Burlington Northern Santa Fe Corporation

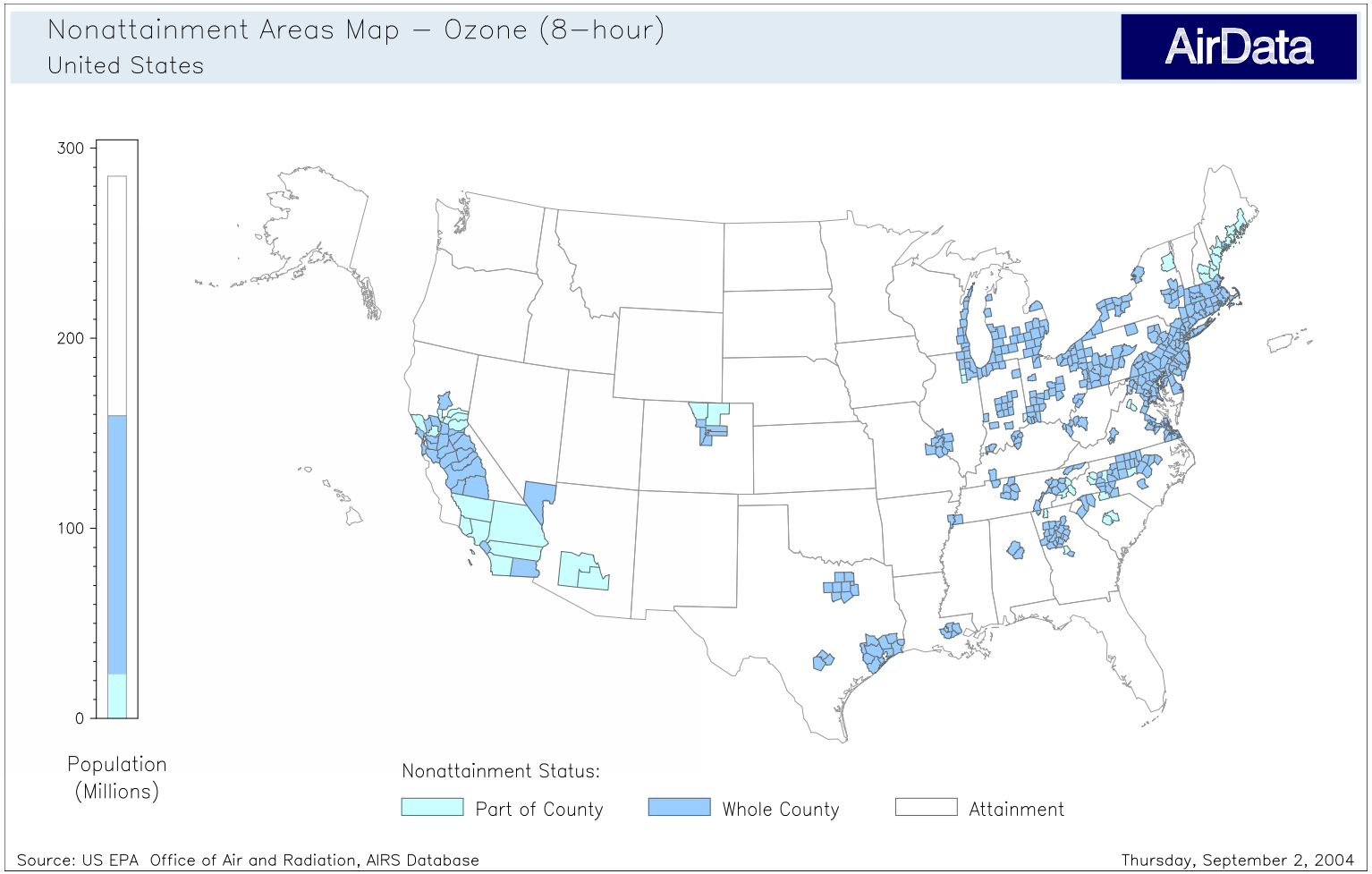
Railroads and Locomotive Emissions Technology
The Business Setting

June 6, 2007

Major Items

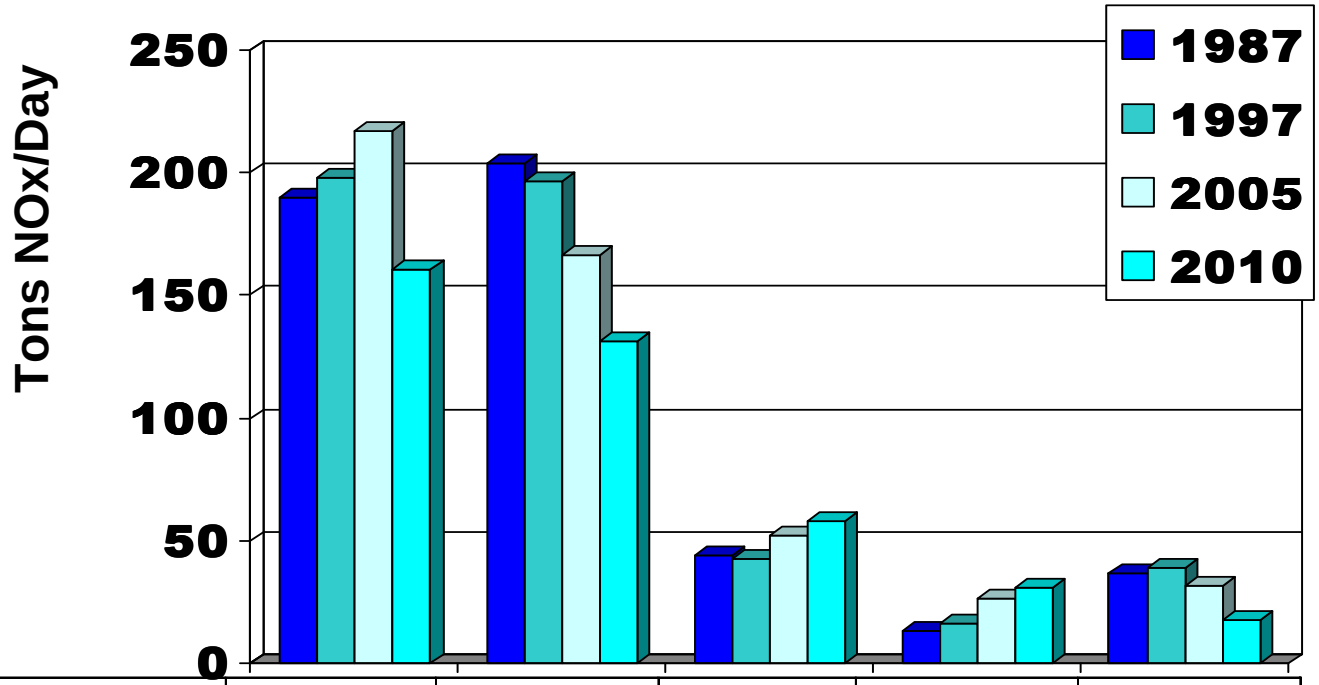
- Air quality and the railroad contribution
- Truck versus rail comparisons
- Railroad emission reductions
- Where are we in our fleet emission reductions
- Fuel efficiency and greenhouse gas emissions
- Other sources of railroad emissions
- Our role in transportation and who will pay for capacity improvements

