

EPA Regulatory Overview: Locomotives

MSTRS Spring Meeting

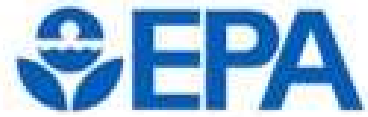
Lauren Steele

Office of Transportation and Air Quality

May 11, 2023



Outline



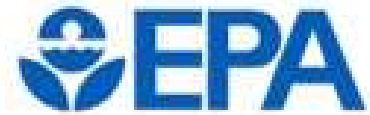
- Key takeaways
- Air quality concerns
- Nature of industry & fleet
- Current regulations



Key Takeaways

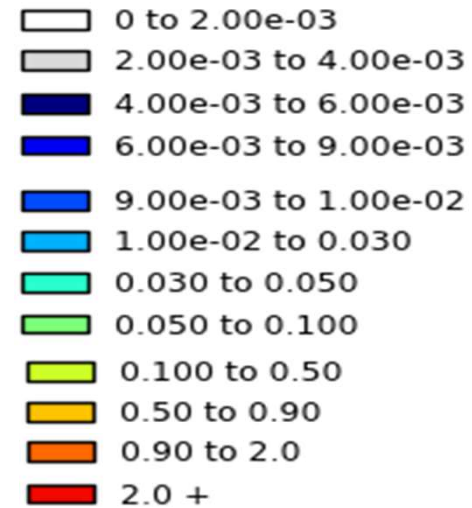
- Rail activity contributes to local, regional, and global pollution (PM_{2.5}, diesel PM, Ozone, GHGs)
- EPA's regulations are structured to deliver health benefits as new equipment is purchased to replace old equipment
- Locomotives are long-lived, high-capital equipment
 - Owners & operators are spending millions to maintain old locomotives
 - Pre-2008 fleet turnover trend (about 4% per yr) has slowed to less than 0.5% per year
- We need to improve our understanding of this sector so any future regulations can be designed to deliver real benefits for communities

Air Quality: Particulate Matter

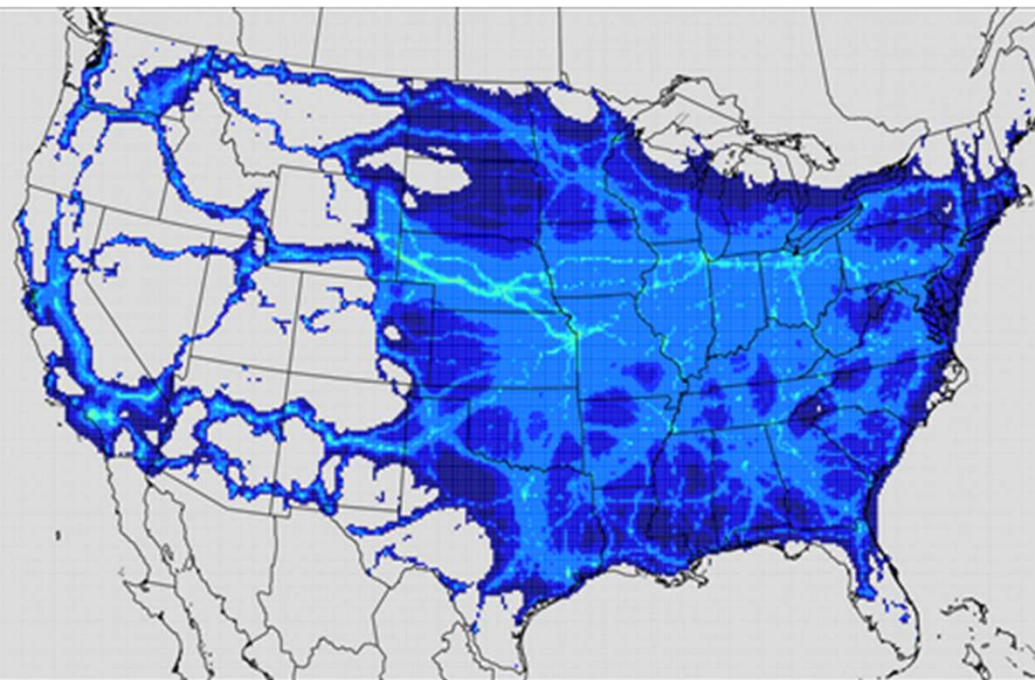


- Locomotive engines directly emit $PM_{2.5}$ (left) and their NO_x emissions contribute to secondary formation of $PM_{2.5}$ (right)
- Rail is an important contributor to $PM_{2.5}$ across large areas of the US

