RFF REPORT

PHMSA's 2015 Tank Car Rule

Should It Stay or Should It Go?

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

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

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

Executive Summary

The Trump administration has prioritized increasing the production of US oil and natural gas, in part through reducing federal regulatory burdens that the administration says restrict development. President Trump signed Executive Order (EO) 13783 in March 2017, requiring agencies to review existing rules, policies, guidance documents, and more that potentially burden the development or use of domestically produced energy resources.[1] 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 with EO 13771, which ordered that agencies must remove two rules for every new rule implemented.[2] Subsequent guidance from the Office of Management and Budget (OMB)[3] 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).[4] 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) 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.[5]

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.[6] We then turned toward understanding what the impacts on industry and the public might be if some of these regulations were eliminated, modified, or delayed. To analyze these impacts, we updated the parameters used in the original agency Regulatory Impact Analyses (RIAs) and assessed the cost savings and forgone benefits of repealing and modifying the following rules:

- the Bureau of Land Management's (BLM's) "Waste Prevention, Production Subject to Royalties, and Resource Conservation" rule;
- the Environmental Protection Agency's (EPA's) "Oil and Natural Gas Sector:

[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] 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.

[3] 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.

[4] 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.

[5] 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.

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

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 PHMSA's "Hazardous Materials: Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains" rule (hereafter referred to as the tank car rule),[7] which was promulgated in 2015 to improve the safety of rail cars transporting crude oil and ethanol.

In the RIA released with the final rule, PHMSA estimated a present value cost of $3.1 billion over 20 years, with present value benefits between $1.4 billion and $4.4 billion (discounted at a 3 percent interest rate) (see Table 1). The benefits estimate is presented as a range, with the low end representing the damages avoided from possible minor derailments and the high end representing the avoided damages from both minor and possible major derailments, as occurred at Lac-Mégantic, Quebec, in 2013. Thus whether one includes the prospect of major derailments in the analysis has dramatic effects on benefits of the rule and on whether the *net benefits* are positive or negative: there are negative net benefits of the rule when only minor derailments are considered but positive net benefits when both major and minor derailments are considered. The same qualitative result holds if a 7 percent discount rate is used.

Table 1 also shows the baseline we use for reanalysis of the rule. The baseline updates relevant factors in the calculation of benefits since the RIA was finalized, including the projected number of carloads and the derailment rate based on past incidents using more current data. Most important, it assumes that the activities required by the rule to occur between 2015 and 2017 in fact occurred, making the costs (and corresponding benefits) sunk in relation to any consideration of rule repeal or modification. These corrections result in a baseline estimate of the remaining impact of the rule of $2.5 billion in costs and between $928 million and $3.3 billion in benefits through 2034 (discounted at 3 percent), which preserves the assumptions about the range of benefits resulting from derailments.

The Trump administration recently announced plans to rescind the braking provision of the rule; however, at this time, there is no plan to eliminate the other provisions of the rule. Were the administration to repeal the entire rule, the rail industry would avoid $2.5 billion in costs, but the industry and society at large would forgo between $928 million and $3.3 billion in benefits (discounted at 3 percent). With the low-end benefits estimate, which accounts for the possibility of minor derailments only, the present value of net benefits of repeal would be $1.5 billion; with the high-end benefits estimate, which accounts for the possibility of both minor and major derailments, repeal would have net costs to society of $859 million.

[7] 80 FR 26644, "Hazardous Materials: Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains," https://www.gpo.gov/fdsys/pkg/FR-2015-05-08/pdf/2015-10670.pdf.

TABLE 1. TOTAL 20-YEAR BENEFITS, NET PRESENT VALUE AT 3% AND 7% (MILLION $)

3%					
KEEPING RULE					
	Costs	Benefits (Low)	Benefits (High)	Net Benefits (Low)	Net Benefits (High)
Original RIA	3,095	1,365	4,352	(1,730)	1,257
Baseline	**2,464**	**928**	**3,323**	**(1,536)**	**859**
REPEALING RULE					
	Costs Avoided	Benefits Forgone (Low)	Benefits Forgone (High)	Net Benefits of Repeal (Low)	Net Benefits of Repeal (High)
Using Original RIA Figures	3,095	1,365	4,352	1,730	(1,257)
Repeal Baseline	**2,464**	**928**	**3,323**	**1,536**	**(859)**
7%					
KEEPING RULE					
	Costs	Benefits (Low)	Benefits (High)	Net Benefits (Low)	Net Benefits (High)
Original RIA	2,482	912	2,905	(1,570)	423
Baseline	**2,039**	**643**	**2,285**	**(1,396)**	**246**
REPEALING RULE					
	Costs Avoided	Benefits Forgone (Low)	Benefits Forgone (High)	Net Benefits of Repeal (Low)	Net Benefits of Repeal (High)
Using Original RIA Figures	2,482	912	2,905	1,570	(423)
Repeal Baseline	**2,039**	**643**	**2,285**	**1,396**	**(246)**

Most of this report will focus on scenarios that affect the costs and benefits of the rule. These were chosen to reflect uncertainty about various inputs in the RIA. They include the following:

- adjusting the projected number of crude oil carloads, which affects the estimation of the number of derailments and thus the benefits of the rule,
- changing the estimated minor derailments damages,
- changing the estimated major derailments damages, and
- increasing the estimated derailment rate.

Based on stakeholder comments on this rule and announcements from the Trump administration, we also consider two scenarios for modifying the rule without eliminating it entirely:

- eliminating the braking provision, and
- applying the electronically controlled pneumatic (ECP) braking requirement to all trains (rather than to a subset of trains as the rule currently stands).

Using our baseline calculation, repealing the tank car rule would result in very large net costs to society when factoring in benefits from both minor and major derailments that this rule would prevent. Considering only the reduction in minor derailments, we estimate that repealing this rule would have net benefits to society. Adjusting the estimated damages and inputs such as carload projections (which affects the estimate of avoided minor derailments) can have a significant impact on whether repealing the rule results in net benefits or net costs, but in general, our scenarios for decreasing estimates of damages result in net benefits to society of repeal, while

our scenarios for increasing estimates of damages result in net costs to society of repeal.

Our baseline analysis indicates that the controversial braking provision is a net benefit to society (and thus its repeal would be a net cost to society), and without it, the remaining provisions of the rule as a group result in net costs to society. However, the Trump administration changed a series of inputs that yield the opposite conclusion, therefore justifying the repeal of the provision. This result largely hinges on how major derailment damages are estimated, which the Trump administration changed significantly from the original RIA conducted under the Obama administration.

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.[8] 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.[9] Subsequent guidance from the Office of Management and Budget (OMB)[10] 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.[11]

2. Objectives

The goals of our project were to catalog the regulations that may be reviewed by the Trump administration[12] 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),[13] 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 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

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[8] 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.

[9] 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.

[10] 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.

[11] 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.

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

[13] 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.

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 fourth in the series).[14] 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 supporting the repeal or modification of the rules. This report covers PHMSA's "Hazardous Materials: Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains," [15] herein referred to as the tank car rule. A forthcoming summary document will include cross-cutting analyses to compare the results of these six analyses—in particular, ranking the results by net benefits (preferred by economists) and also cost savings, the metric emphasized by OMB's guidance related to EO 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.

We took the following steps to conduct our analyses, for this report on the tank car 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.

[14] 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.

[15] 80 FR 26644, "Hazardous Materials: Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains," https://www.gpo.gov/fdsys/pkg/FR-2015-05-08/pdf/2015-10670.pdf.

TABLE 2. DEFINITIONS OF KEY TERMINOLOGY

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

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 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 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's tank car rule uses a 20-year period of analysis and the 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 get 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. When the RIA provided a clear schedule for compliance, as in this case, an adjustment was made, though that is not always the case.

RIAs often account for overlapping or duplicative state regulations, for instance, by not counting costs and benefits from compliance in states with existing regulations. In between the time the regulation is finalized and eliminated, however, additional states may pass overlapping or duplicative regulation. Thus, if the federal regulation is eliminated, the states' regulations will still be in force and there will be less or no associated cost savings from repeal in those states, depending on the stringency of those regulations. One could also argue that states' proposed regulations should also be taken into account.[16]

3.2. Cost Adjustment Scenarios

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

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

3.3. Benefits Adjustment Scenarios

In addition to cost adjustments, we made adjustments to the benefits, using the same

[16] 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.

