Air Resources Board

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Matthew Rodriquez
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April 13, 2017

The Honorable Scott Pruitt, Administrator
U.S. Environmental Protection Agency
Office of the Administrator, Mail Code: 1101A
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Dear Administrator Pruitt:

I am writing to urge the U.S. Environmental Protection Agency (U.S. EPA) to exercise its authority to again adopt more stringent emission standards for locomotives. Reducing locomotive-related emissions and the resulting air toxic hot spots near railyards is a high priority for disadvantaged communities within California and around the nation. In addition, developing technology offers an opportunity for significant fuel cost savings for rail operations. A formal petition for U.S. EPA rulemaking is enclosed.

The gradual introduction of new locomotives meeting U.S. EPA's current Tier 4 emission standards will substantially reduce per-locomotive emissions and partially mitigate projected increases in rail traffic. However, locomotive activity in both impacted communities and severely polluted regions must approach zero emissions to protect the public health and welfare of the nation, as well as achieve federal air quality standards set by U.S. EPA. Developing control technologies offer the opportunity to further reduce locomotive emissions of toxic and criteria air pollutants beyond Tier 4 levels. In addition, use of on-board batteries can support zero-emission rail operation in sensitive areas, as well as cut fuel consumption and greenhouse gas (GHG) emissions.

Peer-reviewed studies have found that there are significant "diesel exposure disparities by race and income among residents living in close proximity to most of the major railyards in California."[1, 2] National locomotive emissions and diesel fuel standards, California Air Resources Board (ARB) agreements with railroads, California emission

[1] Hricko, Andrea, et al. "Global trade, local impacts: Lessons from California on Health Impacts and Environmental Justice Concerns for Residents Living near Freight Rail Yards." *International Journal of Environmental Research and Public Health* Vol. 11(2), 2014, pp. 1914-1941.
[2] U.S. EPA, "Age, Income, and Racial/Ethnic Composition of Populations Exposed to DPM in the Vicinity of Rail Yards and Terminals," Appendix H, 2003.

standards for drayage trucks and cargo equipment, and private and public investments in cleaner equipment are reducing overall emissions and health risk near our major railyards. But we cannot deliver on our collective responsibility to improve conditions on the ground for overburdened communities without new action by U.S. EPA to require a transition to zero and near-zero emission locomotives. ARB is requesting promulgation of updated emission standards, including standards for newly manufactured locomotives and standards for emissions upon remanufacture. Under the proposed standard, with capability for zero-emission operation, newly manufactured locomotives could achieve 99 percent control of oxides of nitrogen and diesel particulate matter, 98 percent control of hydrocarbons, and 10-25 percent control of GHGs.

Potential Amended Emission Standards for Newly Manufactured Locomotives and Locomotive Engines

Tier Level	Proposed Year of Manufacture	NOx		PM		GHG		HC		Proposed Effective Date
		Standard (g/bhp-hr)[1]	Percent Control[2]	Standard (g/bhp-hr)[1]	Percent Control[2]	Standard (g/bhp-hr)[1]	Percent Control[1]	Standard (g/bhp-hr)	Percent Control[2]	
5	2025	0.2	99+	<0.01	99	NA	10-25%	0.02	98	2025
		With capability for zero-emission operation in designated areas.								

1. ARB, Technology Assessment: Freight Locomotives, 2016.[3]
2. Compared with uncontrolled baseline, reflects percent control over line haul baseline for illustrative purposes; ARB staff assumed older pre-Tier 0 line haul and switch locomotives would be able to emit up to the Tier 0 PM emission standards, based on American Association of Railroads in-use emission testing (required to comply with U.S. EPA in-use emission testing requirements) for older switch locomotives with EMD 645 engines.

U.S. EPA has a long history of working for environmental justice in vulnerable, environmentally burdened, and economically disadvantaged communities. In the September 2016 *National Port Strategy Assessment*, U.S. EPA identifies the use of electric locomotives as an "effective port strategy to reduce [carbon dioxide] emissions."[4] In addition, U.S. EPA's *Draft EJ 2020 Action Agenda*[5] (Action Agenda) identifies air pollution from freight-related hubs (like seaports and railyards) as an important national issue. Taking action to deliver locomotives capable of zero-emission operation in overburdened communities would further Goal III of the Action Agenda, to demonstrate progress on significant national environmental justice challenges, and respond to

[3] ARB, Technology Assessment: Freight Locomotives, November 2016 <https://www.arb.ca.gov/msprog/tech/techreport/final_rail_tech_assessment_11282016.pdf> accessed December 9, 2016.
[4] U.S. EPA, National Port Strategy Assessment: Reducing Air Pollution and Greenhouse Gases at U.S. Ports, September 2016 <https://www.epa.gov/sites/production/files/2016-09/documents/420r16011.pdf> accessed December 15, 2016.
[5] U.S EPA, Draft EJ 2020 Action Agenda <https://www.epa.gov/sites/production/files/2016-05/documents/052216_ej_2020_strategic_plan_final_0.pdf> December 15, 2016.