Ozone Non-Attainment Areas



US Railroad Intermodal Flows for 2002

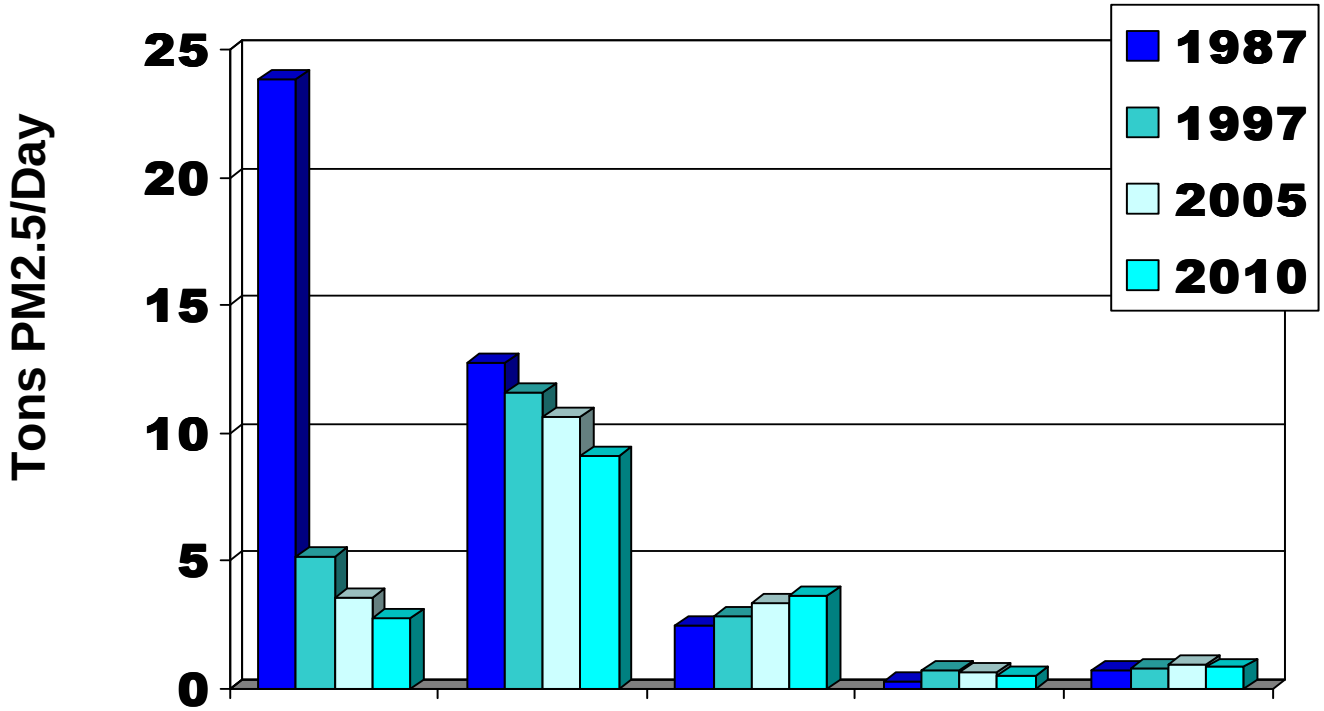
Mobile Source NO_x Inventories



	HHD Trucks	Offroad Equip	Ships	Aircraft	Trains
% SCAQMD NOx Inventory	21%	17%	7%	4%	2%

Data Sources: SCAQMD AQMPs & Other Materials

PM 2.5 Inventories



	HHD Trucks	Offroad Equip	Ships	Aircraft	Trains
% SCAQMD PM2.5 Inventory	2.4%	7.9%	3.2%	0.4%	0.7%

Data Sources: SCAQMD AQMPs & Other Materials

Inherent Efficiencies of Rail

	vs.
Capacity	**1 double stack train equals volume of up to 280 trucks**
Fuel Efficiency	**Trains are <u>2-4 times more fuel efficient</u> than trucks on a ton-mile basis**
NOx Emissions	**Trains are <u>2-3 times cleaner</u> than trucks on a ton-mile basis**

