RFF REPORT

The 2016 BLM Methane Waste Prevention Rule

Should It Stay or Should It Go?

Alan J. Krupnick and Isabel Echarte

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The 2016 BLM Methane Waste Prevention Rule: Should It Stay or Should It Go?

Alan J. Krupnick and Isabel Echarte*

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*Krupnick: senior fellow, Resources for the Future (RFF); krupnick@rff.org. Echarte: research assistant, RFF; echarte@rff.org. We would like to thank RFF's Art Fraas, Jan Mares, and Justine Huetteman for their work on this project and BLM staff for help in understanding the methane RIAs.

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, guidance documents, and policies that potentially burden the development or use of domestically produced energy resources.[1] This EO also specifically identified for review regulations applicable to the oil and gas sector, including the Bureau of Land Management's (BLM's) 2016 methane waste prevention rule.[2]

The Trump administration has also focused on reducing regulatory costs across the federal government more broadly with EO 13771, which ordered that two regulations be removed for every regulation implemented.[3] Subsequent guidance from the Office of Management and Budget (OMB)[4] for implementing EO 13771 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 since President Reagan's EO 12291).[5] But the OMB guidance and EO 13771 also laid out the controversial requirement that only the cost savings from repeal be considered in prioritizing rules for repeal; in other words, only cost savings (and not forgone benefits or net benefits) are to be counted when reviewing regulations under the two-for-one requirement. In a March letter to the Trump administration, 96 economists and other experts expressed concerns about this requirement.[6]

Following these actions, we sought to first catalog existing federal regulations promulgated after 2005 and non-regulatory federal activities of concern to the oil and gas industry.[7] We then turned toward assessing what the effects on industry and the public might be if some of these regulations were eliminated, modified, or delayed. To analyze these impacts, we updated the parameters used by each agency in their original Regulatory Impact Analyses (RIAs) and assessed the cost savings and forgone benefits of repealing and modifying the following rules:

- the BLM's "Waste Prevention, Production Subject Royalties, and Resource Conservation" rule;

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[1] 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.

[2] US Bureau of Land Management (BLM). 2016. Final Rule: Waste Prevention, Production Subject to Royalties, and Resource Conservation. *Federal Register* 81(223): 83008, November 18. https://www.gpo.gov/fdsys/pkg/FR-2016-11-18/pdf/2016-27637.pdf.

[3] 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.

[4] 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.

[5] Executive Office of the President. 1981. Executive Order 12291: Federal Regulation. *Federal Register* 46: 13193, February 17. https://www.archives.gov/federal-register/codification/executive-order/12291.html.

[6] Linn, Joshua, and Alan J. Krupnick et al. 2017. Ninety-Six Regulatory Experts Express Concerns about Trump Administration Reforms. Washington, DC: Resources for the Future, May 24.http://www.rff.org/blog/2017/ninety-six-regulatory-experts-express-concerns-about-trump-administration-reforms.

[7] Information about this catalog will be included in a forthcoming report summarizing the results of the project.

- the Environmental Protection Agency's (EPA's) "Oil and Natural Gas Sector: Emissions 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 the first rule listed: the Obama administration's 2016 BLM methane waste prevention rule (herein referred to as the 2016 rule)—and the Trump administration's proposed repeal of the rule.[8]

BLM's 2016 rule sought to regulate methane emissions from existing sources in upstream oil and gas production on federal lands, with the stated purpose of reducing the waste of natural gas resources. This rule differs from EPA's rule on methane emissions, which covers all new or modified oil and gas sources on federal and non-federal lands. For the 2016 rule, BLM's RIA calculated that implementing the rule would result in $898 million to $1.2 billion in net benefits over 10 years (in 2012 dollars at a 3 percent discount rate).[9] The 2018 RIA for the proposed repeal of the rule, however, estimates that enforcing the same 2016 rule would result in net costs to society of $581 million to $945 million over 10 years (in 2012 dollars at a 3 percent discount rate), thereby allowing BLM to estimate that repealing the 2016 rule would result in net benefits of a similar amount.[10] The main discrepancy between these two estimates is the Trump administration's decision to change how agencies calculate the social costs of greenhouse gas emissions. In its RIA for the 2018 proposed repeal of the rule, BLM used a domestic social cost of methane ($SC\text{-}CH_4$), which the administration has termed its "interim" domestic $SC\text{-}CH_4$. This estimate aims to measure the climate damages from methane emissions to the United States alone. In contrast, the RIA for BLM's 2016 rule used a peer-reviewed global estimate of $SC\text{-}CH_4$, which measures those damages to the United States as well as the rest of the world.

In the analysis we provide below, we use the global social cost of methane in our baseline, a decision outlined further where we discuss benefits adjustment scenarios in Section 5 of this report. Our baseline also adopts three assumptions from the 2018 RIA:

[8] BLM. 2018. Proposed Rule: Waste Prevention, Production Subject to Royalties, and Resource Conservation; Rescission or Revision of Certain Requirements. *Federal Register* 83: 9724, February 22. https://www.federalregister.gov/documents/2018/02/22/2018-03144/waste-prevention-production-subject-to-royalties-and-resource-conservation-rescission-or-revision-of.

[9] BLM. 2016. Regulatory Impact Analysis for: Revisions to 43 CFR 3100 (Onshore Oil and Gas Leasing) and 43 CFR 3600 (Onshore Oil and Gas Operations), Additions of 43 CFR 3178 (Royalty-Free Use of Lease Production) and 43 CF 3179 (Waste Prevention and Resource Conservation). https://www.regulations.gov/document?D=BLM-2016-0001-9127.

[10] BLM. 2018. Regulatory Impact Analysis for the Proposed Rule to Rescind or Revise Certain Requirements of the 2016 Waste Prevention Rule. https://www.regulations.gov/document?D=BLM-2018-0001-0002.

higher compliance cost estimates for administrative burdens, compliance beginning in 2019, and the same discounting methods. We discuss our decision process in creating this baseline in the body of this report. We also create a scenario using the domestic social cost of methane, functioning as a sensitivity analysis and an attempt to replicate the 2018 RIA's results.[11]

Table 1 shows the estimated costs and benefits from keeping or repealing the 2016 rule using assumptions from BLM's 2016 RIA, our baseline using the global SC-CH_4, our attempt to replicate BLM's 2018 RIA using the domestic SC-CH_4, and BLM's 2018 RIA.[12] A range of estimates (for high- and low-cost scenarios) is provided for costs and net benefits due to variation in the potential cost for the flaring requirement. In all scenarios, the costs from enforcing the 2016 rule would be private costs borne by the oil and gas industry. The benefits of keeping the 2016 rule are largely external benefits from reducing methane (CH_4) emissions, though some benefits accrue to industry from the capture and sale of additional gas.

TABLE 1. TOTAL 10-YEAR NET BENEFITS, NET PRESENT VALUE AT 3% DISCOUNT RATE (MILLION 2012$)*

	High-Cost Scenario			Low-Cost Scenario		
KEEPING RULE						
	Costs	Benefits	Net Benefits	Costs	Benefits	Net Benefits
Obama Administration 2016 RIA (Global SC-CH_4)**	1,780	2,678	898	1,464	2,678	1,214
RFF Baseline (Global SC-CH_4)	1,901	2,712	812	1,535	2,712	1,177
RFF Sensitivity Analysis (Domestic SC-CH_4)	1,901	1,037	(863)	1,535	1,037	(498)
Trump Administration 2018 RIA (Domestic SC-CH_4)	2,028	1,083	(945)	1,664	1,083	(581)
REPEALING RULE						
	Costs Avoided	Benefits Forgone	Net Benefits of Repeal	Costs Avoided	Benefits Forgone	Net Benefits of Repeal
Obama Administration 2016 RIA (Global SC-CH_4)	1,780	2,678	(898)	1,464	2,678	(1,214)
RFF Repeal Baseline (Global SC-CH_4)	1,898	2,712	(814)	1,532	2,712	(1,180)
RFF Sensitivity Analysis (Domestic SC-CH_4)	1,898	1,037	860	1,532	1,037	495
Trump Administration 2018 RIA (Domestic SC-CH_4)	2,025	1,083	942	1,661	1,083	578

*Throughout the body of this report, "RFF Baseline" is referred to as "Baseline" and "RFF Repeal Baseline is referred to as "Repeal Baseline." In Table 7, "RFF Sensitivity Analysis" refers to "Domestic SC-CH_4 and SCC."

