



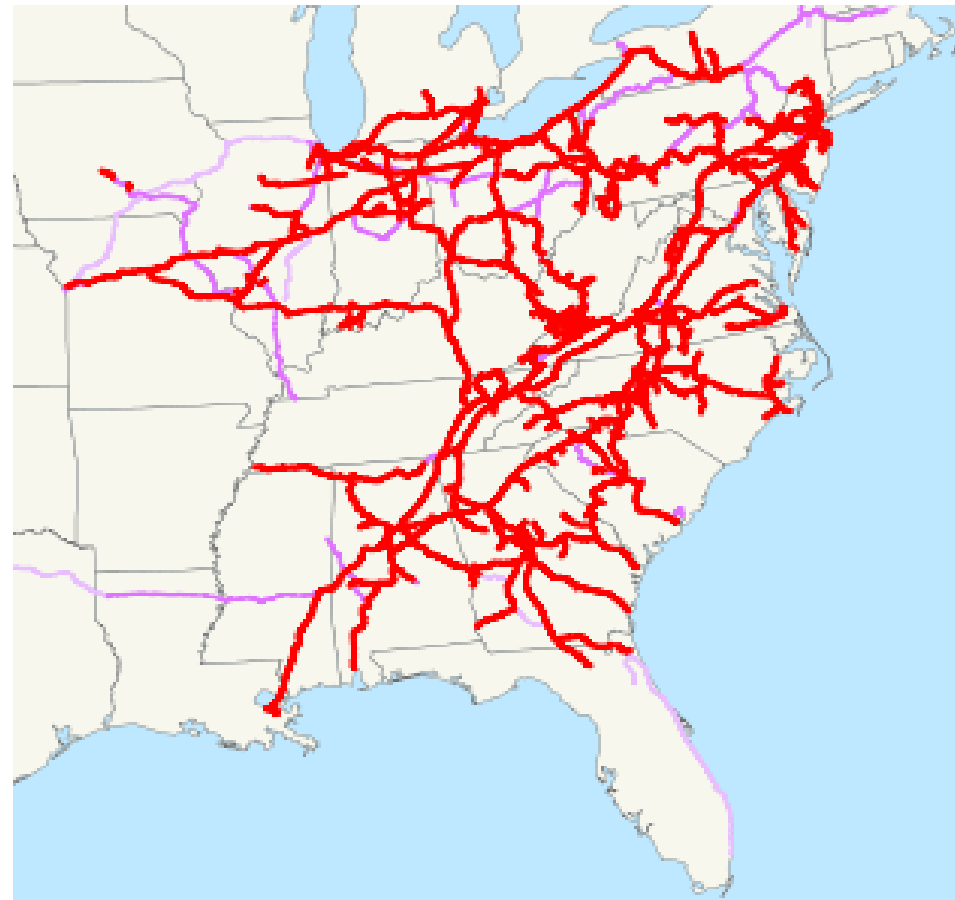
Norfolk Southern Locomotive Fleet Overview

May 7, 2014



Fast Facts

- **20,000 route miles in 22 states and District of Columbia**
- **30,000 employees**
- **\$2.2 billion annual payroll**



