MSTRS Locomotive Working Group Briefing

December 13, 2024

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Lori Clark, North Central Texas Council of Governments

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Goal and Charge Questions

Goal: To inform the EPA on the potential of locomotive technologies related to emissions reduction.

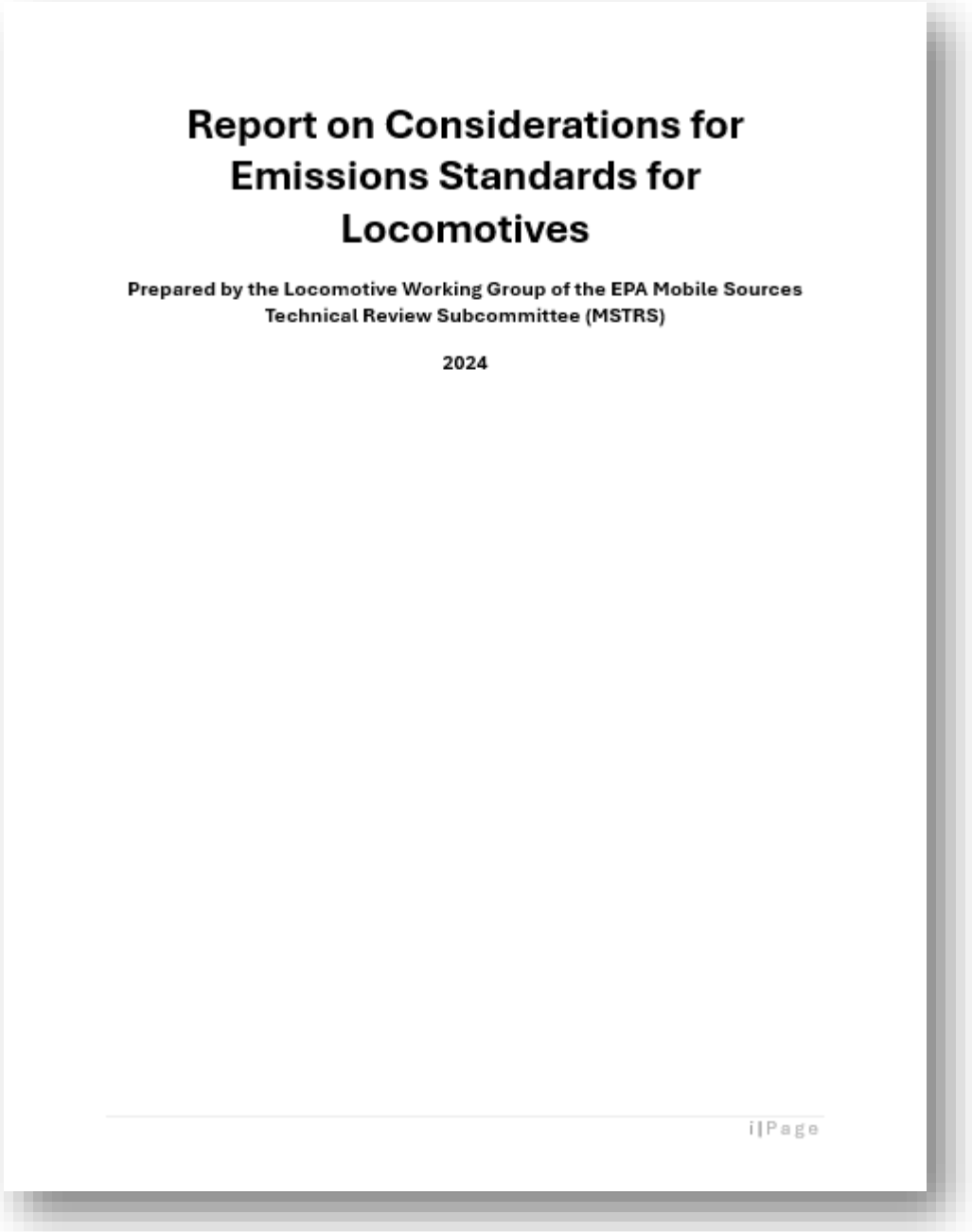
Charge Questions:

- What factors should the EPA consider when developing emission standards for existing locomotives when they are remanufactured?

- What technologies should the EPA consider in setting the next set of emissions standards for newly manufactured locomotives?

Report Background

- In response to petitions received from California air agencies regarding locomotive emissions, EPA committed to several actions:
  - Preemption Rule, completed in 2023
  - Establish an internal Rail Study Team (Advance Rail Team)
  - Task MSTRS to research locomotive issues
- Kickoff Meeting October 3, 2023
- Diverse Representation (extends beyond MSTRS members)
  - Manufacturers
  - Railroads
  - Environmental Groups
  - Consultants
  - Approximately 20-30 members (some rotated in or out)
- Meetings of individual chapter subgroups throughout
- Workgroup Draft Final Report to MSTRS completed November 12, 2024
- Final Workgroup Chairs: Lori Clark (North Central Texas Council of Governments), Matthew Payne (USEPA)


Report on Considerations for Emissions Standards for Locomotives

Prepared by the Locomotive Working Group of the EPA Mobile Sources Technical Review Subcommittee (MSTRS)

