UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF ENERGY EFFICIENCY & RENEWABLE ENERGY

EERE T 540.111-02: Request for Information (RFI)
DE-FOA-0003186: PROGRESSION TO NET-ZERO EMISSION PROPULSION TECHNOLOGIES FOR THE RAIL SECTOR

RESPONSE OF THE AMERICAN SHORT LINE AND REGIONAL RAILROAD ASSOCIATION

The American Short Line and Regional Railroad Association (ASLRRA) submits these comments in response to the Department of Energy's November 17, 2023, request for information titled *Progression to Net-Zero Emission Propulsion Technologies for The Rail Sector*. ASLRRA appreciates the opportunity to share our knowledge of the short line industry and the state of development of zero emissions locomotives. These locomotives are in the developmental stages, expensive and hard to acquire, particularly for small business short line freight railroads with very limited financial resources. As such, any regulatory or policy efforts should focus first on what can be achieved quickly and at no or low cost.

Table of Contents

Interest of the American Short Line and Regional Railroad Association

ASLRRA is a non-profit trade association representing the interests of more than 600 short line railroads in legislative and regulatory matters. These are railroads that are classified as Class II ("regional") or Class III ("short line") according to the Surface Transportation Board. Short lines operate 50,000 miles of track, or approximately 30% of the national freight network, employing approximately 18,000 people, and connecting thousands of manufacturers, businesses, and farmers in communities and small towns to larger markets, urban centers, and ports. Short line railroads play a vital role in providing rail service by maintaining tens of thousands of miles of light density lines throughout the country that in many cases were at risk of abandonment by their former owners. Short lines take that responsibility extremely seriously and do not take their critical role for granted. Short line service is particularly important to small and medium size businesses that ship by rail and to rural areas and small communities. While short lines operate approximately 30% of the national network, they touch about 20% of the freight cars moved, and receive only about 6% of the revenue produced by the national freight rail system.

The U.S. EPA estimates that, as of 2020, short lines operated a fleet of 3,447 diesel-electric locomotives or "units." [1] Of these units, EPA believes 39% are "uncontrolled" and 48% are Tier 0, in accordance with their exhaust emissions standards for locomotives.[2] Around 11% of this fleet are thought by the agency to meet requirements of Tiers 1 to 3, while only 2% are estimated to be Tier 4 units. ASLRRA believes that this analysis significantly underestimates the

[1] (Eastern Research Group, Inc.)
[2] (U.S. EPA)

size of the short line locomotive fleet. The figures are based in part on data from the Association of American Railroad's Universal Machine Language Equipment Register ("UMLER") database. UMLER is a system designed to support interline operations, but most short lines do not carry out significant interline activities that would require UMLER registration for their locomotives. ASLRRA is completing a detailed analysis on a recent fleet survey that may enable a more accurate estimate of short line locomotives in operation in the U.S. under a project funded by FRA. Final survey results are not yet available, but initial feedback suggests the short line locomotive fleet likely consists of over 6,000 units. ASLRRA does believe that the EPA's short line fleet composition estimate is likely accurate in its assessment that short lines operate a significant number of uncontrolled and Tier 0 diesel locomotives and very few Tier 4 units.

The short line motive power fleet composition is driven by the economics of short lines, which are small operations with limited resources. ASLRRA estimates that collectively short lines face a backlog of more than $10 billion in investment to reach a state of good repair, largely consisting of track and structures, such as bridges, that need significant infrastructure improvements.[3] Short lines have typically obtained older–sometimes very old, pre-1973–used motive power relatively inexpensively to operate their railroads.

Road-switcher locomotives are a large part of this fleet. These units support both yard switching activities and the short linehauls of smaller trains operating at lower speeds that are typical of our industry. These locomotives are often 4-axle designs that fall within the 2300 horsepower or less EPA definition of a switcher locomotive. The "prime mover" diesel engine is typically a medium-speed diesel engine operating between 300 and 1,000 revolutions per minute. These used locomotives are periodically rebuilt by the short line but will remain at uncontrolled or Tier 0 levels. These locomotives provide short lines with extremely reliable motive power at low acquisition cost, low maintenance costs, that are relatively simple to maintain, that effectively support the unique characteristics of short line operations, and that provide high reliability and availability.

