EXECUTIVE SUMMARY

This Regulatory Impact Analysis (RIA) discusses potential benefits, costs, and economic impacts of the proposed Emission Guidelines for Greenhouse Gas Emissions from Existing Stationary Sources: Electric Utility Generating Units (herein referred to EGU GHG Existing Source Guidelines). This RIA also discusses the potential benefits, costs and economic impacts of the proposed Standards of Performance for Greenhouse Gas Emissions from Reconstructed and Modified Stationary Sources (EGU GHG Reconstructed and Modified Source Standards).

ES.1 Background and Context of Proposed EGU GHG Existing Source Guidelines

Greenhouse gas pollution threatens Americans' health and welfare by leading to long-lasting changes in our climate that can have a range of severely negative effects on human health and the environment. Carbon Dioxide (CO_2) is the primary greenhouse gas pollutant, accounting for nearly three-quarters of global greenhouse gas emissions and 84 percent of U.S. greenhouse gas emissions. Fossil fuel-fired electric generating units (EGUs) are, by far, the largest emitters of GHGs, primarily in the form of CO_2, among stationary sources in the U.S.

In this action, the EPA is proposing emission guidelines for states to use in developing plans to address greenhouse gas emissions from existing fossil fuel-fired EGUs. Specifically, the EPA is proposing state-specific rate-based goals for carbon dioxide emissions from the power sector, as well as emission guidelines for states to use in developing plans to attain the state-specific goals. This rule, as proposed, would set in motion actions to lower the carbon dioxide emissions associated with existing power generation sources in the United States.

ES.2 Summary of Proposed EGU GHG Existing Source Guidelines

Under Clean Air Act (CAA) section 111(d), state plans must establish standards of performance that reflect the degree of emission limitation achievable through the application of the “best system of emission reduction” (BSER) that, taking into account the cost of achieving such reduction and any non-air quality health and environmental impact and energy requirements, the Administrator determines has been adequately demonstrated.[1] Consistent with CAA section 111(d), this proposed rule contains state-specific goals that reflect the EPA's calculation of the emission reductions that a state can achieve through the application of BSER. The EPA is using the following four building blocks to determine state-specific goals:

1. Reducing the carbon intensity of generation at individual affected EGUs through heat-rate improvements.
2. Reducing emissions from the most carbon-intensive affected EGUs in the amount that results from substituting generation at those EGUs with generation from less carbon-intensive affected EGUs (including natural gas combined cycle [NGCC] units that are under construction).
3. Reducing emissions from affected EGUs in the amount that results from substituting generation at those EGUs with expanded low- or zero-carbon generation.
4. Reducing emissions from affected EGUs in the amount that results from the use of demand-side energy efficiency that reduces the amount of generation required.

The proposed rule also contains emission guidelines for states to use in developing plans that set their standards of performance. The EPA recognizes that each state has different policy considerations, including varying emission reduction opportunities and existing state programs and measures, and characteristics of the electricity system (e.g., utility regulatory structure, generation mix, electricity demand). The proposed emission guidelines provide states with options for establishing standards of performance in a manner that accommodates a diverse range of state approaches. The proposed guidelines would also allow states to collaborate and to demonstrate emission performance on a multi-state basis, in recognition of the fact that electricity is transmitted across state lines, and local measures often impact regional EGU CO_2

[1] Under CAA sections 111(a)(1) and (d), the EPA is authorized to determine the BSER and to calculate the amount of emission reduction achievable through applying the BSER; and the state is authorized to identify the standard(s) of performance that reflects that amount of emission reduction. In addition, the state is required to include in its state plan the standards of performance and measures to implement and enforce those standards. The state must submit the plan to the EPA, and the EPA must approve the plan if the standards of performance and implementing and enforcing measures are satisfactory.

emissions.

While the EPA must establish BSER and is proposing goals and guidelines that reflect BSER, CAA section 111(d) also provides the EPA with the flexibility to design goals and guidelines that recognize, and are tailored to, the uniqueness and complexity of the power generation sector and CO_2 emissions. And, importantly, CAA section 111(d) allows the states flexibility in designing the measures for their state plans in response to the EPA's guidelines. States are not required to use each of the measures that the EPA determines constitute BSER, or use those measures to the same degree of stringency that the EPA determines is achievable at a reasonable cost; rather, CAA section 111(d) allows each state to determine the appropriate combination of, and the extent of its reliance on, measures for its state plan, by way of meeting its state-specific goal. Given the flexibilities afforded states in complying with the emission guidelines, the benefits, cost and economic impacts reported in this RIA are not definitive estimates, but are instead illustrative of compliance actions states may take.

ES.3 Control Strategies for Existing EGUs

States will ultimately determine approaches to comply with the goals established in this regulatory action. The EPA is proposing a BSER goal approach referred to as Option 1 and taking comment on a second approach referred to as Option 2. Each of these goal approaches use the four building blocks described above at different levels of stringency. Option 1 involves higher deployment of the four building blocks but allows a longer timeframe to comply (2030) whereas Option 2 has a lower deployment over a shorter timeframe (2025).