2024

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Current Report Structure

Section I: Executive Summary

Section II: Glossary

Section III: Illustration of Regulatory Terms Applicable to Locomotives

Section IV: Introduction

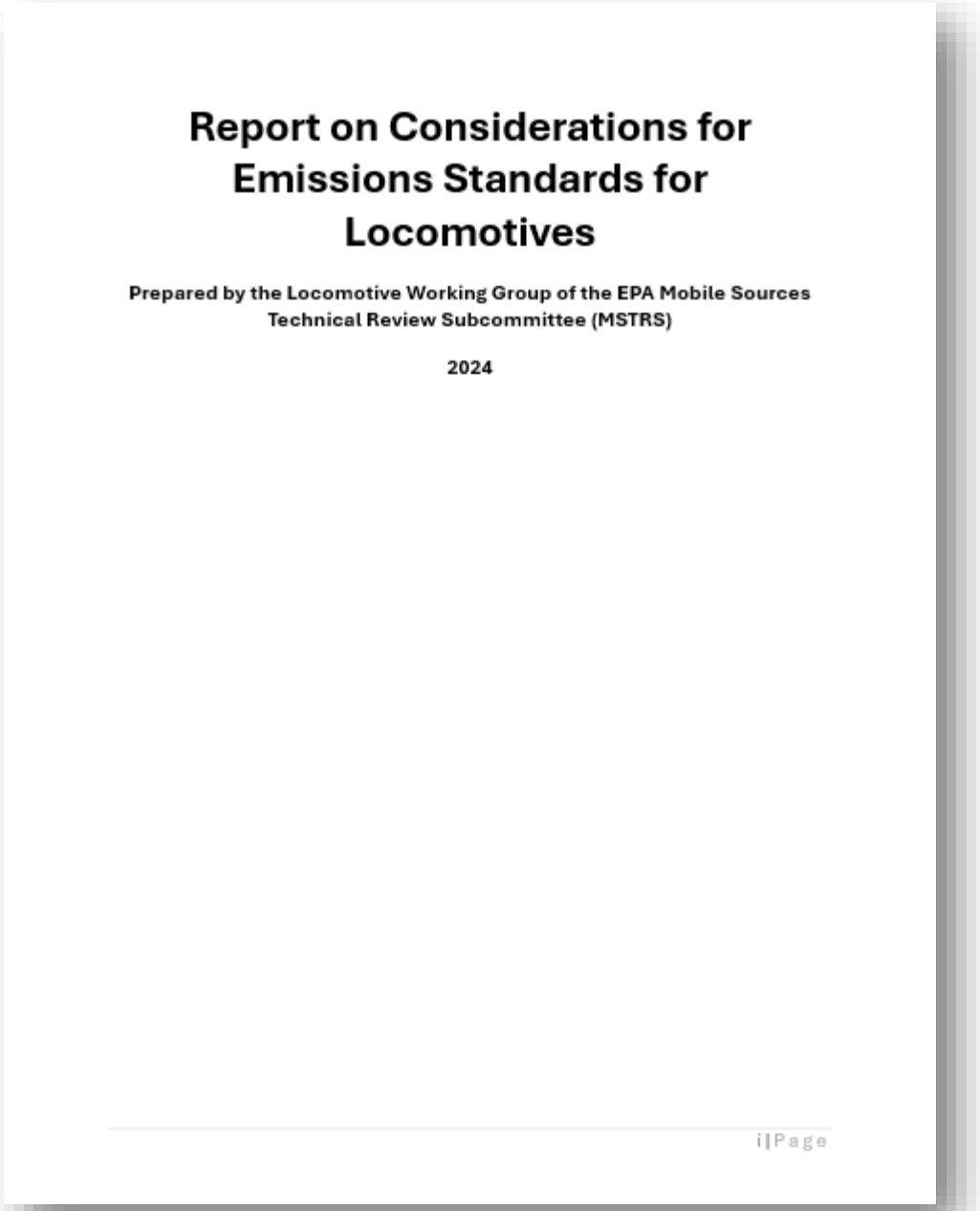
Section V: Environmental Justice

Section VI: Introduction to Railroad Operations

Section VII: Locomotive Technology

Section VIII: Monitoring, Enforcement, Compliance

144 pages total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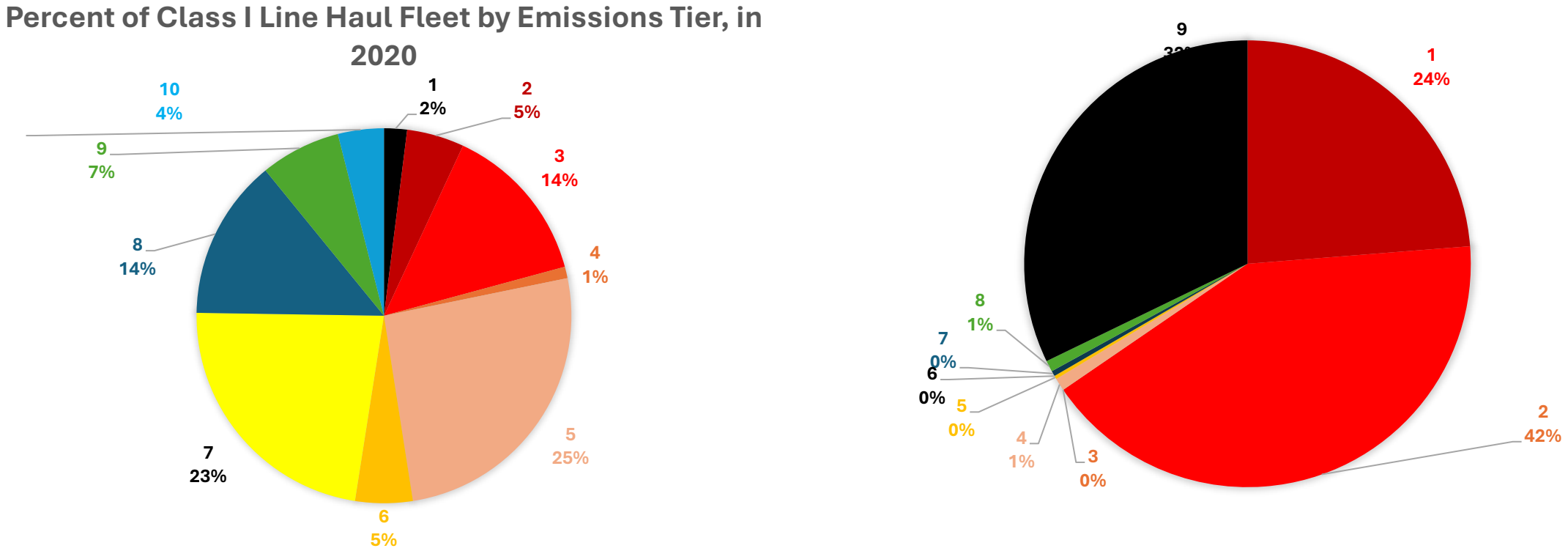
State of the Industry



