RFF REPORT

EPA's 2016 Methane Rule

Should It Stay or Should It Go?

Alan J. Krupnick, Justine Huetteman, and Arthur G. Fraas

RFF Report Series: *The Costs and Benefits of Eliminating or Modifying US Oil and Gas Regulations*

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This report is one in a series: The Costs and Benefits of Eliminating or Modifying US Oil and Gas Regulations.

Executive Summary

The Trump administration has prioritized increasing the production of US oil and natural gas, in part through reducing federal regulatory burdens that the administration says restrict development. President Trump signed Executive Order (EO) 13783 in March 2017, requiring agencies to review existing rules, policies, guidance documents, and more that potentially burden the development or use of domestically produced energy resources. This EO also specifically identified for review regulations applicable to the oil and gas sector, including the Bureau of Land Management's (BLM's) methane rule.[1] EO 13771, which ordered that agencies must remove two rules for every new rule implemented, emphasized that cost-benefit analysis is required for all major regulations being considered for elimination or modification (as has been the practice for new regulations). But it also laid out the controversial requirement that only the cost savings from repeal be considered in prioritizing rules for repeal in that cost savings (and not forgone benefits or net benefits) be counted when complying with the two-for-one requirement. Ninety-six economists and experts expressed concerns about this requirement in a March letter to the Trump administration (Linn and Krupnick 2017).

Following these actions, we at Resources for the Future (RFF) sought to first catalog existing federal regulations promulgated after 2005 and non-regulatory federal activities of concern to the oil and gas industry.[2] We then turned toward understanding what the impacts on industry and the public might be if some of these regulations were eliminated, modified, or delayed. We analyzed these impacts by updating the parameters used in the original agency regulatory impact analyses (RIAs) and assessing the cost savings and forgone benefits associated with repealing and modifying the following rules:

- the Bureau of Land Management's (BLM's) "Waste Prevention, Production Subject to Royalties, and Resource Conservation" rule;
- the Environmental Protection Agency's (EPA's) "Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources New Source Performance Standards" rule;
- the Bureau of Safety and Environmental Enforcement's (BSEE's) "Oil and Gas and Sulfur Operations in the Outer Continental Shelf-Blowout Preventer Systems and Well Control Rule";
- the Pipeline and Hazardous Materials Safety Administration's (PHMSA's) "Hazardous Materials: Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains" rule;
- BSEE's and Bureau of Ocean Energy Management's (BOEM's) "Oil and Gas and Sulphur Operations on the Outer Continental Shelf—Requirements for Exploratory Drilling on the Arctic Outer Continental Shelf" rule; and
- PHMSA's "Pipeline Safety: Integrity Management Program for Gas Distribution Pipelines" rule.

This report analyzes EPA's methane rule,[3] which regulates methane emissions from new

[1] 81 FR 83008, https://www.gpo.gov/fdsys/pkg/FR-2016-11-18/pdf/2016-27637.pdf.

[2] We will produce information about this catalog as part of a forthcoming report summarizing the results of the project.

[3] 81 FR 35824, "Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources," https://www.gpo.gov/fdsys/pkg/FR-2016-06-03/pdf/2016-11971.pdf.

and modified sources in the oil and gas sector. The implementation of the rule as EPA calculated in the final RIA would lead to net benefits of $35 million to $170 million per year, depending on the year and the discount rate (3 percent versus 7 percent), as shown in Table 1 (EPA 2016b). For this RIA, EPA calculated benefits and costs in 2020, for an estimate of the short-term impacts of the rule, and 2025, for an estimate of the longer-term impacts of the rule, which differs from the way many RIAs are done. Benefits are from emissions reductions occurring in either 2020 or 2025.

Our analysis updates relevant factors in the calculation of costs and benefits that have changed since the RIA was finalized, described in further detail in the body of this report, resulting in a baseline estimate of the impacts of the rule that has slightly lower net benefits—between $27 million and $152 million, depending on the year and the discount rate.

The Trump administration has proposed a two-year stay of certain provisions of the rule and has initiated formal reconsideration of those provisions. There has been no movement toward full elimination, though the rule remains controversial, given its impact on the oil and gas industry and issues of accounting for benefits of greenhouse gas reductions. If the administration repeals the rule, we estimate net social costs of $27 million to $152 million, again depending on the year and discount rate, as shown in Table 1.

TABLE 1. SUMMARY OF ORIGINAL RIA AND BASELINE IN 2020 AND 2025 (MILLION 2012$)

3%						
KEEPING RULE						
	2020			2025		
	Costs	Benefits	Net Benefits	Costs	Benefits	Net Benefits
Original RIA	320	360	35	520	690	170
Baseline	**383**	**410**	**27**	**631**	**783**	**152**
REPEALING RULE						
	2020			2025		
	Costs Avoided	Benefits Forgone	Net Benefits of Repeal	Costs Avoided	Benefits Forgone	Net Benefits of Repeal
Using Original RIA Figures	320	360	(35)	520	690	(170)
Repeal Baseline	**383**	**410**	**(27)**	**631**	**783**	**(152)**
7%						
KEEPING RULE						
	2020			2025		
	Costs	Benefits	Net Benefits	Costs	Benefits	Net Benefits
Original RIA	320	360	35	530	690	170
Baseline	**386**	**410**	**24**	**636**	**783**	**146**
REPEALING RULE						
	2020			2025		
	Costs Avoided	Benefits Forgone	Net Benefits of Repeal	Costs Avoided	Benefits Forgone	Net Benefits of Repeal
Using Original RIA Figures	320	360	(35)	530	690	(170)
Repeal Baseline	**386**	**410**	**(24)**	**636**	**783**	**(146)**

Most of the report will focus on a number of scenarios that affect the costs and benefits of the rule. These were chosen to reflect uncertainty about various inputs to the RIA. We present benefit-cost calculations for the following cost adjustments for this rule:

- using different cost figures in the leak detection and repair (LDAR) provisions for wells only,[4] as estimated by industry

We present benefit-cost calculations for the following benefits adjustments for this rule:

- using different emissions reduction estimates in the LDAR provision for wells only, as estimated by industry
- using a domestic SC-CH_4, as produced by the Trump administration

We present benefit-cost calculations for the following rule modifications for this rule:

- amending the LDAR provision through exclusion of low production wells
- amending the LDAR provision through exclusion of oil wells with a gas-to-oil ratio less than 300
- amending the LDAR provision through exclusion of all oil wells
- adjusting the frequency of monitoring, maintenance, and reporting (what we call surveying) requirements

Using our baseline calculation, repealing EPA's methane rule would yield net costs to society in 2020 and 2025. The benefits forgone, however, are highly sensitive to the choice of the social cost of methane. When the social cost of methane is significantly lowered, as it is for the Trump administration's domestic estimate, from the global estimate used in the original RIA, there are net benefits to society of repeal.

[4] BLM uses the abbreviation LDAR (leak detection and repair), while EPA uses "fugitive emissions" to describe provisions related to leaks from components of oil and gas drilling, processing, and transmission. For the sake of continuity with the rest of this study, we will refer to these provisions as LDAR in the EPA methane rule analysis.

1. Introduction

The Trump administration has identified increasing oil and natural gas production as a priority for the United States, in part through reducing federal regulatory burdens that the administration says restrict development. President Trump signed Executive Order (EO) 13783 in March 2017, requiring agencies to review existing rules, policies, guidance documents, and related materials that potentially burden the development or use of domestically produced energy resources.[5] This EO also specifically identifies for review those regulations applicable to the oil and gas sector.

