

## Appendix B

### Summary of Proposed 15-Day Changes and Technical Support Document

#### *Proposed In-Use Locomotive Regulation*

# Table of Contents

I. Introduction.....	2
II. Summary of the Proposed 15-Day Changes.....	2
A. Addition of an Alternative Compliance Plan Application Fee .....	2
1. Cost Impacts .....	3
2. Emissions Impacts.....	3
B. Additional Extensions for Equipment Manufacture and Infrastructure Installation Delays and for Unavailability of Compliance Equipment .....	3
1. Cost Impacts .....	3
2. Emissions Impacts.....	3
C. Alternative Fleet Milestone Option (AFMO).....	3
1. Cost Impacts .....	5
2. Emissions Impacts .....	5
D. Regulation Language Clarifications and Clean Up .....	6
1. Cost Impacts .....	6
2. Emissions Impacts .....	6
III. Updated Emissions Inventory.....	6
A. Overview of Emissions Inventory Changes .....	6
B. Summary of Estimated Emissions Impacts of the 15-Day Changes .....	7
IV. Technical Support Document on Zero Emission Conversions .....	12

## I. Introduction

This attachment describes 15-day changes to the California Air Resources Board (CARB or Board) Proposed In-Use Locomotive Regulation (Proposed Regulation) and discussions of any associated emission reduction or cost impacts.

The 15-day changes described below are changes made since CARB staff released the Initial Statement of Reasons (ISOR) for the Proposed Regulation on September 20, 2022. From 2023–2050, the 15-day changes could result in an approximate increase of one percent particle matter (PM) and the oxides of nitrogen (NO<sub>x</sub>) emissions compared to the emission reductions presented in the ISOR. The 15-day changes do not result in changes that require updates to cost methodology, overall cost estimates, or statewide valuation of avoided adverse health outcomes.

## II. Summary of the Proposed 15-Day Changes

### A. Addition of an Alternative Compliance Plan Application Fee

To recover the cost of implementation, staff are proposing to charge a fee for Alternative Compliance Plan (ACP) applications. The application fee would be based on locomotive fleet sizes and would be as follows:

- \$200 for 1 to 5 locomotives
- \$500 for 6 to 50 locomotives
- \$1,000 for 51 to 100 locomotives
- \$2,500 for more than 100 locomotives

To evaluate ACP applications, staff must review documentation such as locomotive fleet data, emission reduction projections, and procurement schedules. Analysis may also include review of specific equipment duty cycles, load factors, and fuel types, as well as projected usage levels. The ACP application processes will require close coordination between CARB and stakeholders and will result in increased CARB staffing time compared to the conventional compliance pathways (i.e., the Spending Account and In-Use Operational Requirements).

The amount of time required to review and validate a single plan is projected to require a minimum of two days of staff time for fleets of 1 to 5 locomotives, increasing to 20 or more staff days for 100 or more locomotives, including meetings and management review hours. The cost per unit of staff person years is described in the Standardized Regulatory Impact Assessment.<sup>1</sup>

---

<sup>1</sup> See ISOR Appendix B: Standardized Regulatory Impact Assessment Table 3.9, 2022.

## **1. Cost Impacts**

Due to the inherent uncertainty of how many operators would use an ACP, staff are unable to determine an impact from the addition of an ACP application fee would have on overall costs of the Proposed Regulation.

## **2. Emissions Impacts**

This proposed modification would not have an impact on emission reductions.

### **B. Additional Extensions for Equipment Manufacture and Infrastructure Installation Delays and for Unavailability of Compliance Equipment**

To address cases where a regulated party is prevented from complying due to circumstances beyond their control, CARB staff have added extensions for delays in obtaining equipment and infrastructure and for unavailability of compliance equipment. The proposed extensions prescribe the application process and include timelines for approval and re-application in cases where delays or unavailability continue beyond the limit of a single extension. Note that locomotive operators must continue to report the activity of locomotives operating under extensions and must ensure that locomotives operating under an extension abide by the 30-minute idling limit.

This change is necessary to provide locomotive operators additional time to comply with the requirements of the Proposed Regulation due to delays related to supply chain issues, etc. This change affects the amount of time locomotive operators have to comply with the Proposed Regulation, but not the cost to comply and is only applicable in limited circumstances. Therefore, these changes are expected to result in minimal or no impacts to the total emission reductions or estimated costs of the Proposed Regulation.