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 quantify, and doing so in cases of large uncertainty may complicate interpretation of the results.

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

3.4. Rule Modification Scenarios

There are innumerable ways any given rule can be modified, including changes to the sources covered in the rule 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 costs of the rule but may also lower its benefits. Symmetrically, the requested modifications coming from environmental groups would generally increase the benefits of the rule but may also increase the costs. Because the modifications are highly 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 are 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 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

4.1. Purpose

Two primary factors motivate the promulgation of the tank car rule: the increase in the production of crude oil and ethanol and the associated increase in its transport by rail; and the possible coupling of the increased rail traffic with several high-profile derailments of railcars carrying these flammable materials.

In the last decade, US crude oil production has experienced rapid growth due to recent technological advances in extraction. This development has exceeded the capacity of traditional oil transport methods (namely, pipelines and vessels) in some regions, and railroads have emerged as a "flexible alternative" (DOT PHMSA 2015). The amount of crude oil transported via rail increased 423 percent between 2011 and 2012, according to data from the US Energy Information Administration (EIA) (DOT PHMSA 2015).

The RIA assumes that as the volume of crude oil and ethanol transport increases, more derailments will occur. This assumption tracks with past data on the relationship among production, shipment via rail, and derailment frequency (DOT PHMSA 2015). The derailment of cars carrying flammable liquids such as crude oil and ethanol poses a potentially severe risk to human life, the environment (through the contamination of ecosystems), and property. Depending on the scale and location, the consequences of a derailment could be catastrophic.

A recent train derailment in Canada served as one of the primary motivations for the promulgation of this rule. On July 6, 2013, a 63-car train carrying crude oil and traveling at 65 miles per hour (mph) derailed near the small town of Lac-Mégantic, Quebec. The derailment spilled an estimated 1.5 million gallons of oil and resulted in 47 deaths and the evacuation of more than 2,000 residents. The damages from this incident were estimated to be more than $1 billion (DOT PHMSA 2015).

In promulgating this rule, PHMSA hopes to reduce the risk of derailments of trains carrying flammable material, particularly major derailments like the event at Lac-Mégantic, as well as to mitigate the severity of the environmental, economic, and safety consequences should a derailment occur.

4.2. Regulatory History and Current Status

The rule is currently in effect; however, the Trump administration announced in December 2017 that it would initiate a rulemaking to rescind the braking provision based on an updated RIA.[17] At this time, there is no plan to eliminate the other provisions of the rule.

The original rule was finalized on May 8, 2015, and went into effect on July 7, 2015. On the rule's effective date, trains were expected to operate in compliance with the routing, classification, and speed restriction requirements (see Section 4.3 for details). The

[17] 82 FR 58582, "Hazardous Materials: Announcement of the Department of Transportation's Decision on Electronically Controlled Pneumatic Braking," https://www.gpo.gov/fdsys/pkg/FR-2017-12-13/pdf/2017-26546.pdf.

first deadline for retrofitting some existing tank cars was January 1, 2018, with all cars expected to be retrofitted to the rule's standard by May 1, 2025. All new cars constructed after October 1, 2015, are expected to meet the rule's standard. For the braking provision, all unit trains are expected to be in compliance by May 1, 2023, with some cars needing to comply by January 1, 2021, depending on the material being transported.

The final rule has been challenged many times and has undergone extensive review. Under the Hazardous Materials Regulations (HMR), stakeholders are allowed to administratively appeal a PHMSA action. Five appeals to the final rule were submitted to PHMSA by trade associations (Dangerous Goods Advisory Council, American Chemistry Council, Association of American Railroads, and American Fuel and Petrochemical Manufacturers) and Native American tribes (Columbia River Treaty and Northwest Treaty Tribes).[18] PHMSA denied all appeals. The Sierra Club and several environmental groups, as well as API, sued PHMSA over the final rule. These cases were consolidated into one as challenges to the rule, but the case has not progressed.

The Government Accountability Office (GAO) studied the rule and released two reports concerning the rule's assumptions. In 2016, the GAO found that the Department of Transportation's (DOT's) calculation of benefits from the braking provision lacked transparency and could be improved by updating inputs, such as fuel prices and rail traffic, and including ranges of estimates due to uncertainty (GAO 2016). In 2017, the GAO prepared forecasts on derailments, injuries, fatalities, and gallons spilled based on data including 2015 and 2016, which showed that DOT overestimated its derailment and carload forecasts in the early years of the rule (GAO 2017).

In addition, a National Academy of Sciences (NAS) study reported in September 2017 that DOT's justification for part of the braking requirement in the rule is lacking and that the technology may not be superior to other systems (NASEM 2017).

On October 16, 2017, PHMSA released a proposed updated RIA for the braking provision of the rule to comply with Section 7311 of the Fixing America's Surface Transportation (FAST) Act. Our main analysis takes into account updates to current assumptions about projected carloads and derailments from the proposed RIA but does not include updates to cost or other benefit metrics associated with this new update. The reason we do not fully update our analysis with all the elements of PHMSA's analysis for the proposed rule is that PHMSA did not account for compliance with the rule between its promulgation and now.[19] We include a scenario rescinding the braking provision, as well as a section describing the differences between the original and new RIAs and compare these results with our analysis.

[18] 80 FR 71952. The five trade associations that administratively appealed the final rule argued that the rule should be limited to trains carrying crude oil or ethanol, rather than applied to all Class 3 flammable liquids. One association argued that the rule would result in the unnecessary retrofit of thousands of tank cars to which the rule would not apply because rail carriers would be incentivized to retrofit without knowing for sure whether the car would ultimately end up in flammable materials service under the rule's definition of a high-hazard flammable train (HHFT). Native American tribes also administratively appealed the rule, arguing that PHMSA did not properly consult tribal organizations in the promulgation of the rule.

[19] We assume that the schedule for compliance in the rule was met. Attempts to obtain an estimate of actual compliance from the industry were unsuccessful.

4.3. Rule Summary

This rule applies to high-hazard flammable trains (HHFTs) of either 20 or more tank cars in a continuous block or 35 or more tank cars across the entire train carrying a Class 3 flammable liquid. The rule includes additional provisions that apply only to high-hazard flammable unit trains (HHFUTs), trains with 70 or more tank cars carrying a Class 3 flammable liquid traveling at greater than 30 mph. Classification of different Class 3 flammable liquids is based on packing group (PG), which ranges from PG III flammable liquids (the least dangerous) to PG I flammable liquids (the most dangerous). The distinctions in the applicability of the rule based on the length of the train, number of cars carrying a material, and type of material are grounded in rail practices.

The rule has five major provisions:

- enhanced tank car requirements
- braking requirements
- speed restriction requirements
- routing requirements
- classification requirements

The enhanced tank car provision requires a series of retrofits to meet and exceed existing industry best practices for existing and new tank cars. Retrofits to existing cars include valve upgrades and full-height head shields. These upgrades are designed to provide additional protection from puncture in the event of a derailment to prevent leakage of hazardous material and combustion. This provision applies to all HHFTs, with a compliance schedule phased in based on the tank car and the type of material (based on PG) it is expected to carry. New cars must also have a thicker shell and thermal protection.

The braking provision requires all HHFTs to have a two-way end-of-train device or distributed power braking system, both of which are considered more enhanced, reliable braking technologies. Existing Federal Railroad Administration (FRA) regulations require these technologies for Class I and Class II railroads, so PHMSA assumed that no costs or benefits would be associated with the extension to Class III railroads as well. Under this provision, all HHFUTs must be equipped with an electronically controlled pneumatic (ECP) braking system, with a compliance schedule phased in based on the type of material (based on PG) it is expected to carry, in order to provide an even greater reduction in the kinetic energy of a train in a derailment. After the compliance deadlines, an HHFT not operating with an advanced braking system is limited to a speed of 30 mph.

The speed restriction provision, effective immediately, requires all trains to travel at no more than 50 mph in all areas and any trains not meeting the enhanced tank car standard to travel at no more than 40 mph in high-threat urban areas, where the population near the rail is higher. The 50 mph speed limit was already industry practice, but this rule codified it. PHMSA assumed that there are no costs or benefits associated with the 50 mph speed limit.