The Trump administration has also focused on reducing regulatory costs across the federal government more broadly under EO 13771, which ordered that two regulations be removed for every regulation implemented.[6] Subsequent guidance from the Office of Management and Budget (OMB)[7] for implementing EO 13771 emphasized that cost-benefit analysis is required for all major regulations being considered for all major regulations being considered for elimination or modification (as well as for new regulations). But it also lays out the controversial requirement that only the cost savings from repeal be considered in prioritizing rules for repeal as well as in scoring against the costs imposed by new regulations.[8]

2. Objectives

The goals of our project were to catalog the regulations that may be reviewed by the Trump administration[9] and select several to analyze in-depth, conducting a cost-benefit analysis to estimate the potential impacts on industry and the public if the regulations are eliminated, modified, or delayed. These impacts would include cost savings and forgone benefits associated with changes to regulations (as costs and benefits are defined in Circular A-4),[10] and the effects on industry costs as well as any changes to environmental and health outcomes. This project includes two main products: the first is the forthcoming catalog, which inventories existing federal regulations promulgated after 2005 and other federal activities of concern to industry (e.g., permitting) relevant to the development and transportation of oil and gas resources. The second product is a report series that present our analyses of the cost savings and forgone benefits associated with the repeal or modification of six major regulations affecting the oil and gas sector (these are outlined in the

[5] Executive Office of the President. 2017. Executive Order 13783: Promoting Energy Independence and Economic Growth. *Federal Register* 82(61): 16093, March 28. https://www.federalregister.gov/documents/2017/03/31/2017-06576/promoting-energy-independence-and-economic-growth.

[6] Executive Office of the President. 2017. Executive Order 13771: Reducing Regulation and Controlling Regulatory Costs. *Federal Register* 82(22): 9339, February 3. https://www.federalregister.gov/documents/2017/02/03/2017-02451/reducing-regulation-and-controlling-regulatory-costs.

[7] Office of Management and Budget. 2017. Guidance Implementing Executive Order 13771, Titled "Reducing Regulation and Controlling Regulatory Costs." April 5. https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2017/M-17-21-OMB.pdf.

[8] "Presidential Executive Order on Reducing Regulation and Controlling Regulatory Costs," https://www.whitehouse.gov/the-press-office/2017/01/30/presidential-executive-order-reducing-regulation-and-controlling.

[9] We will discuss this catalog in a forthcoming summary document.

[10] Office of Management and Budget. 2003. Circular A-4, Regulatory Analysis. *Federal Register* 68: 58366, October 9. https://www.federalregister.gov/documents/2003/10/09/03-25606/circular-a-4-regulatory-analysis.

executive summary).[11] The six rules were chosen to cover a wide range of types of rules and are not meant to suggest relative importance or that any are most targeted by the Trump administration. They illustrate the technical challenges and opportunities presented in performing cost-benefit analyses to support the repeal or modification of the rules. This report covers EPA's methane rule.[12] A forthcoming summary document will include cross-cutting analyses to compare the results of these six analyses—in particular, ranking the results by net benefits (preferred by economists) and also cost savings, the metric emphasized by OMB's guidance related to EO 13711.

3. Methods

The objective of each cost-benefit analysis was to calculate the cost savings and forgone benefits associated with repeal (also referred to as elimination) and modification of the rule or, in certain cases, delay of the rule. To meet this objective, we carefully read each proposed and final rule and its associated regulatory impact analysis (RIA), as well as any technical support documentation available for the rule. We also noted stakeholder comments and concerns as addressed in the *Federal Register* notice for the final rule (the agency's formal response to commenters) as well as any text in the final rule addressing comments. We also searched for any parallel industry analyses and subsequent industry comments gathered as part of the Trump administration's regulatory reform initiative. Table 2 defines key terminology that will be used in this report and across the series.

TABLE 2. DEFINITIONS OF KEY TERMINOLOGY

Term	Definition
Cost Savings or Avoided Costs	The amount saved by eliminating or modifying the rule (i.e., the opposite of the costs of implementing a rule).
Benefits Forgone	Benefits that would not be realized by eliminating or modifying the rule (i.e., the opposite of the benefits of implementing a rule).
Net Benefits of Repeal or Elimination	The cost savings of a rule minus the benefits forgone with a positive result, meaning eliminating the rule has a positive net welfare effect on society. Net benefits can be negative, in which case they could be termed net costs to society.
Replication	Re-created original RIA and changed nomenclature to put into rule elimination terms: defining costs as cost savings, benefits as benefits forgone, and net benefits (costs) as net benefits (costs) of elimination.
Corrections	Changes to underlying assumptions to bring the replication up to date and make it comparable across different rules
Baseline	The result of corrections to the replication. All subsequent scenarios are compared to the baseline.
Costs Adjustment Scenarios	Sensitivity analyses using changes to underlying cost parameters/assumptions in the original RIA.
Benefits Adjustment Scenarios	Sensitivity analyses using changes to underlying benefit parameters/assumptions in the original RIA.
Rule Modification	Changes to the requirements of rule itself (i.e., sources covered, frequency of surveying, as opposed to changes in parameters/assumptions used in the RIA).

[11] As defined by EO 12866, a "'significant regulatory action' means any regulatory action that is likely to result in a rule that may: (1) Have an annual effect on the economy of $100 million or more", among other criteria.

[12] 81 FR 35824, "Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources," https://www.gpo.gov/fdsys/pkg/FR-2016-06-03/pdf/2016-11971.pdf.

We took the steps outlined below to conduct our analyses, for this report on EPA's methane rule and across the report series: Each discussion of a rule begins with background on the purpose of the rule, its history, and its current status (e.g., whether it has been repealed or is slated for repeal or modification). Next, we summarize the rule with details to provide context about the consequences of repeal or modification of all or some of its parts. We then replicated the cost-benefit analysis presented in the final RIA by creating a series of spreadsheets of extracted data and other information. We were able to replicate the analyses with only very minor differences.

3.1. Corrections to Generate a Baseline

In order to ensure that the cost savings, forgone benefits, and net benefits of elimination reflect the most accurate, currently available information, we changed some of the underlying assumptions of the RIA (and refer to these changes as "corrections). We also made corrections where we could to address compliance issues for calculating the costs and benefits of repealing a regulation. These issues are explained below.

First, we updated data where possible, mainly based on the US Energy Information Administration's (EIA's) oil and gas price estimates released in the *Annual Energy Outlook* each year. Second, if an RIA originally subtracted cost savings from costs, we added cost savings to the benefits side of the equation (and made corresponding adjustments to the RIA cost estimates) so that our analyses remain consistent within recent guidance from the OMB guidance for EO 13771. Third, we also made some further accounting corrections for comparability across rules, including start and end year analyzed (and, implicitly, the period analyzed). As regulations often have an indefinite lifetime, the endpoint for an analysis can be arbitrary. In comparing rules, those with longer periods analyzed will have greater net present values of both benefits and costs, other things equal. EPA's methane rule, for example, uses the years 2020 and 2025—whereas BLM's methane rule uses a 10-year period of analysis and PHMSA's tank car rule for hazardous materials uses a 20-year period of analysis. To address this issue, in our forthcoming summary report, we will compare the net present values of costs, benefits, and net benefits over 10 years.

Once we have updated and corrected the baseline, we create our "repeal baseline," which we use to assess the cost savings and benefits forgone of repealing a regulation. We subtract the benefits forgone (i.e., a cost of repealing a rule) from the costs avoided (i.e., the benefit of repealing a rule) to calculate the net benefits of repeal. The first equation below illustrates the benefits of keeping the rule (termed "baseline"). Scenarios that modify the rule are compared against the baseline for keeping the rule rather than against the repeal baseline, as we do not believe the administration would modify the rule only to later repeal it. The second equation below describes the calculation of the net benefits of repeal, which we use to calculate the repeal baseline. Both baselines include the corrections outline above.

BASELINE

Net benefits (of keeping or modifying the rule)
= Benefits – Costs

REPEAL BASELINE

Net benefits (of repeal)
= Costs avoided – Benefits forgone

The regulated entities may have already begun to comply with the regulation after its passage, until its repeal or until a plan to repeal or modify the rule is publicized. Capital expenditures spent to comply with a regulation are sunk costs, so they should not be counted as cost savings if a regulation is eliminated. Future operating costs, however, would count as costs saved if a regulation is eliminated. To the extent that compliance has

already occurred, cost savings and forgone benefits would be lower. When the RIA provided a clear schedule for compliance, as in this case, an adjustment was made, though that is not always the case.

