)	36
Sub-Division	(38)	18	(27)	7
Grand Total	**(299)**	**215**	**(488)**	**404**

Note: Totals may not add due to rounding.
Source: U.S. EPA analysis, based on EPA's IPM v.5.15 modeling results.

The change in electricity revenue under the federal plan approaches take into account both the profit lost from units that do not operate and the difference in revenue for operating units. The cost of withdrawing a unit as uneconomic is estimated as the base case profit that is foregone by not operating under a federal plan approach. One of the primary drivers of the cost impacts is the reduced revenue due to decreased electricity sales related to the modeled implementation of demand-side energy efficiency measures. The EPA solicits comment on: 1) whether it is likely that small entities would consider demand-side strategies as they responded to a federal plan, 2) the appropriateness of considering the demand-side strategies in the analysis, and 3) if demand-side energy efficiency measures are considered in the final analysis, whether it is appropriate to consider them as a cost for a municipality or city-owned utility, as this reduced revenue will translate to direct cost savings for members of the community served by the affected units.

There are uncertainties and limitations in this analysis that may result in estimates that diverge from what we might see in reality. Some of these have already been noted. Below is a listing of important considerations when interpreting this analysis.

- At the time of this proposal, the EPA has no information on whether any or how many states will require a federal plan. The rate-based and mass-based federal plan approaches analyzed in this IRFA are based on a scenario where all states of the contiguous U.S. will be regulated under a federal plan.

- Results for small entities discussed here do not fully account for the reality that electricity markets are regulated in parts of the country. Entities operating in regulated or cost-of-service markets are likely able to recover compliance costs through rate adjustments; as a result these costs can be viewed as likely being over-estimates for this set of utilities.
- Small entities owning NGCC EGUs operating in competitive markets may be able to recover compliance costs if steam EGUs are setting the marginal price.
- EPA has not factored in consideration of allowances that would be distributed to affected entities nor revenue that could be generated from the sale of ERCs in its analysis. EPA takes comment on how these factors should be considered in the final analysis.
- In this analysis, estimated state demand-side energy efficiency program costs are allocated to utility EGUs owned by IOUs, Co-Ops, Municipals, and Sub-Divisions based on the share of forecasted total state electricity sales that they are projected to provide. To the extent that this differs in practice, associated costs incurred by small entities may be over- or under-estimated.
- To the extent that the EGU owner information used is not reflective of reality, the number of small entities may be over- or under-estimated.
- To the extent that the entity-level ownership information (i.e., NAICS code, number of employees, revenues, and assets) are not reflective of reality, the number of small entities may be over- or under-estimated.

2.3.5 Projected Reporting, Recordkeeping and Other Compliance Requirements

The reporting, recordkeeping and other compliance requirements are most likely covered under Part 75 and Part 98 programs for affected EGUs. Therefore, only a marginal additional cost is expected for the monitoring, reporting and recordkeeping requirements of the proposed federal plan for affected EGUs.

2.3.6 Related Federal Rules

On September 20, 2013, EPA proposed carbon pollution standards for new fossil fuel fired EGUs. On June 2, 2014, the EPA, proposed carbon pollution standards for modified and reconstructed fossil fuel fired EGUs, in addition to the Clean Power Plan EGs, to cut carbon pollution from existing fossil fuel fired EGUs. These existing EGUs are, or will be, potentially impacted by several other recently finalized EPA rules. On February 16, 2012, the EPA issued the mercury and air toxics standards (MATS) rule (77 FR 9304) to reduce emissions of toxic air pollutants from new and existing coal- and oil-fired EGUs. On May 19, 2014, the EPA issued a final rule under section 316(b) of the Clean Water Act (33 U.S.C. 1326(b)). This rule establishes new standards to reduce injury and death of fish and other aquatic life caused by cooling water intake structures at existing power plants and manufacturing facilities. On June 18, 2014 (79 FR 34830), the EPA promulgated the stream electric effluent limitation guidelines (SE ELG) rule to strengthen the controls on discharges from certain steam electric power plants. On April 17, 2015 (80 FR 21302), the EPA promulgated the coal combustion residuals (CCR) rule, which establishes technical requirements for CCR landfills and surface impoundments under subtitle D of the Resource Conservation and Recovery Act (RCRA), the nation's primary law for regulating solid waste.

