A Review of the Pipeline and Hazardous Materials Safety Administration's Draft Regulatory Impact Analysis

Docket No. PHMSA-2012-0082 (HM-251)

PREPARED FOR

The Railway Supply Institute, Committee on Tank Cars

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Table of Contents

List of Figures

List of Tables

I. INTRODUCTION AND SUMMARY

A. OBJECTIVE

At the request of the Railway Supply Institute's, Committee on Tank Cars (RSI-CTC), the Brattle Group has conducted a review of the Pipeline and Hazardous Materials Safety Administration's ("PHMSA") Draft Regulatory Impact Analysis ("DRIA") for its Notice of Proposed Rulemaking ("NPRM" or "Proposed Regulations") regarding Hazardous Materials: Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains[1] for the purpose of providing constructive comments.

B. SUMMARY AND CONCLUSIONS

Based on our review, PHMSA's DRIA does not support any of the ten proposed regulatory alternatives contained in the NPRM. The benefit-cost analysis presented in the DRIA demonstrates that costs always exceed benefits, apart from three exceptions. Two of these exceptions regarding Electronically Controlled Pneumatic (ECP) braking and speed restrictions (within High Threat Urban Areas (HTUAs)) occur only when future derailments and spills are projected to reach unprecedented levels that are not supported by available evidence. The third occurs because of an assumption regarding the effectiveness of ECP braking that is contradicted by research.

Moreover, in many of the cases in which PHMSA provides specific estimates, it overstates the benefits and understates the costs of the proposed regulations. Revising these estimates to reflect available data causes costs to exceed benefits for all of the alternatives considered without exception. Benefits are overstated primarily because PHMSA's projections of derailment related tank car spills absent further regulation are far too high, and its estimates of the effectiveness of the proposed provisions are either unsubstantiated or inconsistent with available research. Costs are understated for a variety of reasons. First, PHMSA fails to account for modification of the entire fleet rather than a subset of tank cars. As we explain in Section IV, the proposed "high-hazard flammable train" ("HHFT") definition would not limit tank car modifications only to crude oil and ethanol tank cars, but would actually require that the entire fleet be modified to comply with the proposed regulations. Second, costs are understated because PHMSA does not account for degree of disruption in the availability of tank cars that would result from its

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[1] Pipeline and Hazardous Materials Safety Administration, U.S. Department of Transportation, Draft Regulatory Impact Analysis, Hazardous Materials: Enhanced Tank Car Standards and Operation Controls for High-Hazard Flammable Trains, Docket No. PHMSA-2012-0082-0179 (HM-251) (July, 2014)

proposed timeline for modification for existing tank cars, and the adoption of new standards for new tank cars. Finally, PHMSA's estimated costs for modification of existing tank cars and for meeting new car standards are also substantially lower than industry estimates.

PHMSA's benefit-cost analysis also fails to provide a basis for ranking the alternative provisions under review. First, because the alternatives are overlapping, provision specific benefits will be influenced by assumptions regarding other provisions that are being implemented simultaneously. For example, reduced trains speeds are expected to reduce derailments and tank car releases, and PHMSA calculates benefits based on this expectation. At the same time, however, benefits regarding spill volume reductions from derailment related spills are calculated without accounting for the effect of the reduced number of derailments. Accounting for further reductions in derailments would reduce the benefits attributable to tank car modifications.

Finally, should PHMSA elect to implement regulatory alternatives requiring tank car modifications, despite the lack of support from its own benefit-cost report or from independent reviews, then the RSI-CTC's recommendations regarding existing tank car modifications, new tank car standards, and compliance timelines would reduce expected compliance costs without notable reductions in projected benefits.

C. Report Structure

The remainder of this report is organized as follows. Section II provides a brief background on events that precipitated the proposed rule and a summary of the proposed rule. Section III presents a critical review of the benefits calculations presented in the DRIA. Section IV discusses problems with the cost calculations presented in the DRIA, focusing on some of the principal costs associated with the proposed rule – disruptions caused by an impractical compliance schedule, the costs of bringing the existing fleet into compliance with proposed requirements and offsets to safety benefits resulting from mode changes (i.e. rail to truck) which are not accounted for in the DRIA. Section V discusses the results presented in the preceding two sections, and presents our findings regarding the benefit-cost analysis and a cost effectiveness analysis as an alternative means of evaluating the proposed rule provisions. Section VI reviews the likely economic impacts on PHMSA's proposed regulations. Section VII summarizes our conclusions.

II. BACKGROUND

A. Cause For Concern

PHMSA's Proposed Regulations were prompted by recent train derailments resulting in crude oil and ethanol spills. PHMSA relies primarily on thirteen spills it identified which range in size from 5,000 gallons to 834,840 gallons between 2006 and May 2014.[2] Ten of these resulted in fires. In addition, the Lac Mégantic derailment in Quebec in 2013 resulted in a large spill and subsequent fire causing over $650 million in damages and 47 deaths according to preliminary estimates.[3] These events have been connected to the rapid growth in rail shipments of crude oil, primarily from the Bakken region in North Dakota, and the increased movement of both crude oil and ethanol in unit trains. In response, the Federal Railroad Administration ("FRA") issued an emergency order in 2013, stating that the agency had "seen a number of serious accidents during rail transportation of flammable liquid since 2009, and there has been significant growth in these types of rail shipments since 2011."[4] The FRA issued another emergency order in May 2014 determining that:

> Upon information derived from recent railroad accidents and subsequent DOT investigations, the Secretary of Transportation (Secretary) has found that an unsafe condition or an unsafe practice is causing or otherwise constitutes an imminent hazard to the safe transportation of hazardous materials. Specifically, a pattern of releases and fires involving petroleum crude oil shipments originating from the Bakken and being transported by rail constitute an imminent hazard under 49 U.S.C. 5121(d).[5]

In addition, the National Transportation Safety Board ("NTSB") released a report in 2014 regarding its investigation of the Lac Mégantic accident, observing that 60 of the 63 DOT-111 tank cars that derailed spilled 1.6 million gallons of crude oil.[6] The NTSB concluded that this accident "shows railroad accidents involving crude oil have the potential for disastrous consequences and environmental contamination equal to that of worst-on-shore pipeline

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2 PHMSA, DRIA, table 1, p. 19.

3 PHMSA, DRIA. PHMSA presents $650 million in damages attributable to property damage, emergency response and cleanup, and re-routed rail traffic (p.206) and "close to $500 million in terms of loss of life (p.39).

4 United States Department of Transportation, Federal Railroad Administration, Emergency Order Establishing Additional Requirements for Attendance and Securement of Certain Freight Trains and Vehicles on Mainline Track or Mainline Siding Outside of a Yard or Terminal ("Emergency Order 28"), 78 Fed. Reg. 48218 (Aug. 2, 2013)

5 United States Department of Transportation, Emergency Order Regarding Petroleum Crude Oil Railroad Carriers (Docket No. DOT-OST-2014-0067) (May 7, 2014).

6 NTSB, Safety Recommendation, R-14-4 through -6 at p. 2 (Jan. 21, 2014), http://www.ntsb.gov/doclib/recletters/2014/R-14-004-006.pdf.

accidents."[7] The Transportation Safety Board of Canada's report on the Lac Mégantic accident determined that the accident revealed that Class 111 tank cars are vulnerable to "accident damage and product release," and that "Design improvements to these types of cars are needed to mitigate risks of a dangerous goods release and the consequences observed in the Lac-Mégantic accident".[8]

B. Overview of PHMSA's Regulatory Impact Analysis

PHMSA's regulatory impact analysis identifies and reviews ten provisions that fall into six categories: 1) rail routing restrictions; 2) tank car integrity; 3) speed restrictions; 4) braking systems; 5) proper classification and characterization of mined liquids and gases; and 6) notification to State Emergency Response Commissions. PHMSA considers three options to improve tank car integrity. These options would impose different modification requirements on new tank cars and existing tank cars. PHMSA also considers three speed restriction provisions differentiated by the population density.

PHMSA conforms largely to OMB Circular A-4, which establishes the methods to be used in conducting regulatory impact analyses.[9] PHMSA provides a benefit-cost analysis as required by circular A-4 in its DRIA. However, this analysis, as discussed in detail below, does not demonstrate that the proposed regulations generate benefits in excess of their costs, unless PHMSA assumes a worst case incident, or assumes safety benefits from installation of ECP brakes well in excess of what is supported by technical evidence. PHMSA arrives at the unfavorable benefit-cost results despite having significantly underestimated the costs that the NPRM would impose on shippers, tank car owners, the environment, and the economy at large. This finding alone should raise concerns by PHMSA leading to the examination of other alternatives and to further research regarding the current regulatory options before imposing any new regulations.

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7 *Id.* at 8.

8 Transportation Safety Board of Canada, Railway Investigation Report R13D0054, Runaway and Main Track Derailment, Montreal, Main & Atlantic Railway Freight Train MMA-002, Mile 0.23, Sherbroke Subdivision Lac-Mégantic, Quebec, 06 July 2013.

9 See White House Office of Management and Budget ("OMB") Circular A-4 (Sept 17, 2003), www.whitehouse.gov/omb/circulars_a004_a-4.

III. REVIEW OF BENEFIT CALCULATIONS PRESENTED IN THE DRAFT REGULATORY IMPACT ANALYSIS

In this section we: 1) critically review the benefit estimates prepared by PHMSA as presented in its DRIA; 2) discuss the implications of these results for rule making; and 3) suggest areas for additional research necessary to develop a more efficient and cost-effective alternative rule to mitigate the consequences of a derailment.

A. Benefits are Overstated for Several Reasons

PHMSA's DRIA estimates the benefits of its proposed regulations following standard practice. First, PHMSA establishes a baseline estimate of expected derailments, spills, and spill volume absent any further regulation. Benefits are defined as damages avoided, including loss of life, property damage, and environmental damage, by implementing a proposed regulation or set of proposed regulations. Estimates of avoided damages are highly sensitive to: 1) the nature of the baseline absent the proposed regulations under consideration; 2) assumptions regarding expected damages from derailments and related spills; and 3) the effectiveness of the proposed regulations in mitigating these damages. All three of these factors are difficult to calculate, especially when substantial uncertainties exist. The DRIA notes many of these uncertainties, and in fact seeks comments to help improve the calculations it presents. Below we present our concerns regarding these calculations, and suggest some alternative methods and assumptions. In brief, the benefits presented in the DRIA appear to be overstated because of problems with all three factors.

1. Problems with the baseline

PHMSA's projected baseline absent further regulation is inconsistent with current data and trends. PHMSA projected future derailment rates, measured as derailments per million carloads, by fitting a simple trend line to the observed derailment rate for all derailment incidents from 1995-2012. PHMSA reduced projected derailments by 38.5%, which is the average share of derailments that are non-mainline derailments. This adjustment obscures readily available data. The proportion of derailment incidents that are not mainline derailment incidents vary from year to year. PHMSA indirectly acknowledges this fact by admitting that mainline derailment rates are decreasing at a faster rate over this period than all derailment rates.[10]

PHMSA opted not to restrict the data to mainline derailments, despite stating that the regulation was unlikely to impact non-mainline derailments.[11] PHMSA stated that all derailments were included in creating their projections because including only mainline derailments resulted in

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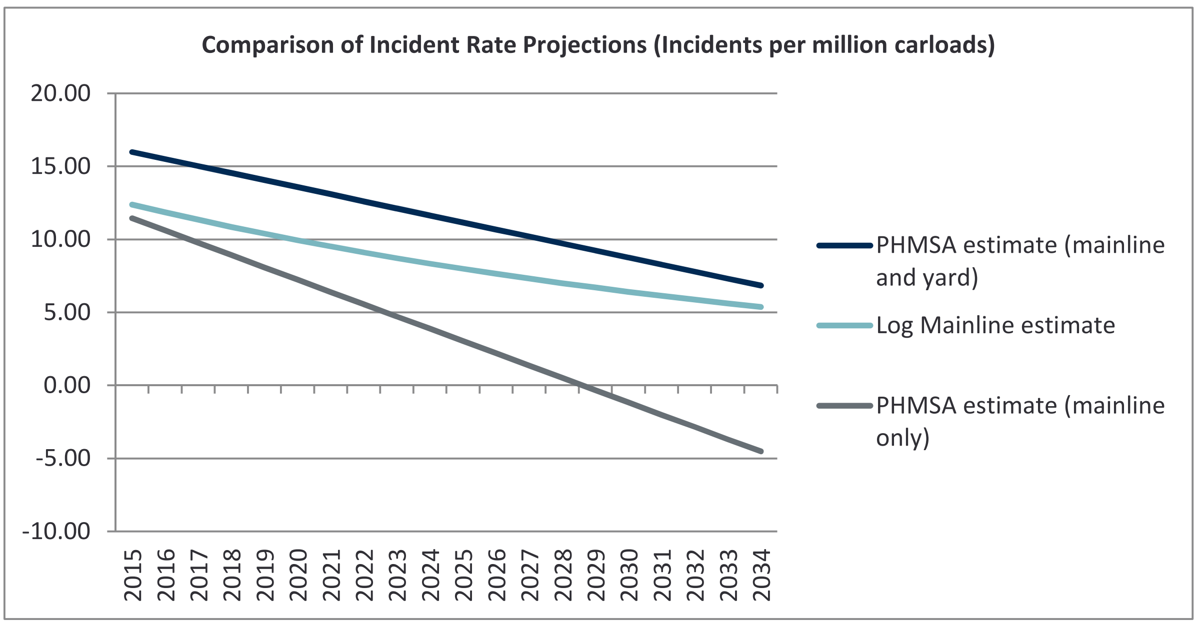
10 DRIA, p. 22.

11 DRIA, p. 21.

negative derailments before the end of the forecast in 2026.[12] This, of course, is an impossible outcome. However, this issue can easily be solved if one specifies the relationship between the mainline derailment rate and time as log-linear.[13] In addition to yielding more sensible results, this model also fits the data better than the linear model chosen by PHMSA. In fact, on average, the forecasting model proposed by PHMSA presents estimates that are approximately 9.5% above or below historic actual values, while the log-linear forecasting model is on average only 7.6% above or below historic actual values.[14] Three derailment rate forecasts are shown below. Our log-linear model does not produce negative accident rates over the forecast periods like the PHMSA model that relies on mainline data, but it does present a significantly lower forecast than PHMSA's model that relies on both mainline and yard derailment data.

Figure 1: Derailments per million carloads by forecasting methodology



12 DRIA, p. 22. It is worth noting that projected derailment rates will also turn negative eventually under the forecasting methodology provided by PHMSA because the trend is negative and linear.

13 More specifically, one could regress the natural log of the observed derailment rate for mainline derailment incidents for each year from 1995 to 2012 on that year.

14 The numbers cited above reflect the calculated MAPE values for each model. MAPE, or mean average percentage error, is a measure of goodness of fit commonly used in forecasting. It is unclear how PHMSA restricted the FRA derailment dataset, so we were unable to exactly replicate their model. However, following their general methodology, we were able to produce a model with nearly identical results.

The PHMSA estimates are always higher than the estimates using the log-linear model proposed above, which flatten out over time. This in turn inflates the total possible benefits associated with PHMSA's derailment estimates. In fact, if we plug our derailment rate forecast into PHMSA benefits calculation, the estimated baseline damages fall by nearly $700 million from $2,664 million to $1,976 million on a present value basis.[15]

Moreover, there are other reasons to expect accident rates and related spills to continue to fall in the future. First, there are several other pending regulatory changes regarding track improvements and worker performance that will improve track maintenance and monitoring and train operations. These include the Railroad Risk Reduction Program, Training standards for Rail Employees, and Controlled Substance Testing.[16] In addition FRA has issued various Emergency Orders and the Association of American Railroads ("AAR") has implemented voluntary initiatives designed to reduce derailments. As acknowledged by PHMSA, and noted in the RSI-CTC comments, track problems and human error continue to account for a large share of accidents.[17] Second, the increase in crude oil tank car shipments is expected to level off by 2020 according to the U.S. Energy Information Administration.[18] Consequently, the risk of spills will not continue to grow beyond that time from increased carloads.

Additionally, the DRIA baseline does not capture traffic patterns and mode choice, which will change as a consequence of the implementation of the proposed policies. These changes will increase truck accidents and spills and as a consequence reduce the effectiveness of the provisions of the proposed rule. This topic is addressed in greater detail in Section IV.

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15 A discount rate of 7% is applied to calculate present value. This is consistent with Circular A-4 and the DRIA.

16 NPRM, 79 Fed. Reg. 45026 (acknowledging on-going rulemaking efforts to address safety issues involving rail defects and human error); *See also* Comments Filed by the RSI-CTC regarding PHMSA's Proposed Rule "Notice of Proposed Rulemaking for Hazardous Materials: Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains" on September 30, 2014, No. PHMSA-2012-0082-2279 at 5 (hereafter, "RSI-CTC NPRM Comments") (listing actions FRA intended to carry out in 2014, as presented to the Railroad Safety Advisory Committee).

17 NPRM, 79 Fed Reg. at 45026; *see also* See RSI-CTC NPRM Comments at 4-5.

18 U.S. Department of Energy, Energy Information Administration, Annual Energy Outlook, 2014.

2. Problems with worst case

In addition to calculating expected derailments, PHMSA also provided a forecast of high impact incidents to create a worst case outcome absent further regulations. PHMSA projected that ten high impact incidents would take place over the next twenty years, where a high impact incident is an incident of the same magnitude (adjusted for population density) as the Lac Mégantic incident in Quebec. Nine of the ten high impact incidents are expected to take place in areas that have average population density,[19] but one incident is expected to take place in an area that is five times as densely populated as the average area.[20] Incidents of any of these magnitudes are unprecedented in the United States. The Lac Mégantic incident was an extreme event that is well outside the range of incidents listed in the DRIA.[21] As shown in the figures below, the Lac Mégantic incident is an extreme outlier by at least three measures—speed, number of tank cars releasing hazardous material, and gallons released. When the train derailed, it was traveling at 65 miles per hour—2.89 standard deviations above the mean speed for rail incidents considered by PHMSA. Fifty-nine cars released hazardous material in the Lac Mégantic incident—8.04 standard deviations above the mean number of cars releasing in the incidents considered by PHMSA. Lastly, over 1.5 million gallons of hazardous material were released—9.02 standard deviations above the mean volume of hazardous material released in the incidents considered by PHMSA.

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19 Average population density is defined as the average density of a square half-kilometer block of land abutting a crude oil or ethanol rail route.