RIAs often account for overlapping or duplicative state regulations, for instance, by not counting costs and benefits from compliance in states with existing regulations. In between the time the regulation is finalized and eliminated, however, additional states may pass overlapping or duplicative regulation. Thus, if the federal regulation is eliminated, the states' regulations will still be in force and there will be less or no associated cost savings from repeal in those states, depending on the stringency of those regulations. One could also argue that states' proposed regulations should also be taken into account.[13]

3.2. Cost Adjustment Scenarios

Working from the repeal baseline, we build scenarios that change the underlying assumptions of the RIA to assess any changes to the costs of the rule if the compliance costs of certain provisions were more or less expensive.

First, we searched the RIA for alternative cost assumptions. Second, we searched the rule's docket for comments that provided enough information for us to use an alternative cost assumption. If we found compelling evidence in either source, we recalculated cost savings, benefits forgone, and net benefits of repeal accounting for this input. The comments we used were submitted by stakeholders, including the American Petroleum Institute (API), Independent Petroleum Association of America (IPAA), Western Energy Alliance, Sierra Club, Environmental Defense Fund, Pew Charitable Trust, and others. We also searched for comments submitted to agencies in the spring of 2017, when they requested public input on the Trump administration's regulatory reform efforts.

3.3. Benefits Adjustment Scenarios

In addition to cost adjustments, we made adjustments to the benefits, using the same process described above and also making what we considered reasonable changes to various assumptions, such as using alternative estimates for the social cost of carbon (SCC) or a range of potential risk reduction levels.

Benefits measurements were often subject to large uncertainties, so for several rules we conducted break-even analyses, a method often employed in RIAs. Break-even analysis in the context of repealing a rule calculates what the uncertain parameter would have to be to equate forgone benefits to cost savings. If decisionmakers think the real value of this parameter is likely to be larger than the break-even parameter estimate, then repeal would not be warranted (in terms of economic efficiency). Symmetrically, if they think the parameter is lower, it may be economically efficient to repeal the rule. Of course, in the face of large uncertainty, a risk averse regulator may choose not to repeal a regulation when it is unclear whether the parameter is lower or higher than the break-even estimate.

Under guidance from the Trump administration, agencies are increasingly questioning the valuation of ancillary benefits (co-benefits) of various rules. These refer to benefits that come along with efforts aimed at addressing another pollutant or activity, such as the climate benefits of reducing mercury pollution, for example. Agencies sometimes forgo the valuation of ancillary benefits, particularly when benefits exceed costs by a wide margin. Agencies may choose to do so

[13] It may be a step too far to assume that some states will be incentivized to pass legislation offsetting the effect of eliminating a federal regulation.

because they find it difficult or impossible to quantify, and doing so in cases of large uncertainty may complicate interpretation of the results.

The Trump administration critiqued the inclusion of ancillary benefits in RIAs, arguing that they mask the "true net costs" of rulemakings (EPA 2017a). When looking at the forgone benefits of repeal, however, ignoring forgone ancillary benefits is not justifiable because they still would have accrued to society regardless of whether these benefits were the target of a regulation. Counting these ancillary benefits ensures that an analysis accurately describes the true net costs of a rulemaking (Krupnick and Keyes 2017). Nevertheless, in this project we were not able to account for ancillary benefits if they were missing from the original RIA.

3.4. Rule Modification Scenarios

There are innumerable ways any given rule can be modified, including changes to the sources covered or frequency of monitoring and reporting, for instance. We limited the possibilities for modification to what was quantifiable based on agency estimates for alternative requirements, quantitative estimates provided by industry or other stakeholder comments, and our judgment about what would make for an enlightening modification. Coming from industry, the requested modifications would generally lower costs of the rule but may also lower the benefits. Symmetrically, the requested modifications coming from environmental groups would generally increase the benefits of the rule but may also increase the costs. Because the modifications are highly rule-specific, we address them in turn—in detail in the respective reports in this series describing our analysis of each rule's RIA.

3.5. Discussion and Conclusions

After presenting the multiple cost-benefit analyses for repeal and modification of each rule, we then provide a qualitative discussion of aspects of repealing or modifying a rule that we could not quantify. These are often driven by comments that criticize some aspect of a rule but provide no basis for us to analyze how costs and benefits would change if the rule were altered to address the comment. We also tracked the agency's response to comments and non-monetized effects of the rules (often indirect or distributional), such as on jobs or commodity prices.

We conclude each report by summarizing the rule-specific analyses and generalize about whether certain types of modifications or repeal make sense from an economic efficiency (net benefit) perspective. We do not compare results across rules in each individual report. A forthcoming summary report will include cross-cutting analyses and comparisons.

4. Background: EPA's 2016 Methane Rule

4.1. Purpose

Because the oil and gas sector is the largest emitter of methane emissions in the country, and because EPA has the authority, according to *Massachusetts v. EPA*, to regulate emissions of greenhouse gases (of which methane is one), EPA promulgated methane standards under the 2016 New Source Performance Standard (NSPS) for the oil and gas sector. This 2016 NSPS, hereafter referred to as EPA's methane rule, amends and adds to the 2012 NSPS, which only covered certain equipment emitting volatile organic compounds (VOCs). The 2012 NSPS regulates hydraulically fractured gas well completions, leaks from natural gas processing plants, pneumatic controllers, centrifugal compressors, and reciprocating compressors for VOCs only, while the 2016 NSPS establishes methane standards for that equipment and also extends VOC and methane regulation to other equipment, including hydraulically fractured oil and gas

well completions, leaks from well sites, compressor stations, and pneumatic pumps.[14]

4.2. Regulatory History and Current Status

EPA under Administrator Scott Pruitt proposed a two-year stay of parts of the rule, which included an economic analysis of the cost savings and forgone benefits associated with the stay (EPA 2017a) as well as proposed a formal reconsideration of the same parts of the rule. The first compliance deadline (for LDAR) was set for June 3, 2017, but the Trump administration announced a 90-day stay of that deadline and other parts of the rule on April 18, 2017. The District of Columbia Circuit Court of Appeals, however, vacated the stay shortly thereafter.[15] On June 16, 2017, EPA published a notice of proposed rulemaking to extend the stay of the same provisions of the rule to two years.[16]

According to EPA's analysis of the stay, the present value of cost savings from the two-year stay is $280 million (discounted at 3 percent), which come primarily from the delay of monitoring and repair costs. There are also forgone benefits from emissions that would have been avoided, which the Trump administration values at $37 million (discounted at 3 percent), based on domestic benefits only. The stay thus leads to $240 million in net benefits. During this time, EPA will evaluate the merits of the delayed provisions.

4.3. Rule Summary

There are five major provisions rule in the following categories: new well completions, LDAR, pneumatic pumps, compressors, and pneumatic controllers. This analysis focuses on the costs, benefits, and net benefits (or cost savings, benefits forgone, and net benefits of repeal) for the rule overall; however, net benefits of the baseline scenario for each provision of the rule can be found in Appendix B. The number of facilities affected each year is estimated based on historical data and a linear trajectory.

The rule sets the following performance standards (or requirements for level of control) or a technology requirement in these five categories:

- Well completions must achieve a 95 percent control rate. There are different venting and combustion requirements based on the type of well (e.g., exploratory/non-exploratory, low pressure).
- LDAR from oil and gas wells must achieve a 60 percent control rate (based on semiannual monitoring), while LDAR from gathering/boosting and transmission stations and storage facilities must achieve an 80 percent control rate (based on quarterly monitoring). The standard allows the use of either optical gas imaging (OGI) or EPA's Method 21 at 500 parts per million to detect leaks.
- Pneumatic pumps at well sites must achieve a 95 percent control rate.
- Reciprocating compressors used in transmission and storage components must achieve an 80 percent control rate, while centrifugal compressors used in storage components must use a wet seal routed to a new combustion device.
- Pneumatic controllers at locations other than processing plants must switch from a high-bleed to a low-bleed device.