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

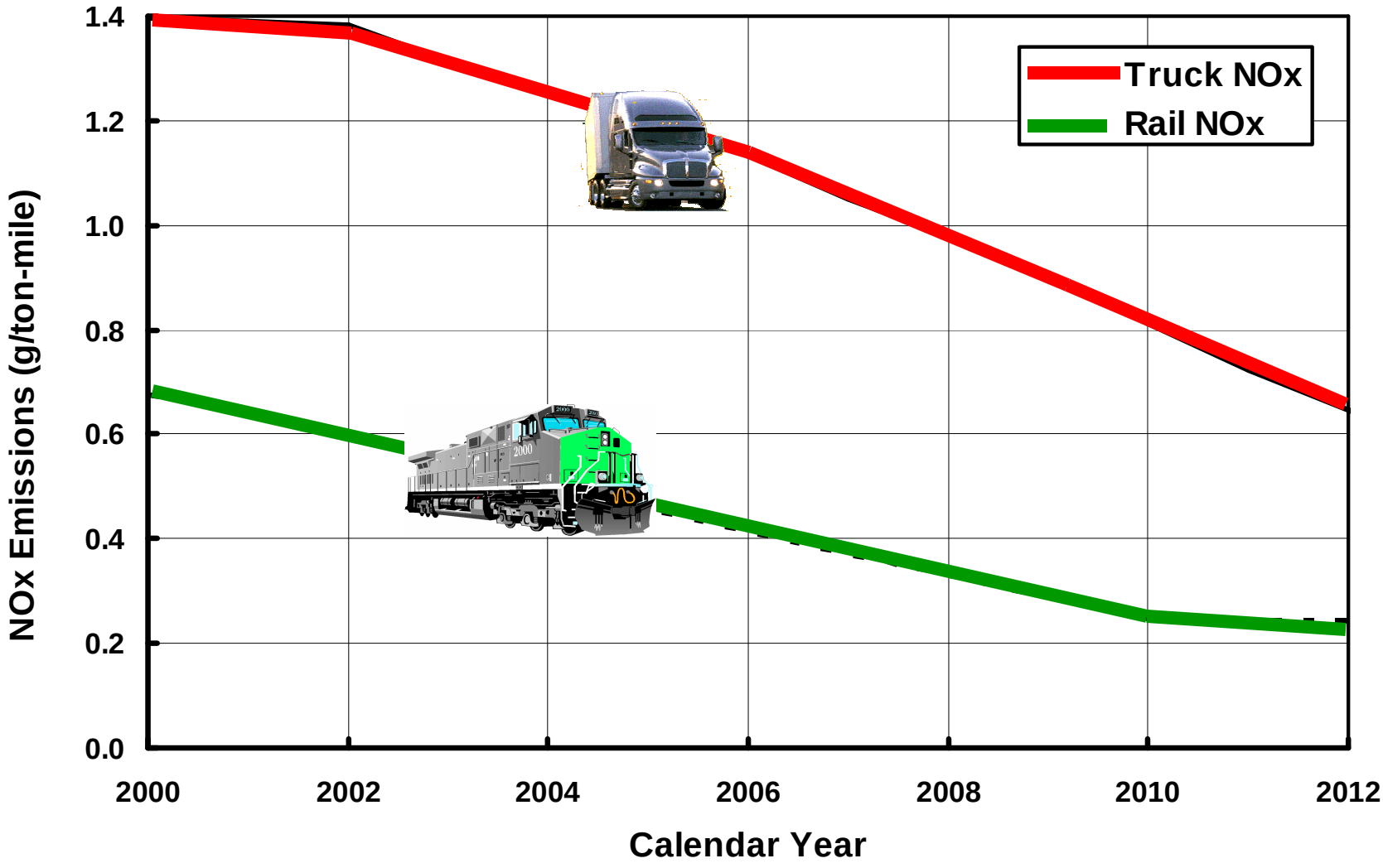
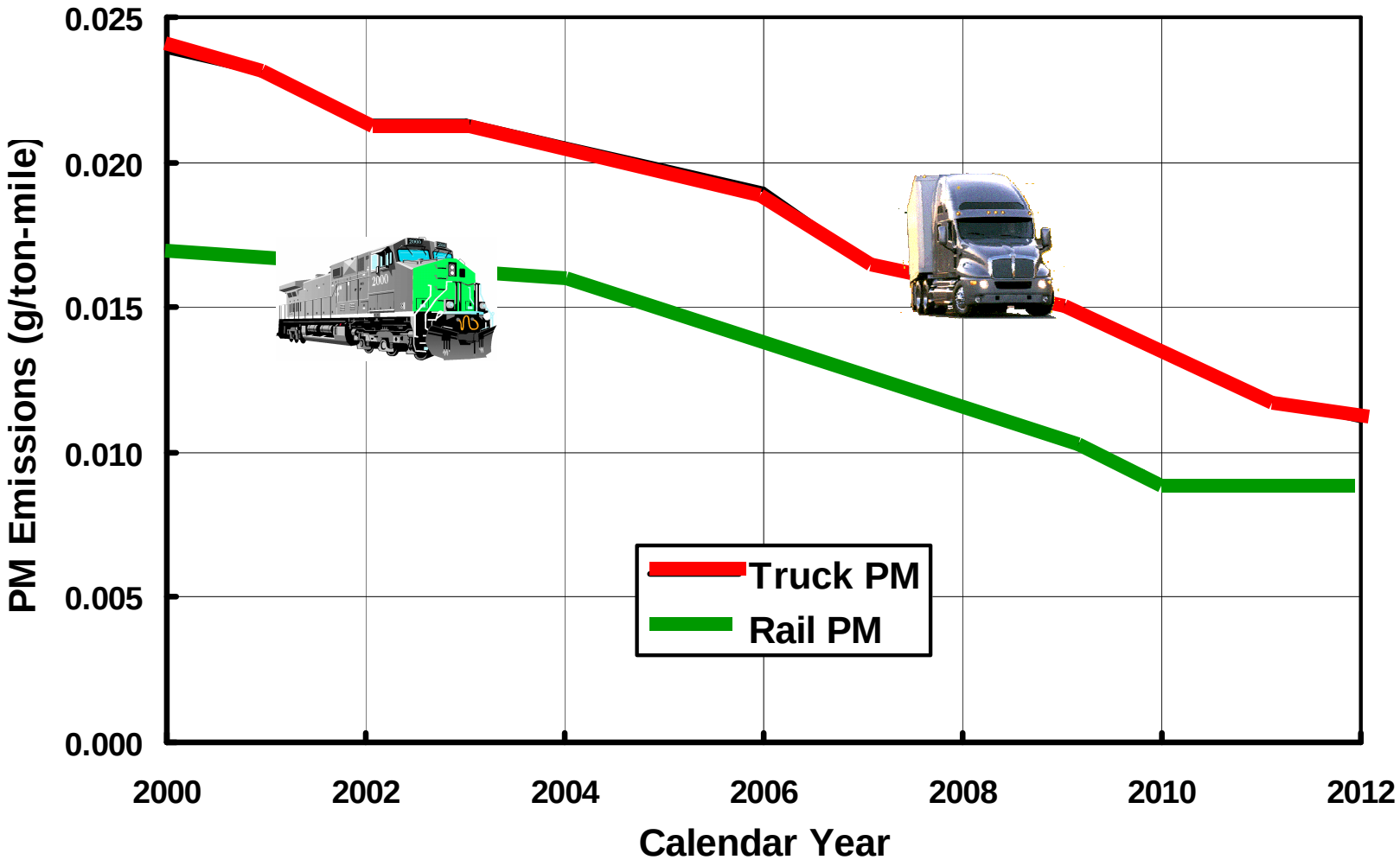


Figure 2 -- PM Emissions per Ton Mile of Freight
South Coast Air Basin



Comparison of Mobile Source Requirements (South Coast Inventory 2010)

	Trucks	Off-Road Equipment	Ships	Aircraft	Urban Buses	Loco-motives
Inventory NOx / PM	21% / 2.4%	17% / 7.9%	7% / 3.2%	4% / 4%	2% /	**2%** / **0.8%**
Standards for New Units	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Retrofit Existing Units	**No**	**No**	**No**	**No**	**Yes**	**Yes (50% Done)**
Rebuild to New Standards	**No**	**No**	**No**	**No**	**No**	**Yes**
NOx Fleet Avg. in SCAQMD	**No**	**No**	**No**	**No**	**No**	**Yes**
Statewide PM 2005 MOU	**No**	**No**	**No**	**No**	**No**	**Yes**

How California MOUs Have Driven Air Quality Investments & Improvements (07/06)

Locomotive Technologies	First Year Available	# of Units	% of CA Fleet	NOx Reduction from Baseline (per unit)	Incremental Air Quality Investment Nationwide to Date	CA Incremental Air Quality Investment Driven by MOUs by 2010	Required of Other Mobile Sources?
New Re-Build –Tier 0 (32% complete nationally)	**2000**	**4621**		**30%**	**$231 million**		**NO**
Buy New Units – Tier 1	**2002**	**1857**		**45%**	**[$3.3 billion]**		**YES**
Buy New Units – Tier 2	**2005**	**1063**		**60%**	**[$2.1 billion]**		**YES**
Future Additional Line-Haul Units to Comply with 1998 MOU	**2005**	**80**				**$160 million**	**NO**
Ultra Low-Emitting California Switchers (Today)	**2000**	**9**	**6%**	**80%**		**$10.8 million**	**NO**
Additional ULEL California Switchers (By 12/07)	**2005**	**77**	**51%**	**80%**		**$92.4 million**	**NO**
Automatic Shutdown Devices							
Line-haul units nationally (35% Complete)	**2001**	**4858**			**$18 million**		**NO**
California units (Completed 6/06)		**230**	**53%**			**$ 4.5 million**	**NO**
California units (Future by 6/08)		**208**	**47%**			**$ 4.1 million**	**NO**
Total Air Quality Investment					**$249 million**	**$ 271.8 million**	