20 See DRIA, p. 51-52 for a more detailed description of the methodology.

21 See DRIA, Appendix B for a list of incidents considered by PHMSA

Figure 2: Incidents by Speed (mph)

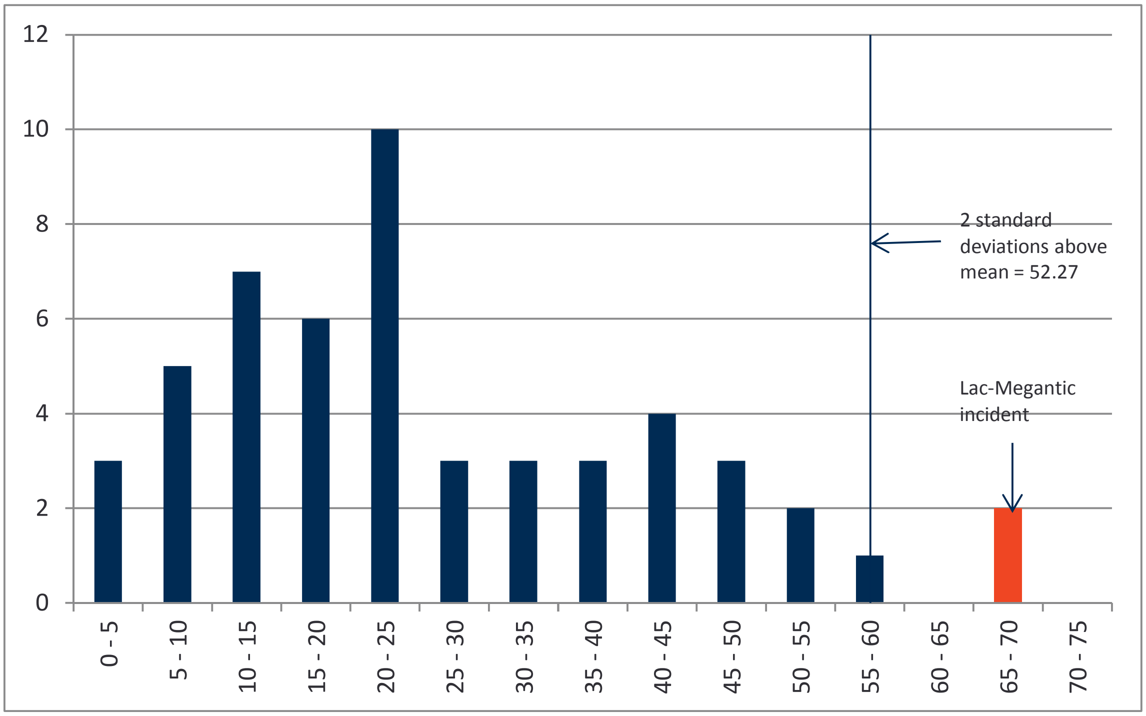


Figure 3: Incidents by Number of Cars Releasing Hazardous Material

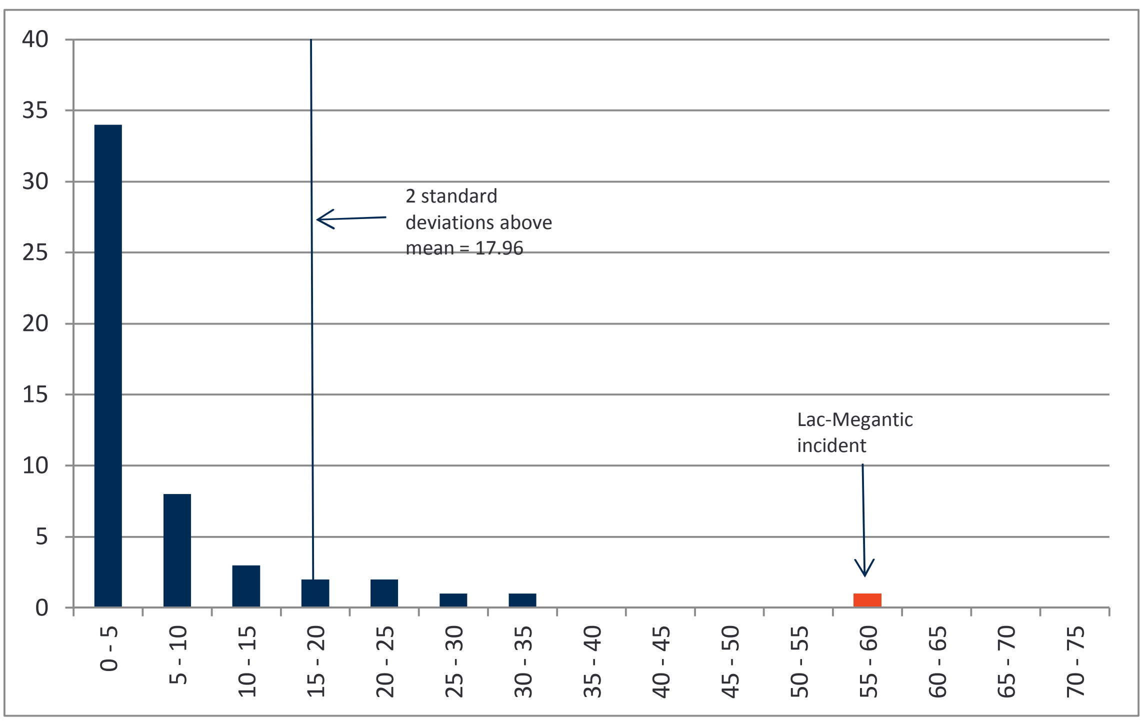
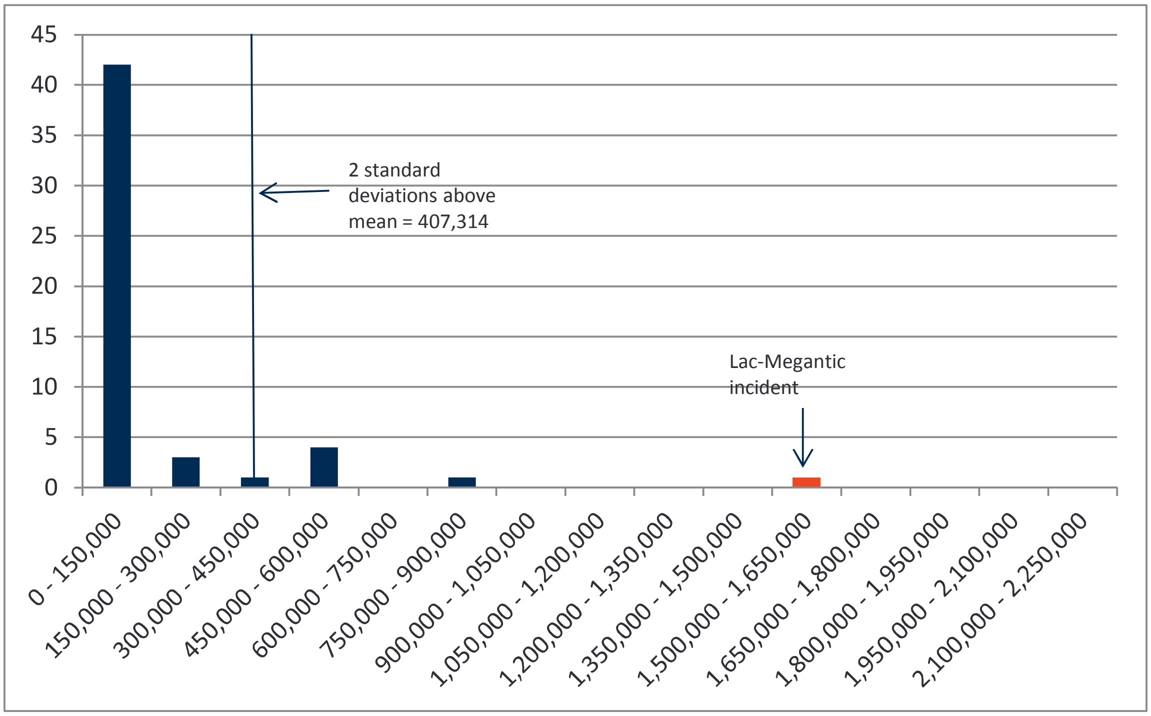


Figure 4: Incidents by Gallons of Hazardous Material Spilled



The DRIA argues that, as part of a worst case, the costs for a Lac Mégantic-like event should not be scaled back to account for either lower speed or fewer cars derailed. The DRIA contends that even at a lower speed with fewer cars, "extraordinary damages could have occurred."[22] While this may be true, it is highly unlikely. This lower probability of occurrence is not factored into the analysis. The combination of assumptions applied to create the dimensions of the worst case scenario in general, are not properly qualified for their low probability of occurrence, resulting in extreme values. The DRIA also fails to account for a leveling off of the number of crude oil and ethanol shipments by train in the near future. The likelihood of an event, all else equal, will level off as well. As noted above in the baseline discussion, all things are not equal—reductions in derailments and spills will occur regardless of the proposed policies through track improvements crew trainings, tank and other voluntary and regulatory changes.

3. Problems with the reliability of the data used to calculate damages

PHMSA uses data that it considers unreliable to estimate damages per incident. In order to estimate damages, PHMSA calculated expected incidents using the derailment incident rate projections described above, which relied on information from the FRA Railroad Safety

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22 DRIA, p. 39.

Information System[23] database ("FRA Incident Database"). These estimates are multiplied by amount spilled per incident and damages per amount spilled in order to calculate damages. The amount spilled per incident comes from the PHMSA Hazardous Materials Incident Report database ("PHMSA Incident Database"), while the damages per gallon spilled come from a single incident PHMSA considers to have reliable data.[24] PHMSA characterized the data from its own Incident Database, which it used to calculate amount spilled per incident, as unreliable.[25] Therefore, it follows that the damage estimates that rely upon this calculation are also unreliable. In contrast, PHMSA used data from a single incident—the Lynchburg derailment—to calculate damages per gallon spilled, because it considered this data to be reliable. Since the agency considered its own PHMSA Incident Database information unreliable, it could have also used data from the Lynchburg derailment to calculate gallons spilled per incident. If it had done this, estimated baseline damages would fall from $2,664 million to just $994 million on a present value basis.[26] This lower value should be acknowledged in the range of benefit estimates.

Additionally, PHMSA relied upon data from the FRA Incident Database where derailments that don't result in spills are rarely reported to calculate amount spilled per derailment.[27] If derailments that do not result in spills are underreported, then it is likely that PHMSA is overstating the average number of gallons spilled per incident. In fact, PHMSA is effectively assuming that a car is guaranteed to spill if it derails, which is inconsistent with RSI-AAR Tank Car Safety Project studies on conditional probability of release ("CPR"). Research by the Tank Car Safety Project concludes that the probability of a tank car releasing hazardous material given

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23 The FRA Incident Database collects information on derailments regardless of the commodity, the type of track (mainline, siding, industry), the number of cars derailed, the number of cars that release product and whether hazmat was involved. *See* DRIA, p. 25. The PHMSA Incident Database contains information on incidents that result in the release of hazardous material in transportation including the type of hazardous materials released, the mode of transport, and the number of packages releasing hazardous material. *Id.* Note that PHMSA generally does not collect information on derailments unless the derailment results in the release of hazardous material while the FRA generally does not collect data on the specific hazmat commodity involved in a derailment. *Id.* For this reason, PHMSA considers both databases to be unreliable.

24 DRIA, p. 34.

25 DRIA, p. 26.

26 A discount rate of 7% is applied to calculate present value.

27 As noted above, PHMSA refers to two databases, its own Hazardous Materials Incident Report database and the FRA's Railroad Information System. The latter does not provide spill data by commodity and is not used for estimating spills per derailment. DRIA, p. 25.

a derailment on a mainline or siding track is 6.39% to 26.62%.[28] Clearly, it is unlikely that every derailment will result in a spill, so PHMSA has likely overstated damages by overstating the amount spilled per incident.

4. Problems with effectiveness estimates

The effectiveness estimates provided by PHMSA are not well explained or documented. It is not clear why PHMSA did not rely on the CPR estimates provided by the Tank Car Safety Project. PHMSA's effectiveness estimate for ECP braking is not supported by research identified by RSI-CTC and AAR.[29]

Additionally, PHMSA does not take into account mode shifting, and, therefore, overstates the effectiveness of the proposed regulation. As discussed in Section IV, shop constraints and costs will idle a large number of tank cars making trucking an alternative shipment mode over longer distances. Increased truck traffic will result in higher truck accidents and spills, which have to be factored into the effectiveness calculations. Using data from PHMSA, we counted the number of crude oil spill trucking incidents from 2005 to 2009 and divided that by the number of ton-miles of crude oil shipped from 2005 to 2009 by truck from the DOT to calculate incidents per ton-mile. These rates were applied to predicted ton-miles with and without the regulation to estimate incidents each year from 2015-2034. This number is multiplied by the mean damages per trucking incident from 2005 to 2009, which is $39,730. While the regulation leads to a decrease in rail incidents, the number of trucking incidents increases because the amount of oil that is shipped by truck increases while tank cars are being taken offline for modifications. Mode choice is discussed in greater detail in Section IV.

5. Adjusted Benefits Calculations

Combined, the corrections discussed above would reduce PHMSA's baseline benefit estimates by over $2 billion on a net present value ("NPV") basis. The impact on baseline benefits of adjusting the incident rate forecast, as suggested in III.A.1, reduces benefits by $0.69 billion. Adjusting the gallons spilled per incident estimates, as suggested in III.A.3, reduces benefits by $1.67 billion. Finally, accounting for modal shift, which is described in detail in the next section, reduces benefits by $0.18 billion.

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[28] RSI-AAR Railroad Tank Car Safety Research and Test Project, Preliminary Report RA-13-04A (publication forthcoming).

[29] See Comments Filed by the RSI-CTC regarding PHMSA's Proposed Rule "Notice of Proposed Rulemaking for Hazardous Materials: Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains" on September 30, 2014, No. PHMSA-2012-0082 (HM-251) at 14-16 (hereafter, "RSI-CTC NPRM Comments").

Table 1: Summary of Adjustments to PHMSA Baseline Benefits Calculation

	Adjustment	Reduction to NPV Damages (Billions of dollars)
[1]	Incident rate projection	$0.69
[2]	Spill amount	$1.67
[3]	Truck mode shift	$0.17
[4]	Total reduction	$2.09

[1] Incident rate is adjusted to use Brattle forecasting methodology instead of PHMSA methodology
[2] Spill amount is adjusted to use Lynchburg estimate instead of PHMSA estimate
[3] Increased incidents from trucks taken into account
[4] Effect of [1], [2], and [3]. [1] and [2] are not independent, but [3] is independent from both [1] and [2]. Therefore, this is not just the sum of [1], [2], and [3].

It is worth mentioning that the incident rate projection and the spill amount adjustments are not independent. This means that if one were to use PHMSA's incident rate projection and calculate the reduction in estimated baseline benefits from changing the spill amount estimate, one would not get the same number as one would if one were to use a different incident rate projection. That is why the total reduction in baseline estimates that we calculate in Table 1 is not equal to the sum of the three individual adjustments.

Accounting for the differences in effectiveness based on CPR estimates, findings regarding ECP brakes and the offset from increased truck related accidents, reduces the avoided derailments, related spills and damages that can be attributed to the regulatory alternatives under review.

6. Topics for Further Research

There are several areas that require further research based on our review. These areas include the baseline forecast (especially the worst case scenario); the estimated effectiveness of the technologies and process changes proposed (especially regarding ECP brakes); and the possible offsetting increases in accidents and spills because of increased reliance on other transport modes (especially trucks) that will likely occur as a result of the proposed regulations.

IV. PHMSA UNDERSTATES THE COSTS ASSOCIATED WITH ITS PROPOSED REGULATIONS

A. PHMSA UNDERESTIMATES THE SIZES OF THE AFFECTED FLEETS

PHMSA's regulatory impact analysis significantly understates the number of tank cars that might require modification under the proposed regulations. While we appreciate the difficulty of developing accurate measurements of the size of a rapidly changing tank car fleet, we also believe that it is critically important that in crafting regulations PHMSA must understand how many tank cars will be affected by those regulations.

As stated in its comments on the NPRM, the RSI-CTC explains that under the proposed definition of a "HHFT" it would be impossible to limit the application of the rule only to tank cars carrying crude oil and ethanol.[30] Furthermore, PHMSA proposes treating PG III products with a flash point above 100 degrees F as combustible liquids, which would exempt them from any modification. However, we do not have data on the portion of the existing tank car fleet that would be covered by that exemption and therefore cannot determine which tank cars would be potentially outside the scope of the Proposed Regulations. Consistent with these conclusions, we assume that the entire existing tank car fleet, including legacy DOT-111s and CPC-1232s, will be modified to meet the proposed deadlines and that all tank cars transporting PG III commodities are treated as flammable liquids.

In the preamble to its proposed regulations, PHMSA notes the rapid growth that has taken place in shipments of crude oil by rail. Between 2009 and 2013 the number of carloads of crude oil moving by rail grew from 10,800 to over 400,000.[31] This growth in traffic has been accompanied by a comparable expansion of the crude oil tank car fleet. To accommodate actual and planned growth, crude oil producers, marketers and refiners have ordered, taken delivery of, and placed into service large numbers of new crude oil tank cars. These realities mean that the size of the crude oil fleet is a moving target. Snapshot estimates of its size and sub-fleet makeup can quickly become out of date as new tank cars are placed into service and other tank cars are removed from service or reassigned to a different commodity.

The rapid growth of the existing tank car fleet, made up of legacy DOT-111s and a growing number of CPC-1232s is illustrated by Table 2, which contrasts AAR measurements of the sizes

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30 RSI-CTC NPRM Comments at 7-9 (explaining that the fundamental flaw in the HHFT approach is the notion that a shipper has advance notice of or control over the type of train in which its tank car moves or that the type of train in which it moves remains static from origin to destination).

31 NPRM, page 9.

of the crude oil tank car fleets as of the end of 2013 and the end of April of 2014.[32] To qualify for inclusion in the end-of-calendar-year 2013 totals, a tank car had to have shipped at least one carload of the commodity in question over the period from January 1, 2012 through December 31, 2013. To qualify for inclusion in April 30, 2014 totals, a tank car had to have shipped at least one carload of the commodity in question over the period from January 1, 2013 through April 30, 2014. Over even this brief period the crude oil fleet expanded substantially.

Table 2: Number of Tank Cars in Crude Oil Service as of 12/31/13 and 04/30/14

Sub-fleet	Fleet as of 12/31/13	Fleet as of 4/30/14
Non-jacketed legacy DOT-111s	22,957	23,090
Jacketed legacy DOT-111s	6,407	7,016
Non-jacketed CPC-1232s	9,402	11,364
Jacketed CPC-1232s	4,966	7,712

The task of tracking changes in the crude oil and ethanol fleets is further complicated by the fact that tank cars are sometimes reassigned from one service to another. The need for a tank car to be thoroughly cleaned before it is ready to carry a new commodity reduces the frequency with which such changes occur. But they do occur. Between December 31, 2013 and April 30, 2014 the number of jacketed DOT-111 tank cars in crude oil service grew from 6,407 to 7,016. However, the only new tank cars being built for crude oil service at this time were CPC-1232 tank cars. The increase in the size of the jacketed and non-jacketed DOT-111 crude oil fleet therefore is the result of tank car reassignment from other commodity services.

The new tank car order backlog provides another indication of the rate at which the tank car fleets covered by the proposed regulations are expanding.

Table 3 shows the number of new tank cars scheduled for delivery in 2014 and 2015. Based on orders from their customers, the RSI-CTC members anticipate that the vast majority of these cars are destined for crude oil service. In calendar year 2104 the CPC-1232 tank car fleet is expected

32 PHMSA appears to have based its estimates of the size of the crude oil and ethanol fleets (presented in DRIA on page 78) on the end of 2013 car counts.

to expand at a rate of nearly 1,800 tank cars per month. These deliveries will continue at a reduced but still substantial pace through 2015.

Table 3: Delivery Schedule for Current New Tank Car Orders

Sub-Fleet	2014 Deliveries	2015 Deliveries
Non-jacketed CPC-1232s	7,481	1,180
Jacketed CPC-1232s	13,647	9,730

The figures presented in Table 2 and

Table 3 do not tell the complete story. A long supply chain connects the facilities where tank cars are manufactured with the unit trains in which crude oil and ethanol move. There are time lags between when a crude oil shipper places an order for a new tank car and when a tank car is manufactured, between when a tank car is manufactured and when it is delivered, between when the tank car is delivered and when it is placed into service, and between when the tank car is placed in service and when it completes a shipment, and thus becomes eligible for inclusion in AAR tank car counts. Given the rapid rate at which the crude oil fleet has been expanding, at any given point in time there can be significant numbers of uncounted tank cars at these various points in this supply chain.

The best estimate by the RSI-CTC members of what the flammable liquids tank car fleet will look like in 2015 is shown in Table 4. This estimate is based upon the most recent tank car counts prepared by AAR, but have been updated to account for projected deliveries of back ordered tank cars and tank cars "in transit" as described above but not yet included in the AAR counts because they have not completed their first shipment.[33]

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[33] As noted above, to qualify for inclusion in April 30, 2014 totals a tank car had to have shipped at least one carload of the commodity in question over the period from January 1, 2013 through April 30, 2014. Because it is possible for an individual tank car to have carried more than one commodity over this period, it is also possible for a tank car to appear in more than one fleet. Therefore these numbers are not additive.

Table 4: Projected Flammable Liquids Tank Car Fleet as of the End of 2015

Sub-fleet	Crude Oil	Ethanol*	Other Flammable Liquids*
Non-jacketed legacy DOT-111s	23,090	27,037	24,790
Jacketed legacy DOT-111s	7,016	88	9,413
Non-jacketed CPC-1232s	21,993	751	2,944
Jacketed CPC-1232s	35,408	23	1,975
Total	**87,597**	**27,899**	**39,122**

* Note: Ethanol and Other Flammable Liquids car counts are based on AAR counts of cars that shipped at least one carload of the commodity in question over the period from January 1, 2013 through April 30, 2014. If an individual car switched services during this period, that car will be counted as part of more than one fleet.

PHMSA's fleet size estimates are derived from a presentation given by the RSI-CTC to the NTSB early in 2014.[34] That presentation included some figures showing the sizes of the various crude oil and ethanol sub-fleets, and counts of number of tank cars on order. The fleet size figures in the presentation to NTSB were based on AAR end of year 2013 tank car counts.[35] In using these figures to derive 2014 and 2015 fleet size estimates PHMSA makes a number of assumptions that are not correct. Specifically, PHMSA assumes that all non-jacketed CPC-1232 tank cars on order will be delivered in 2014, and that an additional 5,000 jacketed CPC-1232 tank cars will be delivered this same year.[36] Based upon the delivery schedules set forth above in

Table 3, both assumptions are incorrect.