The costs of the rule are primarily borne by industry as costs of installing new pollution control technology as well as surveying and repairing leaks.

[14] 81 FR 35824.

[15] *Clean Air Council, et al. v. Pruitt*, No. 17-1145 (D.C. Cir. 2017).

[16] 82 FR 27645, "Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources: Stay of Certain Requirements," https://www.gpo.gov/fdsys/granule/FR-2017-06-16/2017-12698.

It is important to note that although the regulation limits both methane and VOC emissions, the RIA estimates benefits only for reduction of methane emissions, as VOC emissions reductions are very difficult to quantify reliably. Specifically, the methane reduction benefits are those related to climate change.

5. Results

In this section we describe the adjustments made to the original RIA in order to generate a baseline as well as scenarios that change cost and benefit inputs to the RIA and modify the rule. Following EPA's methodology, these results will be presented for the years 2020 and 2025. The discussion will focus on estimates using a 3 percent discount rate. Tables summarizing estimates for a 7 percent discount rate can be found in Appendix A.

5.1. Replication

Consulting the original RIA and technical support documentation[17] for the original RIA, we were able to replicate EPA's final RIA for this rule (with some minor differences due to rounding) (Table 3). In 2020, the net benefits of the rule are $38 million. In 2025, the net benefits of the rule are $164 million.

5.2. Corrections to Generate a Baseline

We made three primary corrections for this rule: updating the natural gas price, treating the cost savings from the recovery of natural gas as a benefit instead of an avoided cost, and using a more precise social cost of methane. Each of these corrections yields only small changes in the RIA estimates, so elimination of the rule would impose net costs on society based on our baseline. Estimates are shown in Table 3.

TABLE 3. GENERATING A BASELINE AT 3 PERCENT DISCOUNT RATE IN 2020 AND 2025 (MILLION 2012$)

KEEPING RULE						
	2020			2025		
	Costs	Benefits	Net Benefits	Costs	Benefits	Net Benefits
Original RIA	320	360	35	520	690	170
Replication	320	358	38	525	689	164
% difference*	*0%*	*0%*	*9%*	*1%*	*0%*	*-3%*
Updating Natural Gas Price	331	358	27	544	689	146
% difference**	*3%*	*0%*	*-29%*	*4%*	*0%*	*-11%*
Natural Gas Savings as Benefits	383	422	38	631	795	164
% difference**	*19%*	*18%*	*0%*	*20%*	*15%*	*0%*
Correcting SC-CH_4	320	358	38	525	695	170
% difference**	*0%*	*0%*	*0%*	*0%*	*1%*	*3%*
Baseline	**383**	**410**	**27**	**631**	**783**	**152**
% difference**	*19%*	*15%*	*-29%*	*20%*	*14%*	*-7%*

**Percentage difference from original.*
***Percentage difference from replication.*

[17] EPA (US Environmental Protection Agency). 2016a. "Background Technical Support Document for the Final New Source Performance Standards 40 CFR Part 60, Subpart OOOOa. Office of Air Quality Planning and Standards." Washington, DC: EPA.

Natural Gas Price. Methane is natural gas, so the reduction in emissions of methane into the air will mean that producers will be able to sell more product. Calculating the impact of this rule must take into account the value of the natural gas that is harnessed and can be sold. The estimate of the natural gas price is thus an important component of this rule. EPA based its estimates for the natural gas price in 2020 and 2025 on the AEO2015, and then conservatively rounded the figure to $4 per thousand cubic feet (Mcf). We updated the natural gas price estimate to the AEO2017, which is projected to be $4.65 per Mcf in 2020 and 2025 (EIA 2017).

In addition, we used the BLM methane rule's 75 percent adjustment factor (see BLM methane rule write-up) to account for the revenues from the sale of captured natural gas.[18] This means that the estimated returns in the sale of natural gas captured in this rule are $3.49 per Mcf in 2020 and 2025. With this correction, the net benefits of the rule decrease to $27 million in 2020 (from $38 million) and $146 million in 2025 (from $164 million).

Revenues from Natural Gas Savings. In this rule, EPA subtracts revenues from recovered natural gas from the cost of the rule. Following OMB guidance on implementing EO 13771, revenues are added to the benefits side, rather than subtracted from costs of compliance. According to our replication of the final RIA, revenues from the sale of natural gas that is captured through the implementation of this rule total $63 million in 2020 and $106 million in 2025 at $4 per Mcf (the figure used in the final RIA). Using our updated estimate of the natural gas price, revenues total $52 million in 2020 and $88 million in 2025. The net benefits of the rule do not change with this correction, though the costs and benefits both increase by about 15 to 20 percent. The costs increase to $383 million in 2020 and $631 million in 2025, while the benefits increase to $422 million in 2020 and $795 million in 2025.

Precision of the Social Cost of Methane ($SC\text{-}CH_4$). EPA uses a social cost of methane of $1,300/metric ton in 2020 and $1,500/metric ton in 2025 (based on a 3 percent discount rate and rounding from IWG 2016). We corrected these estimates to be more precise based on more detailed figures presented in the BLM methane rule. In 2020, the social cost of methane remains at $1,300/metric ton, as EPA used originally, but in 2025, the figure is slightly higher than EPA's estimate at $1,513/metric ton. The net benefits with this correction do not change in 2020, but in 2025, the net benefits increase to $170 million.

Accounting for State Regulations. To account for existing state regulations, EPA estimated the number of new sources in each state already covered by similar methane regulations and excluded them from estimates of the costs and benefits of the rule. While the stringency of some of these states' regulations does not appear to match the federal requirements perfectly, EPA excluded sources in Colorado, Utah, Ohio, and Wyoming for the LDAR provision and Colorado, Wyoming, and North Dakota for the well completions provision requiring either a reduced emissions completion or combustion. These exclusions carry through in our analyses. If we were to drop additional sources in states that have since passed similar methane regulations, they would be in California, where a final methane rule was published in 2017, and Pennsylvania, where a methane rule has been proposed. Making adjustments for these states is beyond

[18] In the RIA for the BLM methane rule, the agency discounts the natural gas price for processing and transportation costs to reflect the revenues actually garnered by producers. For consistency, we include that adjustment here.

the scope of this project but would reduce both costs and benefits of the federal rule.

Combining these three corrections generates our baseline for this rule, as shown in Table 3. In the baseline for 2020, net benefits are $27 million, a 29 percent decrease from the replication. In the baseline for 2025, net benefits are $152 million, a 7 percent decrease from the replication.

We use these results to calculate a repeal baseline, shown in Table 4, which represents the avoided costs and benefits forgone associated with eliminating the rule. Were this rule to be repealed today, there would be negative net benefits, or net costs, to society of $27 million in 2020 and $152 million in 2025.

5.3. Cost Adjustment Scenarios

We developed only one cost adjustment scenario for this rule. API, in an analysis of the final RIA in its comments on the proposed rule, states that EPA significantly underestimated the costs for leak monitoring at well sites by not including the costs of the purchase of the monitoring equipment, equipment training, a data management system, and transportation to conduct monitoring (API 2015).[19] API's analysis, based on surveys of its membership, estimated that annualized well site compliance costs for semiannual monitoring are nearly three times higher than EPA's estimate. This adjustment increases the costs avoided significantly: a 93 percent increase from the baseline to $741 million in 2020, and a 116 percent increase from the baseline to $1.4 billion in 2025. Using API's cost assumptions, there are net benefits to society of repealing the rule of $331 million in 2020 and $579 million in 2025, as shown in Table 5.