Source: Tables 4 and 21, ERG. 2020 National Emissions Inventory Locomotive Methodology; https://www.epa.gov/system/files/documents/2023-01/2020_NEI_Rail_062722.pdf

Key Takeaways on the State of the Industry:

- Older technology is lingering much longer than expected when Tier 4 standards were adopted, particularly in the switcher space
- 98% of yard engines are Tier 0+ or higher emissions rates
- Yard engines are particularly impactful on adjacent communities due to concentration of locomotive activity and emissions, creating emissions ‘hotspots’

Additional Key Takeaways from Report

- Railroads are critically important to U.S. prosperity due to their significant role in delivering essential goods, and a prosperous and efficient rail industry is important. Investment in newer technology can deliver more efficient operations to the rail industry while also reducing criteria pollutants.

- A variety of emissions-reducing strategies are available and should be considered. These include not only ‘traditional’ emissions-reduction technologies focused on exhaust emissions from a specific engine but also options that can reduce emissions from overall locomotive operations even if the engine itself stays the same.

- EPA should review and redefine regulatory terms impacting locomotives that have created a complicated regulatory environment relative to emissions requirements. EPA should consider how best to reflect availability of the latest available emissions-reducing technologies in the regulatory language (e.g. regulatory language around ‘engines’ can inadvertently be interpreted to exclude zero-emissions electric motors).

- EPA should set stricter emissions standards for newly manufactured, remanufactured, and existing locomotives that are being modified through various processes, prioritizing improvements for communities most heavily impacted by current emissions.

Section I: Executive Summary

A: Recaps MSTRS Charge Questions:

1. What factors should the EPA consider when developing emissions standards for existing locomotives when they are remanufactured?
2. What technologies should the EPA consider in setting the next set of emissions standards for newly manufactured locomotives?

Flags that the term "remanufactured" presents complications and sets initial recommendation that EPA (1) evaluate opportunities to redefine and clarify these terms and (2) apply recommendations from this report broadly.

B-E: Summarize Key Takeaways of other Chapters

Section II – Glossary

Brief list of key terms that are important for understanding content and recommendations of the report

Does NOT include terms defined in 40 CFR 1033

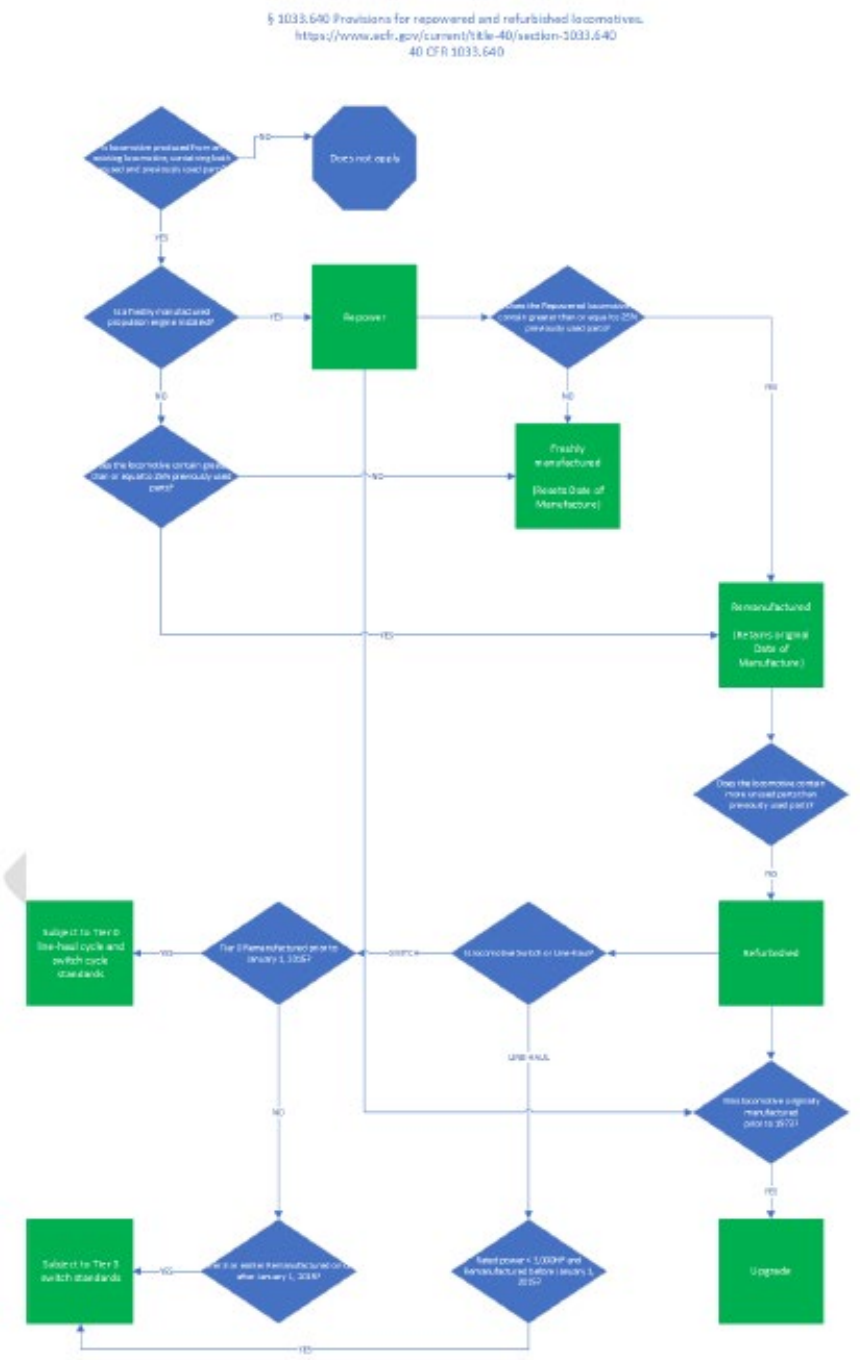
Section III – Illustration of Regulatory Terms Applicable to Locomotives

