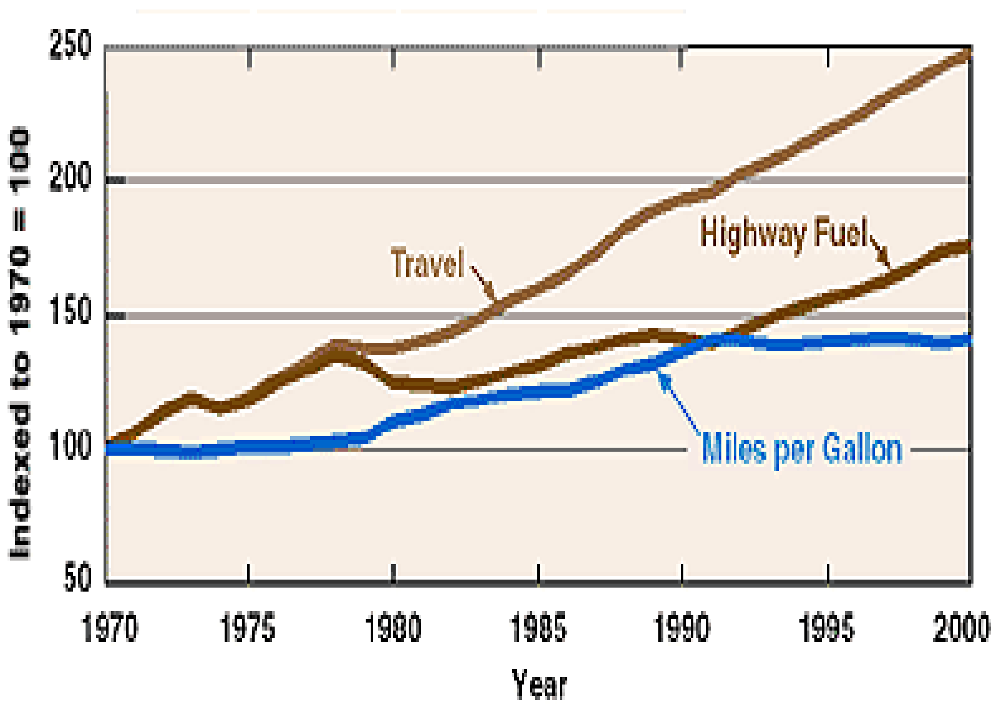
APPENDIX F: FUEL SAVINGS ANALYSIS

Fuel Savings Analysis

Fuel Savings Calculation

- Step 1 – Estimate Fuel Rates per Passenger-Mile for each mode
- Step 2- Estimate Passenger-Mile Diversion from Each Mode, along with Induced Demand
- Step 3 – Calculate Net of Fuel Savings: Savings of each mode, minus Projected Rail Fuel Consumption

: Motor Fuel Use and Miles per Gallon of Fuel for All Vehicles



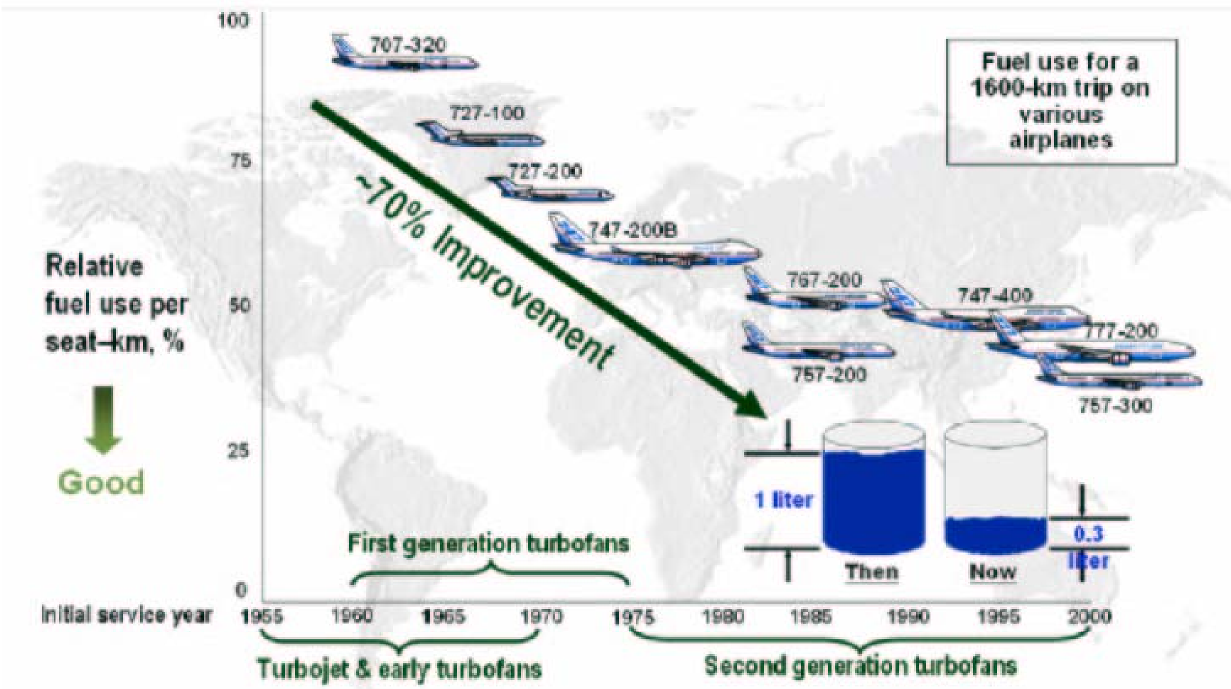
Auto MPG leveled out at about 20.8 mpg since 1990; since then, highway fuel use has been steadily increasing.

