

BNSF Railway Company

California Railroad Emissions

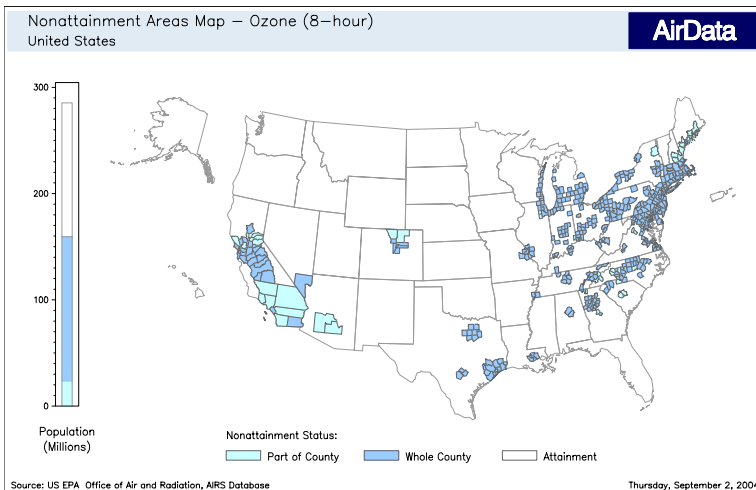
January 30, 2006

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Ozone Non-Attainment Areas



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US Railroad Intermodal Flows for 2002



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Comparison of Mobile Source Requirements

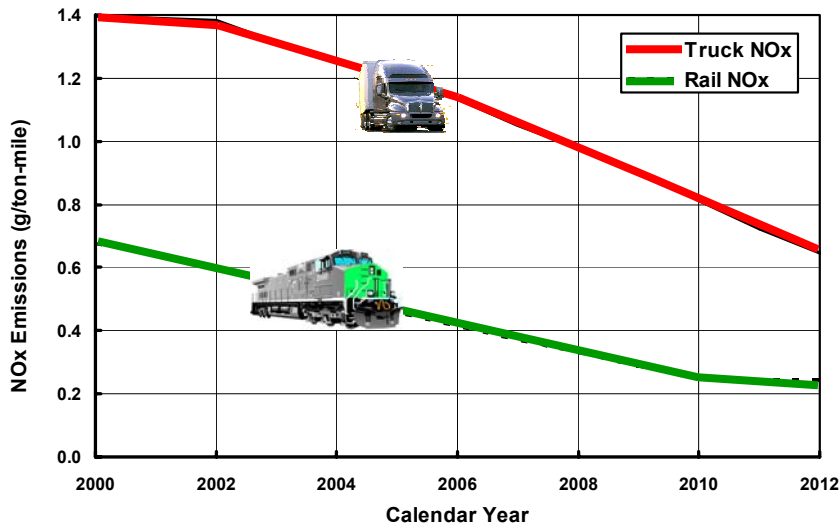
	Trucks	Off-Road Equipment	Ships	Aircraft	Urban Buses	Locomotives
2010 NOx Inventory (SCAQMD)	21%	17%	7%	4%	2%	2%
2010 PM 2.5 Inventory	2.4%	7.9%	3.2%	0.4%		0.7%
Standards for New Units	X	X	X	X	X	X
Retrofit Existing Units					X	X
Rebuild to New Standards						X
In-Use Testing of Emissions						X
Fleet Average for SCAQMD						X



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Figure 1 -- NOx Emissions per Ton Mile of Freight
South Coast Air Basin

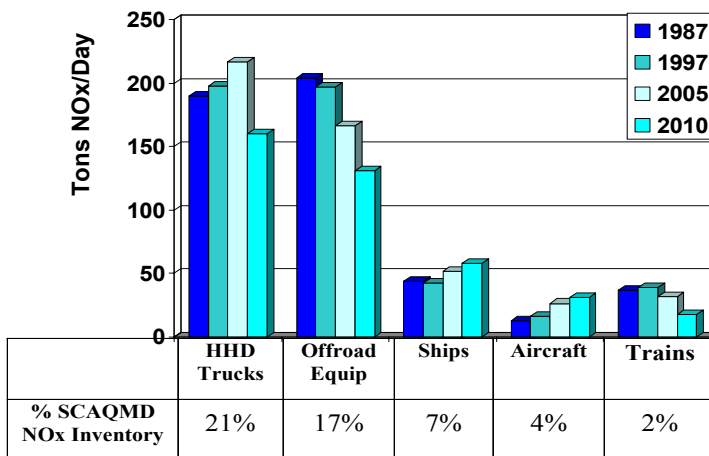


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Mobile Source NO_x Inventories