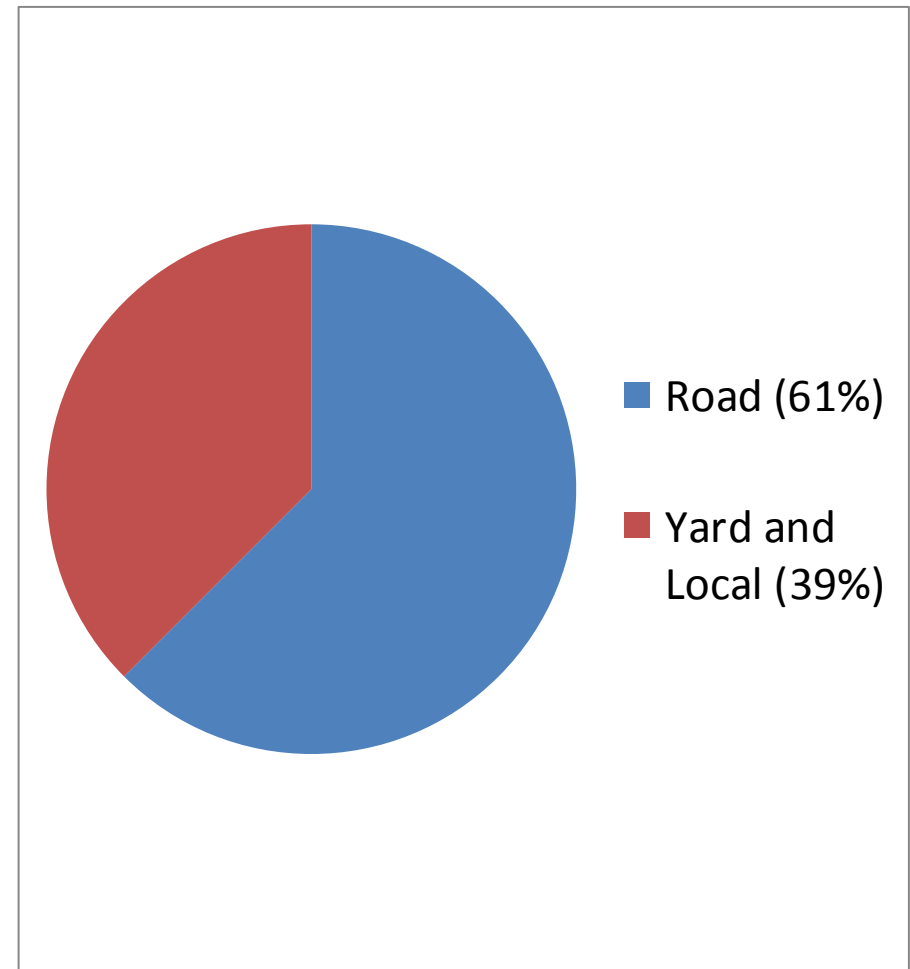
Fast Facts Continued

- **2013 Revenue: \$11.2 billion**
- **2014 Capital Spending: \$2.2 billion**
- **72,560 freight cars**
- **4,073 locomotives**



Locomotives

- Two Major Locomotives Types
 - Road – 2501 units
 - Yard and Local – 1584 units



Road Locomotives

- Used on intermodal trains, unit trains and major freight trains between terminals
- High Horsepower
 - 3800 to 4400
- Weigh 415,000 to 432,000 pounds
- Majority of fleet built since the year 2000
- Life expectancy 20 to 25 years



Road Locomotives (continued)

- Road Locomotives are built by two builders

General Electric (GE)

Electro-Motive Diesel (EMD)
(Progress Rail/ Caterpillar)



Yard and Local Locomotives

- Used in rail yards and on local trains to spot cars at industries
 - Average fewer miles per loco than a road loco
- Lower horsepower locomotives (2000-3000 hp)
- Lighter weight 250,000 – 390,000 lbs.
- Grouped into 4 and 6 axles



EMD SD40-2

A Typical 6 Axle Yard and Local Locomotive

Yard and Local Locomotives

- Majority have been cascaded down from road service
- Oldest of the fleet (average age 28 years)
 - Parts are still plentiful many market suppliers
 - Still very reliable