2.3.7 Regulatory Flexibility Alternatives

2.3.7.1 Panel Process

Small Entity Representatives (SERs) commented on their perceptions of the adequacy of the SBREFA panel process for the section 111(d) federal plan. Under the statute, EPA provides "information on the potential impacts of the proposed rule on small entities and the type of small entities that might be affected." § 609(b)(1). Then SERs are selected, and the Panel collects "advice and recommendations" from each SER. § 609(b)(4). The Panel reviews the SERs' comments, and "any material the agency has prepared in connection with [the RFA]," and "report[s] on the comments of the [SERs] and its findings as to issues related to" preparation of an IRFA. § 609(b)(5). EPA solicited SERs comments during the course of, and after holding three outreach meetings. The Agency provided information to the SERs on two primary regulatory alternatives for the federal plan – a rate-based trading program and a mass-based trading program. The Agency identified specific areas under both of these alternatives where it

was still in the decision making process and open to recommendations. This information forms the basis for consideration of issues and additional regulatory options important to these small entities.

Advocacy shares many of the concerns raised by the SERs (see attached letter from Acting Chief Counsel Claudia Rodgers to EPA Administrator Gina McCarthy). While Advocacy endorses the Panel recommendations, Advocacy agrees that the SERs did not have sufficient information to inform advice and recommendations about specific regulatory alternatives and flexibilities. In Advocacy's view, this is reflected in Panel recommendations that advise EPA to consider issues raised by the SERs rather than to propose or consider regulatory alternatives. Advocacy regrets that the Panel is not able to make more specific recommendations for flexibilities to minimize the impacts on small entities.

While not all members of the Panel agree with all of these concerns, the concerns of the SERs regarding the Panel process have been noted. Nonetheless, EPA is committed to ensuring that it meets the requirements of the RFA and will, to the maximum extent practicable, fully consider the advice and recommendations of representatives of small entities in the development of the proposed rule. The EPA intends to continue working on issues regarding small businesses, and consider appropriate flexibilities, throughout this rulemaking process.

2.3.7.2 Remaining Useful Life

SERs commented that EPA needed to account for remaining useful life of EGUs. Multiple comments addressed challenges that EPA must face in satisfying the statutory mandate that "in applying a standard of performance to any particular source under a plan submitted under this paragraph to take into consideration, among other factors, the remaining useful life of the existing sources to which such standard applies." SERs are concerned that EPA will develop EGs under section 111(d) in a manner that either prohibits plans from providing this consideration or only providing for plans to "make these adjustments at the expense of other sources." AEPCO comments that it has obligations under the Rural Electrification Act to operate under an 80-year mandate. SBA recommends EPA propose allowing for guaranteed amount of run-time for small entities to allow them to recoup investment. EPA believes "remaining useful life" is a concern directed toward plants with short remaining lives, but recognizes that there are concerns about economic viability of some marginal plants.

The Panel recommends that EPA clearly explain how it took into consideration remaining useful life and take comment on other ways of defining the remaining useful life consideration. The Panel also recommends proposing or considering economic incentives for compliance that could avoid early retirement or reduce the financial effects of early retirements. For instance, the EPA could propose continuing allocations for a set number of years to units that retire in order to alleviate the financial effects of the retirement. EPA should request comment on how long such allocations should continue. The EPA should also consider whether there are parallel mechanisms in a rate-based proposal that could provide similar regulatory relief or benefits for small entities, if appropriate.