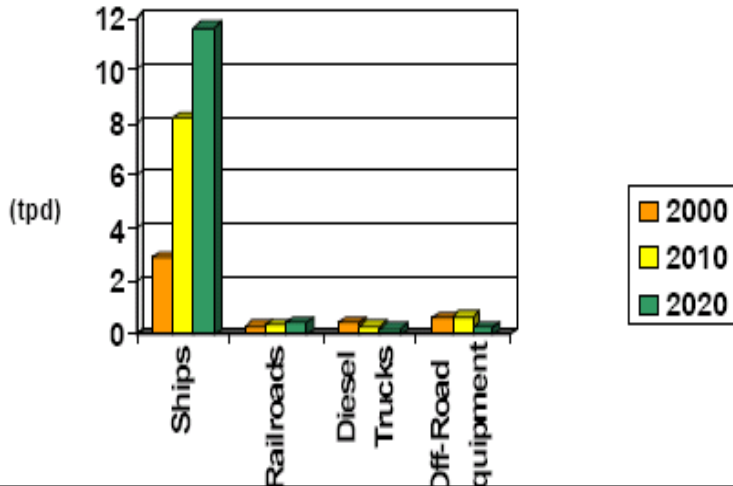
Data Sources: SCAQMD AQMPs & Other Materials

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Emission Trends for Various Port-related Sources In the South Coast Air Basin (PM)



California Environmental Improvement Program

- Supported the US EPA's standards for new and re-manufactured locomotives
- Developed enforceable MOU with ARB achieving accelerated NOX reductions in Southern California
- Created and funded \$5 million for particulate filter research and development at Southwest Research Institute
- Agreed to statewide PM MOU specifying visible emissions performance, locomotive idling limits, health risk assessments at major yards, idle control equipment on intrastate locomotives, and significant use of CARB diesel.

Other Railroad Emission Reduction Program Components

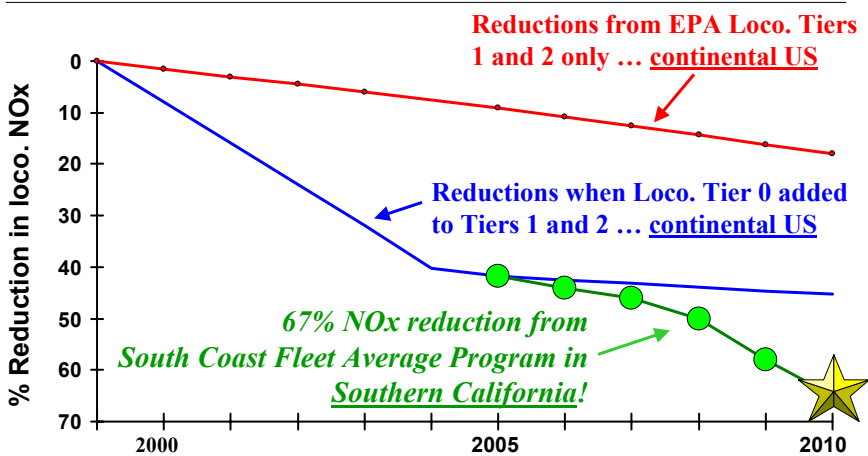
- Working with the Air Resources Board to accelerate Particulate reductions in and around rail yards statewide
- CARB cargo handling regulations
- Funding & demonstrating new locomotive technologies:
 - Multiple Gen Set Switcher locomotives
 - Hybrid locomotives, line haul
 - Green Goat Switcher Technology
 - Spark Ignited LNG technologies
 - Idle reduction devices

