Regulatory Impact Analysis for the Review and Reconsideration of the Oil and Natural Gas Sector Emission Standards for New, Reconstructed, and Modified Sources

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Regulatory Impact Analysis for the Review and Reconsideration of the Oil and Natural Gas Sector Emission Standards for New, Reconstructed, and Modified Sources

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 EXECUTIVE SUMMARY

1.1 Introduction

This regulatory analysis accompanies the final review and reconsideration of the new source performance standards (NSPS) at 40 Code of Federal Regulations (CFR) part 60, subpart OOOO (2012 NSPS OOOO) and OOOOa (2016 NSPS OOOOa). The Environmental Protection Agency (EPA) is finalizing two simultaneous actions that amend the requirements of the 2012 NSPS OOOO and 2016 NSPS OOOOa. This document presents regulatory impact analyses (RIAs) for both actions separately and presents the combined impacts of the two actions.

Policy Review: The first RIA in this document presents the regulatory impacts of the final amendments to the 2012 NSPS OOOO and 2016 NSPS OOOOa. These amendments, which we refer to in this document as the "Policy Review," remove sources in the transmission and storage segment from the source category, rescind the NSPS (including both the volatile organic compounds and GHG requirements in form of limitations on methane) applicable to those sources, and rescind the methane-specific requirements of the NSPS applicable to sources in the production and processing segments.

Technical Reconsideration: The second RIA in this document presents the regulatory impacts of the finalized set of amendments pertaining to several technical aspects of the 2016 NSPS OOOOa, which we refer to in this document at the "Technical Reconsideration." The EPA finalized amendments to the fugitive emissions requirements, well site pneumatic pump standards, requirements for certification of closed vent systems (CVS) by a professional engineer, and alternative fugitive emissions standards for several state programs. The Technical Reconsideration also includes other amendments, though the impacts of these other amendments are not presented in this document for reasons discussed below and in Chapter 3. These other amendments address issues raised in the reconsideration petitions for the oil and natural gas NSPS, as well as streamline the implementation of the rule. The Technical Reconsideration also includes technical corrections and additional clarifying language in the regulatory text and/or preamble where the EPA concluded that further clarification was warranted.

The impacts of regulatory actions are evaluated relative to a baseline that represents the world without the regulatory action. Because the preambles and amended regulatory text for the two actions are sequenced, starting with the Policy Review, we evaluate the regulatory impacts of the actions within this document using the same sequence. The Policy Review removes sources in the transmission and storage segment from the source category, so these sources are not affected by the Technical Reconsideration, and therefore not in the baseline used to estimate impacts of the Technical Reconsideration.

To better inform the public on the aggregate regulatory impacts of the two final actions, we follow the two RIAs with an analysis that combines the regulatory impacts of the two actions relative to a baseline representing the regulatory landscape in the absence of either action, *i.e.*, the same baseline used in the Policy Review analysis. Throughout this document, we focus the analysis on the final amendments that result in quantifiable compliance cost or emissions changes compared to the relevant baseline. We do not analyze the regulatory impacts of all amendments because we either do not have sufficient data or because it is assumed the provisions would not result in compliance cost or emissions impacts; in these instances, we qualitatively discuss the amendments.

Compared to the analysis presented in the 2016 NSPS RIA, this analysis reflects updated assumptions based on new information on existing and projected source counts, model plant emissions and control costs, natural gas prices, and state and local regulations that have been promulgated since the 2016 NSPS OOOOa was finalized. Additional updates reflect information received during the comment period of the Technical Reconsideration.[1] Aside from these updates, which are described in detail in Sections 2.1 and 3.1, the same assumptions and methods used in the 2016 NSPS RIA were used in this analysis to estimate an updated baseline. The updated baseline represents the EPA's best assessment of the current and future state of the industry absent the changes finalized under the Policy Review and Technical Reconsideration.

[1] See the preamble for the Technical Reconsideration and its response to comments document, which are available in the docket.

1.2 Summary of Results

Table 1-1 presents the present value (PV) and equivalent annual value (EAV), estimated using discount rates of 7 and 3 percent, of the changes in quantified benefits, costs, and net benefits, as well as the forgone emissions reductions relative to the baseline due to the Policy Review. These values reflect a 2021 through 2030 analysis period, discounted to 2020, and are presented in 2016 dollars. When discussing net benefits, we refer to the cost reductions as the "benefits" of the final actions and the forgone benefits as the "costs" of the final actions. The net benefits are the benefits (cost reductions) minus the costs (forgone benefits). All costs and benefits presented in Table 1-1 are estimated relative to a baseline without the Policy Review or Technical Reconsideration. Table 1-2 presents the PV and EAV for the Technical Reconsideration, which includes the final amendments of the Policy Review in the baseline. Table 1-3 presents the combined results of the Policy Review and Technical Reconsideration, compared to a baseline without either of the two final rules, which is equivalent to summing the results in Table 1-2 and Table 1-3.

Table 1-1 Compliance Cost Reductions, Forgone Benefits, and Forgone Emissions Reductions of the Policy Review, 2021 through 2030 (millions 2016$)

	7% Discount Rate		3% Discount Rate	
	Present Value	**Equivalent Annualized Value**	**Present Value**	**Equivalent Annualized Value**
Benefits (Total Cost Reductions)	$31	$4.1	$38	$4.3
Cost Reductions	$67	$8.9	$83	$9.4
Forgone Value of Product Recovery	$36	$4.7	$45	$5.1
Costs (Forgone Domestic Climate Benefits)[1]	$17	$2.2	$63	$7.2
Net Benefits	$14	$1.9	-$25	-$2.9
Forgone Emissions Reductions	**2021-2030 Total**			
Methane (short tons)	400,000			
VOC	11,000			
HAP	330			
Methane (million metric tons CO_2 Eq.)	9			

Note: Estimates may not sum due to independent rounding.
[1] The forgone benefits estimates are calculated using estimates of the social cost of methane (SC-CH_4). SC-CH_4 values represent only a partial accounting of domestic climate impacts from methane emissions. While we expect that the forgone VOC and HAP emissions reductions may also degrade air quality and adversely affect health and welfare, data limitations prevent us from quantifying and monetizing these effects.

Table 1-2 Compliance Cost Reductions, Forgone Benefits, and Forgone Emissions Reductions of the Technical Reconsideration, 2021 through 2030 (millions 2016$)

	7% Discount Rate		3% Discount Rate	
	Present Value	**Equivalent Annualized Value**	**Present Value**	**Equivalent Annualized Value**
Benefits (Total Cost Reductions)	$750	$100	$950	$110
Cost Reductions	$800	$110	$1,000	$110
Forgone Value of Product Recovery	$44	$5.9	$57	$6.5
Costs (Forgone Domestic Climate Benefits)[1]	$19	$2.5	$71	$8.1
Net Benefits	$730	$97	$880	$100
Forgone Emissions Reductions	**2021-2030 Total**			
Methane (short tons)	450,000			
VOC	120,000			
HAP	4,700			
Methane (million metric tons CO_2 Eq.)	10			

Note: Estimates may not sum due to independent rounding.
[1] The forgone benefits estimates are calculated using estimates of the social cost of methane (SC-CH_4). SC-CH_4 values represent only a partial accounting of domestic climate impacts from methane emissions. While we expect that the forgone VOC and HAP emissions reductions may also degrade air quality and adversely affect health and welfare, data limitations prevent us from quantifying and monetizing these effects.

Table 1-3 Compliance Cost Reductions, Forgone Benefits, and Forgone Emissions Reductions of the Combined Policy Review and Technical Reconsideration, 2021 through 2030 (millions 2016$)

	7% Discount Rate		3% Discount Rate	
	Present Value	**Equivalent Annualized Value**	**Present Value**	**Equivalent Annualized Value**
Benefits (Total Cost Reductions)	$780	$100	$990	$110
Cost Reductions	$860	$110	$1,100	$120
Forgone Value of Product Recovery	$80	$11	$100	$12
Costs (Forgone Domestic Climate Benefits)[1]	$35	$4.7	$130	$15
Net Benefits	$750	$99	$850	$97
Forgone Emissions Reductions	**2021-2030 Total**			
Methane (short tons)	850,000			
VOC	140,000			
HAP	5,000			
Methane (million metric tons CO_2 Eq.)	19			

Note: Estimates may not sum due to independent rounding.
[1] The forgone benefits estimates are calculated using estimates of the social cost of methane (SC-CH_4). SC-CH_4 values represent only a partial accounting of domestic climate impacts from methane emissions. While we expect that the forgone VOC and HAP emissions reductions may also degrade air quality and adversely affect health and welfare, data limitations prevent us from quantifying and monetizing these effects.

Beyond the top-level cost and benefit information presented in Tables 1-1 through 1-3, there may be other economic impacts resulting from the final Policy Review and the final Technical Reconsideration. Under both actions individually and combined, we expect reductions in the small (less than 1 percent) impacts on energy production and markets estimated for the final NSPS in the 2016 NSPS RIA. While we did not conduct quantitative distributional impacts analyses of the rules, we do not expect the cost reductions to be distributed evenly across affected entities, and we do not expect the forgone benefits resulting from the finalized actions to be distributed uniformly across the U.S. Since these final actions are deregulatory, we concluded that they will relieve regulatory burden for small (and non-small) entities subject to the reconsidered provisions, and thus will not have a significant impact on a substantial number of small entities (SISNOSE). Finally, we expect reductions in labor associated with compliance-related activities due to the Policy Review and Technical Reconsideration; however, we did not quantify broader labor impacts on the industry or other sectors of the economy.

1.3 Organization of this Document

Chapters 2, 3, and 4 present the results of this RIA for the Policy Review, Technical Reconsideration, and Full Review and Reconsideration (*i.e.*, combined actions), respectively. Each of these chapters describes the emissions, compliance cost, and forgone benefits analysis of the final actions relative to their respective baselines, as well as their economic impacts. The analyses use similar methods to those used in the 2016 NSPS RIA.[2] The remainder of this report describes this methodology, with explanations of the instances in which the underlying data, assumptions, or methods changed from the 2016 NSPS RIA. The bulk of the supporting technical details which apply to all three analyses are presented in Chapter 2, with Chapters 3 and 4 referring to Chapter 2 rather than repeating those details.

[2] Found at: https://www3.epa.gov/ttn/ecas/docs/ria/oilgas_ria_nsps_final_2016-05.pdf.

2 REGULATORY IMPACT ANALYSIS FOR THE OIL AND NATURAL GAS SECTOR: EMISSION STANDARDS FOR NEW, RECONSTRUCTED, AND MODIFIED SOURCES REVIEW

2.1 Introduction

This final action (called the "Policy Review" in this document) rescinds the requirements of the subpart OOOO (2012 NSPS OOOO) and OOOOa (2016 NSPS OOOOa) for oil and natural gas sources in the transmission and storage segment. The Policy Review also rescinds the methane standards for sources in the production and processing segments, while leaving VOC requirements in place for production and processing sources. The EPA has determined in this final action that the methane control options are the same as VOC control options, and thus the methane standard is redundant. As such, there are no expected cost or emissions impacts from removing the methane requirements for potential new, reconstructed, and modified sources in the production and processing segments.

In this RIA, we present estimated benefits and costs of the final Policy Review action. A more detailed description of the regulatory baseline is below. We project impacts for the years 2021 through 2030. All monetized impacts of these changes are presented in 2016 dollars. This analysis also presents benefits and costs in a present value (PV) framework. All sources in the transmission and storage segment that are affected by subparts OOOO and OOOOa (hereafter referred to as "the NSPS") are impacted by this final deregulatory action if they would have been affected by the NSPS in the baseline.

The regulatory impacts of this action pertain specifically to potential new, reconstructed, and modified sources under the NSPS. The EPA recognizes that by rescinding the applicability of the NSPS for methane, issued under CAA section 111(b), existing sources in the source category will not be subject to regulation under CAA section 111(d). Analysis of potential impacts of removing the requirement to regulate existing sources under 111(d) is outside the scope of this RIA.

2.1.1 Summary of Changes Since the Final 2016 NSPS RIA

2.1.1.1 Updated Information

This analysis uses the same methodologies as the 2016 NSPS RIA but changes some assumptions based on updated data. The following list highlights the updates and revisions made to the methodology since the 2016 NSPS RIA:

- **Annual Energy Outlook:** For the 2016 NSPS RIA, we used the 2015 Annual Energy Outlook (AEO). For this analysis, we use the AEO2020, published in January 2020.[3] The natural gas price projections are used to estimate the value of product recovery. The use of the AEO2020 for the final rule is also an update from the RIA associated with the proposal of this action, which used the AEO2018. The projections of Henry Hub natural gas prices in AEO2020 are lower than the AEO2015 projections used in the 2016 RIA.
- **Source Projections:** Since the promulgation of the 2016 NSPS OOOOa, the U.S. Greenhouse Gas Inventory (GHGI) has been updated.[4] The data from the updated GHGI were used to project the number of NSPS-affected compressor stations, reciprocating compressors, and pneumatic controllers over time. Compared to the 2016 NSPS RIA, the projected number of NSPS-affected compressor stations, reciprocating compressors, and pneumatic controllers in the transmission and storage segment increased. For centrifugal compressors and storage vessels, we relied on information from the 2016 NSPS OOOOa rule compliance reports received in 2018 and determined that there are unlikely to be new centrifugal compressors and storage vessels constructed in the future in the transmission and storage segment.
- **Social Cost of Methane:** In the 2016 NSPS OOOOa, the EPA used an estimate of the global social cost of methane to monetize the climate related benefits associated with reductions in methane emissions. Since the promulgation of the 2016 NSPS OOOOa, Executive Order (E.O.) 13783 has been signed, which directs agencies to ensure that estimates of the social cost of greenhouse gases used in economic analyses are consistent with the guidance contained in the Office of Management and Budget (OMB) Circular A-4, "including with respect to the consideration of domestic versus international impacts and the consideration of appropriate discount rates" (E.O. 13783, Section 5(c)). Thus, for this action, we use an interim estimate of the domestic social cost of methane to estimate the forgone climate benefits resulting from the forgone methane emissions reductions due to this final action.
- **Model Plants:** The costs of the fugitive emissions monitoring requirements promulgated in 2016 for transmission and storage compressor stations have been updated. Specifically, the estimate of upfront costs of the fugitive monitoring program have increased while the annual cost estimates have decreased.[5]

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[3] AEO2020 can be found at https://www.eia.gov/outlooks/aeo/. Accessed April 26, 2020.

[4] The updated GHGI data used is from the April 2018 release. For information on the inventory, visit https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks/. Accessed April 26, 2020.

[5] For more information on the model plants, see the docketed memorandum titled: U.S. EPA. 2020. Memorandum: Control Cost and Emission Changes under the Final Amendments to 40 CFR Part 60, subpart OOOOa Under Executive Order 13783.

- **Other**: In the 2016 NSPS OOOOa, all dollar figures were presented in 2012 dollars. In this analysis, all estimated impacts are presented in 2016 dollars.[6] In the 2016 NSPS RIA, we presented impacts for the snapshot years of 2020 and 2025. For this analysis, we estimate cost reductions and emissions changes resulting from changes in compliance activities projected to occur in each year from 2021 through 2030 due to this final action. We discount the annual cost reductions to 2020 and present total PV and equivalent annualized value (EAV) over the analysis period.[7]

Note that, although there are states with similar requirements for transmission and storage sources as the NSPS, we are unable to account for these requirements in the evaluation of this action.[8]

2.1.1.2 Updated Baseline for the Policy Review

Table 2-1 shows the projected number of NSPS-affected facilities, methane, VOC, and HAP emission reductions, and the total annualized costs including the value of product recovery in 2021 and 2025 for the sources in the transmission and storage segment as estimated in the 2016 NSPS RIA and relative to the baseline used for this action. Based on updated facility projections,[9] there may be more affected facilities than anticipated in the 2016 NSPS RIA.[10] Consequently, for the subset of 2016 NSPS provisions affected by the Policy Review, compliance cost and emissions impacts of the 2016 NSPS were likely underestimated in the 2016 analysis. The emission reductions presented here are the emission reductions assuming the affected sources were not performing compliance activities prior to the 2016 NSPS OOOOa.

[6] Costs were adjusted to 2016 dollars using the seasonally adjusted annual Gross Domestic Product: Implicit Price Deflator updated by the Federal Reserve on April 13, 2020.

[7] The proposal RIA discounted to 2016. In this RIA, we discount to 2020 to improve interpretability.

[8] For the Policy Review and for the Technical Reconsideration, the EPA projected affected facilities using a combination of historical data from the U.S. GHG Inventory, DI Desktop, EPA compliance reports, and projected activity levels taken from the AEO. Because oil and natural gas well locations are identified in DI Desktop, we can forecast well drilling activities by state. As a result, we can estimate the effects of state regulations on future affected facilities that draw upon state-specific information. However, projections of affected facilities that draw upon the GHGI, such as sources in the transmission and storage segment, are national-scale and, hence, we are unable to account for state-level regulations in our analysis.

[9] See Section 2.3 and Appendix A for details on facility projections.

[10] Results from the 2016 NSPS RIA are generally not comparable to results in this analysis because of changes to the baseline. The higher count of affected facilities in transmission and storage results from higher growth in the historical period used to estimate new facilities compared to the historical data used in 2016, which showed little growth in transmission and storage. Affected facility counts in transmission and storage are sensitive to the historical data used. Changes in transmission and storage-related methane, VOC, and HAP emissions compared to the 2016 baseline shown in Table 2-1 result from changes in the projected facility counts as the source-level emissions characteristics are the same as in the 2016 analysis.

Table 2-1 Projected Impacts of the 2016 NSPS OOOOa Transmission and Storage Requirements: 2016 NSPS RIA and Updated Baseline Comparison[1]

	2016 NSPS RIA		Updated Baseline	
	2021[2]	2025	2021	2025
Counts of NSPS-Affected Sources in Transmission and Storage	970	1,500	3,000	4,600
Methane Emission Reductions (short tons)	12,000	20,000	27,000	43,000
VOC Emission Reductions (tons)	340	540	760	1,200
Total Annualized Compliance cost, without Product Recovery (7%, millions, 2016$)[3]	$3.7	$5.8	$6.0	$9.5
Total Annualized Compliance cost, with Product Recovery (7%, millions, 2016$)[3]	$1.1	$1.8	$2.9	$3.9

1 The emission reductions presented here are the emission reductions assuming the affected sources were not performing compliance activities prior to the 2016 NSPS OOOOa.
2 While the 2016 NSPS RIA only summarized results for 2020 and 2025, we used the same underlying data described in the 2016 NSPS TSD to estimate impacts for 2021.
3 Excluding compliance cost of professional engineer certification, as well as other provisions in the 2016 NSPS OOOOa unrelated to fugitive emissions monitoring requirements.

2.1.2 Rescinded Regulatory Requirements

The projected compliance cost reductions and forgone emission reductions from rescinding the NSPS requirements for transmission and storage sources are equal to the cost and emissions impacts that would have resulted from keeping the 2016 requirements in place after accounting for the updates described in the preceding section. The universe of affected sources includes all sources in the transmission and storage segment that would be considered new or modified under the oil and natural gas NSPS and would be complying with the rule in absence of this action.

For example, compressor stations in the transmission sector that become NSPS-affected sources in 2016 are also affected by this action because they are expected to cease NSPS-required activities related to the fugitive emissions monitoring and repair requirements. However, compressor stations in the gathering and boosting sector are not affected by this action because they are in the production and processing segment, which is still required to comply with quarterly fugitive emissions monitoring and repair requirements. Table 2-2 summarizes the sources affected by this action and their respective regulatory requirements in the baseline.

We estimate that there are no affected centrifugal compressors and storage vessels in the transmission and storage segment, so we do not anticipate any regulatory impacts associated with the Policy Review on these sources. Similarly, we do not currently have the necessary data to estimate the effects of the Policy Review on compressor stations on the Alaska North Slope.

Table 2-2 Emissions Sources and Baseline Requirements in the Transmission and Storage Segment

Emissions Point and Control	Requirements in the Baseline
Fugitive Emissions - Planning, Monitoring and Maintenance	
Compressor Stations	Quarterly monitoring
Compressor Stations on Alaska North Slope[1]	Annual monitoring
Pneumatic Controllers	Replace high-bleed with low-bleed
Reciprocating Compressors	Replace rod packing every 26,000 hours[2]
Centrifugal Compressors[3]	Route to control
Storage Vessels[3]	Storage vessels with VOC emissions of 6 tons a year or more must reduce VOC emissions by at least 95 percent

[1] We do not currently have data to estimate the effects of the Policy Review on compressor stations on the Alaska North Slope.
[2] Operators have a choice to replace rod packings either every 36 months or 26,000 hours. As in the 2016 NSPS TSD, we assume compliance with the latter, which suggests replacement every 3.8 years for transmission sources and 4.4 years for storage sources based on operating data.
[3] We currently estimate that there are no affected centrifugal compressors or storage vessels in the transmission and storage segment.

2.1.3 Policy Review: Summary of Key Results

A summary of the key results is shown below. All estimates are in 2016 dollars. Also, all compliance costs, emissions changes, and benefits are estimated relative to a baseline without the impacts of the Policy Review and Technical Reconsideration. We estimate that the Policy Review will potentially affect approximately 38 firms.[11]

- **Emissions Analysis:** The Policy Review is projected to forgo methane emission reductions of 22,000 short tons in 2021 and 58,000 short tons in 2030 and a total of 400,000 short tons from 2021 to 2030. Forgone VOC emission reductions are projected to be 610 short tons in 2021 and 1,600 short tons in 2030 and a total of 11,000 short tons from 2021 to 2030. Forgone HAP emissions are projected to be 18 short tons in 2021 and 48 short tons in 2030 and a total of 330 short tons from 2021 to 2030.

[11] We estimate the number of firms potentially affected firms using information in the Information Collection Request (ICR) Supporting Statement associated with this rulemaking. Before promulgating the Policy Review, the EPA estimates that up to 575 firms would be subject to NSPS OOOOa during the 3-year period covered by the ICR (Table 1d of the Supporting Statement). We then estimate that up to 537 respondents per year will be subject to NSPS OOOOa during the 3-year period covered by the ICR (Section 6(d) of the Supporting Statement). As a result, we estimate the incremental number of firms potentially affected by the Policy Review to be the difference between 575 and 537, or 38 firms.

- **Benefits Analysis:** The Policy Review is projected to result in forgone climate, health, and welfare benefits. The PV of the domestic forgone climate benefits, using an interim estimate of the domestic social cost of methane (SC-CH_4) and discounting at a 7 percent rate is $17 million from 2021 to 2030. The EAV is estimated to be $2.2 million per year. Using the interim SC-CH_4 estimate based on the 3 percent rate, the PV of forgone domestic climate benefits is estimated to be $63 million; the EAV is estimated to be $7.2 million per year. The EPA expects that forgone VOC emission reductions will negatively affect air quality and likely affect health and welfare adversely due to impacts on ozone, $PM_{2.5}$, and HAP, but we are unable to quantify these effects at this time. This omission does not imply that these forgone benefits do not exist.
- **Compliance Cost Analysis:** The Policy Review is projected to result in compliance cost reductions. The PV of the compliance cost reduction associated with this final rule over the 2021 to 2030 period is estimated to be $67 million (2016$) using a 7 percent discount rate and $83 million using a 3 percent discount rate. The EAV of these cost reductions is estimated to be $8.9 million per year using a 7 percent discount rate and $9.4 million per year using a 3 percent discount rate. These estimates do not include the forgone producer revenues associated with a decrease in the recovery of saleable natural gas due to this final action, as some of the compliance actions required in the baseline would likely have captured saleable product that would have otherwise been emitted. Using the AEO2020 projection of natural gas prices to estimate the value of the change in the recovered gas at the wellhead expected to result from this action, the EPA estimated a PV of regulatory compliance cost reductions of the final rule over the 2021 to 2030 period of $31 million using a 7 percent discount rate and $38 million using a 3 percent discount rate. The corresponding estimates of the EAV of cost reductions after accounting for forgone product recovery revenues are $4.1 million per year using a 7 percent discount rate and $4.3 million per year using a 3 percent discount rate.[12]
- **Energy Markets Impacts Analysis:** The 2016 NSPS RIA estimated small (less than 1 percent) impacts on energy production and markets. The EPA expects that the deregulatory Policy Review will reduce energy market impacts of the NSPS.
- **Distributional Impacts:** The cost reductions and any forgone benefits likely to arise from the Policy Review are not expected to be distributed uniformly across the population, and may not accrue equally to the same individuals, firms, or communities impacted by the 2016 rule. The EPA did not conduct a quantitative assessment of the distributional impacts of the final Policy Review, but we provide a qualitative discussion of the distributional aspects of the cost reductions and the forgone health benefits.
- **Small Entity Impacts Analysis:** The EPA expects this final deregulatory action to reduce the small entity impacts estimated in the RIA for the 2016 NSPS OOOOa. We therefore find that this final action will relieve regulatory burden for small entities affected by this final action and thus will not have a Significant Impact on a Substantial Number of Small Entities (SISNOSE).

[12] There may also be an opportunity cost associated with the installation of environmental controls (for purposes of mitigating the emission of pollutants) that is not reflected in the control costs. In the event that investment in environmental compliance displaces other investment in productive capital, the difference between the rate of return on the investment displaced by the mandatory environmental investment is a measure of the opportunity cost of the environmental requirement. To the extent that such opportunity costs of capital are not accounted for in the estimated compliance cost reductions, the cost reductions may be underestimated.

- **Employment Impacts Analysis:** The EPA expects reductions in labor associated with compliance-related activities due to this action. The EPA estimated the labor impacts due to the forgone installation, operation, and maintenance of control equipment and control activities, as well as the reductions labor associated with reduced reporting and recordkeeping requirements. The EPA estimated one-time and continual, annual labor requirements by estimating hours of labor required for compliance and converting this to full-time equivalents (FTE) by dividing by 2,080 (40 hours per week multiplied by 52 weeks). The reduction in one-time labor needed to comply with the NSPS due to this action is estimated to be about 1.2 FTE in 2021 and 2.5 FTE in 2030. The reduction in annual labor needed to comply with the NSPS due to this action is estimated at about 29 FTE in 2021 and 65 FTE in 2030. The EPA notes that this type of FTE-estimate cannot be used to identify the specific number of employees involved or whether new jobs are created for employees who potentially lose their jobs, versus displacing jobs from other sectors of the economy.

2.1.4 Organization of the Policy Review RIA

Section 2.2 describes the estimated compliance cost reductions and forgone emissions reductions from the Policy Review, including the PV of the projected cost reductions over the 2021 to 2030 period and the associated EAV. Section 2.3 describes the projected forgone benefits resulting from this rule, including the PV and EAV over the 2021 to 2030 period. Section 2.4 describes the economic impacts expected from this action. Section 2.5 compares the projected forgone benefits and compliance cost reductions of this action, as well as a summary of the net benefits.

2.2 Projected Compliance Cost Reductions and Forgone Emissions Reductions

2.2.1 Pollution Controls and Emissions Points Assessed in this RIA

This section provides a basic description of the emissions sources and controls affected by the final Policy Review.

Fugitive Emissions Requirements: Fugitive emissions occur when connection points are not fitted properly or when seals and gaskets start to deteriorate. Pressure, changes in pressure, or mechanical stresses can also cause components or equipment to leak. Potential sources of fugitive emissions include valves, connectors, pressure relief devices, open-ended lines, flanges, closed vent systems, and thief hatches or other openings on a controlled storage vessel. These fugitive emissions do not include devices that vent as part of normal operations.

The projected cost and emission impacts assume implementation of a leak monitoring program based on the use of optical gas imaging (OGI) leak detection combined with leak correction. The monitoring and repair frequency under the baseline is quarterly for transmission and storage compressor stations.[13] This chapter presents estimates of the impacts of removing the fugitive emission requirements for compressor stations in the transmission and storage segment.

Pneumatic Controllers: Pneumatic controllers are automated instruments used for maintaining process conditions such as liquid level, pressure, pressure differential, and temperature. In many situations across all segments of the oil and natural gas industry, pneumatic controllers make use of the available high-pressure natural gas to operate or control a valve. In these "gas-driven" pneumatic controllers, natural gas may be released with every valve movement and/or continuously from the valve control pilot. Not all pneumatic controllers are gas-driven. These "non-gas-driven" pneumatic controllers use sources of power other than pressurized natural gas. Examples include solar, electric, and instrument air. At oil and gas locations with electrical service, non-gas-driven controllers are typically used. Continuous bleed pneumatic controllers can be classified into two types based on their emissions rates: (1) high-bleed controllers and (2) low-bleed controllers. This chapter presents estimates of the impact of not installing low-bleed instead of high-bleed controllers to comply with the bleed limit requirement established in the 2016 NSPS for the transmission and storage segment.

Reciprocating and Centrifugal Compressors: Compressors are mechanical devices that increase the pressure of natural gas and allow the natural gas to be transported from the production site, through the supply chain, and to the consumer. The types of compressors that are used by the oil and gas industry as prime movers are reciprocating and centrifugal compressors. Centrifugal compressors use either wet or dry seals.

Emissions from compressors occur when natural gas leaks around moving parts in the compressor. In a reciprocating compressor, emissions occur when natural gas leaks around the piston rod when pressurized natural gas is in the cylinder. Over time, during operation of the compressor, the rod packing system becomes worn and needs to be replaced to prevent excessive

[13] Monitoring frequency for compressor stations on the Alaska North Slope is annual, however, we do not estimate any compressor stations on the Alaska North Slope.

leaking from the compression cylinder. This RIA estimates the impact of removing the requirements to replace the rod packing approximately either every 3 years (36 months) or 26,000 hours in reciprocating compressors in the transmission and storage segment. As in the 2016 NSPS TSD, we assume compliance with the latter, which suggests replacement every 3.8 years for transmission sources and 4.4 years for storage sources based on operating data.

Emissions from centrifugal compressors depend on the type of seal used: either "wet," which use oil circulated at high pressure, or "dry," which use a thin gap of high-pressure gas. The use of dry gas seals substantially reduces emissions. In addition, their use significantly reduces operating costs and enhances compressor efficiency. The EPA evaluated using a mechanical dry seal system to limit or reduce the emissions from the rotating shaft of a centrifugal compressor. For centrifugal compressors equipped with wet seals, a flare was evaluated as an option for reducing emissions from centrifugal compressors. However, a review of 2016 NSPS OOOOa compliance reports submitted in 2018 from sources in several EPA Regions (3, 6, 8, 9, and 10) with the greatest oil and natural gas activity indicates that there are no affected centrifugal compressors in the transmission and storage segment.[14] As a result, we project there would be no affected centrifugal compressors in the future absent this rule, meaning there are no regulatory impacts associated with deregulating centrifugal compressors.

Storage vessels: Crude oil, condensate, and produced water are typically stored in fixed-roof storage vessels. Some vessels used for storing produced water may be open-top tanks. These vessels, which are operated at or near atmospheric pressure conditions, are typically used in tank batteries. A tank battery refers to the collection of process equipment used to separate, treat, and store crude oil, condensate, natural gas, and produced water. The extracted products from production wells enter the tank battery through the production header, which may collect product from many wells. Emissions from storage vessels are a result of working, breathing, and flash losses. Working losses occur due to the emptying and filling of storage tanks. Breathing losses are due to the release of gas associated with daily temperature fluctuations and other equilibrium

[14] For more information on the EPA's review of the oil and natural gas NSPS compliance reports, see the docketed memorandum titled: U.S. EPA. 2020. Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources Background Technical Support Document for the Final Reconsideration of the New Source Performance Standards, 40 CFR Part 60, subpart OOOOa. Detailed reports are also available at: *https://www.foiaonline.gov/foiaonline/action/public/submissionDetails?trackingNumber=EPA-HQ-2018-001886&type=request.* Accessed April 26, 2020.

effects. Flash losses occur when a liquid with entrained gases is transferred from a vessel with higher pressure to a vessel with lower pressure, thus allowing entrained gases or a portion of the liquid to vaporize or flash. In the oil and natural gas production segment, flashing losses occur when live crude oils or condensates flow into a storage tank from a processing vessel operated under higher pressure. Typically, the larger the pressure drop, the greater the flashing emissions in the storage stage. Two ways of control tanks with significant emissions are to install a vapor recovery unit (VRU) and recover all the vapors from the tanks, or to route the emissions from the tanks to a control device. However, a review of 2016 NSPS OOOOa compliance reports submitted in 2018 from sources in the EPA Regions (3, 6, 8, 9, and 10) with the greatest oil and natural gas activity indicates that there were no storage vessels emitting more than 6 tons per year of VOC in the transmission and storage segment,[15] and therefore we presume there are no regulatory impacts associated with deregulating sources of this type.

2.2.2 Compliance Cost Analysis

There are two main steps in the compliance cost analysis. First, the EPA developed a representative or model plant for each affected emission source, point, and control option.[16] The characteristics of the model plant include typical equipment, operating characteristics, and representative factors including baseline emissions and the costs, emissions reductions, and product recovery resulting from each control option. This source-level cost and emission information for the requirements affected by this action can be found in a docketed technical memorandum associated with this action.[17] Second, the number of incrementally affected facilities for each type of equipment or facility are estimated. Changes in national-level emissions and cost estimates are calculated by multiplying the modeled source-level estimates from the first step by the number of affected facilities in each projection year from the second step. In addition to emissions reductions, some control options result in natural gas recovery, which can then be combusted in production or sold. The estimates of national cost reductions include the value of the forgone product recovery where applicable.

[15] Ibid.

[16] See Section 2 of the TSD accompanying this final action for more detail on how model plants were developed.

[17] U.S. EPA. 2020. Memorandum: Control Cost and Emission Changes under the Final Amendments to 40 CFR Part 60, subpart OOOOa Under Executive Order 13783.

In this section, we present the costs and emissions impacts of the Policy Review from 2021 through 2030, under the assumption that 2021 is the first full year any changes from this action will be in effect. In addition, we provide detailed analysis for 2021 and 2030, which allows the reader to draw comparisons between the first year after the promulgation of the Policy Review and nine years after the impacts have accumulated.[18] While it would be desirable to analyze impacts beyond 2030, the EPA has chosen not to, largely because of the limited information available to model long-term changes in practices and equipment use in the oil and natural gas industry. For example, the EPA has limited information on how practices, equipment, and emissions at new facilities change as they age or shut down. The current analysis assumes that newly established facilities remain in operation for the entire analysis period, which would be less realistic in a longer-term analysis. In addition, in a dynamic industry like oil and natural gas, technological progress is likely to change control methods to a greater extent over a longer time horizon, creating more uncertainty about impacts of the NSPS. For example, the current analysis does not include potential fugitive emissions controls employing remote sensing technologies currently under development.

2.2.3 Projection of Affected Facilities

To project the number of NSPS-affected facilities in transmission and storage, we first updated the number of NSPS-affected facilities for this analysis using average year-over-year increases in facility counts from the GHGI.[19] We assumed that this average number of new affected sources

[18] Any comparison of the 2016 NSPS RIA results to this analysis should be done with caution. The baseline of affected sources has been updated in this analysis, the years of analysis are different, and results in this RIA are presented in 2016 dollars, while the 2016 NSPS RIA presents results in 2012 dollars.

[19] More detailed description of the calculations on new sources are provided in Appendix A. We applied the year-by-year rate of change derived from AEO2020 oil and natural gas drilling projections to the estimated number of wells in 2014 from DrillingInfo, regardless of well type, to project the estimated number of new well sites through 2030.. In addition to well sites, the fugitive emissions requirements apply to gathering and boosting stations, transmission compressor stations, and storage compressor stations. The GHGI is used to estimate the count of newly affected compressor stations in each year. The GHGI uses a variety of data sources and studies to estimate equipment counts and emissions. Many equipment counts are based on the data reported under the GHGRP, scaled up to reflect the total population including both GHGRP-reporting and non-reporting oil and natural gas facilities. We estimated the number of new compressor stations, by type, by averaging the increases in the year-to-year changes in total national counts of equipment over the 10-year period from 2004 through 2014. Year-to-year increases were assumed to represent newly constructed facilities. Decreases in total counts were represented as zeros for that year, and average together with the annual increases. This approach results in the same number of new compressor stations in each projected year, regardless of increases or decreases in AEO projected drilling or production. The average year-to-year increase in compressor station counts are: 212 for gathering and boosting stations, 36 for transmission compressor stations, and 2 for storage compressor stations.

is constant from 2021 through 2030. While new source counts are likely to vary across years, we use this assumption as our best approximation of the average number of new sources in each year. See Appendix A for details on activity count projections.

Over time, facilities are constructed or modified in each year, and to the extent the facilities remain in operation in future years, the total number of facilities subject to the NSPS accumulates.[20] This analysis assumes that all projected new sources from 2015 through 2029 are still in operation in 2030. These sources include fugitive emissions sources at compressor stations, pneumatic controllers, and centrifugal and reciprocating compressors.[21]

Table 2-3 shows the projected number of NSPS-affected sources in each year. The estimates for affected sources are based upon projections of new sources alone, and do not include replacement or modification of existing sources. While some of these sources are unlikely to be modified, the impact estimates may be underestimated due to the focus on new sources. For compressor stations and reciprocating compressors, newly constructed affected facilities are estimated based on averaging year-to-year changes in activity data in the GHGI between 2004 and 2014. The approach averages the number of newly constructed units in all years. In years when the total count of equipment decreased, there were assumed to be no new units. For pneumatic controllers, we use the same averaging technique applied to 2011 to 2014 GHGI data, since the Inventory did not disaggregate pneumatic controllers into high and low bleed prior to 2011.[22] We assume there are no new wet seal centrifugal compressors or affected storage vessels based on the assessment of the recent NSPS oil and natural gas compliance reports.[23]

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[20] This RIA provides more detailed information than previous oil and natural gas NSPS RIA analyses by including year-by-year results over the 2021 to 2030 analysis period.

[21] Due to data limitations, we do not quantify any emissions or cost changes associated with new compressor stations on the Alaska North Slope.

[22] Based on comment received on the proposal of this rule, we treat the installation of low-bleed pneumatic controllers from 2015 to 2020 as irreversible, meaning that they are not assumed to be replaced with high-bleed controllers as a result of this action until the end of their assumed equipment lifetime.

[23] For more information on the EPA's review of the oil and natural gas NSPS compliance reports, see the docketed memorandum titled: U.S. EPA. 2020. Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources Background Technical Support Document for the Final Reconsideration of the New Source Performance Standards, 40 CFR Part 60, subpart OOOOa. Detailed reports are also available at: *https://www.foiaonline.gov/foiaonline/action/public/submissionDetails?trackingNumber=EPA-HQ-2018-001886&type=request.* Accessed April 26, 2020.

Table 2-3 Projected NSPS-Affected Sources in Transmission and Storage, 2021 to 2030[24]

Year	Compressor Stations	Reciprocating Compressors	Centrifugal Compressors	Pneumatic Controllers[1]	Storage Vessels	Total
2021	270	530	0	310	0	1,100
2022	300	610	0	620	0	1,500
2023	340	680	0	920	0	2,000
2024	380	760	0	1,200	0	2,400
2025	420	840	0	1,500	0	2,800
2026	460	910	0	1,800	0	3,200
2027	490	990	0	2,200	0	3,600
2028	530	1,100	0	2,500	0	4,100
2029	570	1,100	0	2,800	0	4,500
2030	610	1,200	0	3,400	0	5,200

Note: Estimates may not sum due to independent rounding
[1] Counts in this column do not include pneumatic controllers installed between 2015 and 2020, which are affected sources under the NSPS but are not expected to change activities as a result of this action until the end of their assumed equipment lifetimes.