1998 MOU **2005 MOU** **1998 and 2005 MOU**

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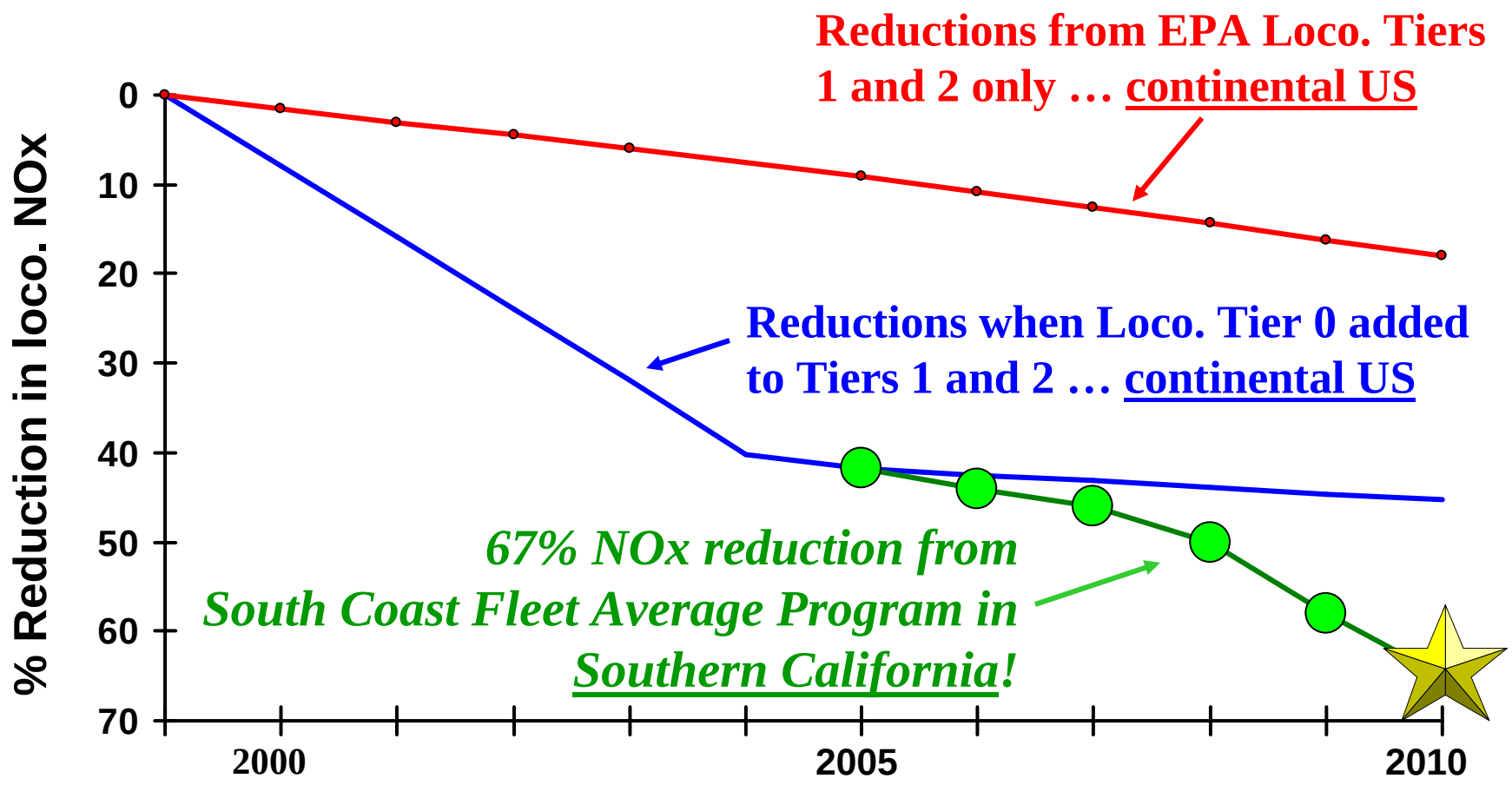
South Coast Fleet Average



Southern California commitment from the Railroads

Switcher Locomotives

Green Goat® Locomotives

- **"Hybrid" light-medium duty switcher**
- **Reduces fuel consumption and atmospheric emissions by 60 percent**
- **Emits 80 to 90 percent fewer pollutants than conventional train engines**
- **Batteries recharged by 290 HP EPA *off-road Tier 2* diesel gen set (significantly exceeds EPA locomotive Tier 2 requirements)**

Liquefied Natural Gas Locomotive

- **BNSF operates the only four environmentally friendly liquid natural gas locomotives that reduce emissions and fuel consumption**
- **1200 sustainable horsepower, spark ignited**