## **1. Cost Impacts**

This modification is not anticipated to have cost impacts. The proposed extensions would provide operators more time to comply, but the cost to comply would generally be the same and thus is not anticipated to have cost impacts.

## **2. Emissions Impacts**

This modification is not anticipated to have emission reduction impacts.

### **C. Alternative Fleet Milestone Option (AFMO)**

As directed by the Board during the November 18, 2022, Board Hearing, staff continued to work with passenger agencies to find a compliance pathway that would

work with the unique way passenger agencies are funded and operated in California. In collaboration with passenger agencies, staff developed an Alternative Fleet Milestone Option (AFMO) that could be used in place of the Spending Account and In-Use Operational Requirements.

Although CARB staff recognizes the passenger agencies' unique funding challenges, as well as the substantial proportions of Tier 4 locomotives currently in operation and the forward-looking zero emission (ZE) plans the passenger agencies have adopted, it is critical to include passenger agencies in the Proposed Regulation because of the unique harm diesel passenger locomotives pose to passengers and the residential communities in which passenger locomotives often operate.

Staff is proposing that any locomotive operator could choose to use the AFMO in lieu of directly complying with the Spending Account and In-Use Operational Requirements of the Proposed Regulation. The AFMO is a fleet option, meaning all locomotives operated by the operator in California must be enrolled in the AFMO. The AFMO has the annual fleet usage requirements listed below, with usage in units of megawatt-hour (MWh) of locomotive activity. ZE provisions are also listed.

- Beginning in 2030, at least 50 percent of annual fleet usage in California must be from Tier 4 (or cleaner) locomotives.
- Beginning in 2035, 100 percent of annual fleet usage in California must be from Tier 4 (or cleaner) locomotives.
- Beginning in 2042, 50 percent of annual fleet usage in California must be ZE.
- Beginning in 2047, 100 percent of annual fleet usage in California must be ZE (no exceptions).
- ZE locomotive or ZE rail equipment provision: Each MWh of ZE locomotive or ZE rail equipment activity in an operator's California fleet, allows equivalent usage for the following other locomotives to be counted as Tier 4 locomotives:
  - Two (2) MWhs from Tier 2 or 3 locomotives, or
  - One and a half (1.5) MWhs from Tier 1 locomotives, or
  - One (1) MWh from Tier 0 locomotives, or
  - Half (0.5) MWh from pre-Tier 0 locomotives.

As previously mentioned, the AFMO could be used by any locomotive operator. However, CARB staff assumes that passenger operators are likely the only locomotive operators that would adopt the AFMO. Passenger operators currently have a large number of Tier 4 locomotives as a percentage of their fleet, which would allow them to more easily achieve the 2030 and 2035 Tier 4 milestones compared to other locomotive operators. Class I, Class II, Class III, and Industrial operators currently have less than six percent of their California operations completed by Tier 4 locomotives, making the 2030 and 2035 Tier 4 milestones harder to achieve. Thus, while other railroad categories are free to choose the AFMO, the proposed deadlines may be more difficult to meet, depending on the railroads' current fleet makeup. Additionally, as part of the AFMO requirements, operators are required to write detailed plans on how they will achieve each milestone, including how operators will reach the 2042 and 2047 milestones. Many non-passenger operators have voiced resistance to adoption

of ZE whereas most passenger operators have board-adopted plans on ZE operation goals.

The Proposed Regulation seeks to reduce exposure of the state's residents to toxic diesel pollution. Diesel PM exhaust from locomotives negatively affects human health along two main pathways: it settles directly in the communities surrounding the locomotive operation, and the NOx emitted by the locomotive contributes to the secondary formation of PM, which can affect the health of Californians through entire regions of the State; passenger operations also raise exposure along a third specific pathway for passengers riding the train. A 2017 study<sup>2</sup> that compared the air pollution exposures experienced by commuters in six common transportation modes utilized by California residents found that train commuters experienced the largest exposure per mile of all the combustion-derived transportation commute modes. Instead of living in a community where trains pass, train commuters ride adjacent to the pollution source continuously throughout a journey, sometimes daily as part of a commute. CARB staff recognize that passenger trains increase transportation equity and access, but train transportation will not be fully equitable until it protects the health of its riders, who are currently exposed to diesel PM at a disproportionate rate compared to those with the ability to afford other modes of transportation.