Action 1.2, to identify and address potential adverse impacts from the commercial distribution of freight.

The same locomotive technology advances needed to protect communities near railyards and high-traffic rail corridors can also cut nitrogen oxides to aid California and other states' ability to achieve the National Ambient Air Quality Standards set by U.S. EPA. Even widespread national deployment of Tier 4 locomotives will not be sufficient to attain the 2015 ozone standard in California or to meet ambitious State and federal targets to cut GHGs and short-lived climate pollutants like black carbon.

ARB, aided by a contract with the University of Illinois, has conducted an in-depth assessment of locomotive technology, operations, and economics to identify options for California to transition to zero and near-zero emission locomotives. U.S. EPA rulemaking to tighten the national locomotive emission standards beyond the current Tier 4 requirements is the most efficient and cost-effective path. Such U.S. EPA action would support environmental justice initiatives in rail-impacted communities, attainment of ambient air quality standards, and climate progress around the country.

We urge U.S. EPA to exercise its authority to adopt more stringent emission standards for locomotives so that all states can meet federal air quality standards and climate goals, and address issues affecting the public health and welfare. We request a response to the enclosed petition by Summer 2017, to ensure adequate time for development of the proposed rulemaking. We are willing to assist in any way possible, including a partnership to perform technical analyses. If you would like to discuss this request, please call me at (916) 322-5840.

Sincerely,

Mary D. Nichols
Chair

Enclosure

cc: See next page.

cc: Elizabeth Adams
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Richard W. Corey
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BEFORE THE ADMINISTRATOR OF THE UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY

PETITION FOR RULEMAKING SEEKING THE AMENDMENT OF THE LOCOMOTIVE EMISSION STANDARDS FOR NEWLY BUILT LOCOMOTIVES AND LOCOMOTIVE ENGINES AND LOWER EMISSION STANDARDS FOR REMANUFACTURED LOCOMOTIVES AND LOCOMOTIVE ENGINES

April 13, 2017

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Introduction and Summary

The California Air Resources Board (ARB) is the California State agency charged with promoting and protecting public health, welfare and ecological resources through the effective and efficient reduction of air pollutants, while recognizing and considering the effects on the economy of the State. ARB, in coordination with local air districts, is also responsible for attaining and maintaining the federal air quality standards set by the U.S. Environmental Protection Agency (U.S. EPA) under the federal Clean Air Act (CAA),[1] and for preparing California's State Implementation Plan (SIP), which lays out California's proposed plan for attainment of the federal air quality standards by identifying both the magnitude of emission reductions needed and the actions necessary to achieve those reductions by the required attainment deadline.[2]

Under the federal CAA, U.S. EPA has the sole authority to establish emissions standards for new locomotives and new engines used in locomotives.[3] By regulation, U.S. EPA has defined "new" locomotives to include both those newly manufactured and those existing locomotives that are remanufactured or rebuilt. Therefore, ARB, pursuant to Title 5, United States Code (U.S.C.) section 553(e) and the federal CAA, hereby petitions U.S. EPA to amend the current "Emission Standards for Locomotives and Locomotive Engines."

Specifically, ARB petitions U.S. EPA to promulgate a standard for newly built locomotives (to be referred to as Tier 5) and a new standard for Tier 4 locomotives upon remanufacture. ARB also petitions U.S. EPA to promulgate remanufacture standards equal to or more stringent than current Tier 4 emission levels for Tier 2 and 3 locomotive engines. Amending U.S. EPA's locomotive standard in these ways is included as an action in ARB's *Revised Proposed 2016 State Strategy for the SIP*. The amendment ARB seeks is vital to the public health and welfare of the nation, as well as to the State's ability to achieve and maintain the federal air quality standards set by U.S. EPA.

Background on Locomotives, Locomotive Operations, and Existing Regulations

While there are various locomotive technologies in use, most locomotives operating today use a diesel engine to drive an alternator, which powers electric traction motors to move the locomotive wheels. These are referred to as diesel-electric locomotives. Since locomotives use diesel engines as their primary power source, there are criteria, toxic, and climate change pollutant emissions associated with their operation, such as oxides of nitrogen (NOx), fine particulate matter 2.5 microns or less in diameter (PM2.5) and its subset of toxic diesel particulate matter (diesel PM), and greenhouse gases (GHG).

[1] 42 U.S.C. § 7401 et. seq.
[2] California Health & Safety Code § 39602, 42 U.S.C. § 7410(a)(1).
[3] 42 U.S.C. § 7547(a)(5).