Average occupancy of 1.2 riders/auto gives average auto fuel rate of 25 passenger-miles

Source:

http://www.fhwa.dot.gov/ohim/onh00/onh2p8.htm

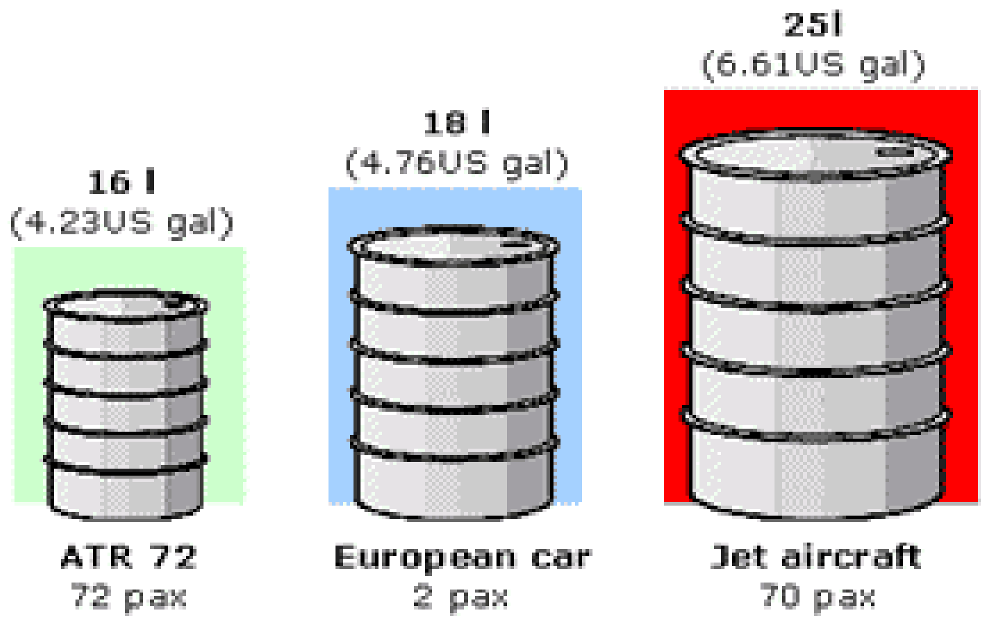
Airline Fuel Efficiency has been Steadily Improving



Source:
http://www.ryanair.com/site/news/releases/2005/elfaa.pdf

Short haul airlines typically get lower fuel efficiency because take-offs and landings consume high amounts of jet fuel

Fuel Consumption per Passenger
200 NM (370 km) Stage Length
Aircraft with 65% LF



Source: http://www.atraircraft.com/outstandfig.htm

. . . Although for short-haul service, tuboprops can be substantially more fuel efficient than jets. 34.8 pmpg for Jet; 54.4 pmpg for ATR; but turboprops are not as well-accepted by potential riders

Bus Fuel Efficiency

- Buses are the most fuel-efficient mode of transportation, provided they operate at reasonably high load-factors
  - 162 pmpg for a fully loaded Greyhound bus. Source: http://ask.metafilter.com/mefi/25722
  - 65% load factor gives 105 pmpg
  - This makes sense considering lighter weight and slower speed of buses, as compared to trains

Rail Fuel Issues

- Historical comparisons of rail fuel efficiency are confounded by express freight, baggage, dining cars, etc which are hard to separate out of the base statistics.
- Source: http://www.railway-technical.com/US-fuel-paper.html
- Very high-speed trains may not be more fuel efficient than airplanes. There is a 50% energy penalty for increasing speed from 300 km/hr (186 mph) to 360 km/hr (225 mph.) This is of course, much higher than the anticipated speed for the Ohio Hub service.

