March 15, 2023

Via Electronic and U.S. Mail

The Honorable Michael Regan, Administrator
United States Environmental Protection Agency
William Jefferson Clinton Federal Building
1200 Pennsylvania Avenue, N.W.
Office of the Administrator, 1101A
Washington, D.C. 20460
Regan.Michael@epa.gov

Cc: Joseph Goffman, Acting Assistant Administrator, Office of Air and Radiation (OAR)
Marianne Engelman-Lado, Acting Principal Deputy Assistant Administrator, Office of Environmental Justice and External Civil Rights (OEJECR)
Sarah Dunham, Director, Office of Transportation and Air Quality (OTAQ)
Lauren P.M. Steele, Diesel Engine Compliance Center, Office of Transportation and Air Quality (OTAQ)
Hal Connolly, Senior Advisor on Climate and Sustainability, Federal Railroad Administration (FRA)

Re: Letter Regarding Proposed Locomotive Action at the United States Environmental Protection Agency.

Dear Administrator Regan:

The undersigned environmental justice, frontline community, health and environmental groups write to urge the United States Environmental Protection Agency (EPA) to take immediate action to clean up the nation's incredibly polluting freight rail industry. The agency recently identified the health crisis from locomotive pollution as needing swift action.[1] Given our organizations' intimate knowledge of locomotive harms, we ask that the EPA actually solve the rail pollution crisis. Specifically, we ask that EPA exercise its authority to adopt a much-needed rulemaking before the end of 2023 to address the public health, dirty air, and climate crises

[1] U.S. Env't Prot. Agency, *Response to California Air Resources Board's Petition*, (Nov. 9, 2022), https://www.epa.gov/system/files/documents/2022-11/locomotive-regs-carb-petition-response-2022-11.pdf.

exacerbated by locomotive pollution.[2] In addition, as a public health and environmental disaster unfolds following the derailment and explosion of a toxic-chemical cargo train in East Palestine, Ohio, the EPA must also take meaningful action to reduce the potential harm to communities and the environment from any future derailments, chemical spills, and explosions.

Our organizations are composed of tens of thousands of residents across the United States that live and work in communities that have experienced systematic environmental injustice from the global freight system. The goods movement industry remains one of the largest sources of pollution in the country, and is responsible for pumping tons of pollution into communities already saddled with other environmental and public health concerns.

The rail industry remains one of the most significant sources of this environmental injustice for many of our communities. We live near railyards and freight rail routes, where some of the dirtiest switcher and line-haul locomotives belch diesel particulate matter each day, sometimes just feet from our homes, schools, and workplaces. Children, families, and workers in our communities have had to pay for the rail industry's pollution with their health for decades and continue to suffer devastating short- and long-term health consequences from exposure to diesel pollution.

Diesel locomotives, which are the most widely used locomotives in the United States, have significant and long-lasting negative impacts on public health, including increased rates of childhood asthma, lung disease, and premature death. Low-income communities and communities of color often suffer the most from the locomotive industry's life-threatening pollution because railyards and rail routes are typically located in, on, near these communities. On top of this, diesel particulate pollution is a key contributor to poor regional air quality and the climate crisis, and as we continue to see, the most marginalized communities are forced to bear the brunt of these health and climate emergencies. The impacts of the rail industry reach into many parts of the United States as significant rail activity occurs in every state.

Now is the time for EPA to begin a rulemaking to adopt a zero-emission locomotive standard that will clean the air for communities, give states the opportunity to meet air quality standards set by the Clean Air Act, and ensure that we are doing everything in our power to have a livable climate for generations to come.

We ask that EPA fulfill its statutory duty to protect and enhance "the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity

[2] The following letter is submitted by Moving Forward Network (MFN). MFN is a national network of over 50 member organizations that centers grassroots, frontline-community knowledge, expertise and engagement from communities across the US that bear the negative impacts of the global freight transportation system. In collaboration with allies and partners, MFN identifies local solutions that call for community, industry, labor, government, and political action that advances equity, environmental justice, and a zero-emissions focused just transition. MFN's vision is for negatively-impacted communities to become healthy, sustainable spaces where individuals, families, students, and workers can thrive, free of the negative impacts of the freight transportation system.

of its population" by adopting the most health-protective emission standards for locomotives possible in light of current technology.[3] Indeed, federal law requires that EPA adopt "the greatest degree of emission reduction achievable through the application of technology that it determines will be available for the model year 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."[4]

Yet, EPA last issued an updated emission standard for locomotives 15 years ago in 2008. The health imperative for cleaning up locomotive pollution has only become more pressing since the agency last revamped its regulatory regime. We now have more information on the immense harms from this industry than we have ever had. Moreover, zero-emission locomotive technology has made significant advances in recent years, making now a perfect time for EPA to set an attainable, health-protective zero-emission standard. Locomotives powered by overhead catenary systems, battery-electric locomotives, fuel cell trains, and hybrid options are already commercially available or in development.[5] In fact, electrifying our freight rail system can also offer attractive cost savings over operating traditional diesel locomotives. Advances in zero-emission locomotive technology, the lower cost of electricity as a fuel compared to diesel, and the rapidly declining cost of batteries translate to potential cost savings for railroad operators.

However, progress toward a zero-emission freight rail system has been delayed because of the political economy factors of private rail ownership and upfront costs.[6] There is no question that the rail industry—some of the most profitable companies in the world—are capable of developing the technology to meet a zero-emission mandate, but industry will not do so unless EPA and other federal agencies have the courage to demand these powerful corporations clean up their pollution. The diesel pollution health crisis in rail adjacent communities means we are well past the time for voluntary measures.

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[3] 42 U.S.C. § 7401(b).
[4] *Id.* § 7547(a)(5).
[5] Progress Rail, *EMD Joule Battery Locomotive*, https://www.progressrail.com/en/Segments/RollingStock/Locomotives/FreightLocomotives/EMDJoule.html (battery-electric switcher locomotive); Joanna Marsh, *BNSF, Wabtec Put Battery-Electric Locomotive to the Test*, (Jan. 5, 2021), https://www.freightwaves.com/news/bnsf-wabtec-put-battery-electric-locomotive-to-the-test (battery-electric line-haul locomotive); Carrie Hampel, *Bombardier Converts Five Trains to Zero-Emission*, (Feb. 8, 2021), https://www.electrive.com/2021/02/08/bombardier-converts-five-trains-to-zero-emission/ (hybrid battery-electric/overhead catenary system passenger train); Brian Yanity, *The Need for Freight Rail Electrification in Southern California*, (May 2017), at 15-16, http://calelectricrail.org/wp-content/uploads/2018/05/BYanity-SoCal-freight-rail-electrification-13May2018.pdf (overhead catenary trains); San Bernardino Cnty. Transp. Auth., *Zero-Emission Rail Technology*, (Feb. 2021),
[6] Natalie Popovich et al., *Economic, Environmental and Grid-resilience Benefits of Converting Diesel Trains to Battery-Electric*, Nature Energy 6, (2021), at 1017-25, https://doi.org/10.1038/s41560-021-00915-5.

The lack of action to clean up rail pollution also indicates a systemic lack of engagement of the federal government with rail impacted communities. The EPA and its companion agencies in the federal government like the Department of Transportation need to engage more with frontline groups to more fully understand the harms the rail industry imposes. We fear that the federal government has engaged too much with the rail industry and its lobbyists, which has had the result of skewing the federal government's perspective. We invite the EPA to engage with the MFN to develop this engagement strategy that provides the requisite input from frontline groups.

The EPA's willingness to prioritize environmental justice concerns is a welcome refrain, but needs to be supported with immediate action to clean up one of the most polluting transportation industries. Adopting a zero-emission locomotive standard for switcher and line-haul locomotives, setting more stringent emission standards for remanufactured locomotives, and requiring the forced retirement and scrappage of all locomotives that cannot meet these health-protective standards are critical steps toward ensuring that the air our communities breathe is safe.