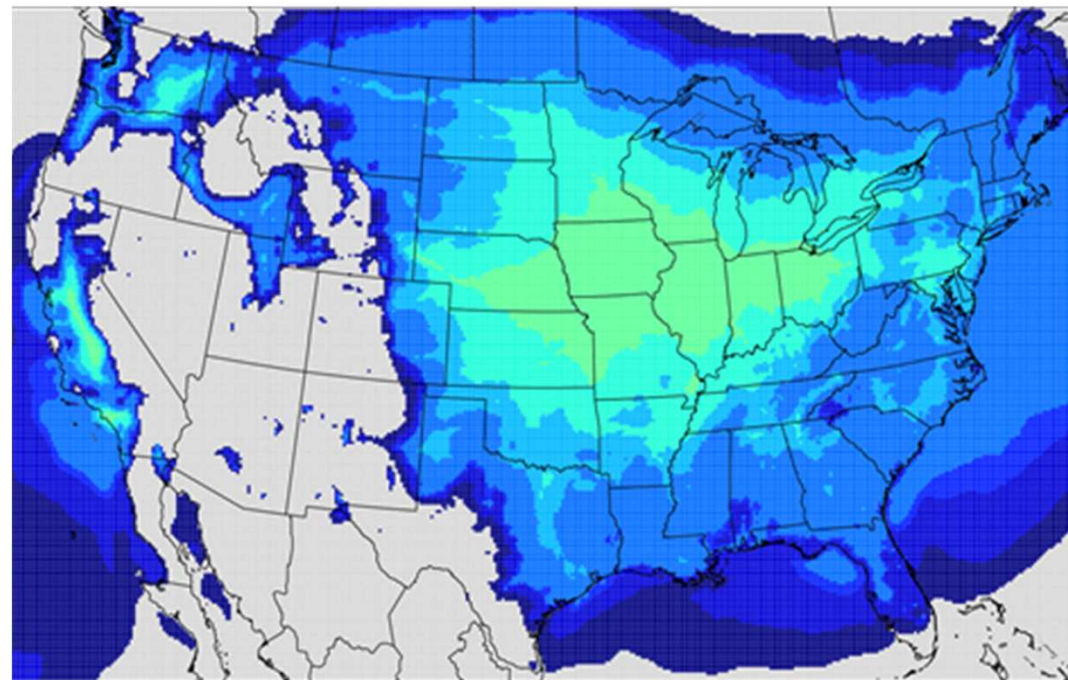
Concentration ($\mu g/m^3$)