**The 2016 RIA seems to have a typo regarding the net benefits as presented in its table on page 112 reflecting the 3%, high-cost net present value, stating that the net benefits are $889 million—though subtracting the benefits and costs in that scenario results in net benefits of $898 million.

[11] Our replication of the 2016 RIA differs by 1–3% from the original analysis, mainly because of slight differences in the benefits calculation. Our replication of the 2018 RIA differs by 4–14%. The reasons for this difference are outlined in the body of this report, under "5.2 Corrections to Generate a Baseline."

[12] In this document, we produce only the 3% discount rate results. The 7% discount rate results can be found in Appendix A.

The analysis below illustrates that using the global SC-CH_4 produces vastly different results than the domestic SC-CH_4. Our baseline is slightly lower than the RIA estimates for the 2016 rule, due to delayed compliance resulting from actions by the Trump administration to postpone the rule. On one hand, our baseline for repealing the rule estimates that doing so would result in net costs of $814 million to $1.2 billion (at a 3 percent discount rate and in 2012 dollars). Our scenario using the domestic SC-CH_4, on the other hand, estimates that repealing the rule would result in $495 million to $860 million in net benefits—figures that are about $100 million smaller than those estimated by the Trump administration in its 2018 RIA. This discrepancy is likely due to slight methodological differences—an issue discussed further in the body of this report.

These results illustrate how the estimated impacts of repealing the BLM 2016 rule are extremely sensitive to the SC-CH_4 estimate used in the analysis. The results using the global estimate strongly support keeping the rule; results using the domestic estimate strongly support repealing or revising the rule.

In the following sections, we present estimates of the cost avoided and benefits forgone from repealing the regulation, after correcting the baseline for more recent natural gas price estimates and other factors. We also perform several analyses based on varying assumptions used to calculate costs and benefits in the original analysis:

- cost estimates for leak detection and repair (LDAR) from the American Petroleum Institute (API), a trade association;
- LDAR cost estimates from Carbon Limits, a research group;
- cost estimates for the liquids unloading requirements from ICF, a consulting firm;
- a lower estimate for SC-CH_4 (the Trump administration's domestic estimate); and
- a higher estimate for SC-CH_4 (the peer-reviewed global estimate that is higher than those generally used in RIAs).

For repealing the regulation, using the domestic SC-CH_4 is the only scenario showing net benefits (between $498 million and $863 million at a 3 percent discount rate). The rest of the analyses show net costs from repealing the rule (from $814 million to $1.7 billion at a 3 percent discount rate). The scenario using API's higher LDAR costs results in $152 million in net costs (under the low-cost scenario) to $213 million in net benefits (under the high-cost scenario) at the same discount rate.

Additionally, we look at the costs and benefits of keeping with certain modifications, either increasing or decreasing the stringency of the rule:

- reducing the frequency of LDAR inspections from semiannual to annual inspections,
- increasing the emissions threshold for storage requirements,
- removing the flaring requirement,
- combining all three of the above actions, and
- increasing the frequency of LDAR inspections.

For the modification analyses, one change reduces net benefits (reducing LDAR inspection frequency) and one change significantly increases net benefits (removing the flaring requirement under the high-cost scenario, where the reduction in costs outweighs the reduction in net benefits).

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.[13] This EO also specifically identified for review 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.[14] Subsequent guidance from the Office of Management and Budget (OMB)[15] for implementing EO 13771 emphasized that cost-benefit analysis is required for all major regulations being considered for elimination or modification (as well as 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 as well as in scoring against the costs imposed by new regulations. [16]

2. Objectives

The goals of our project were to catalog the regulations that may be reviewed by the Trump administration[17] and select several for in-depth assessments, including cost-benefit analyses to estimate the potential impacts on industry and the public if the regulations are eliminated, modified, or delayed. These impacts include cost savings and forgone benefits from changes to regulations (as costs and benefits are defined in Circular A-4),[18] 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 of the repeal or modification of six major regulations affecting the oil and gas sector (these are outlined in the executive summary; this report is the first in the series).[19]

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[13] 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.

[14] 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.

[15] 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.

[16] 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.

[17] We will discuss this catalog in a forthcoming summary report.

[18] 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.

[19] 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.

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 the 2016 BLM methane rule[20] as well as the 2018 proposed repeal. [21] A forthcoming summary report 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 13771.

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 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 repeal or elimination.
Corrections	Changes to underlying assumptions to bring the replication up to date and comparable across different rules
Baseline	The result of corrections to the replication. All subsequent scenarios are compared to the baseline.
Repeal Baseline	The result of subtracting forgone benefits from costs saved (the inverse of 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)

[20] US Bureau of Land Management (BLM). 2016. Final Rule: Waste Prevention, Production Subject to Royalties, and Resource Conservation. *Federal Register* 81(223): 83008, November 18. https://www.gpo.gov/fdsys/pkg/FR-2016-11-18/pdf/2016-27637.pdf.

[21] BLM. 2018. Proposed Rule: Waste Prevention, Production Subject to Royalties, and Resource Conservation; Rescission or Revision of Certain Requirements. *Federal Register* 83: 9724, February 22. https://www.federalregister.gov/documents/2018/02/22/2018-03144/waste-prevention-production-subject-to-royalties-and-resource-conservation-rescission-or-revision-of.

We took the following steps to conduct our analyses, for this report on BLM'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., has it been repealed, or is it 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 with recent guidance from the OMB guidance for EO 13771. Third, we also made some further accounting corrections for comparability across rules, including the 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. BLM's methane rule, for example, uses a 10-year period of analysis—whereas PHMSA' tank car rule for hazardous materials uses a 20-year period of analysis and EPA's methane rule uses the years 2020 and 2025 alone. 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 updated and corrected the baseline, we created 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 outlined 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. Where the RIA provided a clear schedule for compliance (as in this case for BLM's methane rule), 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 a regulation is finalized and eliminated, however, additional states may pass overlapping or duplicative regulations. Thus, if a federal regulation is eliminated, state 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 their regulations. One could also argue that states' proposed regulations should also be taken into account.[22]

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 the cost savings, benefits forgone, and net benefits of repeal to account for this input. The comments we used were submitted by stakeholders including API, the 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 the 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 because they find it difficult or impossible to

[22] 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.

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 2017). 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 the 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 the costs of a rule but may also lower the benefits. Symmetrically, the requested modifications coming from environmental groups would generally increase the benefits of a rule but may also increase the costs. Because the modifications are highly specific to individual rules, 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 provide a qualitative discussion of aspects of repealing or modifying a rule that we could not quantify. These were often driven by comments that criticize some aspect of a rule but provide no basis for empirical analysis of how the costs and benefits would change if the rule were altered to address the comment. We also tracked the agency's response to comments as well as the non-monetized effects of the rules (often indirect or distributional), such as impacts 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 our results across rules in each individual report. A forthcoming summary report will include cross-cutting analyses and comparisons.

4. Background: BLM's 2016 Methane Rule

4.1. Purpose

BLM's stated motivation in promulgating this regulation under the Obama administration was to control the loss of natural gas on federal and American Indian lands. The venting and flaring of natural gas leads to the waste of gas that could otherwise be captured and sold, in addition to contributing to climate change. A 2010 Government Accountability Office (GAO) report estimated that the economically recoverable share of the gas that was being lost represented about $23 million in federal royalties. In addition, when a resource is wasted, "society loses the opportunity to use the resource and social benefits are not maximized" (BLM 2016, 2).

The Obama administration also noted large benefits from reducing emissions of methane and volatile organic compounds (VOCs). Natural gas is mainly made up of methane, a powerful greenhouse gas with a global warming potential 34 times that of carbon dioxide (CO_2). In addition, a small fraction of

flared and vented gas consists of conventional air pollutants (such as VOCs and other hazardous air pollutants) that contribute to localized air pollution and related health issues. Reducing the amount of natural gas vented or flared during oil and gas production prevents this pollution.

The Trump administration, however, argues that enforcing the 2016 rule would exceed BLM's authority and would impose burdensome costs. It furthermore argues that the rule overlaps with state and EPA regulations, and that the rule would constrain energy development.