There have been multiple updates to the GHGI, and the data the EPA used to estimate the number of affected sources in the 2016 NSPS OOOOa was revised where appropriate. We updated the time period used to estimate the number of affected sources. The 2016 NSPS RIA used the ten-year period leading up to 2012, whereas this proposed action estimates the number of affected sources in the ten-year period leading up to 2014. The projected number of affected sources in the transmission and storage segment is sensitive to the ten-year period used for averaging. For example, the 2016 NSPS RIA estimated four new transmission compressor stations a year, and this analysis estimates 36 new transmission compressor stations per year. Though the difference in the count of affected sources as estimated for the 2016 NSPS RIA and the Policy Review is large, when compared to the total number of transmission compressor

[24] See Appendix A for more discussion. Nationwide impacts of certifications for closed vent system design and technical infeasibility of routing pneumatic pumps to an existing control device, rod-packing replacements at reciprocating compressors, route-to-control measures for wet-seal centrifugal compressors, and use of low-bleed pneumatic controllers were calculated by estimating the count of affected facilities installed in a typical year and then using that typical year estimate to estimate the number of new affected facilities for each of the years in the study period, 2021 through 2030. The basis for the counts of affected facilities that would require closed vent system and technical infeasibility certifications in a typical year was information from 2016 NSPS OOOOa compliance information for 2017. These represent the number of new affected facilities in a "typical year." The GHGI was used to generate counts of reciprocating compressors and pneumatic controllers in transmission and storage only. The 2017 compliance report's nationwide number of new affected facilities reported are: 663 pneumatic pumps, 180 reciprocating compressors, 0 centrifugal compressors, 697 storage vessels and 308 pneumatic controllers

stations nationally in 2014 (about 1,800), both are small: 0.2 percent and 2.0 percent, respectively.

In addition, since the 2016 NSPS RIA (which used 2015 GHGI data), the EPA updated the GHGI methodology used to develop station counts. This update had only a small impact on total national counts in the GHGI.[25] The update also resulted in minor changes in year-to-year trends, which have impacted the affected source projection. National estimates of other sources (*e.g.*, compressors and pneumatic controllers) in the transmission and storage segment rely on station counts as an input and are therefore impacted by this change as well. As annual national counts of transmission and storage stations are not directly available from any national-level data source, the EPA applies a methodology to estimate the total national counts of transmission and storage stations. This method was updated between the 2015 GHGI and the 2018 GHGI. For the 2016 NSPS, (using the previous GHGI methodology) transmission station counts were estimated by applying a factor of stations per mile of transmission pipeline to the total national transmission pipeline mileage.[26] Storage station counts were also developed using the previous GHGI methodology (applying a factor of stations per unit of gas consumption to total national gas consumption). In this RIA, transmission station counts are developed using updated data from the 2018 GHGI. In the 2018 GHGI, transmission stations are estimated based on scaled-up Greenhouse Gas Reporting Program (GHGRP) data. Storage stations are estimated by applying a factor to total national storage fields. These improvements to the methods were developed with stakeholder input.

2.2.4 Forgone Emissions Reductions

Table 2-4 summarizes the forgone emissions reductions associated with the Policy Review. The forgone emissions reductions are estimated by multiplying the source-level forgone emissions

[25] For example, the 2018 GHG Inventory estimate of station counts in 2013 is 5 percent lower for transmission stations and 12 percent lower for storage stations.

[26] The EPA used the GHGRP subpart W station count scaled by a factor of 3.52 to adjust for GHGRP coverage. In 2016 for example, 529 transmission stations reported to GHGRP, and the national GHG Inventory calculated 1,862 transmission stations as the national total.

reductions associated with each applicable control and facility type by the number of affected sources of that facility type.[27]

Table 2-4 Projected Forgone Emissions Reductions from Policy Review, 2021 to 2030

	Emission Changes			
Year	**Methane (short tons)**	**VOC (short tons)**	**HAP (short tons)**	**Methane (metric tons CO_2 Eq.)**
2021	22,000	610	18	500,000
2022	26,000	720	21	590,000
2023	30,000	830	25	680,000
2024	34,000	940	28	770,000
2025	38,000	1,000	31	860,000
2026	42,000	1,200	34	940,000
2027	46,000	1,300	37	1,000,000
2028	49,000	1,400	41	1,100,000
2029	53,000	1,500	44	1,200,000
2030	58,000	1,600	48	1,300,000
Total	400,000	11,000	330	9,000,000

Note: Estimates may not sum due to independent rounding.

2.2.5 Forgone Product Recovery

The projected compliance cost reductions presented below include the forgone revenue from the reductions in natural gas recovery projected under the Policy Review. Requirements for compressor stations, reciprocating compressors, and pneumatic controllers are assumed to increase the capture of methane and VOC emissions that would otherwise be vented to the atmosphere, and we assume that a large proportion of the averted methane emissions can be directed into natural gas production streams and sold.

Table 2-5 summarizes the decrease in natural gas recovery and the associated forgone revenue. The AEO2020 projects Henry Hub natural gas prices rising from $2.49/MMBtu in 2021 to $3.29/MMBtu in 2030 in 2019 dollars.[28] To be consistent with other financial estimates in the

[27] For more information on the EPA's review of the oil and natural gas NSPS compliance reports, see the docketed memorandum titled: U.S. EPA. 2020. Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources Background Technical Support Document for the Final Reconsideration of the New Source Performance Standards, 40 CFR Part 60, subpart OOOOa. Detailed reports are also available at: *https://www.foiaonline.gov/foiaonline/action/public/submissionDetails?trackingNumber=EPA-HQ-2018-001886&type=request.* Accessed April 26, 2020.

[28] Available at: http://www.eia.gov/forecasts/aeo/tables_ref.cfm. Accessed April 26, 2020

RIA, we adjust the projected prices in AEO2020 from 2019 dollars to 2016 dollars using the GDP-Implicit Price Deflator. We also adjust prices for the wellhead using an EIA study that indicated that the Henry Hub price is, on average, about 11 percent higher than the wellhead price,[29] and therefore we use a conversion factor of 1.036 MMBtu equals 1 Mcf. Incorporating these adjustments, wellhead natural gas prices are assumed to rise from $2.20/Mcf in 2021 to $2.89/Mcf in 2030.

Table 2-5 Projected Decrease in Natural Gas Recovery for Policy Review, 2021 to 2030

Year	Decrease in Gas Recovery (Mcf)	Forgone Revenue (millions 2016$)
2021	1.3	$2.5
2022	1.5	$3.0
2023	1.7	$3.4
2024	2.0	$4.0
2025	2.2	$4.9
2026	2.4	$5.8
2027	2.6	$6.7
2028	2.9	$7.5
2029	3.1	$8.1
2030	3.4	$8.7

Operators in the transmission and storage segment of the industry do not typically own the natural gas they transport; rather, they receive payment for the transportation service they provide. From a social perspective, however, the increased financial returns from natural gas recovery accrues to entities somewhere along the natural gas supply chain and should be accounted for in a national-level analysis. An economic argument can be made that, in the long run, no single entity bears the entire burden of compliance costs or fully appropriates the financial gain of the additional revenues associated with natural gas recovery. The change in economic surplus resulting from natural gas recovery is likely to be spread across different market participants. Therefore, the simplest and most transparent option for allocating these revenues would be to keep the compliance costs and revenues within a given source category and not make assumptions regarding the allocation of costs and revenues across agents.[30]

[29] See: https://www.researchgate.net/publication/265155970_US_Natural_Gas_Markets_Relationship_Between_Henry_Hub_Spot_Prices_and_US_Wellhead_Prices. Accessed 04/26/2020.

[30] As a sensitivity, we calculated forgone natural gas revenues using the Henry Hub price instead of the estimated wellhead price, as the former may better reflect the value of natural gas in the transmission and storage segment.

2.2.6 Compliance Cost Reductions

Table 2-6 summarizes the compliance cost reductions and forgone revenue from product recovery for the evaluated emissions sources and points. Total cost reductions consist of capital cost reductions; annual operating and maintenance cost reductions, including reporting and recordkeeping costs;[31] and forgone revenue from product recovery. Capital cost reductions include the capital cost reductions from removing the requirements on newly affected controllers and compressors and the planning cost reductions from removing requirements for compressor stations to create survey monitoring plans for the fugitive emissions, as well as the cost reductions for sources that would have had to renew survey monitoring plans or purchase new capital equipment at the end of its useful life. The annual operating and maintenance cost reductions are due to the fugitives monitoring requirement and other reporting and recordkeeping requirements.

Under this alternative fuel price assumption, the forgone revenue associated with unrecovered natural gas is $3.4 million in 2021 and $10.4 million in 2030.

[31] Reporting and recordkeeping cost reductions not due to changes in the fugitive emissions monitoring requirements were drawn from the information collection request (ICR) that have been submitted to the Office of Management and Budget (OMB) under the Paperwork Reduction Act (see preamble for more detail). These reporting and recordkeeping cost reductions are estimated to be about $210,000 in 2021 and increasing to about $330,000 in 2030. Reporting and recordkeeping cost reductions for fugitive emissions monitoring requirements are captured directly as operating and maintenance cost reductions associated with that program. Recordkeeping and recordkeeping cost reductions are estimated for the Policy Review for all affected facilities regardless of whether they are in states with regulatory requirements similar to the final 2016 NSPS OOOOa.

Table 2-6 Estimated Cost Reductions under the Policy Review, 2021 to 2030 (millions 2016$)

Year	Compliance Cost Reductions				
	Capital Cost Reductions[1]	Operating and Maintenance Cost Reductions	Annualized Cost Reductions (w/o Forgone Revenue)[2]	Forgone Revenue from Product Recovery	Annualized Cost Reductions (with Forgone Revenue)
2021	$1.9	$4.2	$6.2	$2.5	$3.7
2022	$1.9	$4.8	$7.1	$3.0	$4.1
2023	$3.2	$5.4	$8.0	$3.4	$4.5
2024	$3.2	$5.9	$8.8	$4.0	$4.8
2025	$3.2	$6.5	$10	$4.9	$4.8
2026	$3.2	$7.1	$11	$5.8	$4.7
2027	$3.6	$7.7	$11	$6.7	$4.7
2028	$3.6	$8.3	$12	$7.5	$4.9
2029	$3.6	$8.9	$13	$8.1	$5.1
2030	$3.7	$9.5	$14	$8.7	$5.4

Note: Sums may not total due to independent rounding.
[1] The capital cost reductions include the planning cost reductions for newly affected sources for fugitive emissions monitoring and capital cost reductions for newly affected controllers and compressors, as well as the cost reductions for sources that would renew survey monitoring plans and purchase new capital at the end of its useful life.
[2] These cost reductions include the capital cost reductions annualized over the requisite equipment lifetimes at an interest rate of 7 percent and the annual operating and maintenance cost reductions for every year, which include the cost reductions from recordkeeping and reporting.

The cost of designing, or redesigning, a fugitive emissions monitoring program occurs every eight years to comply with the 2016 NSPS OOOOa. Pneumatic controllers are assumed to have a lifetime of ten years. Rod packing replacement is assumed to happen about every 3.8 years in the transmission segment and every 4.4 years in the storage segment.[32] The lifetime of the sources affected by this action are unchanged from the assumptions used for the 2016 NSPS OOOOa. The reduction in capital costs in each year outlined in Table 2-6 includes the estimated reduction in costs for newly affected sources in that year, plus the reduction in costs for sources affected previously that have reached the end of their assumed economic lifetime.

The capital and planning cost reductions for reciprocating compressors, pneumatic controllers, and fugitive emissions monitoring program design are annualized over their requisite expected lifetimes at an interest rate of 7 percent and are added to the annual operating and maintenance cost reductions of the requirements to get the annualized cost reductions in each year. The

[32] For the purposes of assigning unannualized capital costs of subsequent replacements to years, we round the lifetimes for rod packing in both transmission and storage to four years.

forgone value of product recovery is then subtracted to get the total annualized cost reductions in each year.

Table 2-7 illustrates the sensitivity of the estimated cost reductions to a given interest rate. We present cost reductions using interest rates of 7 and 3 percent. The choice of interest rate has a very small effect on nationwide annualized cost reductions. The interest rate generally affects estimates of annualized costs for controls with high planning or capital costs relative to annual costs. In this analysis, the planning and capital cost reductions are small relative to the annual operating and maintenance cost reductions, so the interest rate has little impact on total annualized cost reductions for these sources.

Table 2-7 Estimated Cost Reductions for the Policy Review, 2021 to 2030 (millions 2016$)

Year	7 percent			3 percent		
	Annualized Cost Reductions (w/o Forgone Revenue)	Forgone Revenue from Product Recovery	Annualized Cost Reductions (with Forgone Revenue)	Annualized Cost Reductions (w/o Forgone Revenue)	Forgone Revenue from Product Recovery	Annualized Cost Reductions (with Forgone Revenue)
2021	$6.2	$2.5	$3.7	$6.0	$2.5	$3.4
2022	$7.1	$3.0	$4.1	$6.8	$3.0	$3.9
2023	$8.0	$3.4	$4.5	$7.6	$3.4	$4.2
2024	$8.8	$4.0	$4.8	$8.5	$4.0	$4.5
2025	$10	$4.9	$4.8	$9.3	$4.9	$4.4
2026	$11	$5.8	$4.7	$10	$5.8	$4.3
2027	$11	$6.7	$4.7	$11	$6.7	$4.3
2028	$12	$7.5	$4.9	$12	$7.5	$4.4
2029	$13	$8.1	$5.1	$13	$8.1	$4.6
2030	$14	$8.7	$5.4	$14	$8.7	$4.9

Note: Estimates may not sum due to independent rounding.

2.2.7 Detailed Impacts Tables

The following tables show the full details of the cost reductions and forgone emissions reductions by emissions source in 2021 and 2030.

Two of the affected source types, reciprocating compressors and pneumatic controllers, have negative cost reductions, meaning that the potential capital and annual cost reductions from deregulating the transmission and storage segment may be outweighed by the forgone revenue from product recovery. This observation may typically support an assumption that operators would continue to perform the emissions abatement activity, regardless of whether a requirement is in place, because it is in their private self-interest. However, as discussed in the 2016 RIA, operators in the transmission and storage segment of the industry do not typically own the natural gas they transport; rather, the operators receive payment for the transportation service they provide. As a result, financial incentives to reduce emissions may be minimal because operators are not able to recoup the financial value of captured natural gas that may otherwise be emitted. Alternatively, there may also be an opportunity cost associated with the installation of environmental controls (for purposes of mitigating the emission of pollutants) that is not reflected in the control costs. If environmental investment displaces investment in productive capital, the difference between the rate of return on the marginal investment displaced by the mandatory environmental investment is a measure of the opportunity cost of the environmental requirement to the regulated entity. To the extent that any opportunity costs are not added to the control costs, the compliance cost reductions presented above may be underestimated.

Table 2-8 Affected Sources, Forgone Emissions Reductions, and Compliance Cost Reductions for the Policy Review, 2021

		Forgone Emissions Reductions				Compliance Cost Reductions (millions $2016)			
Source/Emissions Points in Transmission and Storage	**Projected No. of Affected Sources**	**Methane (short tons)**	**VOC (short tons)**	**HAP (short tons)**	**Methane (metric tons CO_2 Eq.)**	**Annualized Capital Cost Reductions**	**Operating and Maintenance Reductions**	**Forgone Product Recovery**	**Total Annualized Cost Reductions with Forgone Revenue**
Fugitive Emissions - Compressor Stations	270	9,700	270	8.0	220,000	$1.00	$4.0	$1.1	$3.9
Reciprocating Compressors	530	12,000	320	9.5	260,000	$0.99	$0	$1.3	-$0.32
Centrifugal Compressors	0	0	0	0	0	$0	$0	$0	$0
Pneumatic Controllers	310	860	24	0.7	19,000	$0.008	$0	$0.10	-$0.09
Reporting and Recordkeeping[1]	N/A	0	0	0	0	$0	$0.21	$0	$0.21
TOTAL	**1,100**	**22,000**	**610**	**18**	**500,000**	**$2.0**	**$4.2**	**$2.5**	**$3.7**

Note: Estimates may not sum due to independent rounding.
[1] Applies to reporting and recordkeeping for requirements other than the fugitive emissions monitoring requirements.

Table 2-9 Affected Sources, Forgone Emissions Reductions, and Compliance Cost Reductions for the Policy Review, 2030

		Forgone Emissions Reductions				Compliance Cost Reductions (millions $2016)			
Source/Emissions Points in Transmission and Storage	**Projected No. of Affected Sources**	**Methane (short tons)**	**VOC (short tons)**	**HAP (short tons)**	**Methane (metric tons CO_2 Eq.)**	**Annualized Capital Cost Reductions**	**Operating and Maintenance Reductions**	**Forgone Product Recovery**	**Total Annualized Cost Reductions with Forgone Revenue**
Fugitive Emissions - Compressor Stations	610	22,000	620	18	500,000	$2.3	$9.1	$3.3	$8.1
Reciprocating Compressors	1,200	26,000	730	22	600,000	$2.3	$0	$3.9	-$1.7
Centrifugal Compressors	0	0	0	0	0	$0	$0	$0	$0
Pneumatic Controllers	3,400	9,400	260	8	210,000	$0.09	$0	$1.4	-$1.3
Reporting and Recordkeeping[1]	N/A	0	0	0	0	$0	$0.33	$0	$0.33
TOTAL	**5,200**	**58,000**	**1,600**	**48**	**1,300,000**	**$4.7**	**$9.1**	**$8.7**	**$5.4**

Note: Estimates may not sum due to independent rounding.
[1] Applies to reporting and recordkeeping for requirements other than the fugitive emissions monitoring requirements.

2.2.8 Present Value and Equivalent Annualized Value of Cost Reductions

This section presents the compliance cost reductions of the Policy Review in a PV framework. The stream of the estimated cost reductions for each year from 2021 through 2030 is discounted back to 2020 using 7 and 3 percent discount rates and summed to get the PV of the cost reductions. The PV is then used to estimate the EAV of the cost reductions. The EAV is the single annual value which, if summed in PV terms across years in the analytical time frame, equals the PV of the original (*i.e.*, likely time-varying) stream of cost reductions. In other words, the EAV takes the potentially "lumpy" stream of cost reductions and converts them into a single value that, when discounted and added together over each period in the analysis time frame, equals the original stream of values in PV terms.

Table 2-10 shows the undiscounted stream of cost reductions for each year from 2021 through 2030 due to the Policy Review. Capital cost reductions are the projected capital and planning costs which will no longer be incurred. Total cost reductions are the sum of the capital cost reductions, annual operating cost reductions, and reporting and recordkeeping cost reductions. The forgone revenue from the decrease in product recovery is estimated using the AEO2020 natural gas price projections, as described earlier. Total cost reductions with forgone revenue equals the total cost reductions minus the forgone revenue. Over time, with the addition of new affected sources in each year, the capital cost reductions, annual operating cost reductions, reporting and recordkeeping cost reductions, and forgone revenue increase.

Table 2-10 Undiscounted Projected Compliance Cost Reductions for the Policy Review, 2021-2030 (millions 2016$)

Year	Capital Cost Reductions	Annual Operating Cost Reductions	Total Cost Reductions (w/o Forgone Revenue)	Forgone Revenue from Product Recovery	Total Cost Reductions (with Forgone Revenue)
2021	$1.9	$4.0	$6.1	$2.5	$3.5
2022	$1.9	$4.6	$6.6	$3.0	$3.7
2023	$3.2	$5.1	$8.5	$3.4	$5.1
2024	$3.2	$5.7	$9.1	$4.0	$5.1
2025	$3.2	$6.3	$10	$4.9	$4.8
2026	$3.2	$6.8	$10	$5.8	$4.5
2027	$3.6	$7.4	$11	$6.7	$4.6
2028	$3.6	$8.0	$12	$7.5	$4.5
2029	$3.6	$8.5	$13	$8.1	$4.4
2030	$3.7	$9.1	$13	$8.7	$4.5

Note: Estimates may not sum due to independent rounding.

Table 2-11 shows the discounted stream of cost reductions discounted to 2020 using a 7 percent discount rate. The PV of total compliance cost reductions is $31 million, with an EAV of $4.1 million per year. The PV of the stream of cost reductions discounted to 2020 using a 3 percent discount rate is $38 million, with an EAV of $4.3 million per year.

Table 2-11 Discounted Cost Reductions for the Policy Review using 7 and 3 Percent Discount Rates (millions 2016$)[1]

Year	7 Percent			3 Percent		
	Total Annual Cost Reductions (w/o Forgone Revenue)	Forgone Revenue from Product Recovery	Total Cost Reductions (with Forgone Revenue)	Total Annual Cost Reductions (w/o Forgone Revenue)	Forgone Revenue from Product Recovery	Total Cost Reductions (with Forgone Revenue)
2021	$5.7	$2.4	$3.3	$5.9	$2.4	$3.4
2022	$5.8	$2.6	$3.2	$6.2	$2.8	$3.5
2023	$7.0	$2.8	$4.2	$7.8	$3.1	$4.7
2024	$7.0	$3.1	$3.9	$8.0	$3.6	$4.5
2025	$6.9	$3.5	$3.4	$8.3	$4.2	$4.2
2026	$6.9	$3.9	$3.0	$8.5	$4.9	$3.7
2027	$7.1	$4.2	$2.9	$9.1	$5.5	$3.8
2028	$6.9	$4.3	$2.6	$9.3	$5.9	$3.5
2029	$6.8	$4.4	$2.4	$9.4	$6.2	$3.4
2030	$6.7	$4.4	$2.3	$10	$6.5	$3.3
PV	**$67**	**$36**	**$31**	**$83**	**$45**	**$38**
EAV	**$8.9**	**$4.7**	**$4.1**	**$9.4**	**$5.1**	**$4.3**

Note: Estimates may not sum due to independent rounding.
[1] Cost reductions and forgone revenue in each year are discounted to 2020.

The Policy Review is considered a deregulatory action under E.O. 13771, Reducing Regulation and Controlling Regulatory Costs. The PV of the projected cost reductions from the Policy Review calculated in accordance with E.O. 13771 accounting standards are $45 million over an infinite time horizon (in 2016$, discounted to 2016 at 7 percent). The EAV of the cost reductions over an infinite time horizon are $3.2 million per year (in 2016$, discounted to 2016 at 7 percent).

2.3 Forgone Benefits

2.3.1 Introduction

For the oil and natural gas sector NSPS promulgated in 2012 and 2016, the EPA projected climate and ozone benefits from methane reductions, ozone and fine particulate matter ($PM_{2.5}$) health benefits from VOC reductions, and health benefits from ancillary HAP reductions. These benefits were expected to occur because the control techniques to meet the standards simultaneously reduce methane, VOC, and HAP emissions.[33] As in the 2016 NSPS RIA, methane is the only pollutant with monetized impacts in this RIA. The Policy Review is projected to forgo emissions reductions relative to the baseline. The total forgone emissions reductions over 2021 to 2030 is estimated to be about 400,000 short tons of methane, 11,000 tons of VOC, and 330 tons of HAP. The associated increase in CO_2 Eq. methane emissions is estimated to be 9 million metric tons.

The PV of the projected forgone methane-related climate benefits are estimated to be $19 million from 2021 to 2030 using an interim estimate of the domestic social cost of methane (SC-CH_4) and discounted at 7 percent. The associated EAV is estimated to be $2.9 million per year. Using the interim SC-CH_4 estimate based on the 3 percent rate, the PV of the forgone domestic climate benefits is estimated to be $63 million, and the EAV is estimated to be $10 million per year.

Under the final action, the EPA expects that the forgone VOC emission reductions will worsen air quality and adversely affect health and welfare due to the impacts on ozone, $PM_{2.5}$, and HAP, but we did not quantify these impacts at this time. This omission should not imply that these forgone benefits do not exist, and to the extent that the EPA were to quantify the ozone and PM impacts, it would estimate the number and value of avoided premature deaths and illnesses using the approach detailed in the PM National Ambient Air Quality Standards (NAAQS) and Ozone NAAQS RIAs (U.S. EPA, 2012b; U.S. EPA, 2014). This approach relies on full-form air quality modeling. The Agency is committed to assessing ways of conducting full-form air quality modeling for the oil and gas sector that would be suitable for use in regulatory analysis in the context of New Source Performance Standards, including ways to address the uncertainties regarding the scope and magnitude of VOC emissions. When quantifying the incidence and economic value of the human health impacts of air quality changes, the Agency sometimes relies upon alternative approaches to using full-form air quality modeling, called reduced-form techniques, often reported as "benefit-per-ton" values that relate air pollution impacts to changes in air pollutant precursor emissions (U.S. EPA, 2018). A small, but growing, literature characterizes the air quality and health impacts from the oil and natural gas sector, including

[33] The specific control techniques for the 2016 NSPS OOOOa were also anticipated to have minor disbenefits resulting from secondary emissions of carbon dioxide (CO_2), nitrogen oxides (NO_X), PM, carbon monoxide (CO), and total hydrocarbons (THC), and emission changes associated with the energy markets impacts. This final action is anticipated to reduce these minor secondary emissions.

preliminary VOC benefit-per-ton values (Fann et al., 2018; Litovitz et al., 2013; Loomis and Haefele, 2017). The Agency feels more work needs to be done to vet the analysis and methodologies for all potential approaches for valuing the health effects of VOC emissions before they are used in regulatory analysis but is committed to continuing this work.

In addition, the EPA systematically compared the changes in benefits, and concentrations where available, from its benefit-per-ton technique and other reduced-form techniques to the changes in benefits and concentrations derived from full-form photochemical model representation of five different stationary and mobile source emissions scenarios (IEc, 2019).[34] The Agency's goal was to create a methodology by which investigators could better understand the suitability of alternative reduced-form air quality modeling techniques for estimating the health impacts of criteria pollutant emissions changes in the EPA's benefit-cost analysis, including the extent to which reduced form models may over- or under-estimate benefits (compared to full-scale modeling) under different scenarios and air quality concentrations. The EPA Science Advisory Board (SAB) recently convened a panel to review this report.[35] In particular, the SAB will assess the techniques the Agency used to appraise these tools; the Agency's approach for depicting the results of reduced-form tools; and steps the Agency might take for improving the reliability of reduced-form techniques for use in future RIAs.

For these reasons, we did not quantify VOC-related health impacts in this RIA. This omission should not imply that these forgone benefits may not exist; rather, it reflects the inherent difficulties in modeling the direct and indirect impacts of the reductions in emissions for this industrial sector with the data currently available. Here, we qualitatively assess the forgone health benefits associated with reducing exposure to these pollutants, as well as visibility impairment and forgone ecosystem benefits. Table 2-12 summarizes the quantified and unquantified forgone benefits in this analysis.

[34] This analysis compared the benefits estimated using full-form photochemical air quality modeling simulations (CMAQ and CAMx) against four reduced-form tools, including InMAP; AP2/3; EASIUR and EPA's benefit-per-ton.
[35] 85 FR 23823. April 29, 2020.

Table 2-12 Climate and Human Health Effects of Forgone Emission Reductions under the Policy Review

Category	Specific Effect	Effect Has Been Quantified	Effect Has Been Monetized	More Information
Environment				
Climate effects	Climate impacts from methane (CH_4)	—[1]	✓	Section 3.3
	Other climate impacts (e.g., ozone, black carbon, aerosols, other impacts)	—	—	IPCC, Ozone ISA, PM ISA[2]
Human Health				
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[3]
	Infant mortality (age <1)	—	—	PM ISA[3]
Incidence of morbidity from exposure to $PM_{2.5}$	Non-fatal heart attacks (age > 18)	—	—	PM ISA[3]
	Hospital admissions—respiratory (all ages)	—	—	PM ISA[3]
	Hospital admissions—cardiovascular (age >20)	—	—	PM ISA[3]
	Emergency room visits for asthma (all ages)	—	—	PM ISA[3]
	Acute bronchitis (age 8-12)	—	—	PM ISA[3]
	Lower respiratory symptoms (age 7-14)	—	—	PM ISA[3]
	Upper respiratory symptoms (asthmatics age 9-11)	—	—	PM ISA[3]
	Asthma exacerbation (asthmatics age 6-18)	—	—	PM ISA[3]
	Lost work days (age 18-65)	—	—	PM ISA[3]
	Minor restricted-activity days (age 18-65)	—	—	PM ISA[3]
	Chronic Bronchitis (age >26)	—	—	PM ISA[3]
	Emergency room visits for cardiovascular effects (all ages)	—	—	PM ISA[3]
	Strokes and cerebrovascular disease (age 50-79)	—	—	PM ISA[3]
	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[2,4]
	Cancer, mutagenicity, and genotoxicity effects	—	—	PM ISA[2,4]
Incidence of mortality from exposure to ozone	Premature mortality based on short-term study estimates (all ages)	—	—	Ozone ISA[3]
	Premature mortality based on long-term study estimates (age 30–99)	—	—	Ozone ISA[3]
Incidence of morbidity from exposure to ozone	Hospital admissions—respiratory causes (age > 65)	—	—	Ozone ISA[3]
	Hospital admissions—respiratory causes (age <2)	—	—	Ozone ISA[3]
	Emergency department visits for asthma (all ages)	—	—	Ozone ISA[3]
	Minor restricted-activity days (age 18–65)	—	—	Ozone ISA[3]

Category	Specific Effect	Effect Has Been Quantified	Effect Has Been Monetized	More Information
	School absence days (age 5–17)	—	—	Ozone ISA[3]
	Decreased outdoor worker productivity (age 18–65)	—	—	Ozone ISA[3]
	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[2,4]
Incidence of morbidity from exposure to HAP	Effects associated with exposure to hazardous air pollutants such as benzene	—	—	ATSDR, IRIS[2,3]
Welfare				
Visibility	Visibility in Class 1 areas	—	—	PM ISA[3]
	Visibility in residential areas	—	—	PM ISA[3]
Effects from PM deposition (organics)	Effects on Individual organisms and ecosystems	—	—	PM ISA[2]
Vegetation and ecosystem effects from exposure to ozone	Visible foliar injury on vegetation	—	—	Ozone ISA[3]
	Reduced vegetation growth and reproduction	—	—	Ozone ISA[3]
	Yield and quality of commercial forest products and crops	—	—	Ozone ISA[3]
	Damage to urban ornamental plants	—	—	Ozone ISA[2]
	Carbon sequestration in terrestrial ecosystems	—	—	Ozone ISA[3]
	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]

[1] The climate and related impacts of CO_2 and methane (CH_4) emissions changes, such as sea level rise, are estimated within each integrated assessment model as part of the calculation of the domestic SC-CO_2 and SC-CH_4. The resulting monetized damages, which are relevant for conducting the benefit-cost analysis, are used in this RIA to estimate the domestic welfare effects of quantified changes in CH_4 emissions.
[2] We assess these benefits qualitatively because we do not have sufficient confidence in available data or methods.
[3] We assess these benefits qualitatively due to data limitations for this analysis, but we have quantified them in other analyses.
[4] We assess these benefits qualitatively because current evidence is only suggestive of causality or there are other significant concerns over the strength of the association.

2.3.2 Forgone Emissions Reductions

Oil and natural gas operations in the U.S. include a variety of emission points for methane, VOC, and HAP, including wells, well sites, processing plants, compressor stations, storage equipment, and transmission and distribution lines. These emission points are located throughout much of the country, though they are concentrated in particular geographic regions. For example, wells and processing plants are largely concentrated in the South Central, Midwest, and Southern California regions of the U.S., whereas natural gas compressor stations are located all over the country. Distribution lines to customers are frequently located within areas of high population density.

The Policy Review may result in forgone reductions in ambient $PM_{2.5}$ and ozone concentrations in areas attaining and not attaining the NAAQS. Due to the high degree of variability in the responsiveness of ozone and $PM_{2.5}$ formation to VOC emission reductions, we are unable to determine how this rule might affect attainment status without modeling air quality changes.[36] Because the NAAQS RIAs also calculate ozone and $PM_{2.5}$ benefits, there are important differences worth noting in the design and analytical objectives of each impact analysis. The NAAQS RIAs illustrate the potential costs and benefits of attaining new nationwide air quality standards based on an array of emission control strategies for different sources.[37] By contrast, the emission impacts of implementation rules, including the oil and natural gas NSPS, are generally from a specific class of well-characterized sources. In general, The EPA is more confident in the magnitude and location of the emission reductions for implementation rules rather than illustrative NAAQS analyses. Emission changes realized under these and other promulgated rules will ultimately be reflected in the baseline of future NAAQS analyses, which would affect the incremental benefits and costs associated with attaining future NAAQS.

Table 2-13 shows the total forgone emissions reductions projected under the Policy Review for the period of 2021 to 2030. The impacts of these pollutants accrue at different spatial scales. HAP emissions increase exposure to carcinogens and other toxic pollutants primarily near the emission source. VOC emissions are precursors to secondary formation of $PM_{2.5}$ and ozone on a broader regional scale. Climate effects associated with long-lived greenhouse gases like methane generally do not depend on the location of the emission of the gas and have global impacts. Methane is also a precursor to global background concentrations of ozone (Sarofim, 2015).

[36] The responsiveness of ozone and $PM_{2.5}$ formation is discussed in greater detail in Sections 2.3.4 and 2.3.5, respectively.

[37] NAAQS RIAs hypothesize, but do not predict, the control strategies States may choose to enact when implementing a NAAQS. The setting of a NAAQS does not directly result in costs or benefits, and as such, the NAAQS RIAs are merely illustrative and are not intended to be added to the costs and benefits of other regulations that result in specific costs of control and emission reductions. However, some benefits and costs estimated in this RIA may account for the same air quality improvements as estimated in an illustrative NAAQS RIA.

Table 2-13 Projected Total Forgone Emissions Reductions under the Policy Review, 2021 through 2030

Pollutant	Policy Review
Methane (short tons)	400,000
VOC (short tons)	11,000
HAP (short tons)	330
Methane (metric tons)	360,000
Methane (million metric tons CO_2 Eq.)	9

Table 2-14 shows the projected forgone reductions of methane, VOC, and HAP emissions under the Policy Review for each year from 2021 to 2030.

Table 2-14 Projected Annual Forgone Reductions of Methane, VOC, and HAP Emissions under the Policy Review, 2021 to 2030

	Policy Review		
Year	**Methane (metric tons)**	**VOC (short tons)**	**HAP (short tons)**
2021	20,000	610	18
2022	24,000	720	21
2023	27,000	830	25
2024	31,000	940	28
2025	34,000	1,000	31
2026	38,000	1,200	34
2027	41,000	1,300	37
2028	45,000	1,400	41
2029	48,000	1,500	44
2030	53,000	1,600	48
Total	**360,000**	**11,000**	**330**

Note: Estimates may not sum due to independent rounding.

2.3.3 Methane Climate Effects and Valuation

Methane is the principal component of natural gas. Methane is also a potent greenhouse gas (GHG) that, once emitted into the atmosphere, absorbs terrestrial infrared radiation, which in turn contributes to increased global warming and continuing climate change. Methane reacts in the atmosphere to form ozone, which also impacts global temperatures. Methane, in addition to other GHG emissions, contributes to warming of the atmosphere, which over time leads to increased air and ocean temperatures; changes in precipitation patterns; melting and thawing of global glaciers and ice sheets; increasingly severe weather events, such as hurricanes of greater intensity; and sea level rise, among other impacts.

According to the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (IPCC, 2013), changes in methane concentrations since 1750 contributed 0.48 W/m^2 of forcing, which is about 17 percent of all global forcing due to increases in anthropogenic GHG concentrations, and which makes methane the second leading long-lived climate forcer after CO_2. However, after accounting for changes in other greenhouse substances such as ozone and stratospheric water vapor due to chemical reactions of methane in the atmosphere, historical methane emissions were estimated to have contributed to 0.97 W/m^2 of forcing today, which is about 30 percent of the contemporaneous forcing due to historical greenhouse gas emissions.

The oil and natural gas sector emits significant quantities of methane. The U.S. Inventory of Greenhouse Gas Emissions and Sinks: 1990-2018 (published 2020) estimates 2018 methane emissions from Petroleum and Natural Gas Systems (not including petroleum refineries, petroleum transportation, and natural gas distribution) to be 171 million metric tons CO_2 Eq. In 2018, total methane emissions from the oil and natural gas industry represented 27 percent of the total methane emissions from all sources and account for about 3 percent of all CO_2 Eq. emissions in the U.S., with the combined petroleum and natural gas systems being the largest contributor to U.S. anthropogenic methane emissions (U.S. EPA, 2020).

To give a sense of the magnitude of the forgone methane emissions reduction under the Policy Review, the projected reductions for 2021 (0.5 million metric tons CO_2 Eq.) are equivalent to less than one percent of the methane emissions for this sector reported in the U.S. GHGI for 2018 (about 197 million metric tons CO_2 Eq. are from petroleum and natural gas production and gas processing, transmission, and storage). Expected forgone emission reductions in 2030 (about 1.3 million metric tons CO_2 Eq.) are also equivalent to less than one percent of 2017 emissions.

We estimate the forgone climate benefits under the finalized and alternative options using an interim measure of the domestic social cost of methane (SC-CH_4). The SC-CH_4 is an estimate of the monetary value of impacts associated with marginal changes in CH_4 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 lead to an incremental reduction in cumulative global CH_4 emissions). The SC-CH_4 estimates used in this analysis focus on the direct impacts of climate change that are anticipated to occur within U.S. borders.

The SC-CH_4 estimates presented here are interim values developed under E.O. 13783 for use in regulatory analyses until an improved estimate of the impacts of climate change to the U.S. can be developed based on the best available science and economics. E.O. 13783 directed agencies to ensure that estimates of the social cost of greenhouse gases used in regulatory analyses "are based on the best available science and economics" and are consistent with the guidance contained in OMB Circular A-4, "including with respect to the consideration of domestic versus international impacts and the consideration of appropriate discount rates" (E.O. 13783, Section 5(c)). In addition, E.O. 13783 withdrew the technical support documents (TSDs) and the August 2016 Addendum to these TSDs describing the global social cost of greenhouse gas estimates developed under the prior Administration as no longer representative of government policy. The withdrawn TSDs and Addendum were developed by an interagency working group (IWG) that included the EPA and other executive branch entities and were used in the 2016 NSPS RIA.

Regarding the two analytical considerations highlighted in E.O. 13783 – how best to consider domestic versus international impacts and appropriate discount rates – current guidance in OMB Circular A-4 is as follows. Circular A-4 states that analysis of economically significant proposed and final regulations "should focus on benefits and costs that accrue to citizens and residents of the United States." Because this action is economically significant as defined in E.O. 12866, Section 3(f)(1), we follow this guidance by adopting a domestic perspective in our central analysis. Regarding discount rates, Circular A-4 states that regulatory analyses "should provide estimates of net benefits using both 3 percent and 7 percent." The 7 percent rate is intended to represent the average before-tax rate of return to private capital in the U.S. economy. The 3 percent rate is intended to reflect the rate at which society discounts future consumption, which is particularly relevant if a regulation is expected to affect private consumption directly. The EPA follows this guidance below by presenting estimates based on both 3 and 7 percent discount rates in the main analysis. See Appendix B for a discussion the modeling steps involved in estimating the domestic SC-CH_4 estimates based on these discount rates.

The SC-CH_4 estimates developed under E.O. 13783 will be used in regulatory analysis until improved domestic estimates can be developed, which will take into consideration the recent recommendations from the National Academies of Sciences, Engineering, and Medicine (2017) for a comprehensive update to the current methodology to ensure that the social cost of greenhouse gas estimates reflect the best available science. While the Academies' review focused on the methodology to estimate the social cost of carbon (SC-CO_2), the recommendations on how to update many of the underlying modeling assumptions also pertain to the SC-CH_4 estimates since the framework used to estimate SC-CH_4 is the same as that used for SC-CO_2.

Table 2-15 presents the average domestic SC-CH_4 estimates across all the model runs for each discount rate for emissions occurring in 2021 to 2030. As with the global SC-CH_4 estimates, the domestic SC-CH_4 increases over time because future emissions are expected to produce larger incremental damages as physical and economic systems become more stressed in response to greater climatic change and because GDP is growing over time and many damage categories are modeled in proportion to gross GDP.