We are committed to working with the EPA to address the deadly pollution from freight locomotives and railyards. The undersigned organizations demand that EPA take the following actions:

1. Adopt a rulemaking before the end of 2023 to address the public health, dirty air, and climate crises exacerbated by locomotive pollution.

2. Include in the rulemaking a Tier 5 zero-emission locomotive standard for all new freight locomotives that requires 100 percent of all new switchers be zero-emission by 2025, and 100 percent of all new line-hauls be zero-emission by 2030.

3. Set significantly more stringent emission standards for all remanufactured locomotives and locomotive engines, so that 100 percent of all remanufactured switchers at least meet the Tier 4 standard by 2025, and 100 percent of all line-haul locomotives at least meet the Tier 4 standard by 2027.

4. Require the forced retirement of all locomotives or locomotive engines that do not meet a Tier 5 zero-emission standard by 2045. This requirement must include the scrappage of the non Tier 5 engines.

5. Use the authority in section 108(f)(1)(C) of the Clean Air Act to identify strategies to clean up the toxic hot spots associated with rail and railyard activities to "protect the health of sensitive or susceptible individuals or groups."

6. Work with our organizations to create a strategy to eliminate pollution burdens from concentrated railyard operations that pose significant health and safety risks,

including but not limited to pollution and impacts from the operation of locomotive maintenance facilities, locomotive parking/idling, and supporting warehouses, which are often located in environmental justice communities.

EPA has the authority and responsibility to fulfill its stated commitments to environmental justice by adopting a lifesaving and long overdue locomotive standard by the end of 2023. Your action is critical to providing relief to our communities.

Sincerely,

Kevin D. Hamilton, RRT
Co-Founder & Co-Executive Director
Central California Asthma Collaborative
Fresno, CA

Lucia Marquez
Associate Policy Director
Central Coast Alliance United for a Sustainable Economy
Ventura, CA

Cynthia Pinto-Cabrera
Policy Coordinator
Central Valley Air Quality Coalition
Fresno, CA

Luis Olmedo
Executive Director
Comite Civico del Valle, Inc.
Brawley, CA

Dr. Bruce Strouble, Jr.
Founder and Director
Citizens for a Sustainable Future
Tallahassee, FL

Beto Lugo
Co-Director
CleanAirNow
Missouri/Kansas

Yasmine Agelidis, Sr. Associate Attorney
Adrian Martinez, Deputy Managing Attorney
Earthjustice
Los Angeles, CA

Taylor Thomas
Co-Director
East Yard Communities for Environmental Justice
Commerce/Long Beach, CA

Mata Townsend
Communications and Planning Coordinator
Groundwork Northeast Revitalization Group
Kansas City, MO

Dr. Mildred McClain
Executive Director
Harambee House / Citizens for Environmental Justice
Savannah, GA

Maria Lopez-Nunez
Deputy Director of Organizing and Advocacy
Ironbound Community Corporation
Newark, NJ

José Acosta
Senior Transportation Policy Analyst
Little Village Environmental Justice Organization
Chicago, IL

Sylvia Betancourt
Program Manager
Long Beach Alliance for Children with Asthma
Long Beach, CA

Heather Kryczka
Staff Attorney, Environment, Equity & Justice Center
Natural Resources Defense Council
Santa Monica, CA

Melissa Miles
Executive Director
New Jersey Environmental Justice Alliance
Summit, NJ

Ivette Torres
Research Consultant
Peoples Collective for Environmental Justice
Grand Terrace, CA

Brian Urbaszewski
Director, Environmental Health Programs
Respiratory Health Association
Chicago, IL

Kim Ross
Executive Director
reThink Energy Florida
Tallahassee, FL

Kim Gaddy
Founder and Director
South Ward Environmental Alliance
Newark, NJ

Dr. P. Qasimah Boston
President of the Board of Directors
Tallahassee Food Network
Tallahassee, FL

Juan Parras
Executive Director
Texas Environmental Justice Advocacy Services (T.E.J.A.S.)
Houston, TX

Marcos Ceniceros
Executive Director
Warehouse Workers for Justice
Chicago, IL

Theral Golden
West Long Beach Neighborhood Association
Long Beach, CA

MFN Staff

Molly Greenberg, MSW, MPhil
MFN Campaign Manager

Cecilia Garibay, MPP, MS
MFN Project Coordinator

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I. Executive Summary

The freight system remains one of the largest sources of pollution in the country. Hundreds of thousands of diesel trucks, locomotives, ships, and cargo handling equipment transport massive volumes of goods every single day from manufacturing sites to distribution centers, stores, and people's homes. The goods movement industry dumps tons of pollution into communities that are already overburdened by multiple environmental and health issues, fueling the ongoing public health, dirty air, and climate crises.

EPA has the legal authority and responsibility to address the clean-up of each of these freight transportation sectors, which have resulted in concentrated impacts on environmental justice and frontline communities. The agency should aggressively advance zero-emission technology and solutions across the freight sector, including for trucks, trains, ships, and cargo handling equipment. Specifically, here, we ask EPA to address one of these significant sources of pollution by adopting zero-emissions standards and amendments that require the rail industry to clean up as soon as possible.

Rail pollution impacts the health, safety, and well-being of communities across the country, and it has serious negative effects on our air quality and the climate. Millions of people in the United States live and work near railyards and rail lines, and have had to breathe in diesel pollution day after day, for decades. Communities are getting sick and dying, and we cannot afford to wait any longer for this pollution to be cleaned up.

Now is the time for the Biden Administration and the EPA to address the health crisis created by the freight system, and rail pollution in particular. We are asking the EPA to fulfill its statutory duty to set emission standards for locomotives that achieve "the greatest degree of emission reduction achievable," which today, includes a zero-emission locomotive standard.

Zero-emission locomotive technology is widely available today. Electrified overhead catenary freight trains are used in dozens of countries around the world, and are capable of traveling longer distances and carrying heavier loads than American trains typically do. Battery-electric locomotives and fuel cell-powered trains have also made major strides since EPA adopted its most recent locomotive emission standard 14 years ago. These technologies can be paired with overhead electric lines to support a far-reaching zero-emission freight rail system that spans from coast to coast. On top of this, cleaning up our rail system is not only statutorily required and technologically feasible, but it can also lead to cost savings for railroad operators, and good, high-paying union jobs that will put Americans back to work.

EPA needs to urgently address the compounding health harms from the freight rail industry. Railroads have shown, time and again, that they will avoid cleaning up their own pollution unless absolutely forced to do so. So, EPA must hold the rail industry accountable. The agency should set stringent, zero-emission locomotive emission standards for switchers and line-haul locomotives by the end of 2023, and require a complete transition to zero-emission locomotives everywhere by 2045. The need is apparent, and we have the technology to save thousands of lives. We are asking EPA to lead us to a zero-emission freight future for rail, and to do it now.

II. Background on Locomotives, Locomotive Operations, and Existing Regulations.

A. Switcher and Line-Haul Freight Locomotives Operate in Railyards and on Rail Routes Around the Country.

The nearly $80-billion freight rail industry is operated by seven Class I railroads, with each having operating revenues of $490 million or more per year, 22 regional Class II railroads, and 584 local or short-line Class III railroads.[7] Diesel-electric locomotives, which are the most commonly used locomotives in the United States, are incredibly polluting. They have a large diesel engine with up to 4,400 horsepower that generates electricity to power traction motors near the wheels and propel the locomotive. Because diesel serves as the power source that drives the electric generator or alternator, developing zero-emission locomotives is a matter of changing the source of electricity generation from diesel to non-combustion alternatives.