2.3.7.3 Design of the Compliance System

The panel requested SER input on a number of aspects of the federal plan design, based on EPA's presentation of federal plan options. SER comments ranged quite broadly. Comments included: 1) differing opinions within SERs on favor of rate- vs mass-based approaches, 2) emphasis on market liquidity in a program, 3) support for types of allocation methodologies (in a mass-based allowance system), 4) encouragement for early action crediting, 5) increased averaging and compliance times to help small entities, and 6) whether and how to consider the effects of credit/allowance banking, borrowing, and shelf-life on market liquidity. In some instances, no general consensus emerged. The Panel notes the following specific areas where it is making a recommendation.

Mass-based or rate-based trading

Various SERs favored one system over the other, and some suggested that each individual small entity should be able to choose the system under which they would comply. However, it is unclear to what extent SERs would favor such choice at the expense of a broader trading pool. The panel, however, notes that the idea of individual companies within a state choosing which system to comply would significantly limit the opportunity for intra- or inter-state trading and would therefore not be consistent with other recommendations. The Panel recommends that EPA take comment on which approach (mass or rate) is preferable. In the interests of maximizing liquidity across all federal plan states, the Panel recommends that EPA should propose to finalize a single approach for all federal plans.

Allocations and credit issuance/early action

SERs expressed a variety of views on the appropriate method of allocating allowances under a mass-based system or credits under a rate-based system. Some preferred allowing states to make these decisions. Some wanted allocations to account for early action and energy efficiency efforts. The Panel agrees that EPA should take comment on the use of allocations to minimize the impact of the federal plan on small entities. The Panel notes that the early incentive pool that is part of the EGs does provide credit for early action, but the SERs did not have an opportunity to respond to this flexibility. The panel recommends that in the federal plan the EPA allow credit for early action and energy efficiency efforts to the extent it is allowed under the guidelines.

Non-generating party participation and market liquidity

SERs generally supported developing a system that would ensure a sufficient supply of credits be available on the open market and available for free trade to ensure that they would not be disadvantaged by large utilities withholding excess credits generated by renewable energy in their portfolio. However, some SERs also expressed the need to be able to generate and use credits internally (particularly those with generation across multiple states) (i.e., a portfolio approach). Some SERs endorsed allowing non-generating parties to create and sell credits or allowances. Other SERs warned that third parties should not be allowed to purchase credits or allowances for the purpose of retiring them without offsetting GHG emissions from electricity generation. The Panel recommends that the EPA ensure a liquid market in compliance instruments, through consideration, request or comment, or proposal of several of options, including: allocation methods or rules that could impact liquidity, mechanisms to place allowances or credits into the market relatively early, requirements for public transparency of information related to allowance or credit issuance, tracking, transfers, and holdings, and whether and to what extent oversight authority exists related to measures to ensure liquid markets Additionally, the Panel recommends that EPA solicit comment on other approaches to ensure liquidity, including but not limited to the concept of an early incentive pool which would serve to incentivize early reductions and create a market of additional allowances.

2.3.7.4 Renewable Energy and Energy Efficiency

Generally SERs encouraged EPA to incorporate existing EE efforts into the program in a way that gives credit for the investment and to rely on "deemed" energy savings to earn compliance credits. SERs raised concerns about the accounting of investments in RE and EE efforts in their compliance with GHG emission standards.

SERs also expressed concern that they be able to generate and use credits across state lines. This is particularly important for the investment in renewables, for which the generating potential is highly dependent on geography and is unequally distributed among the states. Thus, the Panel recommends that EPA develop a credit or allowance compliance program that allows for interstate accounting and trading for states under the federal plan. Additionally, the Panel recommends that the program include opportunities for interstate trading between sources in states under the federal plan and states under compatible state plans.

The Panel recommends that EPA consider the treatment of RE and EE in rate-based and mass-based federal plan contexts. EPA should further consider how to implement preferred policy options in a way that incentivizes investment and does not create unintended barriers for small entities. The Panel also recommends that EPA allow crediting of RE across states under the federal plan while soliciting comment for allowing crediting for EE across states under the federal plan.