Table 2-15 Interim Domestic Social Cost of CH_4, 2021 to 2030 (in 2016$ per metric ton CH_4)[1]

Year	Discount Rate and Statistic	
	7% Average	3% Average
2021	58	180
2022	60	190
2023	63	190
2024	65	200
2025	68	200
2026	70	210
2027	73	220
2028	75	220
2029	78	230
2030	81	230

[1] SC-CH_4 values are stated in $/metric ton CH_4 and rounded to two significant digits. The estimates vary depending on the year of CH_4 emissions and are defined in real terms, *i.e.*, adjusted for inflation using the GDP implicit price deflator.

Table 2-16 presents the monetized forgone domestic climate benefits under the Policy Review. Projected forgone methane emissions reductions increases in methane emissions each year are multiplied by the SC-CH_4 estimate for that year. The table shows the annual forgone benefits discounted back to 2020 and the PV and the EAV for the 2021 to 2030 period under each discount rate. The PV of forgone benefits under a 7 percent discount rate is about $17 million, with an EAV of about $2.2 million per year. The PV of forgone benefits under a 3 percent discount rate of $63 million, with an EAV of about $7.2 million per year.

Table 2-16 Projected Forgone Domestic Climate Benefits under the Policy Review, 2021-2030 (millions, 2016$)

	Undiscounted		Discounted back to 2020	
Year	**7 percent**	**3 Percent**	**7 percent**	**3 Percent**
2021	$1.2	$3.6	$1.1	$3.5
2022	$1.4	$4.4	$1.2	$4.2
2023	$1.7	$5.2	$1.4	$4.8
2024	$2.0	$6.1	$1.5	$5.4
2025	$2.3	$7.0	$1.7	$6.0
2026	$2.7	$7.9	$1.8	$6.6
2027	$3.0	$8.9	$1.9	$7.2
2028	$3.4	$10	$2.0	$7.8
2029	$3.8	$11	$2.1	$8.4
2030	$4.2	$12	$2.2	$9.1
PV			**$17**	**$63**
EAV			**$2.2**	**$7.2**

Note: Estimates may not sum due to independent rounding.

The limitations and uncertainties associated with the global SC-CH_4 estimates, which were discussed in detail in the 2016 NSPS RIA, likewise apply to the forgone domestic SC-CH_4 estimates presented in this analysis.[38] Some uncertainties are captured within the analysis, as discussed in detail in Appendix B, while other areas of uncertainty have not yet been quantified in a way that can be modeled. For example, as with the methodology used to calculate SC-CO_2 estimates, limitations include incomplete or inadequate representation in the integrated assessment models of several important factors: catastrophic and non-catastrophic impacts, adaptation and technological change, inter-regional and inter-sectoral linkages, uncertainty in the extrapolation of damages to high temperatures, and the relationship between the discount rate and uncertainty in economic growth over long time horizons. The science incorporated into these models understandably lags the most recent research, and the limited amount of research linking climate impacts to economic damages makes the modeling exercise even more difficult.

[38] The SC-CH_4 estimates presented in the 2016 NSPS RIA are the same as the SC-CH_4 estimates presented in EPA-HQ-OAR-2015-0827-5886, "Addendum to Technical Support Document on Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866: Application of the Methodology to Estimate the Social Cost of Methane and the Social Cost of Nitrous Oxide (August 2016)", except the estimates in the 2016 NSPS RIA were adjusted to 2012 dollar. The estimates published in the 2016 NSPS RIA were labeled as "Marten *et al*. (2014)" estimates. In addition, EPA-HQ-OAR-2015-0827-5886 provides a detailed discussion of the limitations and uncertainties associated with the SC-GHG estimates.

There are several limitations specific to the estimation of SC-CH_4. For example, the SC-CH_4 estimates do not reflect updates from the IPCC regarding atmospheric and radiative efficacy.[39] Another limitation is that the SC-CH_4 estimates do not account for the direct health and welfare impacts associated with tropospheric ozone produced by methane (see the 2016 NSPS RIA for further discussion). In addition, the SC-CH_4 estimates do not reflect that methane emissions lead to a reduction in atmospheric oxidants, like hydroxyl radicals, nor do they account for impacts associated with CO_2 produced from methane oxidizing in the atmosphere. See EPA-HQ-OAR-2015-0827-5886 for more detailed discussion about the limitations specific to the estimation of SC-CH_4. These individual limitations and uncertainties do not all work in the same direction in terms of their influence on the SC-CH4 estimates. In accordance with guidance in OMB Circular A-4 on the treatment of uncertainty, Appendix B provides a detailed discussion of the ways in which the modeling underlying the development of the SC-CH_4 estimates used in this analysis addresses quantified sources of uncertainty and presents a sensitivity analysis to show consideration of the uncertainty surrounding discount rates over long time horizons.

Recognizing the limitations and uncertainties associated with estimating the social cost of greenhouse gases, the research community has continued to explore opportunities to improve estimates of SC-CO_2 and other greenhouse gases. Notably, the National Academies of Sciences, Engineering, and Medicine conducted a multi-discipline, multi-year assessment to examine potential approaches, along with their relative merits and challenges, for a comprehensive update to the IWG methodology. The task was to ensure that the SC-CO_2 estimates that are used in Federal analyses reflect the best available science, focusing on issues related to the choice of models and damage functions, climate science modeling assumptions, socioeconomic and emissions scenarios, presentation of uncertainty, and discounting. In January 2017, the Academies released their final report, Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide,[40] and recommended specific criteria for future updates to the SC-CO_2 estimates, a modeling framework to satisfy the specified criteria, and both near-term

[39] The SC-CH_4 estimates used in the 2016 NSPS RIA served as the starting point to calculate the interim domestic estimates presented in this RIA. The 2016 NSPS RIA SC-CH_4 estimates were calculated in 2014 using atmospheric and radiative efficacy values that have since been updated by the IPCC.

[40] National Academies of Sciences, Engineering, and Medicine. 2017. *Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide.* National Academies Press. Washington, DC Available at https://www.nap.edu/catalog/24651/valuing-climate-damages-updating-estimation-of-the-social-cost-of/. Accessed April 26, 2020.

updates and longer-term research needs pertaining to various components of the estimation process (National Academies 2017). Since the framework used to estimate SC-CH_4 is the same as that used for SC-CO_2, the Academies' recommendations on how to update many of the underlying modeling assumptions also apply to the SC-CH_4 estimates.

The Academies' report also discussed the challenges in developing domestic SC-CO_2 estimates, noting that current IAMs do not model all relevant regional interactions—*e.g.*, how climate change impacts in other regions of the world could affect the United States, through pathways such as global migration, economic destabilization, and political destabilization. The Academies concluded that it "is important to consider what constitutes a domestic impact in the case of a global pollutant that could have international implications that impact the United States. More thoroughly estimating a domestic SC-CO_2 would therefore need to consider the potential implications of climate impacts on, and actions by, other countries, which also have impacts on the United States." (National Academies 2017, pg 12-13). This challenge is equally applicable to the estimation of a domestic SC-CH_4.

In addition to requiring reporting of domestic impacts, Circular A-4 states that when an agency "evaluate[s] a regulation that is likely to have effects beyond the borders of the United States, these effects should be reported separately" (page 15). This guidance is relevant to the valuation of damages from methane and other GHGs, given that GHGs contribute to damages around the world independent of the country in which they are emitted. Therefore, in accordance with this guidance in OMB Circular A-4, Appendix B presents the forgone global climate benefits under the Policy Review using global SC-CH_4 estimates based on both 3 and 7 percent discount rates. Note that the EPA did not quantitatively project the full impact of the 2012 and 2016 NSPS on international trade and the location of production, so it is not possible to present analogous estimates of global cost reductions resulting from the finalized action. However, to the extent that affected firms have some foreign ownership, some of the cost reductions accruing to entities outside U.S. borders is captured in the compliance cost reductions presented in this RIA.

2.3.4 VOC as an Ozone Precursor

This rulemaking may forgo emission reductions of VOC, which are a precursor to ozone. Ozone is not emitted directly into the air, but is created when its two primary components, VOC and oxides of nitrogen (NO_X), react in the atmosphere in the presence of sunlight. In urban areas, compounds representing all classes of VOC are important for ozone formation, but biogenic VOC emitted from vegetation tend to be more important compounds in non-urban vegetated areas (U.S. EPA, 2013). Forgone emission reductions may increase ozone formation, human exposure to ozone, and the incidence of ozone-related health effects. However, we have not quantified the ozone-related forgone benefits in this analysis due to the complex non-linear chemistry of ozone formation, which introduces uncertainty to the development and application of a benefit-per-ton estimate, particularly for sectors with substantial new growth. In addition, the impact of forgone VOC emission reductions is spatially heterogeneous and highly dependent on local air chemistry. Urban areas with a high population concentration are often VOC-limited, which means that ozone is most effectively reduced by lowering VOC. Rural areas and downwind suburban areas are often NO_X-limited, which means that ozone concentrations are most effectively reduced by lowering NO_X emissions, rather than lowering emissions of VOC. Between these areas, ozone is relatively insensitive to marginal changes in both NO_X and VOC.

Due to data limitations regarding potential locations of new, reconstructed, and modified sources affected by this rulemaking, we did not perform air quality modeling for this rule needed to quantify the forgone ozone benefits associated with forgone VOC emission reductions. Due to the high degree of variability in the responsiveness of ozone formation to VOC emissions and data limitations regarding the location of new, reconstructed, and modified well sites, we are unable to estimate the effect that forgone VOC emission reductions will have on ambient ozone concentrations without air quality modeling.[41]

2.3.4.1 Ozone Health Effects

Human exposure to ambient ozone concentrations is associated with adverse health effects, including premature mortality and cases of respiratory morbidity (U.S. EPA, 2010). Researchers have associated ozone exposure with adverse health effects in numerous toxicological, clinical and epidemiological studies (U.S. EPA, 2013). When adequate data and resources are available, the EPA has generally quantified several health effects associated with exposure to ozone (*e.g.*,

[41] EPA is working on improving our understanding of the effects of VOC emission reductions in the oil and natural gas sector.

U.S. EPA, 2010; U.S. EPA, 2011c). These health effects include respiratory morbidity, such as asthma attacks; hospital and emergency department visits; lost school days; and premature mortality. The scientific literature is also suggestive that exposure to ozone is also associated with chronic respiratory damage and premature aging of the lungs.

The EPA has previously estimated the ozone-related benefits of reducing VOC emissions from the industrial boiler sector (U.S. EPA, 2011b)[42] and in the RIA for the proposed Ozone NAAQS (U.S. EPA, 2014). While the benefit-per-ton estimates used to quantify impacts for those rules may provide useful context, the geographic distribution of VOC emissions from the oil and natural gas sector is not consistent with emissions modeled in either analysis. Therefore, we do not believe that those estimates are representative of the monetized forgone benefits of this rule, even as a bounding exercise.

2.3.4.2 Ozone Vegetation Effects

Exposure to ozone has been found to be associated with a wide array of vegetation and ecosystem effects in the published literature (U.S. EPA, 2013). Sensitivity to ozone is highly variable across species, with over 66 vegetation species identified as “ozone-sensitive”, many of which occur in state and national parks and forests. These effects include those that damage to, or impairment of, the intended use of the plant or ecosystem. Such effects are considered adverse to public welfare and can include reduced growth and/or biomass production in sensitive trees, reduced yield and quality of crops, visible foliar injury, changed to species composition, and changes in ecosystems and associated ecosystem services.

2.3.4.3 Ozone Climate Effects

Ozone is a well-known short-lived climate forcing GHG (U.S. EPA, 2013). Stratospheric ozone (the upper ozone layer) is beneficial because it protects life on Earth from the sun’s harmful ultraviolet (UV) radiation. In contrast, tropospheric ozone (ozone in the lower atmosphere) is a harmful air pollutant that adversely affects human health and the environment and contributes significantly to regional and global climate change. Due to its short atmospheric lifetime,

[42] While EPA has estimated the ozone benefits for many scenarios, most of those scenarios also reduce NO_2 emissions, which make it difficult to isolate the benefits attributable to VOC reductions.

tropospheric ozone concentrations exhibit large spatial and temporal variability (U.S. EPA, 2009b). The IPCC AR5 estimated that the contribution to current warming levels of increased tropospheric ozone concentrations resulting from human methane, NO_X, and VOC emissions was 0.5 W/m^2, or about 30 percent as large a warming influence as elevated CO_2 concentrations. This quantifiable influence of ground level ozone on climate leads to increases in global surface temperature and changes in hydrological cycles.

2.3.5 VOC as a $PM_{2.5}$ Precursor

This rulemaking is expected to result in forgone emission reductions of VOC, which are a precursor to $PM_{2.5}$, thus increasing human exposure to $PM_{2.5}$ and the incidence of $PM_{2.5}$-related health effects, although the magnitude of this effect cannot be quantified at this time. Most VOC emitted are oxidized to CO_2 rather than to PM, but a portion of VOC emission contributes to ambient $PM_{2.5}$ levels as organic carbon aerosols (U.S. EPA, 2009a). Analysis of organic carbon measurements suggest only a fraction of secondarily formed organic carbon aerosols are of anthropogenic origin. The current state of the science of secondary organic carbon aerosol formation indicates that anthropogenic VOC contribution to secondary organic carbon aerosol is often lower than the biogenic (natural) contribution and photochemical models typically estimate secondary organic carbon from anthropogenic VOC emissions to be less than 0.1 $\mu g/m^3$ (U.S. EPA, 2009a). Given that only a small fraction of secondarily formed organic carbon aerosols is from anthropogenic VOC emissions, it is unlikely that this sector has a large contribution to ambient secondary organic carbon aerosols. Therefore, we have not quantified the forgone $PM_{2.5}$-related benefits in this analysis.

2.3.5.1 $PM_{2.5}$ Health Effects

Increasing VOC emissions would increase secondary $PM_{2.5}$ formation, and, thus, the incidence of $PM_{2.5}$-related health effects. Increasing exposure to $PM_{2.5}$ is associated with significant human health detriments, including mortality and respiratory morbidity. Researchers have associated $PM_{2.5}$ exposure with adverse health effects in numerous toxicological, clinical and epidemiological studies (U.S. EPA, 2009a). These health effects include premature death in people with heart or lung disease, nonfatal heart attacks, irregular heartbeat, aggravated asthma, decreased lung function, and increased respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing (U.S. EPA, 2009a). These health effects result in hospital and ER visits, lost workdays, and restricted activity days. When adequate data and resources are available, The EPA has quantified the health effects associated with exposure to $PM_{2.5}$ (*e.g.*, U.S. EPA (2011c)).

When the EPA quantifies $PM_{2.5}$-related benefits, the Agency assumes 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 (U.S. EPA, 2009a). Based on our review of the current body of scientific literature, the EPA estimates PM-related premature mortality without applying an assumed concentration threshold. This decision is supported by the data, which are quite consistent in showing effects down to the lowest measured levels of $PM_{2.5}$ in the underlying epidemiology studies.

2.3.5.2 Organic PM Welfare Effects

According to the residual risk assessment that the EPA performed for this sector (U.S. EPA, 2012a), persistent and bioaccumulative HAP reported as emissions from oil and natural gas operations include polycyclic organic matter (POM). POM defines a broad class of compounds that includes polycyclic aromatic hydrocarbon compounds (PAHs). Several significant ecological effects are associated with the deposition of organic particles, including persistent organic pollutants, and PAHs (U.S. EPA, 2009a). This summary is from Section 6.6.1 of the 2012 PM NAAQS RIA (U.S. EPA, 2012b).

PAHs can accumulate in sediments and bioaccumulate in freshwater, flora, and fauna. The uptake of organics depends on the plant species, site of deposition, physical and chemical properties of the organic compound and prevailing environmental conditions (U.S. EPA, 2009a). PAHs can accumulate to high enough concentrations in some coastal environments to pose an environmental health threat that includes cancer in fish populations, toxicity to organisms living in the sediment and risks to those (*e.g.*, migratory birds) that consume these organisms. Atmospheric deposition of particles is thought to be the major source of PAHs to the sediments of coastal areas of the U.S. Deposition of PM to surfaces in urban settings increases the metal and organic component of storm water runoff. This atmospherically associated pollutant burden can then be toxic to aquatic biota. The contribution of atmospherically deposited PAHs to aquatic food webs was demonstrated in high elevation mountain lakes with no other anthropogenic contaminant sources.

The Western Airborne Contaminants Assessment Project (WACAP) is the most comprehensive database available on contaminant transport and the effects of PM deposition on sensitive ecosystems in the Western U.S. (Landers *et al.*, 2008). In this project, the transport, fate, and ecological impacts of anthropogenic contaminants from atmospheric sources were assessed from 2002 to 2007 in seven ecosystem components (air, snow, water, sediment, lichen, conifer needles, and fish) in eight core national parks. The study concluded that bioaccumulation of semi-volatile organic compounds occurred throughout park ecosystems, that an elevational gradient in PM deposition exists with greater accumulation in higher altitude areas, and that contaminants accumulate in proximity to individual agriculture and industry sources, which is counter to the original working hypothesis that most of the contaminants would originate from Eastern Europe and Asia.

2.3.5.3 Visibility Effects

Increasing secondary formation of $PM_{2.5}$ from VOC emissions could reduce visibility throughout the U.S. Fine particles with significant light-extinction efficiencies include sulfates, nitrates, organic carbon, elemental carbon, and soil (Sisler, 1996). Suspended particles and gases degrade visibility by scattering and absorbing light. Higher visibility impairment levels in the East are due to higher concentrations of fine particles, particularly sulfates, and higher average relative humidity levels. Visibility impairment has a direct impact on people's enjoyment of daily activities and their overall sense of wellbeing. Good visibility increases the quality of life where individuals live and work, and where they engage in recreational activities. Previous analyses (U.S. EPA, 2006; U.S. EPA, 2011a; U.S. EPA, 2011c; U.S. EPA, 2012b) show that visibility benefits are a significant welfare benefit category. However, without air quality modeling, we are unable to estimate forgone visibility related benefits, nor are we able to determine whether forgone VOC emissions would be likely to have a significant impact on visibility in urban areas or Class I areas.

2.3.6 Hazardous Air Pollutants (HAP)

When looking at exposures from all air toxic sources of outdoor origin across the U.S., we see that emissions declined by approximately 60 percent since 1990. However, despite this decline, the 2014 National-Scale Air Toxics Assessment (NATA) predicts that some Americans are still exposed to ambient concentrations of air toxics at levels that have the potential to cause adverse health effects.[43] The levels of air toxics to which people are exposed vary depending on where they live and work and the kinds of activities in which they engage. In order to identify and prioritize air toxics, emission source types and locations that are of greatest potential concern, the EPA conducts the NATA.[44] The most recent NATA was conducted for calendar year 2014 and was released in August 2018. NATA includes four steps:

1) Compiling a national emissions inventory of air toxics emissions from outdoor sources;

2) Estimating ambient concentrations of air toxics across the U.S. using dispersion models;

3) Estimating population exposures across the U.S. using exposure models; and

4) Characterizing potential public health risk due to inhalation of air toxics including both cancer and noncancer effects.

Based on the 2014 NATA, the EPA estimates that less than 1 percent of census tracts nationwide have increased cancer risks greater than 100-in-1 million. The average national cancer risk is about 30-in-1 million. Nationwide, the key pollutants that contribute most to the overall cancer risks are formaldehyde and benzene.[45,46] Secondary formation (*e.g.*, formaldehyde forming from

[43] The 2014 NATA is available on the Internet at http://www.epa.gov/nata/. Accessed April 26, 2020.

[44] The NATA modeling framework has several limitations that prevent its use as the sole basis for setting regulatory standards. These limitations and uncertainties are discussed on the 2014 NATA website. Even so, this modeling framework is very useful in identifying air toxic pollutants and sources of greatest concern, setting regulatory priorities, and informing the decision-making process. U.S. EPA. (2018) 2014 National-Scale Air Toxics Assessment. http://www.epa.gov/nata/. Accessed April 26, 2020.

[45] Details on EPA's approach to characterization of cancer risks and uncertainties associated with the 2014 NATA risk estimates can be found at http://www.epa.gov/national-air-toxics-assessment/nata-limitations/ Accessed April 26, 2020.

[46] Details about the overall confidence of certainty ranking of the individual pieces of NATA assessments including both quantitative (*e.g.*, model-to-monitor ratios) and qualitative (*e.g.*, quality of data, review of emission inventories) judgments can be found at http://www.epa.gov/national-air-toxics-assessment/nata-limitations/ Accessed April 26, 2020.

other emitted pollutants) was the largest contributor to cancer risks, while stationary, mobile, biogenics, and background sources contribute lesser amounts to the remaining cancer risk.

Noncancer health effects can result from chronic,[47] subchronic,[48] or acute[49] inhalation exposure to air toxics, and include neurological, cardiovascular, liver, kidney, and respiratory effects as well as effects on the immune and reproductive systems. According to the 2014 NATA, less than 1 percent of the U.S. population was exposed to an average chronic concentration of air toxics that had the potential for adverse noncancer health effects. Results from the 2014 NATA indicate that acrolein is the primary respiratory driver for noncancer respiratory risk.

Figure 2-1 depicts the 2014 NATA estimated census tract-level carcinogenic risk from the assessment. It is important to note that increases in HAP emissions may not necessarily translate into significant increases in health risk because toxicity varies by pollutant, and exposures may or may not exceed levels of concern. For example, just a few pounds of some metals (*i.e.*, Hexavalent Chromium) is more toxic than a ton of benzene. However, the Integrated Risk Information System (IRIS) unit risk estimate (URE) for hexavalent chromium is considerably higher (more toxic) than that for benzene.[50] Thus, it is important to account for the toxicity and exposure, as well as the mass of the targeted emissions.

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[47] Chronic exposure is defined in the glossary of the Integrated Risk Information System (IRIS) database (http://www.epa.gov/iris) as repeated exposure by the oral, dermal, or inhalation route for more than approximately 10 of the life span in humans (more than approximately 90 days to 2 years in typically used laboratory animal species).

[48] Defined in the IRIS database as repeated exposure by the oral, dermal, or inhalation route for more than 30 days, up to approximately 10 of the life span in humans (more than 30 days up to approximately 90 days in typically used laboratory animal species).

[49] Defined in the IRIS database as exposure by the oral, dermal, or inhalation route for 24 hours or less.

[50] Details on the derivation of IRIS values and available supporting documentation for individual chemicals (as well as chemical values comparisons) can be found at http://www.epa.gov/iris/. Accessed April 26, 2020.

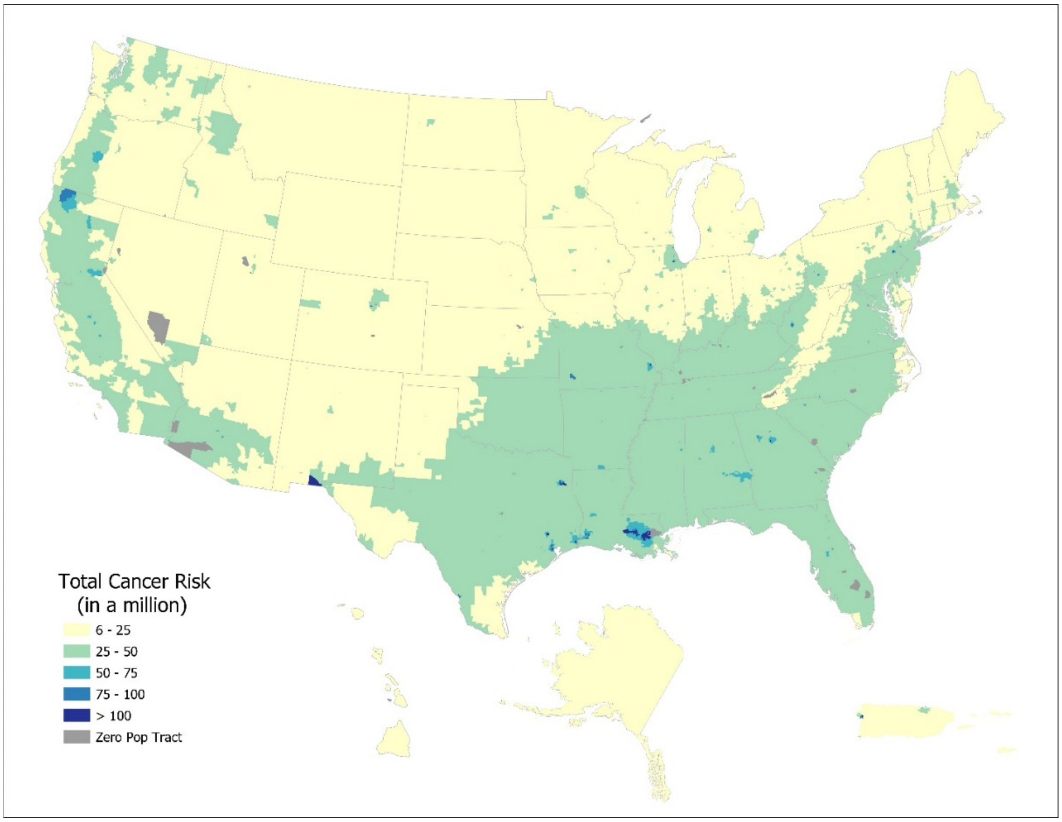

Figure 2-1 2014 NATA Model Estimated Census Tract Carcinogenic Risk from HAP Exposure from All Outdoor Sources based on the 2014 National Emissions Inventory

Due to methodology and data limitations, we were unable to estimate the benefits or disbenefits associated with the hazardous air pollutant emissions changes that could occur as a result of this rule. In a few previous analyses of the benefits of reductions in HAP, the EPA has quantified the benefits of potential reductions in the incidences of cancer and noncancer risk (*e.g.*, U.S. EPA, 1995). In those analyses, The EPA relied on unit risk estimate (URE) and reference concentrations (RfC) developed through risk assessment procedures. The URE is a quantitative estimate of the carcinogenic potency of a pollutant, often expressed as the probability of contracting cancer from a 70-year lifetime continuous exposure to a concentration of one $\mu g/m^3$ of a pollutant. These UREs are designed to be conservative, and as such, are more likely to represent the high end of the distribution of risk rather than a best or most likely estimate of risk. An RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious noncancer health effects during a lifetime. As the purpose of a forgone benefit analysis is to describe the benefits most likely to result from a forgone reduction in pollution, use of high-end, conservative risk estimates would overestimate the forgone benefits of the regulation. While we used high-end risk estimates in past analyses, advice from the EPA's Science Advisory Board (SAB) recommended that we avoid using high-end estimates in benefit analyses (U.S. EPA-SAB, 2002). Since that time, the EPA has continued to develop better methods for analyzing the benefits of reductions in HAP.

As part of the second prospective analysis of the benefits and costs of the Clean Air Act (U.S. EPA, 2011a), the EPA conducted a case study analysis of the health effects associated with reducing exposure to benzene in Houston from implementation of the Clean Air Act (IEc, 2009). While reviewing the draft report, the EPA's Advisory Council on Clean Air Compliance Analysis concluded that "the challenges for assessing progress in health improvement as a result of reductions in emissions of hazardous air pollutants (HAP) are daunting...due to a lack of exposure-response functions, uncertainties in emissions inventories and background levels, the difficulty of extrapolating risk estimates to low doses and the challenges of tracking health progress for diseases, such as cancer, that have long latency periods" (U.S. EPA-SAB, 2008).

In summary, monetization of the forgone benefits of reductions in cancer incidences requires several important inputs, including central estimates of cancer risks, estimates of exposure to carcinogenic HAP, and estimates of the value of an avoided case of cancer (fatal and non-fatal). Due to methodology and data limitations, we did not attempt to monetize the forgone health benefits of forgone reductions in HAP in this analysis. Instead, we are providing a qualitative analysis of the health effects associated with the HAP anticipated to be forgone by this rule. The EPA remains committed to improving methods for estimating HAP benefits by continuing to explore additional concepts of benefits, including changes in the distribution of risk.

Available emissions data show that several different HAP are emitted from oil and natural gas operations, either from equipment leaks, processing, compressing, transmission and distribution, or storage tanks. Emissions of eight HAP make up a large percentage of the total HAP emissions by mass from the oil and natural gas sector: toluene, hexane, benzene, xylenes (mixed), ethylene glycol, methanol, ethyl benzene, and 2,2,4-trimethylpentane (U.S. EPA, 2012a). In the subsequent sections, we describe the health effects associated with the main HAP of concern from the oil and natural gas sector: benzene, toluene, carbonyl sulfide, ethylbenzene, mixed xylenes, and n-hexane. This rule is anticipated to result an increase of a total of 370 tons of HAP emissions over 2021 through 2030. With the data available, it was not possible to estimate the change in emissions of each individual HAP.

2.3.6.1 Benzene

The EPA's IRIS database lists benzene as a known human carcinogen (causing leukemia) by all routes of exposure, and concludes that exposure is associated with additional health effects, including genetic changes in both humans and animals and increased proliferation of bone marrow cells in mice (U.S EPA, 2000; IARC 1982; Irons, 1992). The EPA states in its IRIS database that data indicate a causal relationship between benzene exposure and acute lymphocytic leukemia and suggest a relationship between benzene exposure and chronic non-lymphocytic leukemia and chronic lymphocytic leukemia. The International Agency for Research on Carcinogens (IARC) has determined that benzene is a human carcinogen and the U.S. Department of Health and Human Services has characterized benzene as a known human carcinogen (IARC, 1987; NTP, 2004). Several adverse noncancer health effects including blood disorders, such as preleukemia and aplastic anemia, have also been associated with long-term exposure to benzene (Aksoy, 1989; Goldstein, 1988).

2.3.6.2 Toluene[51]

Under the 2005 Guidelines for Carcinogen Risk Assessment, there is inadequate information to assess the carcinogenic potential of toluene because studies of humans chronically exposed to toluene are inconclusive, toluene was not carcinogenic in adequate inhalation cancer bioassays of rats and mice exposed for life, and increased incidences of mammary cancer and leukemia were reported in a lifetime rat oral bioassay.

The central nervous system (CNS) is the primary target for toluene toxicity in both humans and animals for acute and chronic exposures. CNS dysfunction (which is often reversible) and narcosis have been frequently observed in humans acutely exposed to low or moderate levels of

[51] All health effects language for this section came from: U.S. EPA. 2005. "Full IRIS Summary for Toluene (CASRN 108-88-3)" Environmental Protection Agency, Integrated Risk Information System (IRIS), Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH. Available at http://www.epa.gov/iris/subst/0118.ht/. Accessed April 26, 2020.

toluene by inhalation: symptoms include fatigue, sleepiness, headaches, and nausea. Central nervous system depression has been reported to occur in chronic abusers exposed to high levels of toluene. Symptoms include ataxia, tremors, cerebral atrophy, nystagmus (involuntary eye movements), and impaired speech, hearing, and vision. Chronic inhalation exposure of humans to toluene also causes irritation of the upper respiratory tract, eye irritation, dizziness, headaches, and difficulty with sleep.

Human studies have also reported developmental effects, such as CNS dysfunction, attention deficits, and minor craniofacial and limb anomalies, in the children of women who abused toluene during pregnancy. A substantial database examining the effects of toluene in subchronic and chronic occupationally exposed humans exists. The weight of evidence from these studies indicates neurological effects (*i.e.*, impaired color vision, impaired hearing, decreased performance in neurobehavioral analysis, changes in motor and sensory nerve conduction velocity, headache, and dizziness) as the most sensitive endpoint.

2.3.6.3 Carbonyl Sulfide

Limited information is available on the health effects of carbonyl sulfide. Acute (short-term) inhalation of high concentrations of carbonyl sulfide may cause narcotic effects and irritate the eyes and skin in humans.[52] No information is available on the chronic (long-term), reproductive, developmental, or carcinogenic effects of carbonyl sulfide in humans. Carbonyl sulfide has not undergone a complete evaluation and determination under U.S. EPA's IRIS program for evidence of human carcinogenic potential.[53]

2.3.6.4 Ethylbenzene

Ethylbenzene is a major industrial chemical produced by alkylation of benzene. The pure chemical is used almost exclusively for styrene production. It is also a constituent of crude

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[52] Hazardous Substances Data Bank (HSDB), online database. US National Library of Medicine, Toxicology Data Network, available online at https://pubchem.ncbi.nlm.nih.gov/. Carbonyl sulfide health effects summary available at https://pubchem.ncbi.nlm.nih.gov/compound/10039#section=Safety-and-Hazards. Accessed April 26, 2020.

[53] U.S. Environmental Protection Agency (U.S. EPA). 2000. Integrated Risk Information System File for Carbonyl Sulfide. Research and Development, National Center for Environmental Assessment, Washington, DC. This material is available electronically at http://www.epa.gov/iris/subst/0617.htm/. Accessed April 26, 2020.

petroleum and is found in gasoline and diesel fuels. Acute (short-term) exposure to ethylbenzene in humans results in respiratory effects such as throat irritation and chest constriction, and irritation of the eyes, and neurological effects such as dizziness. Chronic (long-term) exposure of humans to ethylbenzene may cause eye and lung irritation, with possible adverse effects on the blood. Animal studies have reported effects on the blood, liver, and kidneys and endocrine system from chronic inhalation exposure to ethylbenzene. No information is available on the developmental or reproductive effects of ethylbenzene in humans, but animal studies have reported developmental effects, including birth defects in animals exposed via inhalation. Studies in rodents reported increases in the percentage of animals with tumors of the nasal and oral cavities in male and female rats exposed to ethylbenzene via the oral route (Maltoni, 1985, Maltoni, 1997). The reports of these studies lacked detailed information on the incidence of specific tumors, statistical analysis, survival data, and information on historical controls, thus the results of these studies were considered inconclusive by the International Agency for Research on Cancer (IARC, 2000) and the National Toxicology Program (NTP, 1999). The NTP (1999) carried out a chronic inhalation bioassay in mice and rats and found clear evidence of carcinogenic activity in male rats and some evidence in female rats, based on increased incidences of renal tubule adenoma or carcinoma in male rats and renal tubule adenoma in females. NTP (1999) also noted increases in the incidence of testicular adenoma in male rats. Increased incidences of lung alveolar/bronchiolar adenoma or carcinoma were observed in male mice and liver hepatocellular adenoma or carcinoma in female mice, which provided some evidence of carcinogenic activity in male and female mice (NTP, 1999). IARC (2000) classified ethylbenzene as Group 2B, possibly carcinogenic to humans, based on the NTP studies.

2.3.6.5 Mixed Xylenes

Short-term inhalation of mixed xylenes (a mixture of three closely-related compounds) in humans may cause irritation of the nose and throat, nausea, vomiting, gastric irritation, mild transient eye irritation, and neurological effects (U.S. EPA, 2003). Other reported effects include labored breathing, heart palpitation, impaired function of the lungs, and possible effects in the liver and kidneys (ATSDR, 2007). Long-term inhalation exposure to xylenes in humans has been associated with a number of effects in the nervous system including headaches, dizziness, fatigue, tremors, and impaired motor coordination (ATSDR, 2007). The EPA has classified mixed xylenes in Category D, not classifiable with respect to human carcinogenicity.

2.3.6.6 n-Hexane

The studies available in both humans and animals indicate that the nervous system is the primary target of toxicity upon exposure of n-hexane via inhalation. There are no data in humans and very limited information in animals about the potential effects of n-hexane via the oral route. Acute (short-term) inhalation exposure of humans to high levels of hexane causes mild central nervous system effects, including dizziness, giddiness, slight nausea, and headache. Chronic (long-term) exposure to hexane in air causes numbness in the extremities, muscular weakness, blurred vision, headache, and fatigue. Inhalation studies in rodents have reported behavioral effects, neurophysiological changes and neuropathological effects upon inhalation exposure to n-hexane. Under the Guidelines for Carcinogen Risk Assessment (U.S. EPA, 2005), the database for n-hexane is considered inadequate to assess human carcinogenic potential, therefore The EPA has classified hexane in Group D, not classifiable as to human carcinogenicity.

2.3.6.7 Other Air Toxics

In addition to the compounds described above, other toxic compounds might be affected by this rule, including hydrogen sulfide (H_2S). Information regarding the health effects of those compounds can be found in the EPA's IRIS database.[54]

2.4 Economic Impacts and Distributional Assessments

This section includes four sets of discussion for this final action: energy markets impacts, distributional impacts, small business impacts, and employment impacts.

2.4.1 Energy Markets Impacts

As it is implemented, the 2016 NSPS OOOOa may have impacts on energy production and markets, which would be reduced by the finalized Policy Review. For the 2016 NSPS RIA, The EPA used the National Energy Modeling System (NEMS) to project drilling activity, price, and

[54] U.S. EPA Integrated Risk Information System (IRIS) database is available at www.epa.gov/iris. Accessed April 26, 2020

quantity changes in the production of crude oil and natural gas, and changes in international trade of crude oil and natural gas national energy markets as a result of the 2016 NSPS OOOOa.[55] In that analysis, the EPA estimated the following impacts under the final 2016 NSPS OOOOa:

- Natural gas and crude oil drilling levels would decline slightly over the 2020 to 2025 period (by about 0.17 percent for natural gas wells and 0.02 percent for crude oil wells);
- Crude oil production would not change appreciably under the rule, while natural gas production would decline slightly over the 2020 to 2025 period (about 0.03 percent);
- Crude oil wellhead prices for onshore production in the lower 48 states were not estimated to change appreciably over the 2020 to 2025 period, while wellhead natural gas prices for onshore production in the lower 48 states were estimated to increase slightly over the 2020 to 2025 period (about 0.20 percent); and,
- Net imports of natural gas were estimated to increase slightly in 2020 (by about 0.12 percent) and in 2025 (by about 0.11 percent), while net imports of crude oil were not estimated to change appreciably over the 2020 to 2025 period.

As described earlier in this RIA, this final action removes requirements in the 2016 NSPS OOOOa for sources in the transmission and storage segment. The finalized Policy Review is expected to lead to cost reductions compared to the baseline. As a result, the EPA expects this final action to reduce the impacts associated with the 2016 NSPS.

2.4.2 Distributional Impacts

The cost reductions and forgone benefits presented above are not expected to be distributed uniformly across the population. OMB recommends including a description of distributional effects in regulatory analysis, "so that decision makers can properly consider them along with the effects on economic efficiency [*i.e.*, net benefits]. Executive Order 12866 authorizes this approach." (U.S. Office of Management and Budget 2003). Understanding the distribution of the compliance cost reductions and forgone benefits can reveal community-level impacts associated

[55] See Section 6.2 of the 2016 NSPS RIA.

with regulatory actions. This section discusses the general expectations regarding how cost reductions might be distributed across affected entities and how forgone health benefits might be distributed across the U.S. informed by a review of recent literature. The EPA did not conduct a quantitative assessment of these distributional impacts for the final Policy Review, but this section provides a qualitative discussion of the types of distributional impacts that could result from this final action.

2.4.2.1 Distributional Aspects of Compliance Cost Reductions

The compliance costs associated with an environmental regulation can impact households by raising the prices of goods and services; the extent of the price increase depends on if and how producers pass-through those costs to consumers. The literature evaluates the distributional effects of introducing a new regulation; for this action, which is deregulatory, these effects can generally be interpreted in reverse. Expenditures on energy are usually a larger share of low-income household income than that of other households, and this share falls as income increases. Therefore, policies that increase energy prices have been found to be regressive, placing a relatively higher burden on lower income households (*e.g.*, Burtraw et al., 2009; Hassett et al., 2009; Williams et al. 2015). However, compliance costs will not be solely passed on in the form of higher energy prices, but also through lower labor earnings and returns to capital in the sector. Changes in employment associated with lower labor earnings can have distributional consequences depending on several factors (Section 2.4.4 discusses employment effects further). Capital income tends to make up a greater proportion of overall income for high income households. As a result, the costs passed through to households via lower returns to capital tend to be progressive, placing a greater share of the burden on higher income households in these instances (Rausch et al., 2011; Fullerton et al., 2012).