The routing provision requires that railroads conduct a routing analysis that considers 27 safety and security factors (including traffic along the route, track maintenance, and curvature) and base their selection of routes on these findings. This provision also requires that railroads and relevant state, local, and tribal officials provide each other with appropriate contact information for communication related to the routing of hazardous materials through their jurisdictions.

The classification provision requires stricter and more robust documentation related to sampling and testing for all unrefined petroleum-based products and that the documentation be available to DOT on request.

5. Results

In this section, we describe the adjustments made to the original RIA in order to generate a baseline, as well as scenarios that change cost and benefit inputs to the RIA and modify the rule. Following PHMSA's methodology, these results will be presented in net present value terms over 20 years. The discussion and tables in this section will focus on net present value at a 3 percent discount rate; corresponding tables for a 7 percent discount rate can be found in the Appendix.

5.1. Replication

We replicated the calculations in the original RIA. Our estimation is off slightly due to rounding; however, our figures for costs, benefits, and net benefits of the rule are within 5 percent of the original RIA.

The present value of the costs of this rule is estimated at $3.1 billion over 20 years by our replicated analysis. The costs include private costs borne by industry to comply with the rule, such as retrofit and materials costs, training and labor costs, and time-out-of-service costs for cars undergoing retrofit.

PHMSA provides low and high estimates of benefits. The low estimate includes avoided damages from low-consequence events (LCEs), or minor derailments, resulting in environmental impacts and injuries typical of the derailments seen in the United States over the past decade. PHMSA calculated these avoided damages through an analysis of past derailments, including the average gallons of product spilled; costs of cleanup, property damages, and emergency response; and the value of injuries and fatalities avoided. The number of LCEs is projected from a derailment rate, defined as the number of incidents per number of carloads, which in the original analysis is 0.01 per thousand carloads (or one incident per 100,000 carloads). In the year before the rule was promulgated, there were over 950,000 carloads carrying flammable liquids and nine derailments.[20]

The high estimate adds avoided damages from high-consequence but very low-probability events, such as the derailment that occurred at Lac-Mégantic. Because of the unpredictable nature of such high-consequence events (HCEs), or major derailments, and the existence of only one recent example in North America, PHMSA conducted a Monte Carlo simulation to generate estimates of damages, varying the number of events (from one to five), population density of the surrounding area, nonfatality damages, fatalities, and wetlands damages. The high estimate of benefits was defined as the 95th percentile distribution of damages from the simulation, which estimated that four events would take place over 20 years, with damages totaling $12.6 billion (undiscounted).[21] As with LCEs, the maximum number of HCEs is estimated from a derailment rate, defined as the number of incidents per number of carloads, which in the original analysis is one per 5.3 million carloads.[22] This was drawn from data on the total carloads shipped in North America between 1995 and

[20] A carload is defined by CSX (2016) as "a car loaded to its weight or space capacity." A tank car may be part of multiple carloads per year. Costs for this rule are mostly calculated in terms of tank cars, while benefits are calculated in terms of carloads.

[21] PHMSA provided a best estimate of the expected number of events but did not use it in its analysis: two events over 20 years (DOT PHMSA 2015, 118).

[22] Based on the number of carloads, PHMSA estimates that the maximum number of HCEs avoided is five but considers this estimate to be too high. As stated, the 95th percentile distribution of damages in the Monte Carlo simulation estimates four avoided HCEs, which we assume is the number of HCEs avoided by this rule.

2013, over which time there was only one major derailment (Lac-Mégantic).

Both low and high benefits also include estimates of the business benefits, or private benefits, of the braking provision, including reduced car maintenance expenses (from a reduction of wear on wheels and brake shoes) and fuel savings. The present value of low benefits is estimated to be $1.3 billion, while the present value of high benefits is estimated to be $4.3 billion, both over 20 years.

Using PHMSA assumptions in our replication (see Table 3), we find low and high estimates of net benefits: a net present value cost of the rule of $1.8 billion ($1.3 billion minus $3.1 billion) when accounting for benefits of avoided minor derailments only and a net present value benefit of the rule of $1.2 billion ($4.3 billion minus $3.1 billion) over 20 years when accounting for benefits of avoided major and minor derailments.

5.2. Corrections to Generate a Baseline

A series of corrections to the rule were necessary to provide an updated picture of the impact of repealing or modifying the rule. This includes updating the estimates of carloads of crude oil transported and the derailment rate, as well as accounting for sunk costs. All relevant figures are shown in Table 3.

Projection of Carloads. Updating the estimate of carloads projected over 20 years affects only the estimated benefits of the rule, as the number of carloads is used to estimate the number of avoided derailments and thus avoided damages. The costs of the rule are not affected because, as stated previously, many of the cost inputs are based on the number of tank cars, rather than carloads, and the stock of tank cars is assumed to be sufficient to cover peak demand of tank cars constituting carloads.

In the original RIA, PHMSA used data from EIA on past production of ethanol (2005-15) to generate an estimate of future ethanol carloads through 2034 based on a linear trend. For crude oil carloads, PHMSA used projections from the Railway Supply Institute for 2015 to 2025 (RSI 2014). For the remaining period, 2026-34, PHMSA used projections from EIA's AEO2014 on crude oil production growth in the lower 48 states, assuming carload growth tracks with production (see DOT PHMSA 2015, 81-82). For the baseline in our analysis, we leave ethanol carload projections unchanged but update crude oil carload projections to EIA's AEO2017, assuming, as PHMSA did, that crude oil carload growth tracks with production (EIA 2017). This results in a slightly lower number of crude oil carloads than PHMSA originally projected through 2020 but a slightly higher number of crude oil carloads through 2034. Overall, the estimated number of carloads over 20 years increases slightly, to 26.24 million carloads, from the estimate in the original analysis of 26.17 million carloads.

With the change in carloads, the number of estimated avoided minor derailments increases trivially (from 278 to 279 over 20 years), and the present value of benefits (avoided damage) remains flat from the replication. The number of estimated avoided major derailments does not change.

Derailment Rate. The second correction is to update the derailment rate. This correction only affects the estimated benefits of the rule, as the derailment rate is used to estimate the number of avoided derailments and thus avoided damages due to the rule. PHMSA originally estimated the number of derailments based on the number of mainline crude oil and ethanol derailments between 2009 and 2013. Over this period, there was an average of 5.8 derailments and 545,322 carloads per year, generating an average annual derailment rate of about one derailment per 100,000 carloads (0.00001).

With the release of the new RIA for the braking provision in 2017, PHMSA updated the derailment rate to include data on derailments

through 2016. The derailment rate was lowered to 0.7 derailments per 100,000 carloads (0.000007), a decrease of about 30 percent, primarily due to the implementation of enhanced inspection and planning processes by both the rail industry and the FRA that proactively catches and repairs track problems (DOT PHMSA 2017). This update significantly lowers the estimated number of avoided derailments, thus lowering the present value of benefits of the rule from those in the original by 23 percent, to $1 billion (low), and by 7 percent, to $4 billion (high).

Accounting for Sunk Costs. The final correction is to account for sunk costs. This rule went into effect in 2015, with major retrofit compliance deadlines at the beginning of 2018. Though appeals were made to the final rule, they were not accepted, so we assume compliance has taken place over the last three years. We also assume that steps have been taken to comply with the braking requirement, despite the Trump administration's recent decision to rescind the provision. We assume that compliance costs have been accruing on the timeline estimated by PHMSA in the original RIA and with values based on our replication. With these assumptions, much of the costs have already been spent (about $1 billion undiscounted). The present value of the remaining costs of the rule is $2.4 billion.[23]

We assume that benefits attributable to the compliance measures taken in 2015-17 are sunk as well. Three provisions of this rule—the speed restriction, classification, and routing provisions—consist mainly of annual labor costs or costs resulting from actions whose benefits are realized immediately. Both the costs and benefits of these provisions would cease upon repeal of the rule. On the other hand, the retrofit and braking provisions require updates to cars that result in long-term benefits. While future investment in updates would cease upon repeal, some investments have indeed been made that will generate benefits into the future. This means that those benefits (avoided derailments) resulting from improvements to tank cars made in the first three years of the analysis will be realized over the life of the rule, no matter what action is taken by the Trump administration today. We estimate that the present value of remaining benefits is between $1 billion and $3.4 billion with this adjustment.

