

Before the United States Environmental Protection Agency

In the Matter of California's Request for Authorization Pursuant to Clean Air Act
Section 209(e) for the In-Use Locomotive Regulation

Clean Air Act § 209(e)(2) Authorization Support Document Submitted by the California Air Resources Board

November 7, 2023

Introduction and Overview

The California Air Resources Board (CARB or Board) requests that the Administrator of the United States Environmental Protection Agency (EPA) grant California an authorization pursuant to section 209(e)(2) of the Clean Air Act (CAA) in light of the addition of the "In-Use Locomotive Regulation" (Locomotive Regulation; title 13, California Code of Regulations, section 2478), hereinafter referred to as the "Locomotive Regulation" or "Regulation," to California's emission control program for non-road vehicles and engines.

Locomotives operate within railyards and in and around industrial facilities and also travel throughout the state of California on rail lines. Communities surrounding locomotive operations are often densely populated. These communities disproportionately bear health burdens caused by emissions from diesel-electric locomotives. Diesel-electric locomotives emit multiple air pollutants, such as diesel particulate matter (DPM), particulate matter of 2.5 microns or less (PM_{2.5}), oxides of nitrogen (NO_x), and greenhouse gases (GHG), including black carbon. DPM is a known toxic air contaminant and can cause lung cancer and other health problems. PM_{2.5} is associated with premature mortality, increased hospital admissions for heart or lung causes, acute and chronic bronchitis, asthma attacks, emergency room visits, respiratory symptoms, restricted activity days, and reduced lung function growth in children. As a precursor to smog, NO_x can cause or worsen numerous respiratory and other health ailments and is also associated with premature death. GHGs, including black carbon, contribute to climate change which, in turn, exacerbates ozone- and PM_{2.5}-formation.

Section II of this document provides a brief description of the Board's rulemaking action. Section III presents a summary of the elements of the Locomotive Regulation CARB has added to its non-road emission-control program. Section IV identifies the criteria and principles applicable to authorizations, and Section V demonstrates that there is no basis for EPA to deny this authorization under the Clean Air Act. CARB requests that EPA promptly grant the authorization. The remainder of this section provides a brief overview of the Locomotive Regulation.

I. Purpose of the Locomotive Regulation

California has long faced, and still faces, severe challenges protecting its residents from ozone and PM_{2.5} pollution. California has made, and is making, significant strides toward reducing PM_{2.5} and NO_x from the transportation and other sectors, including from light-, medium- and heavy-duty on-road vehicles as well as non-road vehicles and engines. For example, since 2012, California has required heavy-duty trucks to reduce their emissions through the Statewide Truck and Bus Rule. Additionally, CARB adopted the Advanced Clean Trucks Regulation and Advanced Clean Fleets Regulation, both of which will require increasing use of ZE heavy-duty trucks. Although these measures will bring substantial reductions in emissions, challenges remain in meeting the federal ambient air quality standards for ozone and PM_{2.5} in several large and densely populated areas of the State, including, but not limited to, the South Coast Air Basin and San Joaquin Valley. Deadlines to attain national ambient air quality standards (NAAQS) are established under the federal CAA and implemented by EPA each time a new NAAQS is promulgated based on updated information showing health impacts at increasingly lower levels. The near-term targets are a 2023 deadline for attainment of the 80 parts per billion (ppb) 8-hour ozone standard, 2024 for the 35 microgram per cubic meter (µg/m³) 24-hour PM_{2.5} standard, and 2025 for the 12 µg/m³ annual PM_{2.5} standard. There are also mid-term attainment years of 2031 and 2037 for the more recent 8-hour ozone standards of 75 ppb and 70 ppb, respectively. The 2022 State Strategy for the State Implementation Plan (2022 State SIP Strategy). that CARB developed to meet these targets includes the critical emission reductions that would be achieved by the Locomotive Regulation.¹ Furthering the importance of reducing emissions from locomotives, earlier this year, EPA released a proposal to revise the annual PM_{2.5} standard by lowering the level by up to 25%, from 12 µg/m³ to between 9 and 10 µg/m³.²

The Locomotive Regulation is expected to reduce a cumulative total of more than 7,000 tons of PM_{2.5} and almost 400,000 tons of NO_x from its inception through 2050. In fact, the Locomotive Regulation is the largest NO_x reduction strategy in the 2022 State SIP Strategy. It is responsible for more than 60 tons per day of NO_x reduction by 2037, 31% of the 2022 State SIP Strategy's total NO_x reductions. The Locomotive Regulation is not only needed to support the 2022 State SIP Strategy but will provide public health benefits and reduce the cancer risk burden from toxic diesel PM to communities surrounding facilities where they operate, particularly in disadvantaged communities experiencing disproportionate burdens. And that is true, regardless of where those communities are located in the State, including for such communities outside the South Coast and San Joaquin air districts. Without the Locomotive Regulation, in 2030 locomotives are projected to contribute 14% of California's freight diesel emissions NO_x inventory and 16% of California's freight diesel emissions PM_{2.5} inventory.

¹ CARB, 2022 State SIP Strategy, September 22, 2022. (Weblink: https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf).

² U.S. EPA, EPA Proposes to Strengthen Air Quality Standards to Protect the Public from Harmful Effects of Soot, January 6, 2023. (Weblink: <https://www.epa.gov/newsreleases/epa-proposes-strengthen-air-quality-standards-protect-public-harmful-effects-soot>).

Although the Locomotive Regulation is primarily focused on reducing toxic DPM emissions, and NOx, locomotives also emit GHG emissions (including short-lived climate pollutants like black carbon and hydrofluorocarbons). The Locomotive Regulation is projected to reduce GHG emissions by 21.6 million metric tons from 2030 to 2050. These reductions are needed to help mitigate the extreme climate impacts California faces and to achieve California's multiple GHG reduction targets and climate goals, including those required by Senate Bill 32 (Pavley, Chapter 249, Statutes of 2016) and Senate Bill 1383 (Lara, Chapter 395, Statutes of 2016).

Overview of CARB's Rulemaking

CARB posted the initial Notice of Public Hearing for the Locomotive Regulation on September 20, 2022.³ CARB issued a Notice of Public Availability of Modified Text and Availability of Additional Documents and/or Information" (15-Day Notice) outlining changes to the proposed regulation on March 1, 2023.⁴ At its April 27, 2023, public hearing, the Board approved the Locomotive Regulation by Resolution 23-12.⁵ On August 8, 2023, CARB issued a Second Notice of Public Availability of Modified Text and Availability of Additional Documents and Information (Second 15-Day Notice).⁶ CARB submitted the Locomotive Regulation to the California Office of Administrative Law (OAL) for review on September 15, 2023. OAL subsequently approved the Regulation and filed the rulemaking with the California Secretary of State on October 27, 2023. The Locomotive Regulation will become effective under state law on January 1, 2024.

Summary of the Locomotive Regulation

This section provides an overview of the component provisions of the Locomotive Regulation added to California's non-road emission control program for which CARB is requesting an authorization. More detailed descriptions of these provisions are provided in the Staff Report: Initial Statement of Reasons (ISOR or Staff Report),⁷ 15-Day Notice, Second 15-Day Notice, and the Final Statement of Reasons (FSOR).⁸

³ Notice of Public Hearing to Consider Proposed In-Use Locomotive Regulation, September 20, 2022, (Weblink: <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/locomotive22/notice.pdf>).

⁴ Notice of Public Availability of Modified Text, and Availability of Additional Documents, including all Appendices, issued March 1, 2023. (Weblink: <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/locomotive22/15daynotice.pdf>).

⁵ Resolution 23-12, dated April 27, 2023. (Weblink: <https://ww2.arb.ca.gov/sites/default/files/barcu/board/res/2023/res23-12.pdf>).

⁶ CARB, Second Notice of Public Availability of Modified Text and Availability of Additional Documents and Information, August 8, 2023. <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/locomotive22/2nd15daynotice1.pdf>

⁷ Staff Report: Initial Statement of Reasons, including all Appendices, issued September 20, 2022. (Weblink: <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/locomotive22/isor.pdf>).

⁸ Final Statement of Reasons for Rulemaking Including Summary of Comments and Agency Responses, October 27, 2023. (Weblink: <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/locomotive22/fsor2.pdf>).

The Regulation applies to any locomotive operator that operates a locomotive in the State of California or to a delegate of that operator and applies only to locomotives and locomotive engines placed into service in California and only to an operator or delegate's operations inside California. The Regulation does not apply to self-propelled pieces of on-track equipment that are propelled by engines with a total rated power of less than 1,006 horsepower (hp).⁹ The Regulation does not apply to locomotives used for "hands-on experience" certification required for mechanics and locomotive engineers, provided the locomotive is not used for any other purposes, such as to haul freight or passengers. The Regulation also does not apply to military locomotives.

The Regulation and this authorization request use the term Zero Emission (ZE) Configuration to mean an operational configuration for the locomotive that emits no pollution, regardless of whether the locomotive might emit pollution when operated differently. Locomotives have long run on zero-emission electric engines, albeit powered by diesel generators—which is why they are often referred to as "diesel-electric locomotives." This use of electric engines gives operators a variety of options to retrofit or reconfigure their locomotives to zero-emission operation. Examples include ZE locomotives; connecting the existing electric engine of a diesel-electric locomotive to a secondary ZE slug, battery tender-car or fuel cell tender-car; running a hybrid-powered locomotive using the ZE power only; or connecting the electric engine of a locomotive to an overhead catenary line.

II. Spending Account¹⁰

Annually, for each locomotive operated in California, locomotive operators are required to deposit funds into a Spending Account. The account operates as a restricted trust, held by the locomotive operator, with the funds able to be withdrawn for specific uses described below.

The amount deposited in the account is an estimate of the health cost burden on Californians from each locomotive, calculated by estimating the locomotive's emissions in California and the health costs of those emissions. A portion of the spending account funding obligation may be offset through early use of ZE technologies. Funds in the Spending Account may be used for:

1. The purchase, lease, or rental of Tier 4 or cleaner locomotives, or for the remanufacture or repower of other locomotives to Tier 4 or cleaner levels. (Funds may be used in this way through December 31, 2029.)
2. The purchase, lease, or rental of ZE locomotives, ZE capable locomotives, or ZE rail equipment, or to repower other combustion-powered locomotives to ZE locomotives or ZE capable locomotives. A ZE capable locomotive is one that can be operated in a ZE

⁹ EPA similarly defines a locomotive to be on-track equipment with engines that meet or exceed total rated power of 1,006 hp, although if an owner or manufacturer certifies such equipment it becomes, under EPA's definition, a locomotive. 40 CFR § 1033.901.

¹⁰ The provisions related to the spending account are specified in section 2478.4.

configuration in California and will not emit any criteria pollutant, toxic pollutant, or greenhouse gas in California from any onboard source of power.

3. The purchase of ZE infrastructure intended to support ZE locomotives, ZE capable locomotives, or ZE rail equipment.
4. Pilot projects or demonstrations of ZE locomotives or ZE rail equipment technologies.

To incent early action, operators who make qualifying purchases using funds other than the Spending Account can reduce their Spending Account deposit obligation in a given year by the amount of those qualifying purchases.

III. California In-Use Locomotive Operational Requirement¹¹

Starting January 1, 2030, only locomotives with an original engine build date less than 23 years old are allowed to operate in California unless it meets the current cleanest EPA Tier (currently Tier 4) for a locomotive of its type, is operated in a ZE configuration while in California, or if the primary engine has not exceeded the specified MWh. Additionally, if a locomotive has been remanufactured or repowered to a Tier 4 or cleaner emissions standard prior to January 1, 2030, the original engine build date will be based on the first year the locomotive was remanufactured to the Tier 4 or cleaner standard.

As mentioned above, any locomotive can be operated in a ZE configuration in California. For example, powering the electric engines of Tier 2 locomotive using a battery tender car is permitted, so long as the Tier 2 diesel generator of that Tier 2 locomotive is not operated within California.

A. In-Use Locomotive Zero Emission Operational Requirements¹²

Beginning January 1, 2030, all passenger, switch, and industrial locomotives with engine build dates of 2030 or newer, must operate in a ZE configuration while in California. As described above, ZE configuration means a configuration that operates in a ZE capacity. To be considered as operating in a ZE configuration, the locomotive must not emit any criteria pollutant, toxic pollutant, or greenhouse gas from any onboard source of power at any power setting, including any propulsion power that is connected to and moves with the locomotive when it is in motion.

CARB anticipates it will require a longer period for locomotive operators to determine how best to operate their freight line haul locomotives in ZE configuration because of the long distances traveled by, and higher power needs of, these locomotives. Therefore, beginning

¹¹ The provisions related to the in-use operational requirement are specified in section 2478.5(a).

¹² The provisions related to the in-use zero-emission operational requirements are specified in section 2478, subsections (b) and (c).

January 1, 2035, line haul locomotives with engine build dates of 2035 or newer will need to operate in a ZE configuration while in California.

The Regulation requires CARB staff to evaluate, in 2027 and 2032, the status of ZE technologies, configurations, and supporting infrastructure for passenger, switch, and industrial locomotives and freight line haul locomotives, respectively. If either of the evaluations shows the 2030 or 2035 ZE dates to be infeasible, staff will propose regulatory amendments.

IV. Alternative Compliance Plan¹³

The Alternative Compliance Plan (ACP) is a voluntary compliance pathway allowing regulated locomotive operators to comply with the Spending Account and/or In-Use Operational Requirements using a project or projects that achieve(s) equivalent emissions reductions within three miles of the operators' locomotive activities within California. This compliance option was included in response to operators requesting an alternative to the Spending Account and/or In-Use Operational Requirements to allow for equivalent or greater emissions reductions in impacted communities at a lower cost, compared to the cost of direct compliance with the Spending Account and In-Use Operational Requirements. All operators must still comply with idling, registration, reporting and recordkeeping requirements.