4.2. Regulatory History and Current Status

In February 2018, BLM published a proposed rule to rescind most of the requirements of the Obama administration's 2016 rule. This move follows multiple actions taken by the Trump administration to delay and postpone a number of requirements, as well as a failed attempt by Congress to repeal the rule under the Congressional Review Act. Most significantly, in December 2017, BLM published a final rule delaying compliance dates for many of the rule's requirements until 2019.[23] However, a court found that BLM failed to justify its decision to delay the 2016 rule and ordered that the agency enforce the rule.[24] The decision has created much uncertainty regarding compliance and enforcement as companies await the finalization of the 2018 proposed repeal, an issue which complicates our analysis. (We discuss this further in Section 5.2. Corrections to Generate a Baseline.)

These actions were part of the US Department of the Interior's (DOI's) efforts to comply with President Trump's energy independence executive order, which requires suspending, revising, or rescinding regulations that are a "burden" to energy producers and names BLM's 2016 methane waste prevention rule specifically.[25] In a court case challenging the initial implementation of the 2016 rule, the US District Court of Wyoming denied a request by industry groups and some states to block the 2016 rule before it was scheduled to go into effect in January 2017.[26] At issue in this ongoing litigation is whether the rule can be "independently justified as waste prevention measures," as BLM can promulgate rules that have ancillary benefits (including air quality improvements) as long as the intended or primary purpose of the rule is waste prevention. [27] The court's decision to deny the above request reads: "The rub here, however, is whether the Rule, or at least certain provisions

[23] BLM. 2017. Final Rule: Waste Prevention, Production Subject to Royalties, and Resource Conservation; Delay and Suspension of Certain Requirements. *Federal Register* 82(235): 58050, December 8. https://www.gpo.gov/fdsys/pkg/FR-2017-12-08/pdf/2017-26389.pdf.

[24] See *State of California et al. v. Bureau of Land Managament et al.* (17-cv-07186-WHO) and *Sierra Club et al. v. Ryan Zinke et al.* (17-cv-07187-WHO). https://www.eenews.net/assets/2018/02/23/document_ew_04.pdf.

[25] 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.

[26] See *State of Wyoming et al. v. US Department of the Interior et al.* (2:16-cv-00285) and *Western Energy Alliance et al. v. Jewell et al.* (2:16-cv-00280) in the US District Court of Wyoming. https://www.gpo.gov/fdsys/pkg/USCOURTS-wyd-2_16-cv-00280/pdf/USCOURTS-wyd-2_16-cv-00280-0.pdf.

[27] See *State of Wyoming et al. v. US Department of the Interior et al.* (2:16-cv-00285) and *Western Energy Alliance et al. v. Jewell et al.* (2:16-cv-00280) in the US District Court of Wyoming, 19.

of the Rule, was promulgated *for the prevention of waste* or instead for the *protection of air quality*." [28] The latter charge (air quality protection) is under EPA's jurisdiction. As discussed further below, the majority of the rule's monetized benefits are from preventing climate change. The benefits from increases in federal royalties (the focus of this regulation), however, are not counted in the RIAs, as such actions are considered transfer payments and are not counted in cost-benefit analyses more broadly.[29]

4.3. Rule Summary

The rule, as written when it was finalized in November 2016, focuses on reducing venting and flaring of natural gas through a number of measures. Under this rule, operators are required to do the following:

- Flare gas—i.e., burn it and convert it into CO_2—rather than vent it, releasing it into the atmosphere, except in a few situations (referred to as "Flare Measurement" in the RIA).
- Avoid "wasteful" flaring of gas, requiring the capture of this gas for use or sale, with capture targets increasing from 85 percent of total gas production each month in 2017 to 98 percent in 2026 (referred to as "Capture Target" in the RIA). Operators are also allowed to "exempt" a certain amount of production at each well, which decreases over time.
- Implement LDAR programs with semiannual inspections using specified equipment.
- Replace high-bleed pneumatic controllers with lower-emitting controllers.
- Replace certain pneumatic pumps with zero emissions pump or route gas to capture, with some exceptions.
- Capture, flare, use, or reinject gas produced during well drilling and well completions (referred to as "Well Drillings, Completions, and Maintenance" in the RIA).
- Capture or combust emissions from storage vessels with the potential to emit 6 tons per year (tpy) of VOCs or more (referred to as "Storage Tanks" in this analysis).
- Minimize gas vented to unload liquids while optimizing plunger lifts or automated well control systems to minimize gas losses for wells with those systems, assessing methods for liquids unloading aside from manual well purging, and complying with procedures and documentation for venting during manual well purging if necessary (referred to as "Liquids Unloading" in the RIA).

The rule also limits the amount of gas that may be vented (emitted) without royalties during well testing and defines when emitted or lost oil and gas may be subject to royalties, with the following distinction: unavoidably lost oil and gas is royalty-free, whereas avoidably lost oil and gas is not. The rule aligns with EPA's methane rule (by applying similar regulations to existing sources of methane on federal lands while EPA's rule covers all new sources) and allows for differing regulations under states and tribes if those regulations perform at least as well as BLM's regulations. In this analysis, we focus on the net benefits of the rule as a whole. The net benefits of each of these requirements (by year) as

[28] Ibid., 15.

[29] The intuition behind not including a transfer payment in a cost-benefit analysis is that such payments do not add or subtract from overall social welfare; they just affect its distribution. For example, a royalty payment costs industry *X* amount and benefits government *X* amount, canceling its net impact.

estimated in our baseline scenario are presented in Appendix B.

The 2018 proposed rule would effectively repeal all of these provisions and largely return to the previous royalty framework.[30] Some of the liquids unloading requirements (those that BLM says would not place additional costs on producers) would be maintained under the 2018 proposed repeal. The measuring and reporting requirements would likewise be maintained with modifications so that producers would not incur additional costs.

5. Analysis

Here we describe our adjustments to the original RIA in order to generate a baseline as well as a number of scenarios and sensitivity analyses. All of these results are provided as total costs, total benefits, and total net benefits over a 10-year period, in net present value at a 3 percent discount rate in 2012$. Results using a 7 percent discount rate are presented in Appendix A. We followed BLM's methodology and use a 10-year period for analysis.

5.1. Replication

In all, we were able to replicate BLM's results for its 2016 RIA, though we report slightly larger benefits estimates (see Table 3). These differences likely result from rounding or slight methodological differences. The benefits differ by only 1 percent, with net benefits differing by 2 percent to 3 percent as a result.

Though not displayed in Table 3, it is important to note that our attempts to replicate the 2018 RIA were less successful (see Table 1 in the executive summary). The 2018 RIA is less transparent—it states that it uses the same assumptions as the 2016 RIA, but because it did not provide the costs and benefits of each provision by year, we were unable to check why the total costs and benefits over the 10-year period do not match.[31]

5.2. Corrections to Generate a Baseline

We make two primary corrections in order to generate the baseline: updating natural gas prices and using a more precise social cost of methane.

Natural Gas Prices. First, we update natural gas prices to those reported in EIA's *Annual Energy Outlook* (AEO) 2017 from the numbers used in AEO 2016. The updated prices provide slightly smaller estimates of the total net benefits, as the more recent estimates project lower gas prices throughout the 10-year period analyzed (EIA 2017). These prices were published in 2016$, so we discount their value to 2012$ to match the dollar year used in our analysis.

We then calculate the cost savings to operators from capturing gas using the same method as BLM: by discounting the gas prices for processing and transportation costs (the value of recovered gas is 75 percent of the market price. See Appendix C for details on the natural gas prices used in this analysis.) Like BLM in its 2016 analysis, we maintained cost savings on the benefits side of the equation (i.e., we add cost savings to the benefits estimates, as opposed to subtracting from costs).

[30] BLM. 1980. Notice to Lessees and Operators of Onshore Federal and Indian Oil and Gas Leases (NTL-4A). https://www.blm.gov/sites/blm.gov/files/energy_noticetolessee4a.pdf.

[31] Our domestic SC-CH_4 scenario (which replicates the 2018 RIA) estimated costs that were lower by 6–8%, benefits lower by 4%, and net benefits lower by 9–14% compared with the estimates reported in the 2018 RIA. The difference in cost estimates mostly results from the 2018 RIA reporting much larger costs for the gas capture requirements, even adjusting compliance dates. The source of the difference in benefits estimates is less clear. Discounting at the beginning of the year instead of end of the year does not account for the entirety of these discrepancies, and we made sue to account for changes in dollar-year.

