Federal Railroad Administration

Presentation to Mobile Source Technical Review Subcommittee, EPA Clean Air Act Advisory Committee

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Who/what is FRA?

- Primarily regulatory – Office of Safety, inspector force
- Office of Railroad Development
  - High-speed passenger programs
  - Amtrak funding
- No authority to regulate exhaust emissions

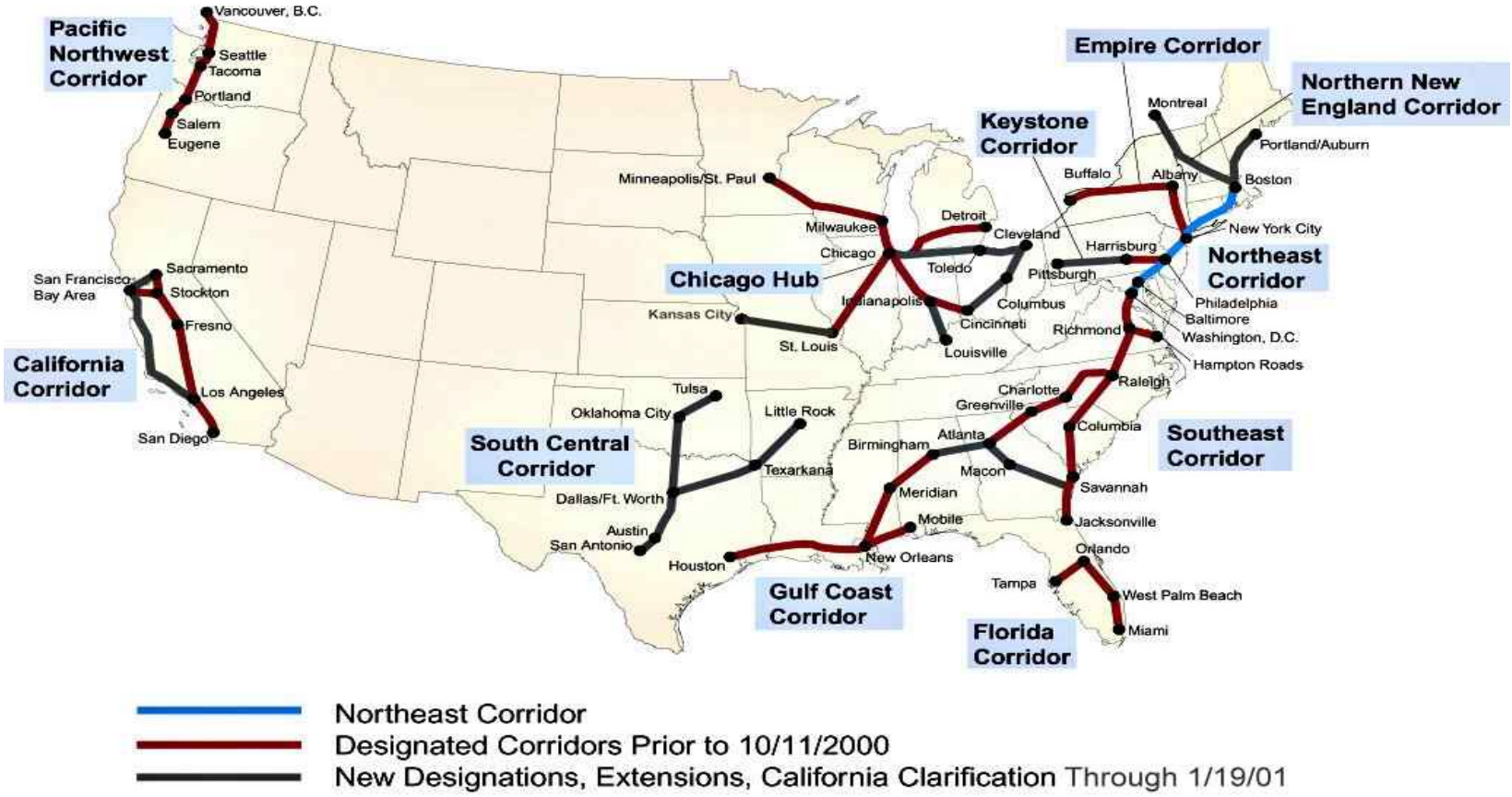
RR Network Efficiency

- Improved RR performance (speed, cost, convenience) tends to divert freight from trucks and passengers from auto/bus/air
- Air-quality benefits from diversion to rail
  - FRA/State/Amtrak passenger programs
  - Freight industry programs to reduce costs/time
- FRA programs to reduce pollution from rail itself

FRA RR Development Programs

- Next Generation High-Speed Rail Tech.
  - Demonstrate incremental speed increases on existing lines to 150mph (passenger service)
- MAGLEV
  - Develop 300 mph + technology
- R & D primarily safety-related
  - Rail lubrication studies, efforts w. DOE

Designated High Speed Rail Corridors As Of 1/19/01



MAGLEV

- Competition to build 1st US high-speed Magnetic Levitation (MAGLEV) train
- Two 40 mile finalists
  - Pittsburgh airport to downtown
  - Baltimore-Washington, DC
  - Both based on German technology

MAGLEV

- FRA matching funds for planning activities
  - Each project to prepare EIS & seek financing
  - Provide DOT information for selecting best project
- Decision to construct in 2003
  - Subject to appropriation of $950M and State/Local/Private financing sources