## **1. Cost Impacts**

CARB staff assumes the AFMO would be used by all California passenger agencies. This change will likely have no impact to the total costs to passenger agency operators but may change the year-over-year costs found in the Standardized Regulatory Impact Assessment due to the difference in the AFMO milestone dates and the Spending Account and In-Use Operational Requirements assumed turnover dates. As described above, other operator types are not anticipated to use the AFMO. However, staff predicts that if other operator types used the AFMO, their costs would be impacted similar to passenger agencies.

## **2. Emissions Impacts**

From 2024 to 2050, the AFMO is projected to reduce a cumulative total of 39 tons of fine particulate matter (PM2.5), and 2,552 tons of NOx from baseline passenger locomotive emissions. When compared to the Spending Account and In-Use Operational Requirements emission reductions for passenger locomotives, the AFMO could lead to a decrease in cumulative emission reductions of 60 tons of PM2.5 and 3,347 tons of NOx from 2024–2050. Because passenger locomotives are less than 5 percent of the total locomotive emissions, the potential decrease in emission reductions from the Proposed Regulation should all passenger locomotives choose the

---

<sup>2</sup> Walter Ham, Abhilash Vijayan, Nico Schulte, Jorn D. Herner, Commuter exposure to PM2.5, BC, and UFP in six common transport microenvironments in Sacramento, California. 12 April 2017. Atmospheric Environment 167 (2017) 335-345.

AFMO is approximately one percent compared to the emission reductions presented in the ISOR.

Other operators are not anticipated to use the AFMO. However, staff predicts that if they used the AFMO, Class I and Class III locomotives would likely have decreased emission reductions, while Industrial locomotives would have the same emission reductions as under the Spending Account and In-Use Operational Requirements. Further discussion is provided in in Section III below.

## **D. Regulation Language Clarifications and Clean Up**

Staff made numerous changes to the Proposed Regulation language, both substantive and non-substantive, to clarify and clean up the regulation language. Most substantive changes were made in response to feedback received from CARB's Board, public comments received during the formal comment period that began September 23, 2022, and ended November 7, 2022, and internal feedback from CARB legal and enforcement staff.

Substantive changes to the Proposed Regulation include: the addition and clarification of definitions, new or revised language to improve clarity and ensure the regulation functions as staff intend, and updates to reporting requirements. These changes were combined and included under one section with non-substantive changes because they clarify requirements already intended in the ISOR regulation language or support the other 15-day changes already described in sections A-C.

Non-substantive changes include: grammar and spelling corrections, minor wording changes, and added abbreviations to help the document read easier. This also includes re-numbering of numerous sections and subsections for clarity and consistency.

### **1. Cost Impacts**

These modifications are not anticipated to have cost impacts.

### **2. Emissions Impacts**

These modifications are not expected to have emission reduction impacts.

## **III. Updated Emissions Inventory**

### **A. Overview of Emissions Inventory Changes**

The ISOR included the Proposed Regulation Order (September 20, 2022, version) and Appendix G: CARB's 2022 In-Use Locomotive Emission Inventory, Regulation Proposal and Scenarios, which supports the September 20, 2022, version of the Proposed Regulation.

CARB staff are proposing changes (15-day changes, dated March 1, 2023) to the Proposed Regulation. This document, Attachment B to the proposed 15-day changes, provides updates to the emissions inventory to reflect proposed 15-day changes. The 15-day changes do not include any updates or changes to baseline inventory inputs or methodology.

As directed by the Board during the November 18, 2022, Board Hearing, staff continued to work with passenger agencies to find a compliance pathway that would work with the unique way passenger agencies are funded and operated in California. In collaboration with passenger agencies, staff developed an AFMO that could be used in place of the Spending Account and In-Use Operational Requirements. The AFMO is discussed in detail in section II.C.

Although it is inherently impossible to determine which locomotive operators would choose to opt into the AFMO, staff has modeled emission reductions impacts assuming the AFMO would be used only by all California passenger agencies, because of their ability to meet the 50 percent Tier 4 milestone in 2030 that would be difficult for other operators to achieve, and the expressed desire from passenger agencies to expedite their use of ZE locomotives and equipment in their fleets.