In addition, we shifted our 20-year time period of analysis from 2015-34 to 2018-37 to reflect the sunk costs and benefits associated with the rule as well as allow for comparability between the new numbers and the original RIA.

Altogether, these corrections generate a present value baseline of $2.5 billion in costs and between $928 million and $3.3 billion in benefits. With the low estimate of benefits, the rule has present value net benefits of $1.5 billion, a 14 percent increase from the replication; with the high estimate of benefits, the rule yields present value net benefits of $859 million, a 30 percent decrease from the replication. With these corrections, it is estimated that the rule will avoid 197 minor derailments and, for the high end estimate, 4 major derailments. Using a 7 percent discount rate has the same qualitative outcome in terms of net costs versus net benefits with implementation.

We use these results to calculate a repeal baseline, shown in Table 4, which represents the avoided costs (or cost savings) and benefits forgone of repealing the rule. Were the rule to be repealed today, the low estimate of forgone benefits would result in net benefits of repeal of $1.5 billion, while the high estimate of forgone benefits would result in negative net benefits, or net costs, of repeal of $859 million, as shown in Table 4.

[23] See footnote 19.

TABLE 3. GENERATING A BASELINE, TOTAL 20-YEAR NET PRESENT VALUE AT 3% DISCOUNT RATE (MILLION $)

KEEPING RULE					
	Costs	Benefits (Low)	Benefits (High)	Net Benefits (Low)	Net Benefits (High)
Original RIA	3,095	1,365	4,352	(1,730)	1,257
Replication	3,097	1,318	4,328	(1,779)	1,231
% difference*	*0%*	*-3%*	*-1%*	*-3%*	*-2%*
Carloads (AEO2017)	3,097	1,325	4,335	(1,772)	1,238
% difference	*0%*	*1%*	*0%*	*0%*	*1%*
Derailment Rate (DOT PHMSA 2017)	3,097	1,014	4,024	(2,083)	927
% difference	*0%*	*-23%*	*-7%*	*-17%*	*-25%*
Accounting for Sunk Costs	2,364	1,048	3,376	(1,315)	1,013
% difference	*-24%*	*-20%*	*-22%*	*26%*	*-18%*
Baseline	**2,464**	**928**	**3,323**	**(1,536)**	**859**
% difference	*-20%*	*-30%*	*-23%*	*14%*	*-30%*

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

TABLE 4. GENERATING A BASELINE FOR REPEAL, TOTAL 20-YEAR NET PRESENT VALUE AT 3% DISCOUNT RATE (MILLION $)

REPEALING RULE					
	Costs Avoided	Benefits Forgone (Low)	Benefits Forgone (High)	Net Benefits of Repeal (Low)	Net Benefits of Repeal (High)
Using Original RIA Figures	3,095	1,365	4,352	1,730	(1,257)
Replication	3,097	1,318	4,328	1,779	(1,231)
% difference*	*0%*	*-3%*	*-1%*	*3%*	*2%*
Carloads (AEO2017)	3,097	1,325	4,335	1,772	(1,238)
% difference	*0%*	*1%*	*0%*	*0%*	*-1%*
Derailment Rate (DOT PHMSA 2017)	3,097	1,014	4,024	2,083	(927)
% difference	*0%*	*-23%*	*-7%*	*17%*	*25%*
Accounting for Sunk Costs	2,364	1,048	3,376	1,315	(1,013)
% difference	*-24%*	*-20%*	*-22%*	*-26%*	*18%*
Repeal Baseline	**2,464**	**928**	**3,323**	**1,536**	**(859)**
% difference	*-20%*	*-30%*	*-23%*	*-14%*	*30%*

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

5.3. Cost Adjustment Scenarios

We do not present cost adjustment scenarios for this rule, as multiple cost possibilities or ranges were not presented in the RIA, nor could we find alternative cost estimates in stakeholder comments or parallel analyses that fit in quantitatively with the parameters set in the RIA or our methods for updating costs and benefits.

5.4. Benefits Adjustment Scenarios

We made multiple benefits adjustments to evaluate the impact of various alternative scenarios on forgone benefits were the rule to be repealed. These are summarized in Table 5.

Carloads. The first adjustment is to the number of carloads. As stated in Section 5.2, the projected number of carloads should be updated based on more recent data for the industry (also one of the GAO's recommendations). For the baseline, we made a conservative adjustment to crude oil carloads based on data in AEO2017, while leaving ethanol carload projections unchanged (EIA 2017). In PHMSA's updated RIA for the braking provision, the agency creates two models for estimating the future number of carloads. The first model projects linear growth in carloads for both commodities based on waybill data and EIA data, which results in a projection that is 21 percent below that of the original RIA; the second model projects a flat or steady number of carloads of crude oil each year based on an average of waybill data for 2012-16, which results in a projection that is 34 percent below that of the original RIA (DOT PHMSA 2017). We provide adjustments based on both models. The total number of carloads over 20 years drops from the baseline estimate of 26.2 million carloads to 20.6 million carloads using the linear model and 17.3 million carloads using the flat model.

The number of estimated avoided low-consequence derailments over 20 years drops from 278 to 156 (linear model) and 127 (flat model). This produces significant changes to the low estimate of forgone benefits of the rule: the low estimate of the present value of benefits drops 21 percent in the linear model, to $730 million, and 36 percent in the flat model, to $592 million. The number of estimated avoided high-consequence derailments over 20 years decreases from four to three, given the drop in the number of carloads. We update the estimated benefits from avoided high-consequence derailments based on PHMSA's existing Monte Carlo simulation, which reduces the high estimate of forgone benefits more than 50 percent, from $3.3 billion to $1.6 billion for the linear model and $1.4 billion for the flat model (DOT PHMSA 2015).[24] The adjustment using the linear model results in net benefits to society of repeal of $1.7 billion (low) or $878 million (high). The adjustment using the flat model results in net benefits to society of repeal of $1.9 billion (low) or $1.1 billion (high).

Sensitivity to Minor Derailment Unit Damage Parameter (Damages per Gallon Spilled). The next adjustment is to the estimated damages per gallon of flammable liquid spilled. Based on an analysis of past incidents, PHMSA estimated the damages per gallon spilled to be $200 in the final RIA. This value is significantly lower than in the proposed RIA, which estimates the damages per gallon spilled to be $300. In comments on

[24] Using the number of events as an indicator, we use the 75th percentile figure for damages, rather than the 95th percentile for damages, as the number of avoided HCEs has decreased from four to three. The number of events is not the only variable changing with the move from the 95th to the 75th percentile, however; the percent of fatalities, population density in the area near the event, fatality damages, nonfatality damages, and wetlands damages decrease as well.

the proposed rule, the Sierra Club and other environmental organizations stated that even the $300 estimate was too low, mainly because of data shortcomings of accident reports. They said that official accident reports likely underestimate the value of damages because remediation efforts are incomplete upon filing of the report ("Conservation Group Comments" 2014). PHMSA acknowledges in the final RIA the many uncertainties associated with the spill data, including the lack of robust research for onshore spill damages (and rail incidents specifically) as well as incomplete or inaccurate incident reports (PHMSA DOT 2015).

As the environmental organizations did not provide a new estimate, we develop a scenario in which the $300 estimate is applied to the parameters of the final rule. This results in significantly higher forgone benefits: the present value of low forgone benefits increases 33 percent, to $1.2 billion, while the present value of high forgone benefits increases 18 percent, to $3.9 billion. Based on the low estimate of forgone benefits, there are present value net benefits to society of repealing the rule of $1.2 billion. Based on the high estimate of forgone benefits, there are present value net costs to society of repealing the rule of $1.5 billion.

On the other hand, the 2016 GAO report concludes that the $200 per gallon estimate is too high. Experts interviewed for the analysis said that the calculation of that value may include an event that could be classified as a major derailment. With the exclusion of this outlier, the Association of American Railroads (AAR) calculates that the cost per gallon spilled is closer to $110 (GAO 2016). Using this unit damage estimate, the low estimate of the present value of benefits drops 29 percent, to $657 million, and the high estimate of the present value of benefits drops 16 percent, to $2.8 billion. Based on the low estimate of forgone benefits, there are present value net benefits to society of repealing the rule of $1.8 billion. There are still net costs to repealing the rule, however, of $316 million, based on the high estimate of forgone benefits. Under a 7 percent discount rate, both scenarios lead to net benefits of repeal.