Table ES-1 shows the proposed state goals for Options 1 and 2. This RIA depicts illustrative rate-based compliance scenarios for the goals set for Options 1 and 2, as well as regional and state compliance approaches for each option. With the state compliance approach, states are assumed to comply with the guidelines by implementing measures solely within the state and emissions rate averaging occurs between affected sources on an intrastate basis only. In contrast under the regional approach, groups of states are assumed to collaboratively comply with the guidelines. States have the discretion of choosing between a regional or state compliance approach, and this RIA reports the economic consequences of compliance under two sets of assumptions: one that assumes all states individually take a rate-based compliance approach and the other that assumes certain groups of states take regional rate-based approaches. The analysis in the illustrative scenarios does not assume that states use any specific policy mechanism to achieve the state goals. The distributions of emissions and electricity generation reflected in the Integrated Planning Model (IPM) analysis of the illustrative scenarios could be achieved by various policy mechanisms. Alternative compliance approaches are also possible. For example, the guidance allows flexibility of compliance, including the possibility of using a mass-based approach. While IPM finds a least cost way to achieve the state goals implemented through the rate-based constraints imposed in the illustrative scenarios, individual states or multi-state regional groups may develop more cost effective approaches to achieve their state goals.

Table ES-1. Proposed State Goals (Adjusted MWh-Weighted-Average Pounds of CO_2 per Net MWh from all Affected Fossil Fuel-Fired EGUs) for Options 1 and 2

State[2]	Option 1		Option 2	
	Interim Goal (2020-2029)	Final Goal (2030 Forward)	Interim Goal (2020-2024)	Final Goal (2025 Forward)
Alabama	1,147	1,059	1,270	1,237
Alaska	1,097	1,003	1,170	1,131
Arizona *	735	702	779	763
Arkansas	968	910	1,083	1,058
California	556	537	582	571
Colorado	1,159	1,108	1,265	1,227
Connecticut	597	540	651	627
Delaware	913	841	1,007	983
Florida	794	740	907	884
Georgia	891	834	997	964
Hawaii	1,378	1,306	1,446	1,417
Idaho	244	228	261	254
Illinois	1,366	1,271	1,501	1,457
Indiana	1,607	1,531	1,715	1,683
Iowa	1,341	1,301	1,436	1,417
Kansas	1,578	1,499	1,678	1,625
Kentucky	1,844	1,763	1,951	1,918
Louisiana	948	883	1,052	1,025

[2] The EPA has not developed goals for Vermont and the District of Columbia because current information indicates those jurisdictions have no affected EGUs. Also, as noted in Chapter 3, EPA is not proposing goals for tribes or U.S. territories at this time.

Table ES-1. Continued

Maine	393	378	418	410
Maryland	1,347	1,187	1,518	1,440
Massachusetts	655	576	715	683
Michigan	1,227	1,161	1,349	1,319
Minnesota	911	873	1,018	999
Mississippi	732	692	765	743
Missouri	1,621	1,544	1,726	1,694
Montana	1,882	1,771	2,007	1,960
Nebraska	1,596	1,479	1,721	1,671
Nevada	697	647	734	713
New Hampshire	546	486	598	557
New Jersey	647	531	722	676
New Mexico *	1,107	1,048	1,214	1,176
New York	635	549	736	697
North Carolina	1,077	992	1,199	1,156
North Dakota	1,817	1,783	1,882	1,870
Ohio	1,452	1,338	1,588	1,545
Oklahoma	931	895	1,019	986
Oregon	407	372	450	420
Pennsylvania	1,179	1,052	1,316	1,270
Rhode Island	822	782	855	840
South Carolina	840	772	930	897
South Dakota	800	741	888	861
Tennessee	1,254	1,163	1,363	1,326
Texas	853	791	957	924
Utah *	1,378	1,322	1,478	1,453
Virginia	884	810	1,016	962
Washington	264	215	312	284
West Virginia	1,748	1,620	1,858	1,817
Wisconsin	1,281	1,203	1,417	1,380
Wyoming	1,808	1,714	1,907	1,869

* Excludes EGUs located in Indian country.

Table ES-2 shows the emission reductions associated with the compliance scenarios for the proposed Option 1 regional and state compliance approaches and Table ES-3 reports emission reductions associated with Option 2. In 2020, the EPA estimates that CO_2 emissions will be reduced by 371 million metric tons under the regional compliance approach and by 383 million metric tons assuming a state specific compliance approach compared to base case levels. CO_2 emission reductions for Option 1 increase to 545 and 555 million metric tons annually in 2030 when compared to the base case emissions for Option 1 regional and state compliance approaches, respectively. Tables ES-2 and ES-3 also show emission reductions for criteria air pollutants.

Table ES-2. Summary of Climate and Air Pollutant Emission Reductions Option 1[1]

	CO_2 (million metric tons)	SO_2 (thousands of tons)	NO_X (thousands of tons)	$PM_{2.5}$ (thousands of tons)
2020 Regional Compliance Approach				
Base Case	2,161	1,476	1,559	212
Proposed Guidelines	1,790	1,184	1,213	156
Emissions Change	-371	-292	-345	-56
2025 Regional Compliance Approach				
Base Case	2,231	1,515	1,587	209
Proposed Guidelines	1,730	1,120	1,166	150
Emissions Change	-501	-395	-421	-59
2030 Regional Compliance Approach				
Base Case	2,256	1,530	1,537	198
Proposed Guidelines	1,711	1,106	1,131	144
Emission Change	-545	-424	-407	-54
2020 State Compliance Approach				
Base Case	2,161	1,476	1,559	212
Proposed Guidelines	1,777	1,140	1,191	154
Emissions Change	-383	-335	-367	-58
2025 State Compliance Approach				
Base Case	2,231	1,515	1,587	209
Proposed Guidelines	1,724	1,090	1,151	146
Emission Change	-506	-425	-436	-63
2030 State Compliance Approach				
Base Case	2,256	1,530	1,537	198
Proposed Guidelines	1,701	1,059	1,109	142
Emissions Change	-555	-471	-428	-56

Source: Integrated Planning Model, 2014.