EMD GP38-2

A Typical 4 Axle Yard and Local Locomotive

Locomotive Regulations

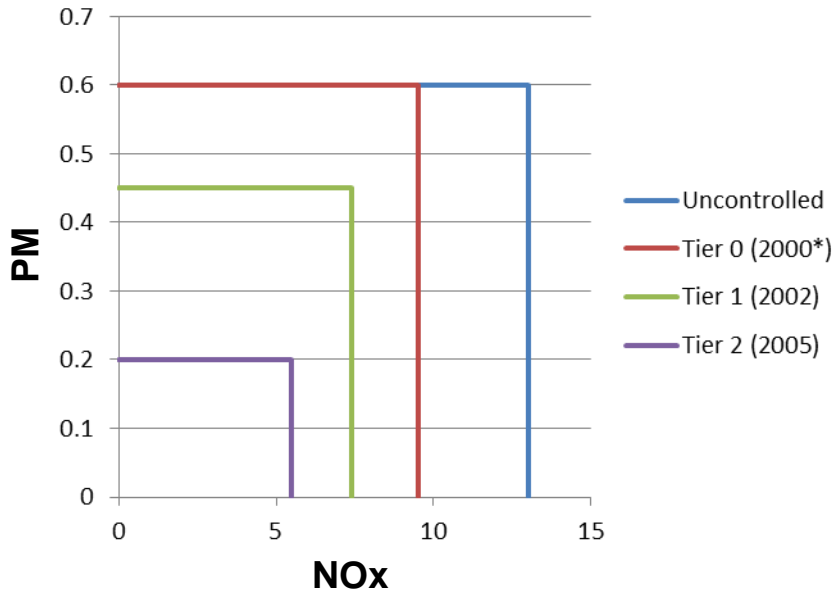
- 49 CFR Part 229 – Federal Railroad Administration
 - Codifies minimum safety requirements for locomotives
 - Requires periodic inspections
 - Prohibits using locomotives when standards not met
- 40 CFR Parts 92 and 1033– Emissions Regulations for locomotives and locomotive engines
 - Developed by US EPA with collaboration of railroads and locomotive builders
 - Focusses on reduction of NO_x, PM, VOC and CO with an emphasis on NO_x and PM
 - All calculations in grams/brake horsepower hour

Emissions Regulations

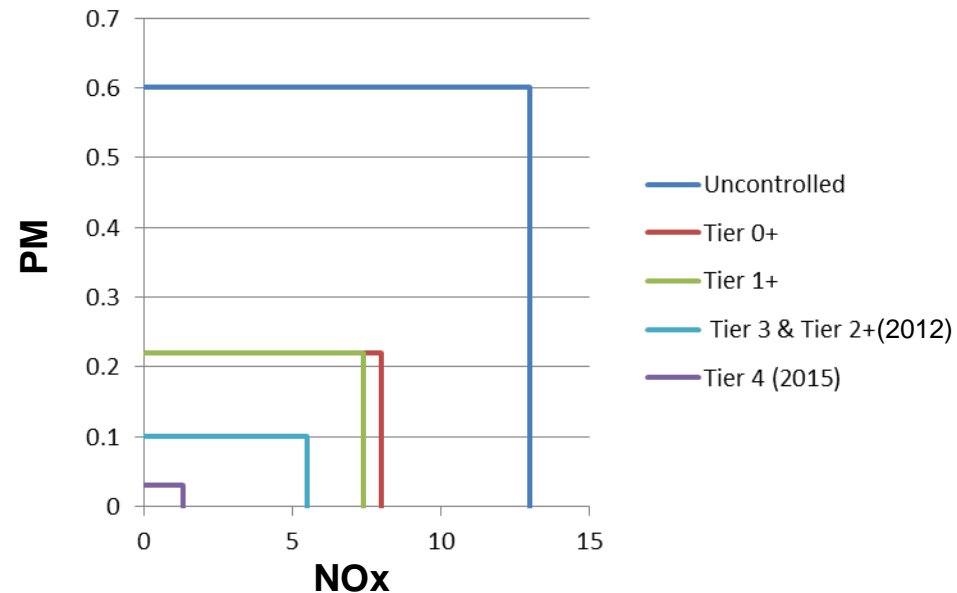
- Tiered approach
 - Phases in emissions reductions over time with 4 Tiers
- Emissions are based upon Line Haul (Road) and Switch Duty Cycle
 - Line Haul – above 2300 horsepower
 - Switch – 2300 horsepower and below
- Applies to all locomotives built after 1973
 - Locomotives that were built after 1973 and prior to 2000 regulations must be brought to Tier 0 and Tier 0+ standards when overhauled

Emissions Reductions (EPA Line Haul Duty Cycle)