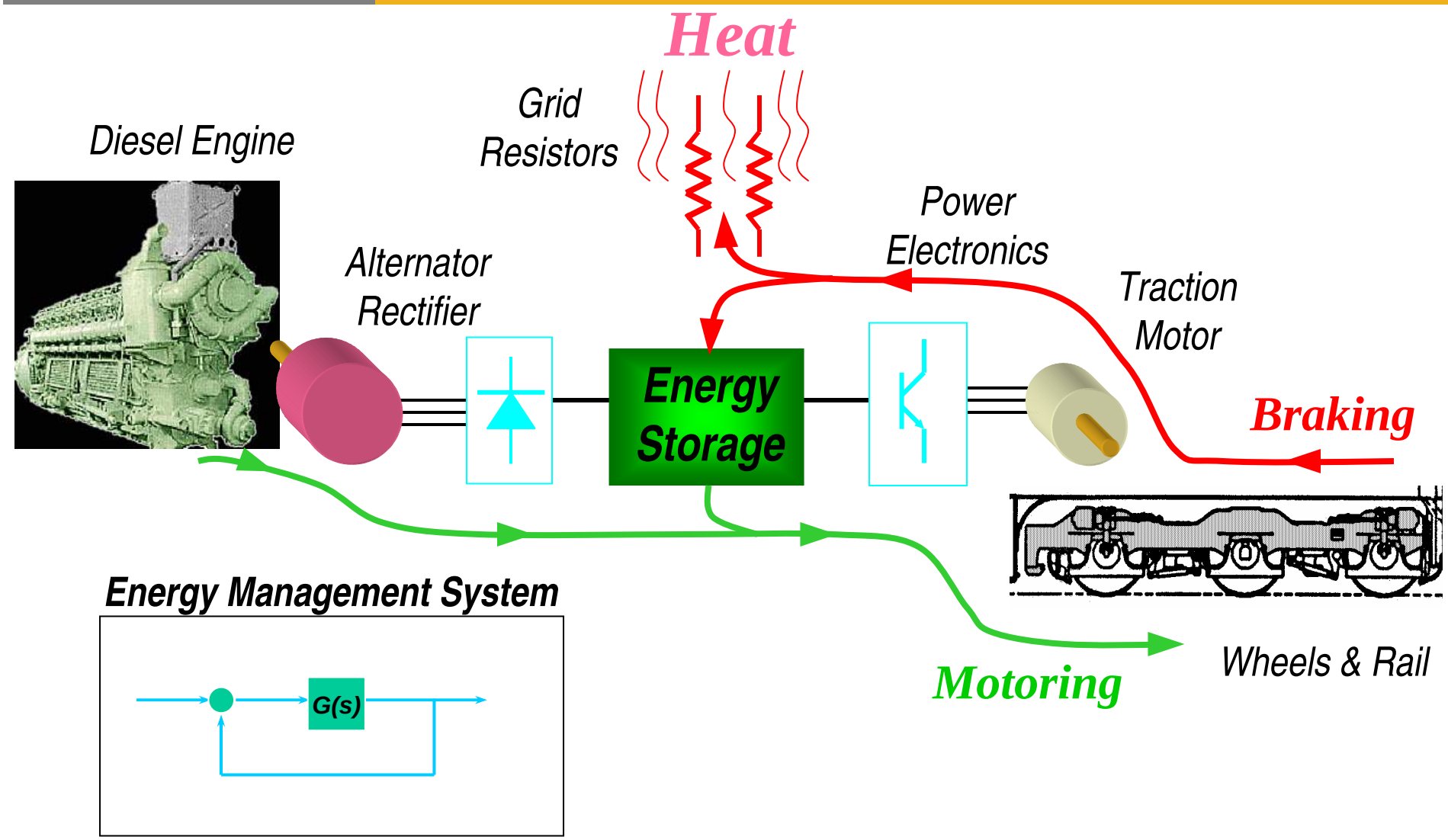
Multiple Gen Set Switcher

- **Powered by multiple diesel gen sets with truck-like engines**
- **700 sustainable horsepower from each gen set**

Switcher Locomotive with Diesel Particulate Filter

1500 sustainable horsepower

Road Locomotive Hybrid Concept



Fleet Composition

- Total fleet is 6600 locomotives
- 300 switch locomotives, 80 from 50's and 60's
- 1140 intermediate power locomotives, 430 post 1972
- 5150 high horsepower locomotives

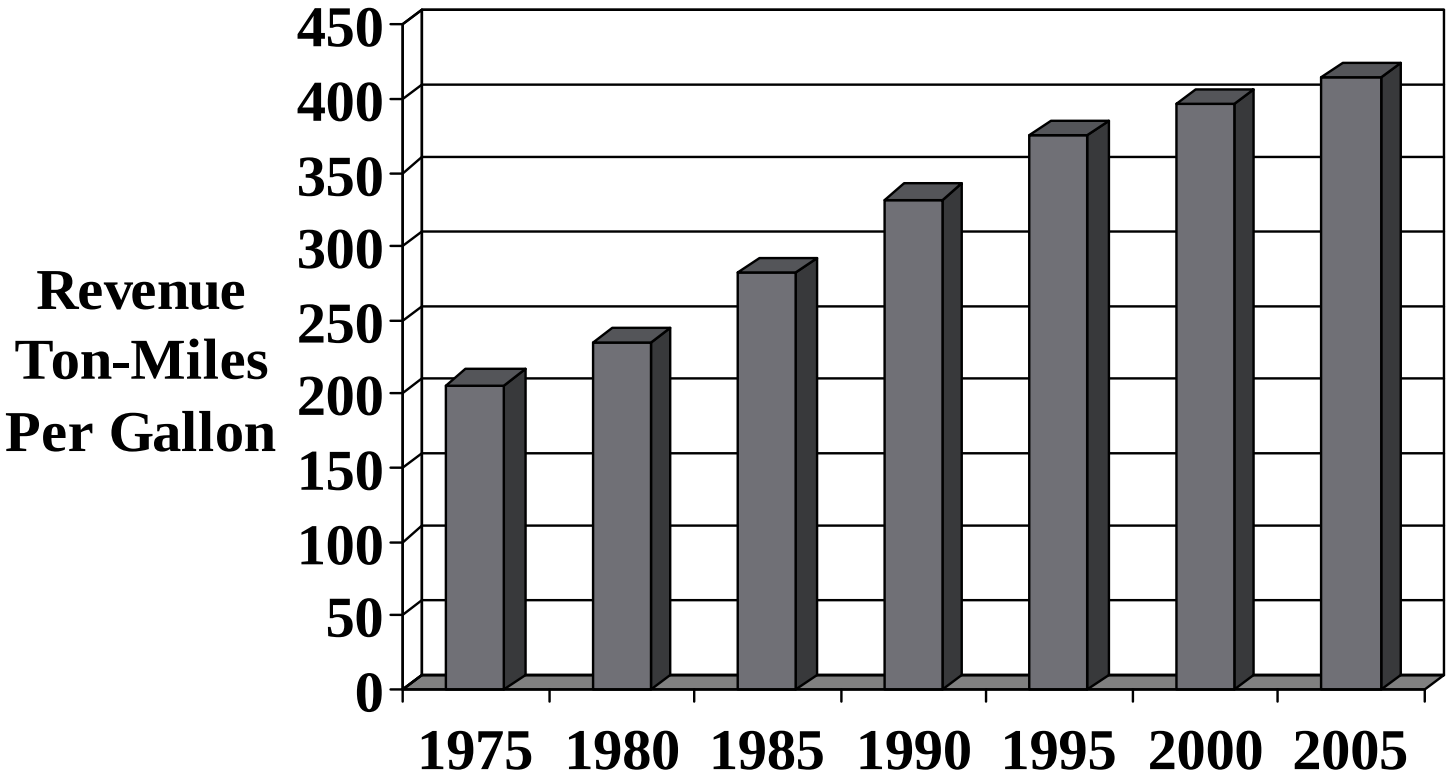
At the end of 2006

- Total fleet is 6600 locomotives
- Installed 3110+ locomotives with AESS
- Retrofit 2200 locomotives to Tier 0
- Purchased 620 Tier 1 locomotives
- Purchased 600 Tier 2 locomotives
- Fleet average nitrogen oxides emissions reduced 30% since 2000
- 2260 more locomotives to retrofit to Tier 0
- 900 locomotives pre 1973 (not subject to retrofit)