Questions and Responses

Combined response to Questions 1, 2, 3, 5 and 14

[3] (ASLRRA)

1.What is your view of zero-emission, or net-zero emission, rail propulsion technologies in the next 5 years? 10 years? 30 years? In your response, please include which rail propulsion technologies for line-haul and railyard operations do you see developing most promisingly. Please provide as many details as possible e.g., battery chemistry for batteries, charger type for electrification, fuel cell vs combustion, feedstock source, etc.
2. What efforts are you aware of to decarbonize rail transportation, including ways to reduce diesel fuel use? Are you aware of intermediate decarbonization milestones for rail transportation? Are you aware of longer term decarbonization goals for rail transportation? If so, describe how those goals might be met, including whether low-carbon biofuels will play a role.
3. What are the benefits and challenges of the various rail propulsion technologies as compared to the other alternatives? If possible, please provide a ranking of the alternative technologies starting with the most viable/promising option.
5. For direct electrification of rail, how do you foresee the infrastructure (such as overhead catenary) being built? Who should own and operate the infrastructure?
14. In your opinion, how do certain technologies (e.g. battery) compare for different use cases (e.g. line haul, switching)?

<u>Policy Changes with Immediate Carbon Emissions Reductions</u>

The Federal Railroad Administration ("FRA") recently updated outdated provisions of a train brake regulation, 49 CFR 232, to allow reduced time for a locomotive idling without incurring additional inspection requirements. [4] This resulted in an estimated carbon emissions reduction that is in excess of 26,000 tons per year. Criteria pollutants would also be similarly reduced.

In early 2021, FRA proposed a rulemaking to amend their Brake System Safety Standards related to Electronic Air Brake Slip Systems.[5] FRA could finalize this similar regulation to allow for changes in car handling and inspection intervals that would eliminate an estimated excess of

[4] (Federal Railroad Administration)
[5] (Federal Railroad Administration)

53,000 tons of carbon emissions per year due to an anticipated further reduction of idling due to redundant brake inspections.

Transitional/Interim Technologies Including Renewable Fuels

Incremental improvement towards net-zero emission rail propulsion by short lines can be made with expanded distribution of biodiesel and renewable diesel over the next five years. There are 43 U.S. states with notable policies promoting and incentivizing biofuel use, including:[6]

- Low carbon fuel standards
- Mandates for transportation
- Tax incentives for sales/income or production
- State fleet requirements
- Mandates for bioheat fuels or bioheat blending incentives
- Sustainable aviation fuel (SAF) tax incentives

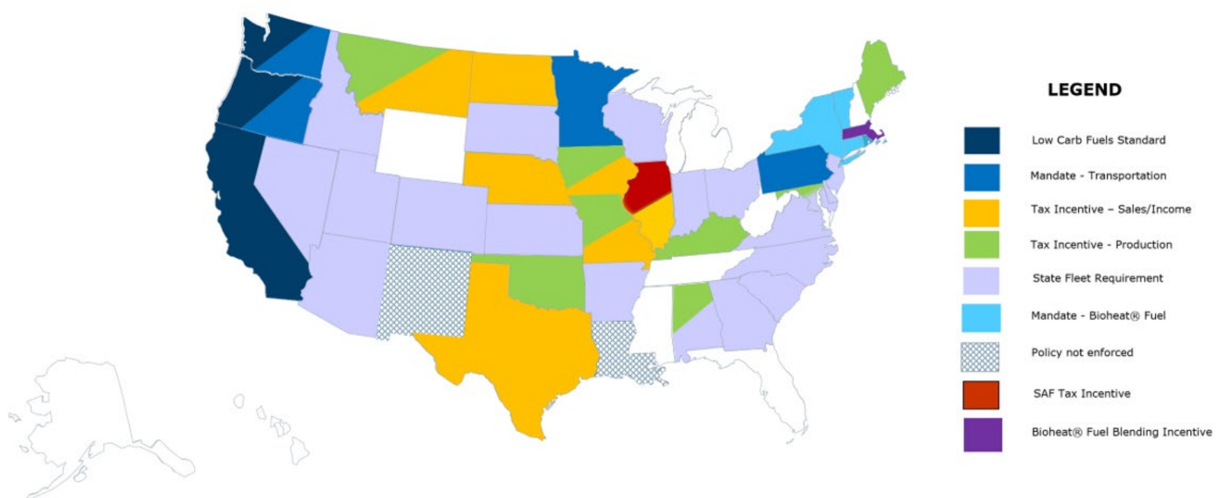

Figure 1: States with notable biodiesel policies

Alternative fuels such as ammonia, methanol, or hydrogen for use in freight locomotives are still at the earliest stages. These fuels cannot be considered as options without further extensive research, development, feasibility, and pilot testing specific to freight rail applications that will take a long-term time frame to perform.

[6] (Clean Fuels Alliance America)

Additionally, as a step towards incremental improvements, ASLRRA is testing non-traditional fuel technologies in partnership with FRA's Office of Research, Development, and Technology.

As described earlier, the project develops an inventory of the short line locomotive fleet, and a methodology to evaluate short line railroad emissions, first through field testing of non-traditional fuel technologies, including but not limited to additives and injectors ("Technologies") in Phase 1 and then through follow-up testing of the same technologies in a controlled environment during Phase 2 to enhance the certainty of the results. A greater understanding of the efficacy of the Technologies will encourage short line railroads to employ these alternative methods, to improve locomotive fuel economy and reduce locomotive emissions. This effort is funded through an FRA Broad Agency Announcement Grant, FRA-RS-003, for "Energy and Environment Sustainability."