TABLE 4. GENERATING A BASELINE FOR REPEAL IN 2020 AND 2025 AT 3 PERCENT DISCOUNT RATE (MILLION 2012$)

REPEALING RULE						
	2020			2025		
	Costs Avoided	Benefits Forgone	Net Benefits of Repeal	Costs Avoided	Benefits Forgone	Net Benefits of Repeal
Using Original RIA Figures	320	360	(35)	520	690	(170)
Replication	320	358	(38)	525	689	(164)
% difference*	*0%*	*0%*	*-9%*	*1%*	*0%*	*3%*
Updating Natural Gas Price	331	358	(27)	544	689	(146)
% difference**	*3%*	*0%*	*29%*	*4%*	*0%*	*11%*
Natural Gas Savings as Benefit	383	422	(38)	631	795	(164)
% difference**	*19%*	*18%*	*0%*	*20%*	*15%*	*0%*
Correcting SC-CH_4	320	358	(38)	525	695	(170)
% difference**	*0%*	*0%*	*0%*	*0%*	*1%*	*-3%*
Repeal Baseline	**383**	**410**	**(27)**	**631**	**783**	**(152)**
% difference**	*19%*	*15%*	*29%*	*20%*	*14%*	*7%*

**Percentage difference from original.*
***Percentage difference from replication.*

[19] See pp. 118–20 of API (2015) for more detail. We used the annual cost per well site with amortized capital cost value in Table 27-6 of API (2015).

TABLE 5. COST ADJUSTMENT SCENARIOS AT 3 PERCENT DISCOUNT RATE IN 2020 AND 2025 (MILLION 2012$)

REPEALING RULE						
	2020			2025		
	Costs Avoided	Benefits Forgone	Net Benefits of Repeal	Costs Avoided	Benefits Forgone	Net Benefits of Repeal
Repeal Baseline	**383**	**410**	**(27)**	**631**	**783**	**(152)**
API's LDAR Costs	741	410	331	1,362	783	579
% difference*	*93%*	*0%*	*1,327%*	*116%*	*0%*	*483%*

**Percentage difference from the baseline.*

TABLE 6. BENEFITS ADJUSTMENT SCENARIOS IN 2020 AND 2025 AT 3 PERCENT DISCOUNT RATE (MILLION 2012$)

REPEALING RULE						
	2020			2025		
	Costs Avoided	Benefits Forgone	Net Benefits of Repeal	Costs Avoided	Benefits Forgone	Net Benefits of Repeal
Repeal Baseline	**383**	**410**	**(27)**	**631**	**783**	**(152)**
API's Emissions per Facility Figures	383	302	82	631	526	106
% difference*	*0%*	*-26%*	*403%*	*0%*	*-33%*	*170%*
Domestic SC-CH_4 (3%)	383	99	285	631	174	457
% difference*	*0%*	*-76%*	*1,156%*	*0%*	*-78%*	*402%*
Higher Global SC-CH_4	383	529	(146)	631	981	(350)
% difference*	*0%*	*29%*	*-440%*	*0%*	*25%*	*-131%*
Combined**	741	81	660	1,362	134	1,228
% difference*	*93%*	*-80%*	*2,551%*	*116%*	*-83%*	*911%*
Combined***	741	386	355	1,362	654	708
% difference*	*93%*	*-6%*	*1,418%*	*115%*	*-16%*	*568%*

**Percentage difference from the baseline.*
***Combined scenario incorporates API's LDAR costs into the calculation of costs avoided and API emissions per facility estimates and domestic SC-CH_4 into the calculation of benefits forgone.*
****Combined scenario incorporates API's LDAR costs into the calculation of costs avoided and API emissions per facility estimates and higher global SC-CH_4 into the calculation of benefits forgone.*

5.4. Benefits Adjustment Scenarios

We made two benefits adjustments for this rule, one accounting for industry comments on potential emissions changes and one exploring changes in assumptions regarding the SC-CH_4. These adjustments are shown in Table 6.

Adjusting Emissions Estimates. API claims that EPA overestimated the fugitive methane emissions that occur at well sites and the potential methane emissions reductions from well site leak repair. API estimates that fugitive methane emissions are just over half of EPA's estimates, so the potential emissions reductions (and thus monetized benefits) from repairing leaks are about half of what EPA

calculated (API 2015).[20] Using API's emissions estimates, the benefits forgone decrease by 26 percent in 2020 to $302 million and by 33 percent in 2025 to $526 million. We found that there are net benefits of repealing the rule of $82 million in 2020 and $106 million in 2025 under API's emissions reduction assumptions.

Sensitivity of the Social Cost of Methane (SC-CH_4). The final RIA estimates benefits of the rule using a social cost of methane (SC-CH_4) figure that encompasses the global benefits of methane reductions. We present here a sensitivity analysis altering the SC-CH_4 in two ways: first, using the domestic SC-CH_4, and second, using a higher global SC-CH_4 than was used in the original RIA. (See Appendix C for more on the social cost of carbon and the SC-CH_4.)

The Trump administration uses domestic social cost figures that encompass benefits accruing only to the United States and has recently developed these estimates for use in RIAs for the review of the Clean Power Plan, the proposed delay of the BLM methane rule, and the proposed delay of this rule (EPA 2017c). The proposed delay lists domestic SC-CH_4 figures for the years 2015–20 discounted at 3 percent and 7 percent. While consistent with OMB Circular A-4 guidance (OMB 2003), the use of the 7 percent discount rate for the social costs of carbon and methane is considered by many economists to be inappropriate, as it means that "the effects of our actions on future generations are largely unaccounted for," which is "incompatible with the long-lived nature of greenhouse gas emissions in the atmosphere, and the fact that damages from emissions today will continue to be felt for generations to come" (Newell 2017).

We use the 2020 figures given in this rule's proposed delay (converted to 2012$ for consistency with the rest of the rule), which are $170 per metric ton and $52 per metric ton (discounted at 3 percent and 7 percent, respectively) (EPA 2017b). Because the rule's proposed delay does not list a 2025 figure, we use the figures presented in the proposed delay for the BLM methane rule in 2025, which are $189 per metric ton and $64 per metric ton (discounted at 3 percent and 7 percent, respectively) (BLM 2017). The figures used here are roughly 13–15 percent of the global SC-CH_4 used in the original rule, which reduces the benefits forgone significantly. In 2020, the benefits forgone drop 76 percent to $99 million, and there are net benefits of eliminating the rule of $285 million. In 2025, the benefits forgone drop 78 percent to $174 million, and there are net benefits of eliminating the rule of $457 million.

We also want to include a higher-bound estimate of the SC-CH_4 value, so we use the figures based on the 2.5 percent discount rate, which are $1,730 per metric ton in 2020 and $1,946 per metric ton in 2025. (The original RIA, our replication, and our baseline use figures that rely on a 3 percent discount rate.) With this adjustment, the net benefits of repeal become net costs of $146 million in 2020 and $350 million in 2025.

We include two (among many possible) additional scenarios to examine costs avoided and benefits forgone with multiple adjustments. Both include the cost adjustment using API's LDAR costs and the benefits adjustment using API's emissions estimates; in addition, each adjusts the SC-CH_4. The first adjustment uses the domestic SC-CH_4, while the second adjustment uses the higher global SC-CH_4. The first combined scenario results in net benefits to society of repeal of $660 million in 2020 and $1.2 billion in 2025. The second combined scenario results in net benefits to society of repeal of $355 million in 2020 and $708 million in 2025.

[20] See Attachment E (Benefit-Cost Analysis in RIA), p. 11 of API (2015), for more detail.

Because the net benefits (or net costs) of repeal are clearly very responsive to the figure chosen for the social cost of methane, we calculated the break-even point of the SC-CH_4 for our baseline. For costs avoided to equal benefits forgone from methane emissions reductions, the social cost of methane would have to be $1,211 per metric ton in 2020 and $1,183 per metric ton in 2025, a 7 percent and 22 percent decrease, respectively, from the figures used in the original RIA and substantially larger than the Trump administration's domestic estimates.

5.5. Rule Modification Scenarios

As previously stated, we reviewed a number of comments on the proposed rule as well as requests for reconsideration of the final rule. The following modifications represent the most commonly cited issues with the rule that can be readily quantified. The following modifications are made only to the LDAR provision. All rule modifications are summarized in Table 7.[21]

Our results indicate that implementing the rule with any of these modifications will lead to net benefits of the modified rule that are higher than those in our baseline in most cases. While the net benefits may increase, the benefits in most modifications decrease, which means there are fewer emissions reductions, which is the stated purpose of the rule. It is important to note that we focus only on the costs and benefits and cannot comment on the technical, legal, or operational aspects of these modifications.