There are two main duty cycles for freight locomotives: switcher operations and line-haul operations. Line-haul locomotives transport heavy freight over long distances and have over 2,300 horsepower.[8] Line-haul operation involves traveling long distances transporting tons of cargo, so the operational duty cycles of high horsepower line-haul locomotives are dominated by higher power notch settings, (i.e., notches 5-8).[9] When operating in railyards, line-hauls typically operate in idle or lower power settings.[10] The pollution from line-hauls is considerable. For example, Class I interstate line-haul locomotives in California contribute 85% of statewide locomotive NOx emissions.[11]

Switchers are used in rail yards to assemble and disassemble trains, and to move trains from one point of the rail yard to another. EPA defines switcher locomotives to be between 1,006 and 2,300 horsepower.[12] Beyond idling, switchers are supposed to operate primarily in the lower-powered notches (i.e., notch 1-4).[13] Oftentimes, locomotives performing line-haul operations are downgraded to switcher operations over the course of their service life as the engine wears down

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[7] Fed. R.R. Admin., *Freight Rail Overview*, https://railroads.dot.gov/rail-network-development/freight-rail-overviewhttps://railroads.dot.gov/rail-network-development/freight-rail-overview.

[8] Gregory Gould et al., *Review of Regional Locomotive Emissions Modeling and the Constraints Posed by Activity Data*, Transportation Research Record: Journal of the Transportation Research Board, (Dec. 2009), at 24-32, https://escholarship.org/uc/item/3gn498w6; Cal. Air Res. Board, *Technology Assessment: Freight Locomotives*, (2016), at ES-4, https://ww2.arb.ca.gov/sites/default/files/classic//msprog/tech/techreport/final_rail_tech_assessment_11282016.pdf.

[9] U.S. Dep't of Transp., *Federal Exhaust Emissions Standards for Locomotives*, at fn.c, https://www.bts.gov/content/federal-exhaust-emissions-standards-locomotives#:~:text=Line%2Dhaul%20locomotives%20are%20powered,of%202300%20hp%20or%20less; Cal. Air Res. Board, *supra* note 7, at III-5.

[10] U.S. Dep't of Transp., *supra* note 8, at fn.c; Cal. Air Res. Board, *supra* note 7, at III-5.

[11] Cal. Air Res. Board, *supra* note 7, at ES-5.

[12] *Id.* at ES-4.

[13] *Id.* at III-6; U.S. Dep't of Transp., *supra* note 8, at fn.c.

and hauling heavy loads over long distances becomes more taxing. Because of this, switcher locomotives are often amongst the oldest models of locomotives, and therefore the dirtiest. These are also the locomotives that operate in rail yards near communities creating a public health crisis for communities near railyards.

Some railyards also have major locomotive repair and maintenance facilities, and these activities often require idling and other operations that result in additional localized emissions.[14] Locomotives receive routine servicing and maintenance in preparation for operation.[15] This routine maintenance includes refueling and checking oil levels, performing minor repairs, and addressing major repairs of locomotive components, including services like traction motor replacement and diesel engine maintenance requiring load testing.[16] In addition to routine service, locomotives are required to undergo several types of periodic inspections and major maintenance activities including load testing.[17] Depending on the maintenance test and locomotive model, these maintenance activities and tests require some period of idling, notch 1 operation, and notch 8 operation, adding to the pollution toll on nearby communities. [18] It is common practice for locomotives to be remanufactured every seven to ten years to ensure the locomotive engine continues to function properly, and to extend the life of the locomotive. Through this process, the locomotive is disassembled to the frame, and its components are replaced as needed.[19] Locomotives must be recertified at each remanufacture before they may be placed back into service. EPA has determined that "existing locomotive engines, when they are remanufactured, are returned to as-new condition and are expected to have the same performance, durability, and reliability as freshly-manufactured locomotive engines."[20] This loophole is exploited by the rail industry to evade adopting cleaner locomotive technology.

B. EPA's Locomotive Emission Standards.

EPA has a duty to set emission standards for locomotives, but has failed to adopt more stringent emission standards that reflect the latest technology developments in 15 years.[21] Under the current emission standards, switchers are subject to slightly more lenient standards than line-hauls, with the justification that, as a total fleet, switchers emit less pollution than line-hauls. While that may be true, this disregards the health impacts of switcher pollution at railyards. In

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[14] Robert Ireson et al., *Development of Detailed Railyard Emissions to Capture Activity, Technology and Operational Changes*, (April 2005), https://www3.epa.gov/ttnchie1/conference/ei14/session8/ireson.pdf.

[15] Sierra Research, *Toxic Air Contaminant Emissions Inventory and Dispersion Modeling Report for the Commerce Rail Yard, Los Angeles, California*, (Feb. 23, 2007), https://ww2.arb.ca.gov/sites/default/files/classic/railyard/hra/sr_com_rpt.pdf.

[16] *Id.*

[17] Robert Ireson, *supra* note 13.

[18] *Id.*

[19] EPA's definition of remanufacturing is "To replace each and every power assembly of a locomotive or locomotive engine, whether during a single maintenance event or cumulatively within a five-year period."

[20] 73 Fed. Reg. 37,096, 37,102 (Feb. 26, 2008).

[21] *Id.* at 37,906; 42 U.S.C. § 7547(a)(5).

fact, switchers have an outsized impact in the immediate vicinity of where they operate, which is typically near communities.

The current locomotive emission framework categorizes standards by tier. Locomotives must meet emission standards for nitrogen oxide (NOx), particulate matter (PM), hydrocarbon, and carbon monoxide based on the year the locomotive was originally built. The tiers run from pre-Tier 0 up to Tier 4, with increasingly stringent NOx and PM standards. For example, locomotives originally built in 1973 to 1999 are subject to pre-Tier 0 standards, while locomotives built in 2015 or later are subject to Tier 4 standards.

Tables 1 and 2 show the current emission tiers for line-hauls and switchers.

Tables 1 & 2:
Federal Locomotive Emission Standards and Percent Control[22, 23]

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	13.0[24]	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

Switcher 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	n/a	0.72	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

[22] 40 C.F.R. Part 1033.101, a.
[23] U.S. Env't Prot. Agency, *Emission Factors for Locomotives (EPA 420-F-09-025)*, Natl. Serv. For Env't Publ'n, (April 2009), https://bit.ly/3BSgkvz.
[24] U.S. Env't Prot. Agency, *Locomotive Emissions Standards: Regulatory Support Document (EPA-420-R-98-101)*, (April 1998), at 96, https://bit.ly/3VihHur.

Even after a locomotive is remanufactured, it effectively continues to be held to the same tier and emission standards as when the locomotive first entered service. In other words, a locomotive may operate for its entire service life—which can be 30 to 60 years—without ever having to reduce its emissions.

The only minor exception to this is for Tier 0 locomotives, *i.e.*, locomotives originally built between 1973 and 1992, which become subject to the equivalent of Tier 1 NOx and PM standards upon remanufacture. While Tier 1 and Tier 2 locomotives must meet Tier 1+ and Tier 2+ standards upon remanufacture, these are simply name changes without any changes to the emission standards. Similarly, locomotives originally built under Tier 3 and Tier 4 remain under Tier 3 and Tier 4 after remanufacture and are not marked with the plus symbol designation.

Because of loopholes in the regulatory scheme, EPA's 2008 locomotive rulemaking has not provided the benefits it originally intended to achieve. Data from the Bureau of Transportation Statistics shows that 77% of Class I railroad locomotives are still using Tier 2 or older technology.[25] **In fact, although the Tier 4 line-haul locomotive standard went into effect in 2015 and required a significant 90 percent reduction of NOx and 95 percent reduction of PM emissions relative to pre-Tier 0 levels, Class I railroads have evaded adopting this Tier 4 technology at scale.** For example, as of 2020, only 4.8 percent of locomotives operating in California have Tier 4 engines.[26] A recent report by the California Air Resources Board confirms that "Tier 4 locomotive engine penetration rates sit at under 1 percent per year on average because the railroads have been purchasing fewer than expected Tier 4 units for the past few years, instead choosing to operate remanufactured Tier 1+ and Tier 2+ units."[27]

[25] Bureau of Transp. Statistics, *Class I Railroad Locomotive Fleet by Year Built*, https://www.bts.gov/content/class-i-railroad-locomotive-fleet-year-built.
[26] Cal. Air Res. Board, *2020 California Locomotive Pollution by Tier*, https://ww2.arb.ca.gov/our-work/programs/reducing-rail-emissions-california/locomotive-fact-sheets.
[27] Cal. Air Res. Board, *2021 Line-Haul Locomotive Emission Inventory*, (Feb. 2021), at 4, https://ww2.arb.ca.gov/sites/default/files/2021-02/2021_line_haul_locomotive_emission_inventory_final.pdf.