An example of an ACP could be if operators elected to electrify trucks or cargo handling equipment that operate in or around their rail facility to reduce the diesel PM and NOx emissions to which nearby communities are exposed. An approved ACP can be a regulated entity's sole pathway to compliance or as part of a "hybrid approach" that combines partial direct compliance with reductions achieved by an ACP.

V. Alternative Fleet Milestone Option¹⁴

During the November 18, 2022, hearing, the Board directed staff to collaborate with transit agencies to support the transition to ZE operations, increase ridership, and minimize repayment of public grant funds for locomotives with grant lives of more than 23 years. Through that collaboration staff developed the Alternative Fleet Milestone Option (AFMO).

The AFMO is a voluntary compliance pathway that may be used in place of directly complying with the Spending Account and In-Use Operational Requirements. All operators must still comply with idling, registration, reporting and recordkeeping requirements. Although the AFMO was developed specifically with passenger operators in mind, this compliance option is available to all locomotive operators.

¹³ The provisions related to the Alternative Compliance Plan are specified in section 2478.7.

¹⁴ The provisions related to the Alternative Fleet Milestone Option are specified in section 2478.8.

Under the AFMO, by the year 2030, an operator must demonstrate that 50% of their operations are accomplished by Tier 4 or cleaner locomotives; beginning in 2035, 100% of operations must be accomplished by Tier 4 or cleaner locomotives; beginning in 2042, at least half of operations must be ZE; and finally, beginning in 2047, 100% of operations must be ZE.

Prior to January 1, 2047, operation of ZE locomotives in California may offset operation of a locomotive operator's pre-Tier 4 locomotives. The value of the offset varies according to the emission level of the pre-Tier-4 locomotive that is operated.

VI. Idling Requirements¹⁵

Due to community members concerns about the public health risks from excessive unnecessary idling of locomotive engines near homes and schools, CARB staff included an idling requirement in the Regulation. Locomotive operators must ensure that an Automatic Engine Stop Start (AESS) equipped locomotive is shut off no more than 30 minutes after the locomotive becomes stationary. A locomotive may only exceed 30 minutes of idling for the following reasons: to prevent engine damage such as to prevent the engine coolant from freezing; to maintain air pressure for brakes or starter system, or to recharge the locomotive battery; to perform necessary maintenance; or to otherwise comply with federal or state regulations.

The Regulation also requires locomotive operators to maintain their AESS systems and to replace or repair malfunctioning AESS systems; in addition, locomotive operators must manually shut off engines during the time when an AESS is not functioning. Although this requirement closely follows the federal idling equipment requirements, 40 C.F.R. § 1033.115(g), the requirement in the Locomotive Regulation is designed to allow California to enforce these idling limitations against operators based on in-use violations.

VII. Registration, Reporting, and Recordkeeping Requirements¹⁶

The Regulation imposes registration, reporting and recordkeeping requirements on locomotive operators for all locomotive activity in California. Locomotive operators are required to register all locomotives operating within the State by July 1, 2026. Required registration information includes operator contact information, locomotive identifying information, and emissions information such as road number, engine tier, and build year.

Annual reporting requirements include all information necessary to establish compliance, as well as data on the quantity of locomotive emissions occurring in California, by operator. For AESS-equipped locomotives: operators must submit a report of each idling event which

¹⁵ The provisions related to the Idling Requirements are specified in section 2478.9.

¹⁶ The provisions related to registration are specified in section 2478.10. The provisions related to reporting are specified in section 2478.11.

exceeds 30 minutes, along with the location and reason for the exceedance. For the spending account: operators must calculate their annual spending account obligation, show evidence that they deposited the funds, and report any purchases made with the funds; locomotive operators wishing to claim spending account credits for early operation of ZE equipment must report their ZE usage and their calculation of credit.

VIII. Additional Flexibility Provided Through Exemptions and Compliance Extensions

The compliance exemptions and extensions that are described in this section will provide locomotive operators enhanced flexibility to comply with the Spending Account and In-Use Operational Requirements.

A. Compliance Extension for Temporary Operations for Relocation or Maintenance of Locomotives or Based on Delays Due to Equipment Manufacture Delays, Installation Delays, or Unavailability of Compliant Equipment, or for Emergency Circumstances.

Locomotive operators may apply for a temporary extension in cases where they must operate a locomotive for maintenance or to move it out of the state.¹⁷ Locomotive operators may also apply for a temporary exemption to operate a locomotive during unforeseen or emergency circumstances, including, but not limited to, fires, floods, earthquakes, embargoes, epidemics, quarantines, war, acts of terrorism, riots, strikes, or lockouts.¹⁸ If a locomotive operator cannot meet the requirements of the regulation due to compliant equipment manufacture delays, installation delays, or unavailability of compliant equipment due to circumstances beyond their reasonable control, the operator may apply for a maximum one-year compliance extension.¹⁹

B. Historic Locomotive Low Use Exemption²⁰

Operators of historic locomotives may apply for a Historic Locomotive Low-Use Exemption, provided they meet the qualifications: the locomotive does not haul freight; is used solely for education, preservation, or historical experience; and the use of the locomotive in its original configuration is key to the educational, preservation, or historical experience. Operators using a historic locomotive low-use exemption must not use more than 10,000 gallons per year of diesel fuel within the operator's entire applicable historic locomotive fleet.

¹⁷ The provisions related to the compliance extension based on emergency events are specified in section 2478.6(a)(1).

¹⁸ The provisions related to the compliance extension based on emergency events are specified in section 2478.6(a)(2).

¹⁹ The provisions related to the compliance extension based on emergency events are specified in section 2478.6(b).

²⁰ The provisions related to the historic railroad low-use exemption are specified in section 2478.13.

Authorization Criteria and Principles

IX. Criteria for Granting Authorizations Under CAA Section 209(e)

Section 209(e)(2)(A) of the CAA sets forth the protocol for the Administrator to grant California an authorization to adopt and enforce standards and other requirements to control emissions from nonroad vehicles and engines that are not otherwise preempted from all state regulation under section 209(e)(1).²¹ California may obtain an authorization under Section 209(e)(2)(A) for a program that includes regulations applicable to locomotives and their engines that are not new (non-new). The Locomotive Regulation is such a regulation. It does not require changes to new locomotive manufacturing. Rather, it imposes requirements on how locomotives in service in California are operated in the State, as well as other requirements based on those in-state operations of in-service locomotives (e.g., the reporting requirements).

Closely tracking the new motor vehicle waiver process, section 209(e)(2)(A) directs the Administrator to grant an authorization to California if California determines that the State's standards will be, in the aggregate, at least as protective of public health and welfare as applicable federal standards, unless he or she finds that: (1) the protectiveness finding of the State is arbitrary and capricious; (2) California does not need a separate state program to meet compelling and extraordinary conditions; or (3) the State's program and accompanying enforcement procedures are not consistent with section 209 of the CAA.²² The criteria for reviewing a California request for authorization under section 209(e)(2) are nearly identical to the criteria that the Administrator must consider under section 209(b). EPA has confirmed that it would similarly interpret sections 209(b) and (e) where the language is similar and it has done so with past authorization requests.²³

CAA section 209(e)(2) requires the Administrator to consider consistency with other subsections of section 209 (whereas for new motor vehicles the requirement is consistency with section 202(a)). In its 209(e) Final Rule, EPA interpreted this provision to require that California's standards and accompanying enforcement provisions must be consistent with sections 209(a), 209(e)(1), and 209(b)(1)(C).²⁴ As the Administrator has stated:

“In [o]rder to be consistent with section 209(a), California's [nonroad] standards and enforcement procedures must not apply to new motor vehicles or new motor vehicle engines. Secondly, California's nonroad standards and enforcement

²¹ Section 209(e)(1)(A) excludes, from state emission standards, “[n]ew engines which are used in construction equipment or vehicles or used in farm equipment or vehicles and which are smaller than 175 horsepower.” Section 209(e)(1)(B) excludes, from state emission standards, “[n]ew locomotives or new engines used in locomotives.”

²² 82 Fed. Reg. 6525, 6256 (Jan. 19, 2017).

²³ Air Pollution Control; Preemption of State Regulation for Nonroad Engine and Vehicle Standards (Final 209(e) Rule), 59 Fed. Reg. 36969 (July 20, 1994), Decision Document accompanying 60 Fed. Reg. 37440 (July 20, 1995) at p. 11; 65 Fed. Reg. 69763, 69764 (Nov. 20, 2000).

²⁴ 59 Fed. Reg. 36969, 36983 (July 20, 1994).

procedures must be consistent with section 209(e)(1), which identifies the categories permanently preempted from state regulation. California's nonroad standards and enforcement procedures would be considered inconsistent with section 209 if they applied to the categories of engines or vehicles identified and preempted from State regulation in section 209(e)(1). Finally, and most importantly in terms of application to nonroad [authorization requests], California's nonroad standards and enforcement procedures must be consistent with section 209(b)(1)(C). EPA will review nonroad authorization requests under the same "consistency" criteria that are applied to motor vehicle waiver requests. Under section 209(b)(1)(C), the Administrator shall not grant California's motor vehicle waiver if she finds that California 'standards and accompanying enforcement procedures are not consistent with section 202(a)' of the [CAA] ..."²⁵

Consistency with section 202(a) "relates in relevant part to technological feasibility and to federal certification requirements."²⁶ Neither the court nor the agency has ever interpreted compliance with section 202(a) to require more."²⁷ Notably, the federal certification component has less obvious application for California regulations applicable to non-new vehicles and engines because federal certification requirements generally apply only to new vehicles and engines.

X. Principles Followed in Granting CAA Section 209(e) Authorizations

A. The Burden Is on the Opponents Challenging the Request

California is presumed to have satisfied the criteria for granting an authorization or waiver, and the burden to show otherwise is on those persons challenging the request.²⁸ This has long been EPA's approach,²⁹ which is directed by the statutory text requiring EPA to grant authorizations or waivers unless it is able to make one or more of the three findings that can support denial. Moreover, the phrasing of the three criteria for denial indicates that opponents, not California, bear the burden because California could not plausibly bear the burden of showing that its protectiveness determination is arbitrary and capricious; that it does not need its own standards; or that its programs are infeasible in the lead time provided. EPA's approach to this burden question has also been upheld by the D.C. Circuit and ratified by

²⁵ 65 Fed. Reg. 69763, 69764 fn. 5 (Nov. 20, 2000).

²⁶ *Motor & Equip. Mfrs. Ass'n v. Nichols*, 142 F.3d 449, 463 (D.C. Cir. 1998) (quoting *Ford Motor Co. v. EPA*, 606 F.2d 1293, 1296 n. 17 (D.C. Cir. 1979)).

²⁷ *Id.* See also Decision Document accompanying 61 Fed. Reg. 53371 (Oct. 11, 1996) at p.2; Even where there is incompatibility between the California and federal test procedures, EPA has granted a waiver under circumstances where EPA accepts a demonstration of federal compliance based on California test results, thus obviating the need for two separate tests. 43 Fed. Reg. 1829, 1830 (Jan. 12, 1978); 40 Fed. Reg. 30311, 30314 (July 18, 1975).

²⁸ *MEMA I*, 627 F.2d 1095, 1121.

²⁹ See e.g., 36 Fed. Reg. 17,458-17,459 (Aug. 31, 1971); 40 Fed. Reg. 23,102, 23,103 (May 28, 1975); Decision Document accompanying 61 Fed. Reg. 53371 at p. 15-16.

Congress.³⁰ Given the identical structure and near identical language of sections 209(b) and 209(e)(2), the opponents of an authorization request bear a similar burden of proof when arguing that authorization should be denied.³¹

B. The Scope of the Waiver/Authorization Proceeding Is Limited

The scope of the Administrator's inquiry in considering a waiver or authorization request is limited by the express terms of CAA sections 209(b)(1) and (e)(2)(A). Once California determines that its standards are, in the aggregate, at least as protective of public health and welfare as applicable federal standards, the Administrator must grant the waiver or authorization unless the record supports one of the three specified findings discussed in Section IV.A.

This reading of the statute is consistent with the decision in *MEMA I* and prior EPA waiver decisions interpreting CAA section 209(b), which hold that the review of a California waiver request is a narrow one.³² For example, in granting the waiver for the CARB On-Board Diagnostic II Regulation in 1996, Administrator Carol Browner concluded that she must grant a waiver if sufficient evidence in the record did not support any of the criteria that would allow a denial.³³ In 2009, Administrator William D. Ruckelshaus stated:

The law makes it clear that the waiver request cannot be denied unless the specific findings designated in the statute can properly be made. The issue of whether a proposed California requirement is likely to result in only marginal improvement in air quality not commensurate with its cost or is otherwise an arguably unwise exercise of regulatory power is not legally pertinent to my decision under section 209 ...³⁴

C. Deference Must Be Accorded to California's Policy Judgments

In granting waivers to California's motor vehicle program, EPA has repeatedly and routinely deferred to the policy judgments of California's decision-makers. EPA has recognized that the intent of Congress in creating a limited review of California's waiver requests was to ensure

³⁰ *MEMA I*, 627 F.2d 1095, 1121. When Congress amended Section 209(b)(1) in 1977 to expand California's discretion, it expressly approved EPA's application of the waiver provision. H.R. Rep. No. 95- 294, at 301 (1977). Then, in 1990, Congress further ratified EPA's approach to Section 209(b)(1) by reenacting virtually identical text in Section 209(e)(2).