## **B. Summary of Estimated Emissions Impacts of the 15-Day Changes**

Figure 1 and Figure 2 show the passenger locomotive emissions estimates in tons per day (tpd) for the 15-day changes version of the Proposed Regulation (identified as "AFMO") compared with the emissions estimates in tpd for the baseline (identified as "Baseline") and the September 20, 2022, version of the Proposed Regulation (identified as "SA&IUOR").



**Figure 1: Comparison of Passenger Locomotive PM2.5 Emissions in Tons Per Day for the Baseline, ISOR Proposal (Spending Account and In-Use Operational Requirements), and 15-Day Changes (AFMO)**

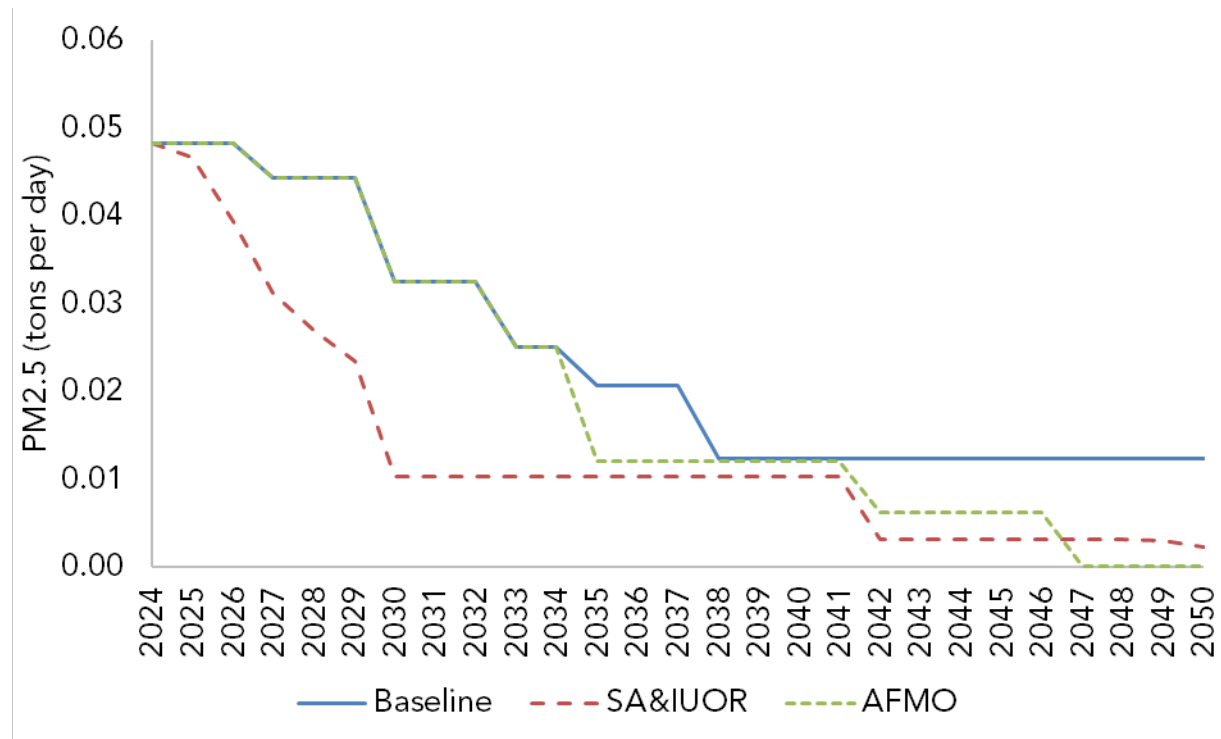


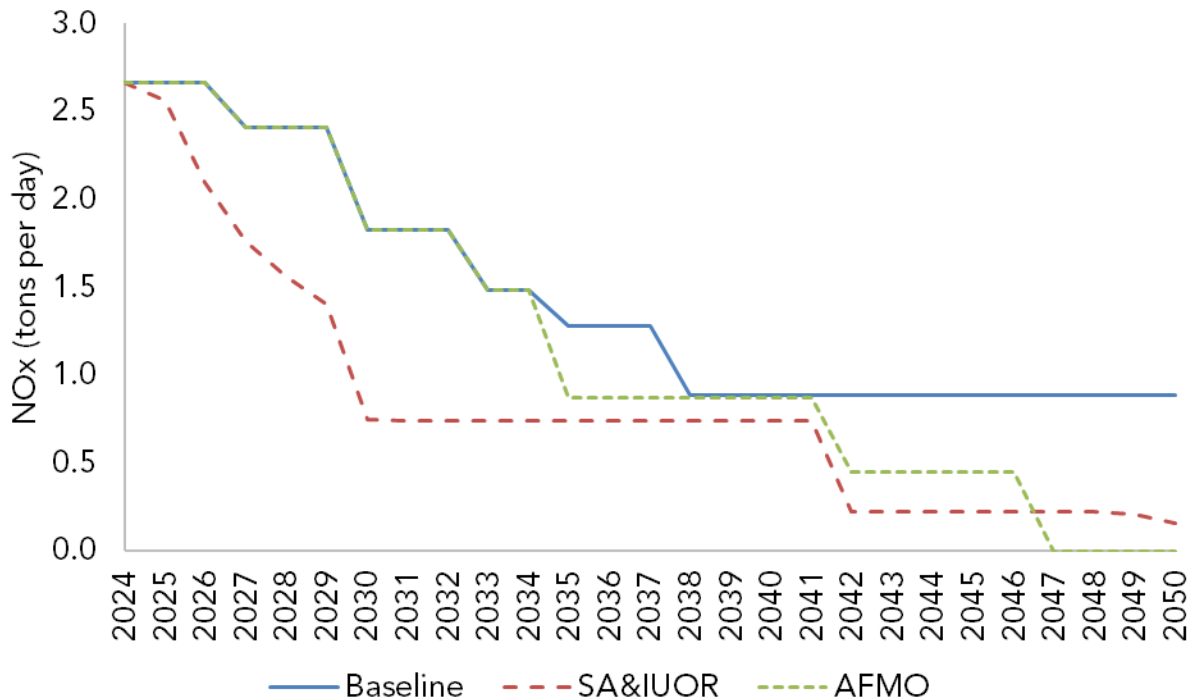
Figure 1 shows that the AFMO would result in more particulate matter (PM) emissions than if passenger agencies followed the Spending Account and In-Use Operational Requirements as required in the ISOR proposal. However, the AFMO would still result in emission reductions compared to the baseline. Table 1 below describes the total PM2.5 emission reductions from the Spending Account and In-Use Operational Requirements for California’s passenger locomotives as 103 tons, or 44 percent less PM2.5 than compared to the baseline, whereas AFMO would result in 39 tons or 16 percent less PM2.5 emissions from 2024–2050 compared to the baseline.