2.3.7.5 Reliability

Multiple SERs expressed concerns that implementation of the EGs, either by states or through a federal plan, could have a negative impact on reliability because individual units could have operational obligations that conflict with the emissions requirements. In their comments, both the American Public Power Association (APPA) and the National Rural Electric Cooperative Association (NRECA) recommend Dynamic Reliability Safety Valve. EPA noted that the use of a reliability mechanism in the EGs is provisioned on the concern that some forms of state plan may create inflexible requirements that could in some limited circumstances raise a reliability concern. However, EPA believes the design of the federal plan as a flexible trading program alleviates these concerns and therefore a reliability mechanism is not needed.

The Panel recognizes the connection between meeting the GHG reduction goals of the federal plan and maintaining the reliability of the electric grid. The Panel recommends that EPA fully explain in the proposal and take comment on methods to address reliability and EPA should take comment on establishing a reliability safety valve, and whether there is a need for regulatory flexibility for reliability critical units beyond the flexibilities already built into the design of the federal plan.

2.3.7.6 Subcategorization/Applicability/Exemptions

SER comments on applicability reflect concerns related to the combined series of rulemakings affecting GHG emissions from electricity generating units: the NSPS, the EGs and the federal plan. SERs endorse excluding RICE and NGSC units from the combined rulemakings. One SER requests a subcategory that addresses the particular characteristics of lignite coal. Some SERs suggest special provisions for small units or utilities, including a small system exemption. The SBA suggested taking comment on an economic hardship exemption for small entities and that EPA propose a mechanism for additional compliance time when generation and transmission investments necessary for compliance have been delayed by government reviews. However, EPA noted that regulatory exemptions must be grounded in statute and supported by analysis, and EPA believes the design of the federal plan itself should maximize compliance options that are both consistent with the EGs and also should adequately address these concerns.

The Panel notes that EPA must be consistent with the EGs on issues of applicability, which should address the SERs' concerns with regard to inclusion of RICE or NGSC units. The Panel also notes that EPA is proposing a design to the federal plan that utilizes emission trading and thus maximizes compliance options such that individual units can take into account their particular characteristics in designing a compliance strategy. In EPA's view, this makes it less likely that there is a need for further sub-categorization or the use of unit-specific exemptions. Additionally, the Panel recommends that EPA solicit comment on an alternative allocation methodology under the mass-based proposed federal plan that may increase allocations for small businesses, and consider whether there are parallel mechanisms in a rate-based proposal that could provide similar regulatory relief or benefits for small entities, if appropriate.

2.4 Unfunded Mandates Reform Act (UMRA)

This action contains a federal mandate under UMRA, 2 U.S.C. 1531-1538, that could potentially result in expenditures of $100 million or more for state, local, and tribal governments, in the aggregate, or the private sector in any one year. This federal plan will apply only to those EGUs located in states that do not submit approvable state plans, which is a subset of the EGUs considered in the RIA for the final emission guidelines (EGs). Because it is impossible to determine at this time which states might be ultimately subject to a federal plan, EPA cannot determine whether this final rule will be subject to UMRA. However, as noted below, the Agency has done substantial outreach to government entities as part of both the federal plan and the related 111(d) rulemaking. Further, regardless of whether EPA does determine that this action ultimately meets the UMRA threshold, the agency intends to do additional outreach with government entities between now and the final rule. Additionally, the EPA has determined that this action is not subject to the requirements of section 203 of UMRA because it contains no regulatory requirements that might significantly or uniquely affect small governments.

Nevertheless, the EPA is aware that there is substantial interest in this rule among small entities (e.g., municipal and rural electric cooperatives). In light of this interest, prior to this action, the EPA sought early input from representatives of small entities while formulating the provisions of the proposed regulation. Such outreach is also consistent with the President's January 18, 2011 Memorandum on Regulatory Flexibility, Small Business, and Job Creation, which emphasizes the important role small businesses play in the American economy. This outreach process has enabled the EPA to hear directly from these representatives, as EPA developed the rule about how the EPA should approach the complex question of how to apply section 111 of the CAA to the regulation of GHGs from these source categories. We invite comments on all aspects of this proposal and its impacts, including potential adverse impacts, on small entities.