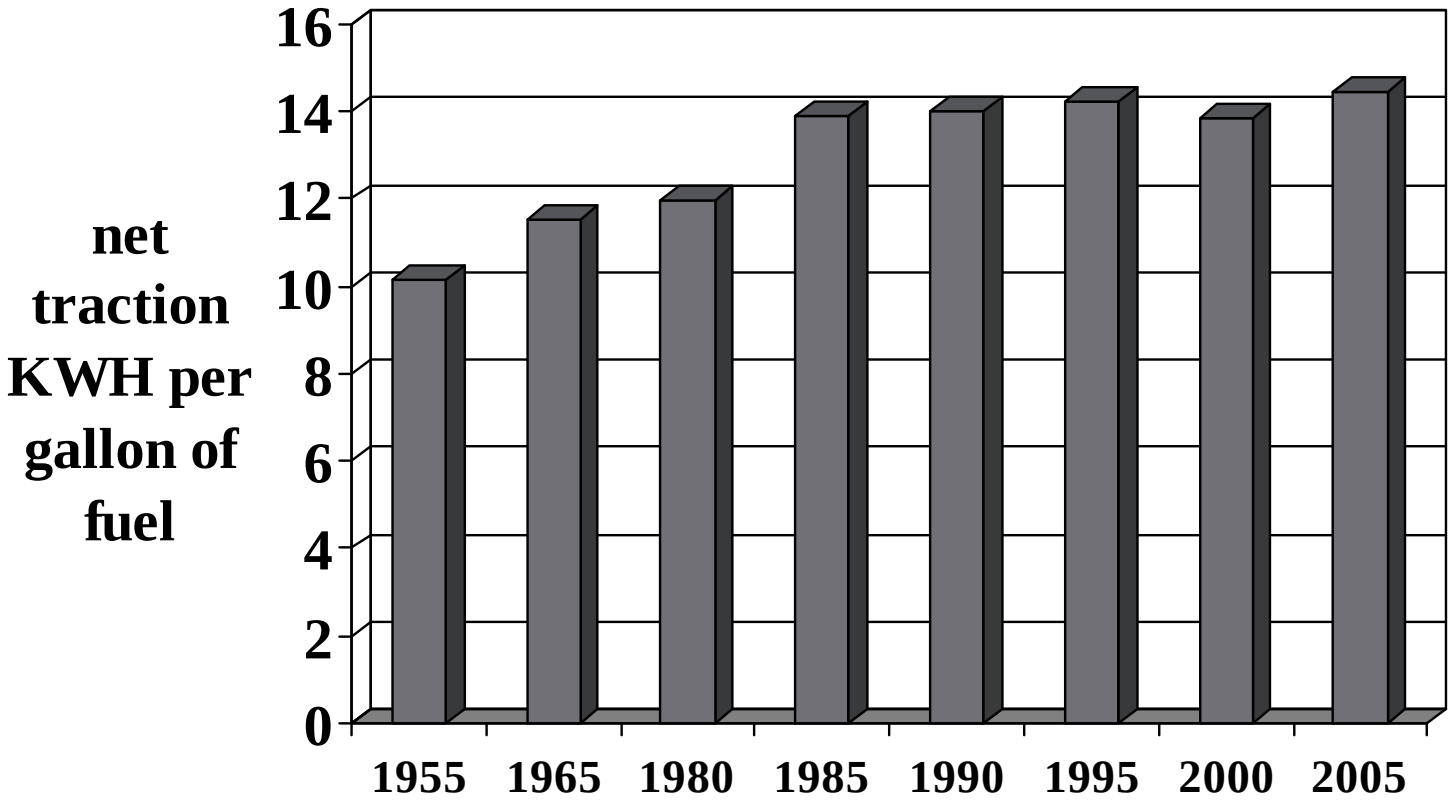
Locomotive Emissions Summary

- Technology continues to reduce emissions
- New locomotives reduce nitrogen oxides emissions by 67%
- Switch locomotives using truck-like engines reduce emissions even more
- Not all truck engine technologies are appropriate for locomotive engines and the same technologies may have different reduction performance
- Voluntary but enforceable agreements allow tailoring reductions to achieve the best results most economically
- Railroads are achieving large reductions in emissions
- If stationary sources were mobile, they could not achieve their current emission reductions

Railroad Industry Fuel Efficiency



Locomotive Fuel Efficiency,
medium duty cycle



Greenhouse Gas Emissions

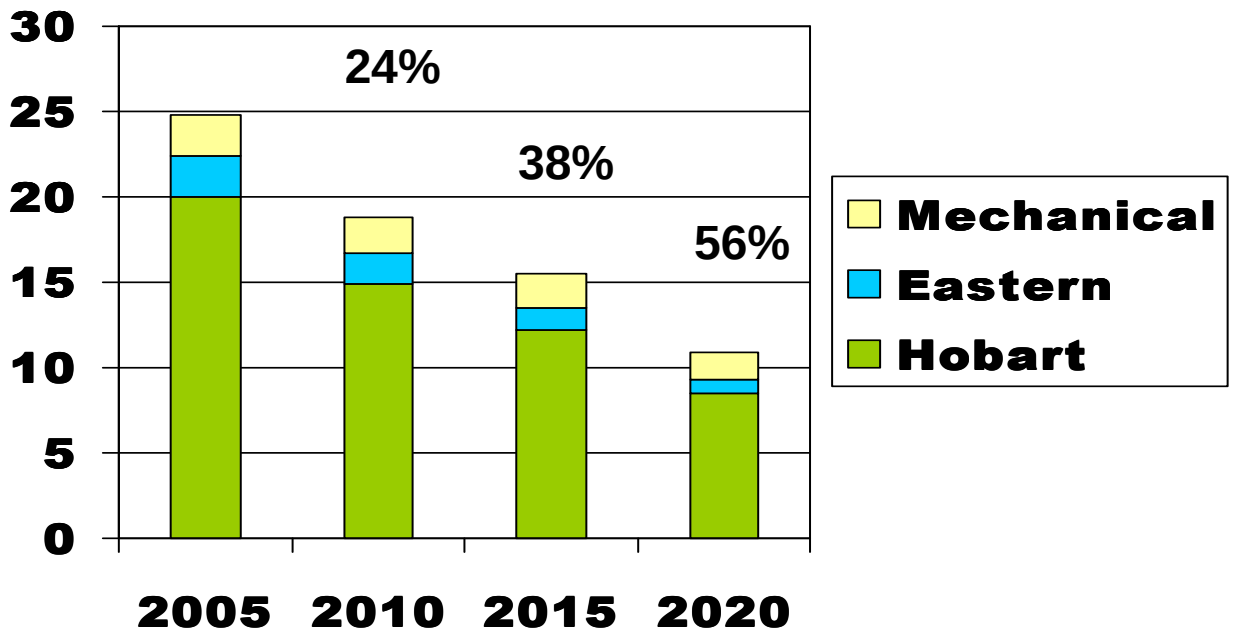
Year	GTM/Gal	Fuel Volume Gal	Million Tons of CO2
1995	693.3	1,080,878,000	12.10
1996	699.4	1,068,834,000	11.96
1997	717.5	1,091,857,000	12.22
1998	736.8	1,154,598,000	12.92
1999	734.4	1,187,305,000	13.29
2000	747.2	1,172,949,000	13.13
2001	760.4	1,177,144,000	13.17
2002	760.3	1,148,682,000	12.86
2003	751.2	1,213,409,000	13.58*