Further, PHMSA incorrectly assumes that beginning in 2015, only enhanced jacketed CPC-1232 tank cars will be delivered into service.[37] While industry has committed to building only

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34 RSI-CTC presentation to NTSB rail safety forum April 22, 2014.

35 The figures in this presentation appear, when rounded to the nearest 100, to match counts that appear in end of year 2013 AAR tabulations.

36 DRIA, page 77.

37 DRIA at 32.

enhanced jacketed CPC-1232s to fill new orders for tank cars in crude oil service going forward, these tank cars may still need minor valve modifications (i.e. addition of the reconfigured BOV and appropriately sized PRV) if they are built before a final rule is in place. In addition, as

Table 3 illustrates, there are 1,180 non-jacketed CPC-1232 tank cars on order in the backlog for delivery in 2015. These contracts would need to be renegotiated between the manufacturers and their customers before these orders could be changed to a jacketed car order, delaying these tank cars' entry into service.

Table 5 compares PHMSA's projection of the size and composition of the crude oil and ethanol fleets as of the end of 2015 with that of the RSI-CTC as set forth above in Table 4. These projections differ at the sub-fleet level. The most significant difference involves jacketed CPC-1232 tank cars, where PHMSA appears to understate the size of the fleet by more than 5,000 tank cars.

Table 5: Comparison of PHMSA and RSI-CTC Estimates of End of 2015 Crude Oil and Ethanol Fleets

Sub-Fleet	PHMSA Projection	RSI-CTC Projection	Difference
Non-jacketed legacy DOT-111s	51,592	50,172	1,420
Jacketed legacy DOT-111s	5,600	7,104	(1,504)
Non-jacketed CPC-1232s	22,380	22,744	(364)
Jacketed CPC-1232s	30,150	35,431	(5,281)
Total	**109,722**	**115,451**	**(5,729)**

Sources: DRIA, Table TC5 and C-3.

PHMSA's fleet size estimates and assumptions significantly understate the challenges of modifying the existing fleet of jacketed CPC-1232 tank cars to bring it into compliance with the proposed regulations. PHMSA starts with a 2013 end-of-year estimate of 4,850 tank cars, and then assumes that 5,000 additional tank cars will be added to this fleet in 2014, resulting in a 2014 end-of-year fleet of 9,850 tank cars. In contrast, if one combines the 4,966 tank cars shown in Table 2 above for the 2013 end-of-year jacketed CPC-1232 fleet with the expected 2014 deliveries of 13,647 tank cars, shown above in

Table 3, one arrives at a 2014 end-of-year fleet of 18,613 cars.[38]

B. PHMSA Makes Unsupportable Assumptions Regarding the Disposition of the Affected Fleets

The RSI-CTC does not believe that the assumptions set forth in the DRIA regarding transfers of tank cars out of crude oil or ethanol services in response to the proposed regulations are realistic.

PHMSA assumes that the sizes of the crude oil and ethanol fleets that will require modification will be substantially reduced by the transfer of thousands of cars into service for the transportation of oil sands crude from Western Canada. This assumption is unrealistic for a number of reasons. First and foremost, many of the cars that PHMSA assumes will be transferred into oil sands service are unmodified legacy DOT-111 tank cars. It is far from clear that Canadian officials would permit such a transfer. Regulatory proposals currently being considered by Transport Canada would require that these tank cars undergo extensive modifications before they would be permitted to carry crude oil within Canada.[39] Moreover, even if Canadian authorities were willing to permit unmodified legacy DOT-111 tank cars to carry oil sands crude, many of these tank cars would still require modifications to carry this commodity. Oil sands crude is heavy and viscous, and would have to be heated to permit tank car unloading. Many of the tank cars that PHMSA assumes would be transferred to oil sands service are not currently equipped with heating coils, and so would have to be modified before the transfer could take

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38 It appears that PHMSA relied on an RSI-CTC presentation delivered to OMB on June 16, 2014 as the source for its figure of 4,850 cars for the 2013 end-of-year jacketed CPC-1232 fleet. The car count shown in Table 2 differs from this figure due to rounding and due to the inclusion of 123 AAR 211 tank cars, which would require similar modifications under the proposed regulations. We have not been able to identify a source for PHMSA's assumption that only 5,000 additional tank cars would be added to the fleet.

39 PHMSA argues that the physical characteristics of oil sands crude would lower risks and potential damages to the point where these crudes could be carried safely in unmodified legacy DOT-111 cars. However, we understand that Transport Canada's position is diluents are added to oil sands for transportation, resulting in characterization of the resulting commodity as a PG I or PG II commodity, and thus requiring transportation in a modified tank car.

place. These modifications would have to be carried out in parallel with the modifications required to meet PHMSA's requirements for tank cars in crude oil and ethanol service. Thus, there is little reason to believe that such a transfer would substantially reduce the burdens imposed by PHMSA's modification requirements. Finally, it is not clear that demand for rail transportation of oil sands crude is growing rapidly enough to absorb the large fleet of tank cars that PHMSA assumes will be transferred to this service.

PHMSA assumes, apparently based solely on the age of the existing tank cars that would be affected by the Proposed Regulations, that any car requiring modification in order to achieve compliance would be actually modified rather than retired from service.[40] Members of the RSI-CTC do not believe that this assumption is accurate. Based upon a survey of its members, the RSI-CTC estimates that because of technical barriers to modification, twenty-eight percent (28%) of the legacy DOT-111s, or approximately 25,600 tank cars, will be retired early from crude oil, ethanol, and other flammable liquids service, rather than undergo modification.[41] The removal of these tank cars from crude oil and ethanol service would reduce the modification burdens associated with the proposed regulations to some extent. However, the early retirement of these tank cars would significantly reduce the capacity that would be available to meet the needs of shippers of crude oil and ethanol. In addition, the premature retirement of these tank cars and their replacement with newly built cars would impose significant economic costs on their owners.

The RSI-CTC does not believe there are many other commodities whose density, shipment volumes, packaging requirements and capacity needs would be suited to the use of significant numbers of redeployed crude oil or ethanol tank cars. These markets are already adequately served by existing tank car fleets, and absent significant growth, would not have the ability to absorb the repositioned assets. It is likely, therefore, that significant numbers of these tank cars would be scrapped rather than repurposed.[42]

To the extent that it does prove feasible to transfer some of these tank cars to another commodity service, any such cars would still need to be cleaned for reassignment—which would utilize scarce repair network capacity and further constrain the limited resources available to complete the modification program.

Table 6 shows the extent to which unsupportable assumptions by PHMSA regarding transfers of tank cars out of crude and ethanol service have caused the agency to underestimate the number

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40 DRIA at 78-79.

41 RSI-CTC Comments to PHMSA at 25.

42 RSI-CTC Comments to PHMSA at 34.

of such cars that would have to undergo modification if the Proposed Regulations were to take effect. The net effect of PHMSA's overestimate of the number of tank cars likely to be transferred to oil sands service and underestimate of the number likely to be retired prematurely from crude oil and ethanol service is to cause the agency to undercount the number of tank cars that would require modifications by approximately 7,200 cars

Table 6: Underestimation of Existing Tank Cars Requiring Modification Due to PHMSA Assumptions Regarding Tank Car Disposition

Subfleet	PHMSA		RSI-CTC		PHMSA Underestimate of Tank Cars Requiring Modification
	Transfers to Oil Sands	Retirements	Transfers to Oil Sands	Retirements	
Jacketed DOT-111	5,600	0	0	1,989	3,611
Non-jacketed DOT-111	7,787	0	0	14,035	(6,428)
Jacketed CPC-1232	9,850	0	0	0	9,850
Non-jacketed CPC-1232	0	0	0	0	0
Total	23,237	0	0	16,024	7,213

C. PHMSA Underestimates the Per Car Costs of the Modifications to Existing Tank Cars Required by the Proposed Regulations

In addition to underestimating the *number* of tank cars that would require modification in order to comply with the Proposed Regulations, PHMSA also underestimates the per tank car cost of carrying out these modifications. The analysis reported in the DRIA reflects a number of unrealistic or unsupported assumptions whose effect is to understate the likely costs of the required modifications.

First, PHMSA assumes that because of unspecified "economies of scale" it is appropriate to reduce the modification cost estimates provided by the RSI-CTC by 10 percent.[43] We question the

43 DRIA at 84.

reasonableness of this assumption. A major modification program of this nature carried out under enormous time pressures is equally if not more likely to experience increases in cost due to production bottlenecks, shortages of critical materials and categories of skilled labor, payment of overtime wages and other such factors. PHMSA provides no discussion of these issues, and fails to offer even speculations regarding the nature and source of its assumed economies of scale.

Second, PHMSA understates the costs of several important components of the modification packages that numerous existing cars would have to undergo. For example, PHMSA's estimates of the cost of installing ECP brakes appear to be seriously understated. There is currently no infrastructure in place to support the installation and maintenance of such systems. Major effort and investment would therefore be required to develop these capabilities, which is not addressed in PHMSA's costs. Moreover, PHMSA's estimates appear to overlook major elements of the installation process. As a result, the RSI-CTC contends that ECP brakes would cost more per car ($7,300 vs. $3,000 for new cars and $7,800 vs. $5,000 for existing cars) and that all cars on a train would require ECP brakes for it to operate effectively. The latter would greatly increase ECP costs beyond what is presented in the DRIA.[44]

PHMSA also seems to have made a number of overly optimistic assumptions regarding the cost of installing a full height head shield on non-jacketed tank cars. The DRIA assumes that installation of a full height head shield would add only $400 to the cost of installing a full jacket,[45] whereas the RSI-CTC has calculated that installation of these head shields would cost $17,500 per car.[46] PHMSA also assumes there will be no costs associated with upgrading tank cars from 263,000 Gross Rail Load ("GRL") to 286,000 GRL;[47] however, the RSI-CTC contends that such an upgrade requires truck modifications and/or truck replacement that will range in cost from $2,850-$24,600.[48]

PHMSA also assumes that all of the jacketed CPC-1232 tank cars, other than the 9,850 it assumes would move to Canadian oil sands service, will be built with the pressure relief valve ("PRV") and reconfigured bottom outlet valve handle ("BOV") that are called for in the NPRM. This assumption is incorrect. According to the AAR, by the end of the first quarter of this year there were already 7,104 of these tank cars operating in crude oil and ethanol service. According to

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44 RSI-CTC NPRM Comments at 25.

45 DRIA at 84.

46 RSI-CTC NPRM Comments at 40.

47 NPRM, 79 Fed. Reg. 45059.

48 RSI-CTC NPRM Comments, Appendix B.

RSI-CTC members, a total of 13,647 of these tank cars are scheduled for delivery in 2014 and another 9,730 in 2015. Given that designs for these new valves have not yet been finalized, it is highly unlikely that they will be installed on any of the jacketed CPC-1232 tank cars scheduled for delivery in 2014. And it is doubtful that designs will be finalized and production of the new valves will be far enough along to permit their installation on newly built tank cars until sometime well into 2015.

Thus, when the rule is finalized, and even if PHMSA's assumptions regarding transfers to Canadian oil sands service were to prove to be correct, there would be a large fleet of jacketed CPC-1232 tank cars requiring valve replacements. While these modifications are small relative to those required for other sub-fleets, such as the non-jacketed DOT-111s, the tank cars must still be cleaned before these modifications can be carried out. Since tank car cleaning capacity is a major factor that limits the pace at which the entire modification program can be carried out, this imposes additional maintenance and repair network capacity constraints.

D. PHMSA Underestimates the Time That Will Be Required to Carry Out the Required Modifications

PHMSA's analysis reflects unrealistically optimistic assumptions about the rate at which modifications can be carried out. In the DRIA, PHMSA assumes that over the 2016-2018 period, modifications will be carried out on 43,805 non-jacketed legacy DOT-111 tank cars and 22,380 non-jacketed CPC-1232 tank cars.[49] Even if one were to assume that these modifications could begin on January 1, 2015 (an assumption that RSI-CTC members do not believe is realistic, given the ramp up period that would be required to order parts and components and hire and train the necessary workforce), it would not be feasible to achieve PHMSA's timeline because doing so requires that the modifications be carried out at a rate of over 1,400 tank cars per month. This rate is far in excess of the most optimistic estimates of industry capacity prepared by the RSI-CTC members, which already account for anticipated capital investment by its members to carry out the large-scale modifications that the proposed regulations would require. During the initial years of the program when the most complex modifications are being carried out on the non-jacketed legacy DOT-111 tank cars, the RSI-CTC does not believe that it will be possible to process more than 550 cars per month. While it may be reasonable to assume some increase in throughput rates as shops become more familiar with the process, the RSI-CTC does not believe that under any realistic scenario it will be possible to approach anything close to the rates assumed in PHMSA's analysis.

We project that large numbers of existing tank cars will undergo extensive modifications. The time required to complete these modification will depend upon the current and projected

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49 DRIA at 91-92.

capacity of the shops where these modifications will be carried out. Below we describe the nature of the modifications called for in the proposed regulations, and the nature of the work involved in carrying them out. For modeling purposes, we have utilized a set of modifications that would bring the existing fleet into compliance with an "enhanced" jacketed CPC-1232 standard, similar to what is contemplated in Option 3 of the Proposed Rule. There are significant challenges associated with modeling Option 1 or Option 2 for tank car modification requirements due to the uncertainty associated with either modifying tank cars a 9/16 inch tank car thickness equivalency (i.e. by adding thicker jackets) or by modifying tank cars to a performance standard associated with a 9/16 inch thick tank. First, the RSI-CTC members have indicated this would result in an increase in the early retirement rate. Second, it would decrease the overall modification capacity of the maintenance and repair network because some shops would not have the equipment necessary to roll and apply thicker jackets. Finally, it would likely add out of service time to the modification process, although the exact amount of added time is unknown. Therefore our analysis is a lower-end estimate of understated costs, because these uncertainties would drive up the overall cost of the modification program.

In this section, we also discuss some of the practical constraints on the rate at which the modification work can be carried out. We summarize the results of a survey conducted by the RSI-CTC members that provides quantitative estimates of projected throughput rates. Finally, we describe the approach we have taken to model the required modification processes, and the conclusions we have drawn regarding the time required to bring existing fleets into compliance.[50]

1. Overview of the Tank Car Modification Process

Tank car modification is an extremely complex process which requires several actions beyond the application of the specific features required by the Proposed Regulations. Before a tank car entering a shop can undergo modification, extensive preparations are required, including: cleaning of the interior of the tank, inspection and removal of valves and fittings—including the top unloading valve, the pressure relief device, the manway cover, and the fittings plate and protective housing—as well as removal of side ladders, top platform, the bottom outlet valve, and the guardrails and brackets on the underside of the tank. Any problems uncovered during the course of this preparation work have to be corrected prior to returning the car to service.

Once the car is adequately prepared, the first step in carrying out the proposed modifications would be to weld head shield supports to the ends of the tank car to support the application of a full-height head shield. Next the tank would be blasted and primed to create the appropriate profile for application of the thermal blanket and jacket. Next jacket spacers would have to be applied to hold the jacket a certain distance from the tank to keep it from crushing the thermal

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50 For a more extensive and detailed discussion of these issues see RSI-CTC Comments to PHMSA at 27-31.

blanket that rests between the jacket and the tank shell. The ceramic blanket would then be applied to the tank. Fabrication of the jacket is a complex process involving costly capital equipment. After attachment of the jacket, all external equipment that would have been removed prior to modification would then be reapplied to the modified tank. Extensive testing would then be required to verify the integrity and serviceability of the modified car. The car would then have to be painted, weighed and stenciled. All regulatory and registration paperwork must be completed before the tank car is released from the facility and returned to service. The scheduling and management of this work will be complicated by uncertainties regarding when tank cars are sent to shops by customers, and when railroads are able to deliver them. Simultaneous to the modification, repair shops must still perform their baseline workload of handling bad orders (i.e. equipment repairs), reassignments of tank cars into new commodity service, and mandatory requalifications.

2. Current Tank Car Modification Capacity

There is currently a finite set of North American facilities that are certified and registered to repair, modify and qualify tank cars. These facilities are listed in Table 7. Because of the complexity of the processes described above, only a subset of the facilities listed in Table 7 are actually capable of carrying out the work. There is no central registry or database that contains enough information to permit reliable identification of shops possessing the requisite facilities, equipment, and work forces. Moreover, even if such facilities could reliably be identified, further investigation would be required to determine the rate at which individual facilities would be able to carry out the necessary modifications.

Table 7: Association of American Railroads Listing of Active Certified Class A, B, C and D Tank Car Facilities

ADM
Cedar Rapids, IA
Alabama Railcar Service, Inc.
Ozark, AL
Alpha Technical Services Corporation
Pasadena, TX
American Railcar Industries
Bude, MS
La Porte, TX
Longview, TX
Marmaduke, AR
North Kansas City, MO
Tennille, GA
Archer Daniels Midland Railcar Repair
Decatur, IL
ARI Fleet Services of Canada, Inc.
Sarnia, ON
Bayou Railcar Services, Inc.
Holden, LA
BRC Rail Car Service Company
Elk Mills, MD
Lynchburg, VA
BW Services
Angleton, TX
Washington, IN
Westlake, LA
CAD Industries, Ltd.
Lachine, QC
CALTRAX, Inc.
Calgary, AB
Chart Industries, Inc.
New Prague, MN
Columbiana Boiler Company LLC
Columbiana, OH
Cryogenic Vessel Alternatives
Mont Belvieu, TX
Crystal Car Line Div.
Bedford Park, IL
Dana Railcare
Wilmington, DE
Eagle Railcar Repair
Elkhart, TX
Eagle Railcar Services-Roscoe, Inc.
Roscoe, TX
Economy Coating Systems, Inc.
Camanche, IA
Equipos Ferroviarios Del Norte, S.A. de C.V.
Gomez Palacio, Durango, Mexico
Equipos Ferroviarios Del Sureste, S.A. de C.V.
La Granja, Veracruz, Mexico
Frit Car Inc.
Brewton, AL
Bridgeton, NC
GATX
Waycross, GA
GATX Corporation
Colton, CA
Donaldsonville, LA
Freeport, TX
Galena Park, TX
Macon, GA
GATX Corporation
Terre Haute, IN
GATX Rail Canada Corp.
Corunna, ON
Montreal, QC
Moose Jaw, SK
GATX Rail Canada Corporation
Red Deer, AB
GATX Rail Corporation
East Chicago, IN
Hearne, TX
Kansas City, KS
Plantersville, TX
GE Equipment Services - Rail Services
Omaha, NE
Regina, SK
Sayre, PA
Texarkana, AR
Waterloo, IA
GreenBrier Rail Services
Atchison, KS
Kansas City, MO
Greenbrier Rail Services - Finley
Kennewick, WA
Gunderson
Frontera, COAH C.P. , Mexico
Hammond Machine
Hammond, IN
Hayes Manufacturing Company
Pineville, LA
Kelso Technology (USA) Inc.
Bonham, TX
McKenzie Valve and Machining LLC
McKenzie, TN
Midwest Railcar Repair, Inc.
Brandon, SD
On-Track Properties, Incorporated
Montgomery, TX

Association of American Railroads
Listing of Active Certified Class A, B, C and D Tank Car Facilities (Continued)

Procor Limited
Blackfalds, AB
Edmonton, AB
Fort Saskatchewan, AB
North Vancouver, BC
Oakville, ON
Pincher Creek, AB
Regina, SK
Sarnia, ON
Trail, BC
Progress Rail Services
Amarillo, TX
Rail Services Inc.
Calvert City, KY
Rescar
Gordon, GA
Rescar Companies
Channelview, TX
Dubois, PA
Kingsport, TN
Longview, TX
Longview, TX
Savanna, IL
Rescar, Inc
Orange, TX
Safety Railway Service
Houston, TX
Victoria, TX
Safety Railway Service, L.P.
Belle Chasse, LA
Safety Railway Service, LP
Knox, IN
Seaboard Railcar Repair and Cleaning
Hugo, OK
Talleres de Equipo Rodante del Bajío, S.A. (TERBSA)
Irapuato, Guanajuato, Mexico
Tank Lining of Paris, Inc
Paris, TN
Texana Tank Car & Manufacturing, Inc.
Nash, TX
TMC Engineering Services
Houston, TX
Transco Railway Products Inc.
Miles City, MT
Transco Railway Products, Inc.
Sioux City, IA
Trinity Industries de Mexico, S de RL de CV
Huehuetoca, Edo. de Mexico
Trinity Rail Car, Inc.
Longview, TX
Trinity Rail de Mexico
CD. Castanos, Coahuila, Mexico
Frontera, Coahuila Mexico
Trinity Rail Sabinas
Sabinas, Coah, Mexico
Trinity Tank Car
Fort Worth, TX
Trinity Tank Car Repair, Inc.
Saginaw, TX
Trinity Tank Car, Inc.
Longview, TX
Longview, TX
Longview, TX
Longview, TX
Oklahoma City, OK
Saginaw, TX
Tulsa, OK
Union Tank Car Company
Altoona, PA
Catlettsburg, KY
Cleveland, TX
Columbus, MS
El Dorado, KS
Evanston, WY
Galena Park, TX
Marion, OH
Mounds, IL
Muscatine, IA
Valdosta, GA
Ville Platte, LA
UTLX Carotanques Servicios, S.A. de C.V.
Celaya, Guanajuato, Mexico
UTLX Manufacturing
Alexandria, LA
Houston, TX
Watco
Fitzgerald, GA
Watco Mechanical Services
Hockley, TX
Hollidaysburg, PA
Houston, TX
Junction City, KS
Neodesha, KS
Omaha, NE
Scottsville, TX
Zwolle, LA
WW Metal Products, Inc.
Texarkana, TX

Source: "Tank Car Committee Certified Tank Car Facilities (Classes A, B, C, D) and Registered Tank Car Facilities (Classes F, G, L)." Table B2. Association of American Railroads, Casualty Prevention Circular. June 14, 2013.