[1] CO_2 emission reductions are used to estimate the climate benefits of the guidelines. SO_2, NOx, and directly emitted $PM_{2.5}$ emission reductions are relevant for estimating air pollution health co-benefits of the proposed guidelines.

Table ES-3. Summary of Climate and Air Pollutant Emission Reductions Option 2[1]

	CO_2 (million metric tons)	SO_2 (thousands of tons)	NO_X (thousands of tons)	$PM_{2.5}$ (thousands of tons)
2020 Regional Compliance Approach				
Base Case	2,161	1,476	1,559	212
Option 2	1,878	1,231	1,290	166
Emissions Change	-283	-244	-268	-46
2025 Regional Compliance Approach				
Base Case	2,231	1,515	1,587	209
Option 2	1,862	1,218	1,279	165
Emissions Change	-368	-297	-309	-44
2020 State Compliance Approach				
Base Case	2,161	1,476	1,559	212
Option 2	1,866	1,208	1,277	163
Emissions Change	-295	-267	-281	-49
2025 State Compliance Approach				
Base Case	2,231	1,515	1,587	209
Option 2	1,855	1,188	1,271	161
Emissions Change	-376	-327	-317	-48

Source: Integrated Planning Model, 2014.

[1] CO_2 emission reductions are used to estimate the climate benefits of the guidelines. SO_2, NOx, and directly emitted $PM_{2.5}$ emission reductions are relevant for estimating air pollution health co-benefits of the guidelines.

ES.4 Costs of Existing EGU Guidelines

The ‘‘compliance costs’’ of this proposed action are represented in this analysis as the change in electric power generation costs between the base case and illustrative compliance scenario policy cases. The compliance scenario policy cases reflect the pursuit by states of a distinct set of strategies, which are not limited to the technologies and measures included in the BSER to meet the EGU GHG emission guidelines, and include cost estimates for demand side energy efficiency. The compliance assumptions, and therefore the projected “compliance costs” set forth in this analysis, are illustrative in nature and do not represent the full suite of compliance flexibilities states may ultimately pursue.

The EPA projects that the annual incremental compliance cost of the proposed Option 1 ranges from $5.4 to $7.4 billion in 2020 and from $7.3 to $8.8 billion in 2030 ($2011), excluding the costs associated with monitoring, reporting, and recordkeeping. The estimated cost of Option 2 is between $4.2 and $5.4 billion in 2020 and between $4.5 and $5.5 billion in 2025 (2011$). The estimated monitoring, reporting and recordkeeping costs for both options are $68.3 million in 2020, $8.9 million in 2025, and $8.9 million in 2030 (2011$). The annual incremental cost is the projected additional cost of complying with the proposed rule in the year analyzed and includes the net change in the annualized cost of capital investment in new generating sources and heat rate improvements at coal steam facilities,[3] 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. Costs for both options are reflected in Table ES-4 below and discussed more extensively in Chapter 3 of this RIA.

Table ES-4. Summary of Illustrative Compliance Costs

	Incremental Cost from Base Case (billions of 2011$)		
	2020	2025	2030
Option 1			
State Compliance	$7.4	$5.5	$8.8
Regional Compliance	$5.4	$4.6	$7.3
Option 2			
State Compliance	$5.4	$5.5	n/a
Regional Compliance	$4.2	$4.5	n/a

Source: Integrated Planning Model, 2014, with post-processing to account for exogenous demand-side management energy efficiency costs. See Chapter 5 of the GHG Abatement Measures TSD for a full explanation. Compliance costs shown here do not include monitoring, reporting, and recordkeeping costs.

The costs reported in Table ES-4 represent the estimated incremental electric utility generating costs changes from the base case, plus end-use energy efficiency program costs (paid by electric utilities) and end-use energy efficiency participant costs (paid by electric utility consumers). For example in 2020 for the proposed Option 1 regional compliance approach, end-use energy efficiency program costs are estimated to be $5.1 billion and end-use efficiency participant costs are $5.1 billion using a 3% discount rate (see Table 3-4). This estimate for end-use energy efficiency costs of $10.2 billion is combined with the costs generated by the IPM that include the costs of states' compliance with state goals associated with changes to reduce the carbon-intensity of electricity production and the energy demand decreases expected from end-use energy efficiency assumed in the illustrative scenarios. In order to reflect the full cost

[3] See Chapter 8 of EPA's Base Case using IPM (v5.13) documentation, available at: http://www.epa.gov/powersectormodeling/BaseCasev513.html

attributable to the policy, it is necessary to include this incremental -$4.8 billion (see Table 3-9) in electricity supply expenditure with the annualized expenditure needed to secure the end-use energy efficiency improvements. As a result, this analysis finds the cost of the Option 1 regional scenario in 2020 to be $5.4 billion (the sum of incremental supply-related and demand-related expenditures). Note that when monitoring, reporting and recordkeeping costs of $68.3 million are added to this estimate, compliance costs become $5.5 billion in 2020.