  Source: http://europa.eu.int/comm/research/news-centre/en/tra/02-07-tra01a.html

Rail Fuel Issues (ctd)

- In spite of the energy increase for higher speed, European trains still maintain their energy efficiency. German studies of high speed rail show their high-speed train - ICE - to use as little as 23% of the energy of aircraft, counting energy from the plant and transmission system as well.

  Source: http://lomaprieta.sierraclub.org/highspeedrailqanda.html
- They can do this for two reasons:
  - European trains are much lighter than their U.S. counterparts, since they don't have to meet U.S. buff strength regulations
  - European trains have more seats and often better load factors than their U.S. counterparts. For example, the French double-deck TGV has 510 seats
- Both of these factors contribute to higher energy efficiency of European trainsets

Ohio Hub Fuel Consumption

- 549.018 million passenger-miles

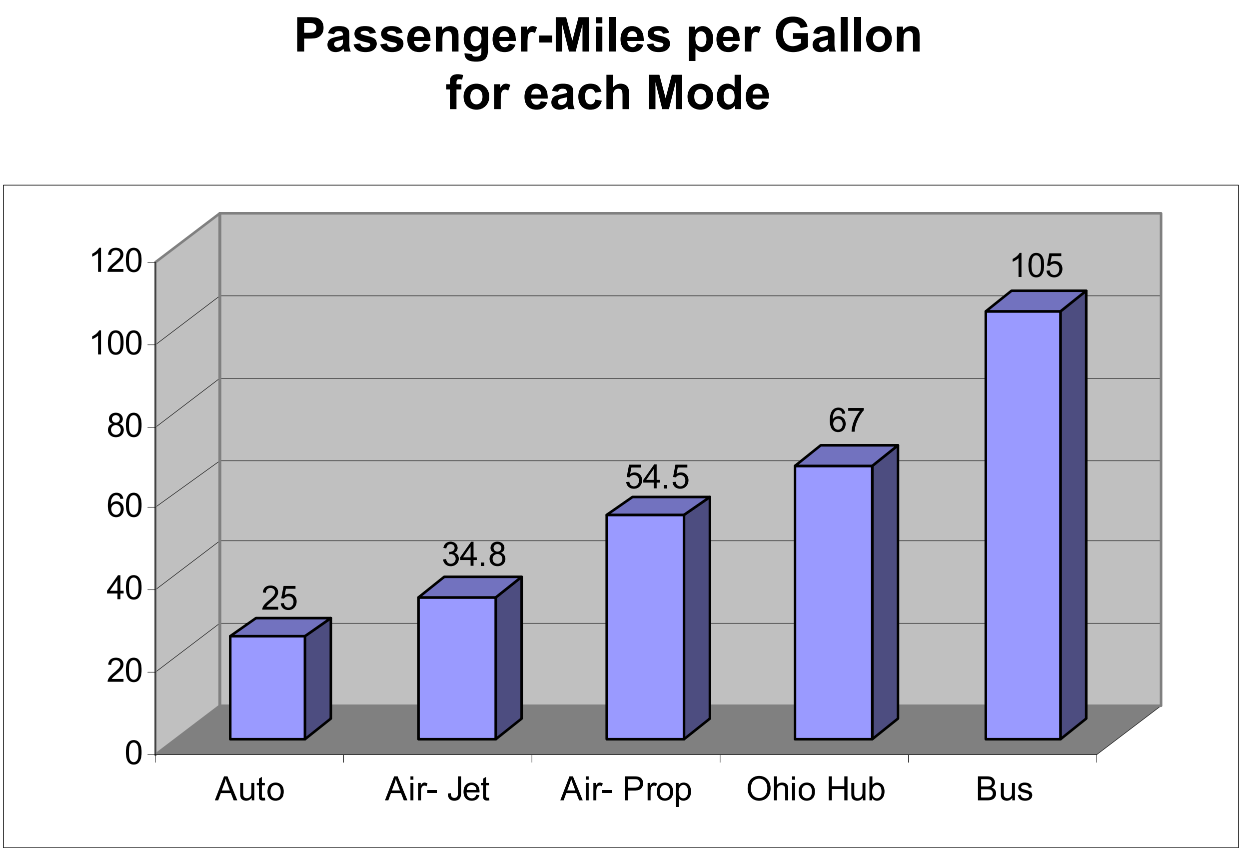
  Source: The Ohio and Lake Erie Regional Rail Cleveland Hub Study: TEMS, Inc. 2004. Exhibit 5-6 (Year 2025, Option 1, High Speed, Shared).