Diesel-electric locomotive repowers

Some older locomotive models that are commonly operated by short lines could be repowered - remanufactured from uncontrolled or lower tier levels to meet the Tier 4 standard. Such a "heavy" rebuild, also referred to as "modernization," involves complete replacement of the engine, control systems and many other elements. This is complex work that can cost $2 million or more per unit, and these projects are facing typical lead times of more than a year from execution of a contract with a supplier. This type of rebuild can result in significant improvements in fuel efficiency, reducing greenhouse gas emissions, and dramatically reducing emissions of criteria pollutants. Models that could be rebuilt in this manner include some of the 4-axle road switcher units commonly in service on short lines.

It is, however, important to note that short lines operate some less common and sometimes very old units. Significant engineering work goes into developing a repowering approach for a given model of locomotive. For less common locomotives, the cost to repower may approach or exceed the cost to buy a new unit. For some models, suppliers may not be willing to offer repowers at all. For the oldest units still in service, the lifespan of a repower could exceed the expected lifespan of the locomotive frame itself.

The distinction between 4- and 6-axle locomotives is particularly important for short lines. Most short lines will have stretches of track that are restricted to operation by 4-axle locomotives due to track geometry constraints and track condition. 6-axle locomotives typically have a longer wheelbase that limits the degree of track curvature they can navigate and can be unstable over certain types of railroad track. 6-axle units are also significantly heavier than 4-axle units, and the per axle weight can exceed the safe capacity of short line track, whose condition is often impaired by the relative lack of investment capital available to short lines.

Due to their limited resources, a transition involving repowers or new locomotive acquisitions by short lines is highly dependent upon availability of public funding. Even if funding were to be broadly available, short lines can face serious challenges even meeting matching funding requirements. Supplier lead times are a factor, as is the limited spare locomotive capacity of most short lines. For these reasons, even assuming funding is made available, the potential uptake of repowers and replacements in a five-year timeframe is limited, perhaps to only a few hundred.

A full short line fleet transition by these means to lower emission diesel or zero emission technology is a multi-decade undertaking. Transition to Tier 4 diesel engines through repowering is likely to continue over the full 10-to-30-year timeframe. Should state or federal regulatory action drive the Class I railroads and passenger rail operators concurrently towards large scale investments in cleaner locomotives, this demand is likely to displace and delay short line transition. Short lines could face substantially lengthened lead times with suppliers if in competition with Class I railroads acquiring significant numbers of new locomotives. Repowers and new builds will draw generally upon the same skilled labor force and supply chains. Sudden large-scale investments by Class I railroads may exacerbate supply chain challenges across the locomotive market, at least over any initial medium-term (5 year) period.

New diesel-electric locomotives

As with diesel-electric repowers, transition to cleaner diesel-electric locomotives through acquisition of new units is a path for short lines over the longer term of 10 to 30 years. Due to the fleet composition of the short line industry, transition to Tier 4-compliant units will achieve significant reductions in emissions of both greenhouse gases and criteria pollutants. The relative contribution of short line locomotives to air pollution within the rail industry is small, smaller still when considered in the context of all mobile source emissions. ASLRRA again emphasizes that the cost to acquire a new tier 4 locomotive is a dramatic increase from the historical motive power acquisition costs for short lines. The availability of public funding to short lines for lower-emission locomotive investments will be a key factor in determining the uptake of new units, in addition to the ability of these public funds to provide a high enough match percentage to make this a viable financial alternative for short lines.

Battery-electric locomotives

Short lines are at the forefront of testing and some initial adoption of battery-electric locomotive (BEL) units. Anacostia & Pacific's Pacific Harbor Line serving the Port of Long Beach, California, is presently piloting a Progress Rail Joule locomotive. Watco, a holding company of multiple short lines, is introducing more than a dozen BELs into service across multiple railroads. The latter was supported with one of 11 awards by the FRA's 2022 CRISI grant program that provided funding for projects to reduce locomotive emissions. These awards will invest in more than 30 locomotives including repowers and replacements, both EPA tier diesel-to-diesel improvements and battery-electric zero emissions solutions. Genesee and Wyoming Inc (G&W) filed a petition Aug. 10, 2023 with the FRA on to pilot new zero-emission rail-freight technology from Culver City-based Parallel Systems on portions of their rail lines. Parallel Systems was awarded a $4.4 million U.S. Department of Energy (DOE) grant to test its autonomous, battery-electric-powered railcar technology.