The compliance costs reported in Table ES-4 are not social costs. These costs represent the illustrative real resources costs for states to comply with the BSER goals for Options 1 and 2. Electric sector compliance costs and monitoring, recordkeeping and reporting costs are compared to social benefits in Tables ES-8, ES-9 and ES-10 to derive illustrative net benefits of the guidelines. For a more extensive discussion of social costs, see Chapter 3 of this RIA.

ES.5 Monetized Climate Benefits and Health Co-benefits for Existing EGUs

Implementing the proposed guidelines is expected to reduce emissions of CO_2 and have ancillary emission reductions (i.e., co-benefits) of SO_2, NO_2, and directly emitted $PM_{2.5}$, which would lead to lower ambient concentrations of $PM_{2.5}$ and ozone. 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*, henceforth denoted as the 2013 SCC TSD.[4] Also, the range of combined benefits reflects different concentration-response functions for the air pollution 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 emission

[4] 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, 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 (May 2013, Revised November 2013). Available at: http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/technical-update-social-cost-of-carbon-for-regulator-impact-analysis.pdf

guidelines, including reducing exposure to SO_2, NO_x, and hazardous air pollutants (e.g., mercury and hydrogen chloride), as well as ecosystem effects and visibility impairment. These unquantified benefits could be substantial, but it is difficult to approximate the potential magnitude of these unquantified benefits and previous quantification attempts have been incomplete. The omission of these endpoints from the monetized results should not imply that the impacts are small or unimportant. Table ES-5 provides the list of the quantified and unquantified environmental and health benefits in this analysis.

Table ES-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	—	✓	SCC TSD
	Climate impacts from ozone and black carbon (directly emitted PM)	—	—	Ozone ISA, PM ISA[1]
	Other climate impacts (e.g., other GHGs such as methane, aerosols, other impacts)	—	—	IPCC[1]
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[1]
	Emergency room visits for cardiovascular effects (all ages)	—	—	PM ISA[1]
	Strokes and cerebrovascular disease (age 50-79)	—	—	PM ISA[1]
	Other cardiovascular effects (e.g., other ages)	—	—	PM ISA[2]
	Other respiratory effects (e.g., pulmonary function, non-asthma ER visits, non-bronchitis chronic diseases, other ages and populations)	—	—	PM ISA[2]
	Reproductive and developmental effects (e.g., low birth weight, pre-term births, etc)	—	—	PM ISA[2,3]
	Cancer, mutagenicity, and genotoxicity effects	—	—	PM ISA[2,3]
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[1]
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[1]
	Other respiratory effects (e.g., premature aging of lungs)	—	—	Ozone ISA[2]
	Cardiovascular and nervous system effects	—	—	Ozone ISA[2]
	Reproductive and developmental effects	—	—	Ozone ISA[2,3]

Table ES-5. Continued

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

Table ES-5. Continued

Reduced effects from nutrient enrichment	Species composition and biodiversity in terrestrial and estuarine ecosystems	—	—	NO_x SO_x ISA[2]
	Coastal eutrophication	—	—	NO_x SO_x ISA[2]
	Recreational demand in terrestrial and estuarine ecosystems	—	—	NO_x SO_x ISA[2]
	Other non-use effects			NO_x SO_x ISA[2]
	Ecosystem functions (e.g., biogeochemical cycles, fire regulation)	—	—	NO_x SO_x ISA[2]
Reduced vegetation effects from exposure to SO_2 and NO_x	Injury to vegetation from SO_2 exposure	—	—	NO_x SO_x ISA[2]
	Injury to vegetation from NO_x exposure	—	—	NO_x SO_x ISA[2]
Reduced ecosystem effects from exposure to methylmercury	Effects on fish, birds, and mammals (e.g., reproductive effects)	—	—	Mercury Study RTC[2]
	Commercial, subsistence and recreational fishing	—	—	Mercury Study RTC[1]

[1] We assess these co-benefits qualitatively due to data and resource limitations for this analysis.

[2] We assess these co-benefits qualitatively because we do not have sufficient confidence in available data or methods.

[3] We assess these co-benefits qualitatively because current evidence is only suggestive of causality or there are other significant concerns over the strength of the association.

ES.5.1 Estimating Global Climate Benefits

We estimate the global social benefits of CO_2 emission reductions expected from this rulemaking using the SCC estimates presented in the 2013 SCC TSD. We refer to these estimates, which were developed by the U.S. government, as “SCC estimates” for the remainder of this document. The SCC 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 the avoided damages as a result of regulatory actions (i.e., benefits of rulemakings that have an incremental impact on cumulative global CO_2 emissions).

The SCC 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 SCC estimation received via the notice and comment period that was part of numerous rulemakings since 2006. In addition, OMB’s Office of Information and Regulatory Affairs recently sought public comment on the approach used to develop the SCC estimates. The comment period ended on February 26, 2014, and OMB is reviewing the comments received.

An interagency process that included the EPA and other executive branch entities used three integrated assessment models (IAMs) to develop SCC estimates and selected four global values for use in regulatory analyses. The SCC 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 SCC 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 RIA Chapter 4 for more discussion.