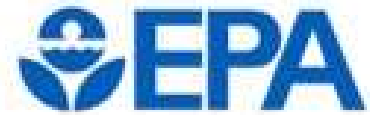
Primary $PM_{2.5}$ from rail in 2025



Secondary $PM_{2.5}$ from rail in 2025

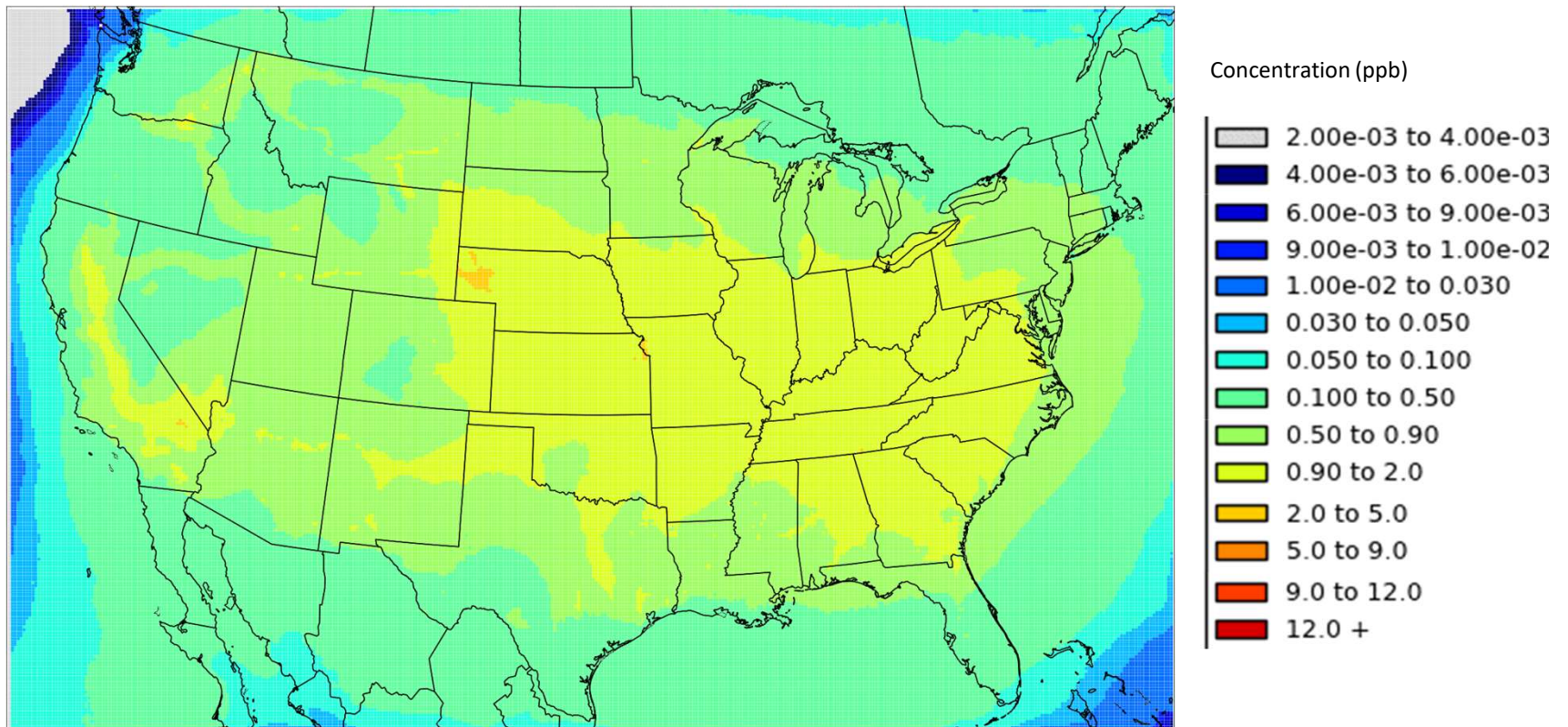


Air Quality: Ozone

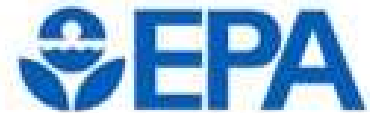


- Both NO_x emissions and volatile organic compounds contribute to ozone pollution.
- Locomotive engines are important contributors to ozone across a large area of the country, most significantly from NO_x

Rail Sector Contribution to Ozone (ppb) in 2025



Locomotive Types



Line-Haul



Switcher

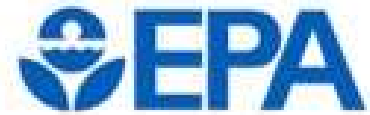


Passenger

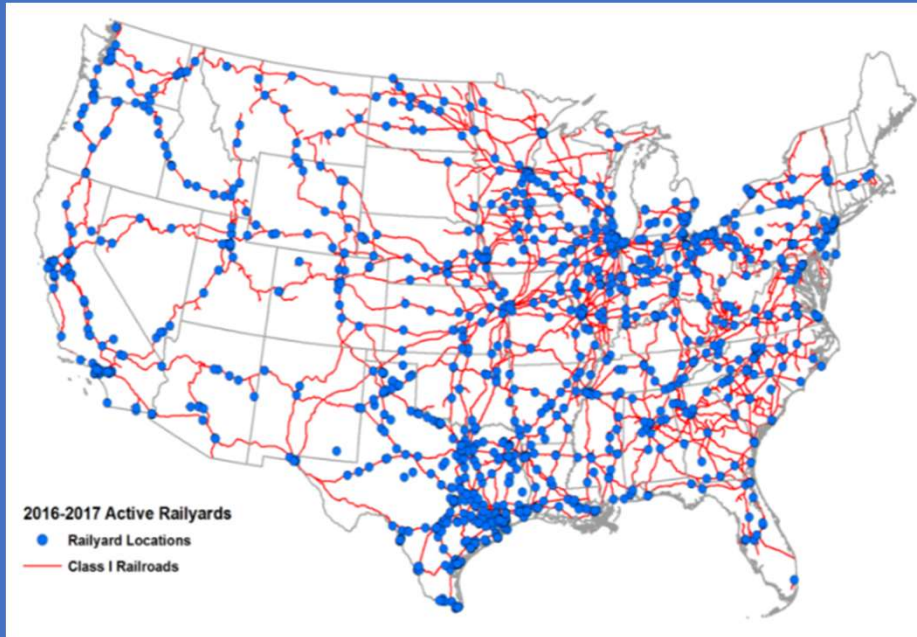


	Line-Haul	Switcher	Passenger
Power	High	Low	High
Power System	Diesel Electric	Diesel Electric	All Electric or Diesel Electric
Operation	Moving heavy freight	Moving railcars in and around railyards	Moving passengers (higher speed/lighter load)
Typical Range	Nationwide (Class I Railroads) Local (Class II/III Railroads)	Railyards Local	Nationwide Local
Fuel Burn Contribution	90% (86% Class I, 4% Class II/III)	6%	4%