The ultimate distributional outcomes of a regulation will depend on how changes in energy prices and lower returns to labor and capital propagate through the economy and interact with existing government transfer programs. Some studies that use economy-wide frameworks find that the overall distribution of compliance costs could be progressive for some policies due to the changes in capital payments and the expectation that existing government transfer indexed to inflation will offset the burden to lower income households (Fullerton et al., 2011; Blonz et al., 2012).[56] However, others have found the distribution of compliance costs to be regressive due to a dominating effect of changes in energy prices to consumers (Fullerton 2011; Burtraw, et. al., 2009; Williams, et al., 2015). There may also be significant heterogeneity in the costs borne by individuals within income deciles (Rausch et al., 2011; Cronin et al., 2019). Different classifications of households, such as those based on lifetime income rather than contemporaneous annual income, may indicate notably different results in a distributional analysis (Fullerton and Metcalf, 2002; Fullerton et al., 2011). Furthermore, there may be important regional differences in the incidence of regulations. There are differences in the composition of goods consumed, regional production methods, the stringency of a rule, as well as the location of affected labor and capital ownership (the latter of which may be foreign-owned) (*e.g.* Caron et al. 2017; Hassett et al. 2009).

2.4.2.2 Distributional Aspects of the Forgone Health Benefits

This section discusses the distribution of forgone health benefits that result from the final Policy Review. The EPA guidance directs analysts to first consider the distribution of impacts in the baseline, prior to any regulatory action (U.S. EPA 2016). Often the baseline incidence of health problems is higher in low-income or minority populations due to a variety of factors, including the tendency for more pollution sources to be located in areas where low-income and minority populations live, work, and play (Bullard, et al. 2007; United Church of Christ 1987); greater susceptibility to a given exposure level due to physiology or other triggers (Akinbami 2012); and higher incidence of pre-existing conditions (Schwartz et al 2011). EPA (2016) recommends analysts examine the distribution of health impacts under the regulatory options being considered. Finally, after assessing the differences between the baseline and policy scenario, analysts should take note of whether the action ameliorates or exacerbates any pre-existing disparities.

Because regulatory health impacts are distributed based on the degree to which housing and work locations overlap geographically with areas where atmospheric concentrations of pollutants

[56] The incidence of government transfer payments (*e.g.*, Social Security) is generally progressive because these payments represent a significant source of income for lower income deciles and only a small source for high income deciles. Government transfer programs are often, implicitly or explicitly, indexed to inflation. For example, Social Security payments and veterans' benefits are adjusted every year to account for changes in prices (*i.e.*, inflation).

change, it is difficult to fully know the distributional impacts of a rule. Air dispersion models provide some information on changes in air quality induced by regulation, but it may be difficult to identify the characteristics of populations in those affected areas, as well as to perform local air dispersion modeling nationwide. Furthermore, the overall distribution of health benefits will depend on whether and how households engage in averting behaviors in response to changes in air quality, *e.g.*, by moving or changing the amount of time spent outside (Sieg et al., 2004).

2.4.3 Small Business Impacts

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. 104121), requires that whenever an agency publishes a proposed rule, it must prepare and make available an initial regulatory flexibility analysis (IRFA), unless it certifies that the 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 rule on small entities and any alternative options that would accomplish the objectives of the rule while minimizing economic impacts on small entities.

An agency may certify that a rule will not have a significant economic impact on a substantial number of small entities if the rule relieves regulatory burden, has no net burden or otherwise has a positive economic effect on the small entities subject to the rule. As the Policy Review eliminates the regulatory requirements of the oil and natural gas sector NSPS for all transmission and storage sources, we have concluded that this final action will relieve regulatory burden for affected small entities in the transmission and storage segment that would otherwise be subject to requirements under the baseline.

2.4.4 Employment Impacts

We analyzed the impacts of the Policy Review on employment, which are discussed in this section.[57] This analysis uses detailed engineering information on labor requirements for the

[57] The employment analysis in this RIA is part of the 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).

rescinded provisions in order to estimate partial employment impacts for affected entities in the oil and natural gas industry. These bottom-up, engineering-based estimates represent only one portion of potential employment impacts within the regulated industry and do not represent estimates of the *net* employment impacts of this rule. Due to data and methodological limitations, other potential employment impacts in the affected industry and impacts in related industries could not be estimated. First, this section presents an overview of the various ways that environmental regulation can affect employment. The EPA continues to explore the relevant theoretical and empirical literature and to seek public comments in order to ensure that the way the EPA characterizes the employment effects of its regulations is reasonable and informative. The section concludes with estimates of partial employment impacts based on engineering-based information for labor requirements.

2.4.4.1 Employment Impacts of Environmental Regulation

E.O. 13777 directs federal agencies to consider a variety of issues regarding the characteristics and impacts of regulations, including the effect of regulations on jobs (Executive Order 13777). Employment impacts of environmental regulations are composed of a mix of potential declines and gains in different areas of the economy over time. Regulatory employment impacts can vary across occupations, regions, and industries; by labor demand and supply elasticities; and in response to other labor market conditions. Isolating such impacts is a challenge, as they are difficult to disentangle from employment impacts caused by a wide variety of ongoing, concurrent economic changes.

Environmental regulation "typically affects the distribution of employment among industries rather than the general employment level" (Arrow *et. al.* 1996). Even if impacts are small after long-run market adjustments to full employment, many regulatory actions have transitional effects in the short run (OMB, 2015). These movements of workers in and out of jobs in response to environmental regulation are potentially important and of interest to policymakers. Transitional job losses have consequences for workers that operate in declining industries, have limited capacity to migrate, or live in communities or regions with high unemployment rates.

As rescinding the oil and natural gas NSPS for transmission and storage segment is likely to cause little change in oil and natural gas exploration and production (and the production and processing segment continues to be regulated by the NSPS), demand for labor employed in exploration and production and associated industries is unlikely to change much, if at all. For affected oil and natural gas entities, some may reduce the labor they allocate to compliance-related activities associated with the now-rescinded oil and natural gas NSPS requirements for the transmission and storage segment.

2.4.4.2 Estimates of Reduction in Labor Required to Comply

The focus of this part of the analysis is on changes in the compliance-related labor requirements resulting from the removal of the requirements for the transmission and storage segment from the oil and natural gas NSPS. This analysis estimates the incremental change in labor required to satisfy environmental mitigation requirements as well as reporting and recordkeeping requirements due to the rescission of requirements for transmission and storage sources. Most of the estimated change in labor requirements relative to the baseline come from rescinding the fugitive emissions program for compressor stations in the transmission and storage segment.

The labor information is based on the cost analysis presented in the TSD that supports this rule. The labor estimates include labor associated with company-level activities and activities at field sites. Company-level activities included one-time "up-front" activities such as planning the company's fugitive emissions program and annual requirements such as reporting and recordkeeping. Field-level activities included inspection and repair of leaks.

Table 2-17 presents the incremental change in labor required to comply with the NSPS due to the Policy Review at the facility level in hours per facility per year. The change in estimates for each of the facility types reflect the following changes from the baseline:

- **Compressor Stations** (in transmission and storage segment): removal of quarterly fugitives monitoring requirements.

- **Reciprocating Compressors:** removal of requirement to replace rod-packing every 36 months, or 26,000 hours.

- **Pneumatic Controllers:** removal of requirement to replace high-bleed controllers with low-bleed controllers.

Table 2-17 Changes in Labor Required to Comply at the Impacted Facility-Level

Facility	Upfront Labor Estimate (hours per facility)			Annual Labor Estimate (hours per facility per year)		
	Under the Baseline	Under Final Policy Review	Incremental Change	Under the Baseline	Under Final Policy Review	Incremental Change
Compressor Stations						
Transmission	64	0	-64	123.2	0	-123.2
Storage	64	0	-64	227.4	0	-227.4
Compressors						
Reciprocating	1	0	-1	1	0	-1
Pneumatic Controllers	0	0	0	0	0	0

Table 2-18 and Table 2-19 present estimates of the decrease in upfront and annual labor requirements, respectively. The estimates are presented in full-time equivalent (FTE) units in these tables; in this analysis we assume one FTE equals 2,080 hours (the product of 40 hours per week over 52 weeks). Note that reductions in labor requirements increase from 2021 to 2030 as the number of sites that would have been regulated under the NSPS under the baseline accumulates.

Table 2-18 Estimates of the Decrease in Upfront Labor Required (in FTEs) under the Policy Review, 2021-2030

	Compressor Stations					
	Transmission	Storage	Reciprocating Compressors	Pneumatic Controllers	Recordkeeping and Reporting	Total
2021	0.06	1.1	0.07	0	0	1.2
2022	0.06	1.1	0.07	0	0	1.2
2023	0.12	2.2	0.11	0	0	2.4
2024	0.12	2.2	0.11	0	0	2.4
2025	0.12	2.2	0.11	0	0	2.4
2026	0.12	2.2	0.11	0	0	2.4
2027	0.12	2.2	0.15	0	0	2.5
2028	0.12	2.2	0.15	0	0	2.5
2029	0.12	2.2	0.15	0	0	2.5
2030	0.12	2.2	0.15	0	0	2.5

Note: Full-time equivalents (FTE) are estimated by first multiplying the projected number of affected units by the per unit labor requirements and then multiplying by 2,080 (40 hours multiplied by 52 weeks). Estimates may not sum due to independent rounding.

Table 2-19 Estimates of the Decrease in Annual Labor Required (in FTEs) under the Policy Review, 2021-2030

	Compressor Stations					
Year	Transmission	Storage	Reciprocating Compressors	Pneumatic Controllers	Recordkeeping and Reporting	Total
2021	0.8	28	0.26	0	1.7	30
2022	1.0	31	0.29	0	1.8	35
2023	1.1	35	0.33	0	1.9	39
2024	1.2	39	0.37	0	2.0	43
2025	1.3	43	0.40	0	2.1	47
2026	1.4	47	0.44	0	2.3	51
2027	1.5	51	0.48	0	2.4	56
2028	1.7	55	0.51	0	2.5	60
2029	1.8	59	0.55	0	2.6	64
2030	1.9	63	0.58	0	2.7	68

Note: Full-time equivalents (FTE) are estimated by first multiplying the projected number of affected units by the per unit labor requirements and then multiplying by 2,080 (40 hours multiplied by 52 weeks). Estimates may not sum due to independent rounding.

The total incremental reductions in up-front labor requirements among entities affected by the Policy Review are projected to increase from 1.2 FTE in 2021 to 2.5 FTE in 2030. The total incremental reductions in annual labor requirements are projected to increase from about 30 to 68 FTEs from 2021 to 2030.

We note that this type of FTE estimate cannot be used to identify the specific number of employees involved or whether new jobs are created for new employees, versus displacing jobs from other sectors of the economy. As stated earlier, this rule is expected to result in little change in oil and natural gas exploration and production and is not expected to result in significant reductions to employment dedicated to these tasks. For the affected oil and natural gas entities, some reductions in compliance-related labor may be expected due to the rescission of requirements for transmission and storage segment under the Policy Review. We did not estimate any potential changes in labor outside of the affected sector. For example, no estimates of labor requirements for manufacturing pollution control equipment, or for producing the materials used in that equipment, are provided as the EPA did not have the information necessary for estimating broader employment impacts.

2.5 Comparison of Benefits and Costs

2.5.1 Comparison of Benefits and Costs

In this section, we present a comparison of the benefits and costs for the Policy Review. Here, we refer to the compliance cost reductions as the "benefits" and the forgone benefits as the "costs" of this action. The net benefits are the benefits (compliance cost reductions) minus the costs (forgone benefits). All benefits, costs, and net benefits shown in this section are presented as the PV of the costs and benefits of the Policy Review from 2021 through 2030 discounted back to 2020 using 7 and 3 discount rates. We also present the associated EAV under each discount rate.

Table 2-20 shows the projected benefits, costs, and net benefits for the Policy Review. Table 2-21 provides a summary of the projected forgone emissions reductions for this action.

Table 2-20 Present Value (PV) and Equivalent Annualized Value (EAV) of Forgone Monetized Benefits, Cost Reductions, and Net Benefits for the Policy Review, 2021 through 2030 (millions, 2016$)

	7 percent		3 percent	
	PV	**EAV**	**PV**	**EAV**
Benefits (Total Cost Reductions)	$31	$4.1	$38	$4.3
Cost Reductions	$67	$8.9	$83	$9.4
Forgone Value of Product Recovery	$36	$4.7	$45	$5.1
Costs (Forgone Domestic Climate Benefits)[1]	$17	$2.2	$63	$7.2
Net Benefits	$14	$1.9	-$25	-$2.9

Note: Estimates may not sum due to independent rounding.
[1] The forgone benefits estimates are calculated using estimates of the social cost of methane (SC-CH_4). SC-CH_4 values represent only a partial accounting of domestic climate impacts from methane emissions.

Table 2-21 Summary of Forgone Emission Reductions for the Policy Review, 2021 through 2030

Pollutant	**Policy Review**
Methane (short tons)	400,000
VOC (short tons)	11,000
HAP (short tons)	330
Methane (metric tons)	360,000
Methane (million metric tons CO_2 Eq.)	9.0

2.5.2 Uncertainties and Limitations

Throughout the RIA, we considered several sources of uncertainty, both quantitatively and qualitatively, regarding the forgone emissions reductions, forgone benefits, and cost reductions estimated for the final Policy Review. We summarize the key elements of our discussions of uncertainty follow.

Source-level compliance costs and emissions impacts: As discussed in Section 2.2.2, the first step in the compliance cost analysis is the development of per-facility national-average representative costs and emissions impacts using a model plant approach. The model plants are designed based upon the best information available to the Agency at the time of the rulemaking. By emphasizing facility averages, geographic variability and heterogeneity across producers in the industry is masked, and regulatory impacts at the facility-level may vary from the model plant averages.

Projection methods and assumptions: As discussed in Section 2.2.2 and 2.2.3, the second step in estimating national impacts is the projection of affected facilities. Uncertainties in the projections informing this chapter include: 1) choice of projection method; 2) data sources and drivers; 3) limited information about rate of modification and turnover of sources; 4) behavioral responses to regulation; and 5) unforeseen changes in industry and economic shocks.

The projection methods significantly impact affected facility projections. For example, some facility types were projected using extrapolations of historical trends from GHGI data, while other facility types were changed to be projected based on compliance report information. These two methods may result in divergent projections. In addition, a given methodology can be sensitive to regular updates or methodological revisions in the source data; for example, past updates to the GHGI have resulted in significant changes to the projections.

Some impacts of this rule are based on projections based on historical estimates in the GHGI and do not account for modifications or turnover, just the estimated number of new sources. To the extent actual counts of new facilities in transmission and storage diverge from the historical average annual increases, the regulatory impacts estimated in this document will be inaccurate.

Additionally, some emissions reducing technologies have become common industry practice under the oil and natural gas sector NSPS, such as the use of dry seals on centrifugal compressors. However, by removing regulatory requirements, there may be incentives to reduce use of these technologies, introducing uncertainties in how regulated entities may respond both directly and indirectly to the removal of NSPS requirements.

The projections do not account for potential changes in technological progress in the oil and gas industry. Additionally, unforeseen economic shocks may affect the impacts of the rule, such as unexpected periods of economic growth or recessions. For example, the projections in this RIA do not account for potential effects of economic shocks arising from the coronavirus pandemic.

Years of analysis: The years of analysis are 2021, to represent the first-year facilities are affected by this action, through 2030, to represent impacts of the rule over a longer period, as discussed in Section 2.2.2. While it would be desirable to analyze impacts beyond 2030 in this RIA, the EPA has chosen not to do this largely because of the limited information available on the turnover rate of emissions sources and controls. Extending the analysis beyond 2030 would introduce substantial and increasing uncertainties in the projected impacts of the final Policy Review.

State regulations in the baselines for this analysis: As discussed in Section 2.1.1, with the information currently available, we are unable to determine where newly affected sources in the transmission and storage segment are expected to locate. Though there may be states with similar requirements to those of the oil and natural gas NSPS for the transmission and storage segment, we are unable to account for such situations in this analysis. Applicable facilities in these states with similar requirements will still be expected to follow state regulations. This analysis likely overestimates the compliance cost reduction from sources in transmission and storage because it includes estimates of incrementally affected facilities that would have similar state-level requirements under the baseline that will continue to apply to these facilities despite this rule.

Wellhead natural gas prices used to estimate forgone revenues from natural gas recovery: The compliance cost reductions estimates presented in this RIA include the forgone revenue associated with the decrease in natural gas recovery resulting from the decrease in emissions reductions. As a result, the national compliance cost reductions depend on the price of natural gas. As explained in Section 2.2.5, natural gas prices used in this analysis are from the projection of the Henry Hub price in the 2020 AEO. To the extent actual natural gas prices diverge from the AEO projections, the actual impacts will diverge from our estimates.

Monetized forgone methane-related climate benefits: The EPA considered the uncertainty associated with the social cost of methane (SC-CH_4) estimates, which were used to calculate the forgone domestic social benefits of the increase in methane emissions expected as a result of this action. The potential impacts of some uncertainties are accounted for in the analysis or discussed quantitatively, while other areas of uncertainty have not yet been quantified in a way that can be modeled. Section 2.3.3 and Appendix B provide detailed discussions of the ways in which the modeling underlying the development of the SC-CH_4 estimates used in this analysis addresses quantified sources of uncertainty and presents a sensitivity analysis to show consideration of the uncertainty surrounding the choice of discount rate over long time horizons.

Non-monetized forgone benefits: Several categories of forgone health, welfare, and climate benefits are not quantified in this RIA. These unquantified forgone benefits, in addition to the forgone benefits from increased emissions of methane, VOCs and HAP, are described in detail in Section 2.3.

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3 REGULATORY IMPACT ANALYSIS FOR THE OIL AND NATURAL GAS SECTOR: THE EMISSION STANDARDS FOR NEW, RECONSTRUCTED, AND MODIFIED SOURCES RECONSIDERATION

3.1 Introduction

This chapter presents the RIA for the final technical reconsideration of certain aspects of the Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources published in the Federal Register on June 3, 2016 ("2016 NSPS OOOOa"), referred to as the "Technical Reconsideration" in this chapter and document as a whole. In the 2016 NSPS OOOOa, new source performance standards (NSPS) were established to reduce greenhouse gas emissions and volatile organic compound (VOC) emissions from the oil and natural gas sector. The emission sources covered in the 2016 rule include hydraulically fractured oil and natural gas well completions, centrifugal compressors, reciprocating compressors, pneumatic controllers, storage vessels, equipment leaks at natural gas processing plants, sweetening units, pneumatic pumps, and fugitive emissions from well sites and compressor stations. In the action evaluated in this chapter, the EPA granted reconsideration of three aspects of the 2016 rule: fugitive emissions monitoring requirements, well site pneumatic pump standards, and requirements for certification of closed vent system design and capacity by a professional engineer. In addition, the EPA clarified definitions and reconsidered several issues to streamline implementation and improve cost-effectiveness of compliance.

In this chapter, we focus on the finalized changes to NSPS OOOOa that result in quantifiable compliance cost or emissions changes compared to a baseline that includes the Policy Review.[58] As described in Chapter 2 of this document, the Policy Review rescinds the requirements of the 2012 NSPS OOOO and the 2016 NSPS OOOOa for oil and natural gas sources in the transmission and storage segment. The Policy Review also rescinds the methane standards for sources in the production and processing segments, while leaving VOC requirements in place for production and processing sources. As a result, the RIA for the Technical Reconsideration

[58] The Technical Reconsideration rule was proposed (October 15, 2018) before the Policy Review was proposed (September 24, 2019). Due to the sequencing of the proposals, the RIA for the proposal of the Technical Reconsideration estimated impacts relative to a baseline that did not include consideration of elements of the later Policy Review proposal.

presented in this Chapter does not evaluate regulatory impacts to previously NSPS-affected sources in transmission and storage. Sequencing the two actions in this way—with the conclusions of the Policy Review in the baseline for the Technical Reconsideration—is consistent with the sequencing applied in the preamble and amended regulatory text for the two final actions.

The provisions analyzed in this chapter are related to fugitive emissions monitoring and professional engineer certification requirements. We do not analyze all finalized changes to NSPS OOOOa that are discussed in the preamble for the Technical Reconsideration because we either do not have the data to do so or because we have concluded that certain provisions are unlikely to result in measurable cost reductions or changes in emissions. Section 3.2.1 provides a basic description of the additional reconsidered provisions that are not quantified in the RIA. For additional details on these provisions, see the preamble to the Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources Reconsideration, found in the docket.[59]

The 2016 NSPS OOOOa required all NSPS-affected well sites to perform semiannual monitoring and all NSPS-affected compressor stations to perform quarterly monitoring. On March 1, 2018, the EPA finalized a package containing amendments to the 2016 NSPS OOOOa (hereon, “Amendments package”) to address immediate concerns regarding implementation issues related to the reliability of emissions monitoring equipment during extended periods of extreme cold temperatures on the Alaska North Slope.[60] The Amendments package reduced monitoring frequency at NSPS-affected well sites on the Alaska North Slope from semiannual to annual. In this final action, the EPA is reducing the required monitoring frequency at NSPS-affected compressor stations on the Alaska North Slope from quarterly to annual. We are unable to quantify the emissions impacts or cost reductions associated with this change for compressor stations on the Alaska North Slope due to a lack of data.[61]

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[59] Found on http://www.regulations.gov under Docket ID No. EPA-HQ-OAR-2017-0483.

[60] 83 FR 10628.

[61] The Amendments package did not change the fugitive emissions requirements for compressor stations located on the Alaska North Slope because there were no NSPS-affected compressor stations at the time, and therefore there was no immediate compliance issue to address (see 83 FR 10635). In this final action, EPA is aligning the fugitive emissions requirements for compressor stations with the changes made in the 2018 Amendments package for well sites on the Alaska North Slope. Nevertheless, there is still no indication that there are any

In the 2016 NSPS OOOOa, the EPA finalized a requirement for closed vent systems (CVS) for NSPS-affected storage vessels, pneumatic pumps, reciprocating compressors, and centrifugal compressors to be certified by a professional engineer. In addition, the EPA finalized a requirement for well site sources claiming that feasibility issues constrain their ability to route pneumatic pump emissions to a control device. The 2016 NSPS required such sources to obtain a certification of technical infeasibility from a "qualified professional engineer." The compliance costs for these engineering certifications were not considered in the rulemaking for the 2016 NSPS OOOOa. For this final action, the EPA estimates and includes those compliance costs in the updated baseline and assesses the impact of a change being finalized which allows technical infeasibility certifications and CVS certifications to be performed by either in-house engineers or professional engineers.

This analysis projects the impacts of the Technical Reconsideration for the years 2021 through 2030. All monetized impacts are presented in 2016 dollars. This analysis also includes a presentation of the impacts in a present value (PV) framework. All sources affected by the 2016 NSPS OOOOa are referred to as "NSPS-affected sources." The subset of sources whose requirements are altered by the Technical Reconsideration of the 2016 NSPS OOOOa are referred to as "reconsideration-impacted sources." Note that the universe of reconsideration-impacted sources varies across the regulatory options considered in this RIA.

3.1.1 Summary of Changes Since the Final 2016 NSPS RIA

This RIA applied several updates to the data, assumptions, source counts, projections, and baseline state and local regulations since finalizing the 2016 NSPS OOOOa. The projected compliance cost and emission impacts of the three options analyzed in this RIA are compared to an updated baseline that includes the Policy Review. These updates include the incorporation of information received during the public comment period for the proposal of this Technical Reconsideration.[62] Other than the updates noted below, the baseline used in this RIA was determined using the same assumptions and methods as the 2016 NSPS RIA. The updated baseline represents the EPA's best assessment of the current and future state of the industry and

compressor stations on the Alaska North Slope currently subject to the 2016 NSPS OOOOa fugitive emissions requirements, nor is EPA able to project potential new or modified compressor stations in specific locations.

[62] See preamble and response to comments document, which are available in the docket.

economy. The changes in the following list were included in the RIA for the proposal of this Technical Reconsideration action. We also indicate the updates in this final RIA made since the proposal RIA.

- **Annual Energy Outlook:** In the 2016 NSPS OOOOa, we used the 2015 Annual Energy Outlook (AEO). For the proposal of this Technical Reconsideration, we used the AEO2018. We use the most recent AEO in this RIA, the AEO2020, published in January 2020.[63] The drilling activity projections in the AEO2020 are used to project the number of NSPS-affected sources over time, and the AEO2020 projections for natural gas prices are used to estimate the value of product recovery in this RIA.
- **Source Projections:** Since the promulgation of the 2016 NSPS OOOOa, the U.S. Greenhouse Gas Inventory (GHGI) has been updated.[64] The data from the updated GHGI was used in the projection of NSPS-affected sources over time. In addition, for a few sources, we relied on information from 2016 NSPS OOOOa compliance reports to inform our projections.
- **DrillingInfo:** This RIA uses a more recent version of the DrillingInfo data, which is used to characterize oil and natural gas wells and completion activity in the base year, than was used for the 2016 NSPS OOOOa.[65] The version used for this analysis was pulled in January 2017 and uses 2014 as the base year. The base year was 2012 in the 2016 NSPS OOOOa RIA.
- **State and Local Regulations:** Since the promulgation of the 2016 NSPS OOOOa, state and local authorities have issued requirements affecting the oil and natural gas sector, with the most significant changes resulting from new regulations in California and general permitting requirements in Pennsylvania. In this analysis, we account for updated requirements in California, Colorado, Ohio, Pennsylvania, Texas,[66] and Utah. Updated requirements for some facilities in these states are expected to result in similar emissions reductions to those expected from the 2016 NSPS OOOOa and this reconsideration, though the programs in these states function differently than the 2016 NSPS OOOOa and this reconsideration. In the RIA for the 2016 NSPS, it was determined that the rule would not achieve additional emissions reductions in Wyoming relative to those that would already be achieved by the state program. The requirements in Wyoming were re-examined and are no longer considered to function in a way that reduces emissions by as

[63] AEO2020 can be found at https://www.eia.gov/outlooks/aeo/.

[64] The updated GHGI data used is from the April 2018 release. For information on the inventory, visit https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks.

[65] DrillingInfo is a private company that provides information and analysis to the energy sector. More information is available at http://info.drillinginfo.com.

[66] EPA proposed that certain fugitive emissions monitoring-related permits in Texas would be considered equivalent, but not all types of permits. At proposal, EPA did not have quantitative information on the share of Texas permits that, as proposed, would be considered equivalent. Information received during the public comment period for this action provides EPA with a basis to perform quantitative analysis for Texas facilities in this RIA. EPA also received additional information of the share of facilities in Ohio that whose fugitive emissions monitoring-related emissions requirements would be considered equivalent to NSPS OOOOa requirements.

much as the NSPS requirements, as Wyoming has facility-specific permit requirements, so requirements are not uniform across the entire state.[67]

- **Fugitive Emissions Monitoring Requirements**: Since the promulgation of the 2016 NSPS OOOOa, the EPA finalized a package amending fugitive emissions monitoring requirements for NSPS-affected oil and natural gas well sites on the Alaska North Slope. The updated baseline used in this RIA accounts for the impacts of the Amendments package, which reduced the frequency of fugitive emissions monitoring requirements for NSPS-affected well sites on the Alaska North Slope from semiannual to annual.
- **Professional Engineer Certification**: The 2016 NSPS OOOOa requires that claims of technical infeasibility for pneumatic pump control requirements and requires the design and operation of CVS be certified by a professional engineer. The cost of this certification requirement was not quantified in the 2016 NSPS RIA. In this analysis, the baseline includes the cost of complying with the professional engineer certification requirement.
- **Social Cost of Methane:** In the 2016 NSPS OOOOa, the EPA used an estimate of the global social cost of methane to monetize the climate related benefits associated with reductions in methane emissions. Since the promulgation of the 2016 NSPS OOOOa, Executive Order (E.O.) 13783 has been signed, which directs agencies to ensure that estimates of the social cost of greenhouse gases used in economic analyses are consistent with the guidance contained in the Office of Management and Budget (OMB) Circular A-4, "including with respect to the consideration of domestic versus international impacts and the consideration of appropriate discount rates" (E.O. 13783, Section 5(c)). Thus, for this reconsideration, we use an interim estimate of the domestic social cost of methane to quantify the forgone climate benefits resulting from the increase in methane emissions due to this final action.
- **Model Plants:** The EPA uses model plants to estimate emissions from well sites and emission reductions due to the fugitive emissions monitoring requirements. Some assumptions used for the model plants have been updated since the 2016 NSPS. The update includes the addition of fugitive emissions components, namely storage vessels. By adding storage vessels to the model plant, the estimates of baseline emissions from well sites are larger, and the reductions attributed to monitoring and repair requirements are larger than those based on the model plants used in the 2016 NSPS RIA.[68]
- **Other**: In the 2016 NSPS OOOOa, impacts were presented in 2012 dollars. In this RIA and the RIA for the proposal of the Technical Reconsideration, impacts are presented in

[67] For information on additional states that were examined and why they are not considered equivalent, see the TSD and the memo "Equivalency of State Fugitive Emissions Programs for Well Sites and Compressor Stations to Standards at 40 CFR Part 60, Subpart OOOOa", both of which are available in the docket.

[68] For more information on the model plants, see the TSD. The number and type of fugitive emissions components located at well sites and compressor stations can consist of a large variety of combinations of process equipment and other components. Model plants were developed be varying the number and types of components and other equipment based on data available to the EPA, including the DrillingInfo database, the 1996 EPA/GRI Study, the EPA's GHG Inventory for 2017, the EPA's GHG Mandatory Reporting Rule (40 CFR part 98, subpart W), and information received in public comments. The number and types of components are associated with emissions factors to estimate uncontrolled emissions for the model plants.

2016 dollars.[69] In the 2016 NSPS RIA, we presented regulatory impacts for the snapshot years of 2020 and 2025. For this analysis, we estimate cost reductions and emissions impacts resulting from changes in compliance activities projected to occur in each year from 2021 through 2030 due to this final action.[70] Impacts are discounted to 2020. We present the PV and equivalent annualized value (EAV) of impacts from this Technical Reconsideration over the analysis period.[71]

3.1.1.1 Updated Baseline for the Technical Reconsideration

Table 3-1 below shows the projected number of NSPS-affected sources, methane emission reductions, VOC emission reductions, and the total annualized compliance costs, including the value of product recovery, in 2021 and 2025 for the 2016 NSPS OOOOa fugitive emissions monitoring requirements for sources in the production and processing segment as estimated in the 2016 NSPS RIA, and under the updated baseline used in this RIA (elsewhere in this document simply referred to as "the baseline"). We compare the different baseline projections for years 2021 and 2025 because those are the earliest and latest years in which the 2016 NSPS RIA analysis horizon and the Technical Reconsideration analysis horizon overlap. We exclude the impacts of other provisions in the 2016 NSPS OOOOa in order to highlight the differences in the estimated impacts of the fugitive emissions monitoring requirements between the 2016 RIA baseline and the updated baseline used in this final RIA. Also, to be consistent with the presentation of impacts in the 2016 RIA, the updated baseline estimates in Table 3-1 exclude the compliance costs associated with the professional engineer certification requirement.

[69] Costs were adjusted to 2016 dollars using the seasonally adjusted annual Gross Domestic Product: Implicit Price Deflator released by the Federal Reserve on January 26, 2018.

[70] In this analysis, the DrillingInfo base year was updated from 2012 to 2014. Therefore, the source projection estimates are based on reconsideration-impacted facilities established starting in 2014 and continuing through 2030.

[71] The Technical Reconsideration proposal RIA discounted the PV of impacts to 2016. In this RIA, we discount the PV to 2020 to improve interpretability.

Table 3-1 Estimated Compliance Costs and Emission Reductions of the 2016 NSPS OOOOa Fugitive Emissions Monitoring Requirements in the Production and Processing Segment: 2016 NSPS RIA and Updated Baseline Comparison

	2016 NSPS RIA		Updated Baseline	
	2021	2025	2021	2025
Counts of NSPS-Affected Fugitive Emissions Monitoring Sources[1]	130,000	210,000	62,000	110,000
Methane Emission Reductions (short tons)	230,000	370,000	100,000	170,000
VOC Emission Reductions (tons)	64,000	100,000	29,000	47,000
Total Annualized Compliance Cost, without Product Recovery (7%, millions 2016$)[2]	$330	$530	$150	$260
Total Annualized Compliance Cost, with Product Recovery (7%, millions 2016$)[2]	$280	$440	$140	$230

[1] The difference in the number of sources is due to updated source count projections based on the GHGI and compliance reports.
[2] Excluding compliance cost of professional engineer certification, as well as other provisions in the 2016 NSPS OOOOa unrelated to fugitive emissions monitoring requirements.

The difference in the estimates stems from a couple of factors. First, the updated baseline includes the Amendments package change to the frequency of fugitive emissions monitoring requirements for well sites on the Alaska North Slope, as explained above. Second, the assumptions used for the updated baseline have been updated from the 2016 NSPS RIA as explained above (*e.g.*, the facility-count and natural gas price projections, state and local regulations, and model plant characteristics). Moreover, the costs associated with the 2016 NSPS OOOOa in Table 3-1 do not match the compliance cost estimates for the fugitive emissions monitoring requirements presented in the 2016 NSPS RIA. This is because costs in the 2016 NSPS RIA were in 2012 dollars, and they have been updated to 2016 dollars in this RIA.

3.1.2 Summary of Changes Based on Information Received During Comment Period

The following list summarizes the changes in this RIA made based on information received during the public comment period for the proposed Technical Reconsideration:

- **Extended final year of analysis from 2025 to 2030:** The RIA for the proposal evaluated impacts from 2019 to 2025. In response to comments, we extend the analysis period in this RIA to 2030. Since this action is being finalized in 2020, we present impacts from 2021 to 2030, as 2021 is expected to be the first year the rule is implemented.
- **Projection of wells sites transitioning to low production status:** In the final rule, the EPA is allowing an option for well site owners or operators to determine when the total production for the well site falls to 15 barrels of oil equivalent (boe) per day or lower, calculated as a rolling 12-month average. If the well site was previously subject to the

fugitive emissions monitoring requirements and total well site production falls to or below this threshold, then the owner or operator has the option to stop monitoring and instead maintain total well site production below this threshold. In order to estimate the impacts of this provision, we model the transition of a well site to low production using historical well information. More detail on this is presented in Section 3.2.3.

- **Streamlined recordkeeping and reporting requirements:** This final rule amends recordkeeping and reporting requirements for well completions and fugitive emissions for well sites and compressor stations. For well completions, the number of data fields required to be recorded and reported have been reduced. For fugitive emissions, this rule includes several changes intended to streamline recordkeeping and reporting, including replacing the sitemap and observation path requirement with other procedures that ensure that all components are monitored during each survey.[72] Based on public comments received, we revised our estimates of recordkeeping and reporting costs associated with the fugitive emissions requirements, as well as our estimates of the cost burden associated with developing and updating the sitemap and observation path.

  We do not expect the changes to recordkeeping and reporting requirements to affect emissions. For some line items, requirements were determined to be redundant. For the site map and observation path, flexibility is now available for sources to use other methods of compliance with the primary objective, which is that all components are monitored during a survey. Details on the costs of recordkeeping and reporting requirements for fugitive emissions can be found in Section V.B of the preamble.

- **Alternative fugitive emissions standards for sites located in certain states:** The final rule includes alternative fugitive emissions standards for well sites and compressor stations located in specific states based on the EPA's review of those state programs and our conclusion that they are equivalent to the fugitive emissions requirements in NSPS OOOOa. These states are California, Colorado, Ohio, Pennsylvania, Texas, and Utah.[73] Alternative fugitive emissions standards may be adopted in lieu of the NSPS fugitive emissions monitoring and repair requirements at individual well sites or compressor stations that are regulated under these state programs. A well site or compressor station regulated under an alternative fugitive emissions standards could comply with state standards for monitoring, repair, recordkeeping, and reporting in lieu of the requirements for those activities in the NSPS provided they still follow the monitoring plan requirements and monitor all fugitive emissions components as defined in the NSPS.

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[72] See Section IV.I of the preamble for a comprehensive summary of changes to recordkeeping and reporting requirements.

[73] We determined that all well sites and compressor stations in four states (California, Colorado, Pennsylvania, and Utah) were subject to state requirements at least as effective as the NSPS OOOOa at reducing emissions. As noted above, at proposal, the EPA did not have quantitative information on the share of Texas permits that, as proposed, would be considered equivalent. Information received during the public comment period for this action provided EPA with a basis to perform quantitative analysis for Texas facilities in this RIA. EPA also received additional information of the share of facilities in Ohio whose fugitive emissions monitoring requirements would be considered equivalent to NSPS OOOOa requirements. Based on analysis received in public comment, we assume that 5.5 percent of sites in Texas and 80 percent of sites in Ohio would qualify for an alternative fugitive emissions standard. All sources in the remaining states listed are assumed to need to comply with the fugitive emissions monitoring requirements in NSPS OOOOa.

The compliance cost reductions associated with this flexibility for the states above were not quantified in the RIA for the proposal of this reconsideration. Based on public comments and a review of the final provisions in this rule, we estimated compliance cost reductions for otherwise NSPS-affected sources in the states listed above assuming they will have reduced annual costs associated with reporting and recordkeeping. The cost reductions associated with the alternative fugitive emissions standards flexibility are not applied retroactively since we assume that the recordkeeping and reporting costs associated with NSPS OOOOa compliance to date have already been incurred.

- **Engineering certifications for closed vent systems:** The final rule includes changes from the proposal in the assumptions for the costs and number of certifications required for closed vent systems. Based on information received in public comments, we revised the labor costs assumed for both professional and in-house engineers upward. Commenters noted that the EPA had underestimated the time required to certify closed vent systems and the had not accounted for the costs associated with obtaining expertise from a third-party service with region and location-specific knowledge. In addition, based on our review of compliance reports, the projected number of facilities requiring certifications decreased compared to the RIA for the proposal.

3.1.3 Regulatory Options

The universe of reconsideration-impacted sources includes sources considered new or modified starting in 2021, as well as sources that were affected by the 2016 NSPS OOOOa before 2021 which are expected to change compliance activity due to this Technical Reconsideration. As we assume that engineer certifications only happen once, the only sources affected by the final changes to the certification requirements are those that are affected starting in 2021, the year this rule is expected to take effect.

We also examine two more stringent alternative regulatory options that were not finalized. The universe of reconsideration-impacted sources may change under the different options. Table 3-2 shows the emissions points and regulatory requirements for affected sources under the 2016 NSPS OOOOa, the updated baseline, and the three options analyzed in this RIA.
The 2016 NSPS OOOOa requires semiannual (twice per year) fugitive emissions surveys and repairs to be performed at NSPS-affected well sites, and quarterly surveys at gathering and boosting compressor stations.[74] Further, as previously stated, the 2016 NSPS OOOOa requires

[74] The 2016 NSPS OOOOa requires quarterly monitoring at all NSPS-affected compressor stations (*i.e.,* gathering and boosting, transmission, and storage compressor stations). For purposes of this analysis, the baseline used reflects the removal of requirements for transmission and storage compressor stations, therefore, this analysis is limited to gathering and boosting compressor stations.

professional engineer certifications of closed vent systems and for any claim that it is technically infeasible to control pneumatic pump emissions.