TABLE 3. GENERATING A BASELINE, NET PRESENT VALUE AT 3% DISCOUNT RATE (MILLION 2012$)

KEEPING RULE						
	High-Cost Scenario			Low-Cost Scenario		
	Costs	Benefits	Net Benefits	Costs	Benefits	Net Benefits
Obama Administration 2016 RIA	1,780	2,669	889	1,464	2,678	1,214
Replication	1,781	2,702	921	1,466	2,702	1,237
*% difference**	*0%*	*1%*	*3%*	*0%*	*1%*	*2%*
Updated gas prices in 2012$	1,781	2,613	831	1,466	2,613	1,147
% difference†	*0%*	*-3%*	*-10%*	*0%*	*-3%*	*-7%*
More precise SC-CH_4, SCC	1,781	2,692	910	1,466	2,692	1,226
% difference†	*0%*	*0%*	*-1%*	*0%*	*0%*	*-1%*
Delay in Compliance‡	1,761	2,718	957	1,454	2,718	1,263
% difference†	*0%*	*3%*	*8%*	*1%*	*3%*	*5%*
Baseline §	**1,901**	**2,712**	**812**	**1,535**	**2,712**	**1,177**
% difference†	*8%*	*3%*	*-8%*	*7%*	*3%*	*-2%*
REPEALING RULE						
	Costs Avoided	Benefits Forgone	Net Benefits of Repeal	Costs Avoided	Benefits Forgone	Net Benefits of Repeal
Repeal baseline‖	**1,898**	**2,712**	**(814)**	**1,532**	**2,712**	**(1,180)**
% difference†	*8%*	*3%*	*-192%*	*7%*	*3%*	*-198%*

*Percentage difference from original
†Percentage difference from replication
‡Here, we use the assumptions used in the 2018 BLM RIA: first, that compliance will not occur until 2019 (with discounting relative to 2018), and second that the administrative burdens were more than double those estimated in the 2016 RIA.
§Baseline combines AEO 2017 natural gas prices and more precise SC-CH_4 and SCC
Repeal Baseline first flips the sign of the net benefits (per equation below) and then subtracts $3 million from the costs avoided, as the 2018 BLM rule rescinding the 2016 rule maintains $3 million in costs over the next 10 years.

Social Cost of Methane. BLM rounded its SC-CH_4 figures slightly in 2016 and also used values that adjust every two to three years (an average in between the five-year estimates reported by the Interagency Working Group on the Social Cost of Greenhouse Gases [IWG 2016a] instead of using values that adjust each year). We correct these figures so that they adjust on a yearly basis, as opposed to every two to three years, as shown in Appendix C. The Trump administration likewise used an SC-CH_4 that varied each year

State Regulations. To account for existing state regulations, BLM subtracted the share of affected operations in states already regulating methane. The agency subtracted only the share of wells on federal lands where the jurisdiction has requirements in place that are at least as strict as BLM's.[32] Although BLM was aware of regulations in Alaska, Colorado, Montana, North Dakota, Utah, and Wyoming, the rule was published prior to the publication of California's and Ohio's final methane rules. Making adjustments for these states is beyond the scope

[32] Flare measurement requirements: removed North Dakota, as operations are already equipped to measure the gas-to-oil ratio. Pneumatic pumps: reduced the share of covered pumps in Wyoming's Upper Green River Basin (UGRB). LDAR: removed operations covered in Wyoming's UGRB and Colorado. Pneumatic controllers: removed controllers required in Wyoming's UGRB and Colorado. Storage tanks: BLM used EPA's methane rule estimates.

of this project but would reduce both costs and benefits of the federal rule, and is an issue that should be considered when BLM finalizes the 2018 RIA.

Compliance. The Trump administration's efforts to delay and repeal the 2016 rule have created significant regulatory uncertainty, making compliance and enforcement requirements murky in some cases. Prior to the Trump administration's efforts to roll back this rule, companies may have begun to comply with the 2016 requirements. Currently at issue is the Trump administration's 2017 rule delaying the compliance dates for the 2016 rule. BLM has been ordered to enforce the 2016 rule despite publishing its 2018 proposed rule to repeal the regulation, meaning companies may be required to comply with the regulation for just a few months. To the extent that companies have complied with certain provisions of the 2016 rule to date, the baseline costs and benefits will be lower with any sunk costs. The cost savings and benefits forgone if the rule is repealed will likewise be lower.

Due to data limitations, we were unable to assess how compliance may have affected the baseline costs and benefits of the rule. When finalizing the RIA for the 2018 repeal, BLM should assess the extent to which companies have complied and should adjust the baseline accordingly. In the 2018 RIA, BLM assumed in its baseline for keeping the rule that compliance would not begin until 2019. This assumption may no longer hold given the February court decision striking down the delay.[33] In our analysis, we maintained the 2019 compliance date given the lack of clarity regarding enforcement and the fact that this court decision may be appealed.

Our baseline figures show greater costs compared with the analysis used for the original rule. This change largely results from the compliance date change for the gas capture requirement—the original rule required compliance beginning in the second year of implementing the rule, but the Trump administration's delay would have the requirement begin at the same time as the others, effectively adding one year of additional costs for the RIA. The cost estimates are also higher because we included larger estimates for administrative burdens, which were revised upward in the 2018 RIA. The benefits are slightly larger because benefits related to the gas capture provision begin to accrue earlier under these assumptions about the compliance date as well. It is important to note that our estimated compliance costs are $100 million lower than those in the 2018 RIA, which we discuss further in Section 5.1.

Table 3 shows that our baseline has net benefits that are about $40 million to $70 million lower than the original RIA. In the end, the total net benefits of the rule are still large—between $812 million and $1.2 billion.

We then use the results for keeping the rule to calculate our baseline for repealing the rule (see Table 3). We do so by flipping the sign of the net benefits (or costs) of repeal, as can be seen in the equation discussed in Section 3 (Methods). Instead of subtracting $1.9 billion in costs from $2.7 billion in benefits to calculate $812 million in net benefits when implementing the rule, we do the opposite and subtract $2.7 billion in benefits forgone from $1.9 billion in cost savings to get *net costs* of repealing the rule of $814 million (i.e., negative net benefits totaling $814 million; see Table 3). As depicted in Table 3, the costs avoided differ slightly, as the 2018 rule maintains a few administrative burdens from the 2016 rule (totaling $3 million over 10 years), so those costs are not considered "avoided." So, the costs and net benefits of repeal in the repeal baseline case differ from

[33] *State of California et al. v. Bureau of Land Management et al.* and *Sierra Club et al. v. Zinke.* https://www.eenews.net/assets/2018/02/23/document_ew_04.pdf.

the costs and net benefits in the baseline scenario by $3 million. The benefits, though, have the same value as the benefits forgone in Table 3.

5.3. Cost Adjustment Scenarios

As stated earlier, industry bears the costs of the rule. These include onetime costs (such as purchasing new equipment), recurring operational costs, and administrative costs. Furthermore, there are very small costs associated with additional CO_2 produced when methane is captured and burned at another location. In general, industry believes that BLM's estimated costs are too low, whereas environmental and research groups generally do not agree. We use LDAR costs from API, a trade association representing the oil and gas industry, and Carbon Limits, a research group. The costs from API are far higher than BLM's, whereas the costs from Carbon Limits are far lower, though a number of reports from other research groups likewise support lower LDAR estimates (as described in the 2016 RIA). We also use slightly lower costs for liquids unloading from ICF International, a consulting firm. In all three scenarios, the cost adjustments relate to cost estimate assumptions and therefore do not affect the benefits of the rule.

API LDAR Costs. When including cost estimates from industry, repealing the rule provides net benefits in most cases. Based on the results of an API survey of producers, LDAR costs were reported to be much larger than BLM's estimates (the former being $5,436 and the latter being $2,265 annualized at 3 percent).[34, 35] As can be seen in Table 4, API's LDAR cost estimates increase the avoided costs when repealing the rule by 57 to 69 percent. In the high-cost scenario, the net benefits of eliminating the rule are $149 million; in the low-cost scenario, the net costs of eliminating the rule are $216 million.