ASLRRA does expect to see some additional BEL units ordered for pilot and revenue service at short lines over the next 5 years. This likely will take place at short lines that have more technical capacity than average and be for use in dedicated switching service. BELs are presently substantially more expensive than equivalent new Tier 4 diesel-electric locomotives. This is a new technology that we consider—for use in short line switching service—to be at a technology readiness level between 6 and 7.[7] We believe it will take at least 5-10 years of a meaningful number of these units to run in service, under different environmental conditions and operational duty cycles, to give railroads confidence in key life cycle performance and operational cost assumptions. Previous deployments of lower emissions locomotive technologies, including early BELs and genset locomotives, generally did not live up to industry expectations for performance and reliability.[8] Technology advances in the development of lower

[7] (U.S. DOT Federal Highway Administration) Table 11. TRL 6 – Prototype demonstrated in relevant environment; TRL 7 – Prototype demonstrated in operational environment.
[8] (Austen)

emissions locomotives – new or repowered - with traditional but improved unitary diesel prime mover technologies, also came to compete with these approaches. While numbers of these battery and genset units remain in service, many have been mothballed or scrapped. ASLRRA is only aware of one smaller supplier that still offers genset technology. The uptake of BELs for switching applications by short lines over a 10-to-30-year timeframe will be dependent upon successful revenue service demonstrations, evolution of the technology over the medium term, and availability of significant public funding resources. An estimation of the potential for short line BEL uptake for use in road or mainline service would be purely speculative at this time.

BELs will regularly operate near railway cars transporting hazardous and flammable materials. The battery packs in BELs are very large and store a tremendous amount of energy. Battery electric vehicle fires have been experienced in the private and commercial automobile and public transit vehicle sectors. These incidents have presented unique challenges and risks to vehicle operators and first responders. Obtaining more information on the expectations for crash and fire (flame, smoke, toxicity) safety performance of BELs in freight service is an area of ASLRRA interest.

The requirements for new or increased provision of electricity distribution for recharging are an important consideration for short lines evaluating BEL technology. Requirements for investments in capacity in electrical charging infrastructure at the railroad operational sites, many of which are likely to be in rural areas, including corresponding investments needed by the serving electrical utility, are an important factor to consider when evaluating this technology.

Other Net-Zero Emissions Technologies

There is insufficient information to speculate on potential demand for short line implementation of locomotives using other propulsion technologies such as hydrogen fuel cells. These technologies are at a low readiness level in limited pilots.

ASLRRA recognizes that straight electric traction power for freight rail, provided through catenary, is a solution in broad use globally. The chart below shows the International Energy Agency's base case forecast through 2050 for the split of diesel versus straight electric power use in freight rail in selected regions and countries, including North America.[9] North America's freight rail sector is very different in current and forecast reliance on diesel motive power.

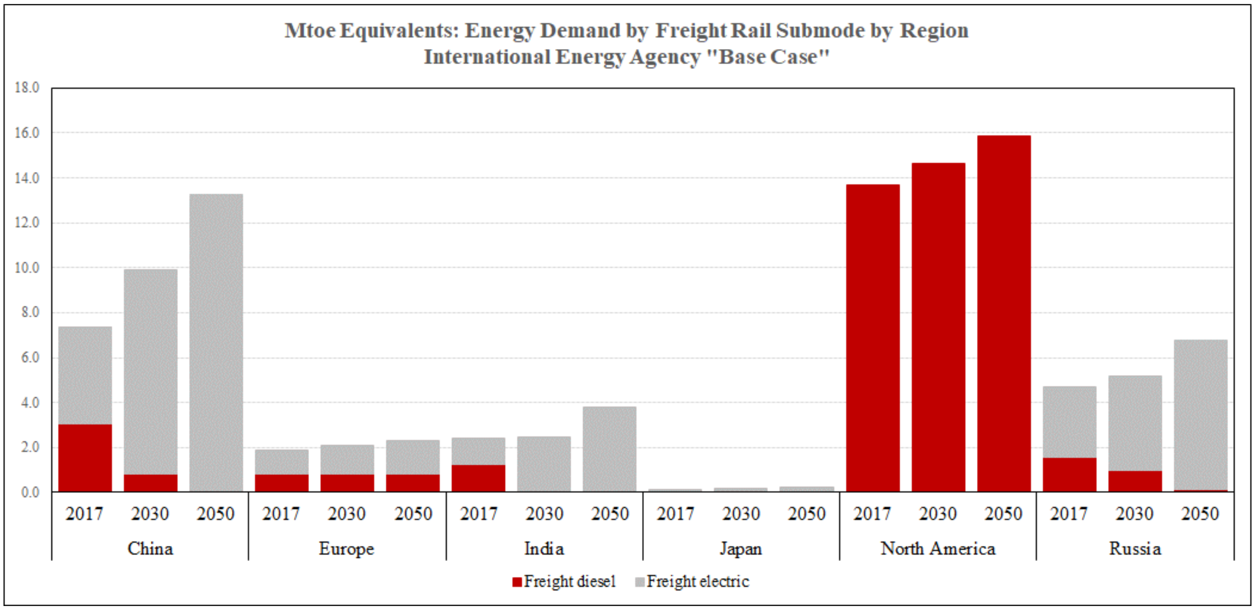

Figure 2: IEA forecast for diesel versus straight electric power utilization for freight rail in different regions through 2050