³¹ See, e.g., Decision Document accompanying 60 Fed. Reg. 37440 (July 20, 1995) at p. 14; Decision Document accompanying 61 Fed. Reg. 69093 (Dec. 31, 1996) at pp. 16-17; 76 Fed. Reg. 77521, 775223 (Dec. 13, 2011); 82 Fed. Reg. 6525, 6528 (Jan. 19, 2017).

³² See 40 Fed. Reg. 23102, 23103 (May 28, 1975).

³³ 61 Fed. Reg. 53371 (Oct. 11, 1996); *Motor & Equip. Mfrs Ass'n v. Nichols*, ("MEMA II") 142 F.3d 449 (D.C. Cir. 1998).

³⁴ 36 Fed. Reg. 17158 (Aug. 31, 1971). See also 40 Fed. Reg. 23102, 23104; Decision Document accompanying 58 Fed. Reg. 4166 (Jan. 7, 1993) at pp. 20-21; 74 Fed. Reg. 32744, 32748 (July 8, 2009).

that the federal government did not second-guess the wisdom of state policy.³⁵ Administrators have recognized that the deference is wide-ranging:

The structure and history of the California waiver provision clearly indicate both a Congressional intent and an EPA practice of leaving the decision on ambiguous and controversial matters of public policy to California's judgment.

* * * * *

It is worth noting ... I would feel constrained to approve a California approach to the problem which I might also feel unable to adopt at the federal level in my own capacity as a regulator. The whole approach of the Clean Air Act is to force the development of new types of emission control technology where that is needed by compelling the industry to "catch up" to some degree with newly promulgated standards. Such an approach ... may be attended with costs ... and by risks that a wider number of vehicle classes may not be able to complete their development work in time. Since a balancing of these risks and costs against the potential benefits from reduced emissions is a central policy decision for any regulatory agency under the statutory scheme outlined above, I believe I am required to give very substantial deference to California's judgments on this score.³⁶

By authorizing California to adopt its own emission standards for nonroad vehicles and engines, and by establishing almost identical requirements for EPA review of authorization requests under section 209(e)(2) as it requires for waiver decisions under section 209(b), Congress unmistakably intended that the EPA accord similar deference to California's decisions under 209(e)(2).³⁷

Authorization Analysis

CARB submits that for the reasons set forth below, and in the documents associated with the Locomotive Regulation rulemaking action, the Administrator must grant California an authorization for its amended nonroad program that now includes the Locomotive Regulation, as the Administrator has no basis under the criteria of CAA section 209(e)(2)(A) to deny California's request.

³⁵ See also, e.g., 74 Fed. Reg. 32744, 32748 (July 8, 2009).

³⁶ 40 Fed. Reg. 23102, 23104 (emphasis added). See also Decision Document accompanying 58 Fed. Reg. 4166 (Jan. 17, 1993) at p. 64.

³⁷ See discussion in *Engine Manufacturers Association v. U.S. EPA (EMA)*, 88 F.3d 1075, 1090 (D.C. Cir. 1996), wherein the court recognized California's leadership in emission control regulation in both new motor vehicles and new and in-use nonroad engines.

XI. Protectiveness

Section 209(e)(2)(A)(i) mirrors section 209(b)(1)(A), which allows EPA to deny California an authorization for nonroad vehicle or engine emission standards if the State’s “determin[ation] that California standards will be, in the aggregate, at least as protective of public health and welfare as applicable Federal standards” is arbitrary and capricious. As with new on-road motor vehicles and engines, California evaluates the protectiveness of its nonroad emission standards “in the aggregate,” assessing whether the State’s nonroad standards, as a whole regulatory program, are at least as protective as EPA’s nonroad program.³⁸ This assessment also occurs against the backdrop of prior authorization grants for which California determined, and EPA affirmed, that California’s existing nonroad emissions program is at least as protective as EPA’s. Consequently, California’s protectiveness determination focuses on whether its new or amended standards would alter the protectiveness of the State’s program in the aggregate – that is, whether the new or amended standards would cause the State’s nonroad emissions control program to become less protective than EPA’s nonroad emissions control program.³⁹

As explained in the cover letter accompanying this document, CARB’s Executive Officer, pursuant to California Health and Safety Code 39516 and Board Resolution 23-12, has determined that the requirements related to the control of emissions from non-new locomotives associated with the Locomotive Regulation will not cause California’s nonroad emission standards, in the aggregate, to be less protective of public health and welfare than applicable federal standards because these regulations provide additional protections to those provided by the federal emissions standards applicable to “new” locomotives. No basis exists for the Administrator to find that CARB’s determination is arbitrary or capricious. The emissions reductions CARB anticipates these regulations will produce further underscore the point. It is consequently clear that there is no way that the Locomotive Regulation will cause California’s nonroad engine and equipment emissions standards, in the aggregate, to be less protective of the public health and welfare than applicable federal standards.

XII. Compelling and Extraordinary Circumstances

The Administrator has consistently recognized that California satisfies the second criterion for waivers and authorizations—that the State continues to have “compelling and extraordinary conditions” and therefore continues to need its own motor vehicle and motor vehicle engine, and nonroad engine and equipment emissions control programs, respectively.

³⁸ CAA § 209(e)(2)(A)(i); 42 U.S.C. § 7543(e)(2)(A)(i).

³⁹ 68 Fed. Reg. 65,702, 65,704 (Nov. 21, 2003) (“[T]he various amendments will not cause the California nonroad standards, in the aggregate, to be less protective of public health and welfare than the applicable Federal standards.”); 75 Fed. Reg. 8056, 8059 (Feb. 23, 2010) (same).

A. Traditional Interpretation of Compelling and Extraordinary Criterion

EPA has traditionally interpreted CAA section 209(e)(2)(A)(ii) consistently with its interpretation of section 209(b)(1)(B), i.e., as requiring an inquiry regarding California’s need for a separate nonroad engine and equipment emissions control program to meet compelling and extraordinary conditions, and not whether any given standard is necessary to meet such conditions. EPA has expressed this as an inquiry into “the existence of ‘compelling and extraordinary’ conditions” of the kind for which a separate state program of controls remains warranted.⁴⁰

In other words, “review ... under section 209(b)(1)(B) is not based on whether California has demonstrated a need for the particular regulations, but upon whether California still needs a separate program to meet compelling and extraordinary conditions.”⁴¹

The citizens of California suffer from exposure to the worst air quality in the nation. The 2021 American Lung Association’s State of the Air report lists the 25 most polluted cities in the country.⁴² Ten California cities were on the top 25 most ozone⁴³ polluted list and seven were on the top 25 PM_{2.5} pollution list—far more than any other state in the nation. Some of the most populated areas in California do not meet the health-based National Ambient Air Quality Standards (NAAQS).⁴⁴ More than half (21 million out of nearly 40 million) of Californians live in areas that exceed the most stringent 70 ppb ozone standard. Further, a disproportionate number of California’s population live in areas that are deemed extreme nonattainment,⁴⁵ meaning they are most impacted by high ozone levels. Additionally, these Californians often live in low-income and disadvantaged communities that experience greater exposure to diesel exhaust and other toxic air pollutants compared to surrounding areas. Two areas of the State have the most critical air quality challenges: The South Coast and the San Joaquin Valley. These regions are the only two areas in the nation with an Extreme classification for the 70 ppb ozone standard.⁴⁶

⁴⁰ 40 Fed. Reg. 23,103 (May 28, 1975); see also *id.* at 23,104 (concluding “[c]ompelling and extraordinary conditions continue to exist in the State of California”). See also 41 Fed. Reg. 44,209 44,210 (Oct. 7, 1976) (“[T]he question of whether these particular standards are actually required by California all fall within the broad area of public policy [left to] California’s judgment ... consistent with the Congressional intent behind the California waiver provision.”).

⁴¹ 44 Fed. Reg. at 38,660, 38,661 (July 2, 1979).

⁴² American Lung Association, 2021 State of the Air Report, 2021. (Weblink:

<https://www.lung.org/getmedia/17c6cb6c-8a38-42a7-a3b0-6744011da370/sota-2021.pdf>).

⁴³ Ozone is formed in the atmosphere through chemical reactions between pollutants emitted from vehicles, factories and other industrial sources, fossil fuels, combustion, consumer products, evaporation of paints, and many other sources. Hydrocarbons and nitrogen oxide gases (NO_x) react in the presence of sunlight to form ozone. CARB, Ozone and Health. (Weblink: https://ww2.arb.ca.gov/resources/fact_sheets/ozone_effects)

⁴⁴ CARB, National Ambient Air Quality Standards. (Weblink: <https://ww2.arb.ca.gov/resources/national-ambient-air-quality-standards>).

⁴⁵ U.S. EPA, 83 Fed. Reg. 10377-10380, March 9, 2018. (Weblink: <https://thefederalregister.org/83-FR/10376/2018-04810.pdf>).

⁴⁶ CARB, 2022 State SIP Strategy, January 31, 2022. (Weblink: https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf).

In response to the undisputed severe air quality problems in California, the California Legislature authorized CARB to consider adopting, *inter alia*, standards and regulations for nonroad engines.⁴⁷ Given the serious air pollution problems California faces and the resultant need to achieve the maximum reductions in emissions, the California Legislature and CARB believe it is necessary to develop emission controls for nonroad sources as well as for motor vehicles.⁴⁸ By adding federal authority to regulate certain nonroad engines and preserving substantial state authority as well, Congress likewise acknowledged the importance of reducing emissions from all mobile sources, including nonroad engines. The Administrator has repeatedly agreed with CARB that California's continuing extraordinary conditions justify separate California nonroad emission control programs.⁴⁹ Unfortunately, while California has made progress in improving air quality, these compelling and extraordinary conditions persist. Accordingly, for all the aforementioned reasons, there is no basis to deny this request under EPA's traditional interpretation of Section 209(e)(2)(A)(ii) because EPA cannot conclude that California no longer needs its own nonroad vehicle and engine emissions control program.

B. Alternative Interpretation of the Compelling and Extraordinary Criterion

Even if EPA applies a narrower standard-specific inquiry, as opponents of this authorization may advocate, the record demonstrates that California "needs" the requirements of the Locomotive Regulation to address compelling and extraordinary conditions in California.

As discussed in Section I, locomotives emit substantial quantities of harmful air pollutants, including NO_x and PM. California needs to achieve substantial reductions of both NO_x and PM to attain the NAAQS for ozone and particulate matter, and the Locomotive Regulation is included in California's 2022 State Implementation Plan (SIP) that is designed to achieve the emissions reductions needed for California to attain those NAAQS.⁵⁰ In addition, NO_x emissions pose serious risks to the health and welfare of Californians. NO_x emissions not only irritate the respiratory system and aggravate respiratory diseases, but they also react in the atmosphere to form ozone and PM. PM, in particular, poses serious risks to the health and environment of Californians, including increased risk of lung and heart diseases, as well as premature death.

EPA has never disputed California's need to reduce emissions of these criteria pollutants.⁵¹ Nor could it. To attain the 2015 ozone NAAQS, NO_x emissions in the South Coast air basin must drop by 67% more than is required by adopted rules and regulations in 2037.⁵² Similarly,

⁴⁷ Cal. Health and Saf. Code, §§ 43013, 43018.

⁴⁸ Cal. Health and Saf. Code, §§ 41750, 41754, 43000.5, 43013 and 43018.

⁴⁹ 60 Fed. Reg. 37440 (July 20, 1995); 61 Fed. Reg. 69093 (Dec. 31, 1996); 71 Fed. Reg. 29623 (May 23, 2006); 76 Fed. Reg. 77521 (Dec. 13, 2011).

⁵⁰ California Air Resources Board, 2022 State Strategy for the State Implementation Plan, September 22, 2022. (Weblink: https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf).

⁵¹ 79 Fed. Reg. 46256, 46261-262 (Aug. 7, 2014).

⁵² South Coast Air Quality Management District, 2022 Air Quality Management Plan, December 2022. (Weblink: <http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2022-air-quality-management-plan/final-2022-aqmp/final-2022-aqmp.pdf?sfvrsn=16>).

in the San Joaquin air basin, NOx emissions must drop by 72% to ensure attainment of the ozone standard by the 2037 deadline.⁵³ Additionally, in January 2023, EPA announced a proposal to reduce the PM2.5 standard level from 12 µg/m³ to between 9 and 10 µg/m³, citing that the currently scientific and technical information available today indicates that the current standards may not be adequate to protect public health and welfare.⁵⁴ California must, therefore, identify all possible reductions, and every fraction of a ton of reduced NOx and PM2.5 is needed to meet federal and state air quality standards and to protect public health. The Locomotive Regulation is projected to reduce emissions of PM2.5 by 7,390 tons and NOx by 386,283 tons from 2023 to 2050. These reductions are unquestionably needed. The Locomotive Regulation is also expected to reduce the total number of incidents for premature mortality, hospital admissions for cardiovascular and respiratory illnesses, and emergency room visits for asthma, in an amount equivalent to monetized health benefits of approximately \$32 billion from 2023 to 2050.

The determination that the Locomotive Regulation satisfies the “compelling and extraordinary” criterion is additionally supported by considerations of the climate change-induced impacts affecting California.