The federal government first released the estimates in February 2010 and updated them in 2013 using new versions of each IAM. The general approach to estimating the SCC values in 2010 and 2013 was to run the three integrated assessment models (DICE, FUND, and PAGE)[5] using the following three inputs in each model: a probabilistic distribution for climate sensitivity; five scenarios capturing economic, population, and emission trajectories; and constant annual discount rates. The 2010 SCC Technical Support Document (SCC TSD) provides a complete discussion of the methodology and the 2013 SCC TSD presents and discusses the updated estimates. The four SCC estimates, updated in 2013, are as follows: $13, $46, $68, and $137 per metric ton of CO_2 emissions in the year 2020 (2011$), and each estimate increases over time. These SCC 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 SCC TSD noted a number of limitations to the SCC analysis, including the incomplete way in which the IAMs capture catastrophic and non-catastrophic impacts, their

[5] 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).

incomplete treatment of adaptation and technological change, uncertainty in the extrapolation of damages to high temperatures, and assumptions regarding risk aversion. Current 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. In particular, the IPCC Fourth Assessment Report concluded that "It is very likely that [SCC 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.

ES 5.2 Estimating Air Pollution Health Co-Benefits

The proposed guidelines would reduce emissions of precursor pollutants (e.g., SO_2, NOx, 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.[6] Unlike the global SCC estimates, the air pollution health co-benefits are only estimated for the contiguous U.S.[7] 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 (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).

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[6] We did not estimate the co-benefits associated with reducing direct exposure to SO_2 and NOx.

[7] We do not have emission reduction information or air quality modeling available to estimate the air pollution health co-benefits in Alaska and Hawaii anticipated from implementation of the proposed guidelines.

We used a "benefit-per-ton" approach to estimate the health co-benefits. To create the benefit-per-ton estimates for $PM_{2.5}$, this approach uses an air quality model to convert emissions of $PM_{2.5}$ precursors (e.g., SO_2, NO_x) and directly emitted particles into changes in ambient $PM_{2.5}$ concentrations and BenMAP to estimate the changes in human health associated with that change in air quality. We then divide these health impacts by the emissions in specific sectors at the regional level (i.e., East, West, and California). We followed a similar process to estimate benefit-per-ton estimates for the ozone precursor NO_x. To calculate the co-benefits for the proposed guidelines, 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, 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 fine particle standard 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-HES (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 pollution emission reductions for the illustrative compliance options for the proposed standards 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.

ES 5.3 Combined Benefits Estimates

The EPA has evaluated the range of potential impacts by combining all four SCC values with health co-benefits values at the 3 percent and 7 percent discount rates. Different discount rates are applied to SCC 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 SCC because the literature shows that the estimate of SCC is sensitive to assumptions about discount rate and because no consensus exists on the appropriate rate to use in an intergenerational context. The U.S. government centered its attention on the average SCC at a 3 percent discount rate but emphasized the importance of considering all four SCC estimates.

Tables ES-6 and ES-7 provide the combined climate benefits and health co-benefits for each option evaluated for 2020, 2025 and 2030 for Options 1 and 2, respectively for each discount rate combination.

Table ES-6. Combined Estimates of Climate Benefits and Health Co-Benefits for Proposed Existing EGU GHG Rule – Regional Compliance Approach (billions of 2011$)*

Option	SCC Discount Rate and Statistic**	Climate Benefits Only	Climate Benefits plus Health Co-Benefits (Discount Rate Applied to Health Co-Benefits)					
			3%			7%		
Option 1	In 2020	371	million metric tonnes CO_2					
	5%	$4.7	$21	to	$42	$19	to	$39
	3%	$17	$33	to	$54	$32	to	$51
	2.5%	$25	$41	to	$63	$40	to	$59
	3% (95th percentile)	$51	$67	to	$88	$65	to	$85
	In 2025	501	million metric tonnes CO_2					
	5%	$7.5	$30	to	$61	$28	to	$56
	3%	$25	$48	to	$78	$46	to	$74
	2.5%	$37	$60	to	$90	$57	to	$85
	3% (95th percentile)	$76	$99	to	$130	$97	to	$120
	In 2030	545	million metric tonnes CO_2					
	5%	$9.3	$35	to	$68	$32	to	$63
	3%	$30	$55	to	$89	$53	to	$84
	2.5%	$44	$69	to	$100	$66	to	$97
	3% (95th percentile)	$92	$120	to	$150	$120	to	$150
Option 2	In 2020	283	million metric tonnes CO_2					
	5%	$3.6	$17	to	$34	$16	to	$32
	3%	$13	$26	to	$44	$25	to	$41
	2.5%	$19	$33	to	$50	$31	to	$47
	3% (95th percentile)	$39	$52	to	$70	$51	to	$67
	In 2025	368	million metric tonnes CO_2					
	5%	$5.5	$23	to	$46	$21	to	$42
	3%	$18	$36	to	$59	$34	to	$55
	2.5%	$27	$44	to	$67	$43	to	$64
	3% (95th percentile)	$56	$73	to	$96	$72	to	$93

*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 direct exposure to NO_2, SO_2, and HAP; ecosystem effects; or visibility impairment. See Chapter 4 for more information about these estimates and regarding the uncertainty in these estimates.
**Unless otherwise specified, it is the model average.