Railroad Types



Class I Railroads

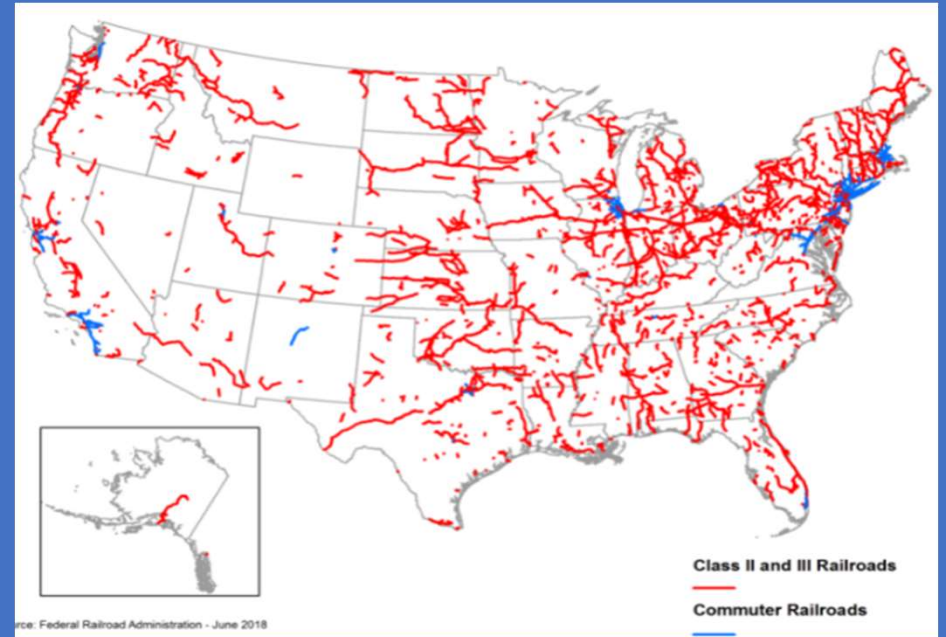


Large Companies

Largely National Freight

6 Railroads*

Class II/III Railroads



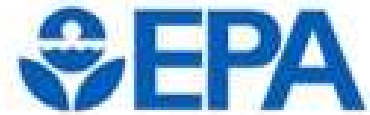
Small Businesses

Largely Short-Line or Regional

Hundreds of Railroads

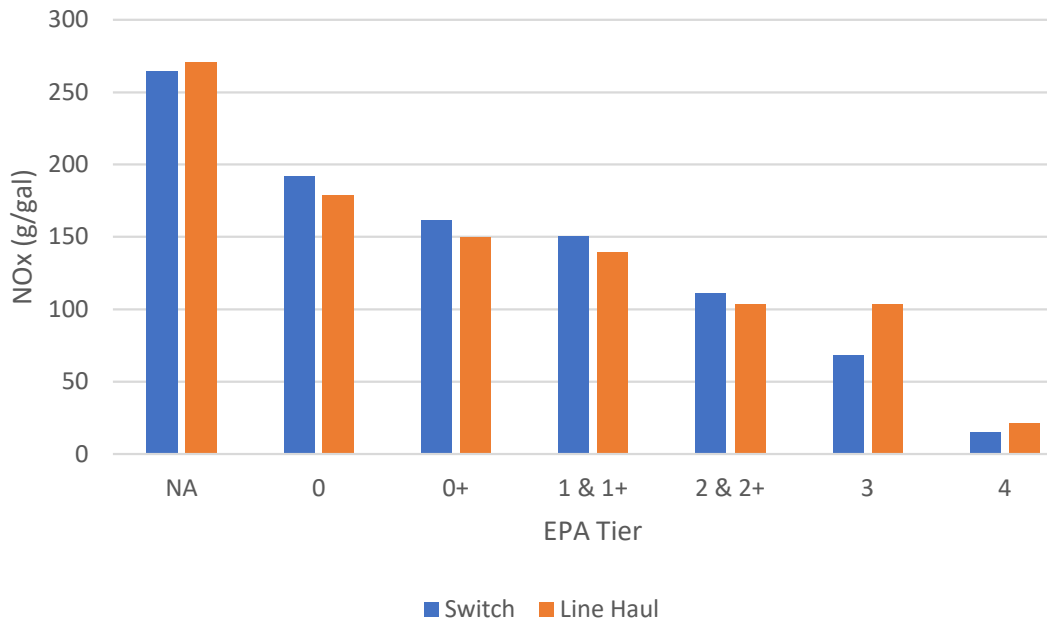
*Burlington Northern and Sante Fe (BNSF), CSX, Canadian National, Canadian Pacific Kansas City (CPKC), Norfolk Southern, and the Union Pacific Railroad