TABLE 4. RESULTS OF COSTS ADJUSTMENTS, NET PRESENT VALUE AT 3% DISCOUNT RATE (MILLION 2012$)

REPEALING RULE						
	High-Cost Scenario			Low-Cost Scenario		
	Costs Avoided	Benefits Forgone	Net Benefits of Repeal	Costs Avoided	Benefits Forgone	Net Benefits of Repeal
Repeal baseline	**1,898**	**2,712**	**(814)**	**1,532**	**2,712**	**(1,180)**
API LDAR	2,861	2,712	149	2,496	2,712	(216)
*% difference**	*51%*	*0%*	*118%*	*63%*	*0%*	*82%*
Carbon Limits LDAR costs	1,365	2,712	(1,347)	1,000	2,712	(1,712)
*% difference**	*-28%*	*0%*	*-65%*	*-35%*	*0%*	*-45%*
ICF Liquids unloading costs	1,886	2,712	(826)	1,521	2,712	(1,191)
*% difference**	*-1%*	*0%*	*-1%*	*-1%*	*0%*	*-1%*

*Percentage difference from baseline.

[34] API's analysis in Attachment A of its comments to BLM reports capital costs and recurring costs for in-house and outsourced LDAR programs (2016). We choose the more expensive in-house figures for the sensitivity analysis and annualize those figures at 3% and 7% for 10 years of costs.

[35] API (2016) also argued that the costs of BLM's flaring measurement requirements were underestimated. However, we did not include these figures, as API did not provide an adequate explanation for its estimates, and it appears BLM made some adjustments to the requirement and analysis after the proposed rule.

Carbon Limits LDAR Costs. Carbon Limits conducted its own survey of almost 4,300 oil and gas facilities in the United States and Canada and assessed emissions rates, repair costs, and repair lifetimes for almost 60,000 components (Carbon Limits 2014). This analysis reports net present value costs using a 7 percent discount rate for both the monitoring program and repairs for well site and batteries in terms of US$ per ton of carbon dioxide equivalent (CO_2e). We found the annualized cost of LDAR to be around $513.[36] While this figure is significantly smaller than the figures from both BLM and API, a number of companies that provide LDAR services commented on the proposed rule and submitted cost figures that were lower than those of Carbon Limits. This change increases the net costs of repealing the rule by 50 to 70 percent. Eliminating the rule results in net costs of $1.3 billion to $1.7 billion over 10 years.

ICF International Liquids Unloading Costs. ICF International's estimates of liquids unloading costs are only slightly smaller than BLM's, the former being $2,345 and the latter being $3,150 (annualized at 3 percent) (ICF International 2014). The overall effect of this change is minimal, with net costs from repealing the rule just 1 percent larger.

5.4. Benefits Adjustment Scenarios

We conducted two sensitivity analyses to assess the degree to which differing SC-CH_4 estimates affect the benefits forgone when repealing the rule. First, we use the Trump administration's interim domestic SC-CH_4 and SCC estimates to create a scenario comparable to the 2018 RIA analysis. The Trump administration produced preliminary estimates of the domestic SCC and SC-CH_4 (quantifying the impacts to the United States only) for the RIAs for the review of the Clean Power Plan, the proposed rulemaking delaying and later repealing BLM's 2016 methane rule, and the proposed rulemaking to delay EPA's methane rule.[37, 38, 39] The resulting figures are 4 percent to 14 percent of the Obama administration's global SC-CH_4 and 2 percent to 13 percent of the Obama administration's global SCC.

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[36] We contacted Carbon Limits to obtain the costs without cost savings from gas sales and learned that the costs of LDAR programs for well sites and well batteries were $9 per ton of CO_2e reduced. We multiply that value times BLM's estimates for methane reduced (in terms of CO_2e) from the LDAR program to determine the estimated cost for each year of the program. The Carbon Limits (2014) report does not state the dollar year of these figures, so we assume they were in 2014$ and use the implicit price deflator to convert them to 2012$. The result has room for error in that the report may assume different levels of emissions reductions from a well site than BLM's RIA, and the types of LDAR programs it assesses may differ from those required by BLM. Furthermore, we do not have the values for a 3% discount rate and use the 7% discount rate values for both columns (though alone, that decision creates a small difference unlikely to affect the overall results of the analysis).

[37] EPA (US Environmetnal Protection Agency). 2017. "Regulatory Impact Analysis for the Review of the Clean Power Plan: Proposal." https://www.epa.gov/sites/production/files/2017-10/documents/ria_proposed-cpp-repeal_2017-10.pdf;

[38] BLM (US Bureau of Land Management). 2017. "Regulatory Impact Analysis for Proposed Rule to Suspend or Delay Certain Requirements of the 2016 Waste Prevention Rule." https://www.regulations.gov/document?D=BLM-2017-0002-0002.

[39] EPA (US Environmental Protection Agency). 2017. "Estimated Cost Savings and Forgone Benefits Associated with the Proposed Rule, 'Oil and Natural Gas: Emission Standards for New, Reconstructed, and Modified Sources: Stay of Certain Requirements.'" October 17. https://www.epa.gov/sites/production/files/2017-11/documents/oilgas_memo_proposed-stay_2017-10.pdf.

One notable aspect of the Trump administration's SCC and SC-CH_4 estimates is its use of a 7 percent discount rate. A 3 percent discount rate had previously been used to calculate the social cost of greenhouse gases, with sensitivity analyses of 2.5 percent and 5 percent discount rates, and the researchers who modeled these social costs do not employ discount rates as high as 7 percent (Cropper et al. 2017). A 7 percent discount rate, while in line with OMB's Circular A-4 guidance,[40] is thought by economists to be inappropriate for calculating the SC-CH_4 and SCC for several reasons (Cropper et al. 2017).[41] Industry endorses the 7 percent discount rate, and using it significantly lowers the social costs of methane and carbon. The Trump administration's SC-CH_4 falls from $164 per ton of methane at a 3 percent discount rate to $50 at a 7 percent discount in the year 2020. The Trump administration's SCC falls from $5 at a 3 percent discount rate to $1 at a 7 percent discount rate in the year 2020. (Appendix A details our results using a 7 percent discount rate).

We use the domestic SC-CH_4 as a sensitivity analysis, as opposed to a baseline, because we chose to align our analysis with the original RIA for the 2016 rule.[42] (Across the other reports in this series, we likewise align our baseline with the RIAs for the original rules). Furthermore, assessing scenarios that adjust costs (such as higher LDAR costs) or modification scenarios provides similar information regardless of the SC-CH_4 used: cost scenarios that lower costs for the global SC-CH_4 baseline case would also lower costs under the domestic SC-CH_4 scenario as well. We include a detailed discussion of the pros and cons of using a domestic SC-CH_4 in cost-benefit analyses in Appendix D.

Second, we use SC-CH_4 and SCC estimates that were higher than those in our baseline and in BLM's analysis. Instead of using the SCC and SC-CH_4 based on a 3 percent discount rate, we use the SCC and SC-CH_4 based on a 2.5 percent discount rate.[43] The SC-CH_4 figures are 30 to 40 percent larger and the SCC figures are around 50 percent larger than the social cost estimates we use in our baseline. The main purpose of this analysis is to assess the effect of higher global SCC and SC-CH_4 estimates, as recent papers have argued that those estimates

[40] Circular A-4, https://obamawhitehouse.archives.gov/omb/circulars_a004_a-4/.

[41] As Cropper et al. (2017) argues, "From a purely practical standpoint, the models used to generate the SCC estimates report their output in terms of what are called 'consumption-equivalent' impacts, which is intended to reflect the effective impact on people's consumption. 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 clearly inappropriate, therefore, 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 employs a discount rate as high as 7 percent in their work. This is a case where unconsidered adherence to the letter of OMB's simplified discounting approach yields results that are inconsistent with and ungrounded from good economics."

[42] We did include the Trump administration's updated cost estimates for the administrative burdens, as BLM states it adjusted these estimates after review. We do not consider this change to vary substantially from the methdology of the original RIA and therefore chose to incorporate it.