**40 CFR Part 92
Year 2000**



**40 CFR Part 1033
Year 2010**

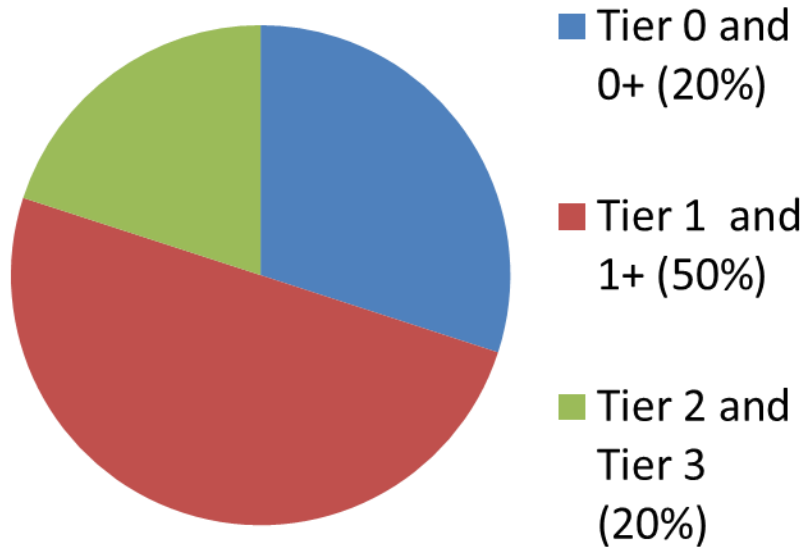


Locomotives that were retrofitted to Tier 0 standards or built as Tier 1 or Tier 2 must be upgraded to higher emissions standards at next overhaul which are the plus (+) levels under Part 1033

*Locomotives built prior to 2000 must be retrofitted to Tier 0 during overhaul

Road Fleet Emissions Make Up

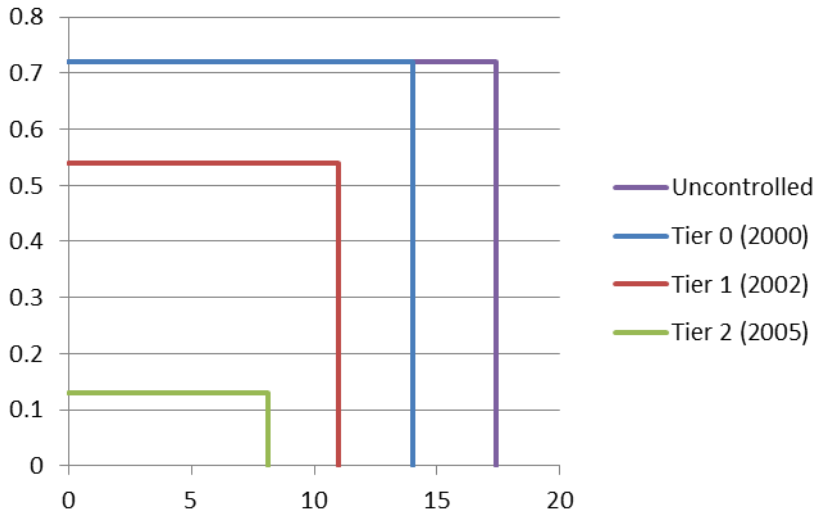
Road Fleet



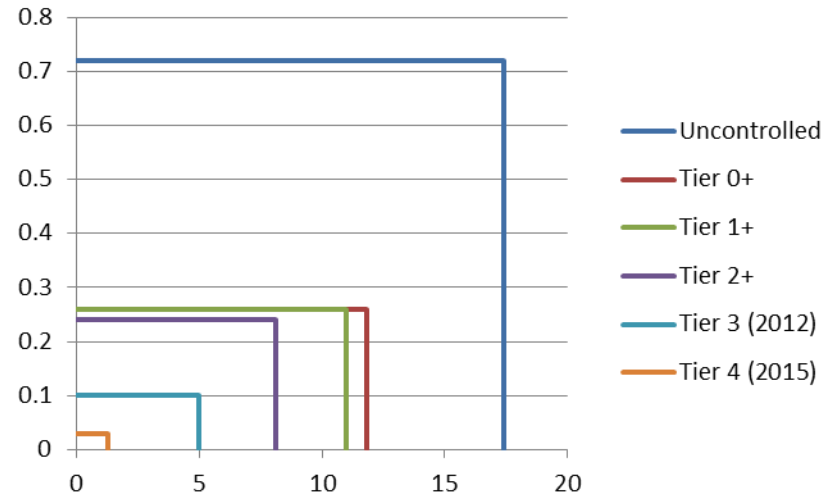
- Overhauls are ongoing and conversions to the Plus (+) standards increase monthly