Excluding Low Production Wells. One of the most controversial provisions of the rule is requiring low production wells to meet the LDAR requirements. EPA excluded them in the proposed rule on the assumption that they were mostly owned by small businesses and that their fugitive emissions are generally low. EPA included them in the final rule after receiving public comments claiming that their potential fugitive emissions are in fact comparable to those of higher-production wells. According to EPA's analysis (based on reviewing 2012 data in the Drillinginfo database), 30 percent of all gas wells and 43 percent of all oil wells are low production wells. EPA stated in the final rule that it did not receive sufficient information from commenters to apply different emissions factors in estimating the emissions reduction potential of low production wells, so low production well emissions are assumed to be equivalent to those of regular wells.[22] To exclude low production wells, we thus adjusted the number of affected facilities in the LDAR provision based on the aforementioned percentages in the Drillinginfo database.

The costs and benefits of the rule decrease 20–30 percent in each year of analysis. The net benefits of implementing the rule with this modification are $36 million in 2020 and $141 million in 2025. Notably, in 2025, there are lower net benefits with this modification than in the baseline, suggesting that over time, this modification will prove more costly to society than leaving the rule in place as it is.

Excluding Oil Wells with GOR <300. Industry also requested that EPA exclude oil wells with a gas-to-oil ratio (GOR) of less than 300 standard cubic feet (scf) per stock

[21] To keep the accounting straight, the baseline for a rule modification is the costs and benefits of the rule, while the baseline for rule elimination is the cost savings and benefits forgone associated with the rule. Put another way, the signs of costs and benefits get switched from the baseline.

[22] 81 FR 35856. https://www.gpo.gov/fdsys/pkg/FR-2016-06-03/pdf/2016-11971.pdf.

tank barrel from the LDAR provision because it is not cost effective to control leaks from wells with limited methane releases.[23] Both the proposed and final rules include these wells, but the final rule distinguishes them from oil wells with GOR greater than 300 scf based on comments on the proposed rule that emissions rates from these two types of wells were inherently different (i.e., wells with GOR greater than 300 scf are higher polluters than wells with GOR less than 300 scf). We thus recalculated the costs and benefits of implementing the rule excluding these wells based on the estimates of the number of these wells provided in the final RIA, which yields net benefits of $68 million in 2020 and $225 million in 2025, much higher than the baseline.

Excluding Oil Wells. Industry also wanted EPA to consider excluding all oil wells from the LDAR provision, independent of GOR, because control of oil wells would not be cost-effective. We thus recalculated the costs and benefits of the rule excluding all oil wells, which yields net benefits similar to those of excluding oil wells with GOR <300: $68 million in 2020 and $197 million in 2025.

Less Frequent Surveying. Another modification requested by industry is to reduce the frequency of fugitive emissions monitoring, maintenance, and reporting (what we refer to collectively as surveying). The final rule requires semiannual surveying for gas and oil wells and quarterly surveying for gathering and boosting stations, transmission stations, and storage facilities. More frequent surveying leads to higher costs, but it also yields greater emissions reductions, while less frequent surveying leads to lower costs but also lower emissions reductions. EPA presented cost and emissions reduction estimates for annual surveying in the RIA, even though the agency elected to go with a more frequent surveying schedule. In this modification, we substitute the annual LDAR cost and emissions reduction estimates for all sources covered under this provision. The net benefits of implementing the rule with this modification are $50 million in 2020 and $175 million in 2025, which are 85 percent and 15 percent higher than the baseline, respectively.

More Frequent Surveying. Environmental groups requested in comments that the frequency of fugitive emissions surveying be increased. As previously stated, the final rule requires semiannual surveying for gas and oil wells and quarterly surveying for gathering and boosting stations, transmissions stations, and storage facilities. In this modification, we substitute quarterly LDAR cost and emissions reduction estimates (which were also included in the final RIA) for gas and oil wells. Costs roughly double for this monitoring frequency, while benefits only increase by about 15–20 percent; however, there are substantially more emissions reductions under this modification. The implementation of this modification yields net costs to society of $93 million in 2020 and $72 million in 2025.

Table 7 also includes a combined modifications estimate. Combining the exclusion of low production wells and all oil wells, as well as decreasing the frequency of surveying leaks, yields net benefits of $48 million in 2020 and $140 million in 2025. In 2020, the net benefits of these combined modifications are 78 percent higher than the baseline, but in 2025, the net benefits are 8 percent lower than the baseline, suggesting that they have diminished value as implementation of the rule continues over time.

[23] Standard cubic feet (scf) is a measurement of molecular quantity at a particular temperature commonly used for gases.

TABLE 7. RULE MODIFICATION SCENARIOS IN 2020 AND 2025 AT 3% DISCOUNT RATE (MILLION 2012$)

KEEPING RULE						
	2020			2025		
	Costs	Benefits	Net Benefits	Costs	Benefits	Net Benefits
Baseline	**383**	**410**	**27**	**631**	**783**	**152**
Excluding Low Production Wells	296	333	36	455	596	141
% difference*	*-23%*	*-19%*	*32%*	*-28%*	*-24%*	*-7%*
Excluding Oil Wells GOR <300	310	378	68	481	706	225
% difference*	*-19%*	*-8%*	*151%*	*-24%*	*-10%*	*49%*
Excluding All Oil Wells	210	277	68	276	472	197
% difference*	*-45%*	*-32%*	*152%*	*-56%*	*-40%*	*30%*
Less Frequent Surveying (Annual)	285	335	50	431	606	175
% difference*	*-26%*	*-18%*	*85%*	*-32%*	*-23%*	*15%*
More Frequent Surveying (Quarterly)	566	474	(93)	1,005	933	(72)
% difference*	*48%*	*15%*	*-443%*	*59%*	*19%*	*-148%*
Combined**	178	225	48	211	351	140
% difference*	*-54%*	*-45%*	*78%*	*-67%*	*-55%*	*-8%*

**Percentage difference from the baseline.*
***Combined scenario includes the exclusion of low production wells and all oil wells, as well as annual surveying.*

6. Discussion

6.1. Public Comments

EPA's methane rule was and continues to be a highly controversial rule among stakeholders. For this section, we consulted the summary of significant comments listed in the final rule text as well as comments by environmental groups, API[24], and IPAA[25] on the proposed rule and requests for reconsideration of the rule.

Industry broadly questioned EPA's authority to regulate methane alone (without regulating other greenhouse gases) based on the greenhouse gas endangerment finding, while a number of environmental and legal groups argued that EPA did have authority to regulate methane. EPA stated in response that it does have authority to regulate methane given that it is a greenhouse gas that endangers public health and welfare.

In general, environmental groups came out strongly in support of the rule and requested

[24] API (American Petroleum Institute). 2016. "Re: Request for Administrative Reconsideration EPA's Final Rule 'Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources.'" August 2. http://www.api.org/~/media/Files/News/Letters-Comments/2016/160802-API-Petition-to-Reconsider-NSPS-OOOOa.pdf.

[25] IPAA (Independent Petroleum Association of America) et al. 2016. "Re: Request for Administrative Reconsideration EPA's Final Rule 'Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources.'" August 2.

that EPA go even further in regulating existing sources as well under Section 111(d) of the Clean Air Act. At the time of the proposed rule, the Clean Air Task Force, Earthjustice, Environmental Defense Fund, Natural Resources Defense Council, and Sierra Club submitted joint comments opposing the exclusion of low production wells. As previously stated, EPA ultimately included low production wells in the final rule.

Industry, on the other hand, made some specific requests that would reduce the costs of the rule and grant greater compliance flexibility to use a wider range of technology that might achieve cost effective emissions reductions. Industry likewise requested a number of more technical changes to specific provisions, some of which were granted while others were not.