The total population of railroads operating in the U.S. consists of: freight railroads (categorized by three classes: Class I, II, and III), passenger railroads, and military and industrial railroads. The Federal Surface Transportation Board defines Class I (major), Class II (regional), or Class III (shortline) railroads based on inflation-adjusted annual operating revenue. In 2014, Class I major railroads were defined as having greater than $475 million in annual operating revenue.[4] Across the U.S., Class I operations generate the vast majority of locomotive activity and emissions, with most of that from interstate line haul locomotives. Using data from the American Association of Railroads, ARB staff estimates that the number of U.S. freight and passenger diesel-electric locomotives that are potentially subject to U.S. EPA locomotive regulations is about 31,000.[5] In the U.S., diesel locomotive engine use among freight railroads has risen from 800 million revenue ton-miles in 1970[6] to more than 1.7 billion revenue ton-miles in 2015,[7] and it is projected to further increase.

U.S. EPA defines two major categories of locomotives that operate in the nation: switch locomotives (switchers), and line haul locomotives. Switchers are specifically defined by U.S. EPA as having engines between 1,006 and 2,300 horsepower;[8] these locomotives tend to operate in and around railyards. Switchers are used to move smaller subsets of railcars from a nearby industry to the railyard, or move a group of railcars within a railyard, to ultimately form a larger regional or interstate freight train. Line haul locomotives have engines with a maximum rated power of 2,301 or more horsepower. Interstate freight trains typically utilize three or more interstate line haul locomotives within chains of railcars up to two miles long to power the movement of freight.

With their long useful life and durability, locomotive engines are designed to be remanufactured several times during their service life; typically, this is done every seven to ten years. Remanufacture is necessary to ensure the continued proper functioning of the engine. When the locomotive engine is remanufactured, it receives replacement parts, which are either freshly-manufactured or remanufactured to as-new condition; this includes the emission-related parts.[9] The emission level of a locomotive engine is dependent upon when it was manufactured or remanufactured, because the date of manufacture or remanufacture determines the standard to which the engine is certified.

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[4] Association of American Railroads, Rail Statistics of Class 1 Freight Railroads <https://www.aar.org/Documents/Railroad-Statistics.pdf> accessed December 12, 2016.
[5] ARB, Technology Assessment: Freight Locomotives, November 2016 <https://www.arb.ca.gov/msprog/tech/techreport/final_rail_tech_assessment_11282016.pdf> accessed December 9, 2016.
[6] U.S. Department of Transportation, Bureau of Transportation Statistics, U.S. Ton-Miles of Freight <http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/2002/html/table_01_44.html> accessed December 12, 2016.
[7] Surface Transportation Board, Office of Economics, Environmental Analysis, and Administration: Quarterly Earnings Reports, 2015 Fourth Quarter Earnings Compilation for All Class 1 Freight Railroads, 12 months ended December 31, 2015 <http://www.stb.dot.gov/econdata.nsf> accessed December 15, 2016.
[8] 40 CFR § 1033.901.
[9] U.S. EPA, Locomotive Emission Standards, Regulatory Support Document, April 1998, section 2.6.

U.S. EPA first established emission standards applicable to locomotives and locomotive engines in 1998, and the standards have been revised over time (see Table 1). Standards were applied to hydrocarbons (HC), NOx, and PM; U.S. EPA has expressed PM emission factors as either "PM" or "PM10." [10]

In 1998, U.S. EPA adopted Tier 0, Tier 1, and Tier 2 emission standards for original manufacture and for subsequent remanufactures of locomotives; these were applicable to locomotives with engine model years from 1973-2011. In 2008, U.S. EPA amended the 1998 locomotive regulation, establishing a Tier 3 and a Tier 4 emission standard, as well as stricter remanufacturing standards for remanufactured Tier 0-2 engines.[11]

The new Tier 3 PM emission standards went into effect for engine model years 2012-2014 for line haul locomotives and represented a minor step change. The Tier 4 line haul locomotive standard, effective in 2015, requires a reduction of NOx and PM emissions of 90 percent for NOx and 95 percent for PM, relative to pre-Tier 0. The key technologies used to achieve these reductions in NOx and PM emissions are exhaust gas recirculation and improvements to the cooling system. Tier 4 locomotives are commercially available and are now being phased in.

[10] U.S. EPA, Technical Highlights of Emission Factors for Locomotives (2009), <https://nepis.epa.gov/Exe/ZyPDF.cgi/P100500B.PDF?Dockey=P100500B.PDF> accessed December 15, 2016. U.S. EPA uses particle mass to distinguish between the two categories of particle pollution. In U.S. EPA documents where factors are expressed as PM, "PM emissions can be expressed as PM10 (which includes all particles up to 10 microns in diameter) or PM2.5 (which includes only those particles 2.5 microns or less in diameter)." Per U.S. EPA Publication EPA-420-F-09-025, Emission Factors for Locomotives, (April 2009), "PM2.5 emissions can be estimated as 0.97 times the PM10 emissions, meaning that nearly all of the PM is [2.5 microns or less] in diameter."