Straight electric motive power via catenary is not a viable solution for short lines over any of the time frames. Catenary installations can cost millions of dollars per mile and introduce a new specialized element of wayside infrastructure to be maintained. Short line railroads operate relatively low-density lines and are financially constrained. Straight-electric traction locomotives are significantly more expensive than any other types of locomotives on the market or in pilot. Straight electric catenary powered freight locomotives are also not available on the North American market. A transition to this technology for short lines would require subsidization of both the capital and operations and maintenance cost for such systems by the railroads, and potentially some elements of investments by utility providers.

Question 4

What obstacles to rail decarbonization is the industry facing? What plans can be put in place to overcome these challenges?

As mentioned previously, the cost of repowering or replacing the existing fleet of locomotives is the largest obstacle. The short line freight industry faces challenges in this

---

[9] (International Energy Agency)

respect. Short lines have almost exclusively equipped their motive power fleets with older, used locomotives. The acquisition cost for these units can be as low as a few hundred thousand dollars apiece. As Class I railroads have implemented comprehensive restructurings to achieve efficiencies over the past two decades, a large amount of high-quality secondhand Class I motive power has entered the secondary market. This has kept those costs low. These older machines are mechanically less complex, highly reliable and can be rehabilitated periodically at the same tier levels for similarly low costs.

The concept of decarbonization of short line freight implies a shift upwards in short line motive power fleet capital costs by an order of magnitude, even if the assumption is a transition to EPA Tier 4 diesel-electric standard. Based on recent funded project cost data, the cost to repower a short line locomotive to Tier 4 can start at $1.7 million. An acquisition of a new Tier 4 locomotive will cost over $3 million, by some estimates substantially more.

A recent example of these costs is the FY 2022 CRISI program grant award by the Federal Railroad Administration to the Bighorn Divide & Wyoming Railroad in Wyoming. This grant will enable a repowering of an EMD GP38 from EPA Tier 0 to Tier 4. The GP38 is a four-axle, 2,000-horsepower, 1970's-era road switcher. This is a model frequently seen on short lines around the country. A repower of this vintage and design of a freight locomotive is not a simple drop-in of an engine. Other major assemblies like the wiring harness, control system and alternator must be replaced. The total cost of this repower project is $3.03 million. In an interview, this railroad cited an estimate of more than $5 million for a new equivalent locomotive.[10]

This quote highlights an important concern for short lines. Today, new freight diesel locomotives are offered in six-axle models. But short lines have many older four-axle locomotives like the GP38. Short lines often have sections of track, especially in yards and at customer sites, that cannot be accessed by six-axle locomotives that are typically longer and heavier. The constraints include track curvature and other geometry elements, sometimes loading gauge, as well as track conditions. A $5 million-dollar-plus price is not surprising if a manufacturer is asked for a quote to design and build just one completely new four-axle Tier 4 diesel locomotive. A huge amount of engineering, design, tooling, and supply chain work would

[10] (Stagl)

go into establishing new production of such a locomotive. Because of this market dynamic, many, if not most, short line Tier 4 projects are likely to be repowers rather than replacements of old with new units.

In California, the new In-Use Locomotive Regulation would force railroads to shift their locomotives to Tier 4 or zero emissions locomotives, through a mix of absolute restrictions on age and propulsion type and fees on emissions. The short line fleet in California—some 160 units—includes approximately 138 locomotives at EPA Tier 3 or below. It is estimated that implementation of this rule—an explicit locomotive decarbonization measure—would impose a cost of between $335 and $427 million on this small number of small firms. This could be 8 to 10 times their likely locomotive capital cost over the same projection timeframe in the absence of this rule. This estimate assumes California short lines shift their fleets to EPA Tier 4 diesel units. Costs per unit to shift to these short line fleets to battery electric propulsion through repowers or replacing old locomotives with new zero emission locomotives would be higher still. California's Air Resources Board admitted that some short lines were unlikely to survive the implementation of their rule due to the great costs.

Question 6

What collaboration with any other entities do you think will be necessary to support the decarbonization of rail transportation?