6.2. Non-Monetary Impacts

The climate-related methane emissions reductions are the only quantified benefit of this rule; however, other emissions reductions will also occur with implementation of this rule. The rule is estimated to reduce VOC emissions by approximately 150,000 short tons in 2020 and 200,000 short tons in 2025. Such VOCs contribute to ambient ozone formation, which degrades human health and the environment, adds to $PM_{2.5}$ ambient concentrations (which affects human health and the environment more strongly than ozone), and affects human health directly, as many VOCs (such as benzene) are known or suspected carcinogens. Were the rule to be repealed, these emissions reductions would disappear.

EPA elected not to quantify emissions reductions due to VOCs given the difficulty in assessing a national impact of such a localized pollutant. There are no comprehensive estimates for the monetary benefit of reducing emissions of VOCs. Though EPA has published such estimates for $PM_{2.5}$ effects alone, using its BenMAP model and applying a national benefits estimate of $2,800 per ton, these estimates assume that exposed populations are denser, on average, than populations living near oil and gas development activities, which are primarily rural. Nevertheless, $PM_{2.5}$ plumes can extend hundreds of miles, potentially affecting populations in urban areas. Estimating the costs and benefits of these changes in VOCs is therefore incredibly difficult with a rule that reduces VOC emissions across a broad and largely rural area. For illustrative purposes, one might multiply the total number of VOC emissions estimated to be reduced by implementing EPA's methane rule (151,000 short tons in 2020 and 209,000 short tons in 2025) by the $2,800 per ton estimate to see potential benefits of $423 million in 2020 and $585 million in 2025. The non-monetized forgone benefits associated with repealing the rule could therefore be quite large.

The RIA estimates minimal changes to the production of natural gas and oil, prices, and number of wells drilled. EPA expects a slight initial increase of 0.03 percent in wells drilled, while later in the rule, it expects a slight decrease of 0.16 percent in wells drilled. Production of natural gas is expected to be slightly lower by 0.03 percent, while production of crude oil is expected to be unchanged in 2020 and slightly higher (0.01 percent) in 2025. Wellhead prices for natural gas are expected to increase slightly in 2020 and 2025 (0.29 percent and 0.12 percent, respectively) with implementation of the rule, while wellhead prices for crude oil are expected to remain unchanged in 2020 and 2025.

The rule is expected to create approximately 1,100 full-time equivalent (FTE) positions in 2020 and 1,800 FTE in 2025, according to the final RIA. (EPA notes that FTE does not automatically equate to new jobs, as there is uncertainty about whether new positions will be created or current employees' time reallocated). The increase is mainly related

to installation and operation of new equipment, primarily from the well completions and the LDAR provisions, as well as activities related to reporting and recordkeeping.

7. Conclusion

Our baseline calculation shows that repealing EPA's methane rule would lead to significant net costs to society in both 2020 and 2025 (which characterize the short- and long-term impacts of this rule, respectively) unless the social cost of methane were lowered against the baseline at least 7 percent in 2020 and 22 percent in 2025—percentages much smaller than when substituting the domestic SC-$CH_4$for the global SC-CH_4. We evaluated making substantial adjustments to inputs to the costs and benefits of the rule, including technical costs and emissions reduction potential, as well as to the social cost of methane. Industry's changes to the cost and potential emissions reductions of LDAR increase the expected costs and decrease the expected benefits of the rule; in repeal terms, these changes increase the expected costs avoided and decrease the expected benefits forgone, thus resulting in net benefits to society of repealing the rule. Using a higher global social cost of methane increases the net costs to society of repealing the rule, while using the Trump administration's domestic social cost of methane results in net benefits to society of repealing the rule.

Our analysis also shows that making certain modifications to the rule, such as excluding certain types of wells and decreasing the frequency of surveying, but nonetheless implementing the rule would result in net benefits. However, nearly all the modifications considered (with the exception of more frequent surveying) result in fewer methane emissions reductions, working against the stated purpose of the rule.

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Appendix A. 7 Percent Discount Rate Results

TABLE A-1. GENERATING A BASELINE IN 2020 AND 2025 AT 7 PERCENT DISCOUNT RATE (MILLION 2012$)

KEEPING RULE						
	2020			2025		
	Costs	Benefits	Net Benefits	Costs	Benefits	Net Benefits
Original RIA	320	360	35	530	690	170
Replication	323	358	36	530	689	159
% difference*	*1%*	*0%*	*2%*	*0%*	*0%*	*-6%*
Updating Natural Gas Price	334	358	24	549	689	140
% difference**	*3%*	*0%*	*-31%*	*4%*	*0%*	*-11%*
Natural Gas Savings as Benefit	386	422	36	636	795	159
% difference**	*20%*	*18%*	*0%*	*20%*	*15%*	*0%*
Correcting SC-CH_4	323	358	36	530	695	165
% difference**	*0%*	*0%*	*0%*	*0%*	*1%*	*4%*
Baseline	**386**	**410**	**24**	**636**	**783**	**146**
% difference**	*20%*	*15%*	*-31%*	*20%*	*14%*	*-8%*

**Percentage difference from original.*
***Percentage difference from replication.*

TABLE A-2. GENERATING A BASELINE FOR REPEAL IN 2020 AND 2025 AT 7 PERCENT DISCOUNT RATE (MILLION 2012$)

REPEALING RULE						
	2020			2025		
	Costs Avoided	Benefits Forgone	Net Benefits of Repeal	Costs Avoided	Benefits Forgone	Net Benefits of Repeal
Using Original RIA Figures	320	360	(35)	530	690	(170)
Replication	323	358	(36)	530	689	(159)
% difference*	*1%*	*0%*	*-2%*	*0%*	*0%*	*6%*
Updating Natural Gas Price	334	358	(24)	549	689	(140)
% difference**	*3%*	*0%*	*31%*	*4%*	*0%*	*11%*
Natural Gas Savings as Benefit	386	422	(36)	636	795	(159)
% difference**	*20%*	*18%*	*0%*	*20%*	*15%*	*0%*
Correcting SC-CH_4	323	358	(36)	530	695	(165)
% difference**	*0%*	*0%*	*0%*	*0%*	*1%*	*-4%*
Repeal Baseline	**386**	**410**	**(24)**	**636**	**783**	**(146)**
% difference**	*20%*	*15%*	*31%*	*20%*	*14%*	*8%*

**Percentage difference from original.*
***Percentage difference from replication.*

TABLE A-3. COST ADJUSTMENT SCENARIOS IN 2020 AND 2025 AT 7 PERCENT DISCOUNT RATE (MILLION 2012$)

REPEALING RULE						
	2020			2025		
	Costs Avoided	Benefits Forgone	Net Benefits of Repeal	Costs Avoided	Benefits Forgone	Net Benefits of Repeal
Repeal Baseline	**386**	**410**	**(24)**	**636**	**783**	**(146)**
API's LDAR Costs	778	410	368	1,438	783	655
% difference*	*102%*	*0%*	*1,605%*	*126%*	*0%*	*548%*

**Percent difference from the baseline.*

TABLE A-4. BENEFITS ADJUSTMENT SCENARIOS IN 2020 AND 2025 AT 7 PERCENT DISCOUNT RATE (MILLION 2012$)

REPEALING RULE						
	2020			2025		
	Costs Avoided	Benefits Forgone	Net Benefits of Repeal	Costs Avoided	Benefits Forgone	Net Benefits of Repeal
Repeal Baseline	**386**	**410**	**(24)**	**636**	**783**	**(146)**
API's Emissions per Facility Figures	386	302	84	636	526	111
% difference*	*0%*	*-26%*	*444%*	*0%*	*-33%*	*176%*
Domestic SC-CH_4 (7%)	386	66	320	636	117	519
% difference*	*0%*	*-84%*	*1,408%*	*0%*	*-85%*	*455%*
Higher Global SC-CH_4	386	529	(143)	636	981	(345)
% difference*	*0%*	*29%*	*-485%*	*0%*	*25%*	*-136%*
Combined**	778	58	720	1,438	97	1,341
% difference*	*102%*	*-86%*	*3,048%*	*126%*	*-88%*	*1,016%*
Combined***	778	386	392	1,438	654	708
% difference*	*101%*	*-6%*	*1,705%*	*126%*	*-16%*	*585%*