Existing Locomotive Fleet



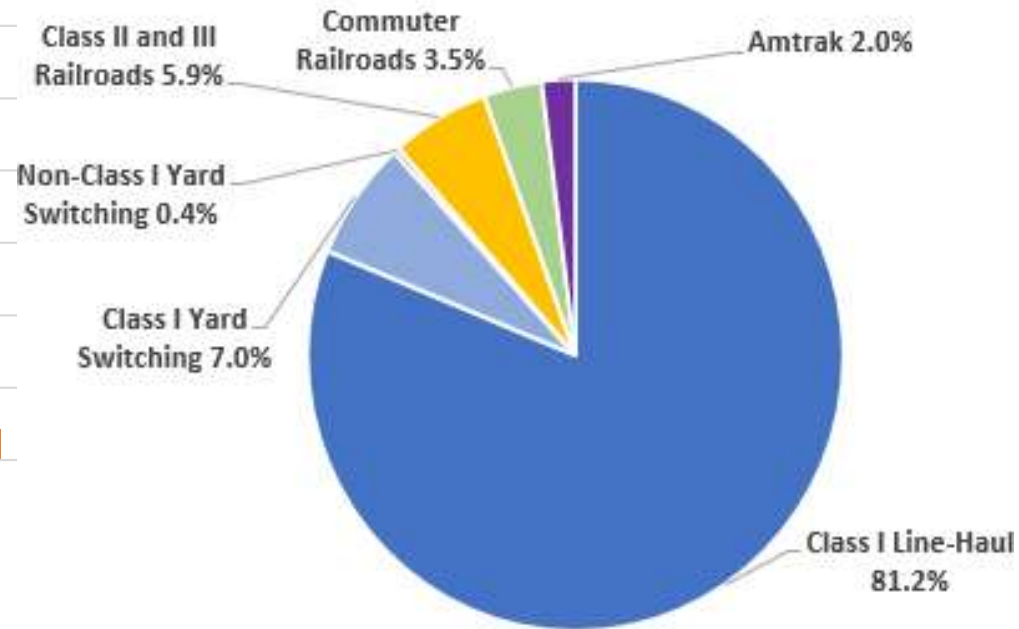
- Uncontrolled (Pre-Tier 0) locomotives are estimated to emit about 40% to 50% more NO_x than Tier 0 locomotives
- Line Haul emissions from Class I Railroads comprise the vast majority of annual NO_x emissions