Decarbonization of short line locomotives will require collaboration with many entities:

- Funding for investments: Federal agencies including, but not limited to EPA, FRA, other DOT Modal agencies, and state and local government.
- Regulatory: STB, DOT FRA, EPA, SBA.
- Development of technologies: supplier community (note key actors), DOE, EPA, USDOT especially OST and FRA.
- Academic community, UTCs and note universities with specialties in motive power engineering
- Class I railroads / Railinc.
- Rail Supply Institute
- Manufacturing workforce
- Training providers

- Environmental advocacy organizations – need their support to recognize economic and operational constraints within the industry.

Question 7

What are the most critical gaps (e.g., with respect to standards, regulations, supply chain, labor) that need to be filled to support acceptance of and markets for alternative rail propulsion technologies?

There is a lot of investment in testing prototype battery-electric (Joule-PHL and hydrogen fuel cell locomotives (Sierra Northern)). These are being tested in pilot projects or like the hydrogen project still in the process of being developed. These technologies need to be thoroughly tested under a variety of operating conditions as a first step.

The challenges with BELs include availability and capacity of the batteries, issues with the reliability of the electrical grid, and upgrades to related infrastructure to provide reliable charging capacity. Short lines that are beginning to work with a few BELs on a pilot basis are trying to understand key parameters like operational performance capabilities, how quickly batteries will hold a charge under different operating scenarios, behavior of BELs under different ambient temperature ranges, response of BEL equipment to typical shock and vibration loads over time, general maintenance requirements, and the actual requirements for frequency and duration of charging. Over the longer-term, baseline maintenance requirements and lifespans of the major new or different assemblies of BELs will need to be determined. The new equipment will require new workforce skills for maintenance and operations. There are also safety considerations related to flame, smoke and toxicity of fires involving large battery power packs as well as management of any risks associated with use of electrical charging infrastructure.

Hydrogen represents a significant challenge as there is no infrastructure for liquefaction, distribution, storage or fueling. Additionally, there are well known risks of using hydrogen.

The alternate propulsion locomotive industry is very much in the beginning stages and further research on the safety, environmental and social impact of these alternative fuel sources is needed along with the in progress or in development demonstration and test.

Question 8

What infrastructure is required to support promising alternative rail propulsion technology? Are there specific routes, railyards, or network segments that would be a good candidate for alternative propulsion technologies (e.g., catenary, hydrogen fuel cells, or batteries)?

Short line railroads are well positioned to use sustainable fuels as distances tend to be less than longer Class I hauls and locomotives are frequently not interchanged. There would need to be greater availability of feedstocks and production, distribution, and storage of sustainable fuels for this to be achieved. Fuel is a major component of a railroad's operating expenditures, typically second only to workforce costs. Price stability of sustainable fuels and affordability relative to historical prices of standard diesel must be an important federal policy objective if a transition to higher levels of use of renewable or bio-diesel by short lines were to be sought. There is also competition for the feedstock used to create biofuels. For example, soybeans are used for this purpose and many other industries use soybeans or soybean oil. There are also a limited number of crushing plants in the US.

Question 9

What type of service testing, or derisking, of these propulsion technologies do you think are necessary for each alternative rail propulsion technology?

Any new technology must be thoroughly tested under a variety of conditions, including climate, terrain, and loading for several years. Current short line operations often see mid-level horsepower units, often four axle locomotives, supporting both yard switching and line haul "local" mainline train services. The impacts on availability relative to the current fleet baseline are an important consideration. Short lines need to see several years of field pilot data to understand if adoption of an alternative propulsion technology will change fleet sizing requirements to meet the same operational performance requirements.

Question 10

What government actions do you think are necessary to help move the rail sector towards net-zero emissions?

The government could take action to reduce emissions now through policy changes that were noted in the Department of Energy's "The U.S. National Blueprint for Transportation Decarbonization" "road freight vehicles such as trucks . . . are the largest contributor to freight emissions . . . Using more efficient modes . . . is essential to reduce overall transportation emissions and energy use."[11]

Government policies should level the costs between modes so that the shipper will use the most environmentally friendly option for transportation.

The government, through taxpayers, funds the infrastructure builds and maintenance that truck transportation uses. Short line railroads are largely privately owned, this means the railroads, not the taxpayers, pay for the network's upkeep, maintenance and repairs. For rail customers, these costs are passed along in the rate for the movement of goods.

The federal government is thus effectively subsidizing the transportation of goods via highways, creating an unlevel playing field that puts safer and more environmentally-friendly freight railroads — especially small business short line freight railroads — at a competitive disadvantage versus trucking entities who rely on publicly-funded infrastructure.