[11] U.S. EPA, 40 CFR Parts 9, 85, et al.

Table 1:
Existing Federal Locomotive Emission Standards and Percent Control[1,2]

Line Haul Locomotives							
Emission Tier	Year of Manufacture	NOx		PM		HC	
		Standard (g/bhp-hr)	Percent Control	Standard (g/bhp-hr)	Percent Control	Standard (g/bhp-hr)	Percent Control
Pre-Tier 0	1973-1999	13.5[3]	n/a	0.6[3]	n/a	1.0	n/a
Tier 0	2000-2001	9.5	30	0.6	0	1.0	0
Tier 1	2002-2004	7.4	45	0.45	25	0.55	45
Tier 2	2005-2011	5.5	59	0.2	67	0.3	70
Tier 3	2012-2014	5.5	59	0.1	83	0.3	70
Tier 4	2015	1.3	90	0.03	95	0.14	86
Switch Locomotives							
Emission Tier	Year of Manufacture	NOx		PM		HC	
		Standard (g/bhp-hr)	Percent Control	Standard (g/bhp-hr)	Percent Control	Standard (g/bhp-hr)	Percent Control
Pre-Tier 0	1973-1999	17.4[3]	n/a	0.72[4]	n/a	2.1	n/a
Tier 0	2000-2001	14.0	20	0.72	0	2.1	0
Tier 1	2002-2004	11.0	37	0.54	25	1.2	43
Tier 2	2005-2011	8.1	53	0.24	67	0.6	71
Tier 3	2012-2014	5.0	71	0.1	86	0.6	71
Tier 4	2015	1.3	93	0.03	96	0.14	93

1. 40 CFR Part 1033.101, a.
2. U.S. EPA, Fact Sheet EPA-420-F-09-025, April 2009.
3. U.S. EPA, Locomotive Emissions Standards, Regulatory Support Document (U.S. EPA, 1998), p. 96 – Estimated NOx Emission Rates.
4. ARB staff assumed older pre-Tier 0 line haul and switch locomotives would be able to emit up to the Tier 0 PM emission standards, based on American Association of Railroads in-use emission testing (required to comply with U.S. EPA in-use emission testing requirements) for older switch locomotives with EMD 645 engines.

Historically, it has taken about seven years for U.S. locomotive manufacturers to implement new engine standards that represented a major step change. For example, it took General Electric and Electro-Motive Diesel, the two U.S. diesel-electric freight interstate line haul locomotive manufacturers, seven years to design, laboratory test, build prototypes, and field demonstrate a number of locomotives to be ready for commercial production of Tier 2 locomotives.[12] While the federal locomotive standards have achieved significant emission reductions since implementation of the first locomotive regulation in 2000, more stringent emission standards are needed to

[12] ARB, Technology Assessment: Freight Locomotives, November 2016 <https://www.arb.ca.gov/msprog/tech/techreport/final_rail_tech_assessment_11282016.pdf> accessed December 9, 2016.

address the air quality, public health, and climate change concerns associated with locomotive operations. This is discussed in detail in the next section.

Need for Amendment

A. U.S. EPA Must Amend the Current Locomotive Emission Standards to Help States to Meet the Federal Air Quality Standards.

Under the federal CAA, U.S. EPA is charged with protecting and enhancing "the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population."[13] To carry out this task, the Administrator must set federal air quality standards that the Administrator has judged are "requisite to protect the public health."[14] In response to new scientific evidence demonstrating health impacts at lower levels of pollution, U.S. EPA has progressively strengthened federal air quality standards to levels it has judged as requisite to protect the public health.[15] In 2015, U.S. EPA revised the primary and secondary 8-hour ozone standard from the 2008 level of 0.075 parts per million (ppm) to 0.070 ppm, and in 2013, the primary annual PM2.5 standard was revised from 15 micrograms per cubic meter ($\mu g/m^3$) to 12 $\mu g/m^3$.[16] U.S. EPA retained the secondary annual PM2.5 standard of 15 $\mu g/m^3$.

Although the states will be given time to comply with the updated standards, prior standards are still not being met in some places. According to a report released by the Congressional Research Service,[17] 122 million people (40 percent of the U.S. population) live in areas classified as being in nonattainment for the 2008 primary and secondary 8-hour ozone standard (0.075 ppm). These areas include 224 counties in 25 states, and the District of Columbia. A Congressional Research Service report on PM2.5 states that roughly 28 million people reside in the 39 counties U.S. EPA designated as nonattainment for the 2013 primary annual PM2.5 standard (12 $\mu g/m^3$).[18]

Around the country, states with rail operations face challenges in meeting the federal air quality standards set by U.S. EPA. States with high concentrations of rail activity and the highest locomotive emissions of NOx, which also have portions of the state in nonattainment of the 0.075 ppm primary and secondary 8-hour ozone standard include: California, Illinois, Pennsylvania, Maryland, New York, New Jersey, and Texas.