Table 3-2 Emissions Sources and Controls Evaluated by Regulatory Alternative

Emissions Point	2016 NSPS OOOOa	Updated Baseline	Option 1	Option 2	Option 3 (Finalized)
Fugitive Emissions Monitoring					
Natural Gas and Oil Well Sites	Semiannual	Semiannual	Semiannual-streamlined	Semiannual-streamlined	Semiannual - streamlined
Natural Gas and Oil Well Sites – Low Production	Semiannual	Semiannual	Semiannual-streamlined	No Monitoring	No Monitoring
Compressor Stations in Gathering and Boosting	Quarterly	Quarterly	Quarterly-streamlined	Quarterly-streamlined	Semiannual-streamlined
The Alaska North Slope					
Natural Gas and Oil Well Sites (Alaska North Slope)	Semiannual	Annual	Annual-streamlined	Annual-streamlined	Annual-streamlined
Natural Gas and Oil Well Sites (Alaska North Slope) – Low Production	Semiannual	Annual	Annual-streamlined	No Monitoring	No Monitoring
Compressor Stations in Gathering and Boosting (Alaska North Slope)[1]	Quarterly	Quarterly	Annual-streamlined	Annual-streamlined	Annual-streamlined
Alternative Means of Emission Limitation	None	None	Operations in Six States	Operations in Six States	Operations in Six States
Certifications					
Closed Vent Systems on Pneumatic Pumps, Reciprocating Compressors, Centrifugal Compressors, and Storage Vessels; and Pneumatic Pump Technical Infeasibility	Professional Engineer	Professional Engineer	In-House Engineer	In-House Engineer	In-House Engineer

[1] We do not currently have data to estimate the effects of this final action for gathering and boosting stations on the Alaska North Slope. All other provisions presented in this table are analyzed in this RIA.

The baseline reflects finalized NSPS OOOOa requirements as of 2020, including that fugitive emissions survey and repair programs are now required to be performed annually at NSPS-affected well sites in the Alaska North Slope due to the Amendments package, semiannually at all other NSPS-affected well sites, and quarterly at gathering and boosting stations. Professional engineer certifications are required for closed vent systems and pneumatic pumps in the baseline.

Option 1 (not selected for promulgation): Option 1 is the most stringent alternative assessed in this RIA. Option 1 retains annual monitoring and repair frequency for affected well sites on the

Alaska North Slope and reduces the monitoring frequency for affected compressor stations on the Alaska North Slope. The semiannual survey and repair requirements are retained for all other NSPS-affected well sites. Quarterly monitoring is retained at all other NSPS-affected gathering and boosting compressor stations. Under this option, recording and recordkeeping requirements at all NSPS-affected sources subject to fugitive emissions monitoring requirements are streamlined. The certification requirement for closed vent systems and pneumatic pump technical infeasibility is changed to allow companies the option of using an in-house engineer as opposed to a professional engineer.[75] Also, fugitive emissions monitoring programs in six states are certified as alternatives, which reduces reporting and recordkeeping burden but does not affect emissions. In aggregate, unselected Option 1 would likely reduce regulatory compliance costs while having no quantifiable impacts on the emissions reductions projected for the 2016 rule.[76]

Option 2 (not selected for promulgation): This option is less stringent than Option 1. Under the option, monitoring frequencies are semiannual for well sites, excluding well sites with total combined oil and natural gas production at or below 15 boe per day (*i.e.*, “low production well sites”), quarterly for gathering and boosting compressor stations, and annual for well sites and compressor stations located on the Alaska North Slope. The option rule excludes fugitive emissions monitoring for low production well sites. Instead, low production well sites are required to maintain total well site production at or below 15 boe per day and maintain records. Additionally, the option allows fugitive monitoring to stop when all major production and processing equipment is removed from a well site such that it becomes a wellhead-only well site; however, the EPA does not have information on the potential number of sites this provision applies to and, as a result, cannot estimate the associated regulatory impacts. Reporting and recordkeeping requirements at all NSPS-affected sources subject to fugitive emissions monitoring requirements are streamlined. The certification requirement for closed vent systems and pneumatic pump technical infeasibility is changed to allow companies the option of using an

[75] Emissions should not be affected by this change in certification requirements to the extent that the use of an in-house engineer does not result in any change in the closed vent systems being certified or the number of technical infeasibility determinations for pneumatic pumps. We are not able to estimate the potential, if any, for such technical changes from allowing in-house engineer certifications.

[76] Reducing monitoring frequency for affected compressor stations on the Alaska North Slope results in reduced regulatory burden related to the reduced monitoring frequency. However, as EPA does not currently have the data to estimate the effects of the final action pertaining to compressor stations on the Alaska North Slope, this RIA does not present quantitative estimates of reduced regulatory compliance costs or potential emissions increases associated with these changes for compressor stations on the Alaska North Slope.

in-house engineer as opposed to a professional engineer. Also, fugitive emissions monitoring programs in six states are certified as alternatives, reducing reporting and recordkeeping burden for some sources.

Option 3 (finalized): Option 3 the least stringent option analyzed in this RIA. The finalized Option 3 is the same as Option 2 except for the monitoring frequency at gathering and boosting compressor stations is reduced to semiannual. This results in higher cost reductions relative to the baseline and increased forgone emissions reductions.

In addition to the requirements listed in Table 3-2, the 2016 NSPS OOOOa contains well completion requirements for a subset of newly completed oil wells that are hydraulically fractured or refractured. The 2016 NSPS OOOOa also requires reductions from centrifugal compressors, reciprocating compressors, pneumatic controllers, storage vessels, equipment leaks at natural gas processing plants, and sweetening units throughout the crude oil and natural gas production source category. These requirements are not analyzed in this RIA because they are not affected by this Technical Reconsideration, and thus the compliance cost and emissions impacts from these 2016 requirements are not altered due to this reconsideration.

3.1.4 Technical Reconsideration: Summary of Key Results

A summary of the key results is shown below. All estimates are in 2016 dollars. Also, all compliance costs, emissions changes, and benefits are estimated relative to a baseline that includes the Policy Review. We estimate that the Technical Reconsideration will potentially affect up to approximately 537 firms.[77]

- **Emissions Analysis:** The Technical Reconsideration is projected to result in forgone methane emission reductions of 19,000 short tons in 2021 and 75,000 short tons in 2030 and a total of 450,000 short tons from 2021 to 2030. Forgone VOC emission reductions are projected to be 5,200 short tons in 2021 and 21,000 short tons in 2030 and a total of 120,000 short tons from 2021 to 2030. Forgone HAP emissions are projected to be 200

[77] We estimate the number of firms potentially affected firms using information in the Information Collection Request (ICR) Supporting Statement associated with this rulemaking. Before promulgating the Policy Review, the EPA estimates that up to 575 firms would be subject to NSPS OOOOa during the 3-year period covered by the ICR (Table 1d of the Supporting Statement). We then estimate that up to 537 respondents per year will be subject to NSPS OOOOa during the 3-year period covered by the ICR (Section 6(d) of the Supporting Statement). The estimate of 537 firms potentially affected by the technical reconsideration should be viewed as an upper bound as some firms affected by NSPS OOOOa may be subject to requirements that are unchanged by this action.

short tons in 2021 and 790 short tons in 2030 and a total of 4,700 short tons from 2021 to 2030.

- **Benefits Analysis:** The Technical Reconsideration is projected to result in forgone climate, health, and welfare benefits. The PV of the domestic forgone climate benefits, using an interim estimate of the domestic social cost of methane (SC-CH_4) and discounting at a 7 percent rate is $19 million from 2021 to 2030. The EAV is estimated to be $2.5 million per year. Using the interim SC-CH_4 estimate based on the 3 percent rate, the PV of forgone domestic climate benefits is estimated to be $71 million; the EAV is estimated to be $8.1 million per year. The EPA expects that forgone VOC emission reductions will negatively affect air quality and likely affect health and welfare adversely due to impacts on ozone, $PM_{2.5}$, and HAP, but we are unable to quantify these effects at this time. This omission does not imply that these forgone benefits do not exist.
- **Compliance Cost Analysis:** The Technical Reconsideration is projected to result in compliance cost reductions. The PV of the compliance cost reductions associated with this final rule over the 2021 to 2030 period is estimated to be $800 million (2016$) using a 7 percent discount rate and $1 billion using a 3 percent discount rate. The EAV of these cost reductions is estimated to be $110 million per year using a 7 percent discount rate and $110 million per year using a 3 percent discount rate. These estimates do not include the forgone producer revenues associated with a decrease in the recovery of saleable natural gas due to this final action, as some of the compliance actions required in the baseline would likely have captured saleable product that would have otherwise been emitted. Using the 2020 Annual Energy Outlook (AEO) projection of natural gas prices to estimate the value of the change in the recovered gas at the wellhead expected to result from this action, the EPA estimated a PV of regulatory compliance cost reductions of the final rule over the 2021 to 2030 period of $750 million using a 7 percent discount rate and $950 million using a 3 percent discount rate. The corresponding estimates of the EAV of cost reductions after accounting for forgone product recovery revenues are $100 million per year using a 7 percent discount rate and $110 million per year using a 3 percent discount rate.
- **Energy Markets Impacts Analysis:** The 2016 NSPS RIA estimated small (less than 1 percent) impacts on energy production and markets. The EPA expects that the deregulatory Technical Reconsideration will reduce energy market impacts of the NSPS.
- **Distributional Impacts:** The cost reductions and any forgone benefits likely to arise from the Technical Reconsideration are not expected to be distributed uniformly across the population, and may not accrue equally to the same individuals, firms, or communities impacted by the 2016 rule. The EPA did not conduct a quantitative assessment of the distributional impacts of the final Technical Reconsideration, but we provide a qualitative discussion of the distributional aspects of the cost reductions and the forgone health benefits.
- **Small Entity Impacts Analysis:** The EPA expects this final deregulatory action to reduce the small entity impacts estimated in the RIA for the 2016 NSPS OOOOa. We therefore find that this final action will relieve regulatory burden for small entities affected by this final action and thus will not have a Significant Impact on a Substantial Number of Small Entities (SISNOSE).
- **Employment Impacts Analysis:** The EPA expects reductions in labor associated with compliance-related activities due to this action. The EPA estimated the labor impacts due

to the forgone installation, operation, and maintenance of control equipment and control activities, as well as the reductions in labor associated with reduced reporting and recordkeeping requirements. The EPA estimated one-time and continual, annual labor requirements by estimating hours of labor required for compliance and converting this to full-time equivalents (FTEs) by dividing by 2,080 (40 hours per week multiplied by 52 weeks). The reduction in one-time labor needed to comply with the NSPS due to this action is estimated to be about 42 FTEs in 2021 and 91 FTEs in 2030. The reduction in annual labor needed to comply with the NSPS due to this action is estimated at about 490 FTEs in 2021 and 1,300 FTEs in 2030. The EPA notes that this type of FTE-estimate cannot be used to identify the specific number of employees involved or whether new jobs are created for employees who potentially lose their jobs, versus displacing jobs from other sectors of the economy.

3.1.5 Organization of the Technical Reconsideration RIA

Section 3.2 describes the estimated compliance cost reductions and forgone emissions reductions from the Technical Reconsideration, including the PV of the projected cost reductions over the 2021 to 2030 period and the associated EAV. Section 3.3 describes the projected forgone benefits resulting from this rule, including the PV and EAV over the 2021 to 2030 period. Section 3.4 describes the economic impacts expected from this action. Section 3.5 compares the projected forgone benefits and compliance cost reductions of this action, including a summary of the net benefits.

3.2 Compliance Cost Reductions and Forgone Emissions Reductions

This section describes the emissions and compliance cost analysis for the final Technical Reconsideration of the 2016 NSPS OOOOa. Projected incremental changes in emissions and compliance costs resulting from this reconsideration are estimated relative to the baseline, which is representative of more up-to-date data and projections and current policy. The baseline also includes the impacts of the final Policy Review, discussed in Chapter 2. Updates to the data and analytic approach from the 2016 NSPS RIA are described in Section 3.1.1. A detailed discussion of the updates since the 2016 NSPS RIA to the methodology, data, and assumptions used to estimate the compliance cost impacts of this reconsideration can be found in the TSD.[78] The methodology, data, and assumptions that are not mentioned are the same as those in the 2016 NSPS RIA and can be found in the 2016 NSPS Final TSD for that action.[79]

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[78] The TSD for this final reconsideration can be found in Docket ID No. EPA-HQ-OAR-2017-0483.
[79] Docket ID No. EPA-HQ-OAR-2010-0505-7631.

There are two main steps in the compliance cost analysis. First, representative facilities (also referred to as model plants) are established for each affected source category.[80] The characteristics of the facilities include equipment inventories, operating characteristics, and representative factors including baseline emissions and the compliance costs, emissions reductions, and product recovery resulting from each compliance measure. Second, we project the number of NSPS-affected facilities in each source category for each type of equipment, and then estimate the number of reconsideration-impacted sources. The change in emissions and compliance costs are calculated by multiplying representative factors from the first step by the number of reconsideration-impacted facilities estimated in the second step for each projection year. In addition to emissions reductions, some aspects of the regulatory options may result in natural gas recovery, which can then be combusted by the sources for production purposes or sold. The compliance cost impacts include the change in estimated revenue from product recovery, where applicable.

Throughout this section, we present the projected effects of the final Technical Reconsideration on compliance costs and emissions from 2021 through 2030, under the assumption that 2021 is the first year the reconsidered requirements will take effect. Comparing the 2016 NSPS RIA results to this analysis should be done with caution. The baseline of affected sources has been updated in this analysis, as explained in Section 3.1.1.1, and results in this RIA are presented in 2016 dollars, while the 2016 NSPS RIA results are in 2012 dollars.

3.2.1 Pollution Controls and Emissions Points Assessed

The RIA in this chapter estimates impacts associated with the reconsidered requirements for fugitive emissions monitoring and certifications of closed vent system design. In addition, the EPA changed requirements related to pneumatic pumps and oil well completions and provided additional technical corrections and clarifications; however, this RIA does not quantify any changes in emissions or costs resulting from these changes. This section provides a basic

[80] See Section 2 of the TSD accompanying this final action for more detail on how model plants were developed. As described in Section 2.3.1 of this TSD, model plants were developed to represent equipment and component counts at the different site types. These model plants allow for consideration of costs and emission reduction impacts. While actual sites may be larger than the models, focus was placed on small sites since that is where the impacts are most likely to be more burdensome. Where impacts are reasonable, we can be certain that they will also be reasonable for larger sites.

description of the emissions sources and control requirements affected by the Technical Reconsideration and indicates which aspects of the final reconsideration we quantify impacts for in this RIA. For more detailed information on the requirements that were reconsidered, see the preamble. For information on the emission sources and control measures evaluated for the 2016 NSPS OOOOa, see the 2016 NSPS RIA.

Fugitive Emissions Monitoring Requirements: Fugitive emissions occur when connection points on equipment are not fitted properly or when seals and gaskets start to deteriorate. Pressure, changes in pressure, or mechanical stresses can also cause components or equipment to leak. Potential sources of fugitive emissions include valves, connectors, pressure relief devices, open-ended lines, flanges, closed vent systems, and thief hatches or other openings on a controlled storage vessel. For purposes of this rulemaking, fugitive emissions points do not include devices that vent as part of normal operations. In the 2016 NSPS RIA, the EPA estimated compliance costs and emission reductions assuming the use of a leak monitoring program where optical gas imaging (OGI) leak detection was combined with leak correction. In addition, the 2016 RIA considered the following alternative frequencies for fugitive emissions survey requirements: annual, semiannual, and quarterly. This RIA estimates the impacts from reducing fugitive emissions monitoring frequency from the frequency required in the 2016 NSPS OOOOa for some NSPS-affected oil and natural gas facilities. The EPA is also making changes to allow several fugitive emissions monitoring state programs to be considered equivalent to NSPS OOOOa in terms of emissions reductions, which will lead to reductions in the NSPS reporting and recordkeeping burden for some sources regulated under some of the designated state programs.

Professional Engineer Certifications: Closed vent systems can be used to route emissions from various equipment at oil and natural gas facilities, including storage vessels, compressors, and pneumatic pumps, to control devices. Closed vent systems must be designed and tailored to individual facilities' equipment configuration and process factors, such as flow rates. For the 2016 NSPS OOOOa, the EPA required closed vent systems be certified by a professional engineer. In addition, the 2016 NSPS OOOOa requires that facilities citing compliance issues due to technical infeasibility in routing emissions from well site pneumatic pumps to an existing control device must have a professional engineer certify said technical infeasibility. The compliance cost impact of the professional engineer certification requirements was not evaluated in the 2016 NSPS RIA. For this analysis, the EPA evaluated the cost impacts of the certification requirements in the 2016 NSPS in order to determine the impact of the reconsidered provision that allows facilities to choose either a professional engineer or an in-house engineer to perform the required certification for technical infeasibility.

Additional Reconsideration Topics Not Quantified in this RIA: The preamble and regulatory text for this final Technical Reconsideration action contain several finalized provisions for which we do not quantify impacts in this RIA. These include, but are not limited to the following:

Pneumatic Pumps: The EPA is finalizing changes in the circumstances for which it may be infeasible to control emissions from well site pneumatic pumps by removing the distinctions between greenfield and non-greenfield sites. These changes are intended to better distinguish the circumstances where pneumatic pump controls may be infeasible. This provision is not expected to result in changes in emissions.

Well Completions: The EPA is finalizing changes and adding clarifications related to the location of separators during flowback operations, recordkeeping requirements for reduced emission completions, and the definition of flowback (*e.g.*, to exclude screenouts, coil tubing cleanouts, and plug drill out processes). Some of these changes could reduce compliance costs (*e.g.*, by decreasing recordkeeping burden) or result in higher emissions relative to the baseline, but the EPA does not have the necessary data and information to quantify these potential impacts.

Fugitive Emissions Monitoring: The EPA is finalizing changes to several definitions used in the fugitive emissions monitoring provisions in NSPS OOOOa, including the definitions for modification, third party equipment, and underground disposal wells. The EPA is also finalizing changes to the repair requirements for fugitive emissions components. Some changes may result in cost reductions (*e.g.*, the exemption of monitoring requirements for third-party equipment and disposal wells), and may result in increased emissions (*e.g.*, by exempting a small number of fugitive components downstream of the custody meter from monitoring requirements), but the EPA does not have the ability to quantify these potential changes due to unavailability of necessary information and data (*e.g.*, counts for the relevant equipment and components).

Gas Processing Plants: The EPA is finalizing an exemption of Leak Detection and Repair (LDAR) requirements for equipment at gas processing plants which is used in VOC service for less than 300 hours per year and only during emergencies, as backup, or during startup and shutdown. This exemption may reduce compliance costs related to monitoring such equipment. This reduces burden related to the scheduling of monitoring when the equipment is in VOC service, however, any potential leaks from the equipment would be addressed once it is no longer in VOC service and monitoring is reinstated. The EPA does not have the data on the use of VOC service equipment needed to quantify potential impacts on costs and emissions from this LDAR exemption, however, any potential impacts are expected to be small based on the EPA's current understanding of the use of this type of equipment at gas processing plants.

Storage Vessels: The EPA is amending applicability criteria for NSPS-affected storage vessels. The final reconsideration clarifies how VOC emissions potential should be calculated for individual storage vessels and establishes criteria for calculating VOC emissions potential specifically from individual storage vessels that are part of a controlled tank battery. For controlled tank battery storage vessels (*i.e.*, two or more storage vessels joined with piping and sharing vapors in their headspaces, with emissions routed through a closed vent system to a control device or process with a VOC emissions control efficiency of at least 95.0 percent) subject to a legally and practicably enforceable limit, VOC emissions may be determined as an average of emissions per individual storage vessel for the entire tank battery. When VOC emissions for an individual storage vessel are greater than 6 tons per year, the storage vessel is affected by the applicable NSPS requirements. If average VOC emissions per storage vessel in a controlled tank battery are greater than 6 tons per year, each of the battery's storage vessels meet the criteria for being regulated under NSPS OOOOa.

3.2.2 Source-level Compliance Cost Reductions and Emission Increases

This RIA quantifies the compliance cost and emissions impacts of the changes to requirements affecting fugitive emissions monitoring, technical infeasibility certifications, and closed vent systems in the finalized Technical Reconsideration. Volume 1 of the TSD contains the facility-level compliance costs and emission reductions from the reconsidered fugitive emission requirements for each model plant. For this reconsideration, the TSD and RIA rely on a larger set of model plants to analyze impacts on oil and natural gas well sites than was used for the 2016 NSPS OOOOa RIA. The 2016 analysis used three model plants representing oil, oil with associated gas, or natural gas well sites, while impacts in this analysis are estimated for six model plants: non-low production natural gas well sites, non-low production oil-only well sites, non-low production oil with associated gas well sites, low-production natural gas well sites, low-production oil-only well sites, and low-production oil with associated gas well sites.

The refinements to the model plants used in this RIA are intended to better reflect the heterogeneity among well sites in the oil and natural gas sector. The production level distinction is important because the applicability of certain requirements in the final NSPS reconsideration depend on site production level. Additionally, the source-level impacts of parts of NSPS OOOOa are likely dependent on site production level (*e.g.*, compared to low-production natural gas well sites, non-low production natural gas well sites would be expected to experience greater forgone revenues associated with lower product recovery due to the monitoring frequency adjustments in this final rule).

The potential facility-level cost reductions and forgone emissions reductions estimated for the alternative regulatory options were calculated by subtracting the estimated NSPS-related compliance costs and emissions for the model plants under the alternative options for the Technical Reconsideration from the estimated NSPS-related compliance costs and emissions for the model plants under the baseline. For greater detail on the compliance cost estimates, including the estimates related to the individual aspects of NSPS OOOOa affected by this Technical Reconsideration, see Volume 1 of the TSD.

We have also re-evaluated our assumptions regarding equivalent state programs for fugitives that qualify as alternative standards. In the proposal analysis, if a well site was in a state determined to have fugitive emissions requirements for well sites effectively equivalent to those of NSPS OOOOa, even if not located in a state formally identified as equivalent, we assumed the proposed rule would reduce the NSPS fugitive emissions monitoring requirements. Thus, it was assumed the proposal would reduce the compliance costs associated with fugitive monitoring requirements in NSPS OOOOa for those sites, including the recordkeeping and reporting costs. In this analysis, we refined the assumptions used to quantify those costs to better reflect the impacts of state programs on fugitive monitoring and whether an alternative fugitive emissions standard could be applied in certain states, which should improve our estimates of the recordkeeping and recording burden reduced by this rule. In this RIA, we limit the cost reductions of the fugitive monitoring recordkeeping and reporting to certain well sites located in the states recognized in the rule as having fugitive emissions requirements that can qualify as an alternative fugitive emissions standard.

The operators with well sites that qualify under an alternative fugitive emissions standard instead of the NSPS OOOOa requirements for fugitive monitoring benefit from reduced recordkeeping and reporting burden. Specifically, for well sites under an alternative fugitive emissions standard, we assume operators save $323 per year per site in reduced recordkeeping and data management costs (e.g., data QA/QC, tracking repairs, and database management fees as reported by commenters) and $184 per year per site on annual reporting costs (equivalent to three labor hours spent preparing an annual report and storing/filing records), resulting in a total yearly cost reduction of $507 per site. Because many firms operate in multiple states, and sources in only some states qualify under an alternative fugitive emissions standard, we continue to assume that operators with sites in non-alternative fugitive emissions standard states will continue to incur reporting and recordkeeping costs related to reading the rule, developing a fugitive emissions monitoring plan, and establishing and maintaining a database.
The costs of the professional engineer certification requirement were not included in the analysis of the 2016 rule. This analysis updates baseline cost estimates to include professional engineer certification costs, and the relative reduction in costs from the reconsidered provision which allows certifications to be done by in-house engineers. The cost of a professional engineer certification is estimated at $4,500, and the cost of the same certification performed by an in-house engineer is estimated at $2,950. Therefore, the cost reduced by this provision of the reconsideration is an estimated $1,550 per certification.[81]

[81] At proposal, the EPA estimated the costs of these certifications to be $358 for a certification by an in-house engineer and $547 for a certification by a professional engineer. Commenters contended that EPA’s cost estimates at proposal were underestimated because the costs did not account for the need to pay for the expertise of an external third-party with region and location-specific knowledge, the amount of time required to certify a CVS, or the other costs associated with the certification process. Based on these and other public comments, EPA revised the estimated cost of a certification by an in-house engineer to $2,950 and to $4,500 per certification performed by a professional engineer.

3.2.3 Projection of Affected Facilities

The second step in estimating national costs and emissions impacts of the final Technical Reconsideration is projecting the number of NSPS and reconsideration-impacted facilities. We first update the number of NSPS-affected facilities under the baseline. We then project the number of reconsideration-impacted facilities, which are facilities that would be expected to change their activities as a result of this reconsideration.

We analyze the effects of this final action on compliance costs and emissions compared to the baseline. The baseline includes the costs and emissions of the projected NSPS-affected facilities, after accounting for updated assumptions and data (Section 3.1.1 and 3.1.2). NSPS-affected facilities include facilities that are new or modified since the 2015 NSPS OOOOa proposal and were/are expected to change activities as a result of the 2016 NSPS OOOOa, starting from a baseline without the 2016 NSPS OOOOa. Over time, more facilities are newly established or modified in each year and, to the extent the facilities remain in operation in future years, the share of facilities in the sector and the total number of facilities which are subject to the 2016 NSPS OOOOa increase. This analysis assumes that all new equipment and facilities established from 2015 through 2029 are still in operation in 2030.

The reconsideration-impacted facilities are the subset of the NSPS-affected facilities that are expected to change activities as a result of this reconsideration. These facilities include sources that became affected facilities under the 2016 NSPS OOOOa prior to the effective date of this final action and assumed to still be in operation, as well as those that are projected to become newly affected sources in the future and are expected to change their compliance activities, relative to what they would have been otherwise, as a result of this final action. For the finalized option, these sources include fugitive emissions sources at well sites outside of the Alaska North Slope and compressor stations both outside of and on the Alaska North Slope.[82] For the change to certification requirements, only the projected newly affected sources that require a certification are considered reconsideration-affected in reference to the certification provision. Sources that

[82] We do not quantify any emissions or cost changes associated with new compressor stations on the Alaska North Slope.

have already completed professional engineer certifications are not counted as reconsideration-impacted sources since they will not need to obtain another certification.

The EPA projected the numbers of affected facilities using a combination of historical data from the GHGI, 2016 NSPS OOOOa compliance reports, and DrillingInfo, and projected activity levels taken from AEO2020. Appendix A contains more detailed information on the data sources and methods used to project reconsideration-impacted facilities. The EPA derived typical counts for new gathering and boosting stations by averaging the year-to-year changes in total national station counts in the GHGI.[83] Counts for storage vessels, pneumatic pumps, and reciprocating compressors, which feed into the assumed number of certifications, are based on 2016 NSPS OOOOa compliance reports.[84] New and modified well sites are based on the count of wells in 2014 from DrillingInfo, and projections and growth rates consistent with the drilling activity in the AEO. For this RIA, the projections have been updated from the AEO2015 projections used in the 2016 NSPS RIA to reflect the projection estimates in the AEO2020.[85] The AEO2020 projects that oil and natural gas well drilling will increase from about 29,000 wells in 2021 to about 32,000 wells in 2030. This projection is lower than the AEO2015 projection of about 43,000 wells in 2020 to about 52,000 wells in 2030 used in the 2016 NSPS RIA.

This RIA includes more detail than previous oil and natural gas NSPS analyses as it includes year-by-year results over the 2021 to 2030 analysis period and greater disaggregation of facilities

[83] The estimates for gathering and boosting stations do not include replacement or modification of existing sources, and so the impacts may be under-estimated due to the focus on new sources. Counts of newly constructed gathering and boosting stations are estimated based on averaging the year-to-year changes from 2004 to 2014 in the activity data in the GHGI. In years when the total count of equipment decreased, it was assumed there were no newly constructed units. In the GHGI, the EPA used an estimate of stations per quantity of marketed gas production (as estimated in Marchese et al., 2015) applied to the total quantity of marketed onshore gas production in a given year. For example, in 2016, the GHGI calculated 5,421 gathering stations in the U.S., based on one station per 53,066 scfd of marketed onshore gas production. More detailed information on how EPA derived these estimates are provided in the Appendix A.

[84] Consistent with the Policy Review analysis, we assume there are no centrifugal compressor affected facilities during our analysis horizon. We maintain our assumption from the 2016 NSPS RIA that 10% of reciprocating compressors are routed to closed vent systems and thus require certification. The total count of reciprocating compressors in the production and processing segment is the sum of: 1) the number of reciprocating compressors at gas processing plants according to 2016 NSPS OOOOa compliance reports; and 2) the number of reciprocating compressors at gathering and boosting stations, which is the number of reciprocating compressors at compressor stations according to 2016 NSPS OOOOa compliance reports less the number of reciprocating compressors at compressor stations in the transmission and storage segment as estimated from the 2004 to 2014 GHGI data.

[85] Note that the RIA associated with the proposal of this action used projections of well drilling and natural gas prices from AEO2018.

by vintage and production levels. While it would be preferable to analyze impacts beyond 2030, the EPA has chosen not to largely because of the limited information available to model long-term dynamics in practices and equipment in the oil and natural gas industry. The EPA has limited information on how practices, equipment, and emissions at new facilities evolve as they age and shut down. The current analysis assumes that newly established facilities remain in operation for the entire analysis period, and this assumption would be less realistic for a longer analysis period. In addition, in a dynamic industry like oil and natural gas, technological progress is likely to change control methods to a greater extent over a longer time horizon, creating more uncertainty about impacts of the NSPS.

The 2016 NSPS RIA assumed that the regulatory programs in the states of Colorado, Utah, Ohio, and Wyoming were expected to result in broadly similar overall emission reductions as the 2016 NSPS OOOOa requirements. For this action, the EPA reviewed state regulations and permitting requirements that require mitigation measures for many emission sources in the oil and natural gas sector. Detailed information is included in the TSD and in the memorandum *Equivalency of State Fugitive Emissions Programs for Well Sites and Compressor Stations to Proposed Standards at 40 CFR Part 60, Subpart OOOOa* ("State memo").[86] Resulting from this analysis, California, Pennsylvania, and Texas have been added as states with programs which are expected to achieve similar emission reductions as the 2016 NSPS OOOOa because additional requirements in these states have been finalized since the promulgation of the 2016 NSPS OOOOa. While the program designs in each of the states differ from the 2016 NSPS OOOOa, for this RIA, the current requirements in California, Colorado, Pennsylvania, and Utah are expected to result in similar overall emissions reductions, while a subset of the requirements in Ohio and Texas are expected to achieve similar emissions reductions. Permit by rule-based requirements in Texas are not included as broadly equivalent to the NSPS requirements in this analysis, while general permits (covering roughly 5.5 percent of the relevant facilities) in Texas are considered equivalent.[87] For roughly 80 percent of the relevant facilities in Ohio, emission reductions from state requirements are considered equivalent. The requirements in Wyoming are

[86] For a more detailed explanation of state programs, see the TSD, as well as the memo "Equivalency of State Fugitive Emissions Programs for Well Sites and Compressor Stations to Proposed Standards at 40 CFR Part 60, Subpart OOOOa", located at Docket ID No. EPA-HQ-OAR-2017-0483.

[87] We do not consider the permit by rule in Texas as equivalent for RIA purposes because these are self-certified permits and we are uncertain about the level of compliance for these permits.

no longer considered to be equivalent for purposes of this RIA because they apply facility-specific permit requirements which do not apply across the entire state. For more information on the states that were examined and why they are or are not considered equivalent, see the TSD and the State memo, both of which are available in the docket.

As discussed in Section 3.1, the EPA is amending the inspection frequency requirements for fugitive emissions components at low production well sites. In the final rule a well site is defined as "low production" if the total combined oil and natural gas production for the well site is less than or equal to 15 boe per day. These sites are excluded from fugitive emissions monitoring requirements but are required to maintain the total well site production at or below 15 boe per day and maintain records to demonstrate production levels. For well sites that have previously been determined to be low production and for which operators later take action (*e.g.*, drills a new well, performs a well workover, etc.) to increase production, the site will again face monitoring requirements if total well site production during the first 30 days of production following completion (or other action intended to increase production from the site) exceeds 15 boe per day.

To estimate the impacts of this provision, it was necessary to estimate the number of well sites that would transition to low production status. We use historical data to estimate the share of sites that transition to low production status as a function of well site age using a combination of Drilling Info data and AEO2020 well drilling projections. The transition percentage is an estimate of the proportion of well sites that transition to low production status as a function of the number of years since completion. The transition percentage also accounts for sites that transitioned from low production status to non-low production status.[88] The low production transition analysis is based on a cross-section of producing wells in 2014 (the base year for the RIA analysis). While it would preferable to perform a time-series analysis of well production decline over a longer period, this population was chosen based on readily available data.

We first estimate the percentage of sites that meet the low production threshold during the first 30 days of production using well-level Drilling Info data for wells completed in 2014. In

[88] As a hypothetical example, if 15 percent of wells transitioned into a low production status and 1 percent transitioned from a low production status into a not-low production status within a given year, the transition percentage would equal 14 percent in that year.

accordance with the model plant analysis presented in the preamble and the TSD, we assume sites have two wells per site. Assuming each of the two wells per model site produces identical quantities of oil and natural gas boe, we approximate the proportion of sites that are initially low production in 2014 (the base year used for well site projections in the RIA) by the proportion of wells producing less than 7.5 boe per day (equivalent to two model plant wells producing fewer than 15 boe per day combined). Using this method, we estimate that about 13 percent of sites would be considered low production based upon the first 30 days of production.[89]

We use the well-level Drilling Info data to estimate the proportion of well sites that change production status in subsequent years as a function of age, accounting for potential transitions from low production status to non-low production status. To this end, for all producing wells in 2014, we characterize each well's initial production status (*i.e.*, during the first 30 days of production) and the well's production status in 2014. Specifically, we categorize a well to be in low production status if production was less than 7.5 boe per day on average in all months of 2014. We cross-tabulate the 2014 production status with the initial production status and the completion year field in the Drilling Info data to estimate the proportion of sites (based on the 2 wells per site assumption) in each of the two categories as a function of age. This cross-tabulation yields information that approximates a decline curve as applied to model well sites. We include completion years from 1999 to 2013 to produce transition proportions for well ages from 1 to 15 years. Figure 3-1 shows the proportion of well sites estimated to have low production status for ages 1 to 15 years.

[89] It is important to note that, under the final rule, production levels are evaluated against the low production threshold at the site level, where sites may have more than one well. While there are comprehensive data available on individual wells, there are no national-level datasets that we are aware of that identify the well sites to which individual wells belong. In addition, we did not receive information in the comment period on the rate at which well sites transition between not-low and low production status. The equal production assumption for model two-well site is the best assumption EPA can come up with to approximate the impacts of the finalized regulatory option.

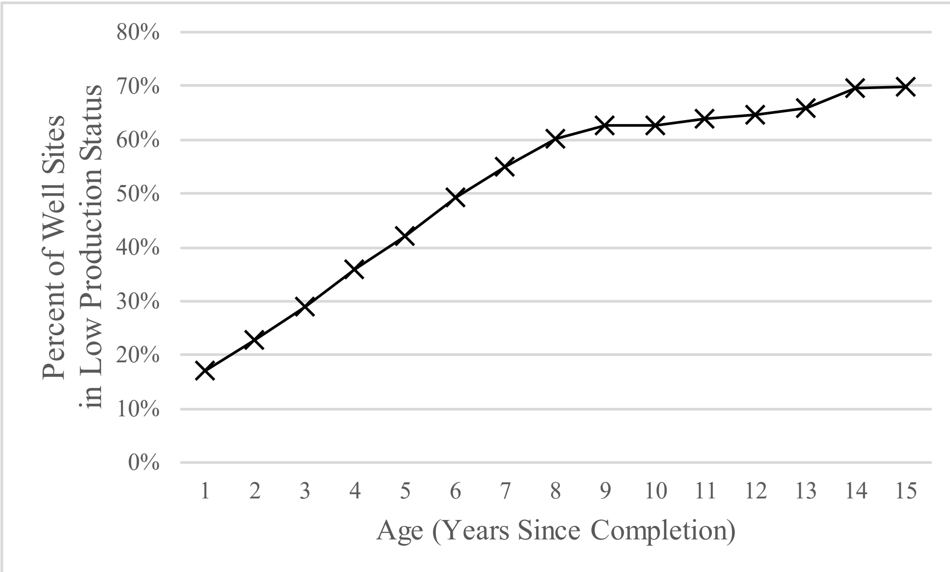

Figure 3-1 Estimated Percent of Well Sites in Low Production Status by Age of Site

We apply these transition percentages to the projected counts of wells sites affected by this final reconsideration. The compliance cost and emissions impacts for sites transitioning into low production status and being relieved of fugitive monitoring requirements are lagged one year due to the 12-month averaging period needed to establish low production status. During the transition year, sites are treated as low production sites for the purposes of assigning compliance costs and emissions impacts, and as non-low production sites for the purposes of assigning a regulatory regime. For example, in the finalized option, if the average daily production of a site in a non-alternative fugitive emissions standard state falls below 15 boe per day during 2020, the site is assumed to incur the cost and emissions impacts associated with a low production site of the monitoring level of a non-low production site (semiannual) in 2020. In 2021, the site is no longer subject to fugitive monitoring requirements.

This analysis relies on a series of assumptions that introduce substantial uncertainties. These uncertainties include the assumption that past production patterns are predictive of future production and the assumption of two wells per site with identical production profiles. The dataset used to estimate the transition proportions excludes wells that were shut-in since completion, which tend to bias estimates of compliance cost and emissions impacts upwards. Lastly, the projection does not separately identify well sites which are wellhead-only, either at the time of completion or later if equipment is removed from the site, and thus not subject to fugitive emissions requirements.

Below, we provide projected source counts in a series of tables. Table 3-3 presents the number of incremental reconsideration-impacted sources for each year of the analysis, broken out by source type. Table 3-4 includes the same information for all reconsideration-impacted sources over the whole period. The total source counts for well sites each year reflect both incrementally affected sources and those affected due to transitions from non-low production to low production status. For example, of the 18,000 low production well sites in 2021, 1,800 are incremental low production sites (see Table 3-3) projected to begin production in 2021. The remainder are non-low production sites that are assumed to have started production between 2015 and 2019 before transitioning to low production status according to the schedule illustrated in Figure 3-1. Finally, Table 3-5 shows the distribution of well sites by production level and alternative fugitive emissions standard status for each year of the analysis.

Table 3-3 Incremental Reconsideration-impacted Source Counts for Finalized Option 3, 2021 to 2030

Year	Non-Low Production Wellsites	Low Production Wellsites	Gathering and Boosting Stations	Certifications	Total
2021	8,400	1,800	210	1,600	12,000
2022	8,800	1,900	210	1,600	12,000
2023	9,000	1,900	210	1,700	13,000
2024	9,200	2,000	210	1,700	13,000
2025	9,300	2,000	210	1,700	13,000
2026	9,400	2,000	210	1,700	13,000
2027	9,400	2,000	210	1,700	13,000
2028	9,500	2,000	210	1,700	13,000
2029	9,500	2,000	210	1,700	14,000
2030	9,500	2,000	210	1,700	13,000

Note: Incrementally reconsideration-impacted sources include sources that are newly affected in each year. Estimates may not sum due to independent rounding.

Table 3-4 Total Reconsideration-impacted Source Counts for Finalized Option 3, 2021 to 2030

Year	Non-Low Production Wellsites	Low Production Wellsites	Gathering and Boosting Stations	Certifications	Total
2021	42,000	18,000	1,500	1,600	63,000
2022	48,000	23,000	1,700	1,600	74,000
2023	54,000	28,000	1,900	1,700	85,000
2024	59,000	33,000	2,100	1,700	97,000
2025	65,000	39,000	2,300	1,700	110,000
2026	70,000	46,000	2,500	1,700	120,000
2027	75,000	52,000	2,800	1,700	130,000
2028	80,000	59,000	3,000	1,700	140,000
2029	84,000	66,000	3,200	1,700	150,000
2030	88,000	73,000	3,400	1,700	170,000

Note: Total reconsideration-impacted sources include sources that are projected to change their activity as a result of the reconsideration in each year. These include sources that are newly affected in each year plus the sources from previous years that experience a change in their compliance activity as a result of this final action compared to the baseline. The table does not include estimated counts of NSPS-affected facilities whose controls are unaffected by the reconsideration. Estimates may not sum due to independent rounding.