To pay for the country's roads and highways, American motorists pay a tax per gallon of gasoline or diesel with every purchase. The revenue from the taxes goes into the federal Highway Trust Fund (HTF), which then is disbursed to states to cover costs of road building and road repairs. The gas tax is 18.4 cents per gallon, and the diesel tax is 24.4 cents per gallon. Both taxes have remained static at those rates since 1993—three decades ago. As costs of construction rise and maintenance needs increase, the tax is worth relatively less and less each year – the "Highway Trust Fund" has now been subsidized by close to a staggering $275b of general funds since 2008. Moreover, electric vehicles (EVs) are increasingly taking to the road, leading to challenges in funding the HTF. The government should consider either raising the tax or going to an alternative such as a Vehicle Miles Travelled (VMT) which also considers a vehicle's weight, and distance travelled.

Question 11

Other than tax credits, what opportunities are there to incentivize transition to clean fuels, recognizing that costs are likely to be higher in the near to mid-term? (For example, vehicle consumer incentives in the on-road sector include the use of high occupancy vehicle (HOV) lanes, free workplace charging, etc.).

---

[11] The U.S. National Blueprint for Transportation Decarbonization (energy.gov)

ALSRRA supports sustainable fuel policies that are neutral between modes of transportation. Expanding the use of renewable diesel and biodiesel will require enhanced production, distribution, and storage capabilities available in all geographic areas and without incentives and subsidies that favor one mode over another.

Question 12

What type of workforce challenges are present? Are you aware of any workforce development programs that are relevant to the clean energy transition in the rail sector?

Currently most short line locomotive maintenance is performed by mechanics specializing in older medium-speed diesel engines. With the increase in electrical components and changes in control system technology there will be an increased need for highly skilled electricians. Short line railroads will be competing with Class I railroads and with other modes of transportation for the same skillsets, so measures to develop an adequate work force will be necessary.

New safety protocols for battery electric operations and potentially new chemicals for delivery and use of fuels would be needed. Additionally new emergency response procedures related to derailments and grade crossing collisions will need to be developed and employees and emergency responders trained.

Question 13

Are you aware of any goals for Total Cost of Ownership (TCO) willingness to pay for advanced technologies? Recognizing that DOE and industry are driving to cost parity with diesel in the long term, what do you think the goals should be regarding reasonable extra costs over the diesel baseline in the near term?

The zero emissions locomotive technologies are in the very early stages of development, so it is difficult to provide any form of total cost of ownership (TCO) analysis. Any such analysis would require the analysis of all costs of acquisition, maintenance, workforce development, first responder training, any potential inefficiencies introduced from interchange impacts, and construction and permitting costs.

Short lines face high capital costs and typically run on extremely tight margins. Portions of their traffic can be very price sensitive and face a fierce competitive threat of a modal shift to trucking. Many short lines also have significant concentrations of traffic, revenue and profit by shipper or commodity. Because of these characteristics, loss of just one or two key shippers can result in a whole segment of the short line's network, or the entire railroad, becoming unprofitable. Therefore, a sustained shift in energy costs over those historically experienced with traditional diesel locomotive operations could be catastrophic for many short line operators. They do not have the traffic diversity or relative financial resources to absorb such a blow for a meaningful amount of time. A sustained shift upwards in energy costs for many short lines could quickly result in abandonment of segments of track or even bankruptcies and closures. Our objective would be that any policy that could introduce a sustained shift in energy costs for short lines be avoided, either through a complete exemption of short lines, or through subsidies or incentives that fully offset the expected cost increases.

Question 15

In your opinion, what percentage of overall locomotives could reasonably be expected to be zero-emission locomotives between now and 2050? How do you think production might scale up over time?

ASLRRA cannot project a percentage of short line locomotives that could be zero-emission by 2050. Only a small number of battery electric freight locomotives (BELs) will be in pilot operations over the next five years. Approximately 10 - 20 zero emissions locomotive projects are in pilot or development the U.S. today.[12] Most of these will be in limited use cases, such as light duty yard switching.

Non-battery zero-emission propulsion technologies are even lower down the scale than BELs in terms of technology readiness level. Before making such a forecast, for each zero-emission technology case, there needs to be up to a decade of dozens of those zero-emissions locomotives conducting carefully monitored and well-documented pilot operations under a variety of use cases and environmental conditions.

The federal government should not underestimate the scale, complexity and duration of pilot and testing work necessary for a new type of non-diesel freight rail motive power to be proven with enough certainty to be deployed broadly on the nation's freight rail network. Past

[12] (California Air Resources Board)

efforts to introduce novel freight locomotive technologies to reduce emissions have resulted in failures at significant costs to railroads. Short lines generally do not have the financial resources to take a risk on unproven motive power technologies. Attempting to regulate such a transition without significant technological improvements and financial support is likely to push many short lines out of business.

Question 16

How do you think power needs should be estimated for the rail industry over time? E.g. number of locomotives or switchers?