Sources of Emissions, Hobart Yard

- **Drayage trucks** **40%**
- **Cargo handling equipment** **20%**
  - **Cranes**
  - **Yard Tractors**
- **Linehaul locomotives** (Arriving & Departing trains) **10%**
- **Transportation Refrigeration Units** **10%**
- **Switch Engines** **10%**
- **Adjacent Mainline Freight** **5%**
- **Adjacent Commuter Rail** **3%**
- **Other** **2%**

BNSF Commerce Yards, emission reductions

Diesel Particulate Matter in metric tons per year



Predicted reductions with 4% annual growth in activity
Typical drayage truck fleet turnover assumed (not CAAP)

Emission Reductions

- Normal drayage fleet turnover
- Compliance with CARB cargo handling equipment rules
- Use of 15 ppm sulfur fuel for purchases in California
- Compliance with the 1998 MOU for nitrogen oxides
- 30% reduction in switch engine idling due to 2005 MOU
- Reduced idling from current locomotives with idle control devices
- Compliance with CARB rules for refrigerated units
- Compliance with CARB rules for off-road equipment
- Compliance with USEPA proposed rules for locomotive emissions

Summary

- The railroads recognize there are serious air quality concerns, both for ozone and for particulate matter in California.
- People living adjacent to rail yards are exposed to similar risks as those faced by persons living adjacent to freeways and other major transportation facilities.
- Diesel emissions from rail yards are going down, greater than 50% reductions are projected from 2005 to 2020 even after a 4% annual activity growth rate.
- Locomotives account for only one-third of the diesel particulate emissions from rail yards.
- On-road drayage trucks account for one-third of the diesel particulate emissions from rail yards.

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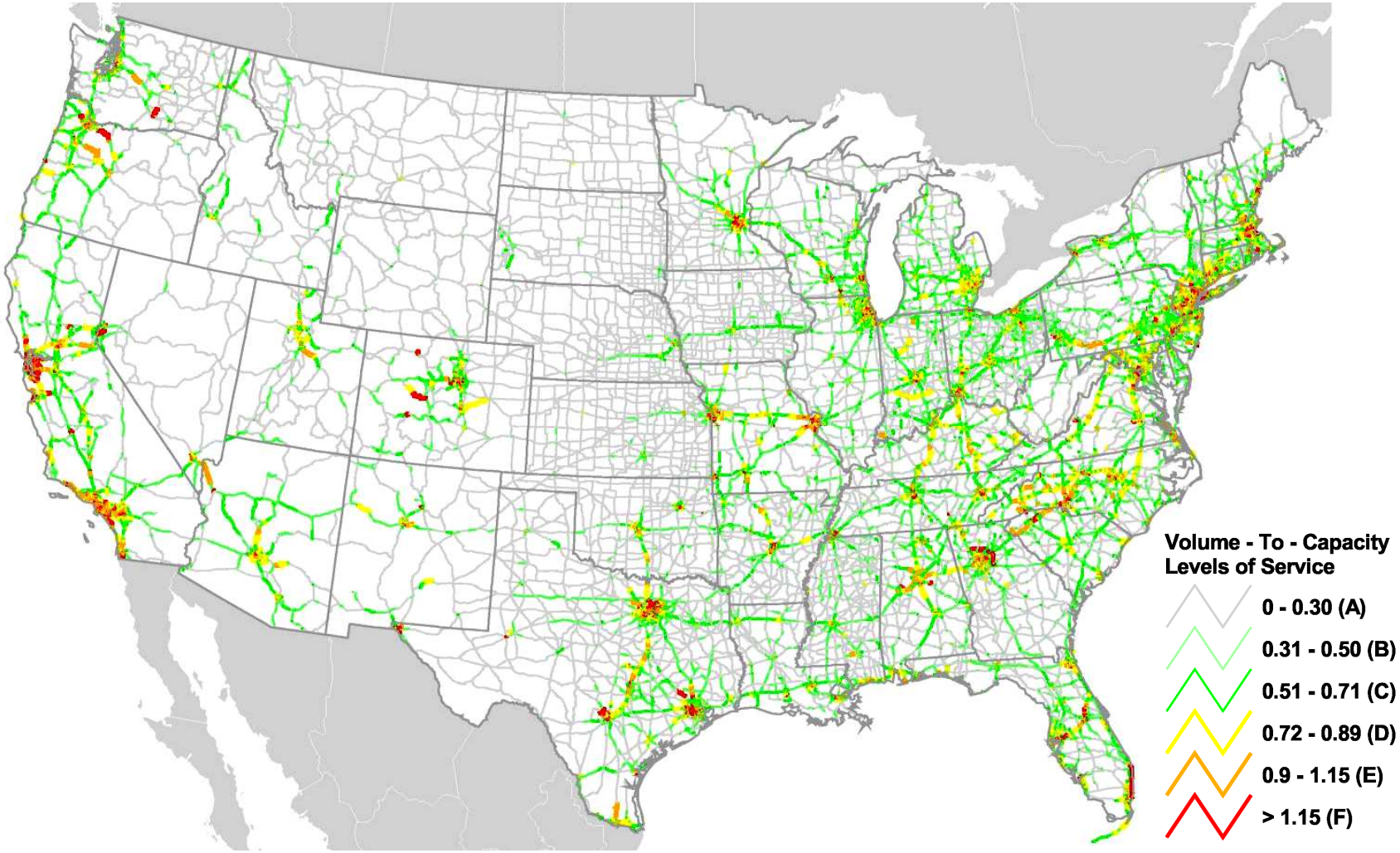
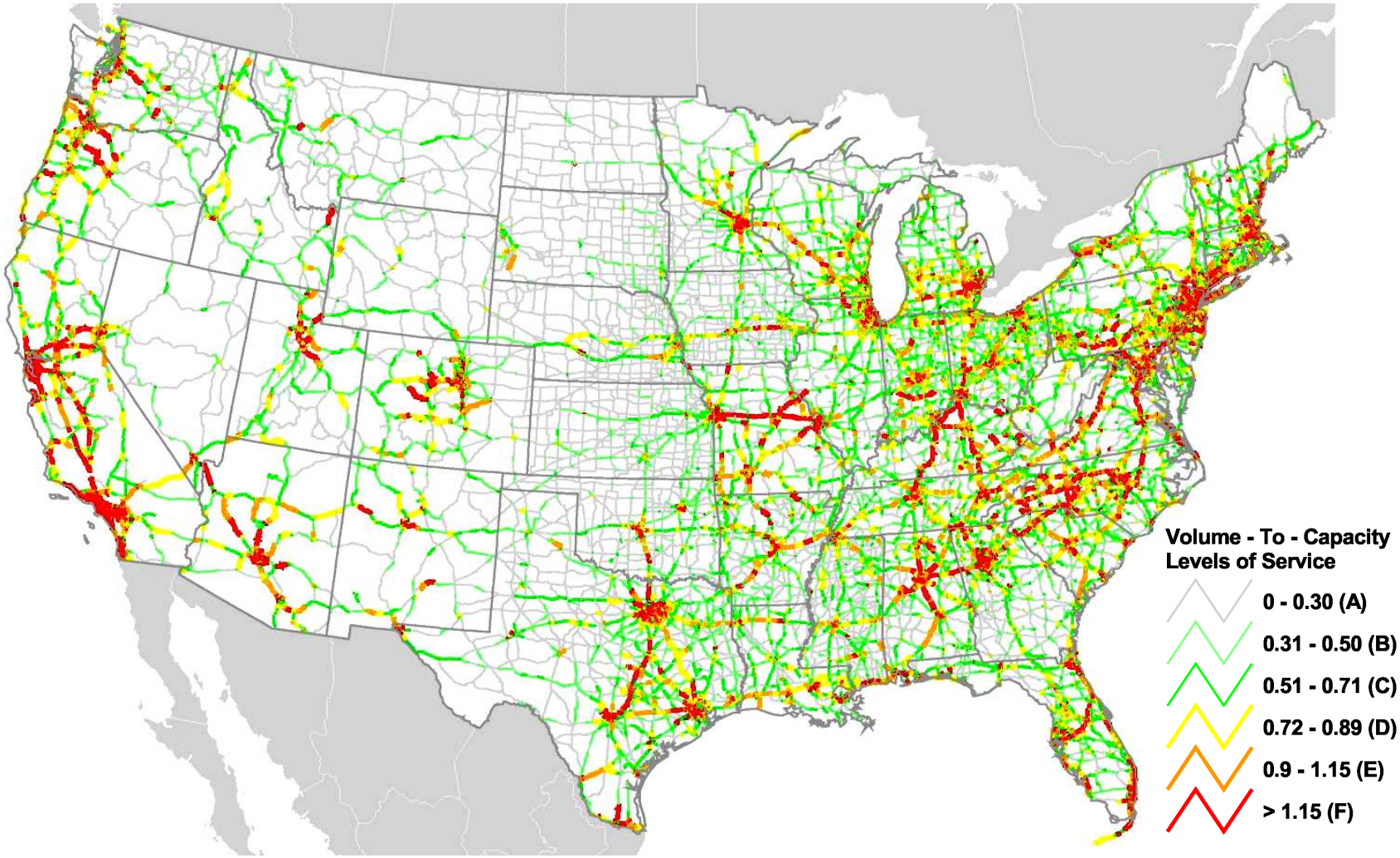
Railroad Emissions, the Future