The term “remanufactured” is used in the EPA charge question, but that term has implications that extend to other regulated locomotive processes

Relationships between terminologies illustrated in graphic

green: regulatory terms

blue: decision steps



The group recommends EPA:

- Revisit the regulatory definitions and terminology
- Apply other recommendations broadly

Section IV: Introduction

Working Group Charge Questions:

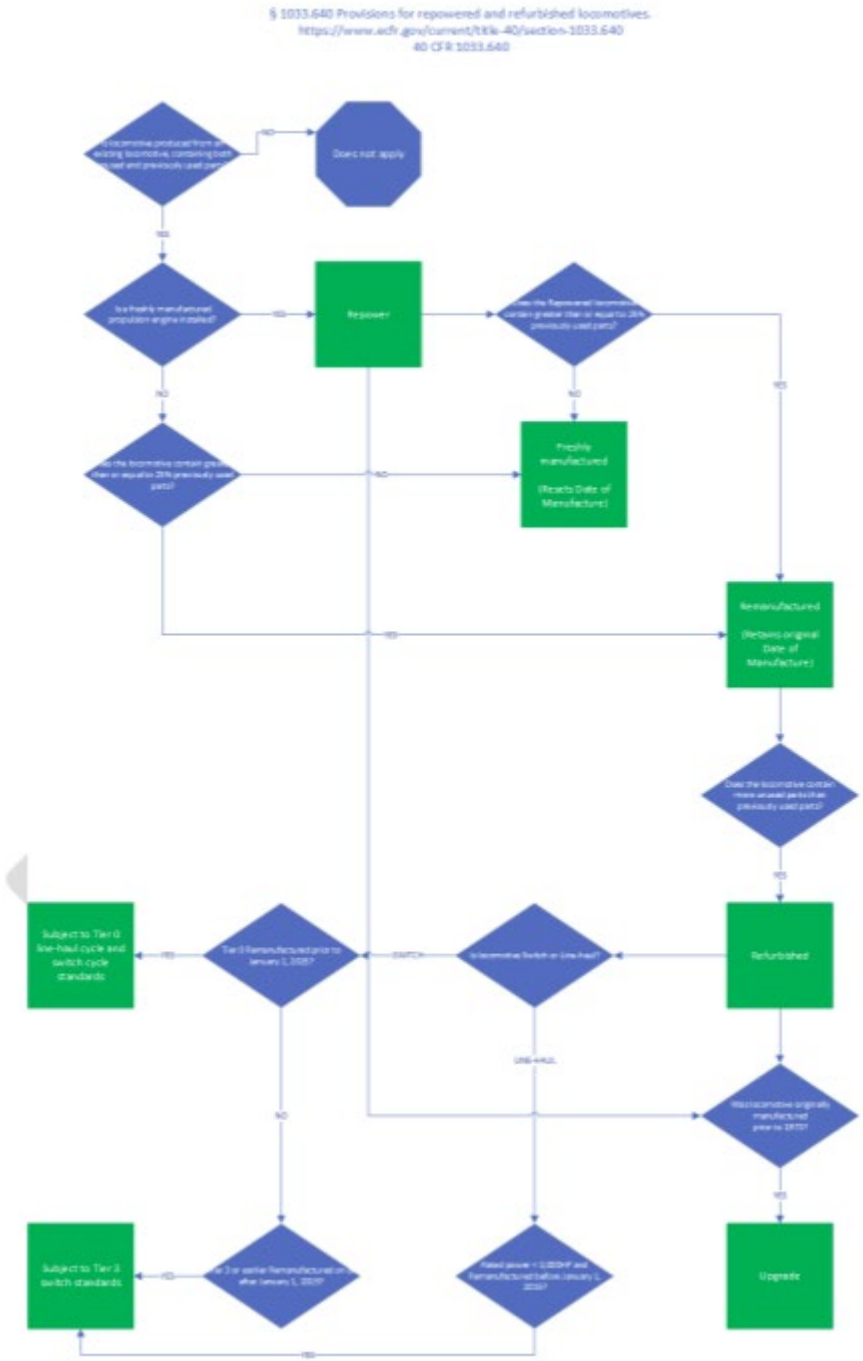
1. What factors should the EPA consider when developing emission standards for existing locomotives when they are remanufactured?
2. What technologies should the EPA consider in setting the next set of emissions standards for newly manufactured locomotives?