To provide a sound basis for evaluating industry capacity for carrying out a major modification program of this sort, the RSI-CTC conducted a survey of its member companies' maintenance and repair shop capacity and that of the outside shops most frequently used by its members. The RSI-CTC asked each member company to estimate the capacity it expected to be able to make available for completing the extensive modifications required to bring cars into compliance with the Proposed Regulations. The RSI-CTC compared information gathered in this way with information from the Alltranstek survey commissioned by the American Petroleum Institute ("API").

In order to standardize the estimates and provide capacity figures that were consistently defined across companies, the RSI-CTC provided its member companies with what it described internally as a "Tier I" modification. The specific work elements included in this modification package are shown in Table 8. Each company was asked to determine the number of such modifications its facilities (or those it frequently relied on for outside work) could carry out per month, taking into account the normal workload of the facility including requalifications, bad order repairs, and reassignments. Companies were also asked to estimate when their facilities would be in a position to start modification work, and to project any increases in capacity that they expected to be able to achieve over the first two years of the program due to capital investment.

Table 8: Alterations Comprising the Basic Tier I Modification Package[51]

Jacket
Full Height Head Shields
Thermal Protection
High Capacity Pressure Relief Valve
Bottom Outlet Valve Modification

51 At the time of the survey, which was conducted prior to the publication of the NPRM, the RSI-CTC included the application of top fittings protection as a modification in its Tier I package of modification. Therefore the shop capacity estimates still account for modification of the top fittings. However, our analysis of PHMSA's Proposed Regulations does not address the costs associated with top fittings protection because this item was not included as a required modification for existing tank cars in the NPRM.

The final industry-wide capacity projections prepared by the RSI-CTC are shown in Table 12. They indicate that the modification rate will eventually rise to 536 cars per month, or 6,432 cars per year.

Table 9: Monthly Modification Capacity for Tier I Tank Cars

Month	Year	Capacity for Tier I Cars (# of Tank Cars Per Month)
January	2015	80
February	2015	80
March	2015	80
April	2015	80
May	2015	80
June	2015	80
July	2015	416
August	2015	536
September	2015	536
October	2015	536
November	2015	536
December	2015	536
January	2016	536
February	2016	536
March	2016	536
April	2016	536
May	2016	536
June	2016	536
July	2016	536
August	2016	536
September	2016	536
October	2016	536
November	2016	536
December	2016	536

Source: RSI Members.

To bring the current flammable liquids tank car fleet into compliance with the Proposed Regulations, it will not be necessary to carry out the list of modifications shown in Table 8 for every tank car in the fleet. Some of the tank cars currently in service are already equipped with jackets. Some are already equipped both with jackets and full height head shields, and would require only valve modifications in order to meet proposed requirements. The specific modifications required for each of the sub-fleets covered by the Proposed Regulations are shown in Table 10. For modeling purposes, we refer to the intermediate modification package that includes installation of full height head shields but no jacket installation as a "Tier II" modification package, and the package that includes only valve replacement as a "Tier III" modification package. The designation applicable to each sub-fleet is shown in column [e].

Table 10 also shows a number of other important aspects of the modification program that the Proposed Regulations would require. Column [a] shows the order in which the various sub-fleets would enter the modification process. This order is consistent with the Proposed Regulations, and reflects the RSI-CTC's assessment that tank car owners and lessors would initially focus on those sub-fleets requiring the more substantial modifications. For modeling purposes, we have assumed that the legacy crude oil fleet will be modified first, followed by the legacy ethanol fleet. We have also assumed that all crude oil is treated as a PG I commodity, while all ethanol is treated as a PG II commodity. Other flammable liquids include PG I, II and III commodities. Given the realities of modification scheduling and the potential for commodity switching, RSI-CTC believes that shippers and car owners will strive to bring tank cars carrying PG I and II commodities into compliance by the earlier deadline applicable to PG I commodities. Column [c] shows the number of months tank cars from each sub-fleet would be offline while undergoing modification. The RSI-CTC has estimated that Tier I and II modifications will require three months to complete for each tank car, while Tier III modifications will require only a single month. Column [d] shows the per tank car modification cost for each of the sub-fleets. Column [f] shows the specific alterations that each sub-fleet will undergo. Column [g] shows the percentage of each sub-fleet that will be retired from service rather than modified. These early retirement percentages were provided to us by the RSI-CTC. The RSI-CTC early retirement rate is based on the age and condition of tank cars in the existing fleet and the likelihood that they will be modified. Finally, column [g] shows the reduction in capacity, in gallons, that will result from the planned modifications. The only sub-fleets expected to lose capacity as a result of the modification process are those sub-fleets containing non-jacketed CPC-1232 good faith cars. The non-jacketed CPC-1232s will weigh more once modified with the jacket and full height head shield, but their overall Gross Rail Load ("GRL") will remain at 286,000 lbs., resulting in a decrease in the carrying capacity of each tank car.[52]

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52 The non-jacketed DOT-111 tank cars will also experience significant increases in weight as a result of the installation of full height head shields and jackets. Both PHMSA and the RSI-CTC have assumed that during the modification process these tank cars will be upgraded to from 263,000 GRL to 286,000 GRL, and that as a result these tank cars will experience no loss in carrying capacity. In its NPRM Comments, the RSI-CTC explains that a significant number of these tank cars may require extensive truck upgrades in order to qualify for this higher gross weight limit. This would be an additional cost to be factored into the overall cost of the Proposed Regulations. Although we have not included it in our cost estimate, the cost of truck upgrades ranges from $2,850 to $24,600 depending on which components must be replaced and whether new wheel sets will be required by AAR. For additional information on the cost of truck upgrades see the RSI-CTC NPRM Comments at 21-23.

Table 10: Modification of Packages by Sub-fleet

Modification Order	Type of Tank Car	Car time offline (months)	Policy Deadline	Modification Cost per car	Modification on Facility Type	Modification Upgrades					Fleet as of 12/31/14	Capacity Loss	Percent Retired Rather Than Retrofit
						J	FHHS	TB	PRV	BOV			
1	Non Jacketed Legacy Crude oil tank cars	3	Oct-17	$46,700	Tier I	1	1	1	1	1	23,090	-	28%
3	Non Jacketed Legacy Ethanol tank cars	3	Oct-18	$46,700	Tier I	1	1	1	1	1	27,037	-	28%
7	Non Jacketed Legacy Other Flammable Liquids tank cars, PG 1 & 2	3	Oct-17	$46,700	Tier I	1	1	1	1	1	19,832	-	28%
10	Non Jacketed Legacy Other Flammable Liquids tank cars, PG 3	3	Oct-20	$46,700	Tier I	1	1	1	1	1	4,958	-	28%
8	Jacketed Legacy Other Flammable Liquids tank cars, PG 1 & 2	3	Oct-17	$27,000	Tier II	0	1	0	1	1	7,529	-	28%
11	Jacketed Legacy Other Flammable Liquids tank cars, PG 3	3	Oct-20	$27,000	Tier II	0	1	0	1	1	1,884	-	28%
9	Non Jacketed CPC-1232 Other Flammable Liquids tank cars, PG 1 & 2	3	Oct-17	$46,700	Tier I	1	1	1	1	1	2,395	-	0%
12	Non Jacketed CPC-1232 Other Flammable Liquids tank cars, PG 3	3	Oct-20	$46,700	Tier I	1	1	1	1	1	599	-	0%
2	Jacketed Legacy Crude oil tank cars	1	Oct-17	$27,000	Tier II	0	1	0	1	1	7,016	-	28%
4	Jacketed Legacy Ethanol tank cars	1	Oct-18	$27,000	Tier II	0	1	0	1	1	88	-	28%
5	Non Jacketed CPC-1232 Crude Oil tank cars	3	Oct-17	$46,700	Tier I	1	1	1	1	1	21,993	3,437	0%
6	Non Jacketed CPC-1232 Ethanol tank cars	3	Oct-18	$46,700	Tier I	1	1	1	1	1	751	3,437	0%

*Costs for truck upgrades and ECP brakes not included here. All cost estimates were provided by the RSI-CTC.

Modification Upgrades Key		Cost
J	Jacket	$16,000
FHHS	Full Height Head Shields	$23,000
TB	Application of a Thermal Blanket	$3,700
PRV	High Capacity Prssure Release Valve	$3,400
BOV	Bottom Outlet Valve Handle Removal	$600

Because the Tier II and III modification packages involve fewer modifications than the Tier I package described in the shop capacity survey, these less extensive modification packages can be expected to place more modest demands on the shop network. Through an analysis of the specific work elements included in the various modification packages the RSI-CTC has estimated that the average shop will be able to carry out 25 percent more Tier II modifications in any given time period than Tier I modifications. We take this additional throughput into account in computing the time required to bring the existing flammable liquids fleet into compliance with the proposed regulations.

For those tank cars only requiring the installation of a PRV and reconfigured BOV—i.e. the existing jacketed CPC-1232s—the proposed modifications are modest enough that this work can be completed as part of the normal requalification process that these tank cars must undergo every ten years. The RSI-CTC believes that the most efficient way to carry out Tier III modifications is in connection with requalifications and other routine shop visits. Bringing tank cars that require Tier III modifications into a shop specifically and solely to carry out the PRV and BOV modifications would greatly increase the out of service time associated with this aspect of the modification program. More importantly, it would significantly increase the total amount of shop capacity required by the modification program, potentially crowding out or delaying other modification work that is far more critical from a risk reduction standpoint. For these reasons, we have modeled the Tier III modification process assuming that these modifications would be carried out in conjunction with other routinely scheduled shop visits. Specifically, we assume that Tier III modifications would be carried out at a constant annual rate over the ten year period following publication of a final rule.

Again, we note that the estimates of modification capacity assume that the existing fleet will have to be brought up to a standard equivalent to that of the "enhanced" jacketed CPC-1232 fleet with the proposed valve modifications. We recognize that PHMSA is considering a requirement that existing cars be modified to a performance level equivalent to that associated with a proposed new car standard incorporating a 9/16 inch tank shell. Modifying the existing tank car fleet to this standard would require more extensive modification work that would be beyond the capabilities of some of the shops included in the capacity figures presented above. Modifying cars to meet a 9/16 inch performance standard would also likely increase the time each car would spend in the shop. In addition, the number of cars that could that would be retired early rather than modified to this standard would be higher than the 28% discussed above. At this time, we are not able to project what the imposition of a 9/16 inch thickness requirement would mean for modification throughput rates, modification costs, or out of service times.

3. Greenfield Facilities

Although it is possible that some number of new facilities may come on line in time to participate in this modification program, such facilities are unlikely to play a significant role, especially in the early years of the program. Because of the certifications and environmental permits that are required, it can take well over a year to open a new tank car repair facility. Not only does the labor force require certification to perform certain types of welding work, but the facility itself must be certified by the AAR and the Bureau of Explosives. In addition, the cleaning and painting operations at a typical repair facility require complex air permits that must be approved by federal and state regulators. The entry level "greenfield" cost is likely to be substantial. In light of these barriers to entry, it is unrealistic to assume any near term significant increase in maintenance and repair network capacity due to the opening of new facilities. The prospects for any such new entry are also significantly diminished by the finite nature of the spike in demand they would be called upon to serve. As demanding as this modification program might be, it will eventually come to an end, potentially leaving the industry with significant amount of surplus repair capacity.

4. Modification Timeline

Given the information and estimates presented above, the task of calculating when the existing flammable liquids tank car fleet can be brought into compliance with the Proposed Regulations is conceptually straightforward, even if somewhat complex to implement. As discussed above in connection with Table 10, we assume that the modification process proceeds with one sub-fleet at a time. As Table 10 indicates, to model the Proposed Regulations we assume that the first sub-fleets to undergo modification will be the non-jacketed and jacketed legacy DOT-111s tank cars in crude oil service, followed by the non-jacketed and jacketed legacy DOT-111 tank cars in ethanol service. The process will then turn to the non-jacketed CPC-1232 tank cars in crude oil service followed by those in ethanol service. The last sub-fleets to be addressed will be the non-jacketed and jacketed legacy DOT-111 tank cars in other flammable liquids service, followed by the jacketed CPC-1232 tank cars. As noted above, we assume that the modification process for the tank cars in these sub-fleets undergoing Tier I and Tier II modifications will last three months, and that each tank car undergoing modification will be offline and unavailable for revenue service during this period. The number of tank cars modified in any particular month depends upon the amount of capacity available in that month,[53] the sub-fleet that is undergoing modification, and the type of modifications involved. In those instances in which the switch to a new sub-fleet occurs mid-month (as is the case for almost all such switches) we apply to each portion of the month processing rates appropriate for the types of modifications being carried out.

When the deadline for bringing a specific sub-fleet into compliance with the Proposed Regulations arrives, two actions occur. First, in those instances in which the RSI-CTC members have determined that some portion of a sub-fleet will be retired from service rather than modified, those tank cars are removed from the active fleet. In other words we assume that early retirements will occur at the compliance deadline for the sub-fleet, and that these tank cars will operate in unmodified form until that point. This assumption affects the timing of the modification process for individual sub-fleets. Switchover to the next sub-fleet occurs when the modification of all non-retiring tank cars has been completed. Second, we assume that any candidate tank cars that have not been modified by the deadline are removed from service and parked until modification capacity becomes available. Note that we treat jacketed CPC-1232 tank cars in the same manner, even though the planned modification process takes place over an extended period of time.

All of this means that at any given point in time in the period following publication of the final rule a specific tank car can be in any one of five possible states: (1) in revenue service in unmodified condition; (2) in the shop undergoing modification; (3) retired from revenue service; (4) parked and awaiting modification; or (5) in revenue service in modified condition. To provide an accurate basis for assessing the implications of this modification program we calculate for each sub-fleet and for each month of the post-rule period how many cars fall into each of the five categories defined above.

One must bear in mind that while subfleets are being prioritized for modification, tank cars from other subfleets will be shopped throughout the modification timeframe due to their regulatory intervals expiring. In some instances, these shoppings will be in advance of the planned timeframe for the specific tank cars. Most likely, these tank cars will be modified at that time, consuming some of the available capacity. The use of capacity for these events will delay the completion of modifications as outlined in this analysis. While useful to note, the complexity of fully modeling this scenario outweighed the value.

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53 As noted in Table 10, the amount capacity available in the first year of the modification program is expected to vary as individual repair shop operators gear up for the process.

Table 11 provides a high level summary of some key outcome measures for the modification program. In all approximately 155 thousand tank cars are potentially subject to this rule. We calculate that by the applicable deadlines modifications will be completed on only approximately 26,000 of these tank cars. Another 26,000 will be retired from flammable liquids service, leaving approximately 103,000 tank cars parked and awaiting modification at various points during the modification program.

Table 11: Tank Cars in Crude Oil, Ethanol and Other Flammable Liquids Service

Number of Cars in Service at Deadline	154,778
Number of Cars Retired at Deadline	25,602
Number of Cars Modified by Deadline	26,206
Number of Cars Awaiting Modification at Deadline	102,971

Table 12 shows our projection of the number of modifications carried out by year and by sub-fleet if we use the RSI-CTC estimates of shop capacity throughput but eliminate the modification deadlines in the Proposed Regulations. We have used the 6,400 figure in Table 12 (the low end of the RSI-CTC's range) to illustrate a conservative estimate of shop capacity throughput, but the RSI-CTC's recommended compliance deadlines assume some additional growth in annual modification capacity will occur based on individual companies' investment decisions.

In Table 12 one can follow the modification process at it works its way through the various sub-fleets. Our projections show that the modification of non-jacketed legacy DOT-111 tank cars in crude oil service begins in 2015 and will not be completed until 2018. In that same year we project that modification of jacketed legacy DOT-111 tank cars in crude oil service will be completed and modification of non-jacketed legacy DOT-111 tank cars in ethanol service will begin. We project that it will take until 2021 to complete modification of the legacy DOT-111 ethanol fleet and until 2025 to complete modification of the non-jacketed good faith CPC-1232 tank cars in crude oil and ethanol service. At that point, we project, modification of tank cars in other flammable liquids service will begin.

Table 12: Tank Car Modifications

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Non Jacketed Legacy Crude oil tank cars	3,576	6,432	6,432	185	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Jacketed Legacy Ethanol tank cars	0	0	0	2,206	6,432	6,432	4,397	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Jacketed Legacy Other Flammable Liquids tank cars	0	0	0	0	0	0	0	0	0	0	6,330	8,040	3,479	0	0	0	0	0	0	0
Jacketed Legacy Crude oil tank cars	0	0	0	5,052	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jacketed Legacy Ethanol tank cars	0	0	0	0	0	0	63	0	0	0	0	0	0	0	0	0	0	0	0	0
Jacketed Legacy Other Flammable Liquids tank cars	0	0	0	0	0	0	0	0	0	0	0	0	4,561	2,216	0	0	0	0	0	0
Non Jacketed CPC-1232 Crude Oil tank cars	0	0	0	0	0	0	2,080	6,432	6,432	6,432	617	0	0	0	0	0	0	0	0	0
Non Jacketed CPC-1232 Ethanol Oil tank cars	0	0	0	0	0	0	0	0	0	0	751	0	0	0	0	0	0	0	0	0
Non Jacketed CPC-1232 Other Flammable Liquids tank cars	0	0	0	0	0	0	0	0	0	0	0	0	0	2,994	0	0	0	0	0	0
Jacketed CPC-1232 Crude Oil tank cars	3,561	3,561	3,561	3,561	3,561	3,561	3,561	3,561	3,561	3,561	0	0	0	0	0	0	0	0	0	0
Jacketed CPC-1232 Ethanol Oil tank cars	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0
Jacketed CPC-1232 Other Flammable Liquids tank cars	198	198	198	198	198	198	198	198	198	198	0	0	0	0	0	0	0	0	0	0

Table 13 shows the projected costs of carrying out these modifications in constant 2014 dollars. We estimate that over the entire period these costs will come to $4.2 billion.

Table 13: Tank Car Modifications Cost ($Millions)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Non Jacketed Legacy Crude oil tank cars	$167	$300	$300	$9	$0	$0	$0	$0	$0	$0
Non Jacketed Legacy Ethanol tank cars	$0	$0	$0	$103	$300	$300	$205	$0	$0	$0
Non Jacketed Legacy Other Flammable Liquids tank cars	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Jacketed Legacy Crude oil tank cars	$0	$0	$0	$136	$0	$0	$0	$0	$0	$0
Jacketed Legacy Ethanol tank cars	$0	$0	$0	$0	$0	$0	$2	$0	$0	$0
Jacketed Legacy Other Flammable Liquids tank cars	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Non Jacketed CPC-1232 Crude Oil tank cars	$0	$0	$0	$0	$0	$0	$97	$300	$300	$300
Non Jacketed CPC-1232 Ethanol Oil tank cars	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Non Jacketed CPC-1232 Other Flammable Liquids tank cars	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Jacketed CPC-1232 Crude Oil tank cars	$14	$14	$14	$14	$14	$14	$14	$14	$14	$14
Jacketed CPC-1232 Ethanol Oil tank cars	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Jacketed CPC-1232 Other Flammable Liquids tank cars	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1
Total Cost	$182	$315	$315	$263	$315	$315	$319	$315	$315	$315

	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Non Jacketed Legacy Crude oil tank cars	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Non Jacketed Legacy Ethanol tank cars	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Non Jacketed Legacy Other Flammable Liquids tank cars	$296	$375	$162	$0	$0	$0	$0	$0	$0	$0
Jacketed Legacy Crude oil tank cars	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Jacketed Legacy Ethanol tank cars	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Jacketed Legacy Other Flammable Liquids tank cars	$0	$0	$123	$60	$0	$0	$0	$0	$0	$0
Non Jacketed CPC-1232 Crude Oil tank cars	$29	$0	$0	$0	$0	$0	$0	$0	$0	$0
Non Jacketed CPC-1232 Ethanol Oil tank cars	$35	$0	$0	$0	$0	$0	$0	$0	$0	$0
Non Jacketed CPC-1232 Other Flammable Liquids tank cars	$0	$0	$0	$140	$0	$0	$0	$0	$0	$0
Jacketed CPC-1232 Crude Oil tank cars	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Jacketed CPC-1232 Ethanol Oil tank cars	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Jacketed CPC-1232 Other Flammable Liquids tank cars	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Cost	$359	$375	$286	$200	$0	$0	$0	$0	$0	$0
Total Cost All Years	**$4,192**									

To summarize briefly, we project that the required modifications to the entire crude oil and ethanol fleets would not be completed until sometime in 2025. In contrast, PHMSA's Proposed Regulations would require that all of the necessary modifications will be completed by 2018, seven years earlier. There is no reliable evidence that suggests that such an aggressive modification timeline is achievable.