California’s Legislature recognizes the severe threats the State faces from climate change. In enacting the California Global Warming Solutions Act of 2006 ((AB 32), Nuñez, Chapter 488, Statutes of 2006), California’s legislature found and declared that:

Global warming poses a serious threat to the economic well-being, public health, natural resources, and the environment of California. The potential adverse impacts of global warming include the exacerbation of air quality problems, a reduction in the quality and supply of water to the state from the Sierra snowpack, a rise in sea levels resulting in the displacement of thousands of coastal businesses and residences, damage to marine ecosystems and the natural environment, and an increase in the incidences of infectious diseases, asthma, and other health-related problems.⁵⁵

Those climate-change induced harms are also discussed in the Staff Report,⁵⁶ CARB’s comments on the Proposed SAFE 1 Action,⁵⁷ California’s briefs in the *Union of Concerned*

⁵³ San Joaquin Air Pollution Control District, 2022 Plan for the 2015 8-Hour Ozone Standard, December 2022. (Weblink: <https://ww2.valleyair.org/media/q55posm0/0000-2022-plan-for-the-2015-8-hour-ozone-standard.pdf>).

⁵⁴ U.S. EPA, Regulatory Impact Analysis for the Proposed Reconsideration of the National Ambient Air Quality Standards for Particulate Matter, December 2022. (Weblink: https://www.epa.gov/system/files/documents/2023-01/naaqs-pm_ria_proposed_2022-12.pdf).

⁵⁵ Cal. Health & Saf. Code § 38501(a).

⁵⁶ Staff Report: Initial Statement of Reasons.

⁵⁷ Analysis in Support of Comments of the California Air Resources Board on the Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks (October 26, 2018), EPA-HQ-OAR-2018-0283-5054. (Weblink: <https://www.regulations.gov/comment/EPA-HQ-OAR-2018-0283-5054>).

Scientists v. Natl. Highway Safety Administration case,⁵⁸ CARB's comments in response to EPA's Notice of Reconsideration of its SAFE 1 Action, and multiple briefs in *Ohio v. EPA*,⁵⁹ including the *amicus brief* of California Climate Scientists.⁶⁰ As many of those documents highlight, California's Fourth Climate Change Assessment⁶¹ discusses some of the existing and expected impacts of climate change specifically occurring in California, including increases in ground-level ozone,⁶² sea-level rise and coastal erosion,⁶³ variability in precipitation and reductions in water supply from reduced snowpack,⁶⁴ increased frequency of droughts and land subsidence,⁶⁵ lower agricultural crop yields, increased susceptibility of forests to wildfires, increased mortality risks to people due to extreme heat events, and flooding of California's coastal transportation infrastructure.⁶⁶

Other studies also establish California is especially impacted by climate change induced harms, including a 2019 study that demonstrated local emissions of a GHG (CO₂) can result in localized environmental effects such as ocean acidification of the Monterey Bay.⁶⁷

Even under a more narrow approach to Section 209(e)(2)(A) the Locomotive Regulation is needed to meet the above-mentioned compelling and extraordinary climate conditions because locomotives emit approximately 21.6 million metric tons of GHGs in California per year. The above-mentioned impacts of climate change in California constitute "compelling and extraordinary" conditions under any reasonable interpretation of section 209(e)(2)(A)(ii).

As CARB has previously set forth:

⁵⁸ Proof Brief of State and Local Government Petitioners and Public Interest Petitioners, *Union of Concerned Scientists v. Natl Highway Safety Administration*, 19-1230, (D.C. Cir. June 29, 2020); Final Reply Brief of State and Local Government Petitioners and Public Interest Petitioners, *Union of Concerned Scientists v. Natl Highway Safety Administration*, 19-1230 (D.C. Cir. Oct. 27, 2020).

⁵⁹ Docket No. EPA-HQ-OAR-2021-0257-0132.

⁶⁰ Brief of Amici Curiae California Climate Scientists in Support of Respondents U.S. Environmental Protection Agency and Michael S. Regan, 22-1081 (D.C. Cir. Jan. 18, 2023).

⁶¹ California's Fourth Climate Change Assessment, *California's Changing Climate 2018: A Summary of Key Findings* (Aug. 2018) (last accessed Nov. 2, 2021), and *California's Fourth Climate Change Assessment Statewide Summary Report* (last accessed Nov. 2, 2021).

⁶² California's Fourth Climate Change Assessment, *California's Changing Climate 2018: Statewide Summary Report* at 40.

⁶³ California's Fourth Climate Change Assessment, *California's Changing Climate 2018: A Summary of Key Findings* 6,18 (Aug. 2018).

⁶⁴ Cal. Gov. Office of Planning and Research et. al, *California's Fourth Climate Change Assessment: Statewide Summary Report*, Aug. 2018, p. 24. (Weblink: https://www.energy.ca.gov/sites/default/files/2019-11/Statewide_Reports-SUM-CCCA4-2018-013_Statewide_Summary_Report_ADA.pdf).

⁶⁵ Cal. Gov. Office of Planning and Research et. al, *California's Fourth Climate Change Assessment: A Summary of Key Findings*, Aug. 2018, pp. 5,14.

⁶⁶ Cal. Gov. Office of Planning and Research et. al, *California's Fourth Climate Change Assessment: Statewide Summary Report*, August 2018, pp. 54-55. (Weblink: https://www.energy.ca.gov/sites/default/files/2019-11/Statewide_Reports-SUM-CCCA4-2018-013_Statewide_Summary_Report_ADA.pdf).

⁶⁷ Docket No. EPA-HQ-OAR-2021-0257-0132, at p. 46, citing Northcott, et al., *Impacts of urban carbon dioxide emissions on sea-air flux and ocean acidification in nearshore waters*, PLoS ONE (2019).

While other States will experience their own substantial climate harms, California’s extensive coastline, reliance on snowpack for water storage, susceptibility to drought, potential for land subsidence, and other geographic and climatic factors render it particularly vulnerable and impacted. Further, the impacts to California’s agricultural sector have the potential to dramatically affect the Nation as a whole because California currently produces more than a third of the country’s vegetables and two-thirds of the country’s fruits and nuts.⁶⁸ Thus, even if EPA’s unlawful requirement that California’s conditions be “sufficiently different” from the rest of the nation could apply here, climate change impacts would still constitute such conditions.⁶⁹

California needs to address these conditions by reducing the State’s contribution to them.

California, therefore, meets the compelling and extraordinary criterion under either EPA’s traditional interpretation of this criterion or the more constrained approach preferred by some waiver/authorization opponents.

XIII. Consistency with CAA Section 209

As noted in Section IV.A, CAA section 209(e)(2) requires consistency with several subsections of section 209; that is the Administrator must consider not only consistency with section 202(a) – as required under section 209(b)(1)(C) – but also sections 209(a) and 209(e)(1).⁷⁰

A. Consistency with CAA section 209(e)(1)

Section 209(e)(1) prohibits states and political subdivisions from adopting or attempting to enforce any standard relating to the control of emissions from new locomotives or new locomotive engines. The Locomotive Regulation is consistent with CAA section 209(e)(1) because it does not set emission standards that require changes to manufacturers’ design or construction of new locomotives or new locomotive engines. Instead, the Regulation only imposes standards or other requirements on locomotives that have been put into use in California, which are by definition non-new.

When Congress enacted section 209(e) as part of the 1990 Clean Air Act amendments, it did so against a backdrop of existing caselaw—for example, *Allway Taxi, Inc. v. City of New York*⁷¹—that interpreted “new” in the context of vehicles and engines to mean vehicles or

⁶⁸ Cal. Dept. of Food and Ag., California Agricultural Production Statistics. (Weblink: <https://www.cdfa.ca.gov/statistics>).

⁶⁹ Analysis in Support of Comments of the California Air Resources Board on the Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks (October 26, 2018), EPA-HQ-OAR-2018-0283-5054, p. 369. (Weblink: <https://www.regulations.gov/comment/EPA-HQ-OAR-2018-0283-5054>).

⁷⁰ Air Pollution Control; Preemption of State Regulation for Nonroad Engine and Vehicle Standards (“Section 209(e) Rule”), 59 Fed. Reg. 36969, 36983 (July 20, 1994).

⁷¹ *Allway Taxi, Inc. v. City of New York*, 340 F. Supp. 1120 (1972), *aff’d*, 468 F.2d 624 (2d Cir. 1972).

engines for which “the equitable or legal title to which . . . [have] never been transferred to an ultimate purchaser.”⁷² This is also the plain meaning of “new” in this context. For example, a car ceases to be new when the title transfers to the purchaser who then drives it off the lot, putting it in use. EPA also used a nearly identical definition of “new” in its 1994 rule for offroad engines.⁷³

In its 1998 locomotive rulemaking, EPA also defined “new” accordingly:

New locomotive or new locomotive engine means:

(1)(i) A locomotive or locomotive engine the equitable or legal title to which has never been transferred to an ultimate purchaser; or

(ii) A locomotive or locomotive engine which has been remanufactured, but has not been placed back into service.

(2) Where the equitable or legal title to a locomotive or locomotive engine is not transferred prior to its being placed into service, the locomotive or locomotive engine ceases to be new when it is placed into service. . . .⁷⁴

As discussed in more detail below, the Locomotive Regulation does not impose any requirements whatsoever on manufacturers or remanufacturers. Nor does the Regulation indirectly circumvent this limitation—the Regulation does not create a situation in which manufacturers would be forced to change practices to comport with the Regulation. Instead, the Regulation imposes a series of requirements on operators, only for locomotives when they are operating in California—in other words, when they are in service and therefore not “new.”

1. The In-Use Operational Requirement⁷⁵ applies only to locomotive placed into service in California

The In-Use Operational Requirement provides that, beginning January 1, 2030, any locomotive older than 23 years shall not operate in California. The requirement provides several exceptions: (1) the locomotive is operated in a ZE Configuration; (2) the locomotive has not exceeded (rated hp) x (20.25) MWh of operation; (3) the locomotive meets the current cleanest U.S. EPA emission standard (currently Tier 4). The requirement also extends the time a locomotive can operate if was repowered to a cleaner tier. In short, this requirement only affects locomotives already placed into service because it is only triggered when a locomotive is older than 23 years of age.

⁷² *Allway Taxi*, 340 F. Supp. at 1124 (citing what was then 42 U.S.C. § 1857f-7(3)).

⁷³ 59 Fed. Reg. 36,969, at 36,986 (amending 40 CFR Part 85, § 85.1602 (Definitions)).

⁷⁴ 63 Fed. Reg. 18,979, at 19,001 (adding 40 CFR § 92.2 (Definitions)).

⁷⁵ The provisions related to the in-use operational requirement are specified in section 2478.5(a).

2. The In-Use Zero-Emission Operational Requirement⁷⁶ applies only to locomotives placed into service in California

The In-Use Zero-Emission Operational Requirement provides that switchers (as of model year 2030) and line-haul locomotives (as of model year 2035) must be operated in a ZE configuration when inside California. This requirements is agnostic as to whether operators do so by shifting their existing fleets (so that the ZE locomotives operators are already starting to purchase are operated in California), by reconfiguring existing locomotives to power existing electric engines with a ZE source rather than a diesel generator, by installing electric lines and using electric locomotives (as in many parts of the world), by other means, or by some combination of these options. Notably, these requirements do not take effect for quite some time, and, accordingly, these requirements must be assessed against what the locomotive industry and fleets may look like at the relevant future points in time.

A few additional points bear highlighting (though there is more information in the attached documents). Because locomotives have long run on ZE electric engines,⁷⁷ locomotive operators have long had the ability to bypass one or more of the diesel generators in a given locomotive—indeed, they sometimes do so in a “mother-slug” configuration (since at least the 1940s) to increase traction for heavy loads at slow speeds.⁷⁸ Altering the source of this electricity to these electric engines does not require manufacturing changes for the production of “new” locomotives.

The United States led the world in railroad electrification between 1910 and 1940, with about 20% of the world’s total of electrified track miles.⁷⁹ Starting in 1909, Great Northern electrified its line over the Cascade Mountains in the Pacific Northwest.⁸⁰ This lead evaporated following the increasingly cheap and abundant diesel fuel oil following World War II.⁸¹ The idea of a dual-mode electric/diesel locomotive (relying on a pantograph and catenary) was considered “technically viable” and “economically attractive” in the 1970s.⁸² Even in 1980, advantages of electrification (or in many cases, *re*-electrification) were clear:

⁷⁶ The provisions related to the in-use zero-emission operational requirements are specified in section 2478, subsections (b) and (c).

⁷⁷ See Michael Bezilla, Steam Railroad Electrification in America, 1920–1950: The Unrealized Potential, 4 THE PUBLIC HISTORIAN 1, at 49 (Winter 1982) (describing the transition to diesel-electric locomotives after World War II).

⁷⁸ CARB, Technical Support Document: Zero Emission Locomotive Conversion, at 10. (Weblink: <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/locomotive22/15dayappc.pdf>).

⁷⁹ U.S. Dep’t of Transp., Railroad Electrification Activity in North America—A Status Report: 1976–1978, at 1–2 (FRA/ORD-80/81 Nov. 1980) (herein “Railroad Electrification Activity”) (Weblink: https://railroads.dot.gov/sites/fra.dot.gov/files/fra_net/16045/1980_RAILROAD%20ELECTRIFICATION%20ACTIVITY%20IN%20NORTH%20AMERICA.PDF).

⁸⁰ Nat’l Park Service, Steamtown: American Electric Locomotives. (Weblink: https://www.nps.gov/parkhistory/online_books/steamtown/shs4.htm).

⁸¹ Railroad Electrification Activity at 1; see also The Stages of U.S. Railroad Electrification, TRAINS Magazine (Sep. 25, 2009). (Weblink: <https://www.trains.com/trn/railroads/history/the-stages-of-us-railroad-electrification/>).

⁸² Railroad Electrification Activity at 25.