Background and Notes:

•Application of the terms “Freshly manufacture,” “Repower,” “Remanufacture,” and “Refurbish” is challenging, even only in the context of the CFR not to mention casual or industry usage.

- •See flow chart – intentionally illegible

•2022 CARB request to address NOx & PM from locomotives



Section V: Understanding the Extent and Impacts of Rail and Locomotives

Environmental Justice:

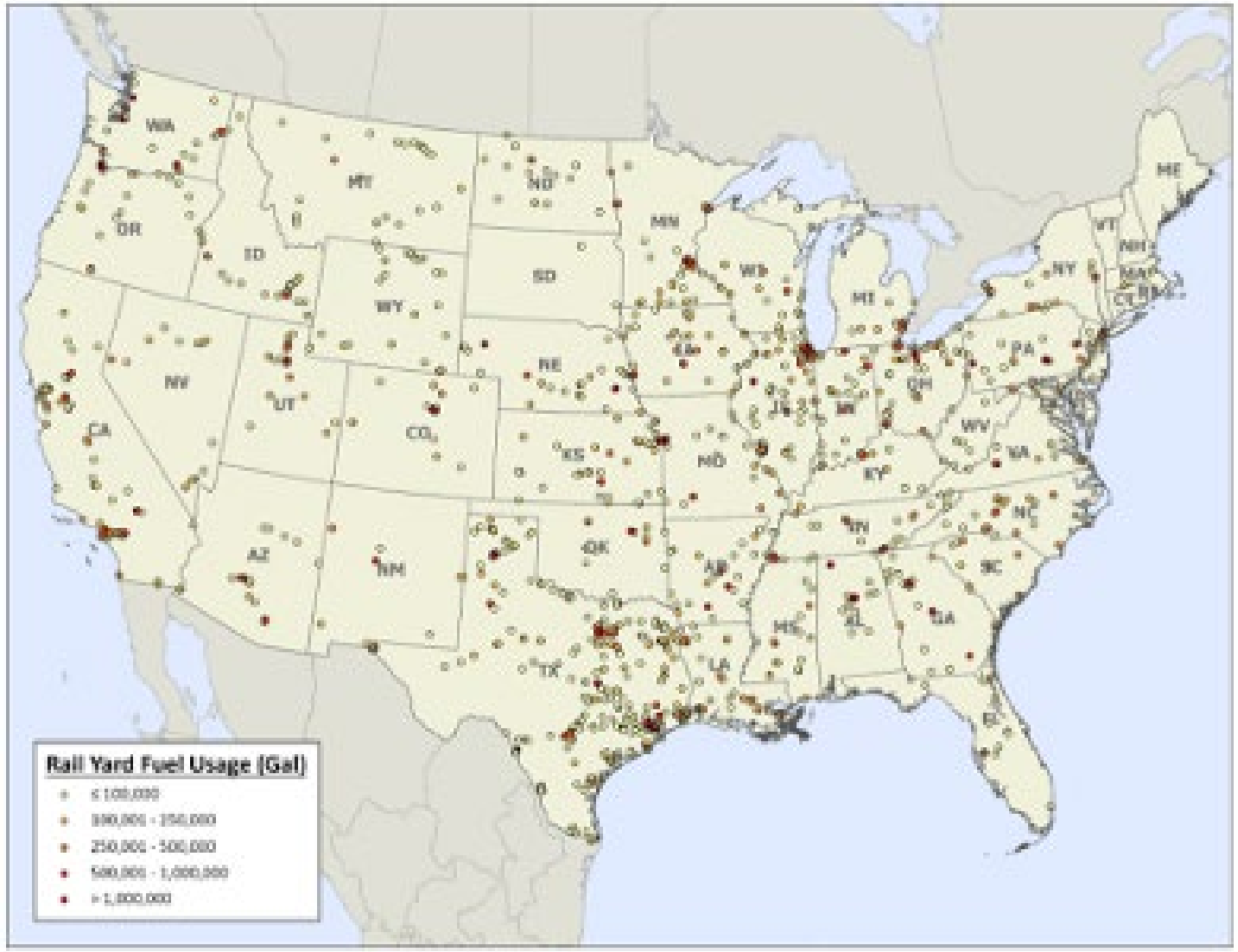
1. Global freight transportation relies on a myriad of trucks, trains, and ships traversing EJ communities to move goods across the country.
2. Generating significant localized pollution in environmental justice communities and impacts frontline workers while exacerbating the climate crisis across the country.
3. Rail pollution impacts the health, safety, and well-being of communities. The impacts of this crisis are being felt across the country.
    a. Class I railyards are located in almost every single state,

4. More than 13 million people in the United States live and work near railyards, rail lines, and ports.

5. People of color make up 41% of the overall population of the U.S., they make up 54% of the nearly 120 million people living in counties with at least one failing air quality grade.