III. EPA Should Adopt the Proposed Emission Standards Because They Achieve the Greatest Degree of Emission Reductions Achievable for Locomotives and Locomotive Engines.

A. EPA Has Clear Legal Authority to Adopt the Proposed Locomotive Emission Standards and Amendments.

It is EPA's statutory duty to protect and enhance "the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population."[28] The public is relying on EPA to set strong, health-protective, attainable standards that will clean up rail pollution.

i. EPA Has a Statutory Duty to Set Strong Emission Standards for Locomotives.

EPA has the regulatory authority, and duty, to set emission standards for locomotives.[29] Section 213(a)(5) of the Clean Air Act, specifically directs the Administrator to establish emission standards for "new locomotives and new engines used in locomotives."[30] In addition, because the agency has determined that remanufactured engines "are returned to as-new condition," EPA's authority to regulate emission standards applies to remanufactured locomotives as well.[31] To fulfill this obligation, EPA is required by federal statute to develop emission standards that have "the greatest degree of emission reduction achievable through the application of technology which the Administrator determines will be available for the model year to which such standards apply, giving appropriate consideration to cost, energy, and safety factors associated with the application of such technology."[32] The agency is authorized to adopt "technology-forcing" emission standards for locomotives to achieve "the greatest degree of emission reduction achievable."[33]

ii. Executive Orders and EPA's Own Commitments Direct EPA to Address Environmental Burdens That Disproportionately Affect Historically Marginalized Communities.

In addition to this clear statutory requirement, EPA is also required to promulgate robust emission standards for locomotives pursuant to the executive orders on environmental justice issued by Presidents Biden and Clinton. These executive orders direct EPA and other agencies to

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[28] 42 U.S.C. § 7401(b).
[29] *Id.* § 7547(a)(5).
[30] *Id.*.
[31] 73 Fed. Reg. at 37,102; 40 C.F.R. § 1033.901(1).
[32] 42 U.S.C. § 7547(a)(5).
[33] *Nat'l Petrochemical & Refiners Ass'n v. EPA*, 287 F.3d 1130, 1136 (D.C. Cir. 2002); *Nat. Res. Def. Council v. EPA*, 655 F.2d 318, 333 (D.C. Cir. 1981); *Sierra Club v. Costle*, 657 F.2d 298, 364 (D.C. Cir. 1981). 42 U.S.C. §§ 7412(d), 7547(a)(3)-(4). *See also* 63 Fed. Reg. 18,982, 18,982 (July 16, 1998) ("EPA is confident that manufacturers will be able to comply with the Tier 2 standards in a cost-effective manner by 2005, but recognizes that these are technology forcing standards which will require significant effort to achieve.").

address the disproportionate health and environmental burdens facing historically marginalized communities, such as, for instance, air pollution burdens.[34]

The freight rail industry has for decades poisoned communities of color and low-income communities at a higher rate, contributing to higher negative health outcomes in these communities. Now is the time for EPA to address some of these critical concerns relating to locomotive pollution.

President Biden's executive order promises that "[a]gencies shall make achieving environmental justice part of their missions by developing programs, policies, and activities to address the disproportionately high and adverse human health, environmental, climate-related and other cumulative impacts on disadvantaged communities, as well as the accompanying economic challenges of such impacts."[35] Likewise, it is "the policy of [the Biden] Administration to secure environmental justice and spur economic opportunity for disadvantaged communities that have been historically marginalized and overburdened by pollution and underinvestment in housing, transportation, water and wastewater infrastructure, and health care."[36]

Similarly, Clinton's executive order directs all federal agencies, including EPA, to prioritize environmental justice, which it defines as the "disproportionately high and adverse human health or environmental effects of [federal agency] programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions."[37] It also directs federal agencies to ensure that any agency action or policy related to human health or the environment does not discriminate on the basis of race, color, or national origin.[38]

Beyond these executive orders, EPA has publicly committed itself to advancing environmental justice in ways that support the adoption of a zero-emission locomotive standard. In its most recent environmental justice strategic action plan, EPA promised to address the "adverse impact of goods movement on community health […] with a place-based focus on communities most impacted by goods movement."[39] The report specifically listed ports, rail yards, and distribution centers as potential sites of future regulation.[40] Moreover, the agency has

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[34] *See* Exec. Order No. 12,898 § 1–101, 59 Fed. Reg. 7629 (1994); Exec. Order No. 14,008, Part II § 201, 86 Fed. Reg. 7622 (2021).
[35] 86 Fed. Reg. at 7629.
[36] *Id.*
[37] *Id.*
[38] *Id.* at 7630-31.
[39] U.S. Env't Prot. Agency, *EJ 2020 Action Agenda*, (May 2016), at 34, https://www.epa.gov/sites/production/files/2016-05/documents/052216_ej_2020_strategic_plan_final_0.pdf.
[40] *Id.*

made public claims that "[a]ddressing the environmental impacts of goods movement on communities is a top priority for EPA."[41]

These executive directives and the agency's promises call on EPA to work toward reducing these health disparities by setting bold standards to regulate the heavily polluting rail industry. A failure by EPA to adopt a strong, health-preserving zero-emission locomotive standard—and to instead permit the continued use of polluting fuels to power locomotives in close proximity to low-income communities of color—would amount to the agency disregarding the existing race- and income-based health disparities that are prevalent in communities where railyards and locomotive pollution are concentrated.

B. A Zero-Emission Locomotive Standard is Necessary to Protect Public Health.

Exposure to diesel pollution from trains is dangerous. Inhaling dirty air day-in and day-out can lead to significant negative health outcomes, especially for people already overburdened by many environmental and health injustices. In addition, the high levels of locomotive pollution also make it challenging for states to meet their obligations under the federal air quality standards.

i. Exposure to Diesel Pollution Has Detrimental Impacts on Health.

By nature of their operation and the combustion process, diesel engines spew thousands of chemicals, including several air pollutants known to pose significant health concerns when inhaled.[42] The toxic brew of locomotive pollution includes diesel exhaust, nitrogen oxides, carbon monoxide, and other gasses and particles.[43] It is abundantly clear that exposure to these emissions—especially long-term exposures—leads to adverse health effects.

As background, diesel locomotives operate by mixing fuel and air in the combustion compartment, and then compressing this mixture under high pressure.[44] The high pressure leads to high temperature, which causes the fuel mixture to spontaneously ignite.[45] The chemical energy of this explosion is then converted into mechanical energy, turning the engine and moving the locomotive, and producing diesel exhaust.[46]

Diesel exhaust, one of the pollutants produced in combustion, is a combination of gasses and particles that has been identified by the State of California as a Toxic Air Contaminant, and

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[41] U.S. Env't Prot. Agency, *EPA's Response to the National Environmental Justice Advisory Council Report: Reducing Air Emissions Associated with Goods Movement: Working Toward Environmental Justice*, (July 2010), at 4, https://www.epa.gov/sites/default/files/2015-02/documents/epa-resp-nejac-goods-movement-2009.pdf.
[42] Ed Avol, Professor of Environmental Health, Keck School of Medicine of University of Southern California, testimony ("Avol Testimony"), at 9.
[43] Avol Testimony, at 9.
[44] Avol Testimony, at 10.
[45] Avol Testimony, at 10.
[46] Avol Testimony, at 10.