In addition to alleviation of uncertainties in the cost and supply of diesel fuel, electrification offers other potential advantages. For example, the electric locomotive has a higher power density because part of the propulsion system is on the wayside. Thus, higher speeds and/or reduced size of the motive power fleet is possible. Further, the maintenance cost is expected to be less because the electric locomotive has fewer moving parts than the diesel-electric. Reduction in atmospheric pollutants is possible because the combustion process at the utility generator is stationary, thus making it amenable to more sophisticated emission control and because the load on the prime mover is more uniform. However, the amount of atmospheric pollutants will be dependent on the choice of fuel at the power plant.⁸³

The electrification of diesel locomotives in the 1970s–80s did not require then (and would not require now) changes to the manufacture of new locomotives or engines. Instead, operators would convert locomotives already in service to run on electric.⁸⁴

For these historical reasons as well as other technical reasons, locomotives have long employed a hybrid diesel-electric configuration, whereby a diesel engine drives either a generator (for direct current) or an alternator (for alternating current) to power either a DC or AC traction motor.⁸⁵ But besides conversion to overhead catenary, locomotive operators today have more options available to them to operate a diesel locomotive in a ZE configuration, including hydrogen fuel cells and battery technology that can be installed either in a hybrid configuration in the locomotive or connected to the locomotive via tender car.⁸⁶

3. Other requirements of the Regulation apply only to locomotives already placed into service in California

The idling requirements apply only to locomotives while they are operating in California which, by definition, means they apply only to locomotives that are not “new” because they have been placed into service. These requirements align with EPA requirements imposed on manufacturers of automatic stop-start systems used in locomotives, but they do not impose any requirements—new or duplicative—on the manufacturers. Other components of the Regulation—such as the Spending Account and the various reporting requirements—likewise have no effect on the manufacturing process. Those requirements also apply only to locomotive operations in California—operations that occur only because the locomotive has been placed into service and is therefore not “new.”

B. Consistency with CAA Section 209(a)

CAA section 209(a) preempts states and political subdivisions from adopting or attempting to enforce any standard relating to the control of emissions from new motor vehicles or new

⁸³ Railroad Electrification Activity at 2.

⁸⁴ Railroad Electrification Activity at 10.

⁸⁵ CARB, Technical Support Document: Zero Emission Locomotive Conversion, at 6.

⁸⁶ CARB, Technical Support Document: Zero Emission Locomotive Conversion, at Part IV.

motor vehicle engines. The Locomotive Regulation is consistent with CAA section 209(a) because it does not apply to new (or any) motor vehicles and engines.

C. Consistency with CAA Section 209(b)(1)(C)

CAA section 209(b)(1)(C) provides that no waiver shall be granted if the Administrator finds that the State's program and accompanying enforcement procedures are not consistent with section 202(a) of the CAA. As discussed above in Section IV, "[t]he 'technological feasibility' component of section 202(a) obligates California to allow sufficient lead time to permit manufacturers to develop and apply the necessary technology."⁸⁷ The Locomotive Regulation does not require *manufacturers* to develop or apply any new technology, or otherwise regulate "new" locomotives, for the reasons discussed above. The following technical discussion explains why this Regulation is technically feasible for locomotive *operators*.

1. All Components of the Regulation Are Technically Feasible

The In-Use Operational Requirement that locomotives be no more than 23 years of age if their emissions exceed EPA's cleanest standard and unless they are operated in ZE Configuration is not technically infeasible by January 1, 2030. EPA's current cleanest standard (Tier 4) has applied to new locomotives since 2015, so any locomotive purchased in the fifteen years between then and 2030 will meet this requirement without further action. Older locomotives may be able to be retrofitted to this standard and, in any event, can be configured to run in a ZE Configuration as explained above. Locomotive operators have more than six years to plan how to comply, which is more than adequate lead time.

The later requirement that operators using switchers built after 2030 and line haul locomotives built after 2035 operate those engines in a ZE Configuration within California will be feasible when those requirements go into effect. As briefly discussed above, and in more detail below, diesel-electric locomotives in operation today have long been able to be operated in a ZE Configuration, provided that the operator provide a sufficient source of electricity. Historically, this has meant catenary, but recent technology developments have expanded options available to operators, including electric batteries and hydrogen fuel cells. And those developments are anticipated to accelerate in the coming years. Moreover, because these requirements only apply to locomotives built six and twelve years from now, the rollout across any given operator's fleet will be gradual and, within the operator's ability to plan. Finally, the 2027 and 2032 assessments required by the Locomotive Regulation are designed to evaluate the requirements of the Regulation, including the ZE Configuration requirements and their timeframes, and CARB will adjust compliance requirements as needed.

The Spending Account requirement of the Locomotive Regulation does not require development or application of any particular technologies, so it is plainly technologically

⁸⁷ Motor & Equip. Mfrs. Ass'n v. Nichols, 142 F.3d 449, 463 (D.C. Cir. 1998) (quoting Ford Motor Co. v. EPA, 606 F.2d 1293, 1296 n. 17 (D.C.Cir.1979)).

feasible. In addition, the magnitude of the deposit obligation is largely in the control of the operator. Operators who operate locomotives with higher emissions will have commensurately higher deposit obligations than operators who use cleaner, lower-emitting locomotives in California. And, at least in the near term, substantial grant funding is available to many operators—which, when awarded and spent, can be used to reduce an operator’s Spending Account obligation.⁸⁸

Reporting for the Locomotive Regulation requires an operator to estimate the number of hours worked by each locomotive in California. Most locomotives are equipped with a MWh meter that can be used for this purpose; operators may also choose to estimate work based on fuel consumption using information in their possession. There is nothing infeasible (technologically or otherwise) about these requirements.

a) Compliance Examples

Class III Operator – Napa Valley Railroad

In 2023, Napa Valley Railroad (NVR) received federal⁸⁹ and state funding⁹⁰ to replace six pre Tier 0 locomotives with two Tier 4 locomotives. Under the In-Use Locomotive Regulation, NVR could operate the two new Tier 4 locomotives for at least 23 years from their manufacture date. In addition, NVR could comply using the ACP in lieu of direct compliance with the Spending Account. Because Tier 4 locomotives reduce over 90% of emissions compared to pre-Tier 0 locomotives, and therefore incur smaller Spending Account funding requirements, it is estimated that Tier 4 locomotives would not incur a high enough Spending Account funding obligation to expect any required emission reductions under the ACP over the useful life of the Tier 4 locomotives. Using an ACP, it may also be possible for NVR to continue operating their Tier 4 locomotives indefinitely (beyond 23 years) by achieving required emission reductions through other measures within three miles of their rail operations. Due to the emissions levels of Tier 4 locomotives, the amount of reductions needed to offset their operations over each ACP period is not estimated to be large.

⁸⁸ Operators may purchase locomotives or invest in ZE infrastructure in advance of their Spending Account deposit obligation using grant funding and receive a “Spending Account Deposit Credit” that offsets their deposit obligation. (13 CCR § 2478.4(h)).

⁸⁹ Federal Railroad Administration, FY 2022 Consolidated Rail Infrastructure and Safety Improvement Program Selections: Project Summaries, September 25, 2023, accessed November 3, 2023. (Weblink: <https://railroads.dot.gov/sites/fra.dot.gov/files/2023-09/FY%202022%20CRISI%20Program%20Selections%20-%20Project%20Summaries.pdf>).

⁹⁰ California Air Resources Board, Case-by-Case Determinations: Locomotives, Reference #2023-14, accessed November 3, 2023. (Weblink: <https://ww2.arb.ca.gov/case-case-determinations-locomotives>).

Class III Operator – Modesto and Empire Traction Railroad

In 2023, Modesto and Empire Traction Railroad (METRR) received federal funding⁹¹ to remanufacture two Tier 0 locomotives to Tier 4. Under the In-Use Locomotive Regulation, METRR can operate the two Tier 4 locomotives for at least 23 years from their remanufacture date. Operation of the Tier 4 locomotives will dramatically reduce METRR's emissions, both by eliminating the high emissions of their Tier 0 locomotives and by decreasing operation of their Tier 3 locomotives. This, in turn, will reduce their Spending Account funding requirement or ACP-required emission reductions. Under an ACP, they may propose to transition more of their operations to Tier 4 or cleaner, but they may also choose any other measure that leads to the required emission reductions within 3 miles of their rail infrastructure. METRR would be allowed to continue operating their locomotives indefinitely, past 23 years, if they were able to meet required emission reductions through other measures.

Class III Operator – Sierra Northern Railroad

Sierra Northern Railway (SERA) received \$4 million from California Energy Commission and \$15.6 million from the California State Transportation Authority to convert four diesel switchers to hydrogen fuel cell units and build hydrogen refueling infrastructure. With early ZE operation, SERA may be able to comply with the Regulation using the AFMO. SERA may use the AFMO's ZE Offset option to meet the 50% Tier 4 by 2030 and 100% Tier 4 by 2035 milestones, while gradually transitioning their fleet to 100% ZE operation by 2047. If they were under the AFMO, SERA would not be required to put money into a Spending Account or stop operating their older diesel locomotives under the In-Use Operational Requirements. This would allow them to move forward with their preexisting plans to transition to 100% ZE without the intermediate step of using Tier 4 technology.

Passenger Operator - Caltrain

Caltrain received funding to electrify their routes from San Francisco to San Jose and replace twenty out of twenty-nine diesel locomotives with nineteen electric trainsets in revenue service by late 2024. Caltrain has also recently approved the purchase of four more electric trainsets and received funding for a battery electric trainset. Under the In-Use Locomotive Regulation, Caltrain could comply using the AFMO, because they will reach the fleet milestones required. While Caltrain may still have some diesel locomotives in its fleet by the 2035 100% Tier 4 and 2042 50% ZE milestones, the offsets generated from early ZE operations are estimated to be able to cover the diesel operation until the final 100% ZE fleet milestone in 2047. Because they would be under the AFMO, Caltrain would not be required to put money into a Spending Account or stop operating their older diesel locomotives under the In-Use Operational

⁹¹ Federal Railroad Administration, FY 2022 Consolidated Rail Infrastructure and Safety Improvement Program Selections: Project Summaries, September 25, 2023, accessed November 3, 2023. (Weblink: <https://railroads.dot.gov/sites/fra.dot.gov/files/2023-09/FY%202022%20CRISI%20Program%20Selections%20-%20Project%20Summaries.pdf>).

Requirements. This would allow them to move forward with their preexisting plans to transition to 100% ZE without the intermediate step of using Tier 4 technology.

2. Operators Have Multiple Options to Comply with the In-Use Operational Requirements, Specifically, and All of Them, Individually and Collectively, Are Feasible Within the Relevant Lead Times

This section outlines the options that locomotive operators may utilize to comply with the In-Use Operational Requirements (and/or reduce their obligations under the Spending Account Requirements). More detailed descriptions of these are provided in Appendix F of the Staff Report⁹² and Appendix C of the Final Statement of Reasons.⁹³ In addition, on March 1, 2023, CARB Released the Technical Support Document: Zero Emission Locomotive Conversion⁹⁴ (technical support document). This document analyzes the feasibility of converting existing (non-new) diesel-electric locomotives to ZE locomotives and ZE capable locomotives. After examining duty cycle information and options for conversion to ZE, this report concluded that it is feasible to convert diesel-electric locomotives currently in use to ZE locomotives or ZE capable locomotives. In sum, a variety of technological options are available to operators today that operators can use to fully comply with the Locomotive Regulation. Thus under U.S. EPA's longstanding interpretation of section 209(b)(1)(C)'s cross-reference to section 202(a), the Administrator has no basis to deny this request as inconsistent with section 202(a).

Existing Locomotives

Operators may comply with the In-Use Requirements by using existing locomotives, as described below. The use of these locomotives as-is is plainly feasible, so when and where that is an option there can be no question that these requirements are feasible. Operators have several options to extend the use of existing locomotives, and these options are either already feasible or will be feasible within the relevant lead times for the requirements.

Existing locomotives fit within one of EPA's "Tiers" connected to when the locomotive was originally manufactured. Tier 4 is the current tier—the one applicable to any new locomotive originally manufactured in 2015 or after. The Locomotive Regulation allows operators to use some older-than-Tier-4 locomotives. Before 2030, there is no limitation based on Tier. Beginning in 2030, operators must begin to use locomotives that meet Tier 4 or cleaner standards in California (as to any locomotive 23 years or older),⁹⁵ but operators may configure older locomotives to do so. As described in Metrolink's Locomotive Fleet Modernization Study Update, staff recommendations included options for a locomotive to be overhauled and

⁹² Staff Report: Initial Statement of Reasons.

⁹³ Final Statement of Reasons.

⁹⁴ CARB, Technical Support Document: Zero Emission Locomotive Conversion.

⁹⁵ Under the In-Use Operational Requirements of the Regulation, a locomotive with a build date prior to 2030 may continue to operate for 23 years from its build date, meaning that some older-tier locomotives may continue to operate in California in a non-ZE Configuration for some time after 2030.

converted to Tier 4 by a specialty overhaul contractor.⁹⁶ Alternatively, in-house experts could complete this conversion rather than specialty contractors or original equipment manufacturers. For example, Western Rail, Inc., purchased Cummins QST30 Tier 4 locomotive power modules⁹⁷ and will remove the old diesel engine from a lower Tier locomotive and drop in the new Tier 4 power module and rewire the old electrical system.⁹⁸ Multiple switchers that have been remanufactured to Tier 4 operate in California.⁹⁹ And, as noted above, METRR will remanufacture two of its older locomotives to Tier 4 standards.

Operators may also choose one of two alternative compliance options that could extend the period during which older locomotives operate. For example, operators utilizing the AFMO would be able to generate credits to offset their use of older-tier locomotives in the state.