E. PHMSA Underestimates the Transportation Impacts of the Proposed Regulations

The Proposed Regulations specify an extremely aggressive schedule for bringing the existing flammable liquids fleet into compliance with a stringent set of new requirements. As documented above, we do not believe that it will be possible to achieve compliance by the specified deadlines. As a result, large portions of the existing fleet will have to be removed from service and parked until the required modifications can be carried out. The immediate effects of this action will be to reduce substantially the capacity available to shippers of crude oil and ethanol. The resulting capacity shortfalls can be expected to have significant impacts on the transportation and production of these commodities.

In order to assess the likely impact of this capacity shortage one must first consider how these markets could have been expected to evolve absent this proposed regulatory intervention. In the sections below we define what this baseline scenario would have looked like, and how it can be expected to change in response to the capacity shortages caused by the Proposed Regulations.

1. Current Domestic Crude Oil Production Trends by Location

In this section, we compare the business as usual case regarding car manufacturing, modification, and use, to the outcomes projected under the Proposed Regulations considered by PHMSA.

Table 14 shows the principal drivers of the demand for rail transportation of crude oil. The various measures of domestic crude oil production shown here are all denominated in thousands of barrels per day. The actual values and forecasts of overall domestic crude oil production shown in lines [1] and [2] are taken from the 2014 Annual Energy Outlook published by the Energy Information Administration, and represent that Agency's Reference and High forecasts.[54] In the Reference forecast U.S. domestic crude oil production peaks in 2019 at 9.608 million barrels per day. In the High forecast production peaks in 2020 at 11.413 million barrels per day. Although we show both forecasts here, our calculations are based on the Reference forecast.[55]

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[54] U.S. Energy Information Administration, "2014 Annual Energy Outlook," (May 7, 2014), http://www.eia.gov/forecasts/aeo/

[55] Although crude oil prices have recently dropped, the EIA reference forecast remains a reasonable basis for our analysis. It is not surprising that actual prices will at times be above or below the reference forecast.

Table 14: Forecast of Domestic Unconventional Crude Oil Production (2010 - 2022)

(millions of barrels per day)

	Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
	EIA Domestic Crude Production													
[1]	Reference Scenario		5,658	6,494	7,722	8,529	9,038	9,542	9,557	9,575	9,608	9,553	9,417	9,289
[2]	High Scenario		5,658	6,494	7,874	8,922	9,842	10,310	10,797	11,098	11,301	11,413	9,444	9,328
[3]	IHS Conventional Crude Production	4,695	4,600	4,375	4,074	3,923	3,935	3,901	3,850	3,782	3,808	3,730	3,614	3,445
[4]	Growth Rate of HIS Conventional Crude Production		-2.02%	-4.89%	-6.88%	-3.71%	0.31%	-0.86%	-1.31%	-1.77%	0.69%	-2.05%	-3.11%	-4.68%
	Implied EIA Non Conventional Production													
[5]	Reference Scenario		1,058	2,119	3,648	4,606	5,103	5,641	5,707	5,793	5,800	5,823	5,803	5,844
[6]	High Scenario		1,058	2,119	3,800	4,999	5,907	6,409	6,947	7,316	7,493	7,683	5,830	5,883
[7]	Bakken Export Production	453	678	1,123	1,548	1,978	2,198	2,523	2,571	2,650	2,694	2,745	2,777	2,837
	Bakken as a Percent of Unconventional													
[8]	Reference Scenario		64.1%	53.0%	42.4%	42.9%	43.1%	44.7%	45.0%	45.7%	46.4%	47.2%	47.9%	48.6%
[9]	High Scenario		64.1%	53.0%	42.4%	42.9%	43.1%	44.7%	45.0%	45.7%	46.4%	47.2%	47.9%	48.6%
	Non-Bakken Unconventional Crude Production													
[10]	Reference Scenario		380	996	2,100	2,628	2,905	3,118	3,136	3,143	3,106	3,077	3,026	3,006
[11]	Reference Scenario Growth Multiple			2.62	2.11	1.25	1.11	1.07	1.01	1.00	0.99	0.99	0.98	0.99
[12]	High Scenario		380	996	2,188	2,852	3,362	3,542	3,818	3,969	4,013	4,060	3,040	3,027
[13]	High Scenario Growth Multiple			2.62	2.20	1.30	1.18	1.05	1.08	1.04	1.01	1.01	0.75	1.00
[14]	Bakken Rail	115	265	660	965	1,195	1,355	1,455	1,474	1,485	1,476	1,469	1,450	1,445
[15]	Rail as a Percent of Total Bakken	25.4%	39.1%	58.8%	62.3%	60.4%	61.6%	57.7%	57.3%	56.0%	54.8%	53.5%	52.2%	50.9%

Table 14 (Continued): Forecast of Domestic Unconventional Crude Oil Production (2023 - 2034)

(millions of barrels per day)

	Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
	EIA Domestic Crude Production												
[1]	Reference Scenario	9,191	9,073	9,004	8,833	8,670	8,516	8,380	8,305	8,160	8,073	8,045	7,985
[2]	High Scenario	9,243	9,189	9,111	8,905	8,726	8,578	8,437	8,356	8,302	8,205	8,159	8,046
[3]	IHS Conventional Crude Production	3,266	3,101	2,956	2,822	2,694	2,571	2,454	2,343	2,237	2,135	2,038	1,945
[4]	Growth Rate of IHS Conventional Crude Production	-5.20%	-5.05%	-4.68%	-4.54%	-4.54%	-4.54%	-4.54%	-4.54%	-4.54%	-4.54%	-4.54%	-4.54%
	Implied EIA Non Conventional Production												
[5]	Reference Scenario	5,925	5,972	6,048	6,011	5,976	5,945	5,926	5,962	5,923	5,938	6,007	6,039
[6]	High Scenario	5,977	6,088	6,155	6,083	6,032	6,007	5,983	6,013	6,065	6,070	6,121	6,100
[7]	Bakken Export Production	2,918	2,983	3,021	3,003	2,985	2,970	2,960	2,978	2,959	2,966	3,001	3,017
	Bakken as a Percent of Unconventional												
[8]	Reference Scenario	49.3%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
[9]	High Scenario	49.3%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
	Non-Bakken Unconventional Crude Production												
[10]	Reference Scenario	3,007	2,989	3,027	3,008	2,991	2,975	2,966	2,984	2,964	2,972	3,006	3,022
[11]	Reference Scenario Growth Multiple	1.00	0.99	1.01	0.99	0.99	0.99	1.00	1.01	0.99	1.00	1.01	1.01
[12]	High Scenario	3,033	3,047	3,080	3,044	3,019	3,006	2,994	3,009	3,035	3,038	3,063	3,053
[13]	High Scenario Growth Multiple	1.00	1.00	1.01	0.99	0.99	1.00	1.00	1.00	1.01	1.00	1.01	1.00
[14]	Bakken Rail	1,449	1,443	1,462	1,453	1,444	1,437	1,432	1,441	1,432	1,435	1,452	1,460
[15]	Rail as a Percent of Total Bakken	49.7%	48.4%	48.4%	48.4%	48.4%	48.4%	48.4%	48.4%	48.4%	48.4%	48.4%	48.4%

Sources & Notes:
[1] - [2]: EIA Domestic Crude Production from 2014 EIA Annual Energy Outlook.

[3]: IHS Conventional Crude Production calculated from Oil & Natural Gas Transportation & Storage Infrastructure: Status, Trends, & Economic Benefits, IHS. December 2013.
[4]: (([3] Current Year / [3] Previous Year) - 1) x 100.
[5]: [1] - [3].
[6]: [2] - [3].
[7]: Total US Williston Basin Crude Oil Year End System Capacity, barrels/day.
[8]: For 2010 - 2016, [7] / [5]. For 2017 - 2024, increased by constant rate using linear growth rate from 2013 - 2016. For 2025 - 2034, assumed equal to 2024.
[9]: [8].
[10]: (1 - [8]) x [5].
[11]: (([10] Current Year / [10] Previous Year) - 1) x 100.
[12]: (1 - [9]) x [6].
[13]: (([12] Current Year / [12] Previous Year) - 1) x 100.
[14]: For 2010 - 2015, Total U.S. Williston Basin Crude Oil Year End System Capacity for rail, barrels/day. For 2016, this includes 100,000 barrels/day attributable to the Keystone Pipeline. For 2017 - 2034, [7] x [15].
[15]: For 2010 - 2016, [14] / [7]. For 2016 - 2024, increased by constant rate using linear growth rate from 2013 - 2016. For 2025 - 2034, frozen at 2024 level.

We divide overall production into production from conventional sources, which tend to be well-served by existing pipeline facilities, and production from nonconventional sources, which has been the principal driver of crude oil shipments by rail.[56] Forecasts of production of crude oil from conventional sources are shown in line [3]. Line [4] shows year to year changes in domestic production of crude oil from conventional sources. Production from conventional sources is projected to decline steadily over the period. The sources from which these forecasts are drawn provided projections through the year 2025. We assumed that in subsequent years conventional production would continue to decline at its average annual rate of decline over the preceding period. Lines [5] and [6] show the projections of production from nonconventional sources implied by the EIS Reference and High forecasts respectively. In the Reference forecast crude oil production from nonconventional sources climbs from 4.6 million barrels per day in 2014 to approximately 6.0 million in 2024, and remains fairly steady at that level thereafter.

Table 14 also shows actual and forecast values for total crude oil production in the Bakken region in line [7], as well as for rail shipments of crude oil originating in the Bakken region in line [8].[57] These figures have been derived from data and forecasts through 2016, published by the North Dakota Pipeline Authority. We assume that from 2017 through 2034 production in the Bakken region will grow at the same rate as overall domestic nonconventional crude oil production. To project rail shipments of crude oil from the Bakken we followed a somewhat more complex

56 Our forecasts of conventional crude oil production are derived from a report entitled "Oil & Natural Gas Transportation & Storage Infrastructure: Status, Trends, & Economic Benefits" prepared for the American Petroleum Institute in December of 2013 by IHS Global (see http://www.api.org/~/media/Files/Policy/SOAE-2014/API-Infrastructure-Investment-Study.pdf). The IHS Global study presented separate historical data and forecasts for U.S. domestic oil production from conventional and unconventional sources. Analysis of the historical data presented in the IHS Global report indicated that conventional oil production in the U.S. had been declining gradually and steadily for a number of years. The IHS Global forecast assumed that this trend in conventional oil production would continue. We incorporated this forecast into our analysis. The EIA and IHS forecasts reflect differing views about the future course of U.S. domestic crude oil production. We assumed that the two sets of forecasts differed primarily in their predictions regarding the future course of nonconventional crude oil production. We chose to rely on the implied EIA forecasts of nonconventional crude oil production both because they reflected more up to date information about this rapidly changing segment of the industry, and because EIA appeared generally to be a more authoritative source.

57 The figures published by the North Dakota Pipeline Authority for rail shipments of crude oil appear to be based upon available terminal capacity, rather than counts of trains or carloads. Based upon economic and trade press commentary on terminal capacity constraints over the relevant period, we believe that terminal capacity is a good proxy for outbound shipment volumes. See, for example, "Busting bottlenecks in the Bakken," fedgazette, April 2013, https://www.minneapolisfed.org/publications_papers/pub_display.cfm?id=5083&&

procedure. According to the North Dakota Pipeline Authority, rail shipments as a percent of total Bakken production peaked in 2013 at 62.3 percent and will decline over the next several years, reaching 57.7 percent in 2016. We assumed that this gradual downward trend in share would continue through 2024, reaching 48.4 percent in that year. Most industry observers expect that some expansion of pipeline capacity will take place.[58] However, the economics of the costly, long-term capital investments required for pipeline construction are not entirely consistent with the production profiles of tight oil production in regions like the Bakken, where production at individual drilling sites tends to decline more rapidly than at conventional sites.[59] In contrast, rail transportation can respond much more readily to changes in production patterns and market demands. Rail transportation provides producers with greater flexibility and the ability to access a wider range of markets offering more favorable netback prices.[60] We believe, therefore, that while the reliance of Bakken producers on rail transportation will decline to some extent as new pipeline capacity becomes available, rail will continue to play a crucial role in this region even over the long term. Our assumptions reflect this belief.

Finally, we show estimates of additional crude oil rail shipments that could originate in the oil sands region of western Canada if the Keystone XL Pipeline is not built.[61]

We believe that a majority of rail shipments of crude oil will continue to originate in the Bakken throughout the period ending in 2034. However, ICF has projected that over the course of this

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58 See, for example, "Platt's Special Report, New Crudes, New Markets March, 2013" page 6: "Estimates for 2016 production vary, but are as high as 1.6 million b/d for the Bakken Formation, spurring a flurry of pipeline expansion and rail projects in progress."

59 See http://www.reuters.com/article/2013/11/21/us-usa-shale-bakken-analysis-idUSBRE9AK08A20131121[8/15/2014 11:12:45 AM]: "Unlike conventional oil development, shale is more like a production line, with daily drilling needed to offset falling output from just recently completed wells."

60 See, for example, "Busting bottlenecks in the Bakken," fedgazette, April 2013, https://www.minneapolisfed.org/publications_papers/pub_display.cfm?id=5083&&. Page 10: "Trains have become a popular alternative to pipelines chiefly because they allow producers to sell Bakken crude oil at higher prices than the benchmark prices posted at pipeline hubs such as Clearbrook and Guernsey, Wyo," or Page 11: "What's more, the iron horse offers Bakken producers more buyer options, delivering oil to refineries in Texas, Louisiana, New York, Pennsylvania and other areas not easily reached via pipeline."

61 The Keystone XL Pipeline is a proposed project to construct a crude oil pipeline from Hardisty, Alberta, in the oil sands region of Alberta, to points in the U.S. where it would connect with points on the U.S. crude oil pipeline network. See http://keystone-xl.com/about/the-keystone-xl-oil-pipeline-project/. This proposal has elicited opposition from environmental interests.

period some rail shipments will originate in the Niobrara basin in Colorado, and a small amount of crude oil may travel by rail from the Permian Basin in Texas to West Coast refineries. We have not accounted for these flows explicitly in our calculations, but rather include them in a residual category of rail traffic that we do not model in a geographically explicit way, and that we project will grow modestly over the forecast period.[62]

2. Domestic Ethanol Production Trends

Table 15 shows the most recent EIA forecast for U.S. ethanol production. This forecast implies a gradual but steady increase in production levels over the period we consider. We assume that rail shipments will grow over this period at the same rate as overall production.

Table 15: EIA Ethanol Forecast

Year	Ethanol Production (million barrels, daily)	Ethanol Production (million barrels, yearly)	Ethanol Production (barrels, yearly)
2013	0.83	301.19	301,193,255
2014	0.85	310.27	310,265,330
2015	0.87	315.83	315,827,930
2016	0.87	318.15	318,145,866
2017	0.88	321.73	321,729,980
2018	0.89	323.34	323,339,630
2019	0.89	324.45	324,448,500
2020	0.90	327.88	327,884,394
2021	0.90	328.45	328,453,280
2022	0.92	334.16	334,160,785
2023	0.91	333.95	333,947,260
2024	0.92	335.09	335,092,398
2025	0.92	334.06	334,061,140
2026	0.92	334.01	334,007,120
2027	0.92	334.04	334,042,890
2028	0.92	335.01	335,012,244
2029	0.91	333.89	333,887,400
2030	0.91	333.91	333,913,315
2031	0.91	333.84	333,841,775
2032	0.91	334.49	334,485,570
2033	0.91	333.57	333,569,850
2034	0.91	333.92	333,919,155
2035	0.91	333.70	333,704,170
2036	0.91	333.86	333,857,880
2037	0.91	332.75	332,754,075
2038	0.91	333.78	333,775,710
2039	0.93	339.04	339,038,645
2040	0.95	346.24	346,237,830

Source: EIA Annual Energy Outlook 2014

[62] In building up the description of baseline crude oil rail traffic flows described above we determined that these flows accounted for the vast majority crude oil rail traffic as described by the most recent waybill sample of the capacity of the crude oil tank car fleet. However, there appeared to be a small amount of residual traffic and capacity that we have included in our calculations for completeness.

3. Traffic Patterns

Measuring the likely impacts of possible curtailments in the supply of rail cars supporting the transportation of crude oil and ethanol requires some information about the routes along which this traffic moves and the alternatives to which shippers would turn if rail transportation were suddenly to become unavailable. Unfortunately, there is no up-to-date, publicly available source for such information. The most likely candidate is the one percent sample of rail freight waybills published annually by the Surface Transportation Board (the "Waybill Sample"). The most recently published public and non-public versions are from the 2012 Waybill Sample. To assure a more up to date representation of current traffic flows we have supplemented the information presented in the Waybill Sample with more recent facts and estimates drawn from trade press.

4. Crude Oil

It appears that currently a large majority of crude oil shipped by rail is originating in the Bakken formation of North Dakota and Montana. Three large movements fan out from this origin to East Coast Refineries, Gulf Coast refineries, and West Coast refineries. Some East Coast bound shipments travel by rail directly to refineries in the Philadelphia area. A large volume of Bakken crude oil travels by rail to Albany, NY, where it is transferred to barges for transportation to East Coast Refineries. In a similar fashion, some Bakken crude oil bound for the Gulf Coast travels all the way by rail, while other shipments travel by rail to the vicinity of St. Louis, where they are transferred to barge. Based on our review of trade press accounts, it appears that most of the Bakken crude oil bound for the West Coast travels by rail to terminals in Washington State, where it is transferred to vessels that take it down the coast to refineries in California. Barge transportation is much less expensive than rail, and shippers use it when they can. In addition, many refineries are located on the water and are already set up to receive waterborne crude oil.

Specialized terminals are required to load and unload crude oil trains. There has recently been a great deal of terminal construction at various points along the routes described above, but the volumes of crude oil that can be accommodated in individual corridors is still constrained by the throughput of the available terminals. Using information from the Energy Information Administration and the Department of State environmental impact report for the Keystone XL pipeline, we have identified the terminal facilities that are currently in operation or are projected to open through 2016. This information appears to be broadly consistent with what has been reported in the trade press. We assume no additions to rail terminal capacity after 2016.

For each of the movements described above we have calculated rail and water distances using minimum distance routings over computerized rail and waterway network models. Using a combination of turnaround times from the Department of State environmental impact report for the Keystone XL pipeline, data on tank car fleet size, and information from the AAR carload waybill sample, we have estimated railcar turnaround times for each of these routes. Our results are broadly consistent with verbal estimates provided to use by the RSI-CTC members.[63]

We assume that Bakken crude oil will be shipped via the routings that offer the highest netbacks. We assume that East Coast destination prices are set by North Sea Brent, that Gulf Coast destination prices are set by WTI Sweet, and that West Coast destination process are equal to California wellhead prices as reported by the EIA. The volume of crude oil shipped along any given routing is constrained by the terminal capacity along that routing, by the capacity of the tank car fleet, and by the total volume of crude oil available for shipment.

Our estimates of baseline Bakken originating crude oil by rail flows are shown in Table 16. We calculate that the highest netbacks are achieved when the Bakken output is shipped to East and Gulf Coast destinations. This result is driven by the fact that destination prices are higher in those locations. While this base case is not complete (some nontrivial amount of Bakken crude oil is moving to the West Coast), we believe that it provides an acceptable baseline for our analysis. The differences in netbacks across destinations for any given mode are much smaller than the differences in netbacks across modes for any given destination.