6. Low-income neighborhoods and communities of color breathe an average of 28% more NOx pollution than higher-income and majority white and wealthier neighborhoods-

Rail Pollution: a National Issue with Localized Impacts



Air Pollution Emissions: Rail and Locomotives

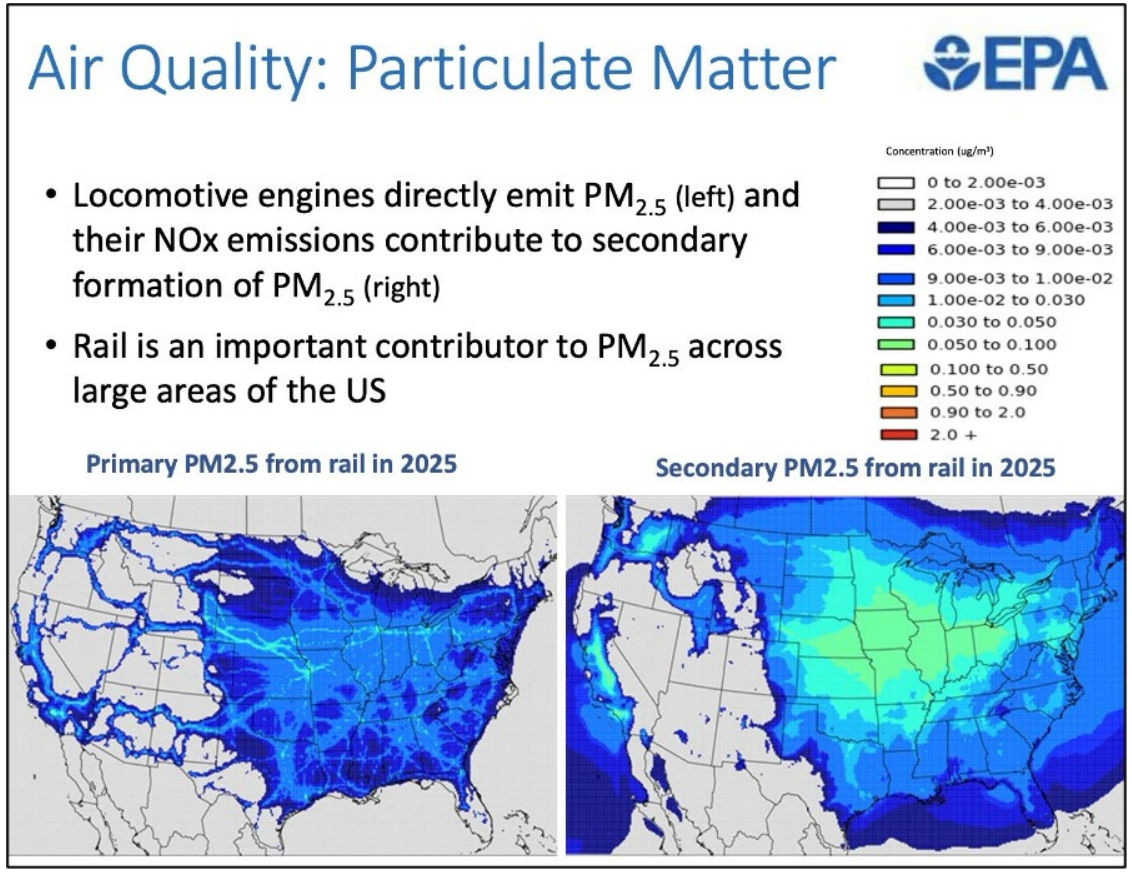
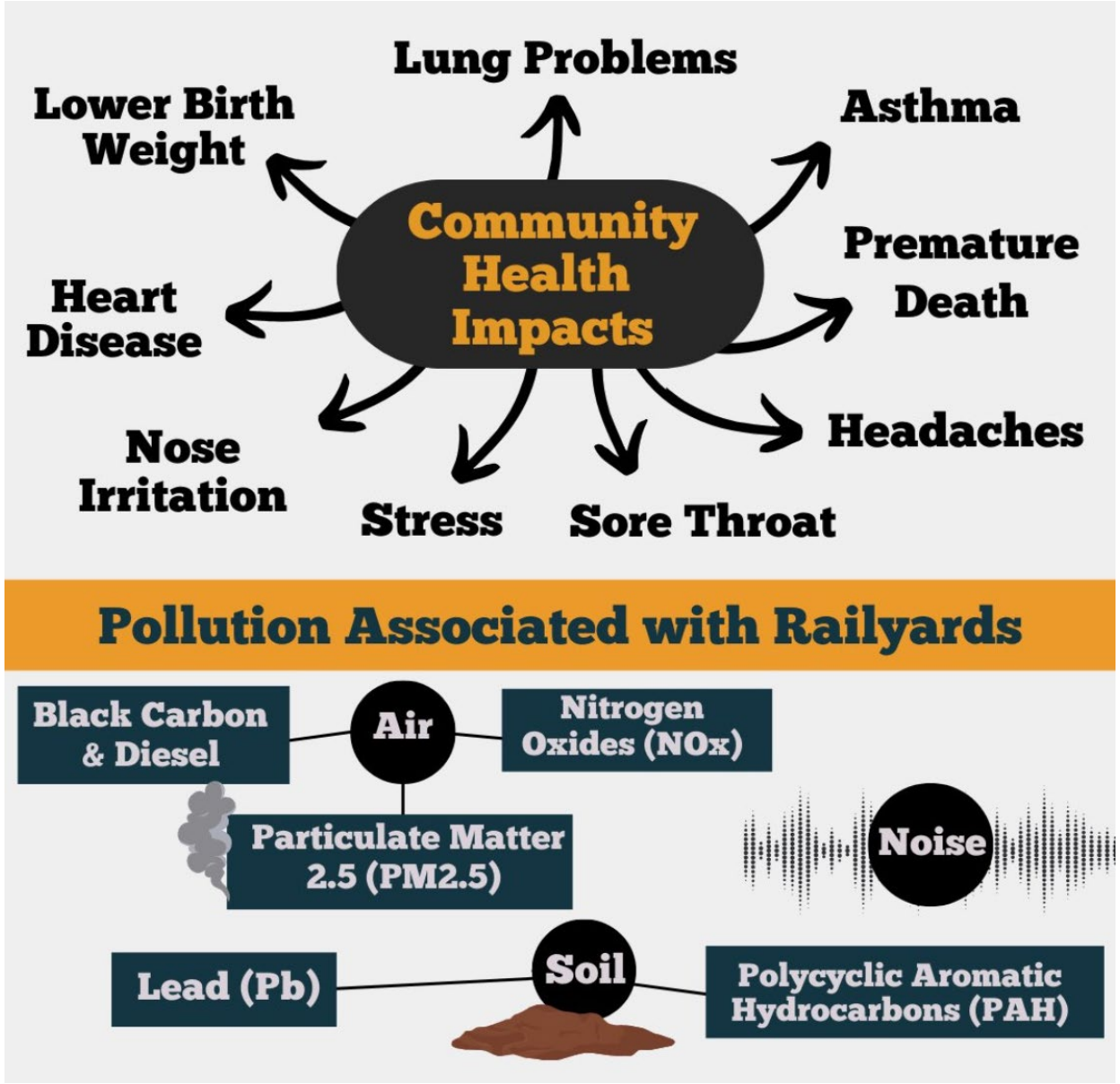