Sensitivity to Major Derailment Damage Parameters. Many industry commenters suggested that the estimated damages from HCEs were too high, particularly given that an event of the scale of Lac-Mégantic has never happened in the United States specifically (API 2014). However, the absence of an event like that in recent US rail history does not mean that it could never happen. Environmental groups wanted the estimate of HCE damages to be higher, with more events likely to occur in the early years before unsafe cars are fully retrofitted ("Conservation Group Comments" 2014).

We thus provide a sensitivity analysis of HCE damages using the 50th percentile (lower) damages as calculated in the final RIA and our estimate of the 96th percentile (higher) damages. Both of these adjustments are made for the high benefits estimate only.

Using the 50th percentile damage estimate of $632 million (undiscounted) over 20 years results in forgone benefits that are much lower than in the original RIA, at a present value of $1.6 billion (a 51 percent decrease) for the high case. Thus in this scenario, there are net benefits to society of repealing the rule of $827 million.

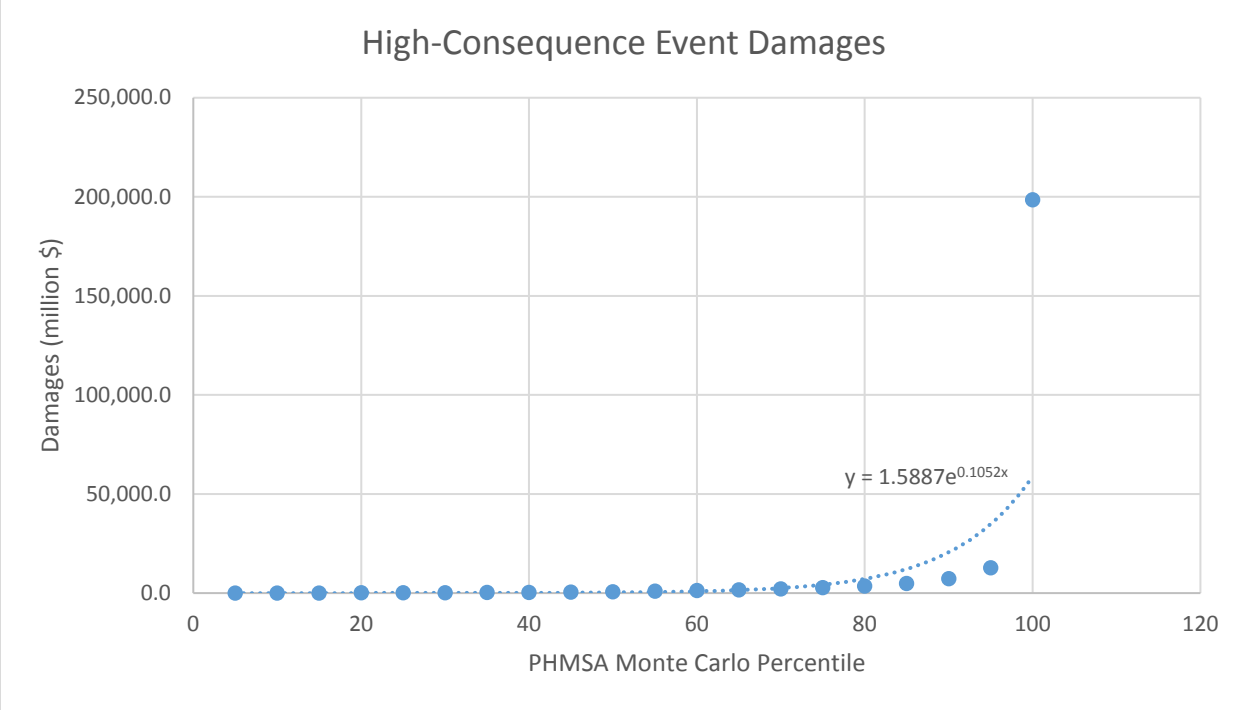
Turning to the 96th percentile scenario, in the final RIA, PHMSA listed damages only for every 5th percentile of its Monte Carlo simulation, meaning that the next calculated figure for the simulation after the 95th percentile is the 100th percentile. The 100th percentile damages are $198 billion (undiscounted) over 20 years. Using this figure seems unreasonable and would increase

damages by more than an order of magnitude (from the 95th percentile damages of $12.6 billion [undiscounted]). Accordingly, we estimate the damages for the 96th percentile by fitting an exponential curve to the data listed in the RIA for each 5 percentile increment, as shown in Figure 1. The equation for the best-fitting line is as follows:[25]

$$y = 1.5887e^{0.1052x}$$

The estimated 96th percentile damages ($38.6 billion [undiscounted]) are more than three times the 95th percentile damages. This substitution results in high forgone benefits of $7 billion (a 110 percent increase from the baseline). In this scenario, there are net costs to society of repealing the rule of $4.5 billion.

FIGURE 1. HIGH-CONSEQUENCE EVENT DAMAGES IN THE ORIGINAL RIA (MILLION $)



Source: DOT PHMSA (2015).

[25] Note that the solution will be expressed in million $.

This damage curve can help determine the break-even point, or the percentile at which damages equal costs. This break-even point is the 65th percentile, using assumptions in our baseline.

Increased Derailment Rate. The final benefits adjustment uses the derailment rate from the original RIA, rather than the updated RIA used to generate the baseline, but with the carloads and sunk costs corrections remaining in place. This provides an indication of what would happen to forgone benefits under a higher derailment rate scenario. The present value of forgone benefits is $1.2 billion and $3.9 billion for the low and high estimates, respectively. In this scenario, there are net costs of repealing the rule of $1.4 billion, based on the high estimate of forgone benefits, which is more than double that of the repeal baseline.

TABLE 5. BENEFITS ADJUSTMENT SCENARIOS, TOTAL 20-YEAR NET PRESENT VALUE AT 3% DISCOUNT RATE (MILLION $)

REPEALING RULE					
	Costs Avoided	Benefits Forgone (Low)	Benefits Forgone (High)	Net Benefits of Repeal (Low)	Net Benefits of Repeal (High)
Repeal Baseline	**2,464**	**928**	**3,323**	**1,536**	**(859)**
Carloads-Linear (DOT PHMSA 2017)	2,464	730	1,586	1,734	878
% difference*	*0%*	*-21%*	*-52%*	*13%*	*202%*
Carloads-Flat (DOT PHMSA 2017)	2,464	592	1,356	1,872	1,108
% difference*	*0%*	*-36%*	*-59%*	*22%*	*229%*
Higher Cost per Gallon Spilled	2,464	1,230	3,927	1,234	(1,463)
% difference*	*0%*	*33%*	*18%*	*-20%*	*-70%*
Lower Cost per Gallon Spilled	2,464	657	2,780	1,807	(316)
% difference*	*0%*	*-29%*	*-16%*	*18%*	*63%*
Lower HCE Damages	2,464	928	1,637	1,536	827
% difference*	*0%*	*0%*	*-51%*	*0%*	*196%*
Higher HCE Damages	2,464	928	6,986	1,536	(4,522)
% difference*	*0%*	*0%*	*110%*	*0%*	*-426%*
Derailment Rate (DOT PHMSA 2015)	2,464	1,200	3,867	1,264	(1,403)
% difference*	*0%*	*29%*	*16%*	*-18%*	*-63%*

**Percentage difference from baseline.*

5.5. Rule Modification Scenarios

We considered two modifications to this rule, both involving the braking provision (summarized in Table 6).

Many industry commenters suggested that the ECP braking requirements should be eliminated altogether, as it was unnecessary to provide safer and more reliable braking. The industry stated in comments that human error is often the cause of accidents and argued for better training (though the counterargument is that human error is hard to eliminate, so systems are needed to mitigate the effects of such error) (AFPM 2017). The NAS report concluded that DOT's modeling could not sufficiently justify requiring ECP braking, though it did not make any recommendations suggesting that the provision be rescinded (NASEM 2017).