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[13] 42 U.S.C. § 7401(b).
[14] 42 U.S.C. § 7409(a) and (b).
[15] 40 CFR, Parts 50, 51, 52, and 58.
[16] U.S. EPA, NAAQS Table, March 29, 2015 <https://www.epa.gov/criteria-air-pollutants/naaqs-table> accessed April 21, 2016 and U.S. EPA, Table of Historical Ozone National Ambient Air Quality Standards (NAAQS), accessed March 4, 2016 <https://www.epa.gov/ozone-pollution/table-historical-ozone-national-ambient-air-quality-standards-naaqs> accessed December 12, 2016.
[17] Congressional Research Service, Ozone Air Quality Standards: EPA's 2015 Revision, January 2016 <https://fas.org/sgp/crs/misc/R43092.pdf> accessed December 12, 2016.
[18] Congressional Research Service, 2013 National Ambient Air Quality Standard (NAAQS) for Fine Particulate Matter (PM2.5): Designating Nonattainment Areas, December 2015 <https://www.fas.org/sgp/crs/misc/R43953.pdf> accessed December 12, 2016.

Portions of Pennsylvania are also in nonattainment of the primary annual 12 $\mu g/m^3$ PM2.5 and the secondary annual 15 $\mu g/m^3$ PM2.5 standards. Although designations using the primary and secondary 8-hour 0.070 ppm ozone standard have not yet been implemented, under current conditions U.S. EPA estimates at least 241 counties in 33 states would be in nonattainment.[19]

ARB has vigorously pursued the adoption and enforcement of regulations to help California meet the federal air quality standards. However, California continues to have some of the worst air quality in the nation. In 2015, PM2.5 emissions from all types of locomotive activity in California were estimated to be about 580 tons per year, about three percent of the total mobile source emissions for the State; NOx emissions from locomotives were estimated to be over 32,000 tons per year, about seven percent of all mobile source emissions for the State.

Current control programs for mobile sources are projected to reduce NOx and PM2.5 emissions in California over 50 percent between 2015 and 2031. However, meeting federal standards in the South Coast and San Joaquin Valley will require significant further reductions; this includes the attainment deadlines to meet the primary and secondary 8-hour 0.08 ppm ozone standard by 2023 in the South Coast and the San Joaquin Valley, the primary and secondary 8-hour 0.075 ppm ozone standard by 2031 in the South Coast and the San Joaquin Valley, and the primary annual 12 $\mu g/m^3$ PM2.5 standard by 2021 to 2025 in the South Coast and the San Joaquin Valley.

To achieve reductions in criteria and toxic emissions over the years, ARB has regulated many on-road and off-road mobile sources and the fuels that power them, including passenger vehicles, heavy-duty trucks, off-road equipment, ocean-going vessels, commercial harbor craft, etc. Incentives have played a key role in achieving early and extra reductions. Agreements have also been critical in helping achieve regional emissions reductions from locomotives. On climate, ARB has adopted far-reaching policies, such as the Regulation for the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms (the Cap-and-Trade Program), the Low Carbon Fuel Standard, and the Advanced Clean Cars Program.

These controls, combined with private investments and efforts at the local and federal level, have achieved measurable improvements in air quality and provide a down payment on the emission reductions needed to meet air quality standards. Nonetheless, given the severity of the State's challenges, particularly in the South Coast and the San Joaquin Valley, the only way to meet federal standards is for all source sectors to further cut emissions. Success in California and in many other states depends on policies to achieve reductions from sources under federal and international regulatory authority, such as locomotives.

[19] U.S. EPA, NAAQS Table, March 29, 2015 <https://www.epa.gov/criteria-air-pollutants/naaqs-table> accessed December 12, 2016.

B. U.S. EPA Must Promulgate the Proposed Standards to Control the Dangers of Locomotive Emissions to the Public Health and Welfare.

U.S. EPA has the authority, and in fact, has the obligation, to set standards for locomotives and locomotive engines.[20] Locomotive activity creates a significant source of NOx and PM2.5. NOx is linked with a number of adverse effects on the respiratory system, and is a primary precursor to ground-level ozone, and fine particle pollution.[21] U.S. EPA calculated that locomotives emitted over 865,000 tons per year of NOx and around 26,000 tons per year of PM2.5 nationwide in 2011.[22]

PM2.5 contributes to premature death, as well as cardiac and respiratory illnesses. Many of the constituent chemicals in the subset of diesel PM are also federally identified hazardous air pollutants, including polycyclic organic matter, various metals such as arsenic, lead, and mercury, and polychlorinated dibenzo(p)dioxins and dibenzofurans.[23] ARB has identified diesel PM as a toxic air contaminant based on published evidence of a relationship between diesel exhaust exposure and lung cancer and other adverse health effects. Diesel PM also contributes to the same non-cancer health effects as PM2.5 exposure. These effects include premature death, hospitalizations and emergency department visits for exacerbated chronic heart and lung disease, including asthma, increased respiratory symptoms, and decreased lung function in children.[24] Those most vulnerable to non-cancer health effects are children whose lungs are still developing and the elderly who often have chronic health problems.