NO_x grams/gal by Locomotive Type



Emission Factors for Locomotives

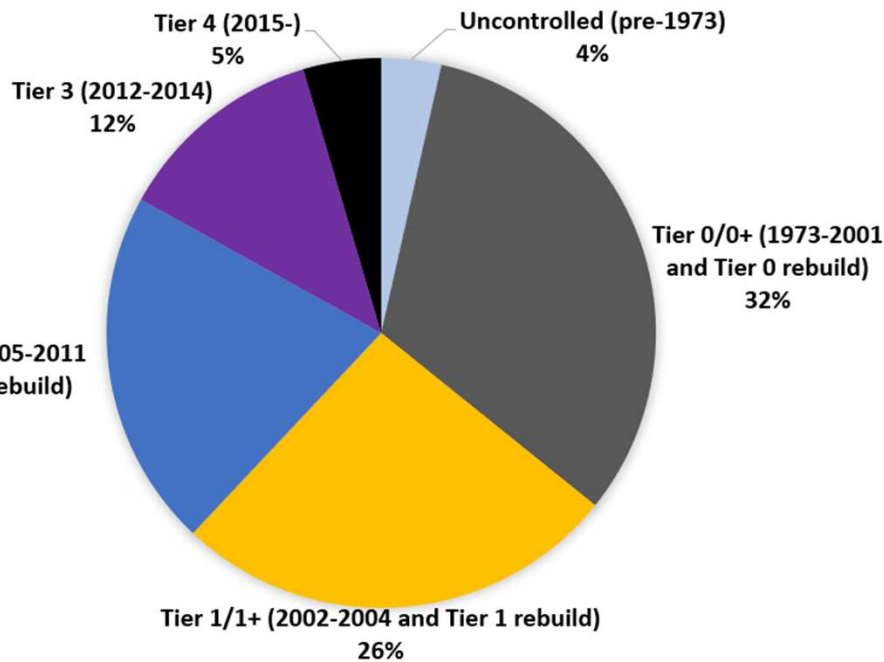
Percent of Annual NO_x by Railroad Type



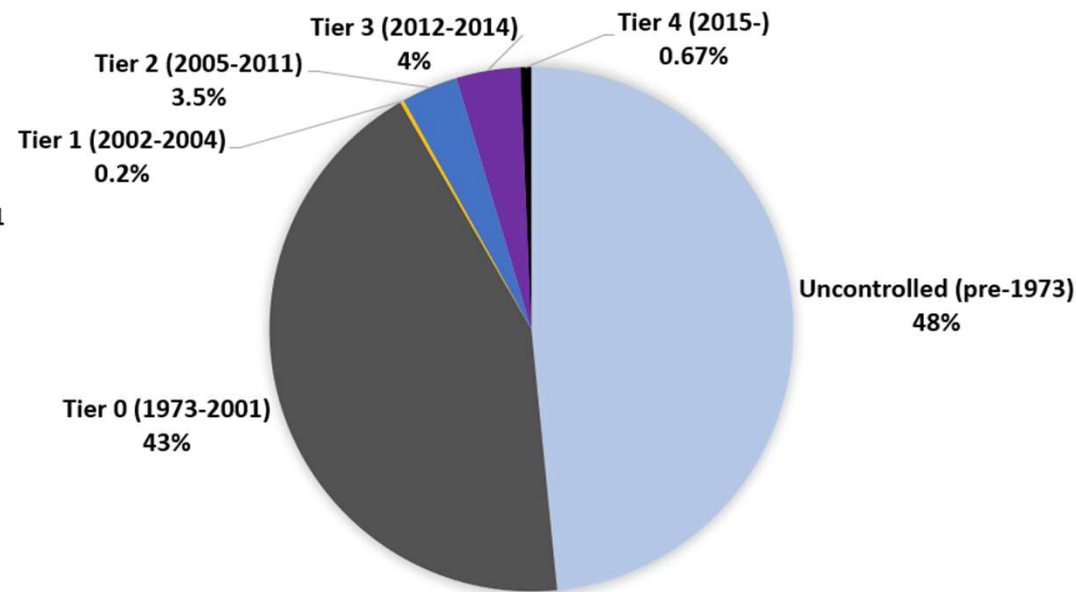
EPA Emission Inventory Estimates

Existing Locomotive Fleet, cont'd.

- There are three manufacturers of fresh-new Tier 4 locomotive engines
 - Progress Rail (owned by Caterpillar), Wabtec (formerly GE), and Cummins
 - There are many manufacturers/suppliers of engine repair and rebuild components
- Pre-Tier 3 engines make up a sizeable portion of the existing fleet
 - Tier 4 locomotives make up a very small portion of today's fleet
 - 91% of locomotives used by Class II and III Railroads are Tier 0 or uncontrolled



Class I Line-Haul Fleet Mix for 2017



Class II and III Fleet Mix for 2016

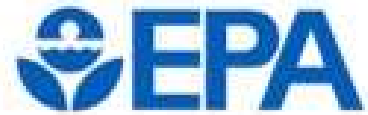
Class 1 Railroad Fleet Trend



Demand for freshly built locomotives has fluctuated considerably over the past 30 years



Current Locomotive Engine Standards



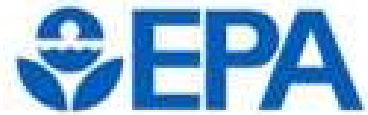
- Locomotive engine standards cover all locomotives built since 1973
 - Pre-1973 locomotives trigger requirements only if “upgraded”
- Tier 4 applies now for all “freshly manufactured” locomotives, while Tiers 0 - 4 are applicable for locomotives that become “new” by remanufacturing
 - The standard for remanufactured engines is based on original manufacture date
 - In-use locomotives become “new” only if/when remanufactured
- Generally Class II and Class III railroads must meet remanufacturing requirements if they own a locomotive that was built after 1973
 - Regulatory flexibilities for small businesses offer limited exemptions
 - Not all locomotives have compatible certified remanufacturing systems
 - In some cases EPA may consider an exemption on the basis of excessive cost
- Extensive maintenance often is performed while avoiding a scope of work that counts as remanufacturing

Current Standards: Anti-Idle



- The regulations require anti-idle emissions controls
 - All new locomotives must be equipped with automatic engine stop/start
 - Freshly manufactured & all tiers of remanufacture systems
 - May be included as part of certified locomotive or may be separately provided by a component supplier
- Must shut down engine within 30 minutes unless an override condition is detected. Allowable override conditions:
 - Prevent coolant freezing; Maintain air pressure for brakes; Maintain battery state of charge; Provide cabin comfort
- From stakeholders, we have learned that many automatic start/stop systems experience a high percent of time with an override condition, engine not shutting down
 - Few locomotives have auxiliary power units (APUs) or other onboard services to maintain acceptable system conditions