The Trump administration recently announced it would rescind this part of the rule. In the next section, we provide an analysis focused only on the braking provision, comparing the Trump administration's RIA with our analysis. Here we provide estimates for the overall rule, subtracting out the costs and benefits provided by the ECP braking requirement.

In rescinding this provision of the rule, the costs are lower, but so are the benefits. This modification would result in a 16 percent decrease in the present value of remaining costs, to $2.1 billion, while the low estimate of the present value of benefits drops 55 percent, to $417 million, and the high estimate of the present value of benefits drops 51 percent, to $1.6 billion. The benefits drop much more significantly than the costs with elimination of this provision, suggesting, under our assumptions, that the braking provision provides greater benefits than costs. In fact, the implementation of the rule without the braking provision would result in net costs to society between $433 million (based on the high estimate of benefits) and $1.7 billion (based on the low estimate of benefits).

Some commenters, including the Sierra Club, recommended that the ECP braking requirement be tightened—that is, it should be applied to all trains rather than just those transporting crude oil and ethanol as part of an HHFUT ("Conservation Group Comments" 2014). In the final rule, 60,231 cars were estimated to be affected. If the provision were extended to all trains, we estimate 80,612 cars would be affected (the sum of all retrofitted and new cars as estimated by PHMSA in the original RIA). Assuming the expansion of the provision occurs today without an adjustment in the compliance deadline, the remaining costs of the rule would increase 17 percent, to $2.9 billion, while benefits of the rule would increase to $1 billion (low) and $3.9 billion (high), an 8 percent and 16 percent increase, respectively. Using the low estimate of benefits, there are net costs of implementing the rule with this modification of $1.9 billion. Using the high estimate of benefits, there are net benefits of implementing the rule with this provision of $970 million, 13 percent higher than the baseline.

TABLE 6. RULE MODIFICATION SCENARIOS, TOTAL 20-YEAR NET PRESENT VALUE AT 3% DISCOUNT RATE (MILLION $)

KEEPING RULE					
	Costs	Benefits (Low)	Benefits (High)	Net Benefits (Low)	Net Benefits (High)
Baseline	**2,464**	**928**	**3,323**	**(1,536)**	**859**
Eliminate ECP Braking Requirements	2,076	417	1,643	(1,659)	(433)
% difference*	*-16%*	*-55%*	*-51%*	*-8%*	*-150%*
Apply ECP Braking to All HHFTs	2,881	1,005	3,850	(1,876)	970
% difference*	*17%*	*8%*	*16%*	*-22%*	*13%*

**Percentage difference from baseline.*

5.6. Braking Provision Scenarios

As required by the FAST Act, the Trump administration conducted a review of the costs and benefits of the braking provision to assess whether the provision's requirements were justified based on updated inputs. The administration's RIA for the braking provision changed many of the assumptions used in the original RIA for the tank car rule, including the following:

- decreasing the estimated number of tank cars and locomotives needing to be retrofitted with ECP braking
- changing the projection of carloads
- decreasing the estimated number of employees needing to be trained to use ECP braking
- increasing the cost to retrofit tank cars with ECP braking
- changing the phase-in schedule of the provision
- decreasing the effectiveness rate of ECP braking
- using the mean HCE damages to calculate a high estimate of benefits (rather than the 95th percentile damages, as done in the original RIA)
- using PHMSA's more recent estimate of the derailment rate (which, as noted above, we included in our baseline)

In Table 7, we present the estimates of costs and benefits of the braking provision in the original RIA, our replication, our baseline, and the Trump administration's RIA. Unlike the original RIA, the Trump administration's RIA provides a range of costs, in addition to a range of benefits. The low and high estimates of costs are based on different estimates of future carloads: the low estimate of costs corresponds to the flat model (which has a lower projection of carloads), while the high estimate of costs corresponds to the linear model (which has a higher projection of carloads) (see Section 5.4). Because of the difference between these two estimates of carloads, the number of tank cars expected to be retrofitted (and therefore costs) varies significantly.

For our baseline listed in Table 7, we use the mean HCE damages for the high benefits estimate instead of the 95th percentile HCE damages (as was done in the original RIA and used throughout the preceding analysis) in order to make our baseline comparable to the Trump administration's RIA of the braking provision. The 95th percentile damages ($12.6 billion undiscounted) are more than four times higher than the mean damages ($2.8 billion undiscounted). While the original RIA did present estimates of the rule using mean damages, the conclusion that the benefits of the rule outweigh the costs was made based on the high net benefits value using the 95th percentile damages. Using the mean damages, the original rule would have had net costs.

Our analysis shows that implementation of the braking provision still delivers net benefits even using the mean HCE damages. Using our baseline (as described above), this provision has present value net benefits of $145 million (with the low benefits estimate) and $360 million (with the high benefits estimate). Repealing the provision would thus yield between $145 million and $360 million in net costs to society. But the Trump administration's RIA states that the provision yields net costs to society between $124 million and $196 million, so repealing the rule would result in between $124 million and $196 million in net benefits (converting to 2014 dollars from 2016 dollars to be comparable with the original RIA figures). The differences between our analysis and the Trump administration's lie primarily in the updated parameters listed above that are not reflected in our baseline.

TABLE 7. BRAKING PROVISION COSTS AND BENEFITS, TOTAL 20-YEAR NET PRESENT VALUE AT 3% DISCOUNT RATE (MILLION $)

KEEPING PROVISION						
	Costs (Low)	Costs (High)	Benefits (Low)	Benefits (High)	Net Benefits (Low)	Net Benefits (High)
Original RIA	579	—	712	933	132	353
Replication	586	—	731	952	145	366
Baseline	**388**	—	**533**	**748**	**145**	**360**
Trump Administration RIA	393	512	196	388	(196)	(124)
REPEALING PROVISION						
	Costs Avoided (Low)	Costs Avoided (High)	Benefits Forgone (Low)	Benefits Forgone (High)	Net Benefits of Repeal (Low)	Net Benefits of Repeal (High)
Using Original RIA Figures	579	—	712	933	(132)	(353)
Replication	586	—	731	952	(145)	(366)
Repeal Baseline	**388**	—	**533**	**748**	**(145)**	**(360)**
Trump Administration RIA	393	512	196	388	196	124

Baseline Scenarios Using Some Trump Administration RIA Parameters. We provide four baseline adjustment scenarios incorporating some of the updated assumptions from the Trump administration's RIA. All four scenarios include the updates to the following:

- the derailment rate (as was used throughout the main analysis)
- carload projections using the flat model (for the low benefits estimate) and the linear model (for the high benefits estimate)
- the ECP braking effectiveness rate
- cost estimates for retrofitting cars with ECP braking technology

The scenarios vary in the inclusion or exclusion of sunk costs and benefits, as well as the use of mean or 95th percentile HCE damages. These differences are indicated by the matrix in Table 8.

TABLE 8. BRAKING PROVISION ADJUSTED BASELINE SCENARIO MATRIX

		HCE Damages	
		Mean	***95th percentile***
Sunk Costs and Benefits	***Accounted for***	Adjusted Baseline 1	Adjusted Baseline 2
	Not accounted for	Adjusted Baseline 3	Adjusted Baseline 4

TABLE 9. BRAKING PROVISION SCENARIOS, TOTAL 20-YEAR NET PRESENT VALUE AT 3% DISCOUNT RATE (MILLION $)

KEEPING PROVISION						
	Costs (Low)	**Costs (High)**	**Benefits (Low)**	**Benefits (High)**	**Net Benefits (Low)**	**Net Benefits (High)**
Baseline	**388**	—	**533**	**748**	**145**	**360**
Trump Administration RIA	393	512	196	388	(196)	(124)
Adjusted Baseline 1	394	—	340	588	(54)	194
Adjusted Baseline 2	394	—	340	1,180	(54)	786
Adjusted Baseline 3	595	—	322	568	(272)	(27)
Adjusted Baseline 4	595	—	322	1,176	(272)	581
REPEALING PROVISION						
	Costs Avoided (Low)	**Costs Avoided (High)**	**Benefits Forgone (Low)**	**Benefits Forgone (High)**	**Net Benefits of Repeal (Low)**	**Net Benefits of Repeal (High)**
Repeal Baseline	**388**	—	**533**	**748**	**(145)**	**(360)**
Trump Administration RIA	393	512	196	388	196	124
Adjusted Baseline 1	394	—	340	588	54	(194)
Adjusted Baseline 2	394	—	340	1,180	54	(786)
Adjusted Baseline 3	595	—	322	568	272	27
Adjusted Baseline 4	595	—	322	1,176	272	(581)

Our estimates for these four adjusted baseline scenarios are in Table 9. Under the scenarios that account for sunk costs and benefits (adjusted baselines 1 and 2), there are net costs to society of keeping the provision of $54 million using the low benefits estimate; however, there are net benefits to society of keeping the provision of $194 million for the mean HCE damages scenario and $786 million for the 95th percentile HCE damages scenario using the high benefits estimates. Using the 7 percent discount rate does not change the direction of these conclusions (see Appendix Table A-6).