- 1998 CARB fleet average agreement for NOx reductions
- 2005 CARB PM MOU
  - Ultra low sulfur fuel 6 yrs earlier than EPA rules.
  - Health risk assessments
  - Community meetings
  - Visible emissions program
  - Idling requirements, manual shutdown for all locos and install equipment on intrastate locomotives
- Voluntary purchase of low emitting switch locomotives
- CARB cargo handling equipment rules for cranes and yard tractors.
- Proposed EPA Tier 3 and Tier 4 rules for new locos

Congested Highways, 2000

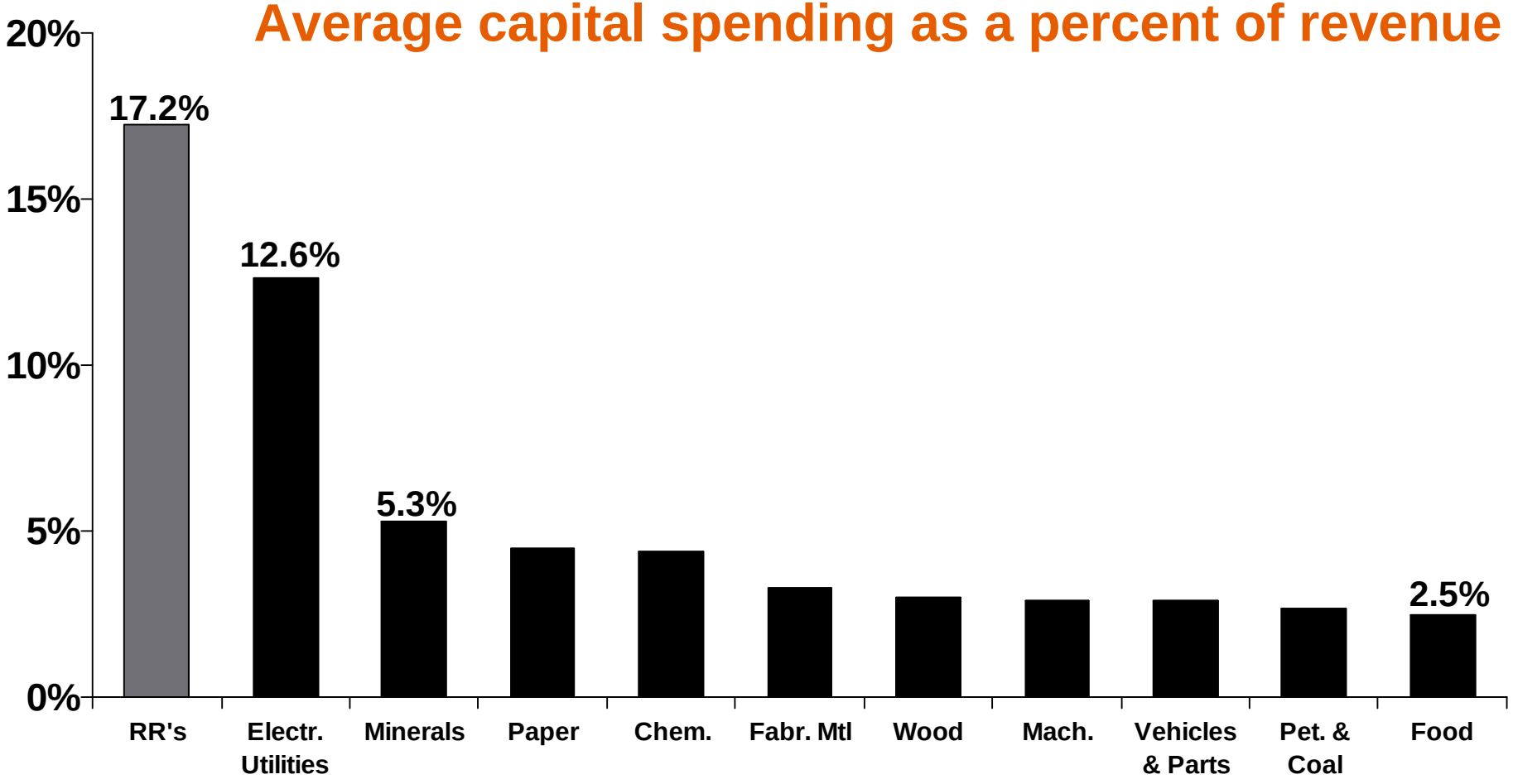


Congested Highways, 2020 predict



Railroading Is Capital Intensive

Average capital spending as a percent of revenue



Source: U.S. Census Bureau; EEI, AAR, Average 1996-2005 (Note: Utilities are 1999-2005)

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