by the International Agency for Research on Cancer as a known human carcinogen.[47] Diesel particles are just one of the many kinds of particles present in PM2.5, so many of the negative health outcomes associated with PM2.5—such as arrhythmia, heart rate variability, blood pressure changes, heart attack, respiratory effects, central nervous system effects, and reproductive and neonatal effects—are also ascribed to diesel exhaust.[48] On top of this, more than 90% of diesel exhaust consists of ultra-fine particles that are less than 1 micron in diameter.[49] Ultra-fine particles have been linked to negative cardiovascular health, and are an increasingly active area of research given their extremely small size and dynamic behavior.[50] In fact, ultra-fine particles are so small that they can cross the air-blood barrier in the lungs and enter the bloodstream, which allows them to travel to virtually any organ system in the body and disrupt normal cell function.[51]

The combustion process also produces nitrogen oxides, which have additional negative impacts on our health.[52] Exposure to nitrogen dioxide (NO2) has been shown to affect several organ systems, including the respiratory and cardiovascular systems.[53] NO2 exposure in humans is linked to increased risk of respiratory infections, exacerbation of asthma, development of asthma, lowered lung function in children, and association with heart attack.[54] There is also data linking long-term NO2 exposure with lung and breast cancer.[55]

NOx is important in terms of its own health impacts, but it is also involved in a series of chemical reactions that can lead to the formation of ground-level ozone, or smog, which is one of the six specifically identified air pollutants in the National Ambient Air Quality Standards (NAAQS).[56] Ozone is a secondary pollutant, which means that it is not directly emitted from a tailpipe or smokestack, but is formed through a series of chemical reactions between other direct pollutants and sunlight.[57] Specifically, NOx reacts with volatile organic compounds (VOCs), which are carbon-containing gasses and vapors emitted from thousands of products like fossil fuels, pesticides, paints and lacquers, and cleaning supplies, in the presence of intense sunlight to produce ozone.[58] Counterintuitively, ozone levels tend to be higher away from busy roads and immediate sources of NOx because of the way the chemical process of ozone creation unfolds.[59]

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[47] Avol Testimony, at 9-10.
[48] Avol Testimony, at 10.
[49] Avol Testimony, at 9.
[50] Avol Testimony, at 1.
[51] Avol Testimony, at 11.
[52] Avol Testimony, at 12.
[53] Avol Testimony, at 12-13.
[54] Avol Testimony, at 12-13.
[55] Avol Testimony, at 12-13.
[56] Avol Testimony, at 3, 12.
[57] Avol Testimony, at 3.
[58] Avol Testimony, at 3; U.S. Env't Prot. Agency, *What Are Volatile Organic Compounds (VOCs)?*, *last updated* Jan. 4, 2022, https://www.epa.gov/indoor-air-quality-iaq/what-are-volatile-organic-compounds-vocs.
[59] Avol Testimony, at 3.

Wind and temperature effects, as well as the presence of mountains or valleys, also helps shape the flow and movement of gasses and particles across regional areas.[60] All of this together means that the highest levels of ozone can often be found downwind of large metropolitan areas.[61]

Exposure to ozone has significant, detrimental impacts on our health in both the short-term (on the order of minutes, hours, or days) and the long-term (over the course of months or years).[62] EPA's own research concludes that exposure to ozone causes significant respiratory effects, including increased airway inflammation, lowered lung function, increased asthma medication usage, increased hospital admissions for asthma and chronic obstructive pulmonary disease (COPD), the development of asthma, and death.[63] Ozone exposure also leads to negative cardiovascular outcomes like high blood pressure, heart arrhythmia, heart attack, increased emergency room visits, and death, as well as poor metabolic effects including inflammation, diabetes, and obesity, and central nervous system effects on short-term and long-term memory, sleep patterns, and behavior.[64]

This life-threatening pollution is concentrated in areas surrounding more active and consistent engine operation, which in the context of locomotives, is near railyards and rail lines.[65] Because switcher operation is generally confined to a specific railyard for the purpose of assembling or disassembling trains for regional or national hauls, the emissions associated with switchers are primarily localized to the adjacent community.[66] Line-haul locomotives are involved in the movement of cargo or goods over tens to hundreds of miles, so the duration of proximal exposure is different than with switchers.[67] Air pollution from line-haul locomotives has more of a regional component to it rather than local, but the cumulative effects to health and air quality remain significant.[68]

Air quality near railyards is a function of both regional and local emissions.[69] The region's air quality sets a baseline for the local air quality, and local pollution from locomotives, trucking, and railyard equipment is piled on top of this.[70] As hubs for regional goods movement, railyards attract a considerable number of pollution sources, including switcher and line-haul locomotives, drayage trucks, cargo-handling equipment (such as cranes, yard hostlers, forklifts, yard trucks, and yard tractors), transportation refrigeration units for both trucks and railcars, and other equipment like refueling trucks.[71] In addition, even though EPA adopted more stringent

[60] Avol Testimony, at 3.
[61] Avol Testimony, at 3.
[62] Avol Testimony, at 4.
[63] Avol Testimony, at 4.
[64] Avol Testimony, at 4.
[65] Avol Testimony, at 13-15.
[66] Avol Testimony, at 15.
[67] Avol Testimony, at 21.
[68] Avol Testimony, at 21.
[69] Avol Testimony, at 17.
[70] Avol Testimony, at 17.
[71] Avol Testimony, at 17.

emission standards for switchers 14 years ago, most switchers are still operating in the highest-polluting tiers.

This barrage of polluting equipment leads to high levels of air pollution in and around railyards, and negatively impacts the health of people who live or work nearby.[72] The air pollution, noise, commotion, space requirements, and around-the-clock operations make living near a railyard less desirable, and therefore neighborhoods and communities adjacent to railyards tend to be inhabited disproportionately by those with limited financial resources and often by people of color.[73] These communities are typically already dealing with several concurrent health, social, financial, and exposure issues, and are the quintessential definition of a "sensitive" subgroup within the general population.[74]

By contrast, pollution from line-haul locomotives is distributed across large distances ranging from tens to hundreds of miles.[75] Line-hauls emit all the same kinds of harmful gases and particles as switchers, including diesel exhaust, PM2.5, and NOx.[76] The health and air quality consequences from these emissions remain significant, but are more regional than local since line-hauls traverse long distances.[77] Therefore, one of the primary issues with line-haul locomotive pollution is the impact it has on a state's ability to meet attainment of the NAAQS.

ii. Locomotive Pollution Negatively Impacts Rail Hub Communities Across the Nation.

Our rail system is a nationwide network. Locomotive pollution impacts rail hub communities across the country, and also contributes to the challenge states face in meeting their obligations under the NAAQS. Even though the petitions requesting action around locomotives stemmed from California, locomotives are wreaking havoc on health in places like Kansas City, Newark, Chicago, Charleston, and many other regions.

C. A Zero-Emission Locomotive Standard is Necessary for States to Meet Attainment of the NAAQS.

Around the country, locomotive pollution makes it challenging for states with substantial rail operations to meet the federal air quality standards set by EPA. The Clean Air Act requires EPA to set federal air quality standards, or NAAQS, for six criteria air pollutants known to cause negative impacts to our health and the environment.[78] For each of the six NAAQS, which include ozone, particulate matter, carbon monoxide, nitrogen dioxide, sulfur dioxide, and lead, EPA must set standards that are "requisite to protect the public health with an adequate margin of safety."[79]

[72] Avol Testimony, at 19.
[73] Avol Testimony, at 19-20.
[74] Avol Testimony, at 19-20.
[75] Avol Testimony, at 21.
[76] Avol Testimony, at 20.
[77] Avol Testimony, at 21.
[78] 42 U.S.C. § 7409(a).
[79] *Id.* § 7409(b).

In turn, states and air basins have a responsibility to regulate mobile and stationary sources within their regions to attain compliance with each of these standards.

Locomotive pollution impacts all of the NAAQS, and ozone and particulate matter in particular. EPA has progressively strengthened the ozone and particulate matter standards in light of new scientific evidence demonstrating health impacts at lower levels of pollution. Most recently, in 2015, EPA revised the primary and secondary 8-hour ozone standard from the 2008 level of 75 parts per billion (ppb) to 70 ppb, and in 2013, the primary annual PM2.5 standard was revised from 15 micrograms per cubic meter ($\mu g/m^3$) to 12 $\mu g/m^3$.