Emissions Reductions (EPA Switch Duty Cycle)

40 CFR Part 92 (Year 2000)



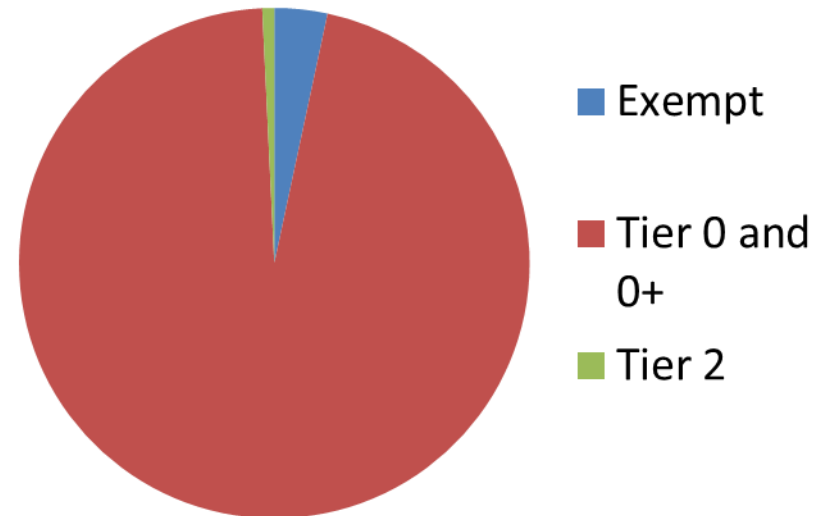
40 CFR Part 1033 (Year 2010)



- Regulations mainly apply to locomotives being overhauled

Yard and Local Fleet Emissions Make Up

- Exempt units built before 1973 – no regulations apply
- Majority of fleet Tier 0 and 0+
- Tier 2 locomotives are a handful of gensets and 710ECO repowers



Challenges in the Yard and Local Locomotive Fleet

- No true switcher or reliable low horsepower locomotives are built today
 - Last switcher built in 1984
 - Last 4 axle locomotive was built in 1991
- No longer can older road locomotives be cascaded down to yard and local service
 - Current road locos too heavy and long for local service
 - Weight and curve restrictions at local industries
- The genset locomotives from all builders have not lived up to performance and reliability expectations

Genset Experiment

- NS tried Gensets from both major manufacturers
 - Both 4 and 6 axle versions
- Performance Issues
 - Slow to load
 - Must get all engines running to kick cars – defeats multi engine concept
 - Too light - limits wet rail pulling ability



Genset Experiment (Continued)

- Reliability less than required
 - EPA certifies engines meet emissions not reliability
 - Engine durability issues
 - Parts availability issues
 - High power electronic failures
 - 40 year old locomotives are more reliable
- Only one Class 1 railroad still purchases gensets



What works for Yard and Local Locomotive Emissions Reductions

- **EMD 710ECO Retrofit kits**
 - True locomotive engine
 - Performance and reliability as expected
- **Challenges**
 - Current yard and local locomotives are reliable
 - Hard to justify cost
 - Competes for other capital spending
 - I.e. Track, bridges, etc.



Emissions Reductions through Slugs

- Locomotive without an engine
 - Electricity for traction motors provided by another locomotive called a mother
- Useful concept where train speeds are below 20 mph and two locomotives are needed
 - Above 20 mph not enough power available from mother loco



Other Methods for Emissions Reductions – Electric Layover System

- Eliminates idle emissions
- Electric heater to keep engine coolant warm and batteries charged
 - Locos don't use antifreeze
- Useful in the winter time when auto engine start stop is not that effective



Current Emissions Experiments

- Natural Gas – Mother/slugs set
 - Under development
 - Major Issue is FRA acceptance
 - FRA still working on regs
- Battery Powered Locomotive Experiment
 - Working on the second battery iteration
 - Further research and development required



Questions