**Table 1: Comparison of the 2024-2050 Total Passenger Locomotive PM Emissions for the Baseline, ISOR Proposal (Spending Account and In-Use Operational Requirements), and 15-Day Changes (AFMO).**

	Baseline	ISOR (SA and IUOR)	AFMO
Total PM Emissions	236 Tons	133 tons	197 tons
PM Reductions From Baseline	-	103 tons (44% reduction)	39 tons (16% reduction)

An increase of 60 tons of PM has an overall impact of approximately 1 percent when compared to the PM emission reductions from all locomotive categories from 2024-2050.

**Figure 2: Comparison of Passenger Locomotive NOx Emissions in Tons Per Day for the Baseline, ISOR Proposal (Spending Account and In-Use Operational Requirements), and 15-Day Changes (AFMO)**



As shown in Figure 2, the from 2024-2050, the AFMO would result in fewer NOx emission reductions than if passenger agencies followed the Spending Account and In-Use Operational Requirements as required in the ISOR proposal. However, the AFMO would still result in NOx emission reductions compared to the baseline. Table 2 below describes the total emission reductions from the Spending Account and In-Use Operational Requirements for California’s passenger locomotives as 5,900 tons or 41 percent less NOx than compared to the baseline whereas the AFMO would result in 2,552 tons or 18 percent less NOx emissions from 2024–2050 compared to the baseline.