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63 The Keystone environmental impacts report contains estimates of rail transit times for specific movements calculated by Hellerworx, a consulting firm. Based upon a statistical analysis of the relationship between route mileages and transit times we were able to estimate similar transit times for the rail routes emanating from the Bakken region. However, these estimates appeared to be either understated or incomplete. The RSI-CTC members indicated that a tank car in crude oil service typically can be expected to complete twelve revenue trips per year. A comparison of the number of carloads reported in the Waybill Sample with the estimated size of the crude oil fleet confirmed the reasonableness of this estimate. However, the days per trip implied by this estimate were in excess of the Hellerworx estimates. We believe that these estimates probably exclude the time required for return trips and normal idle time. For this reason we have adjusted the Hellerworx-derived estimates using a multiplicative factor that allows us to reproduce our best estimate of actual 2013 fleet utilization. This latter estimate is derived from preliminary tabulations of the unpublished 2013 Waybill Sample prepared by the Association of American Railroads.

Table 16: Potential Rail Crude Oil Transportation Demand by Movement and Mode: Without Regulation

Movement	Mode	2014	2015	2016	2017	2018	2019	2020
Bakken/Gulf Coast	Rail	-	46.4	83.1	253.2	257.5	253.9	252.0
Bakken/Gulf Coast	Rail/Water	67.5	67.5	67.7	67.5	67.5	67.5	67.7
Bakken/East Coast	Rail	109.5	109.5	109.8	109.5	109.5	109.5	109.8
Bakken/East Cost	Rail/Water	107.7	107.7	108.0	107.7	107.7	107.7	108.0
Bakken/LA	Rail/Water	151.5	163.5	164.0	-	-	-	-
Saskatchewan/Gulf Coast	Rail/Pipeline	-	-	-	66.6	133.2	199.8	267.2
Total Barrels		436.2	494.6	532.5	604.5	675.4	738.4	804.7
Total Barrels/Day		1.2	1.4	1.5	1.7	1.9	2.0	2.2

Movement	Mode	2021	2022	2023	2024	2025	2026	2027
Bakken/Gulf Coast	Rail	252.0	244.5	242.8	245.7	241.3	245.6	243.9
Bakken/Gulf Coast	Rail/Water	67.7	67.5	67.5	67.5	67.7	67.5	67.5
Bakken/East Coast	Rail	109.8	109.5	109.5	109.5	109.8	109.5	109.5
Bakken/East Cost	Rail/Water	108.0	107.7	107.7	107.7	108.0	107.7	107.7
Bakken/LA	Rail/Water	-	-	-	-	-	-	-
Saskatchewan/Gulf Coast	Rail/Pipeline	267.2	266.5	266.5	266.5	267.2	266.5	266.5
Total Barrels		804.7	795.6	794.0	796.8	794.0	796.7	795.1
Total Barrels/Day		2.2	2.2	2.2	2.2	2.2	2.2	2.2

Movement	Mode	2028	2029	2030	2031	2032	2033	2034
Bakken/Gulf Coast	Rail	238.9	238.1	241.2	239.2	238.3	245.2	248.0
Bakken/Gulf Coast	Rail/Water	67.7	67.5	67.5	67.5	67.7	67.5	67.5
Bakken/East Coast	Rail	109.8	109.5	109.5	109.5	109.8	109.5	109.5
Bakken/East Cost	Rail/Water	108.0	107.7	107.7	107.7	108.0	107.7	107.7
Bakken/LA	Rail/Water	-	-	-	-	-	-	-
Saskatchewan/Gulf Coast	Rail/Pipeline	267.2	266.5	266.5	266.5	267.2	266.5	266.5
Total Barrels		791.6	789.2	792.4	790.4	791.0	796.3	799.2
Total Barrels/Day		2.2	2.2	2.2	2.2	2.2	2.2	2.2

Note: Unit is Millions of Barrels.

5. Ethanol

Ethanol rail traffic patterns differ substantially from those of crude oil, which in turn impacts modal alternatives. A large majority of rail shipments of crude oil originate in the Bakken region, and terminate in one of a small number of refining regions. In contrast, rail shipments of ethanol originate at large numbers of relatively small production facilities, and terminate at many dispersed destinations. Information on specific traffic origins and destinations provided by the 2012 Waybill Sample strongly confirm these qualitative descriptions. Summarizing origins and destinations by Bureau of Economic Analysis ("BEA") region,[64] we find that rail shipments of

64 These regions are defined by Bureau of Economic Analysis, and divide the U.S. into 170 regions.

crude oil originate in 48 BEA regions and terminate in 40 regions. The ten largest region pairs accounted for 58 percent of all rail shipments of crude oil. In contrast, rail shipments of ethanol originate in 142 BEA regions and terminate in 164 regions. The ten largest region pairs accounted for only 16 percent of all rail shipments of ethanol. The two commodities also differed substantially in term of length of haul. In 2012, the average rail shipment of crude oil traveled 1,397 miles, while the average rail shipment of ethanol traveled only 950 miles.

Differences in travel patterns and physical characteristics between crude oil and ethanol have important implications for the modal alternatives available to each commodity. Ethanol travel patterns are not well suited for either pipeline or barge transportation. Pipeline transportation makes economic sense when large volumes of product are consistently shipped along specific corridors. It makes much less sense when smaller volumes of product are shipped along many geographically dispersed corridors, as is the case with ethanol. The waterways on which barges move are geographically limited. They tend to funnel traffic toward specific seaport destinations. Moreover, they are not well suited to handle smaller volumes of product shipped along many geographically dispersed corridors. Additionally, the physical characteristics of ethanol render it unsuitable for pipeline transportation because high concentrations of ethanol tend to cause corrosion of steel pipes.[65]

For these reasons, we have concluded that for ethanol, the primary modal alternative to rail transportation is truck. Because of the dispersed nature of ethanol rail traffic movements and the ubiquitous nature of the primary modal alternative, we analyze ethanol traffic impacts in a non-geographically specific manner. As we describe more fully below, when impacts of the proposed regulations limit rail car availability, we assume that what would otherwise be rail ton miles are converted to an equivalent number of truck ton miles.

6. Uncertainties

Projections of future oil and ethanol production and shipments are difficult to predict because of several important uncertainties. These include the fate of the Keystone Pipeline, hydraulic fracturing regulations at the state and national level, and domestic oil export regulations. Should the Keystone pipeline not go forward, there will be increased demand for rail transport of heavy crude oil from Canada.[66] This demand will increase rail shipments and increase the demand for

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65 See http://www.nace.org/Newsroom/Press-Releases/Solving-ethanol%E2%80%99s-corrosion-problem-may-help-speed-the-biofuel-to-market/

66 We recognize that following the November 2014 elections, with Republicans now in control of the U.S. Senate and the House, the Keystone pipeline may now be approved. However, even if the Keystone pipeline is approved, we anticipate that delays associated with federal and state permitting

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new tank cars. More stringent fracturing regulations at the state or local level could result in increased production in regions that do not impose such regulations – increasing, for example, Bakken crude oil production. National regulations could slow production by increasing production costs. Eliminating oil export restrictions could prompt an increase in domestic production and shipment via rail. These uncertainties, which could either increase or reduce rail shipments, are not explicitly accounted for in the DRIA.

7. PHMSA Underestimates the Potential Mode Choice Impacts of the Proposed Regulations

The Proposed Regulations reduce the ability of the existing fleet to provide rail transportation of flammable liquids through four distinct mechanisms. First, while tank cars are in the shop undergoing modification they are unavailable for revenue service. Second, some fraction of the existing fleet is expected to be retired from flammable liquids service rather than modified. Third, tank cars that cannot be modified by the stated deadline will be unable to comply with the provisions of the Proposed Regulations, and so will have to be removed from service until such time as they can be modified. Finally, some sub-fleets are expected to experience a loss of capacity as a result of the modification process.

Table 17 shows the capacity losses in tank car-years from the first of these four causes. These losses track the progression of the modification program through the various sub-fleets. In total, over 22,000 tank car years of capacity are expected to be lost in this way.

Table 17: Tank Car Years Lost for Time in Shop During Modifications

	Total	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Non Jacketed Legacy Crude oil tank cars	4,136	740	1,608	1,608	180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Jacketed Legacy Ethanol tank cars	4,867	0	0	0	418	1,608	1,608	1,233	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Jacketed Legacy Other Flammable Liquids tank cars	4,462	0	0	0	0	0	0	0	0	0	0	1,415	2,010	1,037	0	0	0	0	0	0	0
Jacketed Legacy Crude oil tank cars	421	0	0	0	421	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jacketed Legacy Ethanol tank cars	5	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0
Jacketed Legacy Other Flammable Liquids tank cars	1,694	0	0	0	0	0	0	0	0	0	0	0	0	973	722	0	0	0	0	0	0
Non Jacketed CPC-1232 Crude Oil tank cars	5,498	0	0	0	0	0	0	386	1,608	1,608	1,608	288	0	0	0	0	0	0	0	0	0
Non Jacketed CPC-1232 Ethanol Oil tank cars	188	0	0	0	0	0	0	0	0	0	0	188	0	0	0	0	0	0	0	0	0
Non Jacketed CPC-1232 Other Flammable Liquids tank cars	749	0	0	0	0	0	0	0	0	0	0	0	0	0	749	0	0	0	0	0	0
Jacketed CPC-1232 Crude Oil tank cars	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jacketed CPC-1232 Ethanol Oil tank cars	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jacketed CPC-1232 Other Flammable Liquids tank cars	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	22,020	740	1,608	1,608	1,019	1,608	1,608	1,624	1,608	1,608	1,608	1,891	2,010	2,010	1,470	0	0	0	0	0	0

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and litigation challenges will likely prevent it from being completed in time to mitigate the impacts of the Proposed Regulation, particularly the impacts of the overly aggressive timetable.

Table 18 shows capacity losses from the second of these causes. Retirements from flammable liquids service occur beginning in October of 2017, when the new requirements take effect for tank cars carrying PG I commodities under the Proposed Regulations. These retired tank cars are thus unavailable for service for the last two months of that year and for all subsequent years. Further retirements occur in October of 2018 and in October of 2020, where the new requirements take effect for cars carrying PG II and PG III commodities. In total over the twenty year period following publication of a final rule almost 430,000 tank car years are lost.

Table 18: Tank Car Years Lost Due to Retirements

	Total	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Non Jacketed Legacy Crude oil tank cars	110,986	0	0	1,078	6,465	6,465	6,465	6,465	6,465	6,465	6,465	6,465	6,465	6,465	6,465	6,465	6,465	6,465	6,465	6,465	6,465
Non Jacketed Legacy Ethanol tank cars	122,387	0	0	0	1,262	7,570	7,570	7,570	7,570	7,570	7,570	7,570	7,570	7,570	7,570	7,570	7,570	7,570	7,570	7,570	7,570
Non Jacketed Legacy Other Flammable Liquids tank cars	114,993	0	0	925	5,553	5,553	5,784	6,941	6,941	6,941	6,941	6,941	6,941	6,941	6,941	6,941	6,941	6,941	6,941	6,941	6,941
Jacketed Legacy Crude oil tank cars	33,724	0	0	327	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964
Jacketed Legacy Ethanol tank cars	398	0	0	0	4	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Jacketed Legacy Other Flammable Liquids tank cars	43,663	0	0	351	2,108	2,108	2,196	2,636	2,636	2,636	2,636	2,636	2,636	2,636	2,636	2,636	2,636	2,636	2,636	2,636	2,636
Non Jacketed CPC-1232 Crude Oil tank cars	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Jacketed CPC-1232 Ethanol Oil tank cars	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Jacketed CPC-1232 Other Flammable Liquids tank cars	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jacketed CPC-1232 Crude Oil tank cars	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jacketed CPC-1232 Ethanol Oil tank cars	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jacketed CPC-1232 Other Flammable Liquids tank cars	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	426,151	0	0	2,682	17,357	23,686	24,005	25,602	25,602	25,602	25,602	25,602	25,602	25,602	25,602	25,602	25,602	25,602	25,602	25,602	25,602

Table 19 shows the tank car years projected to be lost because tank cars could not be modified in time to meet the deadlines set forth in the Proposed Regulations. These losses rise sharply in 2018, the first full year in which the new requirements would be in effect for tank cars carrying PG I commodities, and rise further in 2019, the first full year when the new requirements apply to tank cars carrying PG II commodities. The number of tank cars requiring modification subsequently declines over time as the modification process gradually works its way through the fleet. In total over 490,000 tank car years are projected to be lost due to inability to complete the required modifications prior to the specified dates.

Table 19: Tank Car Years Lost for Non-Compliance

	Total	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Non Jacketed Legacy Crude oil tank cars	75	0	0	75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Jacketed Legacy Ethanol tank cars	25,366	0	0	0	2,921	13,777	7,345	1,323	0	0	0	0	0	0	0	0	0	0	0	0	0
Non Jacketed Legacy Other Flammable Liquids tank cars	135,904	0	0	2,148	12,891	12,891	13,717	17,849	17,849	17,849	17,849	15,086	7,164	612	0	0	0	0	0	0	0
Jacketed Legacy Crude oil tank cars	2,360	0	0	842	1,518	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jacketed Legacy Ethanol tank cars	180	0	0	0	11	63	63	42	0	0	0	0	0	0	0	0	0	0	0	0	0
Jacketed Legacy Other Flammable Liquids tank cars	61,983	0	0	816	4,894	4,894	5,207	6,777	6,777	6,777	6,777	6,777	6,777	5,289	219	0	0	0	0	0	0
Non Jacketed CPC-1232 Crude Oil tank cars	121,210	0	0	3,666	21,993	21,993	21,993	21,568	16,429	9,997	3,565	7	0	0	0	0	0	0	0	0	0
Non Jacketed CPC-1232 Ethanol Oil tank cars	4,718	0	0	0	125	751	751	751	751	751	751	87	0	0	0	0	0	0	0	0	0
Non Jacketed CPC-1232 Other Flammable Liquids tank cars	29,899	0	0	399	2,395	2,395	2,495	2,994	2,994	2,994	2,994	2,994	2,994	2,994	1,257	0	0	0	0	0	0
Jacketed CPC-1232 Crude Oil tank cars	106,824	0	0	7,122	24,926	21,365	17,804	14,243	10,682	7,122	3,561	0	0	0	0	0	0	0	0	0	0
Jacketed CPC-1232 Ethanol Oil tank cars	48	0	0	0	0	14	12	9	7	5	2	0	0	0	0	0	0	0	0	0	0
Jacketed CPC-1232 Other Flammable Liquids tank cars	4,740	0	0	329	988	790	658	790	593	395	198	0	0	0	0	0	0	0	0	0	0
Total	493,307	0	0	15,397	72,661	78,932	70,045	66,347	56,082	45,889	35,697	24,952	16,935	8,895	1,476	0	0	0	0	0	0

Table 20 shows the total number of tank car years lost due to these three causes. In total over the twenty year period following the publication of the final rule we project that almost a million tank car years of capacity will be lost. These losses amount to almost third of the total capacity this fleet might otherwise have been able to provide over this period. Capacity losses are greatest in the years immediately following the proposed compliance deadlines, when we project it will be necessary to park large numbers of unmodified tank cars. In the later years of the period as the modification process comes to a conclusion, capacity losses are dominated by those associated with the premature retirement from flammable liquids service of tank cars that were not capable of modification.

Table 20: Total Tank Car Years Lost for Modifications, Retirements and Non-Compliance

	Total	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Non Jacketed Legacy Crude oil tank cars	115,198	740	1,608	2,761	6,645	6,465	6,465	6,465	6,465	6,465	6,465	6,465	6,465	6,465	6,465	6,465	6,465	6,465	6,465	6,465	6,465
Non Jacketed Legacy Ethanol tank cars	152,620	0	0	0	4,601	22,955	16,523	10,127	7,570	7,570	7,570	7,570	7,570	7,570	7,570	7,570	7,570	7,570	7,570	7,570	7,570
Non Jacketed Legacy Other Flammable Liquids tank cars	255,359	0	0	3,074	18,444	18,444	19,501	24,790	24,790	24,790	24,790	23,443	16,115	8,590	6,941	6,941	6,941	6,941	6,941	6,941	6,941
Jacketed Legacy Crude oil tank cars	36,505	0	0	1,169	3,904	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,964
Jacketed Legacy Ethanol tank cars	583	0	0	0	15	88	88	72	25	25	25	25	25	25	25	25	25	25	25	25	25
Jacketed Legacy Other Flammable Liquids tank cars	107,340	0	0	1,167	7,002	7,002	7,404	9,413	9,413	9,413	9,413	9,413	9,413	8,898	3,576	2,636	2,636	2,636	2,636	2,636	2,636
Non Jacketed CPC-1232 Crude Oil tank cars	126,708	0	0	3,666	21,993	21,993	21,993	21,954	18,037	11,605	5,173	295	0	0	0	0	0	0	0	0	0
Non Jacketed CPC-1232 Ethanol Oil tank cars	4,906	0	0	0	125	751	751	751	751	751	751	275	0	0	0	0	0	0	0	0	0
Non Jacketed CPC-1232 Other Flammable Liquids tank cars	30,647	0	0	399	2,395	2,395	2,495	2,994	2,994	2,994	2,994	2,994	2,994	2,994	2,005	0	0	0	0	0	0
Jacketed CPC-1232 Crude Oil tank cars	106,824	0	0	7,122	24,926	21,365	17,804	14,243	10,682	7,122	3,561	0	0	0	0	0	0	0	0	0	0
Jacketed CPC-1232 Ethanol Oil tank cars	48	0	0	0	0	14	12	9	7	5	2	0	0	0	0	0	0	0	0	0	0
Jacketed CPC-1232 Other Flammable Liquids tank cars	4,740	0	0	329	988	790	658	790	593	395	198	0	0	0	0	0	0	0	0	0	0
Total	962,813	740	1,608	19,687	91,036	104,226	95,658	93,573	83,291	73,099	62,906	52,444	44,547	36,507	28,548	25,602	25,602	25,602	25,602	25,602	25,602
Capacity Loss as a Percent of Total Fleet	31%	0%	1%	13%	59%	67%	62%	60%	54%	47%	41%	34%	29%	24%	18%	17%	17%	17%	17%	17%	17%

8. Expected Impacts of DRIA Proposals on Crude Oil Traffic

Our modal shift analysis for crude oil focused on four movements that we believe will account for a majority of the crude oil on rail traffic. These movements are: (1) Bakken to East Coast; (2) Bakken to Gulf Coast; (3) Bakken to West Coast; and (4) Canadian Oil Sands region to Gulf Coast. For each of these movements we identify the relevant available routings. Note that in no case do we consider an end-to-end pipeline alternative. Because of its lower costs, pipeline transportation, if available, will generally be the dominant alternative. In the identified corridors, however, pipeline capacity is limited. That is the reason why crude oil is either currently moving or is projected to move by rail. One implication of this fact is that if rail capacity is limited, traffic will of necessity move to an inferior alternative.

In the case of East Coast destinations we consider four alternatives: rail direct to East Coast; truck direct to East Coast; rail to Albany, NY combined with waterborne transportation to final destination; and truck to Albany, NY combined with waterborne transportation to final destination.

In the case of West Coast destinations we consider four alternatives: rail direct to West Coast; truck direct to West Coast; rail to Anacortes, WA combined with waterborne transportation to final destination; and truck to Anacortes, WA combined with waterborne transportation to final destination.

In the case of Gulf Coast destinations we consider four alternatives: rail direct to Gulf Coast; truck direct to Gulf Coast; rail to St. Louis, MO combined with waterborne transportation to final destination; and truck to St. Louis, MO combined with waterborne transportation to final destination. We understand that St. Louis is a logical location for rail to water transfers because it is one of the most northern points on the Mississippi that generally remains ice free year round. In addition, the size and geometry of locks located downstream from St. Louis allow them to more easily accommodate large barge tows.

In the case of Canadian oil sands we consider three alternatives: Rail direct to the Gulf Coast; rail to Stroud, OK combined with pipeline transportation to the Gulf Coast; and truck transportation directly to the Gulf Coast. The first two of these specific alternatives were identified in the Department of States environmental impact report for the Keystone XL pipeline. The last is essentially the alternative of last resort.

We treat truck transportation as a costly but unconstrained alternative.

Although we have calculated routings for the various segments included in the model from specific geographic locations, we do not believe that our results are sensitive to these choices. The selection of different modal transfer points and/or different specific coastal destinations would not greatly alter the overall cost or attractiveness of the various routings.

We calculate modal shifts separately for each year of the analysis period.

Within any given period we calculate for each of the movements included in the model an implied wellhead net margin. This margin is defined as the destination price per barrel, minus the per barrel cost of transportation via that routing minus a per barrel wellhead production cost. We assume that shippers will choose the destination/modal alternative offering the highest netback, subject to the constraints imposed by terminal and available tank car fleet capacity. We assume that over the course of the analysis period (through 2034) that the capacity of the tank car fleet expands to accommodate growth in demand, subject to new car construction capacity constraints. We do not assume that new cars will be added to the fleet to cover temporary capacity shortages caused by the inability to bring existing tank cars into compliance with new requirements by the specified deadlines. Given the multi-decade expected lifetimes of tank cars, even the lengthy capacity shortfalls that we project will be caused by the Proposed Regulations are unlikely to make it economically rational to bring long-lived new capacity online to deal with what is essentially a temporary problem.