2.5 Executive Order 13132: Federalism

The EPA believes that this proposed rule may be of significant interest to state and local governments due to its relationship with the Clean Power Plan EGs. Therefore, the EPA has determined that consultations with state and local governments conducted during the Clean Power Plan EGs development process are also relevant to this proposed rule. Consistent with the

EPA's policy to promote communications between the EPA and state and local governments, the EPA consulted with state and local officials early in the process of developing the Clean Power Plan EGs to permit them to have meaningful and timely input into its development. As described in the Federalism discussion in the preamble to the proposed standards of performance for GHG emissions from new EGUs (79 FR 1501; January 8, 2014), the EPA consulted with state and local officials in the process of developing the proposed standards for newly constructed EGUs. A detailed Federalism Summary Impact Statement (FSIS) describing the most pressing issues raised in pre-proposal and post-proposal comments will be forthcoming with the final Clean Power Plan EGs, as required by section 6(b) of Executive Order 13132. In the spirit of Executive Order 13132, and consistent with the EPA's policy to promote communications between the EPA and state and local governments, the EPA specifically solicits comment on this proposed action from state and local officials.

2.6 Executive Order 13175: Consultation and Coordination with Indian Tribal Governments

This proposed action has tribal implications. However, it will neither impose substantial direct compliance costs on federally recognized tribal governments, nor preempt tribal law. The EGU potentially impacted by this proposed rulemaking located on Indian reservations are primarily owned by private entities, and in one case, partially owned by an agency of the U.S. government. As a result, the tribes on whose areas of Indian country those units are located will not be directly impacted by any costs of complying with this proposed rulemaking incurred by the owners/operators of those units. There would only be tribal implications in regards to compliance costs associated with this proposed rulemaking in the case where a tribal government has an ownership interest in a potentially affected EGU. A tribal government could also incur costs in the event that it seeks and is given delegated authority to enforce the federal plan proposed in this rulemaking. The EPA has, nevertheless, offered consultation to the tribes on whose areas of Indian country the units are located. As part of its general outreach to tribes regarding this proposed rulemaking, the EPA received feedback from a number of tribes regarding the potential overall economic impact that both the proposed Clean Power Plan and a proposed federal plan rulemaking may have on them. In these instances, the EPA has reached out to these tribes and as part of the consultation on the Clean Power Plan engaged with them on their concerns regarding a potential federal plan.

The EPA has conducted consultation with tribes on the Clean Power Plan and the Supplemental Proposal for the Clean Power Plan and will offer all tribes consultation on this proposed action. The EPA held consultations with tribes on the Clean Power Plan in the fall of 2014 before the agency issued its Supplemental Proposal for Indian Country and U.S. Territories. Additionally, the EPA held consultations for tribes shortly following the release of the supplemental proposal. The agency also held a public hearing on the supplemental proposal on November 19, 2014, in Phoenix, Arizona. At the public hearing the agency received oral comments from community members representing a number of tribes and a number of tribal officials. The agency also conducted consultation with tribes in the spring and summer of 2015. An overview of the consultations provided as part of the Clean Power Plan is available in section XII.F of the final EGs.

Additionally, the EPA engaged in meaningful dialogue with tribal stakeholders to obtain their feedback in the pre-proposal stages of this rulemaking. We provided an update on this proposed rulemaking on the May 28, 2015, National Tribal Air Association and the EPA Air Policy call. Additionally, staff attended the National Tribal Forum conference on May 20, 2015 and provided an overview of the Clean Power Plan and explained that the agency would be proposing a federal plan.