**Table 2: Comparison of the 2024-2050 Total Passenger Locomotive NOx Emissions for the Baseline, ISOR Proposal (Spending Account and In-Use Operational Requirements), and 15-Day Changes (AFMO)**

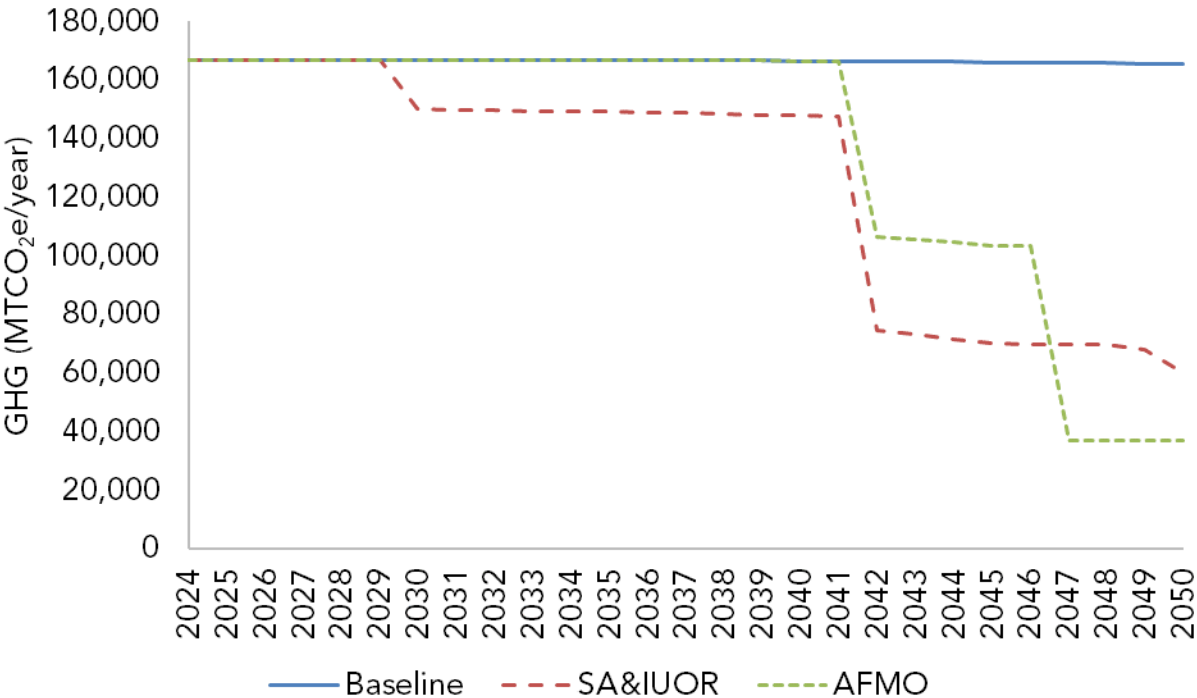
	Baseline	ISOR (SA and IUOR)	AFMO
Total NOx Emissions	14,247 Tons	8,347 tons	11,694 tons

NOx Reductions From Baseline	-	5,900 tons (41% reduction)	2,552 tons (18% reduction)
------------------------------	---	-------------------------------	-------------------------------

An increase of 3,300 tons of NOx has an overall impact of approximately 1 percent when compared to the NOx emission reductions from all locomotive categories from 2024–2050.

Figure 3 shows the passenger locomotive well-to-wheel greenhouse gas (GHG) emissions estimates in metric tonnes of carbon dioxide equivalent per year (MTCO<sub>2</sub>e/year) for the 15-day changes version of the Proposed Regulation (identified as “AFMO”) compared with the emissions estimates in MTCO<sub>2</sub>e/year for the baseline (identified as “Baseline”) and the September 20, 2022, version of the Proposed Regulation (identified as “SA&IUR”).

**Figure 3: Comparison of Passenger Locomotive Well-to-Wheel GHG Emissions in Metric Tonnes of Carbon Dioxide Equivalent Per Year for the Baseline, ISOR Proposal (Spending Account and In-Use Operational Requirements), and 15-Day Changes (AFMO)**



As shown in Figure 3 the AFMO would result in more GHG emissions than if passenger agencies directly complied followed the Spending Account and In-Use Operational Requirements as required in the ISOR proposal. However, the AFMO would still result in emission reductions compared to the baseline of business as usual. Table 3 below describes the total GHG emission reductions from the Spending Account and In-Use

Operational Requirements for California’s passenger locomotives as 1,081,347 metric tonnes, or 24 percent less GHG than compared to the baseline, whereas AFMO would result in 822,658 metric tonnes or 18 percent less GHG emissions from 2024–2050 compared to the baseline.