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South Coast Fleet Average



Southern California commitment from the Railroads



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Major Items

- Emissions inventories
- Cargo handling equipment
- Locomotives

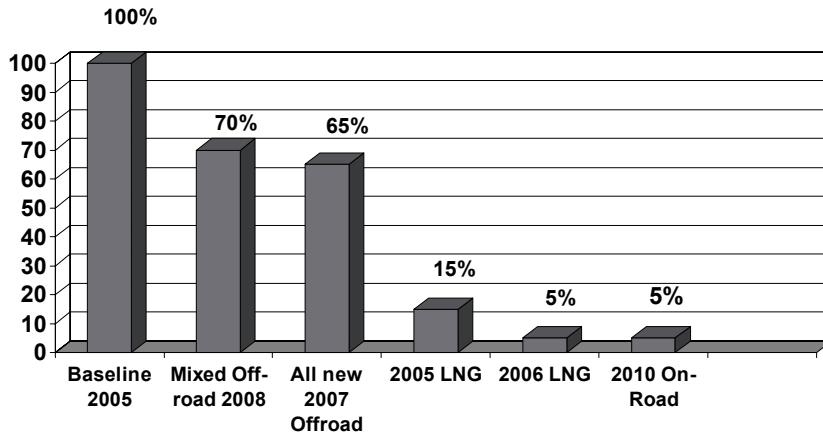
Particulate Matter Emissions From Some Very Large Railroad Yards With Existing Equipment, baseline 2005

Particulate Matter Emissions, 2.5 micron PM in tons/year

	Very Large Intermodal Yard	Very Large Classification Yard
Locomotive Servicing	0.0	9.8
Switch Engines	1.8	5.5
Cargo Handling Equipment	24.9	0.0
Yard Tractors	12.5	
Cranes	7.5	
Forklifts	4.9	
Main Line Train Operations	3.5	11.8
Total	30	27

Estimated Drayage Emissions 28 tons per year

Yard Tractor Particulate Matter Emissions For Different Ages, Engine Types and Fuels



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Nitrogen Oxides Emissions From A Very Large Intermodal Yard With Existing Equipment, baseline 2005

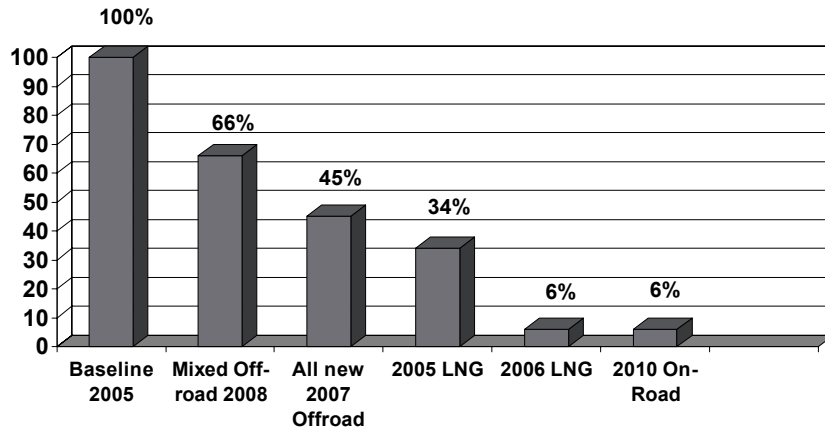
Nitrogen Oxides, in tons/year	
Very Large Intermodal Yard	
Locomotive Servicing	0
Switch Engines	75
Cargo Handling Equipment	363
Yard Tractors	165
Cranes	125
Forklifts	73
Main Line Train Operations	150
Total	588
 Estimated Drayage Emissions	 1743 tons per year

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Yard Tractor Nitrogen Oxides Emissions For Different Ages, Engine Types and Fuels



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Liquefied Natural Gas Switcher Locomotive

1200 sustainable horsepower, spark ignited



Liquefied Natural Gas (LNG) Locomotive

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New Switch Locomotive Technology: Hybrids