Table 21 shows projected modal shifts caused by the Proposed Regulations for crude oil shipments originating in the Bakken and Canadian oil sands regions that would, in the Baseline Scenario, have moved by rail. For purposes of this calculation we assume that production volumes will be unaffected by the proposed regulations, and that any crude oil diverted from rail due to tank car capacity shortages will move via the most economical alternative, regardless of cost. The peak impact year is 2018, the first full year when the Proposed Regulations will be in effect. In that year we project that over 62 billion ton miles of crude oil will be diverted to truck. Smaller amounts will be diverted to barge or pipeline transportation. The magnitude of the projected diversions declines over time as modifications to noncompliant tank cars are gradually completed. Diversions to truck do not end until 2026.

The modal shifts shown in Table 21 could result in significant increases in shipper costs. In the early years of the modification program the lion's share of the diverted traffic travels by truck, which is by far the costliest of the four modes on a per ton mile basis. Table 22 shows the implications of these modal shifts for the transportation costs paid by shippers. The unit transportation costs for rail used in preparing Table 22 are derived from shipment information derived from the STB's waybill sample. Unit transportation costs for the other mode are derived from published reports.[67] In 2018, the peak impact year, the potential increases in shipper costs come to $13.6 billion dollars. These costs decline over time as modifications are completed and the crude oil tank car fleet gradually re-enters service. Over the entire period from 2017 through 2034 the potential increases in shipper costs come to $80.9 billion.

It is not clear that crude oil producers would be willing or able to absorb these cost increases. Faced with onerous costs of bringing product to market, shippers may simply opt to decrease North American production rather than incur the costs and absorb the risks associated with a major modal shift to trucking. We project that in 2018 over 300 million barrels of oil that would otherwise have moved to market by rail could potentially be stranded by the unavailability and/or high cost of alternative transportation. See Table 23. To put these figures in perspective, 300 million barrels of oil amounts to 820,000 barrels per day. In 2018, the Energy Information Administration's ("EIA") most recent forecast projects that total U.S. crude oil production will amount to 9.6 million barrels per day. Thus, the potential loss amounts to roughly one twelfth of national production.

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67 Public 2012 Waybill Sample (transportation costs for rail); "Rail May Hold its Own Against Pipelines", OilPrice.com, July 2012 (transportation costs for pipeline); and "Examining the Crude by Barge Opportunity", BB&T Capital Markets, June 2013 (transportation costs by barge and truck).

Table 21: Effects of Proposed Regulations on Crude Oil Ton-Miles by Mode: Bakken and Oil Sands

Ton-Miles, millions	2014	2015	2016	2017	2018	2019	2020
Without Regulation							
Rail	85,062	97,106	105,336	133,719	152,832	170,221	188,351
Barge	37,900	40,022	40,131	11,222	11,222	11,222	11,252
Truck	-	-	-	-	-	-	-
Pipeline	-	-	-	4,998	9,996	14,995	20,048
With Regulation							
Rail	85,062	97,106	105,336	113,023	77,928	103,299	125,623
Barge	37,900	40,022	40,131	12,743	34,498	18,706	11,252
Truck	-	-	-	19,397	62,283	61,579	60,847
Pipeline	-	-	-	4,998	9,996	14,995	20,048
Increase Due to Regulation							
Rail	-	-	-	(20,696)	(74,904)	(66,922)	(62,729)
Barge	-	-	-	1,522	23,277	7,485	-
Truck	-	-	-	19,397	62,283	61,579	60,847
Pipeline	-	-	-	-	-	-	-

Ton-Miles, millions	2021	2022	2023	2024	2025	2026	2027
Without Regulation							
Rail	186,346	185,986	186,610	186,029	187,299	186,589	186,229
Barge	11,222	11,222	11,222	11,252	11,222	11,222	11,222
Truck	-	-	-	-	-	-	-
Pipeline	19,993	19,993	19,993	20,048	19,993	19,993	19,993
With Regulation							
Rail	130,809	141,502	157,091	172,450	186,608	186,589	186,229
Barge	11,222	11,222	11,222	11,252	11,222	11,222	11,222
Truck	53,871	43,150	28,633	13,171	670	-	-
Pipeline	19,993	19,993	19,993	20,048	19,993	19,993	19,993
Increase Due to Regulation							
Rail	(55,537)	(44,484)	(29,519)	(13,579)	(691)	-	-
Barge	-	-	-	-	-	-	-
Truck	53,871	43,150	28,633	13,171	670	-	-
Pipeline	-	-	-	-	-	-	-

Ton-Miles, millions	2028	2029	2030	2031	2032	2033	2034
Without Regulation							
Rail	185,507	184,953	185,640	185,208	185,375	186,502	187,126
Barge	11,252	11,222	11,222	11,222	11,252	11,222	11,222
Truck	-	-	-	-	-	-	-
Pipeline	20,048	19,993	19,993	19,993	20,048	19,993	19,993
With Regulation							
Rail	185,507	184,953	185,640	185,208	185,375	186,502	187,126
Barge	11,252	11,222	11,222	11,222	11,252	11,222	11,222
Truck	-	-	-	-	-	-	-
Pipeline	20,048	19,993	19,993	19,993	20,048	19,993	19,993
Increase Due to Regulation							
Rail	-	-	-	-	-	-	-
Barge	-	-	-	-	-	-	-
Truck	-	-	-	-	-	-	-
Pipeline	-	-	-	-	-	-	-

Table 22: Effects of Proposed Regulations on Crude Oil Shipping Costs

$, millions	2014	2015	2016	2017	2018	2019	2020
Without Regulation							
Rail	$ 3,550	$ 4,052	$ 4,396	$ 5,578	$ 6,373	$ 7,096	$ 7,850
Barge	$ 273	$ 288	$ 289	$ 81	$ 81	$ 81	$ 81
Truck	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pipeline	$ -	$ -	$ -	$ 38	$ 76	$ 114	$ 152
Total	$ 3,810	$ 4,326	$ 4,669	$ 5,679	$ 6,511	$ 7,272	$ 8,065
With Regulation							
Rail	$ 3,550	$ 4,052	$ 4,396	$ 4,717	$ 3,283	$ 4,435	$ 5,403
Barge	$ 273	$ 288	$ 289	$ 92	$ 248	$ 135	$ 81
Truck	$ -	$ -	$ -	$ 5,160	$ 16,567	$ 16,380	$ 16,185
Pipeline	$ -	$ -	$ -	$ 38	$ 76	$ 114	$ 152
Total	$ 3,810	$ 4,326	$ 4,669	$ 9,989	$ 20,157	$ 21,044	$ 21,803
Increase Due to Regulation							
Rail	$ -	$ -	$ -	$ (861)	$ (3,090)	$ (2,662)	$ (2,447)
Barge	$ -	$ -	$ -	$ 11	$ 168	$ 54	$ -
Truck	$ -	$ -	$ -	$ 5,160	$ 16,567	$ 16,380	$ 16,185
Pipeline	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total	$ -	$ -	$ -	$ 4,310	$ 13,645	$ 13,772	$ 13,738

$, millions	2021	2022	2023	2024	2025	2026	2027
Without Regulation							
Rail	$ 7,766	$ 7,751	$ 7,777	$ 7,753	$ 7,806	$ 7,776	$ 7,761
Barge	$ 81	$ 81	$ 81	$ 81	$ 81	$ 81	$ 81
Truck	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pipeline	$ 152	$ 152	$ 152	$ 152	$ 152	$ 152	$ 152
Total	$ 7,981	$ 7,966	$ 7,992	$ 7,968	$ 8,020	$ 7,991	$ 7,976
With Regulation							
Rail	$ 5,637	$ 6,104	$ 6,807	$ 7,496	$ 8,132	$ 8,114	$ 8,097
Barge	$ 81	$ 81	$ 81	$ 81	$ 81	$ 81	$ 81
Truck	$ 14,330	$ 11,478	$ 7,616	$ 3,504	$ 178	$ -	$ -
Pipeline	$ 152	$ 152	$ 152	$ 152	$ 152	$ 152	$ 152
Total	$ 20,181	$ 17,796	$ 14,638	$ 11,214	$ 8,524	$ 8,327	$ 8,311
Increase Due to Regulation							
Rail	$ (2,129)	$ (1,647)	$ (970)	$ (257)	$ 326	$ 337	$ 336
Barge	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Truck	$ 14,330	$ 11,478	$ 7,616	$ 3,504	$ 178	$ -	$ -
Pipeline	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total	$ 12,200	$ 9,830	$ 6,646	$ 3,246	$ 504	$ 336	$ 335

$, millions	2028	2029	2030	2031	2032	2033	2034
Without Regulation							
Rail	$ 7,731	$ 7,708	$ 7,737	$ 7,719	$ 7,726	$ 7,773	$ 7,799
Barge	$ 81	$ 81	$ 81	$ 81	$ 81	$ 81	$ 81
Truck	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pipeline	$ 152	$ 152	$ 152	$ 152	$ 152	$ 152	$ 152
Total	$ 7,946	$ 7,923	$ 7,951	$ 7,933	$ 7,941	$ 7,987	$ 8,013
With Regulation							
Rail	$ 8,066	$ 8,042	$ 8,071	$ 8,053	$ 8,060	$ 8,109	$ 8,136
Barge	$ 81	$ 81	$ 81	$ 81	$ 81	$ 81	$ 81
Truck	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pipeline	$ 152	$ 152	$ 152	$ 152	$ 152	$ 152	$ 152
Total	$ 8,280	$ 8,255	$ 8,285	$ 8,266	$ 8,274	$ 8,323	$ 8,350
Increase Due to Regulation							
Rail	$ 334	$ 333	$ 335	$ 334	$ 334	$ 336	$ 337
Barge	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Truck	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pipeline	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total	$ 334	$ 333	$ 334	$ 333	$ 333	$ 335	$ 336
Total Increase, All Years	$ 80,899						

Table 23: Barrels of Crude Oil Diverted from Rail as a Result of PHMSA Proposed Regulations

Barrels, millions	2014	2015	2016	2017	2018	2019	2020
Without Regulation							
Bakken	-	-	-	-	-	-	-
Oil Sands	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-
With Regulation							
Bakken	-	-	-	12	177	57	-
Oil Sands	-	-	-	67	133	200	230
Total	-	-	-	78	310	257	230
Increase Due to Regulation							
Bakken	-	-	-	12	177	57	-
Oil Sands	-	-	-	67	133	200	230
Total	-	-	-	78	310	257	230

Barrels, millions	2021	2022	2023	2024	2025	2026	2027
Without Regulation							
Bakken	-	-	-	-	-	-	-
Oil Sands	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-
With Regulation							
Bakken	-	-	-	-	-	-	-
Oil Sands	204	163	108	50	3	-	-
Total	204	163	108	50	3	-	-
Increase Due to Regulation							
Bakken	-	-	-	-	-	-	-
Oil Sands	204	163	108	50	3	-	-
Total	204	163	108	50	3	-	-

Barrels, millions	2028	2029	2030	2031	2032	2033	2034
Without Regulation							
Bakken	-	-	-	-	-	-	-
Oil Sands	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-
With Regulation							
Bakken	-	-	-	-	-	-	-
Oil Sands	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-
Increase Due to Regulation							
Bakken	-	-	-	-	-	-	-
Oil Sands	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-
Total Number of Barrels Diverted, All Years	1,402						

9. Expected Impacts of DRIA Proposals on Ethanol Traffic

Because of modal constraints and the more geographically dispersed nature of ethanol shipments (discussed above), we employ a different analytical approach in modeling the potential impacts of tank car capacity shortages caused the proposed regulations in the ethanol market. Rather than attempting to identify specific routes and specific modal alternatives, we assume simply that any ethanol traffic that we project would otherwise move by rail under the Proposed Regulations, which cannot be accommodated by the in-service tank car fleet would be converted, ton mile for ton mile, into truck traffic. We do not identify the specific corridors along which this diverted traffic will flow. The technical and economic factors constraining the ability of ethanol to move by pipeline or barge (discussed above) support the assumption that truck is the only feasible alternative, and confirm the reasonableness of this approach.

The modal shifts implied by this approach are shown in Table 24. Our analysis indicates that in 2019, the peak impact year for ethanol, approximately one half of the projected Baseline ethanol traffic would be diverted to trucks as a result of the Proposed Regulations. As we have seen before, the magnitude of the projected impacts declines over time as the modification program progresses and the existing ethanol fleet is gradually brought into compliance with the proposed regulations. We project that it will take until 2026 to complete the necessary modifications and end reliance on trucks for the transportation of ethanol.

Table 25 shows the increased costs to ethanol shippers as a result of the modal shifts shown in Table 24. In 2019, the peak impact year, we project that ethanol shipper costs will increase by nearly $5.3 billion. These costs decline over time as the retrofit process continues and the ethanol fleet is gradually brought into compliance with the Proposed Regulations. However, the increase in annual ethanol shipper costs caused by the proposed regulations is projected to remain above a billion dollars through 2021.

As with crude oil, it not entirely clear that ethanol shippers would be able to absorb or pass on cost increases of this magnitude. For this reason, another potential impact of the Proposed Regulations is a substantial cutback in ethanol production. Table 26 shows the projected volumes of ethanol that the active ethanol tank car fleet would not be able to accommodate under the Proposed Regulations, and whose production might therefore be put at risk. In 2019, the year of peak impact, this at risk production could amount to over 100 million barrels. To put this figure in perspective, in its most recent forecasts the EIA projects that in 2018, 323 million barrels of ethanol will be produced in the U.S. The Proposed Regulations, therefore, could potentially jeopardize over 30 percent of U.S. ethanol production in that year. Given the U.S. requirements to blend gasoline with ethanol, a cutback in ethanol production may also impact the availability and price of gasoline.

Table 24: Effects of Proposed Regulations on Ethanol Ton-Miles by Mode:

Ton-Miles, millions	2014	2015	2016	2017	2018	2019	2020
Without Regulation							
Rail	46,243	47,072	47,417	47,939	48,191	48,357	48,869
Truck	-	-	-	12	-	-	-
With Regulation							
Rail	46,243	47,072	47,417	47,939	42,968	23,976	34,173
Truck	-	-	-	13	5,224	24,381	14,696
Difference Due to Regulation							
Rail	-	-	-	0	5,224	24,381	14,696
Truck	-	-	-	(0)	(5,224)	(24,381)	(14,696)

Ton-Miles, millions	2021	2022	2023	2024	2025	2026	2027
Without Regulation							
Rail	48,936	49,804	49,772	49,943	49,789	49,781	49,787
Truck	17	-	-	-	-	-	-
With Regulation							
Rail	43,846	48,666	48,669	48,861	49,325	49,781	49,787
Truck	5,108	1,138	1,103	1,082	465	-	-
Difference Due to Regulation							
Rail	5,090	1,138	1,103	1,082	465	-	-
Truck	(5,090)	(1,138)	(1,103)	(1,082)	(465)	-	-

Ton-Miles, millions	2028	2029	2030	2031	2032	2033	2034
Without Regulation							
Rail	49,931	49,763	49,767	49,757	49,853	49,716	49,768
Truck	-	-	-	-	-	-	-
With Regulation							
Rail	49,931	49,763	49,767	49,757	49,853	49,716	49,768
Truck	-	-	-	-	-	-	-
Difference Due to Regulation							
Rail	-	-	-	-	-	-	-
Truck	-	-	-	-	-	-	-

Table 25: Effects of Proposed Regulations on Ethanol Shipping Costs

USD, millions	2014	2015	2016	2017	2018	2019	2020
Without Regulation							
Rail	$ 2,333.36	$ 2,375.19	$ 2,392.62	$ 2,418.95	$ 2,431.68	$ 2,440.02	$ 2,465.86
Truck	$ -	$ -	$ -	$ 3.30	$ -	$ -	$ -
Total	$ 2,333.36	$ 2,375.19	$ 2,392.62	$ 2,422.25	$ 2,431.68	$ 2,440.02	$ 2,465.86
With Regulation							
Rail	$ 2,333.36	$ 2,384.77	$ 2,403.94	$ 2,430.84	$ 2,179.88	$ 1,220.90	$ 1,781.61
Truck	$ -	$ -	$ -	$ 3.35	$ 1,389.48	$ 6,485.26	$ 3,909.17
Total	$ 2,333.36	$ 2,384.77	$ 2,403.94	$ 2,434.19	$ 3,569.36	$ 7,706.16	$ 5,690.77
Increase Due to Regulation							
Rail	$ -	$ 9.58	$ 11.32	$ 11.89	$ (251.80)	$ (1,219.12)	$ (684.25)
Truck	$ -	$ -	$ -	$ 0.05	$ 1,389.48	$ 6,485.26	$ 3,909.17
Total	$ -	$ 9.58	$ 11.32	$ 11.94	$ 1,137.68	$ 5,266.14	$ 3,224.91

USD, millions	2021	2022	2023	2024	2025	2026	2027
Without Regulation							
Rail	$ 2,469.26	$ 2,513.06	$ 2,511.46	$ 2,520.07	$ 2,512.31	$ 2,511.91	$ 2,512.17
Truck	$ 4.61	$ -	$ -	$ -	$ -	$ -	$ -
Total	$ 2,473.88	$ 2,513.06	$ 2,511.46	$ 2,520.07	$ 2,512.31	$ 2,511.91	$ 2,512.17
With Regulation							
Rail	$ 2,265.11	$ 2,501.19	$ 2,498.66	$ 2,508.32	$ 2,532.02	$ 2,561.36	$ 2,561.27
Truck	$ 1,358.65	$ 302.79	$ 293.40	$ 287.80	$ 123.59	$ -	$ -
Total	$ 3,623.76	$ 2,803.97	$ 2,792.06	$ 2,796.12	$ 2,655.61	$ 2,561.36	$ 2,561.27
Increase Due to Regulation							
Rail	$ (204.15)	$ (11.87)	$ (12.80)	$ (11.75)	$ 19.70	$ 49.45	$ 49.10
Truck	$ 1,354.03	$ 302.79	$ 293.40	$ 287.80	$ 123.59	$ -	$ -
Total	$ 1,149.88	$ 290.91	$ 280.60	$ 276.06	$ 143.29	$ 49.45	$ 49.10

USD, millions	2028	2029	2030	2031	2032	2033	2034
Without Regulation							
Rail	$ 2,519.46	$ 2,511.01	$ 2,511.20	$ 2,510.66	$ 2,515.50	$ 2,508.62	$ 2,511.24
Truck	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total	$ 2,519.46	$ 2,511.01	$ 2,511.20	$ 2,510.66	$ 2,515.50	$ 2,508.62	$ 2,511.24
With Regulation							
Rail	$ 2,568.71	$ 2,560.16	$ 2,560.36	$ 2,559.81	$ 2,564.75	$ 2,557.73	$ 2,560.40
Truck	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total	$ 2,568.71	$ 2,560.16	$ 2,560.36	$ 2,559.81	$ 2,564.75	$ 2,557.73	$ 2,560.40
Increase Due to Regulation							
Rail	$ 49.25	$ 49.16	$ 49.16	$ 49.15	$ 49.24	$ 49.11	$ 49.16
Truck	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total	$ 49.25	$ 49.16	$ 49.16	$ 49.15	$ 49.24	$ 49.11	$ 49.16

Table 26: Barrels of Ethanol Diverted from Rail as a Result of PHMSA Proposed Regulations

	2014	2015	2016	2017	2018	2019	2020
Without Regulation							
Barrels	-	-	-	1,648,665	-	-	-
With Regulation							
Barrels	-	-	-	56,493	23,432,969	109,370,995	65,926,376
Increase Due to Regulation							
Barrels	-	-	-	(1,592,172)	23,432,969	109,370,995	65,926,376
Total Barrels Diverted, All Years	234,735,607						

	2021	2022	2023	2024	2025	2026	2027
Without Regulation							
Barrels	2,308,039	-	-	-	-	-	-
With Regulation							
Barrels	22,913,031	5,106,374	4,948,094	4,853,666	2,084,313	-	-
Increase Due to Regulation							
Barrels	20,604,992	5,106,374	4,948,094	4,853,666	2,084,313	-	-
Total Barrels Diverted, All Years	234,735,607						

10. Trucking Industry Impacts

Table 27 shows the volume of additional truck traffic that would be generated in crude oil and ethanol traffic that would otherwise have moved by rail but was diverted to trucks as a result of tank car shortages created by the Proposed Regulations. We estimate that replacing lost rail capacity in 2017 with truck transportation for crude oil and ethanol shipments in North America, would require approximately 20,000 trucks carrying over 360 thousand truckloads on North American highways. In 2018, the first full year in which the loss of capacity will be felt, replacement transportation would require approximately 65,000 trucks carrying over 1.4 million loads. Note that these figures already reflect what we believe to be reasonable assumptions regarding potential diversions to pipeline and barge transportation.