As to existing Tier 4 locomotives, beginning in 2030 (and not before), an operator can operate such a locomotive in a diesel configuration if that locomotive is less than 23 years old. Tier 4 has been the federal locomotive emission standards since 2015. Tier 4 locomotives are widely available for all types of locomotives. So, this compliance option is unquestionably feasible. Some operators may choose one of the two alternative compliance options, which could extend the period during which that operator's Tier 4 locomotives could operate in California. In addition, as described below, existing locomotives could be reconfigured to operate in ZE mode, and, in that mode, their use would comply with the In-Use Operational Requirements in all time periods.

Catenary

Using overhead catenary lines to provide electric power to locomotives is another compliance option, and this technology is more than 100 years old. Operators could fully comply with the Locomotive Regulation by employing this well-established technology. Overhead Catenary Systems (OCS) may be a strong economic contender in certain applications, such as for powering switchers, some passenger rail, and some high-traffic freight routes. Operators can configure any diesel-electric locomotive in their fleet to operate using ZE through this technology.

⁹⁶ Southern California Regional Rail Authority, Metrolink's Locomotive Fleet Modernization Study Update, April 2, 2021. (Weblink: <https://d2kbkoa27fdvtw.cloudfront.net/metrolink/3420287751df2a30822eaa0b6889889d0.pdf>).

⁹⁷ Cummins, Cummins Rail Expands Clean Diesel Product Offering with QST30 Tier 4 Locomotive Power Module, Nov 16, 2021. (Weblink: <https://www.cummins.com/news/releases/2021/11/16/cummins-rail-expands-clean-diesel-product-offering-qst30-tier-4-locomotive>).

⁹⁸ Western Rail, Inc., Facebook post on March 23, 2022, retrieved on September 18, 2023. (Weblink: <https://www.facebook.com/WesternRailInc/posts/introducing-our-newest-project-the-cummins-qst30-tier-4-engine-package-western-i/4860353364020402/>).

⁹⁹ CARB, Proposed In-Use Locomotive Regulation Standardized Regulatory Impact Assessment (SRIA), May 26, 2022. (Weblink: <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/locomotive22/appb.pdf>).

OCS is utilized in other countries for line haul operations today. For example, Indian Railways in India has electrified many of its routes and operates double-stack intermodal freight trains, which US freight railroads also operate, while running on catenary wires.¹⁰⁰

Passenger rail operators in the United States have also incorporated OCS systems into their operations. Amtrak's Northeast and Keystone corridors currently run on OCS.¹⁰¹ Caltrain expects to run 70% of its fleet using OCS, with operation expected to begin in 2024. Installation of necessary infrastructure is nearing completion, with operation of OCS-compatible trainsets anticipated to begin in late 2024.¹⁰²

OCS is not only a feasible solution in line haul and passenger operations, but also a feasible solution for switching operations in ports and railyards. For example, OCS is used in some ports in Europe. A switching yard in Port of Antwerp-Bruges has 20 tracks (out of 32 railway lines) that are electrified with overhead catenary lines.¹⁰³ The port has seen increased capacity for electric locomotives, which has provided more flexibility and lower costs, therefore making the port more efficient. The Port of Hamburg also has 160 km (out of 290 km) of overhead electrified tracks which also help with their expanding rail demand.¹⁰⁴ Similarly, to promote accessibility and to improve its rail network, Port of Valencia has received investment of nearly 240 million euros to remodel the railway network and electrify its tracks.¹⁰⁵ Across all these examples, OCS is used to expand the railway network at the ports and to increase efficiency of port duties while significantly reducing emissions.

Use of Tender Cars

In its 2023 Technical Support Document, CARB determined that railroads have long used locomotives in a “mother-slug” configuration (two locomotives tied together, with one diesel engine powering the electric motors of both locomotives in order to increase traction and fuel efficiency.) It is a relatively small step from powering the locomotives in such a configuration with diesel to powering them with a ZE source. Indeed, CARB found examples of this ZE

¹⁰⁰ Railway Gazette International, Indian Railways starts double-stack electric operation, June 11, 2020, retrieved on October 24, 2023. (Weblink: <https://www.railwaygazette.com/freight/indian-railways-starts-double-stack-electric-operation/56733.article>).

¹⁰¹ Amtrak, What is Catenary Wire?, retrieved on October 24, 2023. (Weblink: <https://blog.amtrak.com/2014/01/catenary-wire/>).

¹⁰² Caltrain, Electric Trains, retrieved on October 24, 2023. (Weblink: <https://www.caltrain.com/projects/electrification/electric-trains>).

¹⁰³ RailFreight.com, More electrified railway lines for southern yard in Port of Antwerp-Bruges, May 23, 2023, retrieved on October 23, 2023. (Weblink: <https://www.railfreight.com/interoperability/2023/05/23/more-electrified-railway-lines-for-southern-yard-in-port-of-antwerp-bruges/>).

¹⁰⁴ Hamburg Port Authority, Hamburg Port Authority- Port is What We Do, November 12, 2020. (Weblink: https://scanmedfreight.eu/Customer%20Workshop%20201112/Presentations/20201112_Pres_HPA_final.pdf)

¹⁰⁵ Valencia Port, Port of Valencia: more trains, longer trains, more goods and more containers, March 13, 2023, retrieved on October 24, 2023. (Weblink: <https://www.valenciaport.com/en/port-of-valencia-more-trains-longer-trains-more-goods-and-more-containers/>).

technology already in use.^{106,107,108,109,110} This, then, is another feasible method of compliance—and one that is likely to expand before the relevant In-Use Operational Requirements take effect.

Similarly, it is possible to fully power a diesel-electric locomotive, or extend the range of a battery-electric locomotive, with a locomotive tender car, or “tender” which is a specially designed railcar capable of storing fuel. Thus, operators can configure any diesel-electric locomotive in their fleet to operate using ZE through this technology.

Battery tenders, when coupled to another locomotive (either diesel-electric or ZE), can provide additional ZE miles. For an average train carrying 7,500 tons of freight, a battery tender with 5 MWh usable electricity provides 21.3 ZE miles.¹¹¹ Improved battery technology can provide up to 14 MWh usable electricity per battery tender, and a locomotive paired with a single battery tender can achieve a 150-mile ZE range.¹¹² Diesel freight line haul locomotives can operate 1,000 miles or more between refueling. To have a similar operation range, additional battery tenders likely would be required, either in lieu of or in addition to fast-charging.

Conversion of Diesel-Powered Locomotives to ZE Power Sources

In its 2023 Technical Support Document, CARB found conversion from diesel-electric to battery-electric operation to be highly feasible, with the technical support document profiling several cases of conversion that are already occurring. Projected costs depend on the capacity needed to meet the duty cycle. One example within the technical support document analyzed the case of a 50-foot standard railcar with approximately 5,238 cubic feet capacity. Assuming only 30% of capacity were available for batteries due to the battery management system and other necessary components, a 50-foot standard railcar would have 1,571 cubic feet capacity

¹⁰⁶ Trains, David Lustig, Pacific Harbor Line displays battery locomotive at ceremony for engineers, May 7, 2023, accessed November 3, 2023. (Weblink: <https://www.trains.com/trn/news-reviews/news-wire/pacific-harbor-line-displays-battery-locomotive-at-ceremony-for-engineers/>).

¹⁰⁷ BNSF, BNSF and Wabtec commence battery-electric locomotive pilot test in California, January 4, 2021, accessed November 3, 2023. (Weblink: <https://www.bnsf.com/news-media/news-releases/newsrelease.page?releid=bnsf-and-wabtec-commence-battery-electric-locomotive-pilot-test-in-california>).

¹⁰⁸ Businesswire, U. S. Steel Pioneers Battery-Powered Locomotives, Reinforces Commitment to Sustainability and Community, October 30, 2023, accessed November 3, 2023. (Weblink: <https://www.businesswire.com/news/home/20231029717483/en/>).

¹⁰⁹ Port of Stockton, Low & Zero Emission Fuel Options for the Port of Stockton, (https://www.portofstockton.com/wp-content/uploads/2021/11/POS_WhitePaper_LowZeroEmissionFuelOptions_D3.pdf).

¹¹⁰ Railwayage, First U.S. Hydrogen Powered Passenger Trainset Testing at TTC, October 11, 2023, accessed November 3, 2023. (Weblink: <https://www.railwayage.com/passenger/commuterregional/first-u-s-hydrogen-powered-passenger-trainset-testing-at-ttc/>).

¹¹¹ CARB, Transitioning to a Zero or Near-Zero Emission Line-Haul Freight Rail System in California: Operational and Economic Considerations, Spring 2016. (Weblink: https://www.arb.ca.gov/railyard/docs/uoi_rpt_06222016.pdf).

¹¹² Popovich, N.D., Rajagopal, D., Tasar, E. et al. Economic, environmental and grid-resilience benefits of converting diesel trains to battery-electric. *Nat Energy* 6, 1017–1025 (2021). (Weblink: <https://doi.org/10.1038/s41560-021-00915-5>).

for batteries. A standard railcar could still fit 20 MWh of lithium-ion batteries. Using \$143/kWh, the 20 MWh battery will cost about \$2.86 million. As battery cost falls and their energy density increases, staff estimates that the cost of a battery tender could be around \$3–5 million depending on the required battery capacity.¹¹³

Recently, Aurizon, Australia's largest rail freight operator, announced their plans to build the first ZE capable freight locomotives constructed in Australia and the project is already underway. The project will retrofit existing locomotives with EMD710 engines by removing the diesel engine, fuel tank, radiators, alternator, traction inverters, and other components and replacing them with new lithium-ion battery packs as well as some other new components. The locomotives will be converted to heavy-haul freight locomotives, covering much of Australia, and will be built to be capable of operating in harsh conditions.¹¹⁴ Each converted locomotive alone is estimated to be able to travel up to 250 miles, and with the assistance of a battery or hydrogen fuel cell tender could travel up to 530 miles.¹¹⁵ Although it is often said that, in general, locomotives or rail operating in other countries are not comparable to the locomotives used across the United States, the EMD710 engine found in the Aurizon locomotives are also used in many of the freight line haul locomotives operating throughout the United States. Additionally, the chassis used for the Aurizon conversion is slightly smaller than U.S. freight line haul operations, suggesting that there is room for a similar conversion to be practiced for many of the freight locomotives operated in the U.S.

Pacific Harbor Line, operating out of the Port of Long Beach, has purchased and is operating a Progress Rail EMD Joule battery-electric locomotive for switcher operations. That locomotive is a conversion from a Tier 2 locomotive.

The conversion process is not only feasible for battery-electric projects but can also be used for hydrogen fuel cells. Following successful progress made in its first ZE hydrogen conversion plan funded by 2021 grants, in July 2023 SERA received additional funding to convert three more diesel-electric switchers to hydrogen.¹¹⁶ This project takes switchers already existing in Sierra's fleets and converts them from old diesel-electric engines to hydrogen fuel cell ZE technologies.¹¹⁷

¹¹³ Appendix C: Technical Support Document: Zero Emission Locomotive Conversion, March 1, 2023. (Weblink: <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/locomotive22/15dayappc.pdf>).

¹¹⁴ Aurizon, Work starts on first zero-emissions capable freight locomotive built in Australia, May 30, 2023. (Weblink: <https://www.aurizon.com.au/news/2023/work-starts-on-first-zero-emissions-capable-freight-locomotive-built-in-australia>).

¹¹⁵ Aurizon, Factsheet: First Australian-built Battery Electric Locomotive (BEL) for the Australian freight industry, accessed September 19, 2023. (Weblink: https://mc-71bd5e2a-aade-4067-a0ad-8402-cdn-endpoint.azureedge.net/-/media/aurizon-media-library/news/media-releases/2023/bel_factsheet_30052023.pdf?rev=96e2afa09a7a431bb16d3b054bc037a2&hash=9B47CF2CDA4F5D0A4391E2484F91DC73).

¹¹⁶ California State Transport Agency, Port and Freight Infrastructure Program Selected Projects – Project Detail Summary, July 6, 2023. (Weblink: <https://calsta.ca.gov/-/media/calsta-media/documents/pfip-awards-summary-narrative-7-6-23-a11y.pdf>).

¹¹⁷ California Energy Commission, Sierra Northern Railway Grant Request Form, April 1, 2021. (Weblink: <https://www.energy.ca.gov/Calio/filebrowser/download/3035>).

That same (or similar) technology can be used to convert line-haul locomotives, which is primarily a question of range, workload, and battery capacity. CARB's rulemaking record contains additional discussion of the cost of batteries and hydrogen fuel options for longer-range line-haul locomotives.

Hybrid Locomotives

A locomotive is hybridized when batteries are used together with the main source of propulsion power to reduce locomotive emissions and improve energy efficiency. Hybrid technologies are available for any of the main sources of propulsion power such as diesel or natural gas engines, fuel cells, or any other type of power generating system. Hybrid technologies can be used on all locomotive types and Tiers. Hybrid locomotives have the ability to turn off their internal combustion engines and use batteries in designated areas, such as near disadvantaged communities, to maximize the emission reduction benefits. Several hybrid locomotives are commercially available and in use and many are being demonstrated.

Hybrid locomotives could be used in California only in ZE configuration, removing all diesel emissions. Any such hybrid locomotive—whether purchased new between now and when the In-Use Operational Requirements take full effect—could comply with the ZE requirements of the Regulation.