We do not account for sunk costs and benefits in adjusted baselines 3 and 4 because, as previously stated, the updated RIA does not account for them, though we do not believe this choice was appropriate. The estimated costs in these scenarios are much greater than those in the Trump administration's RIA because, due to time constraints, we did not include a few cost parameters—the change in the number of tank cars needing to be retrofit, employee training estimates, and phase-in schedule—which all would likely reduce costs of the provision. Under both of these scenarios, there are net costs to society of keeping the provision of $272 million using the low benefits estimate. The use of the mean or 95th percentile HCE damages makes a difference about the ultimate cost effectiveness of the provision using the high benefits estimate: there are net costs to society of keeping the provision of $27 million for the mean HCE damages scenario (adjusted baseline 3), but there are net benefits to society of keeping the provision of $481 million for the 95th percentile HCE damages scenario (adjusted baseline 4). These qualitative conclusions hold for the 7 percent discount rate (see Appendix Table A-6).

In the repeal context, all of our adjusted baseline scenarios indicate that repealing the braking provision would result in net benefits to society when considering only the reduction in the risk of minor derailments; on the other hand, when accounting for the reduction in the risk of both major and minor derailments, three of our four adjusted baselines show that repealing this provision results in net costs to society. One adjusted baseline results in net benefits to society with repeal, which is the same conclusion of the RIA conducted under the Trump administration. This adjusted baseline most closely resembles the Trump administration RIA in its use of the mean HCE damages without accounting for sunk costs, as well as updating some other inputs to the RIA.

Thus, it is clear that the choice of HCE damages can significantly affect the conclusions drawn about the braking provision. Were the updated RIA to use the 95th percentile HCE damages (the convention set in the original RIA), the Trump administration would likely reach the conclusion that the benefits of the braking provision outweigh the costs (or that the costs of repeal outweigh the benefits).

6. Discussion

6.1. Public Comments

A primary issue in the proposed rule was the compliance schedule, particularly for the retrofit provisions. API and American Fuel & Petrochemical Manufacturers (AFPM) were concerned that the aggressive retrofit schedule would hinder crude oil production (API 2014; AFPM 2014). AAR expressed support for an aggressive retrofit schedule but ultimately conceded that the industry may not be able to handle the added burden (AAR 2014). The timeline was indeed relaxed in the final rule, from a 5-year phase-in to a 10-year phase-in, in response to industry comments and PHMSA modeling of the capacity of retrofit service providers (manufacturers and repair entities, especially those with proper certification) to handle the increased demand (DOT PHMSA

2015, 58-63). Despite the extension of compliance deadlines, API sued over the final retrofit schedule, claiming it was still too demanding. Environmental organizations criticized the fact that the rule still allows nonretrofitted tank cars that are in a train of fewer than 20 cars to transport flammable material and advocated for a shorter compliance timeframe than in the proposed rule so that unsafe trains would be removed from service more quickly ("Conservation Group Comments" 2014). This was the motivation for their lawsuit against DOT (in addition to wanting a more stringent speed restriction).

API, AAR, and AFPM expressed concern over many of the inputs used in PHMSA's proposed RIA. PHMSA updated many of the values in its analysis based on industry comments, including the time-out-of-service costs for tank car retrofits, additional track maintenance costs from the use of heavier tank cars, the number of engineers and conductors requiring training on ECP braking systems, and the inclusion of battery replacement costs for ECP braking systems. The comments from industry led PHMSA to re-calculate the derailment rate used in the final rule on only those derailments involving crude oil and ethanol on mainline track, rather than derailments across industries and the rail system. Regarding the costs of the retrofit provision, AAR stated that PHMSA underestimated the incremental cost of retrofitting a tank car (AAR 2014). In the proposed RIA, PHMSA estimated that the incremental cost was $5,000 per car, but in the final RIA, PHMSA went the other direction, actually lowering its estimate to $3,000 per car. AAR estimated the incremental cost to be $9,665 per car.[26] It also stated that PHMSA failed to properly account for the cost of braking system updates. Because these costs are assumed to be sunk (investments in new cars are spent in 2016), we did not create a scenario based on this information.

RSI and AAR continued to take issue with the transparency of modeling used in the final RIA and updated RIA (AAR 2017; RSI 2017). They stated that the modeling, data, and assumptions—primarily related to the number of carloads and ECP braking efficiencies—on which the RIA relies are inappropriate. Specifically, two major reports used in the RIA, one by Sharma & Associates and one by Booz Allen Hamilton, were frequently cited as using unrealistic simplifications and outdated information. We have attempted to account for some of these problems through our inclusion of multiple carload adjustments and modification of the braking provision, but the transparency issue merits acknowledgment here. Many of these issues were addressed in the updated RIA.

6.2. Non-Monetary Impacts

These benefits were not quantified in the final RIA for this rule:

- additional safety benefits of ECP braking, such as the following:
    - preventing collisions with obstacles on railroads
    - fewer and less severe train collisions
    - reduced risk of runaway trains
    - fewer train-handling accidents
- the elimination of dragging brake issues
- harmonization with a corresponding Canadian tank car standard, thus preventing logistical difficulty in switching tank cars at the border

Factoring these elements into the RIA could increase the benefits of this rule, with

[26] It is not clear in AAR's comments whether it was combining the costs of requirements in the retrofit provision and braking provisions, which PHMSA separates, so we do not include this comment in the quantitative analysis of the rule.

the exception of the last bullet point, which could decrease the benefits of this rule.

In addition, the RIA does not describe impacts on the price of shipping crude oil and ethanol via rail due to this rule, nor does it calculate employment impacts in various sectors due to this rule.

7. Conclusion

Based on our baseline calculation, we find that repealing the tank car rule would result in very large net costs to society when factoring in benefits from both minor and major derailments that this rule would prevent. When factoring in only benefits from minor derailments prevented by this rule, there would be net benefits to society of repeal; however, given uncertainty about the severity of derailments depending on location and scale and because this rule was promulgated in response to a major derailment, we believe it is prudent to factor in the potential avoided damages from major derailments. The agency under the Obama administration added to this cautionary approach by using the 95th percentile estimate of damages for major derailments rather than using a 50th percentile or mean estimate to determine whether the rule had net benefits.

We evaluated making substantial adjustments to inputs to the benefits of the rule, including the number of carloads projected over the 20-year period of analysis of this rule and the derailment rate, which affect the estimated number of avoided minor derailments, as well as the estimated avoided damages for both minor and major derailments. Using more recent data from the Trump administration RIA to estimate carload projections and thus avoided minor derailments, there are net benefits to society of repealing the rule. Using a higher derailment rate than was used in the baseline yields net benefits to society of repeal when considering only benefits from avoiding minor derailments but net costs to society of repeal when considering benefits from both minor and major derailments.

There is a great deal of uncertainty surrounding the figures that should be used to calculate avoided damages from minor derailments, due to a lack of literature evaluating onshore oil and ethanol spills as well as incomplete incident reports. Moreover, with few data points for major derailments, it is extremely difficult to generate a representative estimate for avoided damages. The conclusions drawn on whether to repeal the rule are thus highly sensitive to the figures chosen. In general, decreasing the estimated damages will result in net benefits to society of repeal, while increasing the estimated damages will result in net costs to society of repeal.

We also considered rule modifications concerning the braking provision. Based on our baseline calculation, implementing the rule without the braking provision will yield net costs to society, while expanding the applicability of the braking provision to all tank cars operating as part of an HHFT generates a 13 percent increase in net benefits over the baseline when factoring in both minor and major derailments avoided.