2000 peak horsepower from batteries



“Hybrid” light-medium duty switcher
Batteries recharged by 290 HP EPA off-road Tier 2 diesel gen set
significantly exceeds EPA locomotive Tier 2 requirements

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Multiple Gen Set Switcher Locomotive

1400 sustainable horsepower, multiple truck engine



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Switch Engine Emissions in g/hphr EPA switch engine duty cycle

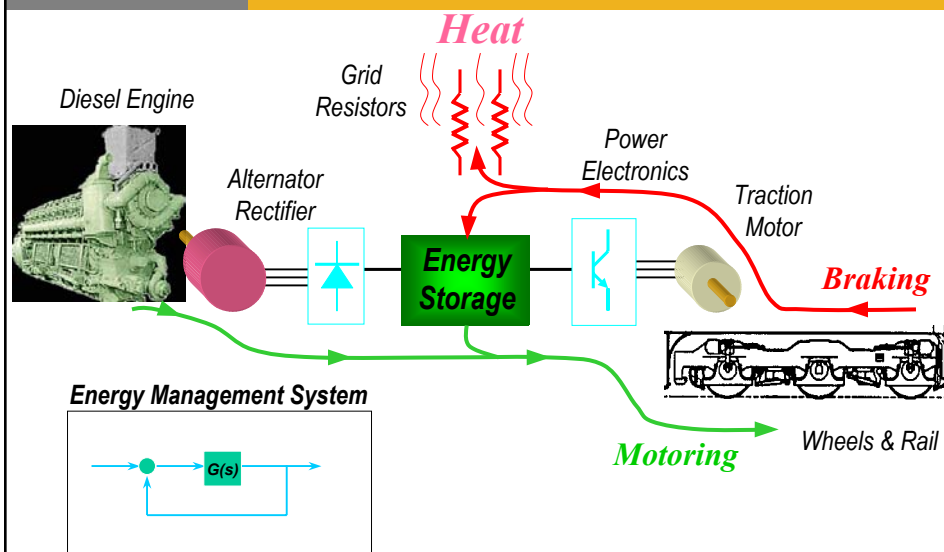
	1970 GP38 Style	EPA Tier 2 STDs	Green Goat	Spark Ignited LNG	Truck like Engines Now	Truck like Engines Future
NOx	12.8	8.1	3.8	1.4	3.8	1 ?
PM	0.42	0.24	0.11	0.09	0.11	.03 ?
HC	0.8	0.6	0.2	3.3	0.3	
CO	2.1	2.4	0.9	2.2		
Locomotive Cost			\$0.8 mil	\$2.0 mil	\$0.9 mil	\$1.1 mil



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Hybrid Locomotive Concept



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Line Haul Locomotive Emissions in g/hphr EPA line haul duty cycle

	1975 SD40-2 style	1975 SD40-2 Tier 0	Dual Fueled LNG	EPA Tier 2 STDS	GE Evo Engines 2005	EMD Engines 2005
NOx	13.1	9.0	5.0	5.5	5.2	5.1
PM	0.27	0.60	0.40	0.20	0.08	0.07
HC	0.44	0.5	1.21 nmhc	0.3	0.17	0.22
CO	1.6	2.1	10.3	1.5	0.3	1.0
BSFC	unity	3% loss	11% loss		20% gain	

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Barriers

- Infancy of the technology, needs time to harden and be durable.
- Need prioritization of the air quality improvement needs. Many locations want the technology first.
- Lack of agreement as to fair share between competing modes of transportation.
- Lack of financial resources to meet everyone's expectations.
- SCAQMD may sue CARB over cargo handling rules, putting acceptable emission limits in doubt, lengthening the time to install the improvements.

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Summary

- Railroads are reducing emissions from linehaul and switch engines.
- Railroads are addressing visible emissions, idling, and risk assessment around yards.
- Local air districts have been very helpful with switcher locomotive emissions.
- Yard tractors are the largest source of emissions inside the fence at intermodal facilities. This will be addressed with cargo handling rules.
- Voluntary agreements are an important way to reduce emissions.