[43] IWG (2016a) reports four SCC and SC-CH_4 estimates. Three use the average results from the three Integrated Assessment Models, reporting those results at discount rates of 2.5, 3, and 5 percent. The fourth estimate is the 95th percentile of the frequency distribution of the SCC estimates based on a 3 percent discount rate, producing much higher estimates than the other three.

should be revised upward in the future.[44] But examining the use of a 2.5 percent discount rate for these social costs is warranted for other reasons as well: the Council of Economic Advisers recently issued a report (CEA 2017) arguing in favor of using 2 percent for the consumption rate of discount (the Integrated Assessment Models used to calculate the SCC and SC-CH_4 report their results as the effective impact on consumption).[45]

Table 5 shows the results of these two sensitivity analyses. Using the Trump administration's domestic SCC and SC-CH_4 sharply reduces the forgone benefits of the rule. On one hand, repealing the rule in this scenario has large net benefits of $495 million to $860 million over the 10-year analysis period. On the other hand, using the higher SCC and SC-CH_4 estimates results in larger forgone benefits and significantly larger net costs of repealing the rule, of $1.4 billion to $1.7 billion. Certain provisions of the rule, however, maintain positive net benefits (and net costs of repeal), regardless of the SC-CH_4 used. Table 6 shows that in all scenarios using the domestic SC-CH_4, keeping the pneumatic controllers and liquids unloading requirements results in net benefits. And depending on the discount rate, the pneumatic pump requirement also results in net benefits. However, the Trump administration's proposed rule repeals these provisions in addition to the others listed in Table 6.

TABLE 5. RESULTS OF BENEFITS ADJUSTMENTS, NET PRESENT VALUE AT 3% DISCOUNT RATE (MILLION 2012$)

REPEALING RULE						
	High-Cost Scenario			Low-Cost Scenario		
	Costs Avoided	Benefits Forgone	Net Benefits of Repeal	Costs Avoided	Benefits Forgone	Net Benefits of Repeal
Repeal baseline	**1,898**	**2,712**	**(814)**	**1,532**	**2,712**	**(1,180)**
Domestic SC-CH_4 and SCC	1,898	1,037	860	1,532	1,037	495
*% difference**	*0%*	*-62%*	*206%*	*0%*	*-62%*	*142%*
Higher global SC-CH_4, SCC	1,898	3,270	(1,372)	1,532	3,270	(1,737)
*% difference**	*0%*	*21%*	*68%*	*0%*	*21%*	*47%*

*Percentage difference from baseline

TABLE 6. NET BENEFITS OF REQUIREMENTS, NET PRESENT VALUE WITH DOMESTIC SCC AND SC-CH_4 (MILLION 2012$)

KEEPING RULE				
	3% Discount		7% Discount	
Requirement	High-Cost Scenario	Low-Cost Scenario	High-Cost Scenario	Low-Cost Scenario
Capture target	(366)	(1)	(278)	(3)
Flare measurement	(38)	(38)	(34)	(34)
Pneumatic controllers	40	40	16	16
Pneumatic pumps	28	28	(2)	(2)
Liquids unloading	62	62	18	18
Storage tanks	(49)	(49)	(48)	(48)
LDAR	(426)	(426)	(409)	(409)
Administrative burden	(116)	(116)	(92)	(92)
Total	(863)	(498)	(829)	(553)

[44] See recent studies such as Moore et al. (2017), who have argued that these figures should be substantially larger.

[45] A more detailed discussion of the use of discount rates in the SCC and SC-CH_4 can be found in Resources for the Future's comments to BLM on its proposal to delay the methane rule at https://www.regulations.gov/document?D=BLM-2017-0002-17257.

5.5. Rule Modification Scenarios

Because BLM's 2016 RIA estimated the costs and benefits of alternative regulatory options for some requirements, we can test how a less-stringent regulation might change the net benefits of keeping the rule (in Table 7, the results are listed as the net benefits of keeping the rule). Modifications of some rule requirements based on industry comments will reduce both the costs and the benefits, while modifications suggested by environmental groups will increases both the costs and the benefits. We compare potential modifications with our baseline for keeping the rule in Table 7, and develop five scenarios to assess these changes: [46]

Annual Frequency for LDAR Inspection. First, we reduce LDAR inspections from semiannual to annual. Industry had requested a lower inspection frequency in its comments to BLM (API 2016)—however, as the results below show, the benefits of semiannual inspections (compared to annual inspections) are quite large. Reducing the frequency decreases net benefits by about $73 million compared to the baseline.

Regulatory Threshold for Emissions from Storage Tanks Increased to 30 Tons per Year. Second, we increase the threshold of emissions from storage tanks to be regulated from 6 tpy of VOCs to 30 tpy—a less stringent measure meaning fewer storage tanks would be covered by the rule. These cost estimates are reported in the 2016 BLM RIA. Though industry groups have supported such a measure, BLM estimates that this modification provides only a 2 percent reduction in costs and a small increase in net benefits of $29 million.

TABLE 7. RESULTS OF RULE MODIFICATIONS, NET PRESENT VALUE AT 3% DISCOUNT RATE (MILLION 2012$)

KEEPING RULE						
	High-Cost Scenario			Low-Cost Scenario		
	Costs	Benefits	Net Benefits	Costs	Benefits	Net Benefits
Baseline	**1,901**	**2,712**	**812**	**1,535**	**2,712**	**1,177**
LDAR to annual inspection*	1,604	2,344	739	1,239	2,344	1,105
*% difference***	*-16%*	*-14%*	*-9%*	*-19%*	*-14%*	*-6%*
30 tpy storage†	1,860	2,701	841	1,494	2,701	1,206
*% difference***	*-2%*	*0%*	*4%*	*-3%*	*0%*	*3%*
No flaring requirement‡	945	2,163	1,218	945	2,163	1,218
*% difference***	*-50%*	*-20%*	*50%*	*-38%*	*-20%*	*4%*
All three above actions	613	1,783	1,170	613	1,783	1,170
*% difference***	*-68%*	*-34%*	*44%*	*-60%*	*-34%*	*-1%*
LDAR to quarterly inspection*	2,485	3,077	592	2,119	3,077	958
*% difference***	*31%*	*13%*	*-27%*	*38%*	*13%*	*-19%*

*From semiannual
**Percentage difference from baseline
†From 6 tpy VOC emissions as threshold for storage tank replacement
‡From including the flaring requirement as-is

[46] To keep the accounting straight, we are using "baseline" as our point of comparison when modifying the rule, as we would not expect the administration to modify and repeal the rule. The previous tables assessed the rule's repeal and used the "repeal baseline."

Flaring Requirement Removed. Third, we remove the flaring requirement by subtracting the costs and benefits of this requirement. Uncertainty in the costs of this requirement is what creates the high- and low-cost scenarios (i.e., the costs of this provision could be quite high—or they could be much smaller). Removing the flaring requirement under the high-cost scenario therefore results in significantly larger benefits than removing the requirement under the lower-cost scenario. The flaring requirement results in net costs on its own, so removing it would facilitate the greatest increase in net benefits (particularly in the high-cost scenario).

Based on BLM's estimates, removing the flaring requirement reduces costs by roughly $590 million to $956 million (38 percent to 50 percent) and reduces benefits by $549 million (20 percent). The result is an increase in the rule's net benefits of 4 percent to 50 percent. According to API's 2016 cost-benefit analysis, removing the flaring requirement (which in its analysis has a net cost of $302 million each year) likewise gives the rule positive net benefits. Although we do not know the technical aspects of this requirement and can only comment on its costs and benefits, this requirement appears to be economically inefficient, indicating that its removal would be a net benefit.

All of the Above. In this scenario, we combine all three of the above changes: annual LDAR inspections, 30 tpy storage, and no flaring requirement. This scenario actually provides lower net benefits than simply removing the flaring requirement in the high-cost scenario, as the other changes can lower net benefits (as discussed earlier).

Quarterly LDAR Inspection Frequency. Finally, we assess the value, using BLM's cost assumptions, of more frequent LDAR inspections, which have been suggested by some environmental groups. Some groups argue that quarterly LDAR inspections are less costly than BLM assumes. We use BLM's cost estimates here. The results in Table 7 show that such a requirement would increase costs more than benefits, resulting in net benefits of $592 million to $958 million, figures lower than the net benefits in the baseline.

6. Discussion

6.1. Public Comments

As noted above, BLM adjusted the final 2016 rule in response to comments in a number of ways, often because of new information, such as technical and safety requirements of some of the regulated equipment and processes. BLM clarified when certain methane emissions are allowed and expanded certain flaring exemptions. The agency also extended the phase-in time for its routine flaring requirements and lowered the final capture target (to 98 percent instead of 100 percent) in response to comments. Furthermore, the final rule allowed operators to average gas capture rates over a county or state to make compliance more flexible. The final rule also made a number of other changes not listed here, most of which seek to make meeting the requirements more feasible (e.g., exemptions, clarifications, greater compliance flexibility, and alignment with state and EPA regulations).