- Assumed fuel rate of 2.42 gallons per mile for a 300-seat train. At 100% load factor this would give a fuel rate of 124 seat-miles per gallon. It also gives the average **fuel price of $0.96 per gallon** that was used in the report.
- Source: The Ohio and Lake Erie Regional Rail Cleveland Hub Study: TEMS, Inc. 2004. page 6-23

- Total fuel cost $7,878,000 per year. This is equivalent to **8.19 million gallons** at $0.96 per gallon

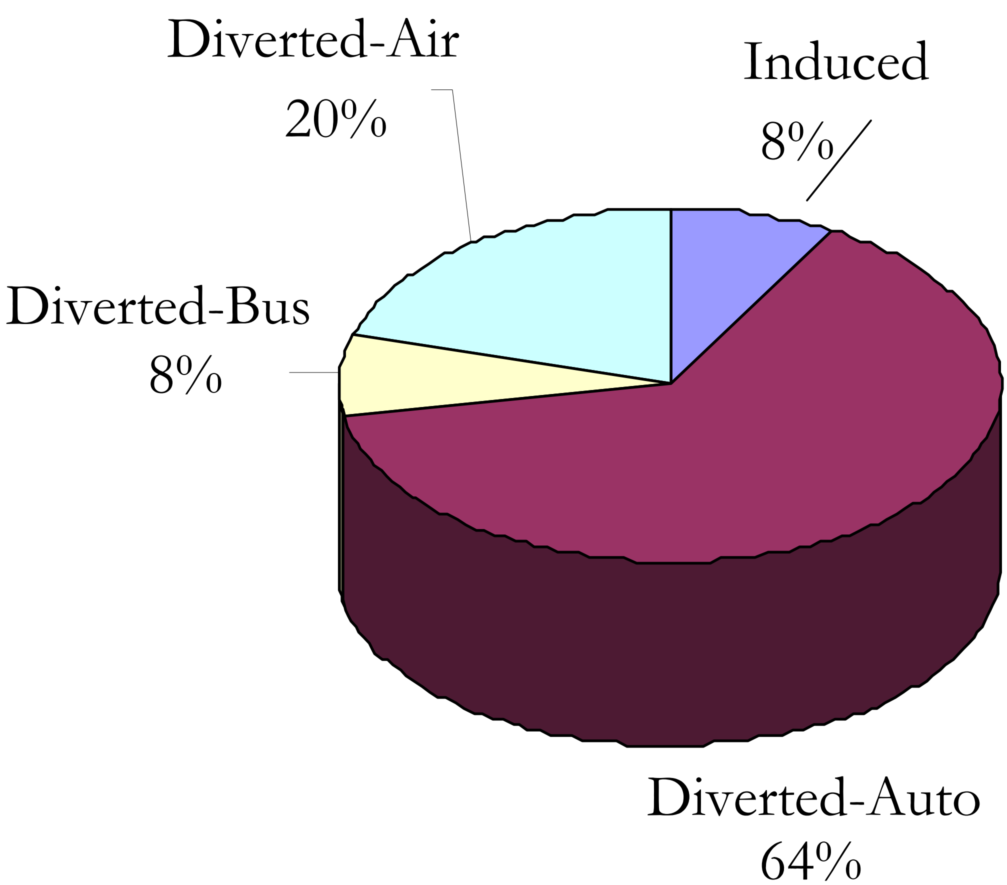
- Average efficiency of Ohio Hub: **67 pmpg**

Relative Modal Fuel Efficiency



Ohio Hub Passenger Miles

549.018 million passenger-miles
Source: The Ohio and Lake Erie Regional Rail Cleveland Hub Study: TEMS, Inc. 2004. Exhibit 5-6 (Year 2025, Option 1, High Speed, Shared).



Ohio Hub Fuel Calculation

Rail Fuel Consumption:	8.2 mill gall
2025 Fuel Savings:	
Auto Diversion	14.0
Air Diversion	3.2
Bus Diversion	0.4
Induced	0
TOTAL Diversion Savings	17.6

Net Fuel Savings in 2025	9.4 mill gall