Table 3-5 Reconsideration-impacted Well Site Counts by Alternative Fugitive Emissions Standards Status for Finalized Option 3, 2021 to 2030

Year	Non-Alternative Fugitive Emissions Standard State		Alternative Fugitive Emissions Standard State	
	Non-Low Production Wellsites	Low Production Wellsites	Non-Low Production Wellsites	Low Production Wellsites
2021	34,000	14,000	7,800	4,600
2022	39,000	17,000	8,900	5,600
2023	44,000	21,000	9,900	6,800
2024	48,000	25,000	11,000	8,000
2025	53,000	30,000	12,000	9,400
2026	57,000	35,000	13,000	11,000
2027	61,000	40,000	14,000	12,000
2028	65,000	45,000	15,000	14,000
2029	68,000	51,000	16,000	15,000
2030	72,000	57,000	16,000	17,000

Note: Projected sources under alternative fugitive emissions standard include all reconsideration-impacted well sites in California, Colorado, Pennsylvania, and Utah; 80 percent of well sites in Ohio; and 5.5 percent of well sites in Texas.

3.2.4 Forgone Emissions Reductions

Table 3-6 summarizes the estimated forgone emissions reductions associated with the finalized Option 3 compared to the baseline. Increases in emissions are estimated by multiplying the source-level increases in emissions from the updated baseline by the corresponding projected number of reconsideration-affected facilities. In the analysis, streamlined elements of the fugitive emissions monitoring requirements and closed vent system and technical infeasibility certification requirements are not associated with any direct emissions changes.[90] Therefore, all forgone emissions reductions are attributed to the frequency changes in the fugitive emissions monitoring program.[91] This does not include projected impacts on emissions from this final action resulting from reducing the monitoring frequency for affected compressor stations on the Alaska North Slope because, as noted, the EPA does not sufficient information on compressor stations there. Also, as noted in Section 3.2.1, some additional provisions included in the preamble are not analyzed because we either do not have the data to do so or because we do not think the provision will lead to measurable cost reductions or emission changes.

Table 3-6 Forgone Emissions Reductions under Finalized Option 3, 2021 to 2030

	Emission Changes			
	Methane (short tons)	**VOC (short tons)**	**HAP (short tons)**	**Methane (metric tons CO_2 Eq.)**
2021	19,000	5,200	200	430,000
2022	23,000	6,500	250	530,000
2023	28,000	7,900	300	650,000
2024	34,000	9,500	360	780,000
2025	40,000	11,000	420	910,000
2026	47,000	13,000	490	1,100,000
2027	53,000	15,000	560	1,200,000
2028	60,000	17,000	630	1,400,000
2029	68,000	19,000	710	1,500,000
2030	75,000	21,000	790	1,700,000
Total	450,000	120,000	4,700	10,000,000

Note: Estimates may not sum due to independent rounding.

[90] Streamlined elements of the fugitive emissions monitoring requirements include the removal of site map and observation path requirements in the monitoring plan and a reduction in the information required to be recorded and reported. After review of the specific requirements, for reasons explained in the Section V of the preamble to the final rule, several elements of the existing program were deemed redundant or not critical to demonstrating compliance with the rule. Emissions should not be affected by the change in certification requirements to the extent that the use of an in-house engineer does not result in any change in the quality of closed vent systems being certified or the number of pneumatic pump technical infeasibility determinations. We do not have the information needed to estimate the potential for emissions impacts, if any, when moving from professional engineer certifications to in-house engineer certifications.

[91] Note that we estimate no change in emissions for well sites projected to be covered under equivalent state programs as discussed in Section 3.2.2.

3.2.5 Forgone Product Recovery

Fugitive emissions monitoring is assumed to increase the capture of methane and VOC emissions that would otherwise be vented to the atmosphere with no fugitive emissions monitoring program, and we assume that a large proportion of the averted methane emissions can be directed into natural gas production streams and sold. In this analysis, we estimate the forgone revenue associated with the decrease in natural gas recovery due to this final action. Reducing the frequency of the monitoring program leads to a reduction in the amount of natural gas that is assumed to be captured and sold, leading to forgone revenue as compared to the baseline.

When including the decrease in natural gas recovery in the cost reductions analysis, we use the projections of natural gas prices provided in the EIA's AEO2020 reference case. The AEO projects Henry Hub natural gas prices rising from $2.49/MMBtu in 2021 to $3.29/MMBtu in 2030 in 2019 dollars.[92] To be consistent with other financial estimates in the RIA, we adjust the projected prices from AEO2020 from 2019 to 2016 dollars using the GDP-Implicit Price Deflator. We also adjust to reflect an estimate of prices at the wellhead using an EIA study result that indicated that the Henry Hub price is, on average, about 11 percent higher than the wellhead price and using the conversion of 1.036 MMBtu equals 1 Mcf.[93] After these adjustments, the wellhead natural gas prices are assumed to rise from $2.20/Mcf in 2021 to $2.89/Mcf in 2030. Table 3-7 summarizes the decrease in natural gas recovery and the associated forgone revenue included in the cost reductions calculations for the finalized Option 3. Option 3, which reduces the frequency of the fugitive monitoring program for compressor stations and eliminates monitoring requirements entirely for low-production well sites, leads to a projected reduction in the amount of natural gas that is assumed to be captured and sold ranging from 1.1 in 2021 to 4.4 bcf in 2030; in turn, this leads to forgone revenue ranging from $2.4 million in 2021 to $13

[92] Available at: http://www.eia.gov/forecasts/aeo/tables_ref.cfm.

[93] See: https://www.researchgate.net/publication/265155970_US_Natural_Gas_Markets_Relationship_Between_Henry_Hub_Spot_Prices_and_US_Wellhead_Prices. Accessed 12/16/2019.

million in 2030.[94] Detailed results for forgone revenues for natural gas recovery associated with all options are presented in Section 3.2.8.

Table 3-7 Decrease in Natural Gas Recovery for Finalized Option 3, 2021 to 2030

Year	Decrease in Gas Recovery (Mcf)	Forgone Revenue (millions 2016$)
2021	1.1	$2.4
2022	1.4	$3.0
2023	1.7	$3.7
2024	2.0	$4.6
2025	2.3	$5.8
2026	2.7	$7.3
2027	3.1	$8.8
2028	3.5	$10
2029	3.9	$11
2030	4.4	$13

3.2.6 Compliance Cost Reductions

Table 3-8 summarizes the cost reductions and forgone revenue from product recovery for the evaluated emissions sources and points. The annual operating and maintenance cost reductions are all attributed to the fugitives monitoring requirement and include the cost of performing the surveys, as well as the costs associated with repairs. The planning cost reductions in Table 3-8 represent reductions in the total planning cost expenditures for affected sources, including the change in planning costs for sources affected prior to the analysis year. The cost reductions are estimated by multiplying the source-level cost reductions relative to the updated baseline associated with applicable control and facility type, discussed in Section 3.2.2, by the number of incrementally affected sources of that facility type, discussed in Section 3.2.3. The cost

[94] Operators in the gathering and boosting part of the industry do not typically own the natural gas they transport; rather, the operators receive payment for the transportation service they provide. As a result, the source-level cost and emission reduction analyses supporting best system of emission reduction (BSER) decisions presented in Volume 1 of the TSD do not include estimates of revenue from natural gas recovery as offsets to compliance costs. From a social perspective, however, the increased financial returns from natural gas recovery accrues to entities somewhere along the natural gas supply chain and should be accounted for in the national impacts analysis. An economic argument can be made that, in the long run, no single entity is going to bear the entire burden of the compliance costs or fully receive the financial gain of the additional revenues associated with natural gas recovery. The change in economic surplus resulting from natural gas recovery is going to be spread out among different agents via price mechanisms. Therefore, the most simple and transparent option for allocating these revenues would be to keep the compliance costs and associated revenues together in a given source category and not add assumptions regarding the allocation of revenues across agents. Also, see the discussion regarding opportunity costs associated investing in pollution abatement capital vs. productive capital in Chapter 2.

reductions from the streamlining of recordkeeping and reporting are included in the annualized cost reductions totals.[95] These cost reductions are described more below.

Table 3-8 Estimated Cost Reductions for Finalized Option 3, 2021 to 2030 (millions 2016$)

Year	Planning Cost Reductions[1]	Operating and Maintenance Cost Reductions	Annualized Cost Reductions (w/o Forgone Revenue)[2]	Forgone Revenue from Product Recovery	Annualized Cost Reductions (with Forgone Revenue)
2021	$6.9	$52	$59	$2.4	$57
2022	$7.2	$62	$71	$3.0	$68
2023	$15	$74	$84	$3.7	$80
2024	$11	$87	$98	$4.6	$93
2025	$12	$100	$110	$5.8	$110
2026	$14	$110	$130	$7.3	$120
2027	$14	$130	$140	$8.8	$130
2028	$14	$140	$160	$10	$150
2029	$15	$160	$180	$11	$160
2030	$15	$170	$190	$13	$180

Note: Estimates may not sum due to independent rounding.
[1] The planning cost reductions include the cost reductions incurred by the newly affected sources for both fugitive emissions monitoring and certifications in each year, as well as the cost reductions of fugitive emissions sources that renew survey monitoring plans after 8 years.
[2] These cost reductions include the planning cost reductions for all fugitive emissions monitoring requirements annualized over 8 years at an interest rate of 7 percent, plus the annual operating and maintenance cost reductions for fugitive emissions monitoring, plus the certification cost reductions, plus the cost reductions from streamlined recordkeeping and reporting.

The cost of designing, or redesigning, the fugitive emissions monitoring program occurs every 8 years to comply with the 2016 NSPS OOOOa requirements. The lifetime of the monitoring program is not changed by this reconsideration. The reduction in planning costs in each year outlined in Table 3-8 includes the estimated reduction in the costs of designing a fugitive emissions monitoring program for the new reconsideration-impacted sources in that year, plus the reduction in the cost of redesigning an existing program for sources that were affected by the reconsideration previously. The first year a redesign cost is included in the planning cost reduction calculation is 2023, as we assume the first NSPS-affected sources completed monitoring plans in 2016, the first year the 2016 NSPS OOOOa affected sources completed compliance activities. The decrease in these program design costs were added to the cost

[95] See the preamble of the final reconsideration for details on the changes to the recordkeeping and reporting requirements.

reductions associated with closed vent system design and technical infeasibility certifications in each year to get the total planning cost reductions for each year.

The fugitive emissions monitoring planning cost reductions, annualized over the expected lifetime of 8 years at an interest rate of 7 percent, are added to the annual cost reductions of associated with fugitive emissions monitoring, the cost reductions associated with certifications, and the cost reductions from streamlined recordkeeping and reporting to get the annualized cost reductions in each year compared to the baseline. The value of forgone product recovery is also subtracted out to estimate the total annualized cost impacts in each year.
Table 3-9 illustrates the sensitivity of the compliance cost and emissions results of the finalized Option 3 to changes in the interest rate. We present costs using interest rates of 7 percent and 3 percent. Table 3-9 shows that the interest rate has minor effects on the nationwide annualized cost reductions of the Technical Reconsideration.

Table 3-9 Estimated Cost Reductions for Finalized Option 3 at 3 and 7 Percent Interest Rates, 2021 to 2030 (millions 2016$)

	7 Percent			3 Percent		
Year	Annualized Cost Reductions (w/o Forgone Revenue)	Forgone Revenue from Product Recovery	Annualized Cost Reductions (with Forgone Revenue)	Annualized Cost Reductions (w/o Forgone Revenue)	Forgone Revenue from Product Recovery	Annualized Cost Reductions (with Forgone Revenue)
2021	$59	$2.4	$57	$58	$2.4	$56
2022	$71	$3.0	$68	$70	$3.0	$67
2023	$84	$3.7	$80	$83	$3.7	$79
2024	$98	$4.6	$93	$97	$4.6	$92
2025	$110	$5.8	$110	$110	$5.8	$110
2026	$130	$7.3	$120	$130	$7.3	$120
2027	$140	$8.8	$130	$140	$8.8	$130
2028	$160	$10	$150	$160	$10	$150
2029	$180	$11	$160	$170	$11	$160
2030	$190	$13	$180	$190	$13	$180

Note: Estimates may not sum due to independent rounding.

3.2.7 Comparison of Regulatory Alternatives

Table 3-10 presents a comparison of projected emissions and compliance cost impacts of the regulatory alternatives in 2021 and 2030. The most stringent option, Option 1, would not change the fugitive emissions monitoring frequency requirements in the 2016 NSPS OOOOa. As a result, there are no changes in projected emissions compared to the baseline for Option 1. However, there are cost reductions from streamlining fugitive emissions monitoring, certifying several state programs as having an alternative fugitive emissions standard, and allowing the use of in-house engineers for certifications. For Option 2, in addition to the changes in requirements captured in Option 1, fugitive emissions monitoring requirements are removed for low production well sites (semiannual under the baseline). We assume 60 percent emissions reductions for semiannual fugitive monitoring.[96] Compliance costs and natural gas recovery vary by survey frequency. The finalized Option 3 is the same as Option 2 but decreases the fugitive emissions monitoring frequency at gathering and boosting stations from quarterly to semiannual. We assume 80 percent emissions reductions for a quarterly fugitive emissions monitoring requirement.

Table 3-10 Comparison of Regulatory Alternatives in 2021 and 2030

	Regulatory Alternative		
	Option 1	**Option 2**	**Option 3 (Finalized)**
Total Impacts, 2021			
Forgone emissions reductions			
Methane Emissions (short tons/year)	0	14,000	19,000
VOC Emissions (short tons/year)	0	3,900	5,200
Decrease in Natural Gas Recovery (bcf)	0	0.8	1.1
Cost Reductions			
Planning Cost Reductions	$5.7	$6.9	$6.9
Annualized Cost Reductions w/o Forgone Revenue (7 percent)	$30	$52	$59
Annualized Cost Reductions with Forgone Revenue (7 percent)	$30	$51	$57
Total Impacts, 2030			
Forgone emissions reductions			
Methane Emissions (short tons/year)	0	64,000	75,000
VOC Emissions (short tons/year)	0	18,000	21,000
Decrease in Natural Gas Recovery (bcf)	0	3.7	4.4
Cost Reductions			
Planning Cost Reductions	$9.8	$15	$15
Annualized Cost Reductions w/o Forgone Revenue (7 percent)	$76	$180	$190
Annualized Cost Reductions with Forgone Revenue (7 percent)	$76	$170	$180

[96] See the TSD for more details on the emission reductions assumptions across fugitive monitoring survey frequencies at well sites and compressor stations.

As shown in Table 3-10, Option 1 is projected to result in no changes in emissions and annualized cost reductions are projected to be $30 million in 2021 and $76 million in 2030. Option 2 is projected to result in a decrease in annualized compliance costs of $51 million in 2021 and $170 million in 2030 after accounting for decreased product recovery. Emissions are projected to increase by 14,000 short tons of methane and 3,900 short tons of VOC in 2021 and 64,000 short tons of methane and 18,000 short tons of VOC in 2030. The finalized Option 3 is projected to result in the largest cost reductions and forgone emissions reductions. Option 3 is projected to decrease annualized costs by $57 million in 2021 and $180 million in 2030 after accounting for the value of forgone product recovery. Option 3 is projected to increase emissions by 19,000 short tons of methane and 5,200 short tons of VOC in 2021 and 75,000 short tons of methane and 21,000 short tons of VOC in 2030.

3.2.8 Detailed Impact Tables

The following tables show the full details of the cost reductions and forgone emissions reductions by emissions source for each regulatory option in the years 2021 and 2030.

Table 3-11 Incrementally Affected Sources, Forgone Emissions Reductions, and Cost Reductions, Option 1, 2021

		Forgone Emissions Reductions				Compliance Cost Reductions (millions $2016)			
Source/Emissions Point	Projected No. of Reconsideration-impacted Sources	Methane (short tons)	VOC (short tons)	HAP (short tons)	Methane (metric tons CO_2 Eq.)	Annualized Planning Cost Reductions	Operating and Maintenance	Forgone Product Recovery	Total Annualized Cost Reductions with Forgone Revenues
Fugitive Emissions									
Non-Low Production Well Sites	42,000	0	0	0	0	$2.3	$16	$0	$18
Low Production Well Sites	18,000	0	0	0	0	$0.90	$7.1	$0	$8.0
Gathering and Boosting Stations	1,500	0	0	0	0	$0.099	$1.0	$0	$1.1
Certifications									
CVS and Technical Infeasibility	1,600	0	0	0	0	$2.5	$0	$0	$2.5
TOTAL	**63,000**	**0**	**0**	**0**	**0**	**$5.7**	**$24**	**$0**	**$30**

Note: Estimates may not sum due to independent rounding.

Table 3-12 Incrementally Affected Sources, Forgone Emissions Reductions, and Cost Reductions, Option 1, 2030

		Forgone Emissions Reductions				Compliance Cost Reductions (millions $2016)			
Source/Emissions Point	Projected No. of Reconsideration-impacted Sources	Methane (short tons)	VOC (short tons)	HAP (short tons)	Methane (metric tons CO_2 Eq.)	Annualized Planning Cost Reductions	Operating and Maintenance	Forgone Product Recovery	Total Annualized Cost Reductions with Forgone Revenues
Fugitive Emissions									
Non-Low Production Well Sites	88,000	0	0	0	0	$4.8	$34	$0	$38
Low Production Well Sites	73,000	0	0	0	0	$3.8	$28	$0	$32
Gathering and Boosting Stations	3,400	0	0	0	0	$0.23	$2.2	$0	$2.4
Certifications									
CVS and Technical Infeasibility	1,700	0	0	0	0	$2.7	$0	$0	$2.7
TOTAL	**170,000**	**0**	**0**	**0**	**0**	**$11**	**$64**	**$0**	**$76**

Note: Estimates may not sum due to independent rounding.

Table 3-13 Incrementally Affected Sources, Forgone Emissions Reductions, and Cost Reductions, Option 2, 2021

Source/Emissions Point	Projected No. of Reconsideration-impacted Sources	Forgone Emissions Reductions: Methane (short tons)	VOC (short tons)	HAP (short tons)	Methane (metric tons CO_2 Eq.)	Compliance Cost Reductions (millions $2016): Annualized Planning Cost Reductions	Operating and Maintenance	Forgone Product Recovery	Total Annualized Cost Reductions with Forgone Revenues
Fugitive Emissions									
Non-Low Production Well Sites	42,000	0	0	0	0	$2.3	$16	$0	$18
Low Production Well Sites	18,000	14,000	3,900	150	320,000	$2.8	$28	$1.8	$29
Gathering and Boosting Stations	1,500	0	0	0	0	$0.099	$1.0	$0	$1.1
Certifications									
CVS and Technical Infeasibility	1,600	0	0	0	0	$2.5	$0	$0	$2.5
TOTAL	**63,000**	**14,000**	**3,900**	**150**	**320,000**	**$7.6**	**$45**	**$1.8**	**$51**

Note: Estimates may not sum due to independent rounding.

Table 3-14 Incrementally Affected Sources, Forgone Emissions Reductions, and Cost Reductions, Option 2, 2030

Source/Emissions Point	Projected No. of Reconsideration-impacted Sources	Forgone Emissions Reductions: Methane (short tons)	VOC (short tons)	HAP (short tons)	Methane (metric tons CO_2 Eq.)	Compliance Cost Reductions (millions $2016): Annualized Planning Cost Reductions	Operating and Maintenance	Forgone Product Recovery	Total Annualized Cost Reductions with Forgone Revenues
Fugitive Emissions									
Non-Low Production Well Sites	88,000	0	0	0	0	$4.8	$34	$0	$38
Low Production Well Sites	73,000	64,000	18,000	670	1,500,000	$12	$120	$11	$120
Gathering and Boosting Stations	3,400	0	0	0	0	$0.23	$2.2	$0	$2.4
Certifications									
CVS and Technical Infeasibility	1,700	0	0	0	0	$2.7	$0	$0	$2.7
TOTAL	**170,000**	**64,000**	**18,000**	**670**	**1,500,000**	**$20**	**$160**	**$11**	**$170**

Note: Estimates may not sum due to independent rounding.

Table 3-15 Incrementally Affected Sources, Forgone Emissions Reductions, and Cost Reductions, Finalized Option 3, 2021

Source/Emissions Point	Projected No. of Reconsideration-impacted Sources	Forgone Emissions Reductions: Methane (short tons)	VOC (short tons)	HAP (short tons)	Methane (metric tons CO_2 Eq.)	Compliance Cost Reductions (millions $2016): Planning Cost Reductions	Operating and Maintenance	Forgone Product Recovery	Total Annualized Cost Reductions with Forgone Revenues
Fugitive Emissions									
Non-Low Production Well Sites	42,000	0	0	0	0	$2.3	$16	$0	$18
Low Production Well Sites	18,000	14,000	3,900	150	320,000	$2.8	$28	$1.8	$29
Gathering and Boosting Stations	1,500	4,900	1,400	52	110,000	$0.10	$7.8	$0.63	$7.3
Certifications									
CVS and Technical Infeasibility	1,600	0	0	0	0	$2.5	$0	$0	$2.5
TOTAL	**63,000**	**19,000**	**5,200**	**200**	**430,000**	**$7.6**	**$52**	**$2.4**	**$57**

Note: Estimates may not sum due to independent rounding.

Table 3-16 Incrementally Affected Sources, Forgone Emissions Reductions, and Cost Reductions, Finalized Option 3, 2030

Source/Emissions Point	Projected No. of Reconsideration-impacted Sources	Forgone Emissions Reductions: Methane (short tons)	VOC (short tons)	HAP (short tons)	Methane (metric tons CO_2 Eq.)	Compliance Cost Reductions (millions $2016): Planning Cost Reductions	Operating and Maintenance	Forgone Product Recovery	Total Annualized Cost Reductions with Forgone Revenues
Fugitive Emissions									
Non-Low Production Well Sites	88,000	0	0	0	0	$4.8	$34	$0	$38
Low Production Well Sites	73,000	64,000	18,000	670	1,500,000	$12	$120	$11	$120
Gathering and Boosting Stations	3,400	11,000	3,100	120	260,000	$0.23	$18	$1.9	$16
Certifications									
CVS and Technical Infeasibility	1,700	0	0	0	0	$2.7	$0	$0	$2.7
TOTAL	**170,000**	**75,000**	**21,000**	**790**	**1,700,000**	**$20**	**$170**	**$13**	**$180**

Note: Estimates may not sum due to independent rounding.

3.2.9 Present Value and Equivalent Annualized Value of Cost Reductions

This section presents the cost reductions for this final action in a present value (PV) framework. The stream of estimated cost reductions for each year from 2021 through 2030 is discounted to 2020 using 7 and 3 percent discount rates and summed to estimate the PV of the cost reductions. This PV represents the sum of the annual cost reductions from 2021 to 2030. The PV is used to estimate the equivalent annualized value (EAV) of the cost reductions. The EAV is the single annual value which, if summed in PV terms across years in the analytical time frame, equals the PV of the original (*i.e.*, likely time-varying) stream of cost reductions. In other words, the EAV takes the potentially "lumpy" stream of cost reductions and converts them into a single value that, when discounted and added together over each period in the analysis time frame, equals the original stream of values in PV terms.

The cost reductions are presented as the change in costs compared to the baseline in 2016 dollars. We evaluate the change in costs for each year where reconsideration-impacted sources are expected to change their compliance activities from the 2016 NSPS OOOOa as a result of this reconsideration, through 2030. For this final action, the change in compliance activities is expected to lead to cost reductions. We have chosen not to evaluate impacts beyond 2030 in part due to the limited information available to model long-term changes in practices and equipment use in the oil and natural gas sector. Technological progress in control technology and other economy-wide factors are likely to change the industry significantly over a longer time horizon.

Table 3-17 shows the unannualized, undiscounted stream of cost reductions for each year from 2021 to 2030. Planning cost reductions are estimated as the sum of the difference in costs of the design of fugitive emissions monitoring plans for new reconsideration-impacted facilities, the difference in costs of the redesign of fugitive emissions monitoring plans for reconsideration-impacted facilities that were affected by the 2016 NSPS OOOOa 8 years prior, and the difference in costs of certification for closed vent system design and pneumatic pump technical infeasibility for new reconsideration-impacted sources compared to the updated baseline. Total cost reductions are the sum of the planning cost reductions and annual operating cost reductions. Over time, as the number of new reconsideration-affected sources increases, the planning cost reductions and annual operating cost reductions also increase.

Table 3-17 Estimated Cost Reductions for Finalized Option 3, 2021 to 2030 (millions 2016$)

Year	Planning Cost Reductions[1]	Operating and Maintenance Cost Reductions	Total Cost Reductions (w/o Forgone Revenue)[2]	Forgone Revenue from Product Recovery	Total Cost Reductions (with Forgone Revenue)
2021	$6.9	$52	$59	$2.4	$56
2022	$7.2	$62	$70	$3.0	$67
2023	$15	$74	$89	$3.7	$85
2024	$11	$87	$98	$4.6	$93
2025	$12	$100	$110	$5.8	$110
2026	$14	$110	$130	$7.3	$120
2027	$14	$130	$140	$8.8	$130
2028	$14	$140	$160	$10	$150
2029	$15	$160	$170	$11	$160
2030	$15	$170	$190	$13	$180

Note: Estimates may not sum due to independent rounding.
[1] The planning cost reductions include the cost reductions incurred by the newly affected sources for both fugitive emissions monitoring and certifications, as well as the cost reductions of emissions sources that renew survey monitoring plans after 8 years.
[2] Total cost reductions include the planning cost reductions for all fugitive emissions monitoring, plus the annual operating and maintenance cost reductions for the fugitive emissions monitoring requirements every year, plus the cost reductions of certifications in each year, plus the cost reductions from streamlined recordkeeping and reporting.

Table 3-18 shows the stream of cost reductions discounted to 2020 using a 7 percent discount rate for the finalized Option 3. Table 3-18 also shows the PV and the EAV of planning cost reductions, annual operating cost reductions, forgone revenue from decreased product recovery and the total cost reductions (after accounting for the forgone product recovery). The PV of total cost reductions is $750 million, and the EAV of total cost reductions is about $100 million per year.

Table 3-18 Discounted Cost Reductions Estimates for Finalized Option 3, 7 Percent Discount Rate (millions 2016$)

Year	Planning Cost Reductions[1]	Operating and Maintenance Cost Reductions	Total Cost Reductions (w/o Forgone Revenue)[2]	Forgone Revenue from Product Recovery	Total Cost Reductions (with Forgone Revenue)
2021	$6.5	$48	$55	$2.2	$52
2022	$6.3	$55	$61	$2.6	$58
2023	$12	$61	$73	$3.0	$70
2024	$8.5	$66	$75	$3.5	$71
2025	$8.7	$71	$80	$4.2	$76
2026	$9.2	$76	$85	$4.9	$80
2027	$8.7	$80	$88	$5.5	$83
2028	$8.4	$83	$91	$5.9	$85
2029	$8.0	$85	$93	$6.2	$87
2030	$7.7	$88	$95	$6.4	$89
PV	**$84**	**$710**	**$800**	**$44**	**$750**
EAV	**$11**	**$95**	**$110**	**$5.9**	**$100**

Note: Cost reductions and forgone revenue in each year are discounted to 2020. Estimates may not sum due to independent rounding.
[1] The planning cost reductions include the cost reductions incurred by the newly affected sources for both fugitive emissions monitoring and certifications in each year, as well as the fugitive monitoring cost reductions for sources that renew their monitoring plans after 8 years.
[2] Total cost reductions include the planning cost reductions for all fugitive emissions monitoring, plus the annual operating and maintenance cost reductions for the fugitive emissions monitoring requirements every year, plus the cost reductions of certifications in each year, plus the cost reductions from streamlined recordkeeping and reporting discounted to 2020.

Table 3-19 shows the discounted cost reductions for the finalized Option 3, as well as the alternative options, for the 2021 to 2030 period compared to the baseline, along with the PV and EAV of the cost reductions, using a 7 percent discount rate. We estimate that Option 1 results in a PV of cost reductions of $350 million, corresponding to an EAV of $46 million. For Option 2, we estimate a PV of cost reductions of $680 million, after accounting for the forgone value of the decrease in product recovery, and a corresponding EAV of $91 million. For the finalized Option 3, we estimate a PV of $750 million in cost reductions after accounting for forgone product recovery, and about $100 million per year in EAV terms.

Table 3-19 Comparison of Regulatory Alternatives, 7 Percent Discount Rate

	Option 1	Option 2	Option 3 (Finalized)
Present Value of Cost Reductions			
Cost Reductions (millions 2016$)			
Planning Cost Reductions	$58	$84	$84
Total Cost Reductions w/o Forgone Revenue	$350	$720	$800
Total Cost Reductions with Forgone Revenue	$350	$680	$750
EAV of Cost Reductions			
Cost Reductions (millions 2016$)			
Planning Cost Reductions	$7.8	$11	$11
Total Cost Reductions w/o Forgone Revenue	$46	$96	$110
Total Cost Reductions with Forgone Revenue	$46	$91	$100

Table 3-20 shows how the choice of discount rate affects the PVs and EAVs. A lower discount rate means that higher cost reductions in later years have a greater impact on PV and EAV. Therefore, the PV and EAV of the cost reductions are higher using a 3 percent discount rate than a 7 percent discount rate. Using a 3 percent discount rate increases the PV of the cost reductions by 27 percent compared to the 7 percent rate. For the EAV, using a 3 percent discount rate increases the annualized cost reductions by about 15 percent compared to the 7 percent rate.

Table 3-20 Cost Reductions for the Finalized Option 3 Discounted at 7 and 3 Percent Rates (millions 2016$)

	7 Percent			3 Percent		
Year	**Total Annual Cost Reductions (without forgone revenue)**	**Forgone Revenue from Product Recovery**	**Total Cost Reductions (with forgone revenue)[1]**	**Total Annual Cost Reductions (without forgone revenue)**	**Forgone Revenue from Product Recovery**	**Total Cost Reductions (with forgone revenue) [1]**
2021	$55	$2.2	$52	$57	$2.3	$55
2022	$61	$2.6	$58	$66	$2.8	$63
2023	$73	$3.0	$70	$81	$3.4	$78
2024	$75	$3.5	$71	$87	$4.0	$83
2025	$80	$4.2	$76	$97	$5.0	$92
2026	$85	$4.9	$80	$110	$6.1	$100
2027	$88	$5.5	$83	$120	$7.2	$110
2028	$91	$5.9	$85	$120	$8.1	$120
2029	$93	$6.2	$87	$130	$8.8	$120
2030	$95	$6.4	$89	$140	$9.4	$130
PV	**$800**	**$44**	**$750**	**$1,000**	**$57**	**$950**
EAV	**$110**	**$5.9**	**$100**	**$110**	**$6.5**	**$110**

Note: Cost reductions in each year are discounted to 2020. Estimates may not sum due to independent rounding.
1 Total cost reductions include the planning cost reductions for all fugitive emissions monitoring, plus the annual operating and maintenance cost reductions for the fugitive emissions monitoring requirements every year, plus the

cost reductions of certifications in each year, plus the cost reductions from streamlined recordkeeping and reporting requirements discounted to 2020.

The Technical Reconsideration is considered a deregulatory action under E.O. 13771, Reducing Regulation and Controlling Regulatory Costs. The PV of the projected cost reductions from the Technical Reconsideration calculated in accordance with E.O. 13771 accounting standards are $1.1 billion over an infinite time horizon (in 2016$, discounted to 2016 at 7 percent). The EAV of the cost reductions over an infinite time horizon are $76 million per year (in 2016$, discounted to 2016 at 7 percent).

3.3 Forgone Benefits of the Technical Reconsideration

The 2016 NSPS OOOOa regulated methane and VOC emissions in the oil and natural gas sector. For the 2016 NSPS OOOOa, the EPA projected climate and ozone benefits from methane reductions, ozone and fine particulate matter ($PM_{2.5}$) health benefits from VOC reductions, and health benefits from ancillary HAP emissions reduction. These benefits were expected because compliance with the standards would simultaneously reduce methane, VOC, and HAP emissions.[97]

As in the 2016 NSPS RIA, methane is the only pollutant with monetized impacts in this RIA. The finalized Option 3 is estimated to increase emissions relative to the baseline. The total forgone emissions reductions from 2021 to 2030 is estimated to be about 450,000 short tons of methane, 120,000 short tons of VOC and 4,700 short tons of HAP. The methane emissions are 10 million metric tons in CO_2 Eq. The PV of the forgone domestic methane-related climate benefits is $19 million from 2021 to 2030 using an interim estimate of the domestic social cost of methane (SC-CH_4) and discounting at a 7 percent rate. The associated EAV is an estimated $3.2 million per year. Using the interim SC-CH_4 estimate and discounting at a 3 percent rate, the PV of the forgone domestic climate benefits is estimated to be $71 million and the EAV is estimated to be $11 million per year.

[97] The specific control techniques required for the 2016 NSPS OOOOa were also anticipated to have minor disbenefits resulting from secondary emissions of carbon dioxide (CO_2), nitrogen oxides (NO_X), PM, carbon monoxide (CO), and total hydrocarbons (THC), and emission changes associated with the energy markets impacts. This final action is anticipated to reduce these minor secondary emissions.

Under the final action, the EPA expects that the forgone VOC emission reductions will worsen air quality and adversely affect health and welfare due to the contribution of VOCs to ozone, $PM_{2.5}$, and HAP, but we are unable to quantify these impacts at this time. This omission should not imply that these forgone benefits do not exist, and to the extent that the EPA were to quantify the ozone and PM impacts, it would estimate the number and value of avoided premature deaths and illnesses using the approach detailed in the PM National Ambient Air Quality Standards (NAAQS) and Ozone NAAQS RIAs (U.S. EPA, 2012; U.S. EPA, 2014).[98]

For much of Section 3.3, we direct readers to refer to the forgone benefits presentation in Chapter 2 (Section 2.3), as the forgone benefits analysis for the Technical Reconsideration mirrors the one for the Policy Review. For a summary of the climate and human health-related impacts associated with the forgone emissions reductions of the pollutants affected by this rule, see Table 2-12 in Section 2.3.1. Section 2.3 provides further reasoning for not quantifying the impacts of the forgone VOC emissions reductions in this RIA.

3.3.1 Forgone Emissions Reductions

Table 3-21 shows the total increase in direct emissions for 2021 to 2030, compared to the baseline, anticipated for this final action for the regulatory options examined. It is important to note that the impacts of these emissions accrue at different spatial scales. HAP emissions increase exposure to carcinogens and other toxic pollutants primarily near the emission source. VOC emissions are precursors to the formation of $PM_{2.5}$ and ozone on a broader regional scale. Climate effects associated with long-lived greenhouse gases like methane generally do not depend on the location of the emissions and have global impacts. Methane is also a precursor to global background concentrations of ozone (Sarofim, 2015).

[98] The Technical Reconsideration may result in forgone reductions in ambient $PM_{2.5}$ and ozone concentrations in areas attaining and not attaining the NAAQS. Due to the high degree of variability in the responsiveness of ozone and $PM_{2.5}$ formation to VOC emission reductions, we are unable to determine how this rule might affect attainment status without modeling air quality changes. Because the NAAQS RIAs also calculate ozone and $PM_{2.5}$ benefits, there are important differences worth noting in the design and analytical objectives of each impact analysis. The NAAQS RIAs illustrate the potential costs and benefits of attaining new nationwide air quality standards based on an array of emission control strategies for different sources. By contrast, the emission reductions for implementation rules, including this rule, are generally from a specific class of well-characterized sources. In general, the EPA is more confident in the magnitude and location of the emission reductions for implementation rules rather than illustrative NAAQS analyses. Emission changes realized under these and other promulgated rules will ultimately be reflected in the baseline of future NAAQS analyses, which would affect the incremental costs and benefits associated with attaining future NAAQS.

Table 3-21 Total Direct Increases in Emissions, 2021 through 2030

Pollutant	Option 1	Option 2	Option 3 (Finalized)
Methane (short tons)	0	370,000	450,000
VOC (short tons)	0	100,000	120,000
HAP (short tons)	0	3,800	4,700
Methane (metric tons)	0	330,000	410,000
Methane (million metric tons CO_2 Eq.)	0	8.3	10

Table 3-22 shows the direct increases in emissions of methane, VOC, and HAP for Option 2 and Option 3 for each year, compared to the baseline. Option 1 is not included in this table, as there are no estimated changes in emissions under Option 1.

Table 3-22 Annual Direct Increases in Methane, VOC and HAP Emissions, 2021 to 2030

	Option 2			Option 3 (Finalized)		
Year	Methane (metric tons)	VOC (short tons)	HAP (short tons)	Methane (metric tons)	VOC (short tons)	HAP (short tons)
2021	13,000	3,900	150	17,000	5,200	200
2022	16,000	4,900	190	21,000	6,500	250
2023	20,000	6,200	230	26,000	7,900	300
2024	25,000	7,500	280	31,000	9,500	360
2025	29,000	9,000	340	36,000	11,000	420
2026	35,000	11,000	400	42,000	13,000	490
2027	40,000	12,000	460	48,000	15,000	560
2028	46,000	14,000	530	55,000	17,000	630
2029	52,000	16,000	600	61,000	19,000	710
2030	58,000	18,000	670	68,000	21,000	790
Total	**330,000**	**100,000**	**3,800**	**410,000**	**120,000**	**4,700**

Note: Estimates may not sum due to independent rounding.

3.3.2 Methane Climate Effects and Valuation

The 2016 NSPS OOOOa was expected to result in climate-related benefits by reducing methane emissions. This action reduces the climate-related benefits associated with the emissions reductions from the 2016 NSPS OOOOa. We estimate the forgone climate benefits under the finalized and alternative options for the Technical Reconsideration using an interim measure of the domestic social cost of methane (SC-CH_4). See Section 2.3.3 for discussion of the climate effects associated with methane emissions and the valuation approach (*i.e.*, SC-CH_4) used in this RIA to estimate the impacts of forgone methane emissions reductions.

For the finalized Option 3 (presented in Table 2-4), the forgone methane reductions estimated for 2021 (0.43 million metric tons CO_2 Eq.) are equivalent to about 0.2 percent of the methane emissions for this sector reported in the GHGI in 2017 (about 197 million metric tons CO_2 Eq. are from petroleum and natural gas production and gas processing, transmission, and storage). Expected forgone emission reductions in 2030 (about 1.7 million metric tons CO_2 Eq.) are equivalent to around 0.9 percent of 2017 methane emissions.

As with the global SC-CH_4 estimates, the domestic SC-CH4 increases over time because future emissions are expected to produce greater marginal damages and because GDP generally grows over time and many damage categories are modeled in proportion to gross GDP. To monetize the forgone domestic climate benefits, the projected increases in methane emissions due to this regulatory action each year are multiplied by the SC-CH4 estimate for that year. See Table 2-15 in Section 2.3.3 for the average interim domestic SC-CH4 estimates developed under E.O. 13783 for emissions occurring in 2021 to 2030 and Section 2.3.3 and Appendix B for discussion of the limitations and uncertainties associated with the SC-CH_4 estimates. Appendix B also presents the forgone global climate benefits from the finalized option using global SC-CH_4 estimates based on both 3 and 7 percent discount rates.

Table 3-23 presents the monetized forgone domestic climate benefits for the finalized Option 3, both undiscounted and discounted. It shows the annual forgone benefits discounted back to 2020 and the PV and the EAV for 2021 to 2030 under each discount rate. Regardless of whether they are discounted, the annual forgone benefits increase between 2021 and 2030 as the number of sources impacted by this Technical Reconsideration grows over time.