Table 27: Crude and Ethanol Truck Traffic Required to Replace Lost Capacity

With Regulation	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Trucks Dedicated to Crude and Ethanol Service, thousands	-	-	-	20	65	65	64	56	45	30	14	1
Truckloads, thousands	-	-	-	365	1,455	1,227	1,090	956	762	506	234	12

The safety and environmental consequences of such a substantial increase in truck traffic would be significant. From 2002-2009, the over-the-road truckers transporting hazardous materials spilled 58% more total liquid hazardous materials and roughly double the total equivalent hazardous materials (including gasses, liquids and solids) than railroads did per year and per billion ton-miles. These trucks are traveling on major highways and roads alongside passenger traffic. In addition, 71.5 million additional tons of CO2 are associated with this increase in truck traffic.

Table 28: Change in CO2 Emissions from Regulation by Mode and Year (tons of CO2)

Mode of Transportation	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Truck	0	0	0	3,673,961	12,786,504	16,281,685	14,308,583	11,167,919	8,388,575	5,632,336	2,699,739	214,886
Pipeline	0	0	0	0	0	0	0	0	0	0	0	0
Rail	0	0	0	-482,272	-1,867,191	-2,127,621	-1,804,217	-1,412,799	-1,063,133	-713,574	-341,638	-26,920
Barge	0	0	0	27,526	421,052	135,387	0	0	0	0	0	0
Total	0	0	0	3,219,214	11,340,365	14,289,451	12,504,366	9,755,120	7,325,443	4,918,761	2,358,101	187,966

It is unreasonable, however, to assume that a sudden and substantial increase in truck demand would not affect rates. The current tank truck fleet is fully occupied today hauling other hazardous commodities that require secure trailers with sufficient strength and safety features to provide safe highway transport. If the demand for these same trailers suddenly rises in order to satisfy substantial additional demand from crude oil producers, a shortage of hazardous materials ("hazmat") tankers will arise quickly in this market. Rates for their services can be expected to soar. Such increases can be expected to lead to even greater increases in costs to shippers of crude oil and ethanol, but also to significant disruptions to the markets for other commodities currently carried by these tankers.

It is also unclear whether a modal shift of this magnitude to truck transportation is either operationally or economically feasible. We can reasonably assume that the current truck fleet is matched to the current demand for the commodities it transports. The proposed regulations would create a sudden surge in demand for these vehicles. Any rapid change in their production rate would take time to roll out. More importantly, however, it is unclear how fleet owners would respond to what is essentially a temporary surge in demand. Expanding the truck fleet capacity to meet this temporary surge could potentially lead to a situation in which motor carriers would be left with capital investments in trailers that are not fully depreciated, yet are non-competitive with the new rail cars, once the rail fleet is in compliance with the new requirements. Whether they would in fact be willing to make the necessary investments under such circumstances is unclear.

Trucking companies would also be required to recruit, screen and train a corresponding number of additional truck drivers to operate an increasing number of trucks. For the past three decades, however, driver retention and recruitment has historically been a significant challenge for the trucking industry.[68] This problem has become especially acute for drivers who qualify and are licensed for transport of hazardous materials.

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68 Southern, R. Neil, James P. Rakowski, and Lynn R. Godwin. 1989. "Motor Carrier Road Driver Recruitment in a Time of Shortages." *Transportation Journal* Vol.28, No.4:pp 42-48. Mele, Jim.

Continued on next page

The rapidly increasing demand for tank trucks, to replace the unusable tank cars, would also challenge the truck- and trailer-manufacturing sectors.

To the extent that either the trucking industry proves incapable of absorbing this surge of new traffic, or that the rates it charges prove to be more than producer economics can absorb, the inevitable result will be crude oil and ethanol production cutbacks that can themselves be expected to result in widespread economic losses.

F. Summary of PHMSA's Understatement of the Costs of Its Modification Program

To calculate our estimates of the modification costs associated with the Proposed Regulations, we sum three components: the direct cost of the modifications; the out of service time cause by the proposed regulations; and the increased shipper costs associated with the use of alternative modes while the relevant tank car fleets are out of service. The first of these components is taken from Table 13. To calculate the second, we multiply our projections of lost service time, shown in Table 17 and Table 19, by the per year values of lost service time used by PHMSA in its draft regulatory impact analysis.[69] To compute the third, we simply sum the increased shippers' costs for crude oil and ethanol shippers shown in Table 22 and Table 25, respectively. Note that these increased shipper costs do not include any provision for the possibility (discussed above) of temporary increases in trucking rates caused by the sudden surge in demand likely to result from the Proposed Regulations. While the projected direct modification and lost service time costs are large, they are dwarfed by the projected increases in shipper costs associated with the shift of traffic toward trucks.

Table 29 presents the breakdown of our estimates of modification related costs for tank cars in crude and ethanol service. The direct modification costs in this table differ from the direct modification costs presented in Table 13 because the figures in Table 29 exclude costs associated with modifying tank cars used to transport flammable liquids other than crude oil and ethanol. Table 30 compares our estimates of the overall modification program costs implied by the Proposed Regulations to those of PHMSA for its Option 3 for existing crude oil and ethanol tank cars. The difference between these estimates is substantial, exceeding $58 billion on a present value basis.

Continued from previous page

1989. "Carriers Cope With Driver Shortage." *Fleet Owner* Vol.84, No.1:pp 104-11. Machalaba, Daniel. 1993. "Long Haul: Trucking Firms Find It Is a Struggle to Hire and Retain Drivers". *Wall Street Journal*, December 28, 1993, pg. 1.

69 DRIA at 85-86.

Table 29: The Brattle Group's Projection of Modification Program Related Costs

Year	Direct Modification Costs	Time Out-of-Service Cost	Increased Shipper Costs	Total Modification Program Related Costs
2014	$ -	$ -	$ -	$ -
2015	$ 181	$ 3	$ 10	$ 194
2016	$ 315	$ 7	$ 11	$ 333
2017	$ 315	$ 77	$ 4,322	$ 4,714
2018	$ 262	$ 313	$ 14,783	$ 15,358
2019	$ 315	$ 340	$ 19,039	$ 19,693
2020	$ 315	$ 289	$ 16,963	$ 17,567
2021	$ 318	$ 238	$ 13,350	$ 13,907
2022	$ 315	$ 181	$ 10,122	$ 10,617
2023	$ 315	$ 120	$ 6,927	$ 7,361
2024	$ 315	$ 58	$ 3,523	$ 3,896
2025	$ 64	$ 3	$ 648	$ 715
2026	$ -	$ -	$ 386	$ 386
2027	$ -	$ -	$ 385	$ 385
2028	$ -	$ -	$ 384	$ 384
2029	$ -	$ -	$ 382	$ 382
2030	$ -	$ -	$ 384	$ 384
2031	$ -	$ -	$ 383	$ 383
2032	$ -	$ -	$ 383	$ 383
2033	$ -	$ -	$ 385	$ 385
2034	$ -	$ -	$ 386	$ 386
Total	$ 3,028	$ 1,631	$ 93,156	$ 97,815
Present Value	$ 1,942	$ 1,025	$ 56,975	$ 59,942

Note: Unit is Millions of Dollars. Discount rate of 7% is used.

Table 30: Comparison of PHMSA and the Brattle Group's Modification Program Related Costs

Year		Brattle Group Modification Program Related Costs		PHMSA Modification Program Related Costs		Difference
2014	$	-	$	-	$	-
2015	$	194	$	-	$	194
2016	$	333	$	608	$	(275)
2017	$	4,714	$	608	$	4,106
2018	$	15,358	$	805	$	14,553
2019	$	19,693	$	-	$	19,693
2020	$	17,567	$	-	$	17,567
2021	$	13,907	$	-	$	13,907
2022	$	10,617	$	-	$	10,617
2023	$	7,361	$	-	$	7,361
2024	$	3,896	$	-	$	3,896
2025	$	715	$	-	$	715
2026	$	386	$	-	$	386
2027	$	385	$	-	$	385
2028	$	384	$	-	$	384
2029	$	382	$	-	$	382
2030	$	384	$	-	$	384
2031	$	383	$	-	$	383
2032	$	383	$	-	$	383
2033	$	385	$	-	$	385
2034	$	386	$	-	$	386
Total	$	97,815	$	2,021	$	95,795
Present Value	$	59,942	$	1,534	$	58,408

Note: Unit is Millions of Dollars. Discount rate of 7% is used.

Table 31 portrays the present value of lost tank car years resulting from premature retirement of existing tank cars. As shown in Table 18, we estimate that over 425,000 tank cars years are lost because of retirements. We do not expect that these tank cars will be used to transport Canadian oil sands. The loss of $928 million is based on the estimated lost years times the annual service losses estimated by PHMSA.

Table 31: Present Value of Costs of Car-Years Lost Due to Retirements (2015-2034)

Car type	Present Value
Legacy cars	$928
CPC-1232 cars	$0
Total	$928

Notes:
A discount rate of 7% is applied to calculate the present value.
Annual service values are taken from Table TC9 from the DRIA.
Costs are presented in millions of dollars.

V. REVIEW OF DRIA BENEFIT-COST ANALYSIS

A. PHMSA's Benefit-Cost Analysis Does Not Support the Implementation of Any of the Policies Under Consideration

PHMSA identified 10 regulatory alternatives to reduce the number of derailments and spills of crude oil and ethanol. Specific benefits and costs were estimated for 7 of them. As shown in Table 32, net benefits (benefits less costs) calculated by PHMSA are negative – a result that indicates costs exceed benefits in all but three instances. Thus, these alternatives fail a benefit-cost test. The three instances where benefits exceed costs have a common feature – the inclusion of ECP brakes. As discussed previously, the effectiveness of ECP brakes is questionable and the costs are understated. Consequently, despite the positive net benefits determined by PHMSA for these three alternatives, there are serious reasons to remain skeptical regarding the attractiveness of these alternatives. It is also worth noting that PHMSA's tank car option 1 includes ECP brakes. Removing this feature, results in negative benefits for this option (between $1 and $2.4 billion).

Table 32: Summary of Costs and Benefits of Regulations Proposed by PHMSA

		Benefits		Net Benefits	
Regulatory Proposal	Cost (millions)	Low	High	Low	High
Rail Routing	$5	na	na		
Classification of Mined Gas and Liquid	$16	na	na		
Notification to SERCs	$0	na	na		
Speed Restriction: 40mph all areas	$2,680	$199	$636	-$2,481	-$2,044
Speed Restriction: 40mph areas 100k population	$240	$34	$108	-$206	-$132
Speed Restriction: 40mpg in HFUAs	$23	$7	$22	-$16	-$1
Braking	$500	$737	$1,759	$237	$1,259
PHMSA and FRA designed car (option1)	$3,030	$822	$3,256	-$2,208	$226
AAR 2014 car (option 2)	$2,571	$610	$2,426	-$1,961	-$145
Jackteted CPC-1232 (new construction) (option 3)	$2,040	$393	$1,570	-$1,647	-$470
PHMSA and FRA (option 1) stripped of braking	$2,530	$85	$1,497	-$2,445	-$1,033

Reducing benefits and increasing costs as discussed in Sections III and IV further reduce support for the proposed provisions. In fact, these changes eliminate the three instances where the DRIA indicated that benefits exceeded cost.

B. The Magnitude of Overstated Benefits and Understated Costs in the DRIA is Large

Table 33 summarizes the revisions to PHMSA's benefit and cost estimates described in previous sections. Based on our review and analysis, PHMSA's benefits estimates are overstated by $2.1 billion on an NPV basis. PHMSA's cost estimates are understated by $3.9 billion accounting for modification costs, lost service time, and premature tank car retirement costs. Adding increased transportation costs associated with the mode shift from rail to truck, increases costs by $62.3 billion, reflecting the high costs of truck relative to rail costs. As noted, oil producers in the Bakken region may not be able to absorb these costs. If this is the case, then oil production in the region will fall. The economic impact of this outcome is discussed below.

Finally, the social costs attributable to increased CO_2 emissions from increased truck reliance should be considered. Using the emissions estimate from Table 28 and OMB's social cost per ton of CO_2[70] results in a cost of about $500 million on a present value basis.

70 Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis – Under Executive Order 12866, May 2013.

Table 33: Summary of Benefit Reductions and Cost Increases to DRIA Estimates

	(billions of dollars)	
Decreased Benefits		
baseline adjustment	$	0.7
spill adjustment	$	1.7
truck mode shift	$	0.2
Total	$	2.1
Increased Costs		
direct modification	$	1.9
time out of service	$	1.0
premature tank car retirement	$	0.9
Subtotal	$	3.8
increased shipper costs	$	57.0
Total	$	60.8

Sources and Notes:
Benefits from Table 1. As noted in Table 1, these benefits are not independent of one another, so they cannot be treated as additive. Therefore, the total is not the sum of the three categories.
Modification, time out of service, and increased shipper costs are from Table 29.
Premature tank car retirement costs are from Table 31.
All figures are presented on a net present value basis

C. PHMSA's Benefit-Cost Analysis is Insufficient for Rulemaking Purposes

The benefit-cost analysis conducted by PHMSA does not provide a sound basis to select an efficient regulation. Some of the regulations considered are intended to reduce the likelihood of derailments while others are intended to reduce the likelihood of a crude oil or ethanol spill. There is also the interdependence of the regulatory alternatives. If any single provision is implemented, the impacts of the others will change. The existing analysis by PHMSA does not provide a means to rank or order the regulatory options. As a consequence, it is impossible to make direct and complete comparisons across the options.[71]

D. Taking a Cost Effectiveness Approach

One approach to dealing with the comparison problem is calculating the cost effectiveness of each provision independently of the others. Under a cost-effectiveness approach, each provision or proposed regulation would be measured by how much it costs to meet a specific goal – thereby

71 PHMSA acknowledges this limitation and provides some combination of provisions where the overlap is accounted for in Tab 6 ES3 (DRIA p.6) Costs exceed benefits for these combinations as well.

normalizing the measure for comparison purposes.[72] In this case, a major goal of further regulation is avoiding the loss of life. Consequently, each regulatory proposal could be measured in terms of costs per life saved. The DRIA, however, does not provide the necessary information to make these calculations. In addition, the benefit calculation approach taken by PHMSA appears to assume a fixed proportion of lives saved and damages avoided. This is problematic. Some of the proposed regulatory provisions target high density locations. As a consequence, they may reduce the number of accidental deaths disproportionately to other damages.

The cost-effectiveness approach does allow us to consider the alternative regulatory approach recommended by the RSI-CTC. This approach, largely adopts the tank car modifications consistent with PHMSA's Option 3 and the new car requirements consistent with Option 2 for new cars entering flammable liquids service. Further, the RSI-CTC proposes a modification timeline that avoids many of the modal shift costs associated with unrealistic compliance deadlines. As a result, assuming PHMSA's benefits are correct, adopting the RSI-CTC's recommended timeline will simply maintain the expected benefits, but at much lower cost.

VI. ECONOMIC IMPACTS

PHMSA's DRIA does not address whether the proposed regulations result in substantial economic impacts although this is required by OMB Circular A-4. Since the regulatory compliance costs discussed above are likely to raise the delivered price of crude oil from the Bakken region, leading to lower oil production from the region, this is an important omission and indicates that the economic impact on the Bakken region could be significant.

Bakken oil production has been an economic boon to North Dakota. Studies prepared by the Federal Reserve and North Dakota State show that the unemployment rate has decreased and that wages have increased, especially in counties within or near the oil fields.[73] The North Dakota study found that each new well generates about $4 million in economic output within the state. The Federal Reserve study found that wages grew by 140 percent between 2001 and 2011. Consequently, regulations that raise the costs of delivered crude oil will result in negative economic impacts in North Dakota and parts of Montana.

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72 The OMB Circular A-4 recognizes this approach.

73 Dean A. Bangsund and Nancy Hodur, "Petroleum Industry's Economic Contribution to North Dakota in 2011," North Dakota State University, Agribusiness and Applied Economics, March, 2013 and Dulguun Batbold and Rob Grunewald, "Bakken activity: How wide is the ripple effect," Fedgazette, Nine District Feature, July, 2013, p. 14.

The proposed regulations can also be expected to significant impacts on the ethanol industry. To the extent that rail capacity constraints caused by the Proposed Regulations force ethanol traffic from rail to trcuks, industry costs will increase substantially. We have estimated that in 2019, the peak impact year for the ethanol fleet, ethanol shipper costs could increase by over $5.2 billion. To place this figure in perspective, we note that the Renewable Fuels Association estimates that in 2013 the ethanol industry spent $36.1 billion on raw materials, inputs and other goods and services.[74] Thus, the Proposed Regulations could impose significant cost increases on ethanol producers, forcing many to shut down. Such shutdowns could reduce economic activity and elimante jobs across a broad swath of the Mid West. Significant redcutions in ethanol supplies could also raise fuel costs throughout the country.

At the national level, however, the impact of these changes on overall oil production may be modest because other domestic supply sources may increase production in response to price increases caused by Bakken supply reductions. As a result, employment losses in the Bakken region may be offset by gains in other oil producing regions. In addition, tank car modifications and replacement will create employment in various parts of the country. On the other hand, increases in domestic crude oil productions will raise the costs of petroleum based fuel and increase costs in many different sector of the economy. Consequently, the economic impact of the proposed rule is more an issue of distribution – there will be winners and losers -- not a large net loss the economy. Note this does not provide support for the proposed regulations. The standard for economic efficiency is the benefit-cost test. Large scale redistributions, however, must be recognized to address equity concerns.

VII. CONCLUSIONS

For the reasons explained throughout this report, PHMSA's DRIA does not support any of the ten proposed regulatory alternatives contained in the NPRM. Aside from the three alternatives that incorporate ECP braking and speed restrictions in HTUAs, the benefit-cost analysis presented in the DRIA demonstrates that costs always exceed benefits. However these three alternatives are still flawed because benefits only exceed the costs when future derailments and spills are projected to reach unprecedented levels that are not supported by available evidence. Additionally, PHMSA's assumption regarding the effectiveness of ECP braking is contradicted by research.

We have identified several instances where PHMSA provides specific estimates that overstate the benefits and understate the costs of the Proposed Regulations. Revising these estimates, as we suggest, to reflect available data causes costs to exceed benefits for all of the alternatives

[74] Renewable Fuels Association, 2014 Ethanol Industry Outlook, page 4.

considered without exception. Benefits are overstated primarily because PHMSA's projections of derailment related tank car spills absent further regulation are far too high, and its estimates of the effectiveness of the proposed provisions are either unsubstantiated or inconsistent with available research. Costs are understated because PHMSA does not account for degree of disruption in the availability of tank cars that would result from its proposed timeline for modification for existing tank cars, and the adoption of new standards for new tank cars. We have also identified at several instances where PHMSA's estimated costs for modification of existing tank cars and for meeting new car standards are also substantially lower than industry estimates.

PHMSA's benefit-cost analysis also fails to provide a basis for ranking the alternative provisions under review. First, because the alternatives are overlapping, provision-specific benefits will be influenced by assumptions regarding other provisions when implemented simultaneously. For example, reduced trains speeds are expected to reduce derailments and tank car releases, and PHMSA calculates benefits based on this expectation. At the same time, however, benefits regarding spill volume reductions from derailment related spills are calculated without accounting for the effect of the reduced number of derailments. Accounting for further reductions in derailments would reduce the benefits attributable to tank car modifications.

PHMSA should conduct the research necessary to improve the quality of its cost benefit analysis. This research would include developing a more robust forecast of future derailments and spills. The current forecasts do not clearly account for recently adopted regulations or anticipated railroad operating and maintenance regulations, and do not rely on a scientific approach regarding a worst case scenario. Research is also necessary regarding the effectiveness of various elements in the proposed regulations. The effectiveness of ECP braking is controversial and its uncertain value should be reflected in the analysis. PHMSA should also rely more heavily on conditional probability of release and related studies rather than on recent consulting reports. PHMSA should also review the impacts of the proposed compliance schedule, given the substantial compliance costs associated with the proposed deadlines.

Should the agency choose to finalize its Proposed Rule rather than conduct additional research, the proposal recommended by the RSI-CTC is a far more cost-effective alternative because it achieves many of the same benefits while reducing the costs associated with implementation. The most significant difference is the modification timeline—the deadlines proposed by the RSI-CTC are far more consistent with the shop capacity available to carry out the modification work. Therefore, the RSI-CTC's proposal avoids many of the deficiencies and costs highlighted in this report that are attributable to the modal shift accompanying an overly aggressive timeline.