As mentioned above, hybrid locomotives are commercially available and therefore feasible technology. While there are no hybrid locomotives operating in the U.S., Union Pacific plans to demonstrate six units by 2024.¹¹⁸ Union Pacific's hybrid locomotives will operate as "mother-slug" sets where one diesel locomotive and a connected battery locomotive operate as a set, and they can operate in single engine, battery charging, or electric only modes. Progress Rail provides hybrid locomotives to customers, and Rumo, the largest railway operator in Brazil began demonstrating two Progress Rail hybrid locomotives in October 2023.^{119, 120} In Europe, Alstom Prima H3 hybrid locomotives have been operating since 2016 by various operators such as Volkswagen, Deutsche Bahn, and Audi, and received certificate from the German Federal Railway Authority to conduct mainline operations.¹²¹ In 2020, Deutsche Bahn ordered 50 HDB 800 hybrid locomotives from Toshiba, equipped with two

¹¹⁸ Union Pacific, Union Pacific and ZTR Partner on New Hybrid-Electric Locomotives, October 6, 2022. (Weblink: <https://www.up.com/media/releases/hybrid-electric-locomotives-nr-221006.htm>).

¹¹⁹ Progress Rail, Progress Rail Providing Hybrid Diesel/Battery Electric Locomotives to Support Customers' Emission Reduction Goals. (Weblink: <https://www.progressrail.com/en/Company/News/PressReleases/ProgressRailProvidingHybridDieselBatteryElectricLocomotivesToSupportCustomersEmissionReductionGoals.html>).

¹²⁰ Progress Rail, Rumo invests in hybrid locomotives from Progress Rail, reducing environmental impact of freight operations, October 4, 2023. (Weblink: <https://www.progressrail.com/en/Company/News/PressReleases/RumoinvestsinhybridlocomotivesfromProgressRailreducingenvironmentalimpactoffreightoperations.html>).

¹²¹ Mass Transit, Alstom's Shunting Loco Prima H3 Receives Final Homologation from EBA, April 5, 2017. (Weblink: <https://www.masstransitmag.com/rail/press-release/12322903/alstom-transport-alstoms-shunting-loco-prima-h3-receives-final-homologation-from-eba>).

diesel engines and lithium-ion batteries that enable ZE operation in required areas.¹²²

Use of Locomotives Manufactured as Zero-emission

Manufacturers are already offering, and operators are buying, some ZE locomotives. While CARB's Locomotive Regulation does require operators to purchase new ZE locomotives, operators could nevertheless choose to do so.

To date, ZE battery-electric locomotives (switchers) are commercially available while ZE hydrogen-fueled are not as far along. CARB expects both technologies—and possibly hybrids of the two—to be commercially available before 2030 for switchers and 2035 for line-haul. A CARB analysis concludes the current California grid would already be able to meet the demands of an all battery-electric switcher fleet in California.¹²³

Hydrogen as a locomotive fuel offers many advantages. Hydrogen fuel is lightweight, can be used in conjunction with other technologies, can be scaled to the locomotive energy need and offers fast refueling times. Similar to battery-electric locomotives, hydrogen-powered locomotives are interchangeable with diesel locomotives in that they do not require specialized systems to operate on existing tracks (e.g., electrified tracks or catenary lines).

Typical line haul locomotives can carry up to 5,000 gallons of diesel fuel and operate 1,000 miles without refueling. To provide the operation range of line haul locomotives, hydrogen tenders—railcars used to store hydrogen fuel—may be necessary. Hydrogen provides refueling times similar to refueling times of diesel.

Hydrogen locomotives may be coupled with tender railcars to reduce the need for refueling. A 2021 study conducted by the Federal Rail Administration (FRA) on hydrogen fuel technology suggests that, with some revisions, the strategies used for the safe implementation of NG and LNG should be directly applicable for establishing gaseous or liquid hydrogen tenders.¹²⁴

While no liquid hydrogen fuel tender is currently used to power a locomotive, Florida East Coast Railway operates natural gas locomotives with 11,000-gallon liquid natural gas fuel tenders.¹²⁵ Assuming same volume, an 11,000-gallon liquid hydrogen tender will hold about 3,000 kg of hydrogen, equivalent to about 3,000 gallons of diesel in energy. While this is less than the 5,000-gallon capacity of typical diesel freight line haul locomotives, fuel cell

¹²² Toshiba, Battery improves climate footprint: DB Cargo buys 50 Toshiba hybrid locomotives, January 23, 2020. (Weblink: <https://www.global.toshiba/www/news/infrastructure/2020/01/news-20200123-01.html>).

¹²³ California Air Resources Board, Yes, the California grid can handle electrification of all switchers in all railyards, June 28, 2023. (Weblink: <https://ww2.arb.ca.gov/resources/fact-sheets/yes-california-grid-can-handle-electrification-all-switchers-all-railyards>).

¹²⁴ United States Department of Transportation – Railroad Administration, Study of Hydrogen Fuel Cell Technology for Rail Propulsion and Review of Relevant Industry Standards, June 2021. (Weblink: <https://railroads.dot.gov/sites/fra.dot.gov/files/2021-06/Study%20of%20Hydrogen%20Fuel%20Cell%20Tech.pdf>)

¹²⁵ Chart Industries, LNG on the Rails- Precursor to LH2 on the Rails? 2018. (Weblink: <https://www.energy.gov/sites/prod/files/2019/04/f62/fcto-h2-at-rail-workshop-2019-nason-larson.pdf>).

locomotives have 30% or higher efficiency than the diesel engine.¹²⁶ Combined, a hydrogen locomotive paired with a single liquid hydrogen tender may be able to meet diesel freight line haul locomotive operation requirements for range and refueling time.

Any of these ZE locomotives provide operators with another feasible compliance option, particularly in light of the lead time provided before ZE operations are required.

Replacement with Other Rail Equipment

It is possible that for some railyard processes locomotives are not required. There are other rail equipment options that may be used in place of a locomotive—e.g., in railyard operations. While this type of replacement is not an express compliance option under the Locomotive Regulation—much less required by it—these replacements are occurring. And, where they occur, they reduce operators' Spending Account obligations (by reducing their locomotive emissions) and would also remove locomotives subject to the In-Use Operational Requirements from the operators' fleets.

Rail equipment such as railcar movers perform similar functions as switchers, moving railcars in and around railyards.¹²⁷ There are several ZE models commercially available that could potentially perform the duties of switcher locomotives.¹²⁸ The Port of Stockton received grant funds from the Sustainable Terminals Accelerating Regional Transformation (8) Project to purchase a Zephyr Battery-Electric Rail Car Mover with Range Extender¹²⁹ and in 2023, they were awarded \$45.9 million for the Rail Infrastructure Improvements for Sustainable Exports (RIISE) Project, which includes the purchase of a ZE electric railcar mover.¹³⁰

As mentioned in the Initial Statement of Reasons Technical Feasibility Assessment, Parallel Systems, a startup company based out of California, has developed autonomous battery-electric rail equipment that moves individual shipping containers. Individual shipping containers are placed on the rail equipment and then the rail equipment move the individual containers to their destination. Since the publication of CARB's initial feasibility assessment,

¹²⁶ R. K. Ahluwalia, D. Papadias, and X. Wang, Rail and Maritime Metrics, U.S. DOE Hydrogen and Fuel Cells Program 2020 Annual Merit Review and Peer Evaluation Meeting, Washington, D.C., May 19 - 21, 2020. (Weblink: https://www.hydrogen.energy.gov/pdfs/review20/ta034_ahluwalia_2020_o.pdf).

¹²⁷ David Lustig, Railcar movers are replacing shop locomotives, Trains.com, August 14, 2023. (Weblink: <https://www.trains.com/trn/train-basics/abcs-of-railroading/railcar-movers-are-replacing-shop-locomotives/>).

¹²⁸ CARB, Appendix F Technology Feasibility Assessment for the Proposed In-Use Locomotive Regulation, September 20, 2022, pp. 37–42.

¹²⁹ CARB, Sustainable Terminals Accelerating Regional Transformation (START) Project Phase 1, 2019, accessed September 19, 2023. (Weblink: <https://ww2.arb.ca.gov/sites/default/files/movingca/pdfs/start.pdf>).

¹³⁰ Port of Stockton, Port of Stockton Awarded \$45.9 Million Grant. July 7, 2023. (Weblink: [https://www.portofstockton.com/press-release-port-of-stockton-awarded-45-9-million-grant/#:~:text=STOCKTON%2C%20CA%20%E2%80%93%20July%20%2C,Freight%20Infrastructure%20Program%20\(PFIP\)\)](https://www.portofstockton.com/press-release-port-of-stockton-awarded-45-9-million-grant/#:~:text=STOCKTON%2C%20CA%20%E2%80%93%20July%20%2C,Freight%20Infrastructure%20Program%20(PFIP)))).

Parallel Systems has introduced the second-generation of their rail equipment and plans to pilot test on existing U.S. and international rail networks sometime in 2024.¹³¹

Additional Flexibility Provided Through Exemptions and Compliance Provisions

While CARB expects all Locomotive operators to be able to meet the compliance deadlines in the Regulation, the compliance extensions described in Section III.D—and the alternative compliance pathways described in Section III.X—provide increased flexibility to comply with the Regulation. The Regulation includes an extension of up to one-year if the owner can demonstrate that Locomotive Regulation noncompliance is the result of delays due to compliant equipment manufacture delays, installation delays, or unavailability.

3. Compliance Costs

CARB considered the cost of compliance of the Locomotive Regulation by estimating the costs and cost savings associated with each requirement. The total net cost of the regulation from 2023 to 2050 is estimated to be \$13.8 billion. The costs directly to regulated parties will vary depending on the compliance pathway(s) selected and include equipment capital and installation costs and recurring costs for maintenance, electricity and hydrogen usage, Spending Account opportunity costs, and operator administrative costs for registration and reporting. The largest portion of the compliance costs are the equipment capital costs that account for over half of the total compliance costs.

As noted above, because the Spending Account obligation is directly based on the calculated cost of negative health impacts from locomotive emissions, the amount required to be set aside in the Spending Account can be reduced by reducing an operator's locomotive emissions. For operators that choose to invest in any of the allowed Spending Account purchases, the cost of the investment can be used as a credit in the Spending Account. This includes any grant funding used for the purchase. For example, if an operator applies for and receives grant funding for a new ZE locomotive and the infrastructure needed to operate the ZE locomotive, the total amount of the purchase and infrastructure investment can be used to credit the Spending Account requirement, even though the grant funds have covered 80% of the costs and the operator only funded 20% of the project. Operators also have the option to forgo putting any funds away in a Spending Account by utilizing the ACP or AFMO. CARB staff developed the AFMO with collaboration with the passenger locomotive operators, and expect all passenger locomotive operators will comply with the Regulation using one of the two alternative pathways—meaning that they will not be obligated to deposit any funds in a Spending Account.

¹³¹ Railway Age, Watch: Parallel Systems Debuts 2nd-Gen Autonomous Battery-Electric Freight Car, September 12, 2023. (Weblink: <https://www.railwayage.com/mechanical/freight-cars/watch-parallel-systems-debuts-2nd-gen-autonomous-battery-electric-freight-car/>).

In the initial years of the Locomotive Regulation, operators can earn ZE credit for any ZE locomotive or ZE rail equipment they use in California. The ZE credit is doubled for any ZE activity in a designated disadvantaged community.

The CARB Board directed staff to continue outreach efforts to ensure that affected industries are aware of the requirements of the In-Use Locomotive Regulation, with a focus on Class III and industrial operators, and available incentive funding opportunities. Staff created a new Grant Orientation for Zero Emission Rail Operation (GO ZERO) program, to help Class III and Industrial Operators transition towards ZE rail operations with minimal cost. Staff is coordinating with federal and state agencies to increase the potential to secure federal and state funding for ZE rail operation projects.

CARB staff determined the estimated annual net cost to regulated entities as part of the Standardized Regulatory Impact Assessment, which can be found in ISOR Appendix B: Standardized Regulatory Impact Assessment (SRIA) for the Proposed In-Use Locomotive Regulation.¹³² CARB staff determined that direct costs to comply with the Locomotive Regulation will largely be borne by locomotive operators but acknowledge that affected businesses may pass compliance costs through to consumers of freight moved by rail. Assuming the total net costs of the Regulation are fully passed through to consumers, the total impact of the Locomotive Regulation from 2023 to 2050 is \$976 per California household with a yearly average of \$36. While changes in passenger fares are not directly linked to changes in operational and capital costs, staff calculated the hypothetical impact to fares if passenger operators passed through 100% of their costs to riders. Under this assumption, local passenger fares could increase by approximately 35 cents, and state passenger fares could increase by \$2.00 on average.

Based on the above reasons, the Locomotive Regulation is feasible within the time provided for compliance, giving appropriate consideration of costs.

XIV. Consistency with Federal Test Procedures

The Locomotive Regulation does not present an issue of incompatibility between California and federal test procedures as it does not regulate how new locomotives or manufactured or tested, much less alter the federal test procedures specified for certifying new locomotive engines.¹³³

¹³² Staff Report: Initial Statement of Reasons.

¹³³ 40 CFR 1033.501.

Conclusion

Based on the foregoing, CARB respectfully requests that the Administrator grant California's request for an authorization for California's non-road program, including the Locomotive Regulation pursuant to CAA section 209(e)(2)(A).

CARB Contacts

Technical questions or requests for additional technical information on this item should be directed to Mr. Ajay Mangat, Chief, Freight Technology Advancement Branch, Transportation and Toxics Division, at (279) 208-7298, or Ms. Layla Gonzalez, Staff Air Pollution Specialist, Transportation and Toxics Division, at (279) 208-7827. Legal questions should be directed to Mr. Rhead Enion, Senior Attorney, Office of Legal Affairs, at (279) 208-7770.