Table ES-7. Combined Estimates of Climate Benefits and Health Co-Benefits for Proposed Existing EGU GHG Rule – State Compliance Approach (billions of 2011$)*

Option	SCC Discount Rate and Statistic**	Climate Benefits Only	Climate Benefits plus Health Co-Benefits (Discount Rate Applied to Health Co-Benefits)					
			3%			7%		
Option 1	In 2020	383	million metric tonnes CO_2					
	5%	$4.9	$22	to	$45	$20	to	$41
	3%	$18	$35	to	$57	$33	to	$54
	2.5%	$26	$43	to	$66	$42	to	$62
	3% (95th percentile)	$52	$69	to	$92	$68	to	$88
	In 2025	506	million metric tonnes CO_2					
	5%	$7.6	$31	to	$62	$29	to	$57
	3%	$25	$49	to	$80	$46	to	$75
	2.5%	$37	$61	to	$92	$58	to	$87
	3% (95th percentile)	$77	$100	to	$130	$98	to	$130
	In 2030	555	million metric tonnes CO_2					
	5%	$9.5	$36	to	$72	$34	to	$66
	3%	$31	$57	to	$93	$55	to	$87
	2.5%	$44	$71	to	$110	$69	to	$100
	3% (95th percentile)	$94	$120	to	$160	$120	to	$150
Option 2	In 2020	295	million metric tonnes CO_2					
	5%	$3.8	$17	to	$35	$16	to	$32
	3%	$14	$27	to	$45	$26	to	$42
	2.5%	$20	$34	to	$52	$32	to	$49
	3% (95th percentile)	$40	$54	to	$72	$53	to	$69
	In 2025	376	million metric tonnes CO_2					
	5%	$5.6	$23	to	$47	$22	to	$43
	3%	$19	$36	to	$60	$35	to	$56
	2.5%	$28	$45	to	$69	$44	to	$65
	3% (95th percentile)	$57	$75	to	$98	$73	to	$95

*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 direct exposure to NO_2, SO_2, and HAP; ecosystem effects; or visibility impairment. See Chapter 4 for more information about these estimates and regarding the uncertainty in these estimates.

**Unless otherwise specified, it is the model average.

ES.6 Monetized Benefits, Compliance Costs and Net Benefits of the Proposed Guidelines for Existing Sources

In this summary, the EPA provides the estimates of the climate benefits, health co-benefits, compliance costs and net benefits of the proposed Option 1 and alternative Option 2 assuming a regional compliance approach and an alternative state compliance approach. In Table

ES-8, the EPA estimates that in 2020 the proposed Option 1 regional compliance approach will yield monetized climate benefits of $17 billion using a 3 percent discount rate (model average, 2011$). The air pollution health co-benefits in 2020 are estimated to be $16 billion to $37 billion (2011$) for a 3 percent discount rate and $15 billion to $34 billion (2011$) for a 7 percent discount rate. The annual compliance costs, including monitoring and reporting costs, are approximately $5.5 billion (2011$) in 2020. The quantified net benefits (the difference between monetized benefits and costs) are $28 billion to $49 billion (2011$) for 2020 (Table ES-8 below) and $48 billion to $82 billion (2011$) for 2030 (Table ES-10 below), using a 3 percent discount rate (model average). For the Option 1 state compliance approach in 2020, the EPA estimates monetized climate benefits of approximately $18 billion using a 3 percent discount rate (model average). The air pollution health co-benefits in 2020 are estimated to be $17 billion to $40 billion for a 3 percent discount rate and $15 billion to $36 billion (2011$) for a 7 percent discount rate. The annual compliance costs including monitoring and reporting costs, are approximately $7.5 billion (2011$) in 2020. The quantified net benefits (the difference between monetized benefits and costs) are $27 billion to $50 billion for 2020 (Table ES-8 below) and $49 billion to $84 billion (2011$) for 2030 (Table ES-10 below). Benefit and cost estimates for Option 1 regional and state compliance approaches for 2020, 2025, and 2030 and are presented in Tables ES-8, ES-9, and ES-10, and similar estimates for Option 2 regional and state compliance approaches are presented in Tables ES-8 and ES-9 for 2020 and 2025.

The EPA could not monetize some important benefits of the guidelines. Unquantified benefits 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 and hydrogen chloride), as well as ecosystem effects and visibility impairment. Upon considering these limitations and uncertainties, it remains clear that the benefits of this proposal are substantial and far outweigh the costs.

Table ES-8. Summary of Estimated Monetized Benefits, Compliance Costs, and Net Benefits for the Proposed Guidelines – 2020 (billions of 2011$) [a]

	Option 1 - state		Option 2 – state	
	3% Discount Rate	7% Discount Rate	3% Discount Rate	7% Discount Rate
Climate Benefits [b]				
5% discount rate	$4.9		$3.8	
3% discount rate	$18		$14	
2.5% discount rate	$26		$20	
95th percentile at 3% discount rate	$52		$40	
Air pollution health co-benefits [c]	$17 to $40	$15 to $36	$14 to $32	$12 to $29
Total Compliance Costs [d]	$7.5		$5.5	
Net Benefits [e]	$27 to $50	$26 to $46	$22 to $40	$20 to $37
Non-Monetized Benefits	Direct exposure to SO_2 and NO_2 1.5 tons of Hg Ecosystem Effects Visibility impairment		Direct exposure to SO_2 and NO_2 1.2 tons of Hg Ecosystem Effects Visibility impairment	
	Option 1 - regional		Option 2 – regional	
	3% Discount Rate	7% Discount Rate	3% Discount Rate	7% Discount Rate
Climate Benefits [b]				
5% discount rate	$4.7		$3.6	
3% discount rate	$17		$13	
2.5% discount rate	$25		$19	
95th percentile at 3% discount rate	$51		$39	
Air pollution health co-benefits [c]	$16 to $37	$15 to $34	$13 to $31	$12 to $28
Total Compliance Costs [d]	$5.5		$4.3	
Net Benefits [e]	$28 to $49	$26 to $45	$22 to $40	$21 to $37
Non-Monetized Benefits	Direct exposure to SO_2 and NO_2 1.3 tons of Hg Ecosystem effects Visibility impairment		Direct exposure to SO_2 and NO_2 0.9 tons of Hg Ecosystem effects Visibility impairment	

[a] All estimates are for 2020 and are rounded to two significant figures, so figures may not sum.