However, BLM maintained some of the requirements of the proposed rule when industry favored certain changes. The agency, for example, did not remove requirements for marginal wells (those producing 15 barrels of oil equivalent or less per day), because the available data did not support the exemption and because 85 percent of the wells on BLM lands would classify as marginal.

6.2. Non-monetary Impacts

The 2016 rule, if enforced, would have a number of impacts that are difficult to monetize and therefore are not reflected in these cost-benefit analyses. First, the rule will greatly reduce emissions of volatile organic

compounds (VOCs) emissions. Addressing methane leaks will invariably capture a large amount of VOCs. VOCs contribute to air pollution that affects human health and degrades the environment (e.g., ambient ozone and fine, inhalable particulate matter concentrations). Some VOCs are likewise known or suspected carcinogens.

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 BLM's 2016 rule (2.59 million tons) by the $2,800 per ton estimate to see potential benefits of $7.2 billion over 10 years. The non-monetized forgone benefits from repealing the 2016 rule could therefore be quite large (or at least close enough to the potential cost savings that repealing the rule may not result in net benefits).

Second, BLM notes the potential for a slight decrease in drilling on federal lands, as the 2016 rule includes two requirements addressing new liquids unloading and new oil wells flaring not covered by EPA's methane rule. Though BLM does not believe new drilling would shift away from federal and American Indian lands, there is a concern that the rule could "discourage developmental wells in regions lacking any means for capturing and transporting gas to market" (BLM 2016, 121). The agency also notes that increased costs could affect marginal wells but mentions that these wells "are highly unlikely" to have emissions or flaring large enough to require control (2016, 123).

Third, in terms of employment, BLM believes "the rule would not alter the investment or employment decisions of firms or significantly or adversely impact employment" (2016, 119). We could not find mention of the potential for job losses in API's comment. However, API also stated that a "significant number" of wells were at risk of shut-in, meaning operators would choose not to produce at wells that are capable of producing due to costs (API 2016, A-6). A number of trade associations dispute BLM's assessment and say the rule could result in the loss of 1,780 direct jobs in oil and gas companies in western states (IPAA et al. 2016).

Fourth, the 2016 RIA also notes that the rule might cause a slight increase in natural gas production (of 0.03 to 0.15 percent of total US production) and a slight decrease in crude oil production (of up to 0.07 percent of total US production), but BLM does not believe such a change would affect prices, supply, or distribution. Some of the oil and gas that would have been produced by a certain date may be deferred to a later date to meet flaring requirements, though these production changes are more uncertain. API notes that deferring production may impose large costs on producers (2016).

Finally, BLM, in its 2016 RIA, expected increased royalties of $3 million to $10 million per year as a result of the rule, as it would increase natural gas production (because the gas would be captured rather than emitted as methane). This impact is not included in the benefit-cost analysis above, as royalties are considered transfer payments (an issue discussed earlier). The operators pay these fees to the government, so the costs equal the benefits from society's perspective. It is important to note, however, that this cost is

borne by industry, and while it is not part of the cost-benefit analysis, it is an important factor in the rule's impacts on producers.

7. Conclusion

The Trump administration has made its case in favor of repealing BLM's 2016 methane rule in large part because it has argued that keeping the rule would result in large net costs to society. The cost-benefit analysis presented here shows that enforcing the 2016 rule provides significant net benefits when using a global estimate for SC-CH_4, though it provides significant net costs when using a domestic estimate for SC-CH_4. In its RIA accompanying the 2018 proposed repeal, the Trump administration focused solely on the domestic SC-CH_4, thereby arguing that repealing the rule results in net benefits.

Because of issues with the Trump administration's interim domestic social cost figures (outlined in the body of this document and in Appendix D), we believe BLM should at least include both the peer-reviewed global estimate produced by the IWG (2016a, 2016b) and the interim domestic figure to provide a range of estimates in the RIA. That range could inform readers and decisionmakers of a possible range of climate impacts to the United States as a result of repealing the rule. Furthermore, other considerations beyond the 10-year net benefits of the rule should be taken into account. For example, certain provisions remain cost-effective regardless of the SC-CH_4 used, and non-monetized benefits from reductions of VOC emissions have the potential to be very large.

Our analysis shows that repealing the 2016 BLM methane rule could result in large net costs or large net benefits. We summed up our main takeaway as follows in a brief article published shortly ahead of this report:[47] In deciding whether the rule should be repealed, the Trump administration should take into account that its goal of reducing regulatory burdens has the potential to result in large net costs to society. Even if the administration believes that large net costs are unlikely, it should explicitly consider whether its goal—reducing compliance burdens for industry—warrants even the possibility of these large net costs.

[47] Krupnick, Alan J., and Isabel Echarte. 2018. "Does Repealing BLM's 2016 Methane Rule Pass a Cost–Benefit Test?" *Resources* 197 (Spring). Washington, DC: Resources for the Future. http://www.rff.org/research/publications/does-repealing-blm-s-2016-methane-rule-pass-cost-benefit-test

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Appendix A. 7% Discount Rate Results

TABLE A-1. TOTAL 10-YEAR NET BENEFITS, NET PRESENT VALUE (MILLION 2012$)

	High-Cost Scenario			Low-Cost Scenario		
KEEPING RULE						
	Costs	**Benefits**	**Net Benefits**	**Costs**	**Benefits**	**Net Benefits**
Obama Administration 2016 RIA (Global SC-CH_4)	1,484	2,224	740	1,241	2,224	983
RFF Baseline (Global SC-CH_4)	1,498	2,111	613	1,222	2,111	889
Sensitivity Analysis (Domestic SC-CH_4)	1498	669	(829)	1222	669	(553)
Trump Administration 2018 RIA (Domestic SC-CH_4)	1598	695	(903)	1323	695	(628)
REPEALING RULE						
	Costs Avoided	**Benefits Forgone**	**Net Benefits of Repeal**	**Costs Avoided**	**Benefits Forgone**	**Net Benefits of Repeal**
Obama Administration 2016 RIA (Global SC-CH_4)	1,484	2,224	(740)	1,241	2,224	(983)
RFF Baseline (Global SC-CH_4)	1495	2111	(615)	1219	2111	(891)
Sensitivity Analysis (Domestic SC-CH_4)	1496	669	827	1220	669	551
Trump Administration 2018 RIA (Domestic SC-CH_4)	1596	695	901	1321	695	626

TABLE A-2. GENERATING A BASELINE FOR REPEAL, NET PRESENT VALUE AT 7% DISCOUNT RATE (MILLION 2012$)

KEEPING RULE						
	High-Cost Scenario			Low-Cost Scenario		
	Costs	**Benefits**	**Net Benefits**	**Costs**	**Benefits**	**Net Benefits**
Original	1,484	2,224	740	1,241	2,224	983
Replication	1,427	2,123	696	1,184	2,123	939
*% difference**	*-4%*	*-5%*	*-6%*	*-5%*	*-5%*	*-4%*
Updated gas prices in 2012$	1,427	2,056	629	1,184	2,056	872
% difference†	*0%*	*-3%*	*-10%*	*0%*	*-3%*	*-7%*
More precise SC-CH_4, SCC	1,427	2,112	685	1,184	2,112	928
% difference†	*0%*	*-1%*	*-2%*	*0%*	*-1%*	*-1%*
Delay in Compliance‡	1,381	2,109	729	1,153	2,109	956
% difference†	*-3%*	*-1%*	*5%*	*-3%*	*-1%*	*2%*
Baseline, keeping rule§	**1,498**	**2,111**	**613**	**1,222**	**2,111**	**889**
% difference†	*5%*	*-1%*	*-12%*	*3%*	*-1%*	*-5%*
REPEALING RULE						
	Costs Avoided	**Benefits Forgone**	**Net Benefits of Repeal**	**Costs Avoided**	**Benefits Forgone**	**Net Benefits of Repeal**
Baseline, repealing rule‖	**1,495**	**2,111**	**(615)**	**1,219**	**2,111**	**(891)**
% difference†	*5%*	*-1%*	*-188%*	*3%*	*-1%*	*-195%*

*Percentage difference from original
†Percentage difference from replication
‡Here, we use the assumptions used in the 2018 BLM RIA: first, that compliance will not occur until 2019 (with discounting relative to 2018), and second that the administrative burdens were more than double those estimated in the 2016 RIA.
§Baseline combines AEO 2017 natural gas prices and more precise SC-CH_4 and SCC
Repeal Baseline first flips the sign of the net benefits (per equation below) and then subtracts $3 million from the costs avoided, as the 2018 BLM rule rescinding the 2016 rule maintains $3 million in costs over the next 10 years.