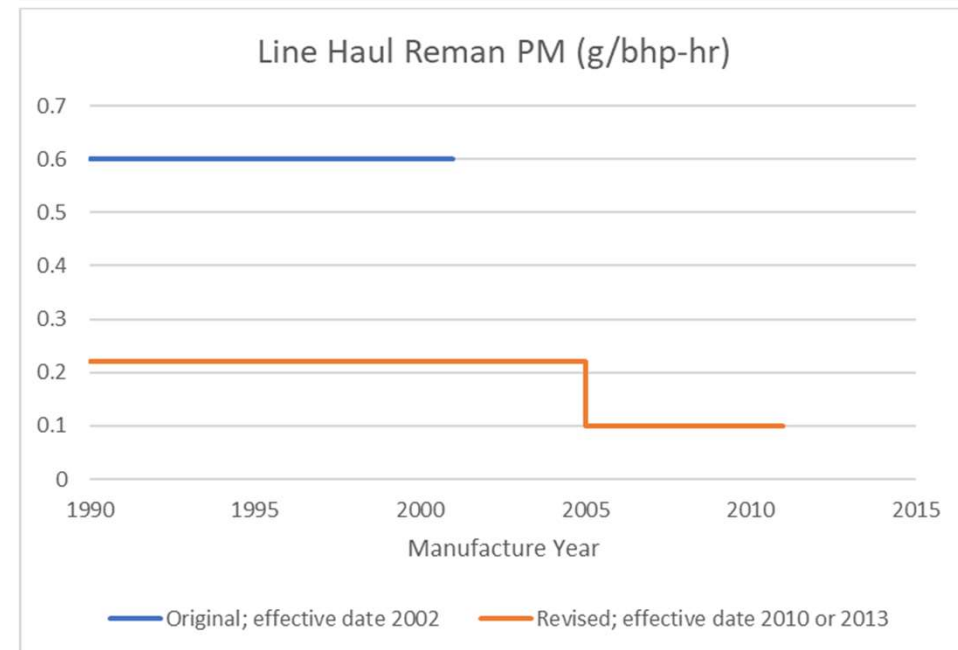
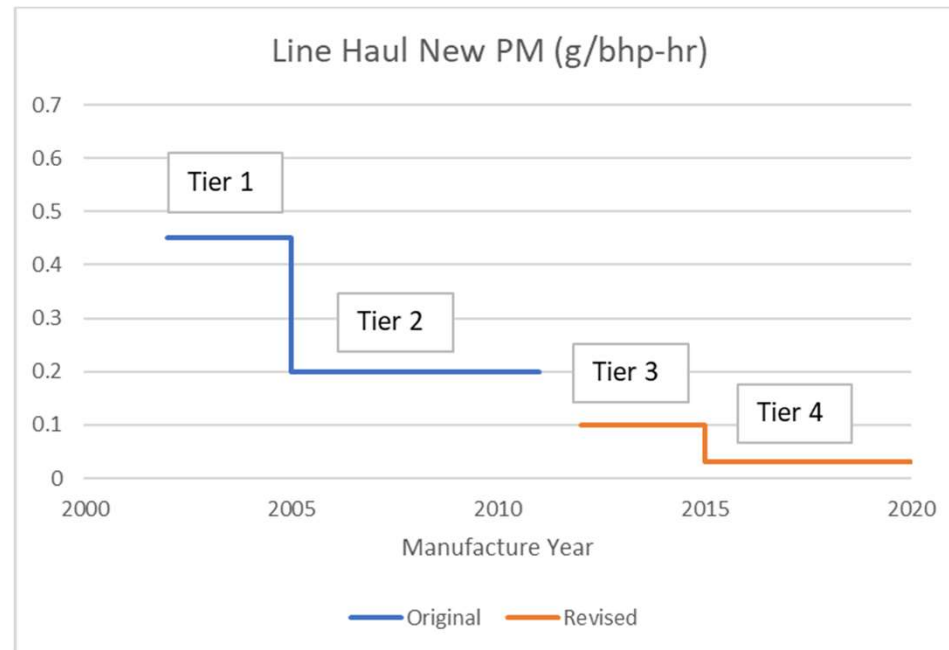
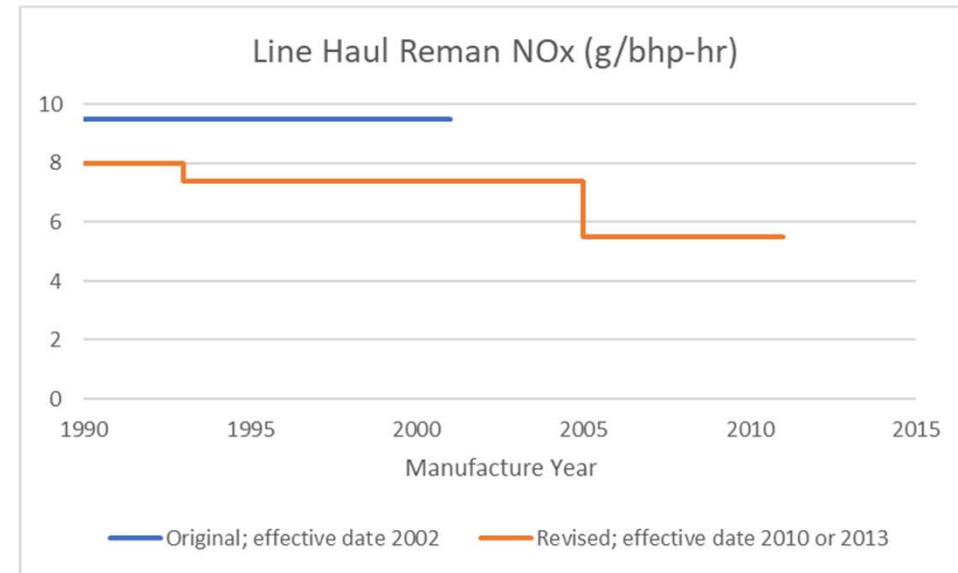
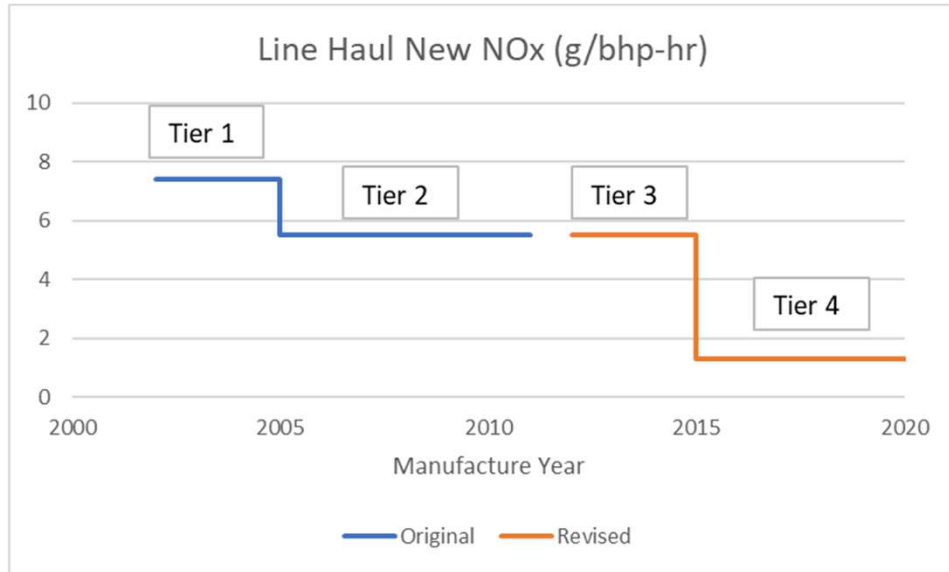
Wrap-up / Hand-Off



- This introductory presentation does not tell the whole story. The next few speakers will offer other perspectives
- Representatives of member organizations within the Moving Forward Network will present community perspectives
 - Jose Acosta, LVEJO, Chicago
 - Ivette Torres, PCEJ, Southern California
 - Beto Lugo Martinez, CleanAirNow, Kansas
- William Carnegie from Wabtec will present a manufacturer's perspective of the locomotive sector
- Theresa Romanosky of Association of American Railroads will present the perspective of the North American Rail Industry

Appendix

Current Locomotive Engine Standards



NOx & PM Switch standards for MY2015+ are the same as line haul

Statutory Authority

EPA's authority to set locomotive standards is from CAA §213(a)(5)

(5) Within 5 years after November 15, 1990, the Administrator shall promulgate regulations containing standards applicable to emissions from new locomotives and new engines used in locomotives. Such standards shall achieve the greatest degree of emission reduction achievable through the application of technology which the Administrator determines will be available for the locomotives or engines to which such standards apply, giving appropriate consideration to the cost of applying such technology within the period of time available to manufacturers and to noise, energy, and safety factors associated with the application of such technology.