[b] The climate benefit estimates in this summary table reflect global impacts from CO_2 emission changes and do not account for changes in non-CO_2 GHG emissions. Also, different discount rates are applied to SCC than to the other estimates because CO_2 emissions are long-lived and subsequent damages occur over many years. The SCC estimates are year-specific and increase over time.

[c] The air pollution health co-benefits reflect reduced exposure to $PM_{2.5}$ and ozone associated with emission reductions of directly emitted $PM_{2.5}$, SO_2 and NO_X. The range reflects the use of concentration-response functions from different epidemiology studies. The reduction in premature fatalities each year accounts for over 90 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.

[d] Total social costs are approximated by the illustrative compliance costs which, in part, are estimated using the Integrated Planning Model for the proposed option and a discount rate of approximately 5%. This estimate 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 SCC at a 3 percent discount rate (model average). The RIA includes combined climate and health estimates based on these additional discount rates.

Table ES-9. Summary of Estimated Monetized Benefits, Compliance Costs, and Net Benefits for the Proposed Guidelines – 2025 (billions of 2011$) [a]

	Option 1 – state		Option 2 – state	
	3% Discount Rate	7% Discount Rate	3% Discount Rate	7% Discount Rate
Climate Benefits [b]				
5% discount rate	$7.6		$5.6	
3% discount rate	$25		$19	
2.5% discount rate	$37		$28	
95th percentile at 3% discount rate	$77		$57	
Air pollution health co-benefits [c]	$23 to $54	$21 to $49	$18 to $41	$16 to $37
Total Compliance Costs [d]	$5.5		$5.5	
Net Benefits [e]	$43to $74	$41 to $69	$31 to $55	$29 to $51
Non-Monetized Benefits	Direct exposure to SO_2 and NO_2 2.0 tons of Hg Ecosystem Effects Visibility impairment		Direct exposure to SO_2 and NO_2 1.7 tons of Hg Ecosystem Effects Visibility impairment	
	Option 1 – regional		Option 2 – regional	
	3% Discount Rate	7% Discount Rate	3% Discount Rate	7% Discount Rate
Climate Benefits [b]				
5% discount rate	$7.5		$5.5	
3% discount rate	$25		$18	
2.5% discount rate	$37		$27	
95th percentile at 3% discount rate	$76		$56	
Air pollution health co-benefits [c]	$23 to $53	$21 to $48	$17 to $40	$16 to $36
Total Compliance Costs [d]	$4.6		$4.5	
Net Benefits [e]	$43 to $74	$41 to $69	$31 to $54	$29 to $50
Non-Monetized Benefits	Direct exposure to SO_2 and NO_2 1.7 tons of Hg Ecosystem effects Visibility impairment		Direct exposure to SO_2 and NO_2 1.3 tons of Hg Ecosystem effects Visibility impairment	

[a] All estimates are for 2025 and are rounded to two significant figures, so figures may not sum.

[b] The climate benefit estimates in this summary table reflect global impacts from CO_2 emission changes and do not account for changes in non-CO_2 GHG emissions. Also, different discount rates are applied to SCC than to the other estimates because CO_2 emissions are long-lived and subsequent damages occur over many years. The SCC estimates are year-specific and increase over time.

[c] The air pollution health co-benefits reflect reduced exposure to $PM_{2.5}$ and ozone associated with emission reductions of directly emitted $PM_{2.5}$, SO_2 and NO_X. The range reflects the use of concentration-response functions from different epidemiology studies. The reduction in premature fatalities each year accounts for over 90 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.

[d] Total social costs are approximated by the illustrative compliance costs which, in part, are estimated using the Integrated Planning Model for the proposed option and a discount rate of approximately 5%. This estimate 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 SCC at a 3 percent discount rate (model average). The RIA includes combined climate and health estimates based on these additional discount rates.

Table ES-10. Summary of Estimated Monetized Benefits, Compliance Costs, and Net Benefits for the Proposed Guidelines –2030 (billions of 2011$) [a]

	Option 1– state	
	3% Discount Rate	7% Discount Rate
Climate Benefits [b]		
5% discount rate	$9.5	
3% discount rate	$31	
2.5% discount rate	$44	
95th percentile at 3% discount rate	$94	
Air pollution health co-benefits [c]	$27 to $62	$24 to $56
Total Compliance Costs [d]	$8.8	
Net Benefits [e]	$49 to $84	$46 to $79
Non-Monetized Benefits	Direct exposure to SO_2 and NO_2 2.1 tons of Hg and 590 tons of HCl Ecosystem effects Visibility impairment	
	Option 1– regional	
	3% Discount Rate	7% Discount Rate
Climate Benefits [b]		
5% discount rate	$9.3	
3% discount rate	$30	
2.5% discount rate	$44	
95th percentile at 3% discount rate	$92	
Air pollution health co-benefits [c]	$25 to $59	$23 to $54
Total Compliance Costs [d]	$7.3	
Net Benefits [e]	$48 to $82	$46 to $77
Non-Monetized Benefits	Direct exposure to SO_2 and NO_2 1.7 tons of Hg and 580 tons of HCl Ecosystem effects Visibility impairment	

[a] All estimates are for 2030, and are rounded to two significant figures, so figures may not sum.