Next Generation High-Speed Rail (NGHSR)

- Develop & demonstrate technologies to improve feasibility of incremental HSR
  - Non-Electric Locomotives
    - No catenary required, reduces implementation barriers/costs, net air quality benefit over no service
  - Positive Train Control
  - Grade Crossings/Innovative Technologies
  - Track & Structures

NGHSR Turbine Electric Demo. Locomotive

- 5000hp gas turbine-electric locomotive
- Based on Acela Express power car body
- Joint FRA-Bombardier $13M/$13M shared
- Performance similar to electric, to 150mph
- Provide high-speed service outside of NEC
- Under test, demonstration to start 9/01

NGHSR Turbine Electric Demo. Locomotive

NGHSR Turbine Electric Demo. Locomotive

- Estimated Emissions on Simulated Route
  - Toronto-Montreal
  - 1-4-0 consist, 125 mph maximum
  - 9 inches cant deficiency
  - 239 seats, 350 kW HEP load
  - Compared to Tier II compliant diesel

(courtesy of Bombardier Transportation)

NGHSR Turbine Electric Demo. Locomotive

Toronto to Montreal Estimated Emissions – 1 Train, 1-Way			
	HC (kg)	CO (kg)	NOx (kg)
EPA - Tier 2	2.74	13.48	52.64
Turbine-Electric – Estimated	1.75	5.32	38.97
Reduction	.99	8.16	13.67
Turbine-Electric Improvement	36%	61%	26%
*Particulate matter data not available for turbine at this time (courtesy of Bombardier Transportation)			

Auto-Air-Rail Comparison

10,000 Passengers, Toronto to Montreal				
Mode	Fuel (kg)	HC (kg)	CO (kg)	NOx (kg)
Auto[1.)]	95,563	868	7,200	847
Air[2.)]	260,905	123	1,304	18,512
Rail[3.)]	44,310	105	319	2,338

1.) 22 mpg, MY1999 EPA emissions, 1.7 occupants
2.) 50% Boeing 767-200, 50% Airbus 320, 70% Load Factor
3.) 1-4-0 consist, 70% Load Factor
(courtesy of Bombardier Transportation)

Advanced Locomotive Propulsion Systems (ALPS)

- Develop/demonstrate technologies
  - high-speed lightweight generator
  - energy storage flywheel
- Demonstrate with Bombardier locomotive
- U-Texas @ Austin (lead), Honeywell, Navy (NSWC), Argonne NL, Seneca Group

ALPS

- Lightweight 15,000 rpm generator for direct drive from turbine (no reduction gear)
  - Module with TF-40 turbine in loco. in CY02
- Flywheel (recover braking energy, aid acceleration, reduce turbine cycling)
  - 2MW (2700hp) for 3 minutes
  - Demonstrate with locomotive CY2003

Turboliner Upgrade

- Turbine trainset for Empire Corridor (NYC-Albany) service @ 110+ mph
- RTL-2 test vs. diesel (F-40) (approximate):
  - 90% reduction in NOx, 80% reduction CO
  - 70% reduction in PM, HC improved some

  (Source: USDOT/FRA – " Measurement of Air Pollution Emission from the RTL-2 Turboliner", 2/9/98)
- 7 RTL-3s now being built - expected to be even better

Turboliner Upgrade

Positive Train Control/Grade X-ing.

- 2 train control technology demonstration programs underway (MI & IL)
  - Increased safety and maximum speeds, lower implementation costs over current technology
  - Increased capacity/efficiency -> reduced idling on sidings and speed changes
    - Reduced fuel consumption and emissions
- Grade crossing improvements can increase speeds, decrease trip times & emissions

Modal Energy Consumption

- Truck vs. Freight Rail (kW-hr/Ton-Mi)
  - Truck: 0.876 kW-hr/Ton-Mi
  - Rail: 0.106 kW-hr/Ton-Mi
- Truck - 1,027,000 Million Ton Miles/year
- Rail - 1,376,802 Million Ton Miles/year

(Source: Transportation Energy Data Book - Edition 20–2000)
(http://www-cta.ornl.gov/data/tedb20/Index.html)

Modal Energy Consumption

- Air vs. Auto vs. Intercity Rail (National Average)
  - Air: 1.171 kW-hr/Passenger- mile
  - Auto: 1.075 kW-hr/Passenger - mile
  - Intercity Rail: 0.720 kW-hr/Passenger - mile

(Source: Transportation Energy Data Book - Edition 20–2000)
(http://www-cta.ornl.gov/data/tedb20/Index.html)

Modal Energy Consumption

- Maglev vs. Metroliner vs. Diesel (Hypothetical Route)
  - Maglev: 163 W-hr/Seat Mile
  - Metroliner: 98 W-hr/Seat Mile
  - Diesel: 55 W-hr/Seat Mile
- Assumptions:
  - Diesel efficiency ~ 0.3, 40.64 kW-hr/gallon
  - Maglev - 150 seats, Metroliner and Diesel - 264 seats
  - 50 mile straight flat route

(Source: USDOT/FRA – " High-Speed Ground Transportation for America", 9/97)

Summary

- Rail/MAGLEV transportation of people and goods can offer substantial air quality benefits over auto/truck/air transport
- Benefits of Next Generation turbine-electric passenger locomotives/ALPS over traditional equipment appears significant, remain to be demonstrated

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