Table 5: 2020 Line-haul Locomotive Emission Factors by Tier, AAR Fleet Mix (g/gal)

Tier	Tier Name	CH4	CO	CO2	N2O	NH3	NOX	PM10	PM25	SO2	VOC
0	1973-2001	0.8	26.624	10,150	0.26	0.0833	**178.88**	6.656	6.45632	0.0939	10.513152
0+	Tier 0 Rebuild	0.8	26.624	10,150	0.26	0.0833	149.76	4.16	4.0352	0.0939	6.57072
1	2002-2004	0.8	26.624	10,150	0.26	0.0833	139.36	6.656	6.45632	0.0939	10.294128
1+	Tier 1 Rebuild	0.8	26.624	10,150	0.26	0.0833	139.36	4.16	4.0352	0.0939	6.351696
2	2005-2011	0.8	26.624	10,150	0.26	0.0833	102.96	3.744	3.63168	0.0939	5.694624
2+	Tier 2 Rebuild	0.8	26.624	10,150	0.26	0.0833	102.96	1.664	1.61408	0.0939	2.847312
3	2012-2014	0.8	26.624	10,150	0.26	0.0833	102.96	1.664	1.61408	0.0939	2.847312
4	2015 and later	0.8	26.624	10,150	0.26	0.0833	**20.8**	0.312	0.30264	0.0939	0.876096
4C	Tier 3 Built after 2014	0.8	26.624	10,150	0.26	0.0833	102.96	1.664	1.61408	0.0939	2.847312
NC	UNCONTROLLED Pre-1973	0.8	26.624	10,150	0.26	0.0833	270.4	6.656	6.45632	0.0939	10.513152
N/A	2020 Class I Line Haul Fleet-Weighted	0.8	26.624	10,150	0.26	0.0833	120.5	3.042	2.95076	0.0939	4.854434

Public Health and Cumulative Impacts from Rail and Locomotives

- Railyard pollution, remains exceptionally harmful to the health of people who live and work near these facilities.
- Diesel exhaust contains carcinogens and toxic air pollutants that significantly affect the health of communities living closest to freight operations.
- Exposure to pollution from diesel-powered vehicles has also been linked to low birth rate, premature birth, lower IQ, diabetes, stroke, congestive heart failure, heart disease, obesity, asthma, and allergies.
- Cancer clusters in neighborhoods near railyards show the undeniable link between diesel emissions from locomotives and other railyard equipment and adverse health harms
- **Cumulative Impacts:**
  - Idling
  - Bright Lights
  - Noise
  - Vibrations



Source for Infographic is from Environmental Research Lab, University of Southern California 2024

Section VI: Introduction to Railroad Operations

- **Locomotive Evolution:** Railroads have transitioned from steam to diesel-electric locomotives, significantly improving efficiency and reducing emissions. Locomotive improvements continue to be an evolutionary process.
- **Rail Network:** The North American rail network is extensive, consisting of approximately 140,000 route miles of track.
- **Locomotive Types:** Locomotives are primarily classified as line-haul and switcher units, each serving specific functions within the rail network.
- **Operations:** Railroad operations involve complex coordination of locomotives, trains, and infrastructure, including fueling, maintenance, and safety measures.

Operations Recommendations

- **Investigate Real-World Duty Cycles:** Study actual locomotive operations to better understand their emissions profiles and develop more accurate test cycles.
- **Consider Locomotive Overhaul Criteria:** Evaluate the factors that trigger the application of emission standards when locomotives are overhauled or rebuilt.
- **Address Locomotive Idling:** Explore the causes of idling and potential mitigation strategies to reduce emissions.
- **Engage with Railroads and Rail Workers:** Gather insights into railroad operating practices and their impact on locomotive duty cycles and emissions.