Although states are required to comply with these standards, many continue to fail to meet one or more ozone standards. In fact, almost 125 million people, or 37.7 percent of the U.S. population, live in areas currently classified as being in nonattainment of the 2015 8-hour ozone standard (70 ppb).[80] These areas include 204 counties in 23 states, including California, Illinois, Missouri, New Jersey, and New York.[81] Parts of California and Pennsylvania are also in nonattainment of the PM2.5 standard.[82]

Many of the states that continue to fail to meet the ozone standards also have high concentrations of rail activity, which adds to the pollution burden that local residents breathe and that states must clean up. For example, in California, locomotive emissions represent a considerable 12 percent of statewide NOx emissions, and 8 percent of statewide PM2.5 emissions.[83] Given the severity of the State's air quality 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.

As long as federally-regulated industries like locomotives, trucks, marine vessels, and aircrafts continue to pollute at significant levels under weak emission standards set by the EPA, states and air basins will continue to struggle to attain federal air quality standards. Attainment of the NAAQS in almost half the states in the country depends on policies to achieve reductions from sources under federal regulatory authority, including locomotives.

D. A Zero-Emission Locomotive Standard is Technologically and Economically Feasible.

EPA has historically adopted technology-forcing emission standards that encourage industry to develop the latest, cleanest locomotive technology. Now, in line with this practice,

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[80] U.S. Env't Prot. Agency, *8-Hour Ozone (2015) Designated Area/State Information*, (Nov. 30, 2022), https://www3.epa.gov/airquality/greenbook/jbtc.html.
[81] *Id.*
[82] *Id.*
[83] Cal. Air Res. Board, *Draft In-Use Locomotive Regulation Workshop*, (March 30, 2021), at 11, https://ww2.arb.ca.gov/sites/default/files/2021-03/Draft%20In-Use%20Locomotive%20Regulation%20Workshop%20Slides%203-30-2021_0.pdf.

EPA needs to take action to set the most stringent emission regulations for locomotives, which in light of the latest technology developments, is a zero-emission standard.

i.i. EPA Should Set Technology-Forcing Emission Standards for Locomotives that Achieve "the Greatest Degree of Emission Reduction Achievable."

EPA has a duty to adopt locomotive emission standards that offer "the greatest degree of emission reduction achievable through the application of technology which the Administrator determines will be available for the model year to which such standards apply, giving appropriate consideration to cost, energy, and safety factors associated with the application of such technology."[84]

Importantly, the agency is authorized to adopt—and has historically adopted—"technology-forcing" emission standards for locomotives and locomotive engines.[85] For example, in 1998, EPA set technology forcing Tier 2 locomotive emission standards that would, according to EPA, "require significant effort to achieve."[86] The agency acknowledged that "the technology forcing nature of the standards" would require manufacturers to "identify, develop, and apply" new technology that was not being used in locomotives manufactured at the time.[87] Engine manufacturers expressed strong concern about being able to comply with the technology forcing Tier 2 standard, but EPA adopted the standards anyway.[88] The agency provided that it was "confident that manufacturers [would] be able to comply with the Tier 2 standards in a cost-effective manner" even though it also conceded that "as with all technology forcing standards, there is some uncertainty in predicting the successful development and application of the expected emission control technologies."[89] Despite their initial protests, the engine manufacturers did not petition EPA for reconsideration of the Tier 2 standard.

Likewise, in 2008, EPA adopted a Tier 4 locomotive emission standard that would be implemented two years earlier than was initially proposed.[90] Despite industry pushback regarding feasibility and EPA's own acknowledgement that meeting the Tier 4 standard in the earlier timeline "will be challenging," the agency concluded that delaying implementation would be "not consistent" with EPA's obligations under section 213(a)(5) of the Clean Air Act to "achieve the greatest degree of emission reduction achievable."[91]

Given the health burdens this industry imposes on communities, particularly low income communities and communities of color, we ask the agency to continue its practice of adopting technology forcing emission standards for locomotives here. Industry will always oppose

[84] 42 U.S.C. § 7547(a)(5).
[85] 63 Fed. Reg. at 18,982.
[86] *Id.*
[87] *Id.*
[88] *Id.*
[89] *Id.*
[90] 73 Fed. Reg. at 37,121.
[91] *Id.*

stronger standards, even though they have or are capable of developing the technology to meet them.

ii.ii. Zero-Emission Locomotive Technology is Technically Feasible and Economically Attractive for all Freight Duty Cycles.

Today, zero-emission locomotive technology is already technically feasible for both switcher and line-haul duty cycles. In fact, this technology is not even new—about one-quarter of the world's rail lines are electrified.[92] There are several kinds of zero-emission locomotive technologies primed for wide scale adoption across the United States, including locomotives powered by overhead catenary systems, battery-electric models, and hybrid options. In addition, this technology can actually offer cost savings compared to traditional diesel locomotives because the cost of electricity as a fuel source is significantly cheaper than diesel.

As background, traditional diesel locomotives use a diesel-powered engine to generate electricity to propel the locomotive. Therefore, transitioning diesel trains to zero-emission operations involves replacing the electricity generation system with one or more non-combustion options.

a. Locomotives Powered by Overhead Catenary Systems.

Locomotives powered by electricity via an overhead catenary system are the most established and widely used zero-emission locomotives around the world, and can be widely replicated in the United States. Power lines located along the railway deliver electricity directly to the train's electric motor via a contact system on the locomotive. These trains are incredibly efficient. While diesel-powered trains transfer about 30-35 percent of the energy generated by combustion to the wheels, overhead powerlines transfer an incredible 95 percent of the electricity to the wheels.[93]

Electric locomotives are also the highest-powered locomotives in the world, and capable of carrying the heaviest loads. All-electric line-haul locomotives in China, Russia, South Africa, and Australia carry some of the heaviest hauls in the world. In fact, the world's highest-powered locomotive is an electric overhead catenary coal train in China with 28,800 horsepower—almost five times as powerful as the average American line-haul.[94] Similarly, South African catenary locomotives carry iron ore in excess of 40,000 metric tons, which is more than double the weight of a typical line-haul in the United States.[95]

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[92] Brian Yanity, *supra* note 4, at 16.

[93] EESI, *Electrification of U.S. Railways: Pie in the Sky, or Realistic Goal?*, (May 30, 2018), https://www.eesi.org/articles/view/electrification-of-u.s.-railways-pie-in-the-sky-or-realistic-goal.

1. [94] Oliver Cuenca, *CRRC Zhuzhou Unveils 28.8MW Electric Freight Locomotive*, (Aug. 4, 2020), https://www.railjournal.com/locomotives/crrc-zhuzhou-unveils-28-8mw-electric-freight-locomotive/; Brian Yanity, *supra* note 4, at 21.

[95] Brian Yanity, *supra* note 4, at 19.

This explains why many of the world's largest freight rail systems are fully electrified. Almost every industrialized country, including almost all of Europe and Japan, has an extensive network of electrified freight rail.[96] Ethiopia and Switzerland, both very mountainous countries, have freight rail systems that are 99-100 percent electrified.[97] Likewise, 70 percent of railroads in South Korea and Japan are electric.[98]

Moreover, several countries have embarked on significant overhauls of their diesel-powered rail lines to transition them to electric operation. China rapidly increased the percentage of its electrified rail from 5 percent in 1975 to over 60 percent as of 2015, and climbing.[99] Russia electrified its Trans-Siberian Railway, the world's longest continuous rail line measuring 6,000 miles long.[100] Last year, India began operation of the world's first overhead catenary line that accommodates double-stacked intermodal trains.[101] The United Kingdom's rail system is currently 42 percent electrified, and it recently announced that diesel-only trains will be phased out by 2040.[102] Likewise, France has set a goal of phasing out diesel trains by 2035.[103] A lack of action by EPA could mean our rail industry and those manufacturing locomotives could lose on competitiveness to other countries pursuing these technologies.