In 2012, additional studies on the cancer-causing potential of diesel exhaust published since ARB's determination led the International Agency for Research on Cancer, a division of the World Health Organization, to list diesel engine exhaust as "carcinogenic to humans." This determination is based primarily on evidence from occupational studies that show a link between exposure to diesel particulate matter and lung cancer induction, as well as death from lung cancer.[25]

Concentrated local exposure in and around freight railyards and passenger locomotive maintenance yards is a particular hazard for yard workers and residents of nearby communities. Freight locomotives are cascaded down throughout their useful lives as they age, beginning in line haul work and ending in railyards or other locales in close proximity to residents. As a result, locomotives operating continuously near rail hubs

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[20] 42 U.S.C. § 7547.
[21] U.S. EPA, Nitrogen Dioxide <https://www.epa.gov/no2-pollution/basic-information-about-no2#Effects> accessed December 12, 2016.
[22] U.S. EPA, 2011 NEI data <https://www.epa.gov/air-emissions-inventories/2011-national-emissions-inventory-nei-data> accessed December 12, 2016.
[23] U.S. EPA, Urban Air Toxics <https://www.epa.gov/urban-air-toxics> accessed December 12, 2016.
[24] ARB, Diesel Exhaust and Health <https://www.arb.ca.gov/research/diesel/diesel-health.htm> accessed December 12, 2016.
[25] International Agency for Research on Cancer, Diesel and Gasoline Engine Exhausts and Some Nitroarenes, vol. 105, 2012.

and industrial centers are often among the oldest, and are therefore the least controlled and highest emitting.

California is home to a large number of railyards. Eight of its 18 major freight railyards are intermodal railyards with extensive truck traffic. California-specific requirements for cleaner fuels, trucks, and yard equipment have accelerated the reduction of emissions and health risks. Even with these stringent controls, ARB estimates that the highest risk railyards in California will still expose nearby residents to significant excess cancer risks.

In March 2015, the Office of Environmental Health Hazard Assessment released an update to its recommended methodology for conducting health risk assessments in California. For many facilities, including railyards and maintenance yards, use of the new risk assessment methodology and air dispersion model will result in higher estimated pollutant concentrations, higher exposures, and higher estimated potential cancer risks than would have been calculated with the prior (2003) methodology—for the same level of emissions. The historical potential inhalation cancer risk using the new methodology may be 1.5 to three times (or more) higher than what was estimated using the 2003 methodology that was the basis for ARB's health risk assessments of the 18 major railyards.[26]

The remaining 10 of the 18 major railyards in the State are identified as classification railyards, where chains of railcars are broken up or assembled by a switcher based on their common destination. In classification railyards, locomotives that power or build trains are refueled and are subject to ongoing service and maintenance. These activities result in engine idling time, which results in emissions that can increase associated health risks in nearby communities. Depending on the type of railyard, freight interstate line haul locomotives can contribute 70 to 100 percent of railyard diesel PM emissions.[27]

In California and across the nation, these harmful emissions often occur in or near densely populated areas and neighborhoods, creating toxic "hot spots." For example, U.S. EPA's 2011 National Air Toxics Assessment maps show high levels of cancer risk and high concentrations of respiratory hazards in the communities near operations in Chicago, Dallas/Fort Worth, Houston, Atlanta, Minneapolis/St. Paul, Seattle, Portland, and the various ports in and around New York City.[28]

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[26] ARB, Railyard Health Risk Assessment and Mitigation Measures <https://www.arb.ca.gov/railyard/hra/hra.htm> accessed December 12, 2016.
[27] ARB, Technology Assessment: Freight Locomotives, November 2016 <https://www.arb.ca.gov/msprog/tech/techreport/final_rail_tech_assessment_11282016.pdf> accessed December 9, 2016.
[28] U.S. EPA, 2011 National Air Toxics Assessment Map <https://www.epa.gov/national-air-toxics-assessment/2011-nata-map> accessed December 12, 2016.

Reducing GHG emissions from locomotives is also a concern for California, the entire country, and the world. U.S. EPA has the authority to and must regulate sources of air pollution and GHG which endanger the public health or welfare.[29] The 2015 United Nations Agreement on Climate Change (Paris Agreement) noted with concern that

> . . . much greater emission reduction efforts will be required than those associated with the intended nationally determined contributions in order to hold the increase in the global average temperature to below 2˚C above pre-industrial levels.