[b] The climate benefit estimates in this summary table reflect global impacts from CO_2 emission changes and do not account for changes in non-CO_2 GHG emissions. Also, different discount rates are applied to SCC than to the other estimates because CO_2 emissions are long-lived and subsequent damages occur over many years. The SCC estimates are year-specific and increase over time.

[c] The air pollution health co-benefits reflect reduced exposure to $PM_{2.5}$ and ozone associated with emission reductions of directly emitted $PM_{2.5}$, SO_2 and NO_X. The range reflects the use of concentration-response functions from different epidemiology studies. The reduction in premature fatalities each year accounts for over 90 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.

[d] Total social costs are approximated by the illustrative compliance costs which, in part, are estimated using the Integrated Planning Model for the proposed option and a discount rate of approximately 5%. This estimate 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 SCC at a 3 percent discount rate (model average). The RIA includes combined climate and health estimates based on these additional discount rates.

ES.7 Economic Impacts of the Proposed Emission Guidelines for Existing EGUs

The proposed guidelines have important energy market implications. Under Option 1, average nationwide retail electricity prices are projected to increase roughly 6 to 7 percent in 2020, and roughly 3 percent in 2030 (contiguous U.S.), compared to base case price estimates modeled for these same years. Average monthly electricity bills are anticipated to increase by roughly 3 percent in 2020, but decline by roughly 9 percent by 2030 because increased energy efficiency will lead to reduced usage.

The average delivered coal price to the power sector is projected to decrease by 16 to 17 percent in 2020 and roughly 18 percent in 2030, relative to the base case (Option 1). The EPA projects coal production for use by the power sector, a large component of total coal production, will decline by roughly 25 to 27 percent in 2020 from base case levels. The use of coal by the power sector will decrease by roughly 30 to 32 percent in 2030.

The EPA also projects that the electric power sector-delivered natural gas prices will increase by 9 to 12 percent in 2020, with negligible changes by 2030 relative to the base case. Natural gas use for electricity generation will increase by as much as 1.2 trillion cubic feet (TCF) in 2020 relative to the base case, declining over time.

Renewable energy capacity is anticipated to increase by roughly 12 GW in 2020 and by 9 GW in 2030 under Option 1. Energy market impacts from the guidelines are discussed more extensively in Chapter 3 of this RIA.

ES.8 Economic Impacts of the Proposed Guidelines for Existing EGUs for Sectors Other Than the EGU Sector and for Employment

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 and these market changes may affect the profitability of firms and the economic welfare of their consumers. The EPA recognizes that these guidelines provide significant flexibilities and states implementing the guidelines may choose to mitigate impacts to some markets outside the EGU sector. Similarly, demand for new generation or energy efficiency can result in changes in production and profitability for firms that supply those goods and services. The guidelines provide flexibility for states that may want to enhance demand for goods and services from those sectors.

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, during periods of sustained high unemployment, employment impacts are of particular concern and questions may arise about their existence and magnitude.

States have the responsibility and flexibility to implement policies and practices for compliance with Proposed Electric Generating Unit Greenhouse Gas Existing Source Guidelines. Given the wide range of approaches that may be used, quantifying the associated employment impacts is difficult. The EPA’s illustrative employment analysis includes an estimate of projected employment impacts associated with these guidelines for the electric power industry, coal and natural gas production, and demand side energy efficiency activities. These projections are derived, in part, from a detailed model of the electricity production 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 estimates that these guidelines could result in an increase of approximately 28,000 to 25,900 job-years in 2020 for Option 1, state and regional compliance approaches, respectively. For Option 2, the state and regional compliance approach estimates reflect an increase of approximately 29,800 to 26,700 job-years in 2020. The Agency is also offering an illustrative calculation of potential employment effects due to demand-side energy efficiency programs. Employment impacts in 2020 could be an increase of approximately 78,800 jobs for Option 1 (for both the state and regional compliance approaches). For Option 2 demand-side energy efficiency employment impacts in 2020 could be an increase of approximately 57,000 jobs (for both the state and regional compliance approaches). More detail about these analyses can be found in Chapter 6 of this RIA.

ES.9 Modified and Reconstructed Sources

The EPA is proposing emission limits for CO_2 emitted from reconstructed and modified EGUs under section 111(b) of the CAA. Based on historical information that has been reported to the EPA, the EPA anticipates few, if any, covered units will trigger the reconstruction or modification provisions in the period of analysis (through 2025). As a result, we do not anticipate any significant costs or benefits associated with this proposal. However, because there have been a few units that have notified the EPA of modifications in the past, in Chapter 9 of this RIA we present an illustrative analysis of the costs and benefits for a hypothetical unit if it were to trigger the modification provision.

ES.10 References

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