Operations Chapter Significant Topics

- US railroad historical development
- Railroad classifications & US network
- Interoperability
- Modern Diesel Electric Locomotives
  - Linehaul vs Switcher
  - Operating considerations – performance, fueling, maintenance, tier levels, & idling
- Railyard operations
- Assembly & Movement of freight trains
- Passenger & Commuter Operations

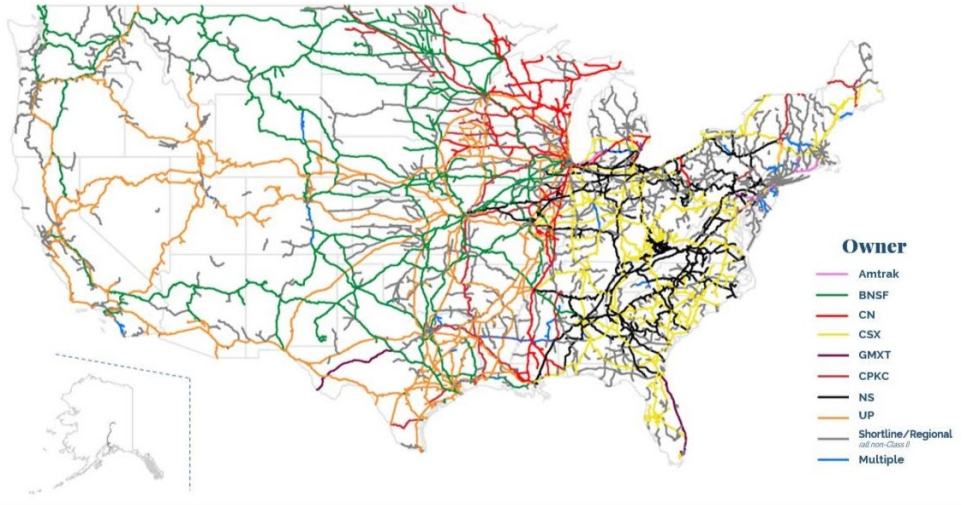


Figure 7: The North American rail network. Source: AAR (map is based on the U.S. DOT National Transportation Atlas Database, July 2020 revision).

Section VII: Locomotive Technology

Locomotive Technology Chapter Structure

- Recommendations
- Things to Consider
- Overview of Technologies
  - Electrification
  - Battery Electric
  - Hybrid (Diesel and Battery)
  - Diesel @ T4 emissions
  - Energy Management Systems (EMS)
  - Idle Reduction
  - Diesel Aftertreatment
  - Alternative Fuels
    - Hydrogen
    - Methanol and Ethanol
    - Ammonia

Recommendations

- 7 recommendations are documented, where the group is not alignment it is noted.
- Recommendations do not provide specific solutions, rather recommends approaches to implement during rulemaking as to not hinder technology adoption and produce the maximum reduction on the best timeline.

Things to Consider

- 13 things to consider are documented
- Topics covered in things to consider
  - Aligning tech to application and emission/health impact
  - Relationship between technology and infrastructure
  - Adoption challenges with new tech – needs time

Overview of Technologies

- 8 technology categories are discussed
- For each technology the following topics are discussed
  - Explanation of technology
  - Current state
  - Emissions reduction potential
  - Implementation potential

Monitoring, Enforcement, Compliance Chapter Significant Topics

- Actions by Federal Agencies
- Idling
- Labeling Requirements and e-labels
- On-Board Diagnostics (OBD) and On-Board Monitoring (OBM)
- Data and Reporting Systems
- Monitoring Emissions in Frontline Communities
- Funding

Section VIII: Monitoring, Enforcement, Compliance

Key Areas of Recommendations:

Clear Standards: Revising EPA regulations to provide clear, effective, enforceable definitions for when a locomotive must meet a lower-emitting or ZE standard

Incentives and Disincentives: increasing financial incentives and decreasing disincentives for railroads to invest in lower-emitting and ZE technologies, prioritizing yard locomotives in frontline communities

Data Collection and Reporting: Putting into place data collection and reporting systems that support fulfillment of lower-emitting and ZE standards for locomotives

Collaboration: Collaborating is required among EPA, Department of Transportation (DOT) agencies, DOE, and the private sector – including railroads, manufacturers, and utilities -- to achieve faster emissions reduction progress

Examples of Considerations

Costs: Lower-emitting or ZE units that yield lower public health costs in frontline communities or lower cost of delay from HAZMAT rail incidents may increase other railroad costs.

Data: Balancing the need for detailed emissions data with protecting locomotive manufacturers' proprietary information.

Infrastructure: Limited availability of facilities for in-use locomotive emissions testing.

Technological Innovation: Technological applications for collecting and reporting locomotive emissions data are not broadly applied.

Additional Revisions Since Final Draft Distribution – See Handout

Non-Substantive Revisions – Provided for Transparency

- Updates needed to Table of Contents
- Executive Summary: updated pie charts' color schemes
- Page 7: revision to Section E Heading
- Page 14: remove redundant Section B
- Page 18: revision to restore intended original language that was lost during revisions
- Pages 51-52: delete duplicative pie chart from page 51; update pie charts' color scheme on page 52 to match Executive Summary
- Page 67: formatting issues, subheading "A" should be
- Page 74: remove NYC from the list of cities operating electrified third-rail systems as their system is not fully electric
- Page 86: revision to replace "repowering" with "conversion" in reference to alternative fuels
- Page 129: add missing word "that" to item 5

Additional Revisions Since Final Draft Distribution – See Handout

Substantive Revisions Recommended for MSTRS Discussion by Chapter Leads

- Executive Summary: Add new overarching “key takeaways” in advance of chapter-specific breakdown, and rewrite chapter summaries, to reflect this slide deck.
- Streamline references to Executive Orders rather than the Biden-Harris Administration specifically?

Options for MSTRS Action Today

Option 1:

Vote to Accept the Report As-Is with Only Non-Substantive Revisions as Detailed in Handout

Option 2:

Vote to Accept the Report Pending Updates with both Substantive and Non-Substantive Revisions

Option 3:

Send Report Back to Working Group for Revisions and Consider a Revised Draft at Subsequent Meeting