According to our baseline, implementation of the braking provision itself yields net benefits using both the low and high estimates of benefits, though the Trump administration's updated RIA comes to the opposite conclusion. Factoring some of their updates into our baseline, including the lowered effectiveness rate, carload projections and thus avoided minor derailments estimate, and major derailment damages estimate, we find that implementing the braking provision yields net costs when factoring in only the avoidance of minor derailments and net benefits when factoring in the avoidance of both major and minor derailments in all but one case. When using the mean HCE damages and not accounting for sunk costs, as was done in the Trump administration's RIA, we find as the administration did that the braking provision

yields net costs to society. However, if we use the higher estimate for major derailments, as the Obama administration did, then we are fairly certain that even accounting for all the cost parameter changes made in the Trump RIA, the braking provision benefits society on net. Accounting for sunk costs and benefits, which is best practice in our view, society would benefit on net from this provision even if we use a mean estimate of the damages from major derailments.

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Appendix: Seven Percent Discount Rate Results

TABLE A-1. GENERATING A BASELINE, TOTAL 20-YEAR NET PRESENT VALUE AT 7% DISCOUNT RATE (MILLION $)

KEEPING RULE					
	Costs	Benefits (Low)	Benefits (High)	Net Benefits (Low)	Net Benefits (High)
Original RIA	2,482	912	2,905	(1,570)	423
Replication	2,478	874	2,885	(1,604)	407
% difference*	*0%*	*-4%*	*-1%*	*-2%*	*-4%*
Carloads (AEO2017)	2,478	877	2,887	(1,601)	409
% difference	*0%*	*0%*	*0%*	*0%*	*0%*
Derailment Rate (DOT PHMSA 2017)	2,478	671	2,682	(1,807)	204
% difference	*0%*	*-23%*	*-7%*	*-13%*	*-50%*
Accounting for Sunk Costs	1,990	756	2,421	(1,233)	431
% difference	*-20%*	*-13%*	*-16%*	*23%*	*6%*
Baseline	**2,039**	**643**	**2,285**	**(1,396)**	**246**
% difference	*-18%*	*-26%*	*-21%*	*13%*	*-40%*

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

TABLE A-2. GENERATING A BASELINE FOR REPEAL, TOTAL 20-YEAR NET PRESENT VALUE AT 7% DISCOUNT RATE (MILLION $)

REPEALING RULE					
	Costs Avoided	Benefits Forgone (Low)	Benefits Forgone (High)	Net Benefits of Repeal (Low)	Net Benefits of Repeal (High)
Using Original RIA Figures	2,482	912	2,905	1,570	(423)
Replication	2,478	874	2,885	1,604	(407)
% difference*	*0%*	*-4%*	*-1%*	*2%*	*4%*
Carloads (AEO2017)	2,478	877	2,887	1,601	(409)
% difference	*0%*	*0%*	*0%*	*0%*	*0%*
Derailment Rate (DOT PHMSA 2017)	2,478	671	2,682	1,807	(204)
% difference	*0%*	*-23%*	*-7%*	*13%*	*50%*
Accounting for Sunk Costs	1,990	756	2,421	1,233	(431)
% difference	*-20%*	*-13%*	*-16%*	*-23%*	*-6%*
Repeal Baseline	**2,039**	**643**	**2,285**	**1,396**	**(246)**
% difference	*-18%*	*-26%*	*-21%*	*-13%*	*40%*

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

TABLE A-3. BENEFITS ADJUSTMENT SCENARIOS, TOTAL 20-YEAR NET PRESENT VALUE AT 7% DISCOUNT RATE (MILLION $)

REPEALING RULE					
	Costs Avoided	Benefits Forgone (Low)	Benefits Forgone (High)	Net Benefits of Repeal (Low)	Net Benefits of Repeal (High)
Repeal Baseline	2,039	643	2,285	1,396	(246)
Carloads-Linear (DOT PHMSA 2017)	2,039	499	1,085	1,539	954
% difference*	*0%*	*-22%*	*-53%*	*10%*	*488%*
Carloads-Flat (DOT PHMSA 2017)	2,039	408	933	1,630	1,106
% difference*	*0%*	*-36%*	*-59%*	*17%*	*550%*
Higher Cost per Gallon Spilled	2,039	852	2,703	1,186	(664)
% difference*	*0%*	*33%*	*18%*	*-15%*	*-170%*
Lower Cost per Gallon Spilled	2,039	455	1,908	1,584	131
% difference*	*0%*	*-29%*	*-16%*	*14%*	*153%*
Lower HCE Damages	2,039	643	1,133	1,396	905
% difference*	*0%*	*0%*	*-50%*	*0%*	*468%*
Higher HCE Damages	2,039	643	4,784	1,396	(2,746)
% difference*	*0%*	*0%*	*109%*	*0%*	*-1,016%*
Derailment Rate (DOT PHMSA 2015)	2,039	832	2,662	1,207	(623)
% difference*	*0%*	*29%*	*17%*	*-14%*	*-153%*

**Percentage difference from baseline.*

TABLE A-4. RULE MODIFICATION SCENARIOS, TOTAL 20-YEAR NET PRESENT VALUE AT 7% DISCOUNT RATE (MILLION $)

KEEPING RULE					
	Costs	Benefits (Low)	Benefits (High)	Net Benefits (Low)	Net Benefits (High)
Baseline	**2,039**	**643**	**2,285**	**(1,396)**	**246**
Eliminate ECP Braking Requirements	1,705	289	1,126	(1,416)	(580)
% difference*	*-16%*	*-55%*	*-51%*	*-2%*	*-336%*
Apply ECP Braking to All HHFTs	2,406	695	2,650	(1,710)	244
% difference*	*18%*	*8%*	*16%*	*-23%*	*-1%*

**Percentage difference from baseline.*

TABLE A-5. BRAKING PROVISION COSTS AND BENEFITS, TOTAL 20-YEAR NET PRESENT VALUE AT 7% DISCOUNT RATE (MILLION $)

KEEPING PROVISION						
	Costs (Low)	Costs (High)	Benefits (Low)	Benefits (High)	Net Benefits (Low)	Net Benefits (High)
Original RIA	492	—	470	613	(22)	121
Replication	491	—	486	630	(5)	139
Baseline	**333**	**—**	**371**	**519**	**38**	**185**
Trump Administration RIA	367	480	138	278	(229)	(203)
REPEALING PROVISION						
	Costs Avoided (Low)	Costs Avoided (High)	Benefits Forgone (Low)	Benefits Forgone (High)	Net Benefits of Repeal (Low)	Net Benefits of Repeal (High)
Using Original RIA Figures	492	—	470	613	22	(121)
Replication	491	—	487	630	5	(139)
Repeal Baseline	**333**	**—**	**371**	**519**	**(38)**	**(185)**
Trump Administration RIA	367	480	138	278	229	203

TABLE A-6. BRAKING PROVISION SCENARIOS, TOTAL 20-YEAR NET PRESENT VALUE AT 7% DISCOUNT RATE (MILLION $)

KEEPING PROVISION						
	Costs (Low)	Costs (High)	Benefits (Low)	Benefits (High)	Net benefits (Low)	Net benefits (High)
Baseline	**333**	**—**	**371**	**519**	**38**	**185**
Trump Administration RIA	367	480	138	278	(229)	(203)
Adjusted Baseline 1	339	—	236	404	(103)	65
Adjusted Baseline 2	339	—	236	810	(103)	472
Adjusted Baseline 3	498	—	210	366	(289)	(132)
Adjusted Baseline 4	498	—	210	760	(289)	262
REPEALING PROVISION						
	Costs Avoided (Low)	Costs Avoided (High)	Benefits Forgone (Low)	Benefits Forgone (High)	Net Benefits of Repeal (Low)	Net Benefits of Repeal (High)
Repeal Baseline	**333**	**—**	**371**	**519**	**(38)**	**(185)**
Trump Administration RIA	367	480	138	278	229	203
Adjusted Baseline 1	339	—	236	404	103	(65)
Adjusted Baseline 2	339	—	236	810	103	(472)
Adjusted Baseline 3	498	—	210	366	289	132
Adjusted Baseline 4	498	—	210	760	289	(262)

Note: See Table 8 in main report for adjusted baseline scenario comparison.