Zero-emission electric locomotives powered by overhead catenary are well-established, and they can already be cost-effective compared to diesel locomotives. In fact, the cost of a fully electric engine is about 20 percent lower than that of a comparable diesel engine, and maintenance costs are also 25-35 percent less for electric engines because they have fewer moving parts.[104]

Even more importantly, electricity as a fuel is cheaper than diesel. In addition, renewable electricity is already half the price of electricity from fossil fuels and is expected to continue declining even faster than models projected.[105] If locomotives have flexibility in their recharging

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[96] *Id.* at 15.
[97] *Id.* at 16.
[98] *Id.*
[99] *Id.* at 15; The World Bank, *Railway Reform: Toolkit for Improving Rail Sector Performance*, (Dec. 27, 2017), at 398, https://bit.ly/3ViYfgS.
[100] Brian Yanity, *supra* note 4, at 15.
[101] Oliver Cuenca, *Indian Railways Launches Electric Double-Stack Container Operation*, (June 16, 2020), https://www.railjournal.com/freight/indian-railways-launches-electric-double-stack-container-operation/.
[102] FutureRail, *The UK's Diesel Phase-Out and Rail Innovation*, (May 2018), https://rail.nridigital.com/future_rail_may18/the_uk_s_diesel_phase-out_and_rail_innovation.
[103] Carrie Hampel, *supra* note 4.
[104] EESI, *supra* note 91.
[105] Marta Victoria et al., *Solar Photovoltaics is Ready to Power a Sustainable Future*, 5 Joule 5 (May 19, 2021), at 1044-45, https://www.sciencedirect.com/science/article/pii/S2542435121001008?dg; Important to note renewable energy may have many definitions based on the source of energy. MFN considers solar and wind to be renewable energy. However, there are important EJ and equity implications that come from these "cleaner" energy sources (i.e siting, manufacturing, shipping, etc). All of these must be considered

times, they can charge batteries primarily when there is surplus renewable electricity available. Exploiting low-cost, surplus renewable energy can make locomotives cheaper to fuel with electricity than diesel, even in the near term.[106] For example, in 2018, researchers examined a simulation of a line-haul locomotive traveling a 2,800 kilometer route from Kansas City to Los Angeles, and found that it would be significantly cheaper for an electric locomotive powered by overhead catenary to travel the route compared to diesel.[107] In fact, this overhead line-powered locomotive was estimated to have an excellent cost-benefit ratio and a payback period of about 11 years.[108]

Finally, the job creation benefits of building out a nationwide electric freight rail system would be astounding. The president and CEO of Wabtec Corporation, a Pennsylvania-based rail company, testified that increased rail utilization and zero-emission locomotives could create up to 250,000 jobs.[109]

b. b. Battery-Electric Locomotives.

Battery-electric locomotives are also well-suited for deployment across the United States, particularly for switcher operations in railyards but also for line-hauls. These locomotives are powered by on-board batteries that provide energy to the motor and replace the train's diesel engine. Battery-electric locomotives are also uniquely able to take advantage of regenerative braking, which allows the train to capture enormous amounts of otherwise wasted energy from braking a large, heavy load traveling at high speeds. Important advances in battery-electric locomotive technology, rapidly declining costs of batteries, and increasing availability of fast charging show that the technology is ready for a mandatory transition to zero-emissions. In fact, lead researchers find that battery-electric freight trains can achieve cost parity with diesel trains today.[110]

There are already battery-electric switcher and line-haul models ready for order and commercialization. Progress Rail's EMD Joule Switcher has up to 3,000 horsepower, and a run time of up to 24 hours, depending on charging and utilization.[111] Like any other battery-electric

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with EJ leadership before endorsing specific renewable energy recommendations. MFN Letter submitted to EPA 10/26/2021, https://www.movingforwardnetwork.com/wp-content/uploads/2021/11/MFN-Zero-Emission-in-Freight-Letter-to-EPA-10_26_21.pdf

[106] Natalie Popovich et al., *supra* note 5, at 1017-25.

[107] Federico Zenith, *Techno-economic Analysis of Freight Railway Electrification by Overhead Line, Hydrogen, and Batteries: Case Studies in Norway and USA*, (July 7, 2019), at 798, https://journals.sagepub.com/doi/pdf/10.1177/0954409719867495.

[108] *Id.*

[109] Rafael Santana, *The Business Case for Climate Solutions – House Committee on Transportation and Infrastructure*, (March 17, 2021), https://transportation.house.gov/imo/media/doc/Santana%20Testimony.pdf.

[110] Natalie Popovich et al., *supra* note 5, at 1017-25.

[111] Progress Rail, *EMD Joule Battery Locomotive*, https://www.progressrail.com/en/Segments/RollingStock/Locomotives/FreightLocomotives/EMDJoule.html.

transportation, the switcher's battery recovers energy through dynamic braking, which allows the battery to restore its energy reserves in route.[112] Similarly, Wabtec Corporation completed tests in April 2021 of its battery-powered line-haul locomotive, FLXdrive.[113] BNSF tested the battery-powered heavy line-haul locomotive in Southern California on a 350-mile track between Barstow and Stockton, California.[114] The electric, battery-powered locomotive was operated between two Tier 4 diesel locomotives as part of a hybrid consist.[115] Wabtec plans to commercialize this battery-powered locomotive for hybrid operation, and this research will also undoubtedly support the further development of fully zero-emission line-haul locomotives.[116]

Electrifying our freight locomotive system also offers attractive cost savings over operating traditional diesel locomotives. Advances in battery energy density translate to lighter, energy-packed battery packs that can carry a battery-electric locomotive very long distances.[117] Indeed, a single typical boxcar can hold a 14-MWh battery and inverter capable of delivering enormous range.[118] In fact, a typical diesel line-haul retrofitted with this technology is capable of traveling an impressive 450 miles—three times the average daily distance for a freight train in the United States.[119] Even with the added weight of the battery car, all-electric drives are far more efficient than diesel trains, and can travel these long distances at cost parity with diesel, assuming electricity charging costs of 0.06$/kWh.[120]

As the size and capacity of battery packs continue to grow, their costs rapidly decline, outpacing even expert predictions. In 2010, battery packs cost $1,000 per kWh, and many assumed it might take until 2030 to reach battery pack prices around $200/kWh. But instead, between 2010 and 2020, battery energy densities tripled and battery pack prices declined 87 percent.[121] The actual average cost in 2020 blew past estimates to $137/kWh, with some battery packs pricing less than $100/kWh.[122] Now, average costs of $100/kWh are expected as early as 2023, and the new estimate for battery prices in 2030 is $50/kWh.[123]

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[112] *Id.*
[113] Joanna Marsh, *supra* note 4.
[114] Bill Stephens, *Wabtec's FLXdrive battery-electric locomotive begins revenue tests on BNSF*, (Jan. 4, 2021), https://www.trains.com/trn/news-reviews/news-wire/wabtecs-flxdrive-battery-electric-locomotive-begins-revenue-tests-on-bnsf/.
[115] Joanna Marsh, *supra* note 4.
[116] Rafael Santana, *supra* note 107.
[117] Natalie Popovich et al., *supra* note 4, at 1017-25.
[118] *Id.*
[119] *Id.*
[120] *Id.*
[121] Kyle Field, *BloombergNEF: Lithium-Ion Battery Cell Densities Have Almost Tripled Since 2010*, CleanTechnica, (Feb. 19, 2020), https://cleantechnica.com/2020/02/19/bloombergnef-lithium-ion-battery-cell-densities-have-almost-tripled-since-2010/.
[122] BloombergNEF, *2020 Battery Price Survey* (Dec. 16, 2020), https://about.bnef.com/blog/battery-pack-prices-cited-below-100-kwh-for-the-first-time-in-2020-while-market-average-sits-at-137-kwh/.
[123] *Id.*

At the same time, commercial, high-capacity fast charging is increasingly available, which allows battery-powered locomotives to travel longer distances without needing to charge. This rise in fast chargers also allows railroads to have more flexibility in determining their routes without having to necessarily return to a single base to charge, and it adds the option of quickly charging locomotives during operational hours. All of this is to say that the costs of operating a battery-electric locomotive are already, and will continue to, rapidly decline.

c. c. Hybrid Locomotives.