**Table 3: Comparison of the 2024-2050 Total Passenger Locomotive Well-to-Wheel GHG Emissions for the Baseline, ISOR Proposal (Spending Account and In-Use Operational Requirements), and 15-Day Changes (AFMO).**

	Baseline	ISOR (SA and IUOR)	AFMO
Total GHG Emissions	4,498,321 metric tonnes	3,416,974 metric tonnes	3,675,663 metric tonnes
GHG Reductions from Baseline	-	1,081,347 metric tonnes (24% reduction)	822,658 metric tonnes (18% reduction)

An increase of 258,689 metric tonnes of GHG has an overall impact of approximately 1 percent when compared to the GHG emission reductions from all locomotive categories from 2024–2050.

Staff did not conduct a detailed analysis on how the AFMO will affect emissions from other locomotive categories because as discussed previously, due to current fleet makeup, it is unlikely other locomotive categories would use the AFMO. Additionally, without having information to project how other operators would use the ZE provision in subsection 2478.8(c) of the regulatory language to meet the milestones staff instead qualitatively analyzed other locomotive categories.

If Class I railroads followed the AFMO, the emission reductions are likely less than what they would have achieved under the Spending Account and In-Use Operational Requirements. It is possible that the Class I railroads’ emission reductions from the AFMO may be similar to the Spending Account and In-Use Operational Requirements, because the AFMO milestones for 2030, 2035, and 2042 are similar to the fleet makeup projection under the Spending Account and In-Use Operational Requirements. However, it is more likely that the Class I railroads would use the ZE locomotives provision extensively under the AFMO to offset the usage of older locomotives, in which case the emission reductions would be less than they would have achieved under the Spending Account and In-Use Operational Requirements. However, though overall emission reductions from 2024–2050 would be less, transition to full ZE fleets would be achieved by 2047, which is over 10 years earlier than what is expected under the Spending Account and In-Use Operational Requirements.

If Class III railroads used the AFMO, staff expects emission reductions from 2024–2050 to decrease overall, because Class III railroads are projected to transition to Tier 4 and ZE locomotives at a faster rate under the Spending Account and In-Use Operational

Requirements than the AFMO requirements. However, transition to full ZE fleet will be achieved by 2047, which is about 5 years earlier than what is expected under the Spending Account and In-Use Operational Requirements. Additionally, in 2021, Class III locomotive operators contributed two percent of the total PM and NOx emissions in California. Accordingly, if Class III operators chose to use the AFMO, overall emission impacts would be minimal.

Staff expects that emission reductions from the Industrial locomotives would not change if they used the AFMO option. Many Industrial operators operate a single locomotive, and an operator with a single locomotive can comply with the Regulation by one of three pathways. One is to follow the Spending Account and In-Use Operational Requirements by purchasing a Tier 4 locomotive prior to 2030 and purchasing a ZE locomotive 23 years later, or a ZE locomotive by 2030. The second pathway is complying under an ACP which would lead to a similar locomotive turnover. Finally, the third pathway is to follow the AFMO, and any percentage milestones in the AFMO less than 100 percent would have to be satisfied by replacing their single locomotive. In such case, the AFMO effectively reduces to two milestones, "100 percent Tier 4 or cleaner by 2030," and "100 percent ZE by 2042." In this example, the operator would most likely purchase a ZE locomotive by 2030, because a Tier 4 locomotive would have to be replaced in only 12 years under the AFMO. Therefore, there is no benefit for most Industrial operators to follow the AFMO, and if they followed the AFMO, the compliance pathway would be indistinguishable from the Spending Account and In-Use Operational Requirements.

## **IV. Technical Support Document on Zero Emission Conversions**

Appendix F, Technology Feasibility Assessment for the Proposed In-Use Locomotive Regulation, released on September 20, 2022, focused mainly on new locomotive technologies available for purchase from original equipment manufacturers (OEM). However, because most locomotives in operation today are actually diesel-electric, it is possible operators could replace the power source for their locomotive motors from diesel fuel to another source, such as batteries or hydrogen fuel cell, at a lower cost than purchasing new ZE locomotives from OEMs. The technical support document on ZE conversions (Appendix C) provides further discussion on conversion of existing locomotives and is intended as an introduction on the topic, with more technical analysis to be conducted for the first technology assessment of the Proposed Regulation, scheduled in 2027.