Participants in the Paris Agreement also acknowledged: "All Parties should strive to formulate and communicate long-term low greenhouse gas emission development strategies."[30] GHG emissions from locomotives are increasing; U.S. EPA estimates that nationwide GHG emissions from rail transport grew by 21.4 percent from 1990 to 2014.[31] In addition to GHG, PM2.5 constituents include black carbon, a powerful short-lived climate pollutant which darkens and warms the atmosphere and accelerates snow melt.[32]

C. U.S. EPA Must Promulgate The Proposed Standards Because They Obtain the Greatest Degree of Emission Reduction Achievable Through The Application Of Technology Which The Administrator Determines Will Be Available for Regulated Locomotives and Locomotive Engines.

The Administrator must promulgate emission standards for new locomotives and locomotive engines which

> . . . achieve the greatest degree of emission reduction achievable through the application of technology which the Administrator determines will be available for the locomotives or engines to which such standards apply, giving appropriate consideration to the cost of applying such technology within the period of time available to manufacturers and to noise, energy, and safety factors associated with the application of such technology.[33]

Such standards are to take effect at the earliest possible date, considering lead time necessary for the development and application of requisite technology and the cost of compliance, energy, and safety.[34]

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[29] *Massachusetts v. U.S. EPA,* 549 U.S. 497 (2007).
[30] Conference of the Parties to the United Nations Framework Convention on Climate Change, Paris Agreement, Article 4.
[31] U.S. EPA, Fast Facts U.S. Transportation Sector Greenhouse Gas Emissions 1990-2014, June 2016 <https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100ONBL.pdf> accessed December 12, 2016.
[32] U.S. EPA, Report to Congress on Black Carbon, March 2012, section 2.6.2.
[33] 42 U.S.C. § 7547(a)(5).
[34] *Id.* § 7547(b).

The federal CAA is technology-forcing, and the Administrator may adopt standards which require the use of technology which is expected to be available in the foreseeable future.[35] The current U.S. EPA Tier 4 locomotive emission standards no longer reflect the best available technology. Since the 2008 amendment of the locomotive engine emission standards, technology has advanced significantly, allowing for additional emission reduction benefits. New, stricter standards for both newly built locomotives and remanufactured locomotives are feasible with the advanced technologies currently being developed and tested.[36] Technologies such as aftertreatment (compact selective catalytic reduction (SCR), diesel oxidation catalyst (DOC) filters), and on-board batteries for hybrid-electric locomotives, as well as battery and fuel-cell electric locomotives with zero-exhaust emissions, could be used to achieve the reductions needed in diesel PM, PM2.5, NOx, and GHG.[37]

Aftertreatment-equipped locomotives can be augmented with on-board batteries to provide an additional 10-25 percent reduction in fuel consumption and GHG emissions. On-board batteries provide zero-emission track mile capabilities in and around railyards to further reduce PM and associated health risks in nearby communities. It is feasible for locomotives with these technologies to be available in the timeframe proposed in Table 2, and to advance progress towards zero-emission locomotives. In addition, emission performance standards should be established now to allow adequate time for full demonstration and testing in locomotive applications for these and other feasible technologies.

Petition

U.S. EPA should exercise its authority to amend the current "Emission Standards for Locomotives and Locomotive Engines" to achieve emission rates equal to or less than those shown in Table 2. Specifically, U.S. EPA should establish a standard for newly built locomotives (to be referred to as Tier 5), and a new standard for Tier 4 engines upon remanufacture (to be referred to as Tier 4+). U.S. EPA should also establish standards equal to or more stringent than the current Tier 4 level (to be referred to as Tier 2++, Tier 3+), upon remanufacture of Tier 2 and 3 locomotive engines. The emission rates identified in Table 2 are based on the extensive analysis presented in ARB's 2016 *Technology Assessment: Freight Locomotives*.[38]

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[35] 42 U.S.C. § 7412 (d) and § 7547 (a)(3)and (a)(4).

[36] University of Illinois, Transitioning to a Zero or Near-Zero Emission Line-Haul Freight Rail System in California: Operational and Economic Considerations. <http://www.arb.ca.gov/railyard/docs/uoi_rpt_06222016.pdf> accessed December 12, 2016.

[37] ARB, Technology Assessment: Freight Locomotives, November 2016 <https://www.arb.ca.gov/msprog/tech/techreport/final_rail_tech_assessment_11282016.pdf> accessed December 9, 2016.

[38] ARB, Technology Assessment: Freight Locomotives, November 2016 <https://www.arb.ca.gov/msprog/tech/techreport/final_rail_tech_assessment_11282016.pdf> accessed December 9, 2016.

Table 2:
Potential Amended Emission Standards for Locomotives and Locomotive Engines

Tier Level	Year of Manufacture	NOx		PM		GHG		HC		Proposed Effective Date
		Standard (g/bhp-hr)[1]	Percent Control[2]	Standard (g/bhp-hr)[1]	Percent Control[2]	Standard (g/bhp-hr)[1]	Percent Control[2]	Standard (g/bhp-hr)	Percent Control[2]	
2++	2005-2011	1.3	90	0.03	95	NA	0	0.14	85	2023
3+	2012-2014	1.3	90	0.03	95	NA	0	0.14	85	2023
4+	2015-2024	0.3	99	<0.01	99	NA	0	0.05	95	2023
5	2025	0.2	99+	<0.01	99	NA	10-25%	0.02	98	2025
		With capability for zero-emission operation in designated areas.								