**Percentage difference from the baseline.*
***Combined scenario incorporates API's LDAR costs into the calculation of costs avoided and API emissions per facility estimates and domestic SC-CH_4 into the calculation of benefits forgone.*
****Combined scenario incorporates API's LDAR costs into the calculation of costs avoided and API emissions per facility estimates and higher global SC-CH_4 into the calculation of benefits forgone.*

TABLE A-5. RULE MODIFICATION SCENARIOS IN 2020 AND 2025 AT 7 PERCENT DISCOUNT RATE (MILLION 2012$)

KEEPING RULE						
	2020			2025		
	Costs	Benefits	Net Benefits	Costs	Benefits	Net Benefits
Baseline	**386**	**410**	**24**	**636**	**783**	**146**
Excluding Low Production Wells	299	330	31	458	596	137
% difference*	*-23%*	*-20%*	*28%*	*-28%*	*-24%*	*-6%*
Excluding Oil Wells GOR <300	312	378	66	485	706	221
% difference*	*-19%*	*-8%*	*169%*	*-24%*	*-10%*	*51%*
Excluding All Oil Wells	211	277	67	278	472	195
% difference*	*-45%*	*-32%*	*173%*	*-56%*	*-40%*	*33%*
Less Frequent Surveying (Annual)	286	335	49	433	606	174
% difference*	*-26%*	*-18%*	*101%*	*-32%*	*-23%*	*19%*
More Frequent Surveying (Quarterly)	567	474	(93)	1,006	933	(74)
% difference*	*47%*	*15%*	*-481%*	*58%*	*19%*	*-150%*
Combined**	178	225	47	212	352	139
% difference*	*-54%*	*-45%*	*96%*	*-67%*	*-55%*	*-5%*

**Percentage difference from the baseline.*
***Combined scenario includes the exclusion of low production wells and all oil wells, as well as annual surveying.*

Appendix B. Baseline Costs and Benefits by Requirement

TABLE B-1. BASELINE COSTS AND BENEFITS BY REQUIREMENT IN 2020 AND 2025 AT 3 PERCENT DISCOUNT RATE (MILLION 2012$)

KEEPING RULE						
	2020			2025		
	Costs	Benefits	Net benefits	Costs	Benefits	Net benefits
Well completions	148	156	7	158	190	32
Fugitive emissions (LDAR)	226	232	7	460	541	81
Pneumatic pumps	3	15	13	5	36	31
Compressors	1	5	5	2	12	11
Pneumatic controllers	0.01	2	2	0.02	4	4
Recordkeeping/reporting	6	—	(6)	6	—	(6)
Total	383	410	27	631	783	151

TABLE B-2. BASELINE COSTS AND BENEFITS BY REQUIREMENT IN 2020 AND 2025 AT 7 PERCENT DISCOUNT RATE (MILLION 2012$)

KEEPING RULE						
	2020			2025		
	Costs	Benefits	Net benefits	Costs	Benefits	Net benefits
Well completions	148	156	7	157	189	32
Fugitive emissions (LDAR)	227	232	5	464	541	77
Pneumatic pumps	3	15	12	6	36	30
Compressors	1	5	4	2	12	11
Pneumatic controllers	0.01	2	2	0.2	4	4
Recordkeeping/reporting	6	—	(6)	6	—	(6)
Total	386	410	24	636	783	146

Appendix C. Issues in Using a Domestic or Global Social Cost of Methane (SC-CH_4) and CO_2 (SCC)

Economists, policymakers, and others have been debating the appropriate metric for counting the benefits from reducing greenhouse gas emissions. These debates surround whether the global or domestic social costs of greenhouse gas reductions should be used in RIAs accompanying regulations, as well as how large those costs might be given uncertainties in measuring both global and domestic social costs. Whether one uses a global or domestic social cost is highly consequential, as most of the damages from global warming will fall on more vulnerable, poorer nations. Some models even show the United States benefiting, at least partly, from global warming, particularly in agriculture.

The argument for a domestic SCC and SC-CH_4 is that the use of global estimates may conflict with long-standing federal regulatory policy: Circular A-4 directs agencies to "focus on benefits and costs that accrue to citizens and residents of the United States. Where you choose to evaluate a regulation that is likely to have effects beyond the borders of the United States, these effects should be report separately" (OMB 2003, 15). Based on this policy, Fraas et al. (2016) argue that "a decision to issue a regulation with substantial domestic costs based on a finding that benefits to foreigners 'justify' such costs would be irregular at best" (569).

The main argument for using a global SCC and SC-CH_4 is that greenhouse gases are global pollutants—damages occur in the United States and abroad, and furthermore, some impacts occurring abroad can affect the United States through the global economy (Cropper et al. 2017). Cropper et al. (2017) note that using a domestic SCC would ignore 86 percent of the costs. Further, as Cropper et al. (2017) states, the choice to use a domestic figure while it "is consistent with a narrow application of prior regulatory analysis practice under OMB's Circular A-4, it is unnecessarily and unreasonably constrained for addressing inherently global pollutants such as greenhouse gases" (4). (There are other reasons for and against using domestic SCC and SC-CH_4 figures. Readers are encouraged to consult the congressional testimony of Ted Gayer[26] for arguments in favor of a domestic social cost, and Howard and Schwartz (2017)[27] for arguments in favor of a global social cost.)

A practical middle ground is to calculate benefits of regulations using each measure, without indicating a preference or weight, so decisionmakers can see a range of potential impacts.

But even if all agree that a domestic SCC and SC-CH_4 should be used in an RIA, there is still a question about what domestic value should be used (indeed, the same question can be asked of the global estimates; see below). In particular, several RFF researchers have taken issue with the Trump administration's interim domestic estimates specifically due to the methodology used to calculate those figures (Cropper et al. 2017). The Trump

[26] US House of Representatives, Committee on Science, Space, and Technology. 2017. Joint Hearing: At What Cost? Examining the Social Cost of Carbon. Serial No. 115-04. Witness statement: Ted Gayer. https://www.gpo.gov/fdsys/pkg/CHRG-115hhrg24670/pdf/CHRG-115hhrg24670.pdf; pg. 24–33.

[27] Howard, Peter, and Jason Schwartz. 2017. "Think Global: International Reciprocity as Justification for a Global Social Cost of Carbon." Columbia Journal of Environmental Law 42: 203-294.

administration's interim figure makes use of a 7 percent discount rate, which many economists find to be inappropriate for use in the SCC or SC-CH_4. Cropper et al. (2017) outline the issues with using a 7 percent discount rate in their comments to BLM:

"Though the addition of an estimate calculated using a 7 percent discount rate is consistent with past regulatory guidance under OMB Circular A-4, it is inappropriate for use in estimating the SC-CH_4 through BLM's methodology. The integrated assessment models used to generate the estimates report their output in terms of "consumption-equivalent" impacts, which is intended to reflect the effective impact on people's consumption (as opposed to investment). Standard economic practice is to discount consumption equivalents at the "consumption rate of interest", which according to OMB's current guidance is a 3 percent discount rate. It is therefore inappropriate to use such modeling results with OMB's 7 percent discount rate, which is intended to represent the historical before-tax return on private capital. None of the researchers whose model results were used to generate the interim values employs a discount rate as high as 7 percent in their work" (5).

Cropper et al. (2017) also point to a recent Council of Economic Advisers study that suggests using a 2 percent consumption rate of interest at most, given historical trends (2017).

For the reasons outlined above, the Trump administration's domestic estimate is likely to underestimate impacts to the United States from greenhouse gas emissions. Furthermore, both the global and domestic social costs are likely underestimates, as the models used to calculate both values rely on older research, particularly with respect to agricultural damages (Moore et al. 2017). For now, presenting both the global and interim domestic figures together, but using a 3 percent rather than a 7 percent discount rate, as suggested by Cropper et al. (2017), provides the most informative results.