Consistent with previous rulemakings impacting the power sector, there is significant tribal interest in these rulemakings because of the potential indirect impacts that rules such as the Clean Power Plan and this proposed federal plan may have on tribes. The EPA specifically solicits additional feedback from tribal officials on all aspects of this proposed rulemaking, including whether tribes whose areas of Indian country contain affected EGU(s) are interested in developing their own plan implementing the final EGs. Additionally, tribal stakeholders will be included in the outreach that the agency will be conducting with those communities already overburdened by pollution, which are often low-income communities, communities of color, and indigenous communities. The actions that the agency will be taking are outlined in section IX of the preamble.

2.7 Executive Order 13045: Protection of Children from Environmental Health Risks and Safety Risks

The EPA interprets EO 13045 (62 FR 19885, April 23, 1997) as applying to those regulatory actions that concern health or safety risks, such that the analysis required under section 5–501 of the Order has the potential to influence the regulation. This action is not subject to EO 13045 because it does not involve decisions on environmental health or safety risks that may disproportionately affect children. The EPA believes that the CO2 emission reductions resulting from implementation of the proposed guidelines, as well as substantial ozone and PM2.5 emission reductions as a cobenefit, would further improve children's health.

2.8 Executive Order 13211: Actions That Significantly Affect Energy Supply, Distribution, or Use

This action, which is a significant regulatory action under EO 12866, is likely to have a significant effect on the supply, distribution, or use of energy. The EPA has prepared a Statement of Energy Effects for this action as follows. We estimate a 1 to 2 percent change in retail electricity prices on average across the contiguous U.S. in 2025, and a 22 to 23 percent reduction in coal-fired electricity generation as a result of this rule. The EPA projects that utility power sector delivered natural gas prices will increase by up to 2.5 percent in 2030. For more information on the estimated energy effects, please refer to the economic impact analysis for this proposal in Chapter 1 of this RIA.

2.9 National Technology Transfer and Advancement Act (NTTAA)

This proposed action does not involve technical standards.

2.10 Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

Executive Order 12898 (59 FR 7629; February 16, 1994) establishes federal executive policy on EJ. Its main provision directs federal agencies, to the greatest extent practicable and permitted by law, to make EJ part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations in the U.S. The EPA defines EJ as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and

enforcement of environmental laws, regulations, and policies. The EPA has this goal for all communities and persons across this Nation. It will be achieved when everyone enjoys the same degree of protection from environmental and health hazards and equal access to the decision-making process to have a healthy environment in which to live, learn, and work.

Leading up to this rulemaking the EPA summarized the public health and welfare effects of GHG emissions in its 2009 Endangerment Finding. As part of the Endangerment Finding, the Administrator considered climate change risks to minority populations and low-income populations, finding that certain parts of the population may be especially vulnerable based on their characteristics or circumstances. Populations that were found to be particularly vulnerable to climate change risks include the poor, the elderly, the very young, those already in poor health, the disabled, those living alone, and/or indigenous populations dependent on one or a few resources. See sections X.F and X.G of the preamble where the EPA discusses Consultation and Coordination with Tribal Governments and Protection of Children. The Administrator placed weight on the fact that certain groups, including children, the elderly, and the poor, are most vulnerable to climate-related health effects.

The record for the 2009 Endangerment Finding summarizes the strong scientific evidence in the major assessment reports by the U.S. Global Change Research Program, the Intergovernmental Panel on Climate Change (IPCC), and the National Research Council of the National Academies that the potential impacts of climate change raise EJ issues. These reports concluded that poor communities can be especially vulnerable to climate change impacts because they tend to have more limited adaptive capacities and are more dependent on climate-sensitive resources such as local water and food supplies. In addition, Native American tribal communities possess unique vulnerabilities to climate change, particularly those impacted by degradation of natural and cultural resources within established reservation boundaries and threats to traditional subsistence lifestyles. Tribal communities whose health, economic well-being, and cultural traditions that depend upon the natural environment will likely be affected by the degradation of ecosystem goods and services associated with climate change. The 2009 Endangerment Finding record also specifically noted that Southwest native cultures are especially vulnerable to water quality and availability impacts. Native Alaskan communities are already experiencing disruptive impacts, including coastal erosion and shifts in the range or abundance of wild species crucial to their livelihoods and well-being.