1. ARB, Technology Assessment: Freight Locomotives, 2016.[39]
2. Compared with uncontrolled baseline, reflects percent control over line haul baseline for illustrative purposes; ARB staff assumed older pre-Tier 0 line haul and switch locomotives would be able to emit up to the Tier 0 PM emission standards, based on American Association of Railroads in-use emission testing (required to comply with U.S. EPA in-use emission testing requirements) for older switch locomotives with EMD 645 engines.

If U.S. EPA promulgates the requested amendments such that they are effective by 2020 or earlier, ARB proposes that the Tier 5 standards go into effect in 2025; these standards should reduce GHG by 10-25 percent, NOx by at least 99 percent, and PM by at least 99 percent, relative to pre-Tier 0. Staff believes these reductions are attainable for both switchers and line haul locomotives in freight and passenger rail service.

As previously explained, Congress has specifically authorized U.S. EPA to promulgate these proposed amendments, which would establish emission standards for new locomotives and locomotive engines that safely achieve the greatest possible reductions at the earliest possible date, through the use of applicable technology.[40] The federal CAA is technology-forcing, and the Administrator may promulgate standards which require the use of technology which is expected to be available in the foreseeable future.[41] Since the 2008 amendment of the locomotive engine emission standards, technology has advanced significantly, allowing for additional emission reduction benefits. Stricter standards are feasible with technologies, including SCR, DOC filters, on-board batteries for hybrid electric locomotives, and battery and fuel-cell electric locomotives with zero-exhaust emissions. Standards should be established

[39] ARB, Technology Assessment: Freight Locomotives, November 2016 <https://www.arb.ca.gov/msprog/tech/techreport/final_rail_tech_assessment_11282016.pdf> accessed December 9, 2016.
[40] *Id.* § 7547(a)(5); *International Harvester Co. v. Ruckelshaus*, 478 F.2d 615, 648 (D.C. Cir. 1973); NRDC vs. *U.S. Envtl. Protection Agency* 06-73217 (D.C. Cir. 2014); 42 U.S.C. § 7547 (b).
[42] 42 U.S.C. § 7547(a)(5).

now to allow adequate time for full demonstration and testing in locomotive applications for this and other feasible technologies.

ARB staff estimates that U.S. EPA could require manufacturers to implement the new locomotive emission regulations by as early as 2023 for remanufactured locomotives and 2025 for newly manufactured locomotives. This estimate would allow seven years to develop and apply the technology for new Tier 5 standards. The proposal for stricter remanufacturing standards would allow five years for locomotive engine manufacturers to apply improved engine designs and technologies in their remanufacturing practices. The costs and development timelines would be in line with those seen in prior locomotive engine standard promulgations.

A new Tier 4 freight interstate line haul locomotive costs about $3 million, ARB staff estimates a compact SCR/DOC system could cost an additional $250,000 per locomotive, bringing the cost of a Tier 4+ locomotive to about $3.25 million. ARB staff estimates that a locomotive capable of Tier 5 standards, with compact SCR and DOC aftertreatment and on-board batteries, would have total capital costs of about $4 million. This would represent about an additional $1 million beyond Tier 4.[42]

Conclusion

California has achieved tremendous success in reducing harmful emissions. For California and for many other states to reduce toxic hot spots and to meet critical air quality standards and climate goals, we must achieve reductions beyond those that the states can reach on their own under existing programs. Achieving these goals will provide much needed public health protection for millions of Americans who still breathe unhealthy air, and will improve air quality in our most disadvantaged communities.

Timely action is critical. ARB is requesting that U.S. EPA promulgate the requested amendments such that they are effective by 2020 or earlier. California's *Revised Proposed 2016 State Strategy for the SIP* relies on the benefits that can be achieved by U.S. EPA promulgation of more protective emission standards for newly manufactured and remanufactured locomotives. Delaying promulgation until a later date would impede achievement of the federal air quality standards that U.S. EPA established, and forego critical emission and health benefits in California and throughout the nation.

ARB requests that U.S. EPA amend the current "Emission Standards for Locomotives and Locomotive Engines" and requests a response to this petition by Summer 2017, in order to ensure adequate time to develop the proposed rulemaking. ARB offers itself as a partner to provide technical assistance during the rulemaking process.

[42] ARB, Technology Assessment: Freight Locomotives, November 2016 <https://www.arb.ca.gov/msprog/tech/techreport/final_rail_tech_assessment_11282016.pdf> accessed December 9, 2016.