Table 3-23 Estimated Forgone Domestic Climate Benefits of Option 3, 2021-2030 (millions, 2016$)

	Undiscounted		Discounted to 2020	
Year	**7 percent**	**3 Percent**	**7 percent**	**3 Percent**
2021	$1.0	$3.1	$0.9	$3.0
2022	$1.3	$4.0	$1.1	$3.7
2023	$1.6	$5.0	$1.3	$4.6
2024	$2.0	$6.1	$1.5	$5.5
2025	$2.5	$7.4	$1.8	$6.4
2026	$3.0	$8.9	$2.0	$7.4
2027	$3.5	$10	$2.2	$8.5
2028	$4.1	$12	$2.4	$9.5
2029	$4.8	$14	$2.6	$11
2030	$5.5	$16	$2.8	$12
PV			**$19**	**$71**
EAV			**$2.5**	**$8.1**

Note: Estimates may not sum due to independent rounding.

Table 3-24 shows the total forgone emissions reductions over the time horizon as well as the PV and EAV of the forgone domestic climate benefits using 3 percent and 7 percent discount rates. The forgone climate benefits are highly sensitive to the choice of the discount rate, as climate impacts accrue over long time horizons and models project increasing marginal damages associated with greenhouse gas emissions over time. The PV of forgone benefits under a 7 percent discount rate is about $19 million, with an EAV of about $2.5 million per year. The PV of forgone benefits under a 3 percent discount rate is $71 million, with an EAV of about $8.1 million per year.

Table 3-24 Total Estimated Forgone Domestic Climate Benefits (millions, 2016$)

	Option 1	Option 2	Option 3 (Finalized)
Total Increase in Emission, 2021-2030			
Forgone CH_4 reductions (metric tons)	0	330,000	410,000
Forgone CH_4 reductions (million metric tons of CO_2 Eq.)	0	8.3	10
Forgone Domestic Climate Benefits (millions 2016$)			
PV			
3% (average)	$0	$58	$71
7% (average)	$0	$15	$19
EAV			
3% (average)	$0	$6.6	$8.1
7% (average)	$0	$2.0	$2.5

The SC-CH_4 values are dollar-year and emissions-year specific. SC-CH_4 values represent only a partial accounting of climate impacts.

3.3.3 VOC as an Ozone Precursor

This final action is expected to result in forgone VOC emission reductions, which are a precursor to ozone. The impacts of forgone VOC emission reductions are not monetized in this RIA. See Section 2.3.4 for a qualitative discussion of the forgone ozone benefits associated with forgone VOC emission reductions. Sections 2.3.4.1, 2.3.4.2, and 2.3.4.3 discuss the health, vegetation, and climate effects of ozone, respectively.

3.3.4 VOC as a $PM_{2.5}$ Precursor

This final action is expected to result in forgone emission reductions of VOC, a precursor to $PM_{2.5}$, which is associated with impacts on human health. We have not quantified the forgone $PM_{2.5}$-related benefits due to this rule. See Sections 2.3.5.1, 2.3.5.2, and 2.3.5.3 for qualitative discussions of the health, welfare, and visibility effects, respectively, associated with $PM_{2.5}$.

3.3.5 Hazardous Air Pollutants (HAP)

This rulemaking is expected to result in forgone emission reductions of HAP, or air toxics. Available emissions data show that several different HAP are emitted from oil and natural gas operations, from equipment leaks, processing, compressing, transmission and distribution, and storage tanks. The main air toxics emitted by the source category include benzene, toluene, carbonyl sulfide, ethylbenzene, mixed xylenes, and n-hexane. This rule is anticipated to result in a total of 3,800 short tons of forgone HAP emissions reductions over 2021 to 2030, although it was not possible to estimate the changes in emissions of individual HAP due to data limitations.

Non-cancer health problems can result from chronic, subchronic, or acute inhalation exposure to air toxics, and include neurological, cardiovascular, liver, kidney, and respiratory effects as well as effects on the immune and reproductive systems. Section 2.3.6 discusses the EPA's assessment (*i.e.*, the National Air Toxics Assessment, or NATA) of the cancer and non-cancer health effects associated with exposure to air toxics. In the subsections within Section 2.3.6, we provide greater detail on the health effects associated with the main HAP of concern for the oil and natural gas sector: benzene, toluene, carbonyl sulfide, ethylbenzene, mixed xylenes, n-hexane, and several other air toxics.

3.4 Economic Impacts and Distributional Assessments

The EPA evaluated the following economic impact categories for this final Technical Reconsideration: energy market impacts, distributional impacts, small business impacts, and employment impacts. For much of this section, we direct readers to refer to the presentation of economic impacts in Chapter 2 (Section 2.5), as the methods used and several of the findings of the economic impact analysis for the Technical Reconsideration mirror those of the Policy Review.

3.4.1 Energy Markets Impacts

The RIA for the 2016 NSPS OOOOa concluded that the rule may have impacts on energy production and markets. Like the Policy Review, the Technical Reconsideration is expected to reduce compliance costs incurred by oil and natural gas sources. Thus, the finalized Option 3 for the Technical Reconsideration, like the Policy Review, is expected to reduce the energy market impacts associated with the 2016 NSPS OOOOa. See Section 2.4.1 for a summary of the energy market impact analysis conducted in the RIA for the 2016 NSPS OOOOa.

3.4.2 Distributional Impacts

The cost reductions and forgone health benefits associated with the Technical Reconsideration may be distributed unevenly across the U.S. population. The EPA did not conduct a quantitative assessment of distributional impacts for the Technical Reconsideration, but we provide a qualitative discussion of the types of distributional impacts that could result from this final action in the Policy Review. See Section 2.4.2 and subsection 2.4.2.1 for details.

3.4.3 Small Business Impacts

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. 104121), provides that whenever an agency publishes a proposed rule, it must prepare and make available an initial regulatory flexibility analysis (IRFA), unless it certifies that the 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 rule on small entities and any significant alternatives to the rule that would accomplish the objectives of the rule while minimizing significant economic impacts on small entities.

An agency may certify that a rule will not have a significant economic impact on a substantial number of small entities if the rule relieves regulatory burden, has no net burden, or otherwise has a positive economic effect on small entities subject to the rule. Like the Policy Review described in Chapter 2 of this RIA, this reconsideration reduces the stringency of the requirements on a substantial portion of the sources affected by the 2016 NSPS OOOOa, and thus reduces the impacts of NSPS OOOOa. In addition, the three options being analyzed in this RIA would result in neutral or beneficial effects on the affected facilities. The Technical Reconsideration decreases the burden on affected sources through direct changes in the requirements, increased clarity of requirements (for example, through more robust definitions), finalizing alternative fugitive emissions standards, and the streamlining of recordkeeping and reporting requirements. We have therefore concluded that this final action will relieve regulatory burden on small entities affected by the reconsidered provisions.

3.4.4 Employment Impacts

In addition to addressing the costs and emissions reductions estimated for the final reconsideration, the EPA has analyzed the impacts of this rulemaking on employment.[99] Using detailed engineering information on labor requirements for the reconsidered provisions, we estimate partial employment impacts for affected entities in the oil and natural gas industry. These bottom-up, engineering-based estimates represent only one portion of potential employment impacts within the regulated industry and do not represent estimates of the *net* employment impacts of this rule. Due to data and methodology limitations, other potential employment impacts in the affected industry and impacts in related industries are not estimated. For an overview of the various ways that environmental regulation can affect employment, see Section 2.4.4 and subsection 2.4.4.1.

We estimate the impacts of the Technical Reconsideration on the labor required to comply with the 2016 NSPS OOOOa. We estimate the incremental change due to the reconsideration, as compared to the baseline, in labor required to satisfy environmental mitigation requirements as well as reporting and recordkeeping requirements. Most of the estimated change in labor requirements relative to the baseline come from the changes to the fugitive emissions program.

The labor estimates include labor associated with company-level activities and activities at field sites. Company-level activities included one-time "up-front" activities such as planning the company's fugitive emissions program and annual requirements such as reporting and recordkeeping. Field-level activities included inspection and repair of leaks. The labor information is based upon the cost analysis presented in the TSD that supports this rule.

Table 3-25 presents the incremental change in labor required to comply with the NSPS due to the final amendments at the facility level in hours per facility per year. The change in estimates for each of the facility types reflect the following changes from the baseline:

[99] The employment analysis in this RIA is part of the 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).

- **Well sites:** change from semiannual fugitives monitoring requirements to streamlined requirements for semiannual monitoring and alternative fugitive emissions standards in relevant areas.[100]

- **Well sites (low production):** change from semiannual fugitives monitoring requirements to no monitoring requirements.

- **Gathering and Boosting Stations:** change from quarterly fugitives monitoring requirements to streamlined requirements for quarterly monitoring.[101]

- **Certifications:** change from requirement that professional engineer perform certification to an in-house engineer performing certifications.

Table 3-25 Facility-level Changes in Labor Required to Comply with NSPS OOOOa (hours per facility per year)

	Upfront Annual Labor Estimate (hours per facility per year)			Annual Labor Estimate (hours per facility per year)		
Facility	Baseline	Recon-sideration	Incremental Change	Baseline	Recon-sideration	Incremental Change
Well Sites						
Annual monitoring	8.5	2	-6.5	12.5	10	-2.5
Semiannual monitoring	8.5	2	-6.5	18.6	14.6	-4
Well Sites (Low Production)						
Annual monitoring	8.5	0	-8.5	10.3	0	-10.3
Semiannual monitoring	8.5	0	-8.5	14.2	0	-14.2
Compressor Stations						
Gathering and Boosting	10.6	4.1	-6.5	65.7	37.5	-28.2
Certifications	6	5	-1	0	0	0

Tables 3-26 and 3-27 present estimates of the decrease in upfront labor requirements for compliance requirements for non-low production well sites, low production well sites, gathering and boosting stations, and certifications, respectively. The estimates are presented in terms of FTE in these tables; in this analysis we assume one FTE equals 2,080 hours (the product of 40

[100] Since the 2018 Amendment package reduced monitoring frequency at NSPS-affected well sites on the Alaska North Slope from semiannual to annual frequency, Alaska well sites change from annual fugitives monitoring requirements to streamlined annual requirements.

[101] EPA is reducing the required monitoring frequency at NSPS-affected gathering and boosting stations from quarterly to annual for those on the Alaska North Slope. We are unable to quantify the potential compliance-related labor impacts associated with this provision.

hours per week over 52 weeks). Reductions in labor increase from 2021 to 2030 as the number of sites affected by the Technical Reconsideration accumulates.

Table 3-26 Estimates of the Decrease in Upfront Labor Required (in FTE), 2021-2030

Year	Well Sites	Well Sites (Low Production)	Gathering and Boosting Stations	Certifications	Total
2021	33	7.3	0.66	0.76	42
2022	35	7.6	0.66	0.79	44
2023	55	32	1.3	0.80	90
2024	46	19	1.3	0.81	67
2025	49	23	1.3	0.82	74
2026	53	28	1.3	0.82	83
2027	54	29	1.3	0.83	85
2028	55	30	1.3	0.83	87
2029	56	31	1.3	0.83	89
2030	57	32	1.3	0.83	91

Note: Full-time equivalents (FTE) are estimated by first multiplying the projected number of affected units by the per unit labor requirements and then multiplying by 2,080 (40 hours multiplied by 52 weeks). Estimates may not sum due to independent rounding.

Table 3-27 Estimates of the Decrease in Annual Labor Required (in FTE), 2021-2030

Year	Well Sites	Well Sites (Low Production)	Gathering and Boosting Stations	Certifications	Total
2021	340	120	20	0	490
2022	390	160	23	0	570
2023	440	190	26	0	660
2024	490	230	29	0	740
2025	530	270	32	0	830
2026	570	310	34	0	920
2027	610	360	37	0	1,000
2028	650	400	40	0	1,100
2029	690	450	43	0	1,200
2030	720	500	46	0	1,300

Note: Full-time equivalents (FTE) are estimated by first multiplying the projected number of affected units by the per unit labor requirements and then multiplying by 2,080 (40 hours multiplied by 52 weeks). Estimates may not sum due to independent rounding.

The total incremental reductions in up-front labor requirements for the affected industry to comply with the final reconsideration are estimated to increase from 42 FTE in 2021 to 91 FTE in 2030. The total incremental reductions in annual labor requirements for the affected industry to comply with the final reconsideration are estimated to increase from about 490 FTE in 2021 to 1,300 FTE in 2030.

We note that this type of FTE estimate cannot be used to identify the specific number of employees involved or whether new jobs are created for new employees, versus displacing jobs from other sectors of the economy. As stated earlier, this rule is expected to result in little change in oil and natural gas exploration and production and is not expected to result in significant reductions to the labor dedicated to these tasks. For impacted oil and natural gas entities affected, some reductions in labor from 2016 NSPS OOOOa-related requirements may be expected under the final reconsideration. We did not estimate any potential impacts on labor outside of the affected sector. For example, no estimates of labor requirements for manufacturing pollution control equipment, or for producing the materials used in that equipment, are provided as the EPA did not have the necessary information.

3.5 Comparison of Benefits and Costs

3.5.1 Comparison of Benefits and Costs

In this section, we present a comparison of the benefits and costs of this final Technical Reconsideration across regulatory options. We refer to the cost reductions as the "benefits" of this final action and the forgone benefits as the "costs" of this final action. The net benefits are the benefits (cost reductions) minus the costs (forgone benefits). All costs and benefits in this RIA are estimated relative to the baseline. The benefits, costs, and net benefits shown in this section are presented in PV terms for 2021 to 2030 discounted to 2020 using 7 percent and 3 percent discount rates, along with the associated EAVs.

Table 3-28 shows the estimated benefits, costs and net benefits for Option 1, the most stringent option. In this option, we estimate the impact of streamlined fugitive emissions monitoring reporting and recordkeeping, certifying several state fugitive emissions monitoring programs as alternative fugitive emissions standards, and in-house certifications. As there are no projected changes in emissions under this unselected option, there are no costs (forgone benefits). For option 1, at a 7 percent discount rate, the PV of net benefits is estimated to be $350 million with an EAV of $46 million. At a 3 percent discount rate, the PV of net benefits is estimated to be $440 million with an EAV of $50 million.

Table 3-28 Present Value (PV) and Equivalent Annualized Value (EAV) of Forgone Monetized Benefits, Cost Reductions, and Net Benefits for Unselected Option 1 from 2021 to 2030 (millions, 2016$)

	7%		3%	
	PV	**EAV**	**PV**	**EAV**
Benefits (Total Cost Reductions)	$350	$46	$440	$50
Cost Reductions	$350	$46	$440	$50
Forgone Value of Product Recovery	$0	$0	$0	$0
Costs (Forgone Domestic Climate Benefits)	$0	$0	$0	$0
Net Benefits	$350	$46	$440	$50

Note: Estimates may not sum due to independent rounding.

Table 3-29 shows the estimated benefits, costs and net benefits for Option 2. Option 2 results in net benefits greater than those of Option 1, but less than those of Option 3. In this option, we estimate the impact of removing of the fugitive emissions monitoring requirement for low production well sites, streamlining fugitive emissions monitoring reporting and recordkeeping at non-low production well sites and gathering and boosting stations, certifying several state fugitive emissions monitoring programs as alternative fugitive emissions standards, and allowing in-house engineering certifications for closed vent systems and infeasibility . For the finalized Option 3, at a 7 percent discount rate, the PV of net benefits is estimated to be $670 million with an EAV of $89 million. At a 3 percent discount rate, the PV of net benefits is estimated to be $810 million with an EAV of $92 million.

Table 3-29 Present Value (PV) and Equivalent Annualized Value (EAV) of Forgone Monetized Benefits, Cost Reductions, and Net Benefits for Unselected Option 2 from 2021 to 2030 (millions, 2016$)

	7%		3%	
	PV	**EAV**	**PV**	**EAV**
Benefits (Total Cost Reductions)	$680	$91	$860	$98
Cost Reductions	$720	$96	$910	$100
Forgone Value of Product Recovery	$36	$4.8	$47	$5.3
Costs (Forgone Domestic Climate Benefits)	$15	$2.0	$58	$6.6
Net Benefits	$670	$89	$810	$92

Note: Estimates may not sum due to independent rounding.

Table 3-30 shows the estimated benefits, costs and net benefits for the finalized Option 3. Option 3 is estimated to have the greatest cost reductions, forgone benefits, and net benefits of the three options analyzed. The finalized Option 3 is identical to Option 2 with the exception that fugitive emissions monitoring and repair frequency at gathering and boosting stations is reduced from quarterly to semiannual. For Option 3, the PV of net benefits is estimated to be $730 million with an EAV of $97 million at a 7 percent discount rate. The PV of net benefits is estimated to be $880 million with an EAV of $100 million at a 3 percent discount rate.

Table 3-30 Present Value (PV) and Equivalent Annualized Value (EAV) of Forgone Monetized Benefits, Cost Reductions, and Net Benefits for Finalized Option 3 from 2021 to 2030 (millions, 2016$)

	7%		3%	
	PV	**EAV**	**PV**	**EAV**
Benefits (Total Cost Reductions)	$750	$100	$950	$110
Cost Reductions	$800	$110	$1,000	$110
Forgone Value of Product Recovery	$44	$5.9	$57	$6.5
Costs (Forgone Domestic Climate Benefits)[1]	$19	$2.5	$71	$8.1
Net Benefits[2]	$730	$97	$880	$100

Note: Estimates may not sum due to independent rounding.
[1] The forgone benefits estimates are calculated using estimates of the social cost of methane (SC-CH_4). SC-CH_4 values represent only a partial accounting of domestic climate impacts from methane emissions. See Section 2.3 for more discussion.

Table 3-31 provides a summary of the forgone emissions reductions for each regulatory option. There are no changes in emissions estimated as a result of Option 1. Option 3 results in the greatest forgone emissions reductions compared to the baseline.

Table 3-31 Summary of Total Forgone Emissions Reductions across Options, 2021 to 2030

Pollutant	**Option 1**	**Option 2**	**Option 3 (Finalized)**
Methane (short tons)	0	370,000	450,000
VOC (short tons)	0	100,000	120,000
HAP (short tons)	0	3,800	4,700
Methane (metric tons)	0	330,000	410,000
Methane (million metric tons CO_2 Eq.)	0	8.3	10

3.5.2 Uncertainties and Limitations

There are several sources of uncertainty regarding the forgone emissions reductions, forgone benefits, and cost reductions estimated in this RIA for the Technical Reconsideration. We summarize the key uncertainties and limitations here:

Source-level compliance costs and emissions impacts: As discussed in Section 3.2.2, the first step in the compliance cost analysis is the development of per-facility national-average representative costs and emissions impacts using a model plant approach. The model plants are designed based upon the best information available to the Agency at the time of the rulemaking. By emphasizing facility averages, geographic variability and heterogeneity across producers in the industry may be masked, and regulatory impacts at the facility-level may vary from the model plant averages.

Projection methods and assumptions: As discussed in Section 3.2.3, the second step in estimating national impacts is the projection of affected facilities. Uncertainty in the projections informing this chapter include uncertainties such as: 1) choice of projection method; 2) data sources and drivers; 3) limited information about rate of modification and turnover of sources; 4) behavioral responses to regulation; and 5) unforeseen changes in industry and economic shocks.

Over time, more facilities are established or modified in each year, and to the extent the facilities remain in operation in future years, the total number of facilities subject to NSPS OOOOa accumulates. The impacts of this rule are highly influenced by projections and growth rates for drilling activity in the AEO2020. To the extent actual drilling activities diverge from the AEO projections, the regulatory impacts will diverge from those shown in this RIA. The projection of low production well sites also relies on a series of assumptions that introduce substantial uncertainties, which are discussed in Section 3.2.3. These uncertainties include the assumption that past production levels can be used to predict future production and the assumption that there are two wells per site with identical production profiles. The dataset used to estimate the transition proportions may also exclude wells that were shut-in since completion, which would lead to over-estimates of compliance cost and emissions impacts.

Additionally, some emissions reducing technologies have become common industry practice under the oil and natural gas sector NSPS. However, by removing regulatory requirements, there may be incentives to reduce use of these technologies, introducing uncertainties in how regulated entities may respond both directly and indirectly to the removal of NSPS requirements.

The projections do not account for potential changes in technological progress in the oil and gas industry. Additionally, unforeseen economic shocks may affect the rule's impacts, such as unexpected economic growth or recessions. For example, the projections in this RIA do not account for potential effects of economic shocks arising from the coronavirus pandemic.

Years of analysis: The years of analysis are 2021, to represent the first-year facilities are affected by this Technical Reconsideration, through 2030, to represent impacts of the rule over a longer period. While it is desirable to analyze impacts beyond 2030, the EPA has chosen not to do so largely because of the limited information available on the turnover rate of emissions sources and controls. Extending the analysis beyond 2030 would introduce increasing uncertainties in projected impacts of the final reconsideration.

Fugitive emissions monitoring requirements and alternative fugitive emissions standards: The EPA reviewed state regulations and permitting requirements. Emissions reductions from applicable facilities under state requirements that are considered equivalent to the NSPS are included in the baseline for this analysis. We also estimate cost reductions from deeming programs in six states as equivalent to NSPS OOOOa, which reduces reporting and recordkeeping burden for sources regulated under those programs. We made simplifying assumptions to estimate the cost reductions associated with the reduced recordkeeping for affected facilities regulated under the state programs deemed equivalent to NSPS OOOOa.[102] Due to uncertainty regarding these assumptions, there is uncertainty in the assumed cost reductions from reduced federal reporting and recordkeeping requirements for facilities under alternative fugitive emissions standards.

Wellhead natural gas prices used to estimate forgone revenues from natural gas recovery: The cost reductions estimated in this RIA include the forgone revenue associated with the decrease in natural gas recovery resulting from forgone emissions reductions. As a result, the forgone revenues in the cost reduction estimates depend on the price of natural gas. The natural gas prices used in this analysis are from the projection of the Henry Hub price in the AEO2020. As with any modeling of prices, many assumptions regarding future economic activity and several of the data sources used to inform the AEO in projecting natural gas prices are subject to uncertainty. To the extent actual natural gas prices diverge from the AEO projections, the impacts estimated in this RIA will diverge from actual impacts.

[102] For example, we assume that operators in equivalent states will continue to incur company-level reporting and recordkeeping costs related to reading the rule, developing a fugitive emissions monitoring plan, and establishing and maintaining a database. If an affected entity operates solely within an equivalent area, the entity would not incur any of these costs due to federal requirements, and thus cost reductions for such an entity's facilities would be understated in the impact estimates in this RIA.

Monetized forgone methane-related climate benefits: The EPA considered the uncertainty associated with the social cost of methane (SC-CH_4) estimates, which were used to estimate the forgone domestic benefits associated with the increase in methane emissions projected under the regulatory options examined in this RIA. Several sources of uncertainty cannot be quantified. Section 2.3.3 and Appendix B provide detailed discussions of the ways in which the modeling underlying the development of the SC-CH_4 estimates used in this analysis addresses quantifiable sources of uncertainty, and presents a sensitivity analysis to show how the choice of discount rate affects the SC-CH_4 estimates over long time horizons.

Non-monetized forgone benefits: Several categories of forgone health, welfare, and climate benefits are not quantified and monetized in this RIA. These unquantified forgone benefits are associated with increased emissions of methane, VOCs, and HAP. Section 3.3 describes the unquantified forgone benefits associated with these emissions.

3.6 References

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4 ANALYSIS OF THE COMBINED REGULATORY IMPACTS OF THE POLICY REVIEW AND TECHNICAL RECONSIDERATION

4.1 Introduction

To better inform the public on the aggregate regulatory impacts of the two final actions discussed in this document, this chapter presents the analysis of the combined regulatory impacts of the two actions. The combined impacts are projected relative to a baseline representing the regulatory landscape in the absence of either action, *i.e.*, the same baseline used in the Policy Review analysis.

As a reminder, Chapter 2 in this document presents the regulatory impacts of the final amendments referred to in this document as the Policy Review, while Chapter 3 presents the regulatory impacts of the final amendments which we refer to in this document at the Technical Reconsideration. The Policy Review removes sources in the transmission and storage segment from the source category, rescinds the NSPS (including both the volatile organic compounds and methane requirements) applicable to those sources, and rescinds the methane-specific requirements of the NSPS applicable to sources in the production and processing segments. The Technical Reconsideration finalizes amendments to the 2016 OOOOa NSPS fugitive emissions requirements, well site pneumatic pump standards, requirements for certification of closed vent systems (CVS) by a professional engineer, and the provisions which outline the use of alternative fugitive emissions standards for several state programs.

To avoid redundant descriptions of the methods, assumptions, and data used to estimate the impacts presented in this chapter, we refer readers back to Chapters 2 and 3 and focus this chapter on presenting the results of the analysis for the combined final actions. Readers can also find tables with more detailed results for the individual actions in Chapters 2 and 3.

4.2 Compliance Cost Reductions and Forgone emissions reductions

4.2.1 Pollution Controls and Emissions Points Assessed in this RIA

The analysis presented in this chapter reflects the emissions points and controls assessed in the preceding chapters. This includes fugitive emissions monitoring requirements at well sites and gathering and boosting stations (Technical Reconsideration), and transmission and storage compressor stations (Policy Review); replacement of high-bleed pneumatic controllers with low-bleed controllers in the transmission and storage segment (Policy Review); rod-packing replacement at reciprocating compressors in the transmission and storage segment (Policy Review); and certification of closed vent systems or technical infeasibility at storage vessels, compressors, and pneumatic pumps (Technical Reconsideration). See Sections 2.2.1 and 3.2.1 for more details.

4.2.2 Projection of Affected Facilities

The projected affected facility counts for this analysis are identical to the projected counts used in the analyses underlying the preceding chapters. See Sections 2.2.2 and 3.2.2 and the associated tables for details.

4.2.3 Forgone Emissions Reductions

Table 4-1 presents the projected forgone emissions reductions associated with the combined rulemakings compared to the baseline (i.e., where neither rule has been promulgated). Increases in emissions are estimated by multiplying the source-level increases in emissions from the updated baseline by the corresponding projected number of affected facilities. The projected forgone emissions reductions in Table 4-1 are equivalent to the sum of the forgone emissions reductions in Table 2-4 and Table 3-6. As noted in previous chapters of this document, some provisions included in the Policy Review and Technical Reconsideration are not analyzed because we either do not have the data to do so or because the provision is not expected to result in cost reductions or emission changes.

Table 4-1 Projected Forgone Emissions Reductions from the Combined Policy Review and Technical Reconsideration, 2021 to 2030

	Emission Changes			
Year	Methane (short tons)	VOC (short tons)	HAP (short tons)	Methane (metric tons CO_2 Eq.)
2021	41,000	5,800	220	930,000
2022	49,000	7,200	270	1,100,000
2023	58,000	8,800	320	1,300,000
2024	68,000	10,000	390	1,500,000
2025	78,000	12,000	450	1,800,000
2026	88,000	14,000	520	2,000,000
2027	99,000	16,000	600	2,200,000
2028	110,000	18,000	670	2,500,000
2029	120,000	20,000	750	2,700,000
2030	130,000	23,000	840	3,000,000
Total	850,000	140,000	5,000	19,000,000

Note: Estimates may not sum due to independent rounding.

4.2.4 Forgone Product Recovery

Some emissions control requirements in the baseline capture methane and VOC emissions that would otherwise be emitted in absence of such requirements (*i.e.*, the fugitive emissions monitoring program requirements), and we assume that a large proportion of these averted methane emissions in the baseline can be directed into natural gas production streams and sold. When including the decrease in natural gas recovery in the cost reductions analysis, we use the projections of natural gas prices provided in the EIA's AEO2020 reference case. See Section 2.2.5 for details on natural gas price assumptions.

Table 4-2 summarizes the projected decrease in natural gas recovery and the associated forgone revenues included in the cost reductions calculations for the combined Policy Review and Technical Reconsideration. The projected decrease in natural gas recovery and the associated forgone revenue reductions in each row of Table 4-2 is equivalent to the sum of the values in the corresponding rows from Table 2-5 and Table 3-7.

Table 4-2 Projected Decrease in Natural Gas Recovery from the Combined Policy Review and Technical Reconsideration, 2021 to 2030

Year	Decrease in Gas Recovery (Mcf)	Forgone Revenue (millions 2016$)
2021	2.4	$4.9
2022	2.9	$5.9
2023	3.4	$7.1
2024	3.9	$8.6
2025	4.5	$11
2026	5.1	$13
2027	5.7	$16
2028	6.4	$18
2029	7.0	$20
2030	7.7	$21

4.2.5 Compliance Cost Reductions

Table 4-3 summarizes the projected cost reductions and forgone revenue from product recovery for the combined Policy Review and Technical Reconsideration. Annualized cost reductions are estimated by applying a capital recovery factor, based on a 7 percent interest rate and the assumed equipment lifetime, to capital cost reductions. The projected cost reductions and forgone revenue in Table 4-3 are equivalent to the sum of projected cost reductions and forgone revenues in Table 2-6 and Table 3-8.

Table 4-3 Estimated Cost Reductions from the Combined Policy Review and Technical Reconsideration, 2021 to 2030 (millions 2016$)

Year	Compliance Cost Reductions				
	Capital Cost Reductions[1]	Operating and Maintenance Cost Reductions	Annualized Cost Reductions (w/o Forgone Revenue)[2]	Forgone Revenue from Product Recovery	Annualized Cost Reductions (with Forgone Revenue)
2021	$8.8	$56	$65	$4.9	$61
2022	$9.1	$67	$78	$5.9	$72
2023	$18	$79	$92	$7.1	$85
2024	$14	$93	$110	$8.6	$98
2025	$15	$110	$120	$11	$110
2026	$17	$120	$140	$13	$120
2027	$18	$140	$150	$16	$140
2028	$18	$150	$170	$18	$150
2029	$18	$170	$190	$20	$170
2030	$19	$180	$210	$21	$190

Note: Estimates may not sum due to independent rounding.
[1] The capital cost reductions include the planning cost reductions for newly affected sources for fugitive emissions monitoring and capital cost reductions for newly affected controllers and compressors, as well as the cost reductions for sources that would renew survey monitoring plans and purchase new capital at the end of its useful life.
[2] These cost reductions include the capital cost reductions annualized over the requisite equipment lifetimes at an interest rate of 7 percent, plus the annual operating and maintenance cost reductions for every year, plus the cost reductions from streamlined recordkeeping and reporting.

Table 4-4 illustrates the sensitivity of the estimated cost reductions to the interest rate used to annualize capital costs. We present cost reductions using interest rates of 7 percent and 3 percent. The results in Table 4-4 are equivalent to the sum of projected cost reductions and forgone revenue in Table 2-7 and Table 3-9.

Table 4-4 Estimated Cost Reductions from the Combined Policy Review and Technical Reconsideration, 2021 to 2030 (millions 2016$)

Year	7 percent			3 percent		
	Annualized Cost Reductions (w/o Forgone Revenue)	**Forgone Revenue from Product Recovery**	**Annualized Cost Reductions (with Forgone Revenue)**	**Annualized Cost Reductions (w/o Forgone Revenue)**	**Forgone Revenue from Product Recovery**	**Annualized Cost Reductions (with Forgone Revenue)**
2021	$65	$4.9	$61	$64	$4.9	$60
2022	$78	$5.9	$72	$77	$5.9	$71
2023	$92	$7.1	$85	$91	$7.1	$84
2024	$110	$8.6	$98	$110	$8.6	$97
2025	$120	$11	$110	$120	$11	$110
2026	$140	$13	$120	$140	$13	$120
2027	$150	$16	$140	$150	$16	$140
2028	$170	$18	$150	$170	$18	$150
2029	$190	$20	$170	$190	$20	$170
2030	$210	$21	$190	$200	$21	$180

Note: Estimates may not sum due to independent rounding.

4.2.6 Present Value and Equivalent Annualized Value of Cost Reductions

This section presents the cost reductions for the combined Policy Review and Technical Reconsideration in a present value (PV) framework. Table 4-5 shows the unannualized, undiscounted stream of cost reductions for each year from 2021 to 2030. Table 4-6 then shows the stream of discounted cost reductions for each year from 2021 to 2030. The stream of estimated cost reductions for each year from 2021 through 2030 is discounted to 2020 using 7 and 3 percent discount rates and summed to estimate the PV of the cost reductions from 2021 to 2030. Table 4-6 also shows the equivalent annualized value (EAV) associated with the PV of the cost reductions. The EAV is a single annual value which, when discounted and summed across years in the analysis time frame, equals the PV of the original stream of values. In other words, the sum of the EAV across years in PV terms yields the PV of the (generally) time-varying stream of values.

Table 4-5 Undiscounted Projected Compliance Cost Reductions from the Combined Policy Review and Technical Reconsideration, 2021-2030 (millions 2016$)

Year	Capital Cost Reductions	Annual Operating Cost Reductions	Total Cost Reductions (w/o Forgone Revenue)	Forgone Revenue from Product Recovery	Total Cost Reductions (with Forgone Revenue)
2021	$8.8	$56	$65	$4.9	$60
2022	$9.1	$67	$76	$5.9	$70
2023	$18	$79	$98	$7.1	$90
2024	$14	$93	$110	$8.6	$98
2025	$15	$110	$120	$11	$110
2026	$17	$120	$140	$13	$120
2027	$18	$140	$150	$16	$140
2028	$18	$150	$170	$18	$150
2029	$18	$170	$180	$20	$160
2030	$19	$180	$200	$21	$180

Note: Estimates may not sum due to independent rounding.

Table 4-6 Discounted Cost Reductions from the Combined Policy Review and Technical Reconsideration, using 7 and 3 Percent Discount Rates (millions 2016$)[1]

Year	7 Percent			3 Percent		
	Total Annual Cost Reductions (w/o Forgone Revenue)	Forgone Revenue from Product Recovery	Total Cost Reductions (with Forgone Revenue)	Total Annual Cost Reductions (w/o Forgone Revenue)	Forgone Revenue from Product Recovery	Total Cost Reductions (with Forgone Revenue)
2021	$60	$4.6	$56	$63	$4.8	$58
2022	$67	$5.2	$62	$72	$5.6	$66
2023	$80	$5.8	$74	$89	$6.5	$83
2024	$82	$6.6	$75	$95	$7.6	$87
2025	$87	$7.6	$79	$100	$9.2	$96
2026	$92	$8.8	$83	$120	$11	$100
2027	$95	$9.7	$86	$120	$13	$110
2028	$98	$10	$88	$130	$14	$120
2029	$100	$11	$90	$140	$15	$130
2030	$100	$11	$91	$150	$16	$130
PV	**$860**	**$80**	**$780**	**$1,100**	**$100**	**$990**
EAV	**$110**	**$11**	**$100**	**$120**	**$12**	**$110**

Note: Estimates may not sum due to independent rounding.
[1] Cost reductions and forgone revenue in each year are discounted to 2020.

The Policy Review and Technical Reconsideration are considered deregulatory actions under E.O. 13771, Reducing Regulation and Controlling Regulatory Costs. The PV of the combined projected cost reductions from the two final rules calculated in accordance with E.O. 13771 accounting standards are \$1.1 billion over an infinite time horizon (in 2016\$, discounted to 2016 at 7 percent). The EAV of the cost reductions over an infinite time horizon are \$79 million per year (in 2016\$, discounted to 2016 at 7 percent).

4.3 Forgone Benefits

For the 2012 NSPS OOOO and 2016 NSPS OOOOa, the EPA projected climate and ozone benefits from methane reductions, ozone and fine particulate matter ($PM_{2.5}$) health benefits from VOC reductions, and health benefits from ancillary HAP emissions reduction. Compliance with these standards was projected to yield benefits due to reductions in methane, VOC, and HAP emissions.

Under the Policy Review and Technical Reconsideration, the EPA expects that the forgone VOC emission reductions will worsen air quality and adversely affect health and welfare due to the contribution of VOCs to ozone, $PM_{2.5}$, and HAP, but we are unable to quantify these impacts at this time. This omission does not imply that these forgone benefits do not exist.

We estimate the forgone climate benefits under the combined Policy Review and Technical Reconsideration using an interim measure of the domestic social cost of methane (SC-CH_4). The SC-CH_4 is an estimate of the monetary value of impacts associated with marginal changes in CH_4 emissions in a given year. It includes a wide range of anticipated climate impacts, including those on agricultural productivity and human health, property damage due to increased flood risk, and energy system costs, (*e.g.*, 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.*, the benefits associated with incremental reductions in cumulative CH_4 emissions due to regulation). The SC-CH_4 estimates used in this analysis focus on the direct impacts of climate change that are anticipated to occur within U.S. borders. See Section 2.2.3 and Appendix B for more detailed discussion of the SC-CH_4.

Table 4-7 presents the projected monetized forgone domestic climate benefits associated with the combined Policy Review and Technical Reconsideration. The results in Table 4-7 are equal to the sum of the projected monetized forgone domestic climate benefits presented in Table 2-16 and Table 3-23.

Table 4-7 Projected Forgone Domestic Climate Benefits Reductions from the Combined Policy Review and Technical Reconsideration, 2021-2030 (millions, 2016$)

	Undiscounted		Discounted back to 2020	
Year	**7 percent**	**3 Percent**	**7 percent**	**3 Percent**
2021	$2.1	$6.7	$2.0	$6.5
2022	$2.7	$8.4	$2.4	$7.9
2023	$3.3	$10	$2.7	$9.3
2024	$4.0	$12	$3.1	$11
2025	$4.8	$14	$3.4	$12
2026	$5.6	$17	$3.8	$14
2027	$6.5	$19	$4.1	$16
2028	$7.5	$22	$4.4	$17
2029	$8.6	$25	$4.7	$19
2030	$9.8	$28	$5.0	$21
PV			**$35**	**$130**
EAV			**$4.7**	**$15**

Note: Estimates may not sum due to independent rounding.

4.4 Economic Impacts and Distributional Assessments

As in the preceding chapters, we discuss but do not quantify energy market, distributional, or small business impacts associated with the combined Policy Review and Technical Reconsideration. We expect that the combined final actions will reduce the energy market impacts associated with the 2016 NSPS OOOOa, may have unevenly distributed impacts across the U.S. population, and will have neutral or beneficial impacts on small businesses (*i.e.*, no SISNOSE). See Sections 2.4.1, 2.4.2, and 2.4.3 for more detailed discussion.

We estimated partial employment impacts for entities in the oil and natural gas industry projected to be affected by the Policy Review and Technical Reconsideration. Table 4-8 presents estimates of the decrease in upfront and annual labor requirements associated with compliance activities resulting from the combined final actions. In total, we estimate decreases in compliance-related labor ranging from 550 full-time equivalents (FTE) in 2021 to 1,400 FTE in 2030, mostly driven by decreases in annual labor requirements. We did not estimate changes in labor in the oil and natural gas sector beyond the labor related to the compliance activities directly affected by these actions, nor did we estimate changes in labor in other sectors that may result from these final actions. See Section 2.4.4 for a broader discussion of the labor impacts, including a qualitative overview of regulatory impacts on employment.

Table 4-8 Estimates of the Decrease in Labor Required for Compliance (in FTEs), 2021–2030

Year	Upfront	Annual	Total
2021	43	520	560
2022	45	610	650
2023	92	700	790
2024	70	790	860
2025	76	880	960
2026	86	970	1,100
2027	87	1,100	1,100
2028	90	1,200	1,200
2029	92	1,200	1,300
2030	94	1,300	1,400

Note: Estimates may not sum due to independent rounding.

4.5 Comparison of Benefits and Costs

4.5.1 Comparison of Benefits and Costs

In this section, we present a comparison of the benefits and costs of the combined Policy Review and Technical Reconsideration (Table 4-9). Here, we refer to the cost reductions as the "benefits" of this combined actions and the forgone benefits as the "costs" of the combined actions. The net benefits are the benefits (cost reductions) minus the costs (forgone benefits). All costs and benefits in this RIA are estimated relative to a baseline in which neither action has been implemented. The benefits, costs, and net benefits shown in this section are presented in PV terms for 2021 to 2030 discounted to 2020 using 7 percent and 3 percent discount rates, along with the associated EAVs. Table 4-10 provides a summary of the projected forgone emissions reductions for this action. Both Table 4-9 and Table 4-10 are equivalent to the sum of the values in their respective tables in Sections 2.5.1 and 3.5.1.