Finally, battery-powered trains are already being blended as hybrid systems with overhead catenary power or fuel cells to perform as fully zero-emission locomotives. Batteries used in conjunction with locomotives that have overhead line power can allow for continued zero-emission operation where some locations like tunnels might make it challenging to erect power lines. Hybrid systems can also yield energy savings and improve overall operations, since batteries can store braking energy for later use and reduce the strain on overhead lines during peak power periods, while power lines allow the train to travel long distances without recharging.[124]

Several hybrid locomotives are already in development. For example, Bombardier plans to convert five diesel-hybrid trains to zero-emissions by 2023 through a combination of overhead catenary and battery power.[125] Likewise, BNSF piloted Wabtec's FLXdrive, a hybrid battery-electric diesel line-haul locomotive, earlier this year.[126] Even though some of these hybrid developments are not fully zero-emissions, they have tremendous value in showing that the technology is primed for further direction from EPA, and that various kinds of fully zero-emission switchers and line-hauls are on the horizon.

In sum, there is no question that zero-emission locomotive technology is already technically feasible for both switcher and line-haul duty cycles. In fact, this technology can actually offer cost savings compared to traditional diesel locomotives. EPA should adopt health- and climate-protecting zero-emission locomotive standards for switcher and line-haul locomotives that requires the industry to clean up its pollution on a wide scale.

II. IV. EPA Needs to Adopt Life-Saving and Climate-Protecting Locomotive Emission Standards Before the End of 2023.

In light of all of the above, we ask that EPA take immediate action to clean up the nation's incredibly polluting freight rail industry. Children, families, and workers live near railyards and freight rail routes where some of the dirtiest switcher and line-haul locomotives belch diesel particulate matter each day, sometimes just feet from homes, schools, and

[124] Carrie Hampel, *supra* note 4.
[125] *Id.*
[126] Bill Stephens, *supra* note 112.

workplaces. Exposure to diesel pollution from locomotives has significant, detrimental impacts on our health, and these health burdens continue to fall on our most vulnerable communities, year after year. Communities of color and low-income communities often have few other options besides living or working near railyards, where harmful pollution remains concentrated. Likewise, pollution from line-hauls exacerbates regional air pollution, making it challenging for states with substantial rail operations to meet the federal air quality standards set by EPA. Communities have been living with and dying from diesel pollution for decades. We cannot afford any additional delays.

The tremendous advances in zero-emission switcher and line-haul locomotive technology make now an optimal time for EPA to set a clear course to clean up the country's freight rail system. Locomotives powered by overhead catenary lines have a clear and longstanding track record, and advances in battery and fast charger technology demonstrate a direct path to widespread deployment of battery-electric locomotives and hybrid options. On top of all this, electrifying our freight locomotive system can also offer attractive cost savings over operating traditional diesel locomotives.

We ask that EPA act expeditiously to begin developing a zero-emission locomotive standard that will save lives. Commenters therefore respectfully request that the Administrator take the following actions:

1. EPA should exercise its authority to adopt a much-needed rulemaking before the end of 2023 to address the public health, dirty air, and climate crises exacerbated by locomotive pollution.

2. Specifically, this rulemaking should include a Tier 5 zero-emission locomotive standard for all new freight locomotives that requires 100 percent of all new switchers be zero-emission by 2025, and 100 percent of all new line-hauls be zero-emission by 2030. As documented above, the health impacts from the operation of diesel-powered switcher and line-haul locomotives are significant. At the same time, there have been tremendous advances in the development of zero-emission locomotive technology, including with trains powered by electric overhead catenary lines, battery-electric models, and hybrid options.

3. We also ask that EPA set significantly more stringent emission standards for all remanufactured locomotives and locomotive engines, so that 100 percent of all remanufactured switchers meet the Tier 4 standard by 2025, and 100 percent of all line-haul locomotives meet the Tier 4 standard by 2027.

4. Require the forced retirement of all locomotives or locomotive engines that do not meet a Tier 5 zero-emission standard by 2045. This requirement must include the scrappage of the non Tier 5 engines.

5. EPA should use the authority in section 108(f)(1)(C) of the Clean Air Act to identify strategies to clean up the toxic hot spots associated with rail and railyard activities to "protect the health of sensitive or susceptible individuals or groups."

6. Finally, EPA should work with our organizations to create a strategy to eliminate pollution burdens from concentrated railyard operations that pose significant health and safety risks, including but not limited to pollution and impacts from the operation of locomotive maintenance facilities, locomotive parking/idling, and supporting warehouses, which are often located in environmental justice communities.

III. V. Conclusion

Environmental justice communities continue to bear the public health and environmental brunt of the global freight system. For decades, the rail industry has been poisoning families, workers, and communities with a barrage of pollution from outdated locomotives. We are calling on the EPA to fulfill its duty and make the rail industry stop polluting our communities, now.

Respectfully Submitted,

Kevin D. Hamilton, RRT
Co-Founder & Co-Executive Director
Central California Asthma Collaborative
Fresno, CA

Lucia Marquez
Associate Policy Director
Central Coast Alliance United for a Sustainable Economy
Ventura, CA

Cynthia Pinto-Cabrera
Policy Coordinator
Central Valley Air Quality Coalition
Fresno, CA

Luis Olmedo
Executive Director
Comite Civico del Valle, Inc.
Brawley, CA

Dr. Bruce Strouble, Jr.
Founder and Director
Citizens for a Sustainable Future
Tallahassee, FL

Beto Lugo
Co-Director
CleanAirNow
Missouri/Kansas

Yasmine Agelidis, Sr. Associate Attorney
Adrian Martinez, Deputy Managing Attorney
Earthjustice
Los Angeles, CA

Taylor Thomas
Co-Director
East Yard Communities for Environmental Justice
Commerce/Long Beach, CA

Mata Townsend
Communications and Planning Coordinator
Groundwork Northeast Revitalization Group
Kansas City, MO

Dr. Mildred McClain
Executive Director
Harambee House / Citizens for Environmental Justice
Savannah, GA

Maria Lopez-Nunez
Deputy Director of Organizing and Advocacy
Ironbound Community Corporation
Newark, NJ

Sylvia Betancourt
Program Manager
Long Beach Alliance for Children with Asthma
Long Beach, CA

José Acosta
Senior Transportation Policy Analyst
Little Village Environmental Justice Organization
Chicago, IL

Heather Kryczka
Staff Attorney, Environment, Equity & Justice Center
Natural Resources Defense Council
Santa Monica, CA

Melissa Miles
Executive Director
New Jersey Environmental Justice Alliance
Summit, NJ

Ivette Torres
Research Consultant
Peoples Collective for Environmental Justice
Grand Terrace, CA

Brian Urbaszewski
Director, Environmental Health Programs
Respiratory Health Association
Chicago, IL

Kim Ross
Executive Director
reThink Energy Florida
Tallahassee, FL

Kim Gaddy
Founder and Director
South Ward Environmental Alliance
Newark, NJ

Dr. P. Qasimah Boston
President of the Board of Directors
Tallahassee Food Network
Tallahassee, FL

Juan Parras
Executive Director
Texas Environmental Justice Advocacy Services (T.E.J.A.S.)
Houston, TX

Marcos Ceniceros
Executive Director
Warehouse Workers for Justice
Chicago, IL

Theral Golden
West Long Beach Neighborhood Association
Long Beach, CA

MFN Staff

Molly Greenberg, MSW, MPhil
MFN Campaign Manager

Cecilia Garibay, MPP, MS
MFN Project Coordinator