As in the transition from steam to diesel, where more and more-powerful steam engines were replaced by diesel-electric locomotives of varying horsepower ratings utilized in many different combinations and configurations, ASLRRA expects there will be significant change in how short lines approach powering their train operations. As new technologies are introduced, optimizing how power is utilized will change based on the motive power available and the loads to be transported. Power needs for the railroad industry should be based on the size and quantity of loads forecast to be transported over the rail network, with consideration of how different motive power technologies can be combined to effectively move freight. The rail industry and its federal partners should be prepared to support considerable research into the most efficient means to power trains with locomotives powered via multiple means.

Question 17

What do you think should be the estimated global market size for net-zero emission locomotives or retrofitting technologies?

It is estimated there are approximately 6,000 traditional diesel-electric locomotives in U.S. short line freight service. Repowering and replacement of short line locomotives with cleaner diesel units, over the medium term, could result in a significant reduction of the emissions profile of this fleet, resulting in reductions in greenhouse gas (GHG) emissions and emissions of criteria pollutants. Due to the limited financial resources of the short line industry, this cannot occur without substantial public capital funding support. Short line operators would also benefit from having a clearer understanding of the differential in total cost of ownership (TCO)–including relative fuel efficiency—between their mostly older, lower tier diesel freight locomotives and the latest repowered or new diesel Tier 4 compliant units. Should TCO be found to rise materially, tax incentives offsetting additional operating costs associated with transitioning are a tool that could incentivize participation by short lines in capital grant programs to carry out replacements and repowers. Matching funding requirements for capital grants should recognize the unique situation of extremely low short line historical locomotive fleet capital cost basis and attempt to fully cover the order of magnitude differential in costs between old, used and new, lower-emitting diesel motive power.

Submitting and Points of Contact

Respectfully submitted,

Jo Strang
Senior Vice President, Safety, Regulatory & Environmental Policy
American Short Line and Regional Railroad Association
50 F Street NW Suite 500
Washington, DC 20001
jstrang@aslrra.org

February 12, 2024

Bibliography

ASLRRA. "Estimate of State of Good Repair Backlog for Class II and III Freight Railroads (Short Lines)." 25 June 2021: 4. Document.

Austen, Ian. "Hybrid Locomotive Maker Loses Steam." *The New York Times* 5 February 2009. Newspaper. 2024. <https://archive.nytimes.com/green.blogs.nytimes.com/2009/02/05/hybrid-locomotive-maker-loses-steam/>.

California Air Resources Board. "Zero Emission Rail Project Dashboard." n.d. 6 February 2024. <https://ww2.arb.ca.gov/applications/zero-emission-rail-project-dashboard?utm_medium=email&utm_source=govdelivery>.

Clean Fuels Alliance America. "States with Notable Biodiesel Policies." 2023. Document.

Eastern Research Group, Inc. *2020 National Emissions Inventory Locomotive Methodology*. Public Report. Washington, D.C.: U.S. Environmental Protection Agency, 2020. Document.

Federal Railroad Administration. "49 CFR Part 232. Notice of Proposed Rulemaking, Amendments to Brake System Safety Standards Governing Operations Using an Electronic Air Brak Slip System." *Federal Register* 15 January 2021: 3957. Periodical. 8 February 2024. <https://www.federalregister.gov/documents/2021/01/15/2020-28870/amendments-to-brake-system-safety-standards-governing-operations-using-an-electronic-air-brake-slip>.

—. "49 CFR Parts 218, 221, and 232. Final Rule, Miscellaneous Amendments to Brake System Safety Standards and Codification of Waivers." *Federal Register* 11 December 2020: 80544. 8 February 2024. <https://www.federalregister.gov/documents/2020/12/11/2020-25817/miscellaneous-amendments-to-brake-system-safety-standards-and-codification-of-waivers>.

International Energy Agency. *Energy demand from rail in selected regions and by technology in a base scenario*. n.d. 8 February 2024. <https://www.iea.org/data-and-statistics/charts/energy-demand-from-rail-in-selected-regions-and-by-technology-in-a-base-scenario>.

Stagl, Jeff. "Wyoming short line gains first-ever federal grant to climb aboard the sustainability train." *Progressive Railroading RailPrime* 12 October 2023. Periodical.

<https://www.progressiverailroading.com/RailPrime/Details/Wyoming-short-line-gains-first-ever-federal-grant-to-climb-aboard-the-sustainability-train--70390>.

U.S. DOT Federal Highway Administration. *Technology Readiness Level Guidebook*. Report. Washington, DC: FHWA, 2017. Document. 8 February 2024. <https://www.fhwa.dot.gov/publications/research/ear/17047/index.cfm>.

U.S. EPA. *Title 40 Code of Federal Regulations Part 1033-Control of Emissions from Locomotives*. Washiington, D.C.: U.S. EPA, n.d. 8 February 2024. <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-U/part-1033?toc=1>.