Table 4-9 Present Value (PV) and Equivalent Annualized Value (EAV) of Forgone Monetized Benefits, Cost Reductions, and Net Benefits from the Combined Policy Review and Technical Reconsideration, 2021 through 2030 (millions, 2016$)

	7 percent		3 percent	
	PV	**EAV**	**PV**	**EAV**
Benefits (Total Cost Reductions)	$780	$100	$990	$110
Cost Reductions	$860	$110	$1,100	$120
Forgone Value of Product Recovery	$80	$11	$100	$12
Costs (Forgone Domestic Climate Benefits)[1]	$35	$4.7	$130	$15
Net Benefits	$750	$99	$850	$97

Note: Estimates may not sum due to independent rounding.
[1] The forgone benefits estimates are calculated using estimates of the social cost of methane (SC-CH_4). SC-CH_4 values represent only a partial accounting of domestic climate impacts from methane emissions.

Table 4-10 Summary of Forgone Emission Reductions from the Combined Policy Review and Technical Reconsideration, 2021 through 2030

Pollutant	**Policy Review**
Methane (short tons)	850,000
VOC (short tons)	140,000
HAP (short tons)	5,000
Methane (metric tons)	770,000
Methane (million metric tons CO_2 Eq.)	19

4.5.2 Uncertainties and Limitations

The results of the combined analysis presented in this Chapter are subject to the uncertainties discussed in Sections 2.5.2 and 3.5.2. While the reader is referred to those sections for more detail, we list the main sources of uncertainties here:

- Source-level compliance costs and emissions impacts
- Projection methods and assumptions
- Years of analysis
- State regulations in the baselines for this analysis
- Wellhead natural gas prices used to estimate forgone revenues from natural gas recovery
- Monetized forgone methane-related climate benefits
- Non-monetized forgone benefits

APPENDIX A ADDITIONAL INFORMATION ON ACTIVITY COUNT PROJECTIONS

A.1 Updated Baseline

The baseline used in this analysis represents our estimate of the present and future state of the oil and natural gas industry as of this final action. This includes an estimate of the number of sources that are subject to the 2016 NSPS OOOOa using the same methods as were used in the 2016 NSPS analysis. A description of these methods is in the 2016 NSPS Final TSD and 2016 RIA. Where possible, we updated the information used, including sources of information, as described below. For well sites, we used a base year, in this case 2014, estimate of the number of oil and natural gas wells, along with a year-by-year rate of change in the number of new oil and natural gas wells, to project the number of affected oil and natural gas wells through 2030. For gathering and boosting stations and transmission and storage facilities, we estimated an average number of new facilities per year.

A.2 Data Sources

Data from oil and natural gas technical documents and inventories, including previous TSDs for oil and gas actions, were used to estimate the number of new sources for each of the oil and natural gas segments. Information from the DrillingInfo database and the GHGI were updated from the 2016 NSPS OOOOa analysis. DrillingInfo was used to estimate the number of new well sites in 2014, and AEO2020 was used to project the number of new well sites through 2030. The GHGI was used to update the equipment counts for well sites and gathering and boosting stations, while equipment counts for the transmission and storage compressor stations were not updated for the model plants. We used the GHGI to estimate the number of new gathering and boosting, transmission, and storage compressor stations, and other equipment in the transmission and storage segment, such as reciprocating compressors and pneumatic controllers. Finally, we relied on data submitted in compliance reports for the 2016 NSPS OOOOa to inform our projections for a few sources, such as storage vessels, pneumatic pumps, and centrifugal compressors.

A.3 Number of Well Sites

The DrillingInfo database provided the information on the total number of oil and natural gas wells completed or recompleted in 2014 in the U.S. The base year of 2014 was chosen because 2014 predated the proposal for the 2016 NSPS OOOOa, and therefore activity in that year was not affected by those requirements. The DrillingInfo data includes information on GOR, location, and production. The EPA used this data to calculate the number of affected sources for each sub-type of model plant based on the GOR and initial production information, which characterized completion status, use of hydraulic fracturing, and location of the well. The GOR categories are gas wells (GOR greater than 100,000), oil with associated gas wells (GOR less than 100,000 and greater than 300), and heavy oil wells (GOR less than 300). Wells are categorized by GOR based on the total production in the base year (2014).

For newly completed or recompleted well sites, the EPA evaluated the emission reductions and cost of control for low production well sites, defined as sites in which the combined oil and natural gas production is less than 15 boe per day averaged over the first 30 days of production, separately from that of non-low production well sites. We used production information from the DrillingInfo data to estimate the proportion of well sites that would be classified as low production (less than 15 boe per day production) or non-low production (greater than 15 boe per day production) by calculating the proportion of wells in the dataset producing less than 7.5 boe per day, which is equivalent to the model plant, which is assumed to have two wells per site, producing fewer than 15 boe per day combined. These production levels were based on the initial production reported in DrillingInfo. The DrillingInfo field ‘PRAC_IP_BOE’ was used, which includes both liquid and gas production and is based on the second month production recorded for the well. The second month was used to represent practical initial production because the first month record may be a partial month depending on when production started. After estimating the number of new wells based on each subcategory and subtype that are subject to the 2016 NSPS OOOOa, we applied the same assumption of two wells per well site as used in the model plant analysis to obtain the number of each well site subject to the 2016 NSPS OOOOa. A discussion of how EPA estimated the transitions to and from low production status in later periods in presented in Section 3.2.3 above.

Additionally, the EPA published final amendments to the 2016 OOOOa rule on March 12, 2018 that created separate fugitives monitoring and repair requirements for well sites on the Alaska North Slope.[103] In summary, these amendments granted additional time for initial monitoring during cold weather months and required annual monitoring for these well sites. We used the location information from DrillingInfo to identify these well sites, and those in the states subject to fugitive emissions standards under state regulations.

Table A-1 shows the count of well sites in the base year (2014) for each model plant. In this table, wells are broken out into states of interest, including Alaska, California, Colorado and Texas.

Table A- 1 Well Completions in 2014 by Production Level and Well Type

	Non-low production wells			**Low production wells**		
Location	**Natural Gas**	***Oil (GOR >300)***	***Oil (GOR <300)***	**Natural Gas**	***Oil (GOR >300)***	***Oil (GOR <300)***
Alaska/North-Slope	2	59	2	0	4	0
Alaska/Other	14	6	1	6	1	0
California	9	298	575	2	133	581
Colorado	284	1,035	44	33	20	16
Louisiana	231	281	111	23	50	407
North Dakota	0	2,081	138	0	48	17
New Mexico	43	950	55	12	116	27
Ohio	169	290	10	71	97	134
Oklahoma	341	1,383	421	63	71	231
Pennsylvania	605	103	6	64	408	337
Texas	973	10,302	1,397	141	1,176	1,459
Utah	122	558	42	12	131	9
Wyoming	255	549	113	55	20	65
Other states	954	484	780	335	169	1,058

Source: DrillingInfo database extracted January 2018.[104]

We used the AEO2020 projection of wells drilled in the contiguous 48 states to estimate a year-by-year rate of change from 2014 through 2030. We applied that year by year rate of change to the estimated number of wells in 2014 from DrillingInfo, regardless of well type, to project the estimated number of new well sites through 2030, scaled to the AEO oil and natural gas drilling

[103] 83 FR 10628.
[104] Memorandum to Jameel Alsalam, EPA, Elizabeth Miller, EPA, and Melissa Weitz, EPA from Casey Pickering, ERG and Robyn Reid, ERG titled, *DI Desktop Data Processing Overview for OAP/OAQPS* located at Docket ID No. EPA-HQ-OAR-2017-0473. February 6, 2018.

activity projections. The estimated number of new or modified facilities using this well drilling-based approach varies across projection years depending on projected oil and natural gas drilling activity from the AEO.

In the process of estimating fugitive emissions controls at well sites in the baseline and regulatory options, the EPA accounted for wells that were assumed to be covered by state regulations. In cases where state regulations would achieve equal or greater controls as the 2016 NSPS OOOOa controls, the regulatory options in this reconsideration do not result in a change in applied controls. Based on EPA's analysis, programs in six states have enacted regulations we believe meet or exceed the 2016 NSPS OOOOa standard for fugitive emissions monitoring: California, Colorado, Ohio, Pennsylvania, Texas and Utah.[105] These states are broken out in Table A-1 above. In this analysis, we take the requirements from California, Colorado, Ohio, Pennsylvania, Texas, and Utah into account.[106]

A.4 Gathering and Boosting Stations and Transmission and Storage Compressor Stations

In addition to well sites, the fugitive emissions requirements apply to gathering and boosting stations, transmission compressor stations, and storage compressor stations. The GHGI is used to estimate the count of newly affected compressor stations in each year. The GHGI uses a variety of data sources and studies to estimate equipment counts and emissions. Many equipment counts are based on the data reported under the GHGRP, scaled up to reflect the total population including both GHGRP-reporting and non-reporting oil and natural gas facilities.

We estimated the number of new compressor stations, by type, by averaging the increases in the year-to-year changes in total national counts of equipment over the 10-year period from 2004

[105] For information on additional states that were examined and why they are not considered equivalent, see the TSD and the memo "Equivalency of State Fugitive Emissions Programs for Well Sites and Compressor Stations to Standards at 40 CFR Part 60, Subpart OOOOa", both of which are available in the docket.

[106] EPA proposed that certain fugitive emissions monitoring-related permits in Texas would be considered equivalent, but not all types of permits. At proposal, EPA did not have quantitative information on the share of Texas permits that, as proposed, would be considered equivalent. Information received during the public comment period for this action provides EPA with a basis to perform quantitative analysis for Texas facilities in this RIA. EPA also received additional information of the share of facilities in Utah that whose fugitive emissions monitoring-related emissions requirements would be considered equivalent to NSPS OOOOa requirements.

through 2014. Year-to-year increases were assumed to represent newly constructed facilities. Decreases in total counts were represented as zeros for that year, and average together with the annual increases. This approach results in the same number of new compressor stations in each projected year, regardless of increases or decreases in AEO projected drilling or production. These values reflect that construction of compressor stations and transmission pipelines are longer-term investments not necessarily correlated with short-term fluctuations in production. In addition, this approach may result in fewer total new and modified compressor stations for two reasons: (1) modifications of existing compressor stations are not captured, and (2) if existing compressor stations are closed and replaced with new facilities, those would not be reflected in the net increase in the year-to-year total. The national equipment counts estimated in the GHG Inventory are not disaggregated by state, therefore, activity data using this approach is only estimated at the national level. The average year-to-year increase for compressor stations is summarized in Table A-2.

Table A- 2 Average Year-to-Year Increases in Compressor Station Counts

Location	Average Year-to-Year Increase
Gathering and Boosting Stations	212
Transmission Compressor Stations	36
Storage Compressor Stations	2

A.5 Nationwide Activity Data for Other Equipment

Nationwide impacts of certifications for closed vent system design and technical infeasibility of routing pneumatic pumps to an existing control device, rod-packing replacements at reciprocating compressors, route-to-control measures for wet-seal centrifugal compressors, and use of low-bleed pneumatic controllers were calculated by estimating the count of affected facilities installed in a typical year and then using that typical year estimate to estimate the number of new affected facilities for each of the years in the study period, 2021 through 2030. Closed vent system and technical infeasibility certifications impact pneumatic pumps, centrifugal compressors, reciprocating compressors, and storage vessels. The other measures only generate impacts for sources in the transmission and storage segment in this final action.

The basis for the counts of affected facilities that would require closed vent system and technical infeasibility certifications in a typical year was information from 2016 NSPS OOOOa compliance information for 2017. The total number of new pneumatic pumps, centrifugal compressors, reciprocating compressors, and storage vessel affected facilities reported for 2017 are shown in Table A-3. These represent the number of new affected facilities in a “typical year.” The GHGI was used to generate counts of reciprocating compressors and pneumatic controllers in transmission and storage only; those values are also included in the table.

Table A- 3 Nationwide Number of New Affected Facilities Reported in Compliance Reports for Year 2017

Type of Affected Facility	Total Count
Pneumatic Pumps	663
Reciprocating Compressors	180
Production and Processing	104
Transmission and Storage	76
Centrifugal Compressors	0
Storage Vessels	697
Pneumatic Controllers (Transmission and Storage Only)	308

A.5.1 Pneumatic Pumps

As shown in Table A-3, there were 663 pneumatic pump affected facilities reported in 2017. Per the definition of pneumatic pump affected facility in §60.5365a(h), the only pneumatic pumps subject to the 2016 NSPS OOOOa are natural gas-driven diaphragm pumps. It is therefore assumed that all the pneumatic pumps reported in 2017 were diaphragm pumps. The compliance information did not specify the number of pneumatic pumps at sites with a control device. Therefore, the percent of pneumatic pumps assumed to be controlled retains the assumption from the Final NSPS 2016 TSD and the 2018 NSPS Proposal TSD that 75 percent of the new pumps are at sites with a control device or a process to which the pump discharge could be routed. For these pumps, the owner or operator would either need a certification of the closed vent system or a certification that it is infeasible to route the pump discharge emissions to a control device/process. Therefore, an estimated 497 pneumatic pumps will need certifications in a typical year. No information was available to determine differences in the number of new pneumatic pumps year-by-year, so the estimate of 497 was assumed for each of the study years of 2021 through 2030.

A.5.2 Compressors

No centrifugal compressor affected facilities appeared in the 2017 compliance reports. Therefore, we assume that there will be no new wet-sealed centrifugal compressors for any of the study years.

As shown in Table A-3, there were 180 new reciprocating compressor affected facilities reported in 2017. Of those, 32 were located at gas processing plants (in the production and processing segment) and 148 were located at compressor stations. Because the reports did not distinguish between reciprocating compressors at gathering and boosting versus transmission and storage stations, we assumed that 76 were located at the latter (72 in transmission and 4 in storage) based on the average change in reciprocating compressors in the transmission and storage segment in the GHGI from 2004 to 2014 (censoring yearly changes below by zero). The remaining 72 compressors were assigned to gathering and boosting stations, and so 104 compressors in total were assumed to be in the production and processing segment.

Not all new reciprocating compressors require engineering certification. If an owner or operator complies via the rod packing replacement compliance option provided in the rule, there is no requirement to obtain a certification of a closed vent system. However, if an owner or operator of a reciprocating compressor complies with the rule by routing the rod packing emissions through a closed vent system to a process, they would be required to obtain a certification of the closed vent system. The compliance information did not contain information regarding the number of reciprocating compressors complying with each of these options, but it is anticipated that the majority of the owners and operators of reciprocating compressors will comply via the rod packing changeout option. In the absence of specific information, the assumption that 10 percent of the reciprocating compressor affected facilities in the production and processing segment (an estimated 10 reciprocating compressor affected facilities) would comply by routing the emissions through a closed vent system to a process and thus require a certification. No information was available to determine differences in the number of new reciprocating compressor affected facilities year-by-year, so the estimated 10 reciprocating compressor affected facilities was assumed for each of the analysis years of 2021 through 2030.

A.5.3 Storage Vessels

There were 697 new storage vessel affected facilities reported in the 2017 compliance reports. Each of these storage vessels are required to route emissions through a closed vent system to a control device and are therefore required to obtain a closed vent system certification. This number is considerably lower than the estimate assumed in the 2018 NSPS Proposal TSD. The reason EPA believes that the estimate assumed in the 2018 NSPS Proposal TSD and the number of reporting new storage vessel affected facilities differ is attributed to the fact that the majority of new storage vessels are subject to legally and practicable enforceable limits in operating permits or regulations that result in VOC emissions below the 6 tons per year applicability threshold and are therefore not be subject to the 2016 NSPS OOOOa rule. In order to estimate the year-by-year number of storage vessel affected facilities, the 2017 number of 697 new storage vessel affected facilities was adjusted proportionally based on the number of projected wells drilled in a given year, according to AEO2020 projections.

A.5.4 Pneumatic Controllers

The annual count of new high-bleed pneumatic controllers in transmission and storage is 308. This estimate was generated by calculating the average annual change in high-bleed controllers in transmission and storage from 2011 to 2014 in the GHGI. In years in which the number of controllers decreased, we assume that the number of new controllers was zero.

A.5.5 Summary of Affected Facilities Requiring Certification

Table A-4 summarizes the projected number of the facilities in the years 2021 through 2030 that are affected by this reconsideration that require certification under the 2016 NSPS OOOOa rule.

Table A- 4 Estimated Number of Affected Facilities Requiring Certifications, 2021-2030

Type of Affected Facility	Pneumatic Pumps	Centrifugal Compressors	Reciprocating Compressors	Storage Vessels	Total
2021	497	0	10	1,074	1,589
2022	497	0	10	1,127	1,642
2023	497	0	10	1,162	1,677
2024	497	0	10	1,182	1,697
2025	497	0	10	1,194	1,709
2026	497	0	10	1,205	1,720
2027	497	0	10	1,209	1,724
2028	497	0	10	1,216	1,731
2029	497	0	10	1,226	1,741
2030	497	0	10	1,219	1,734

APPENDIX B UNCERTAINTY ASSOCIATED WITH ESTIMATING THE SOCIAL COST OF METHANE

B.1 Overview of Methodology Used to Develop Interim Domestic SC-CH_4 Estimates

The domestic SC-CH_4 estimates rely on the same ensemble of three integrated assessment models (IAMs) that were used to develop the IWG global SC-CH_4 (and SC-CO_2) estimates: DICE 2010, FUND 3.8, and PAGE 2009.[107] The three IAMs translate emissions into changes in atmospheric greenhouse concentrations, atmospheric concentrations into changes in temperature, and changes in temperature into economic damages. The emissions projections used in the models are based on specified socio-economic (GDP and population) pathways. These emissions are translated into atmospheric concentrations, and concentrations are translated into warming based on each model's simplified representation of the climate and a key parameter, equilibrium climate sensitivity. The effect of these Earth system changes is then translated into consumption-equivalent economic damages. As in the IWG exercise, these key inputs were harmonized across the three models: a probability distribution for equilibrium climate sensitivity; five scenarios for economic, population, and emissions growth; and discount rates.[108] All other model features were left unchanged. Future damages are discounted using constant discount rates of both 3 and 7 percent, as recommended by OMB Circular A-4.

The domestic share of the global SC-CH_4 — *i.e.*, an approximation of the climate change impacts that occur within U.S. borders[109] — is calculated directly in both FUND and PAGE. However, DICE 2010 generates only global estimates. Therefore, the EPA approximates U.S. damages as 10 percent of the global values from the DICE model runs, based on the results from a regionalized version of the model (RICE 2010) reported in Table 2 of Nordhaus (2017).[110] Although the regional shares reported in Nordhaus (2017) are specific to SC-CO_2, they still

[107] The models' full 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).

[108] See the IWG's summary of its methodology in the docket, document ID number EPA-HQ-OAR-2015-0827-5886, "Addendum to Technical Support Document on Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866: Application of the Methodology to Estimate the Social Cost of Methane and the Social Cost of Nitrous Oxide (August 2016)". See also National Academies (2017) for a detailed discussion of each of these modeling assumptions.

[109] Note that inside the U.S. borders is not the same as accruing to U.S. citizens, which may be higher or lower.

[110] Nordhaus, William D. 2017. Revisiting the social cost of carbon. *Proceedings of the National Academy of Sciences of the United States,* 114(7): 1518-1523.

provide a reasonable interim approach for approximating the U.S. share of marginal damages from methane emissions. Direct transfer of the domestic share from the SC-CO_2 may understate the U.S. share of the IWG global SC-CH_4 estimates based on DICE due to the combination of three factors: a) regional damage estimates are known to be highly correlated with output shares (Nordhaus 2017, 2014), b) the U.S. share of global output decreases over time in all five EMF-22 based socioeconomic scenarios used for the model runs, and c) the bulk of the temperature anomaly (and hence, resulting damages) from a perturbation in emissions in a given year will be experienced earlier for CH_4 than CO_2 due to the shorter lifetime of CH_4 relative to CO_2.

The steps involved in estimating the social cost of CH_4 are like those used for CO_2. The three integrated assessment models (FUND, DICE, and PAGE) are run using the harmonized equilibrium climate sensitivity distribution, five socioeconomic and emissions scenarios, constant discount rates described above. Because the climate sensitivity parameter is modeled probabilistically, and because PAGE and FUND incorporate uncertainty in other model parameters, the final output from each model run is a distribution over the SC-CH_4 in year *t* based on a Monte Carlo simulation of 10,000 runs. For each of the IAMs, the basic computational steps for calculating the social cost estimate in a particular year *t* are: 1.) calculate the temperature effects and (consumption-equivalent) damages in each year resulting from the baseline path of emissions; 2.) adjust the model to reflect an additional unit of emissions in year *t*; 3.) recalculate the temperature effects and damages expected in all years beyond *t* resulting from this adjusted path of emissions, as in step 1; and 4.) subtract the damages computed in step 1 from those in step 3 in each model period and discount the resulting path of marginal damages back to the year of emissions. In PAGE and FUND, step 4 focuses on the damages attributed to the US region in the models. As noted above, DICE does not explicitly include a separate US region in the model and therefore, the EPA approximates U.S. damages in step 4 as 10 percent of the global values based on the results of Nordhaus (2017). This exercise produces 30 separate distributions of the SC-CH_4 for a given year, the product of 3 models, 2 discount rates, and 5 socioeconomic scenarios. Following the approach used by the IWG, the estimates are equally weighted across models and socioeconomic scenarios in order to consolidate the results into one distribution for each discount rate.

B.2 Treatment of Uncertainty in Interim Domestic SC-CH_4 Estimates

There are various sources of uncertainty in the SC-CH_4 estimates used in this analysis. Some uncertainties pertain to aspects of the natural world, such as quantifying the physical effects of greenhouse gas emissions on Earth systems. Other sources of uncertainty are associated with current and future human behavior and well-being, such as population and economic growth, GHG emissions, the translation of Earth system changes to economic damages, and the role of adaptation. It is important to note that even in the presence of uncertainty, scientific and economic analysis can provide valuable information to the public and decision makers, though the uncertainty should be acknowledged and when possible taken into account in the analysis (National Academies 2013).[111] OMB Circular A-4 also requires a thorough discussion of key sources of uncertainty in the calculation of benefits and costs, including more rigorous quantitative approaches for higher consequence rules. This section summarizes the sources of uncertainty considered in a quantitative manner in the domestic SC-CH_4 estimates.

The domestic SC-CH_4 estimates consider various sources of uncertainty through a combination of a multi-model ensemble, probabilistic analysis, and scenario analysis. We provide a summary of this analysis here; more detailed discussion of each model and the harmonized input assumptions can be found in the 2017 National Academies report. For example, the three IAMs used collectively span a wide range of Earth system and economic outcomes to help reflect the uncertainty in the literature and in the underlying dynamics being modeled. The use of an ensemble of three different models at least partially addresses the fact that no single model includes all the quantified economic damages. It also helps to reflect structural uncertainty across the models, which stems from uncertainty about the underlying relationships among GHG emissions, Earth systems, and economic damages that are included in the models. Bearing in mind the different limitations of each model and lacking an objective basis upon which to differentially weight the models, the three integrated assessment models are given equal weight in the analysis.

[111] Institute of Medicine of the National Academies. 2013. Environmental Decisions in the Face of Uncertainty. The National Academies Press.

Monte Carlo techniques were used to run the IAMs many times. In each simulation the uncertain parameters are represented by random draws from their defined probability distributions. In all three models the equilibrium climate sensitivity is treated probabilistically based on the probability distribution from Roe and Baker (2007) calibrated to the IPCC AR4 consensus statement about this key parameter.[112] The equilibrium climate sensitivity is a key parameter in this analysis because it helps define the strength of the climate response to increasing GHG concentrations in the atmosphere. In addition, the FUND and PAGE models define many of their parameters with probability distributions instead of point estimates. For these two models, the model developers' default probability distributions are maintained for all parameters other than those superseded by the harmonized inputs (*i.e.*, equilibrium climate sensitivity, socioeconomic and emissions scenarios, and discount rates). More information on the uncertain parameters in PAGE and FUND is available upon request.

For the socioeconomic and emissions scenarios, uncertainty is included in the analysis by considering a range of scenarios selected from the Stanford Energy Modeling Forum exercise, EMF-22. Given the dearth of information on the likelihood of a full range of future socioeconomic pathways at the time the original modeling was conducted, and without a basis for assigning differential weights to scenarios, the range of uncertainty was reflected by simply weighting each of the five scenarios equally for the consolidated estimates. To better understand how the results vary across scenarios, results of each model run are available in the docket.

The outcome of accounting for various sources of uncertainty using the approaches described above is a frequency distribution of the SC-CH_4 estimates for emissions occurring in each year for each discount rate. Unlike the approach taken for consolidating results across models and socioeconomic and emissions scenarios, the SC-CH_4 estimates are not pooled across different discount rates because the range of discount rates reflects both uncertainty and, at least in part, different policy or value judgements; uncertainty regarding this key assumption is discussed in more detail below. The frequency distributions reflect the uncertainty around the input parameters for which probability distributions were defined, as well as from the multi-model ensemble and socioeconomic and emissions scenarios where probabilities were implied by the

[112] Specifically, the Roe and Baker distribution for the climate sensitivity parameter was bounded between 0 and 10 with a median of 3 °C and a cumulative probability between 2 and 4.5 °C of two-thirds.

equal weighting assumption. It is important to note that the set of SC-CH_4 estimates obtained from this analysis does not yield a probability distribution that fully characterizes uncertainty about the SC-CH_4 due to impact categories omitted from the models and sources of uncertainty that have not been fully characterized due to data limitations.

Figure B-1 presents the frequency distribution of the domestic SC-CH_4 estimates for emissions in 2020 for each discount rate. Each distribution represents 150,000 estimates based on 10,000 simulations for each combination of the three models and five socioeconomic and emissions scenarios.[113] In general, the distributions are skewed to the right and have long right tails, which tend to be longer for lower discount rates. To highlight the difference between the impact of the discount rate on the SC-CH_4 and other quantified sources of uncertainty, the bars below the frequency distributions provide a symmetric representation of quantified variability in the SC-CH_4 estimates conditioned on each discount rate. The full set of SC-CH_4 results through 2050 is available as part of the RIA analysis materials.

[113] Although the distributions in Figure 1 are based on the full set of model results (150,000 estimates for each discount rate), for display purposes the horizontal axis is truncated with 0.001 to 0.013 percent of the estimates lying below the lowest bin displayed and 0.471 to 3.356 percent of the estimates lying above the highest bin displayed, depending on the discount rate.

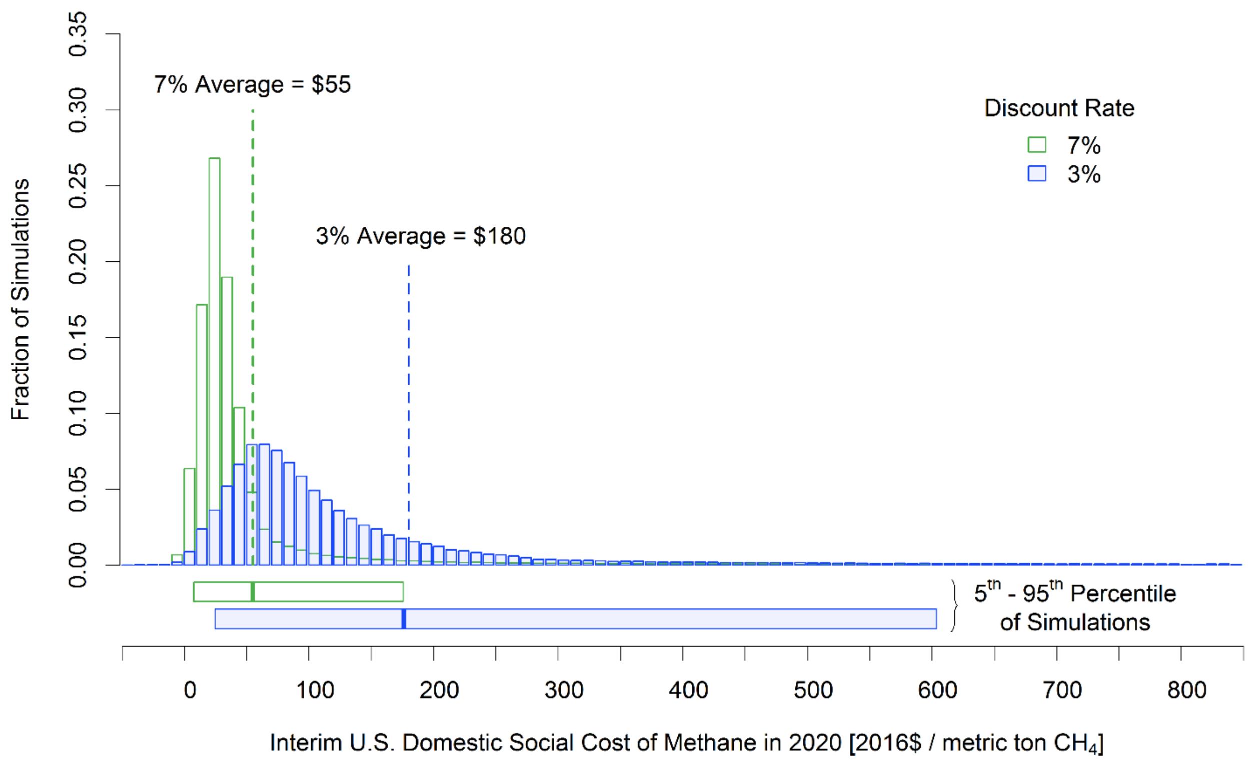

Figure B-1 Frequency Distribution of Interim Domestic SC-CH_4 Estimates for 2020 (in 2016$ per metric ton CH_4)

As illustrated by the frequency distributions in Figure B-1, the assumed discount rate plays a critical role in the ultimate estimate of the social cost of methane. This is because CH_4 emissions today continue to impact society far out into the future,[114] so with a higher discount rate, costs that accrue to future generations are weighted less, resulting in a lower estimate. Circular A-4 recommends that costs and benefits be discounted using the rates of 3 percent and 7 percent to reflect the opportunity cost of consumption and capital, respectively. Circular A-4 also recommends quantitative sensitivity analysis of key assumptions,[115] and offers guidance on what sensitivity analysis can be conducted in cases where a rule will have important intergenerational benefits or costs. To account for ethical considerations of future generations and potential

[114] Although the atmospheric lifetime of CH_4 is notably shorter than that of CO_2, the impacts of changes in contemporary CH_4 emissions are also expected to occur over long time horizons that cover multiple generations. For more discussion, see document ID number EPA-HQ-OAR-2015-0827-5886, "Addendum to Technical Support Document on Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866: Application of the Methodology to Estimate the Social Cost of Methane and the Social Cost of Nitrous Oxide (August 2016)".

[115] "If benefit or cost estimates depend heavily on certain assumptions, you should make those assumptions explicit and carry out sensitivity analyses using plausible alternative assumptions." (OMB 2003, page 42).

uncertainty in the discount rate over long time horizons, Circular A-4 suggests "further sensitivity analysis using a lower but positive discount rate in addition to calculating net benefit using discount rates of 3 and 7 percent" (page 36) and notes that research from the 1990s suggests intergenerational rates "from 1 to 3 percent per annum" (OMB 2003). We consider the uncertainty in this key assumption by calculating the domestic SC-CH_4 based on a 2.5 percent discount rate, in addition to the 3 and 7 percent used in the main analysis.

Using a 2.5 percent discount rate, the average domestic SC-CH_4 estimate across all the model runs for emissions occurring in 2021 is $230 per metric ton of CH_4 (2016$).[116] For the Policy Review, the projected undiscounted forgone domestic climate benefits are $4.6 million in 2021.[117] By 2030, the average domestic SC-CH_4 using a 2.5 percent discount rate is $290 per metric ton of CH_4 (2016$), and the corresponding projected undiscounted forgone domestic climate benefits of the action increase to $15 million. The PV of the forgone domestic climate benefits under a 2.5 percent discount rate for the SC-CH_4 estimate and the stream of forgone benefits is $81 million, with a corresponding EAV of $9 million per year.

For the Technical Reconsideration, the projected undiscounted forgone domestic climate benefits are $3.9 million in 2021.[118] By 2030, the corresponding undiscounted forgone domestic climate benefits of the action increase to $20 million. The PV of the forgone domestic climate benefits under a 2.5 percent discount rate for the SC-CH_4 estimate and the stream of forgone benefits is $91 million, with a corresponding EAV of $10 million per year.

In addition to the approach to accounting for the quantifiable uncertainty described above, the scientific and economics literature has further explored known sources of uncertainty related to estimates of the social cost of carbon and other greenhouse gases. For example, researchers have examined the sensitivity of IAMs and the resulting estimates to different assumptions embedded

[116] The estimates are adjusted for inflation using the GDP implicit price deflator and then rounded to two significant digits.

[117] We make a distinction between the discounting used to generate the SC-CH_4 estimate, and the discounting applied to the stream of forgone climate benefits. Here, the former is based on a 2.5 percent discount rate, while the latter is undiscounted, *i.e.*, for each year, it is the product of the year-specific SC-CH_4 estimate and the estimated forgone methane reductions.

[118] We make a distinction between the discounting used to generate the SC-CH_4 estimate, and the discounting applied to the stream of forgone climate benefits. Here, the former is based on a 2.5 percent discount rate, while the latter is undiscounted, *i.e.*, for each year, it is the product of the year-specific SC-CH_4 estimate and the estimated forgone methane reductions.

in the models (see, *e.g.*, Hope 2013, Anthoff and Tol 2013, Nordhaus 2014, and Waldhoff et al. 2011, 2014). However, there remain additional sources of uncertainty that have not been fully characterized and explored due to remaining data limitations. Additional research is needed to expand the quantification of various sources of uncertainty in estimates of the social cost of carbon and other greenhouse gases (*e.g.*, developing explicit probability distributions for more inputs pertaining to climate impacts and their valuation). On the issue of intergenerational discounting, some experts have argued that a declining discount rate would be appropriate to analyze impacts that occur far into the future (Arrow et al., 2013). However, additional research and analysis is still needed to develop a methodology for implementing a declining discount rate and to understand the implications of applying these theoretical lessons in practice. The 2017 National Academies report also provides recommendations pertaining to discounting, emphasizing the need to more explicitly model the uncertainty surrounding discount rates over long time horizons, its connection to uncertainty in economic growth, and, in turn, to climate damages using a Ramsey-like formula (National Academies 2017). These and other research needs are discussed in detail in the 2017 National Academies' recommendations for a comprehensive update to the current methodology, including a more robust incorporation of uncertainty.

B.3 Forgone Global Climate Benefits

In addition to requiring reporting of impacts at a domestic level, OMB Circular A-4 states that when an agency "evaluate[s] a regulation that is likely to have effects beyond the borders of the United States, these effects should be reported separately" (page 15).[119] This guidance is relevant to the valuation of damages from GHGs, given that most GHGs (including CH_4) contribute to damages around the world independent of the country in which they are emitted. Therefore, in this section we present the forgone global climate benefits from this rulemaking using the global

[119] While Circular A-4 does not elaborate on this guidance, the basic argument for adopting a domestic only perspective for the central benefit-cost analysis of domestic policies is based on the fact that the authority to regulate only extends to a nation's own residents who have consented to adhere to the same set of rules and values for collective decision-making, as well as the assumption that most domestic policies will have negligible effects on the welfare of other countries' residents (EPA 2010; Kopp et al. 1997; Whittington et al. 1986). In the context of policies that are expected to result in substantial effects outside of U.S. borders, an active literature has emerged discussing how to appropriately treat these impacts for purposes of domestic policymaking (*e.g.*, Gayer and Viscusi 2016, 2017; Anthoff and Tol, 2010; Fraas et al. 2016; Revesz et al. 2017). This discourse has been primarily focused on the regulation of greenhouse gases (GHGs), for which domestic policies may result in impacts outside of U.S. borders due to the global nature of the pollutants.

$SC\text{-}CH_4$ estimates — *i.e.*, reflecting quantified impacts occurring in both the U.S. and other countries — corresponding to the model runs that generated the domestic $SC\text{-}CH_4$ estimates used in the main analysis. The average global $SC\text{-}CH_4$ estimate across all the model runs for emissions occurring over the years analyzed in this RIA (2021-2030) range from $380 to $530 per metric ton of CH_4 emissions (in 2016 dollars) using a 7 percent discount rate, and $1,400 to $1,800 per metric ton of CH_4 using a 3 percent discount rate.[120] The domestic $SC\text{-}CH_4$ estimates presented above are approximately 15 percent and 13 percent of these global $SC\text{-}CH_4$ estimates for the 7 percent and 3 percent discount rates, respectively.

Forgone Global Climate Benefits for Policy Review: Applying these estimates to the forgone CH_4 emission reductions under the Policy Review results in estimated undiscounted forgone global climate benefits ranging from $7.6 million in 2021 to $28 million in 2030, using a 7 percent discount rate for the $SC\text{-}CH_4$ estimate. The PV of the forgone global climate benefits using a 7 percent discount rate for the $SC\text{-}CH_4$ estimate and the stream of forgone benefits is $110 million, with an associated EAV of $15 million per year.

The estimated undiscounted forgone global climate benefits under the Policy Review are $29 million in 2021 and increase to $96 million in 2030 using a 3 percent rate for the $SC\text{-}CH_4$ estimate. The PV of the forgone global climate benefits using a 3 percent discount rate for the $SC\text{-}CH_4$ estimate and the stream of forgone benefits is $500 million, with an associated EAV of $56 million per year.

Under the sensitivity analysis considered above using a 2.5 percent discount rate, the average global $SC\text{-}CH_4$ estimate across all the model runs for emissions occurring in 2021-2030 ranges from $1,900 to $2,300 per metric ton of CH_4 (2016$). The undiscounted forgone global climate benefits under the Policy Review are estimated to be $38 million in 2021 and $120 million in 2030 using a 2.5 percent discount rate for the $SC\text{-}CH_4$ estimate. The PV of the forgone global climate benefits using a 2.5 percent discount rate for the $SC\text{-}CH_4$ estimate and the stream of forgone benefits is $660 million, with an associated EAV of $74 million per year. All estimates are reported in 2016 dollars.

[120] The estimates are adjusted for inflation using the GDP implicit price deflator and then rounded to two significant digits.

Forgone Global Climate Benefits for Technical Reconsideration: Applying these estimates to the forgone CH_4 emission reductions under the Technical Reconsideration results in estimated undiscounted forgone global climate benefits ranging from $6.5 million in 2021 to $36 million in 2030, using a 7 percent discount rate for the SC-CH_4 estimate. The PV of the forgone global climate benefits using a 7 percent discount rate for the SC-CH_4 estimate and the stream of forgone benefits is $123 million, with an associated EAV of $16 million per year.

The estimated undiscounted forgone global climate benefits under the Technical Reconsideration are $24 million in 2021 and increase to $124 million in 2030 using a 3 percent rate for the SC-CH_4 estimate. The PV of the forgone global climate benefits using a 3 percent discount rate for the SC-CH_4 estimate and the stream of forgone benefits is $560 million, with an associated EAV of $64 million per year.

Under the sensitivity analysis considered above using a 2.5 percent discount rate, the undiscounted forgone global climate benefits under the Technical Reconsideration are estimated to be $32 million in 2021 and $160 million in 2030. The PV of the forgone global climate benefits using a 2.5 percent discount rate for the SC-CH_4 estimate and the stream of forgone benefits is $750 million, with an associated EAV of $83 million per year. All estimates are reported in 2016 dollars.

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