Reference Materials

The following references are attached to this request:

1. CARB, 2022 State SIP Strategy, September 22, 2022, https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf.
2. U.S. EPA, EPA Proposes to Strengthen Air Quality Standards to Protect the Public from Harmful Effects of Soot, January 6, 2023, <https://www.epa.gov/newsreleases/epa-proposes-strengthen-air-quality-standards-protect-public-harmful-effects-soot>.
3. Notice of Public Hearing to Consider Proposed In-Use Locomotive Regulation, September 20, 2022, <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/locomotive22/notice.pdf>
4. Notice of Public Availability of Modified Text, and Availability of Additional Documents, including all Appendices, issued March 1, 2023, <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/locomotive22/15daynotice.pdf>
5. Resolution 23-12, dated April 27, 2023, <https://ww2.arb.ca.gov/sites/default/files/barcu/board/res/2023/res23-12.pdf>
6. Staff Report: Initial Statement of Reasons, including all Appendices, issued September 20, 2022, <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/locomotive22/isor.pdf>

7. Final Statement of Reasons for Rulemaking Including Summary of Comments and Agency Responses, October 27, 2023,
<https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/locomotive22/fsor2.pdf>
8. American Lung Association, 2021 State of the Air Report, 2021,
<https://www.lung.org/getmedia/17c6cb6c-8a38-42a7-a3b0-6744011da370/sota-2021.pdf>
9. CARB, Ozone and Health Factsheet, [https://ww2.arb.ca.gov/resources/fact sheets/ozone effects](https://ww2.arb.ca.gov/resources/fact%20sheets/ozone%20effects)
10. CARB, National Ambient Air Quality Standards, <https://ww2.arb.ca.gov/resources/national-ambient-air-quality-standards>
11. South Coast Air Quality Management District, 2022 Air Quality Management Plan, December 2022, <http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2022-air-quality-management-plan/final-2022-aqmp/final-2022-aqmp.pdf?sfvrsn=16>
12. San Joaquin Air Pollution Control District, 2022 Plan for the 2015 8-Hour Ozone Standard, December 2022, <https://ww2.valleyair.org/media/q55posm0/0000-2022-plan-for-the-2015-8-hour-ozone-standard.pdf>
13. U.S. EPA, Regulatory Impact Analysis for the Proposed Reconsideration of the National Ambient Air Quality Standards for Particulate Matter, December 2022, https://www.epa.gov/system/files/documents/2023-01/naaqs-pm_ria_proposed_2022-12.pdf.
14. Analysis in Support of Comments of the California Air Resources Board on the Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks (October 26, 2018), EPA-HQ-OAR-2018-0283-5054,
<https://www.regulations.gov/comment/EPA-HQ-OAR-2018-0283-5054>
15. Cal. Gov. Office of Planning and Research et. al, California's Fourth Climate Change Assessment: Statewide Summary Report, Aug. 2018, p. 24.,
https://www.energy.ca.gov/sites/default/files/2019-11/Statewide_Reports-SUM-CCCA4-2018-013_Statewide_Summary_Report_ADA.pdf
16. Cal. Dept. of Food and Ag., California Agricultural Production Statistics,
<https://www.cdfa.ca.gov/statistics>
17. Michael Bezilla, Steam Railroad Electrification in America, 1920–1950: The Unrealized Potential, 4 THE PUBLIC HISTORIAN 1, at 49 (Winter 1982)

18. U.S. Dep't of Transp., Railroad Electrification Activity in North America—A Status Report: 1976–1978, at 1–2 (FRA/ORD-80/81 Nov. 1980)
https://railroads.dot.gov/sites/fra.dot.gov/files/fra_net/16045/1980_RAILROAD%20ELECTRIFICATION%20ACTIVITY%20IN%20NORTH%20AMERICA.PDF
19. Nat'l Park Service, Steamtown: American Electric Locomotives,
<https://www.trains.com/trn/railroads/history/the-stages-of-us-railroad-electrification/>
20. The Stages of U.S. Railroad Electrification, TRAINS Magazine (Sep. 25, 2009),
<https://www.trains.com/trn/railroads/history/the-stages-of-us-railroad-electrification/>
21. Federal Railroad Administration, FY 2022 Consolidated Rail Infrastructure and Safety Improvement Program Selections: Project Summaries, September 25, 2023, accessed November 3, 2023, <https://railroads.dot.gov/sites/fra.dot.gov/files/2023-09/FY%202022%20CRISI%20Program%20Selections%20-%20Project%20Summaries.pdf>
22. California Air Resources Board, Case-by-Case Determinations: Locomotives, Reference #2023-14, accessed November 3, 2023, <https://ww2.arb.ca.gov/case-case-determinations-locomotives>
23. Southern California Regional Rail Authority, Metrolink's Locomotive Fleet Modernization Study Update, April 2, 2021,
<https://d2kbbkoa27fdvtw.cloudfront.net/metrolink/3420287751df2a30822eaa0b6889889d0.pdf>
24. Cummins, Cummins Rail Expands Clean Diesel Product Offering with QST30 Tier 4 Locomotive Power Module, Nov 16, 2021,
<https://www.cummins.com/news/releases/2021/11/16/cummins-rail-expands-clean-diesel-product-offering-qst30-tier-4-locomotive>
25. Western Rail, Inc., Facebook post on March 23, 2022, retrieved on September 18, 2023,
<https://www.facebook.com/WesternRailInc/posts/introducing-our-newest-project-the-cummins-qst30-tier-4-engine-package-western-i/4860353364020402/>
26. Railway Gazette International, Indian Railways starts double-stack electric operation, June 11, 2020, retrieved on October 24, 2023, <https://www.railwaygazette.com/freight/indian-railways-starts-double-stack-electric-operation/56733.article>
27. Amtrak, What is Catenary Wire?, retrieved on October 24, 2023,
<https://blog.amtrak.com/2014/01/catenary-wire/>
28. Caltrain, Electric Trains, retrieved on October 24, 2023,
<https://www.caltrain.com/projects/electrification/electric-trains>

29. RailFreight.com, More electrified railway lines for southern yard in Port of Antwerp-Bruges, May 23, 2023, retrieved on October 23, 2023, <https://www.railfreight.com/interoperability/2023/05/23/more-electrified-railway-lines-for-southern-yard-in-port-of-antwerp-bruges/>
30. Hamburg Port Authority, Hamburg Port Authority- Port is What We Do, November 12, 2020, https://scanmedfreight.eu/Customer%20Workshop%20201112/Presentations/20201112_Pres_HPA_final.pdf
31. Valencia Port, Port of Valencia: more trains, longer trains, more goods and more containers, March 13, 2023, retrieved on October 24, 2023, <https://www.valenciaport.com/en/port-of-valencia-more-trains-longer-trains-more-goods-and-more-containers/>
32. Trains, David Lustig, Pacific Harbor Line displays battery locomotive at ceremony for engineers, May 7, 2023, accessed November 3, 2023, <https://www.trains.com/trn/news-reviews/news-wire/pacific-harbor-line-displays-battery-locomotive-at-ceremony-for-engineers/>
33. BNSF, BNSF and Wabtec commence battery-electric locomotive pilot test in California, January 4, 2021, accessed November 3, 2023, <https://www.bnsf.com/news-media/news-releases/newsrelease.page?relId=bnsf-and-wabtec-commence-battery-electric-locomotive-pilot-test-in-california>
34. Businesswire, U. S. Steel Pioneers Battery-Powered Locomotives, Reinforces Commitment to Sustainability and Community, October 30, 2023, accessed November 3, 2023, <https://www.businesswire.com/news/home/20231029717483/en/>
35. Port of Stockton, Low & Zero Emission Fuel Options for the Port of Stockton, https://www.portofstockton.com/wp-content/uploads/2021/11/POS_WhitePaper_LowZeroEmissionFuelOptions_D3.pdf
36. Railwayage, First U.S. Hydrogen Powered Passenger Trainset Testing at TTC, October 11, 2023, accessed November 3, 2023, <https://www.railwayage.com/passenger/commuterregional/first-u-s-hydrogen-powered-passenger-trainset-testing-at-ttc/>
37. CARB, Transitioning to a Zero or Near-Zero Emission Line-Haul Freight Rail System in California: Operational and Economic Considerations, Spring 2016, https://www.arb.ca.gov/railyard/docs/uoj_rpt_06222016.pdf
38. Popovich, N.D., Rajagopal, D., Tasar, E. et al. Economic, environmental and grid-resilience benefits of converting diesel trains to battery-electric. *Nat Energy* 6, 1017–1025 (2021), <https://doi.org/10.1038/s41560-021-00915-5>

39. Appendix C: Appendix C Technical Support Document: Zero Emission Locomotive Conversion, March 1, 2023, <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/locomotive22/15dayappc.pdf>
40. Aurizon, Work starts on first zero-emissions capable freight locomotive built in Australia, May 30, 2023, <https://www.aurizon.com.au/news/2023/work-starts-on-first-zero-emissions-capable-freight-locomotive-built-in-australia>
41. Aurizon, Factsheet: First Australian-built Battery Electric Locomotive (BEL) for the Australian freight industry, accessed September 19, 2023, https://mc-71bd5e2a-aade-4067-a0ad-8402-cdn-endpoint.azureedge.net/-/media/aurizon-media-library/news/media-releases/2023/bel_factsheet_30052023.pdf?rev=96e2afa09a7a431bb16d3b054bc037a2&hash=9B47CF2CDA4F5D0A4391E2484F91DC73
42. California State Transport Agency, Port and Freight Infrastructure Program Selected Projects – Project Detail Summary, July 6, 2023, <https://calsta.ca.gov/-/media/calsta-media/documents/pfip-awards-summary-narrative-7-6-23-a11y.pdf>
43. California Energy Commission, Sierra Northern Railway Grant Request Form, April 1, 2021, <https://www.energy.ca.gov/Calio/filebrowser/download/3035>
44. Union Pacific, Union Pacific and ZTR Partner on New Hybrid-Electric Locomotives, October 6, 2022, <https://www.up.com/media/releases/hybrid-electric-locomotives-nr-221006.htm>
45. Progress Rail, Progress Rail Providing Hybrid Diesel/Battery Electric Locomotives to Support Customers' Emission Reduction Goals, <https://www.progressrail.com/en/Company/News/PressReleases/ProgressRailProvidingHybridDieselBatteryElectricLocomotivestoSupportCustomersEmissionReductionGoals.html>
46. Progress Rail, Rumo invests in hybrid locomotives from Progress Rail, reducing environmental impact of freight operations, October 4, 2023, <https://www.progressrail.com/en/Company/News/PressReleases/RumoinvestsinhybridlocomotivesfromProgressRailreducingenvironmentalimpactoffreightoperations.html>
47. Mass Transit, Alstom's Shunting Loco Prima H3 Receives Final Homologation from EBA, April 5, 2017, <https://www.masstransitmag.com/rail/press-release/12322903/alstom-transport-alstoms-shunting-loco-prima-h3-receives-final-homologation-from-eba>
48. Toshiba, Battery improves climate footprint: DB Cargo buys 50 Toshiba hybrid locomotives, January 23, 2020, <https://www.global.toshiba/ww/news/infrastructure/2020/01/news-20200123-01.html>
49. CARB, Yes, the California grid can handle electrification of all switchers in all railyards, June 28, 2023, <https://ww2.arb.ca.gov/resources/fact-sheets/yes-california-grid-can-handle-electrification-all-switchers-all-railyards>

50. United States Department of Transportation – Railroad Administration, Study of Hydrogen Fuel Cell Technology for Rail Propulsion and Review of Relevant Industry Standards, June 2021, <https://railroads.dot.gov/sites/fra.dot.gov/files/2021-06/Study%20of%20Hydrogen%20Fuel%20Cell%20Tech.pdf>
51. Chart Industries, LNG on the Rails- Precursor to LH2 on the Rails? 2018, <https://www.energy.gov/sites/prod/files/2019/04/f62/fcto-h2-at-rail-workshop-2019-nason-larson.pdf>
52. R. K. Ahluwalia, D. Papadias, and X. Wang, Rail and Maritime Metrics, U.S. DOE Hydrogen and Fuel Cells Program 2020 Annual Merit Review and Peer Evaluation Meeting, Washington, D.C., May 19 - 21, 2020, https://www.hydrogen.energy.gov/pdfs/review20/ta034_ahluwalia_2020_o.pdf
53. CARB, Sustainable Terminals Accelerating Regional Transformation (START) Project Phase 1, 2019, accessed September 19, 2023, <https://ww2.arb.ca.gov/sites/default/files/movingca/pdfs/start.pdf>
54. Port of Stockton, Port of Stockton Awarded \$45.9 Million Grant. July 7, 2023. <https://www.portofstockton.com/press-release-port-of-stockton-awarded-45-9-million-grant/>
55. Railway Age, Watch: Parallel Systems Debuts 2nd-Gen Autonomous Battery-Electric Freight Car, September 12, 2023, <https://www.railwayage.com/mechanical/freight-cars/watch-parallel-systems-debuts-2nd-gen-autonomous-battery-electric-freight-car/>).
56. Second Notice of Public Availability of Modified Text, and Availability of Additional Documents, including all Appendices, issued August 8, 2023, <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/locomotive22/2nd15daynotice1.pdf>
57. Updated Informational Digest, <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/locomotive22/uid.pdf>
58. Final Regulation Order, <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/locomotive22/fro2.pdf>
59. Office of Administrative Law Approval Notice, dated Date October 27, 2023
60. Transcript of November 18, 2022, Public Hearing, agenda item number 22156
61. Transcript of April 27, 2023, Public Hearing, agenda item number 23-41 <https://ww2.arb.ca.gov/sites/default/files/barcu/board/mt/2023/mt042723.pdf>