TABLE A-3. RESULTS OF COSTS ADJUSTMENTS, NET PRESENT VALUE AT 7% DISCOUNT RATE (MILLION 2012$)

REPEALING RULE						
	High-Cost Scenario			Low-Cost Scenario		
	Costs Avoided	Benefits Forgone	Net Benefits of Repeal	Costs Avoided	Benefits Forgone	Net Benefits of Repeal
Repeal baseline	**1,495**	**2,111**	**(615)**	**1,219**	**2,111**	**(891)**
API LDAR costs	2,347	2,111	236	2,071	2,111	(40)
*% difference**	*57%*	*0%*	*138%*	*70%*	*0%*	*96%*
Carbon Limits LDAR costs	1,068	2,111	(1,043)	792	2,111	(1,319)
*% difference**	*-29%*	*0%*	*-69%*	*-35%*	*0%*	*-48%*
ICF liquids unloading costs	1,487	2,111	(623)	1,212	2,111	(899)
*% difference**	*-1%*	*0%*	*-1%*	*-1%*	*0%*	*-1%*

*Percentage difference from baseline

TABLE A-4. RESULTS OF BENEFITS ADJUSTMENTS, NET PRESENT VALUE AT 7% DISCOUNT RATE (MILLION 2012$)

REPEALING RULE						
	High-Cost Scenario			Low-Cost Scenario		
	Costs Avoided	Benefits Forgone	Net Benefits of Repeal	Costs Avoided	Benefits Forgone	Net Benefits of Repeal
Repeal baseline	**1,495**	**2,111**	**(615)**	**1,219**	**2,111**	**(891)**
Domestic SC-CH_4 and SCC	1,495	669	826	1,219	669	550
*% difference**	*0%*	*-68%*	*234%*	*0%*	*-68%*	*162%*
Higher SC-CH_4, SCC	1,495	3,270	(1,060)	1,219	3,270	(1,336)
% difference	*0%*	*55%*	*72%*	*0%*	*55%*	*50%*

*Percentage difference from baseline

TABLE A-5. RESULTS OF RULE MODIFICATIONS, NET PRESENT VALUE AT 7% DISCOUNT RATE (MILLION 2012$)

KEEPING RULE						
	High-Cost Scenario			Low-Cost Scenario		
	Costs	Benefits	Net Benefits	Costs	Benefits	Net Benefits
Baseline	**1,498**	**2,111**	**613**	**1,222**	**2,111**	**889**
LDAR to annual inspection*	1,262	1,821	559	986	1,821	835
*% difference***	*-16%*	*-14%*	*-9%*	*-19%*	*-14%*	*-6%*
30 tpy storage†	1,461	2,102	641	1,185	2,102	917
*% difference***	*-2%*	*0%*	*5%*	*-3%*	*0%*	*3%*
No flaring requirement‡	770	1,698	928	770	1,698	928
*% difference***	*-49%*	*-20%*	*51%*	*-37%*	*-20%*	*4%*
All three above actions	503	1,399	896	503	1,399	896
*% difference***	*-66%*	*-34%*	*46%*	*-59%*	*-34%*	*1%*
LDAR to quarterly inspection*	1,961	2,397	436	1,685	2,397	712
*% change***	*31%*	*14%*	*-29%*	*38%*	*14%*	*-20%*

*From semiannual; **Percentage change from baseline; †From 6 tpy VOC emissions as threshold for storage tank replacement; ‡From including the flaring requirement as-is

Appendix B. Baseline Costs and Benefits by Requirement

TABLE B-1. BASELINE COSTS AND BENEFITS OVER 10 YEARS BY REQUIREMENT AT 3% DISCOUNT RATE (MILLION 2012$)

KEEPING RULE						
	High-Cost Scenario			Low-Cost Scenario		
Requirement	Costs	Benefits	Net Benefits	Costs	Benefits	Net Benefits
Capture target	915	549	(366)	549	549	(1)
Flare measurement	38	0	(38)	38	0	(38)
Pneumatic controllers	13	222	210	13	222	210
Pneumatic pumps	30	310	281	30	310	281
Liquids unloading	44	447	403	44	447	403
Storage tanks	58	78	20	58	78	20
LDAR	688	1106	417	688	1106	417
Administrative burden	116	0	(116)	116	0	(116)
Total	1901	2712	812	1535	2712	1177

TABLE B-2. BASELINE COSTS AND BENEFITS OVER 10 YEARS BY REQUIREMENT AT 7% DISCOUNT RATE (MILLION 2012$)

KEEPING RULE						
	High-Cost Scenario			Low-Cost Scenario		
Requirement	Costs	Benefits	Net Benefits	Costs	Benefits	Net Benefits
Capture target	691	412	(278)	415	412	(3)
Flare measurement	34	0	(34)	34	0	(34)
Pneumatic controllers	12	174	163	12	174	163
Pneumatic pumps	29	244	215	29	244	215
Liquids unloading	38	349	311	38	349	311
Storage tanks	51	61	10	51	61	10
LDAR	550	869	318	550	869	318
Administrative burden	92	0	(92)	92	0	(92)
Total	1498	2111	613	1222	2111	889

Appendix C. Parameters and Assumptions

Table C-1 displays the adjusted natural gas prices used in our analysis. In Tables C-2 and C-3, IWG refers to the estimates published in IWG (2016a, 2016b), which list figures for only every five years. The RFF figures are those we extrapolate to fill in the years between (in equal steps between each IWG estimate). The original RIA figures are those BLM used in 2016. The domestic figures are those published by the Trump administration in 2017. The IWG estimates will differ from those reported in the IWG document because those reports use 2007 as the dollar year, whereas we use 2012.

TABLE C-1. ADJUSTED NATURAL GAS PRICES (2012$)

Year	Original RIA Values Using AEO 2016 ($/Mcf)	AEO 2017 Adjusted Value ($/Mcf)
2017	2.39	2.32
2018	2.80	2.48
2019	3.11	2.89
2020	3.43	3.30
2021	3.35	3.21
2022	3.37	3.11
2023	3.67	3.13
2024	3.87	3.22
2025	3.97	3.30
2026	3.86	3.39
2027	3.83	3.47
2028	3.87	3.55

Note: Values in both columns are 75 percent of AEO reported values to reflect amount recovered by operators.

TABLE C-2. SOCIAL COSTS OF METHANE, DISCOUNT RATES IN PARENTHESIS (2012$ PER METRIC TON)

Year	IWG (3%)	Original RIA (3%)	RFF Global (3%)	RFF Global (2.5%)	Domestic (3%)	Domestic (7%)
2017		1,189	1,130	1,600	153	47
2018		1,189	1,186	1,643	159	49
2019		1,297	1,243	1,686	164	50
2020	1,300	1,297	1,300	1,730	170	52
2021		1,297	1,343	1,773	174	54
2022		1,405	1,385	1,816	178	57
2023		1,405	1,428	1,859	181	59
2024		1,513	1,470	1,902	185	62
2025	1,513	1,513	1,513	1,946	189	64
2026		1,513	1,556	1,989	195	67

TABLE C-3. SOCIAL COSTS OF CARBON, DISCOUNT RATE IN PARENTHESIS (2012$ PER METRIC TON)

Year	IWG (3%)	Original RIA (3%)	RFF Global (3%)	RFF Global (2.5%)	Domestic (3%)	Domestic (7%)
2017		42	42	63	5	1
2018		43	43	64	5	1
2019		44	44	66	5	1
2020	45	45	45	67	6	1
2021		45	46	68	6	1
2022		46	47	70	6	1
2023		48	48	71	6	1
2024		49	49	72	6	1
2025	50	50	50	74	7	1
2026		51	51	75	7	1

Appendix D. 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 US benefitting, 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 gasses are global pollutants—damages occur in the US and abroad, and furthermore some impacts occurring abroad can affect the US 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[48] for arguments in favor of a domestic social cost, and Howard and Schwartz (2017)[49] 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 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

[48] 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.

[49] 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.

> 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 US 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 7 percent discount rate, as suggested by Cropper et al. (2017), provides the most informative results.