The most recent assessments continue to strengthen scientific understanding of climate change risks to minority populations and low-income populations in the U.S.[51] The new assessment literature provides more detailed findings regarding these populations' vulnerabilities and projected impacts they may experience. In addition, the most recent assessment reports provide new information on how some communities of color may be uniquely vulnerable to climate change health impacts in the U.S. These reports find that certain climate change related impacts—including heat waves, degraded air quality, and extreme weather events—have disproportionate effects on low-income populations and some communities of color (in particular, populations defined jointly by ethnic/racial characteristics and geographic location), raising EJ concerns. Existing health disparities and other inequities in these communities increase their vulnerability to the health effects of climate change. In addition, assessment reports also find that climate change poses particular threats to health, well-being, and ways of life of indigenous peoples in the U.S.

As the scientific literature presented above and as the 2009 Endangerment Finding illustrates, low income populations and some communities of color are especially vulnerable to the health and other adverse impacts of climate change. The EPA believes that communities will benefit from this proposed federal plan because this action directly addresses the impacts of climate change by limiting GHG emissions through the establishment of CO_2 emission standards for existing affected fossil fuel-fired EGUs.

In addition to reducing CO_2 emissions, the guidelines finalized in this rulemaking would reduce other emissions from affected EGUs that reduce generation due to higher adoption of EE

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[51] Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014: *Climate Change Impacts in the United States: The Third National Climate Assessment.* U.S. Global Change Research Program, 841 pp.

IPCC, 2014: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects.* Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, 1132 pp.

IPCC, 2014: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, 688 pp.

and RE. These emission reductions will include SO_2 and NO_x, which form ambient $PM_{2.5}$ and ozone in the atmosphere, and HAP, such as mercury and hydrochloric acid. In the final rule revising the annual $PM_{2.5}$ NAAQS,[52] the EPA identified low-income populations as being a vulnerable population for experiencing adverse health effects related to PM exposures. Low-income populations have been generally found to have a higher prevalence of pre-existing diseases, limited access to medical treatment, and increased nutritional deficiencies, which can increase this population's susceptibility to PM-related effects.[53] In areas where this rulemaking reduces exposure to $PM_{2.5}$, ozone, and methylmercury, low-income populations will also benefit from such emissions reductions. Chapter 1 of this RIA provides additional information regarding the health and ecosystem effects associated with these emission reductions.

Additionally, as outlined in the community and EJ considerations section IX of the preamble, the EPA has taken a number of actions to help ensure that this action will not have potential disproportionately high and adverse human health or environmental effects on vulnerable communities. The EPA consulted its May 2015, *Guidance on Considering Environmental Justice During the Development of Regulatory Actions*, when determining what actions to take.[54] As described in the community and EJ considerations section of the preamble the EPA also conducted a proximity analysis, which is available in the docket of this rulemaking and is discussed in section IX of the preamble. Additionally, as outlined in sections I and IX of the preamble the EPA has engaged meaningfully with communities throughout the development of the CPP and has devised a robust outreach strategy for continual engagement throughout this rulemaking.

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[52] "National Ambient Air Quality Standards for Particulate Matter, Final Rule," 78 FR 3086 (Jan. 15, 2013).

[53] U.S. Environmental Protection Agency (U.S. EPA). 2009. *Integrated Science Assessment for Particulate Matter (Final Report)*. EPA-600-R-08-139F. National Center for Environmental Assessment – RTP Division. December. Available on the Internet at *http://www.cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=216546*.

[54] Guidance on Considering Environmental Justice During the Development of Regulatory Actions. http://www.epa.gov/environmentaljustice/resources/policy/considering-ej-in-rulemaking-guide-final.pdf. May 2015.

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