

**AVIATION OPERATIONAL MEASURES FOR**  
**FUEL AND EMISSIONS REDUCTION**  
**WORKSHOP**



**Fuel Efficiency**  
*We've come a long way --*



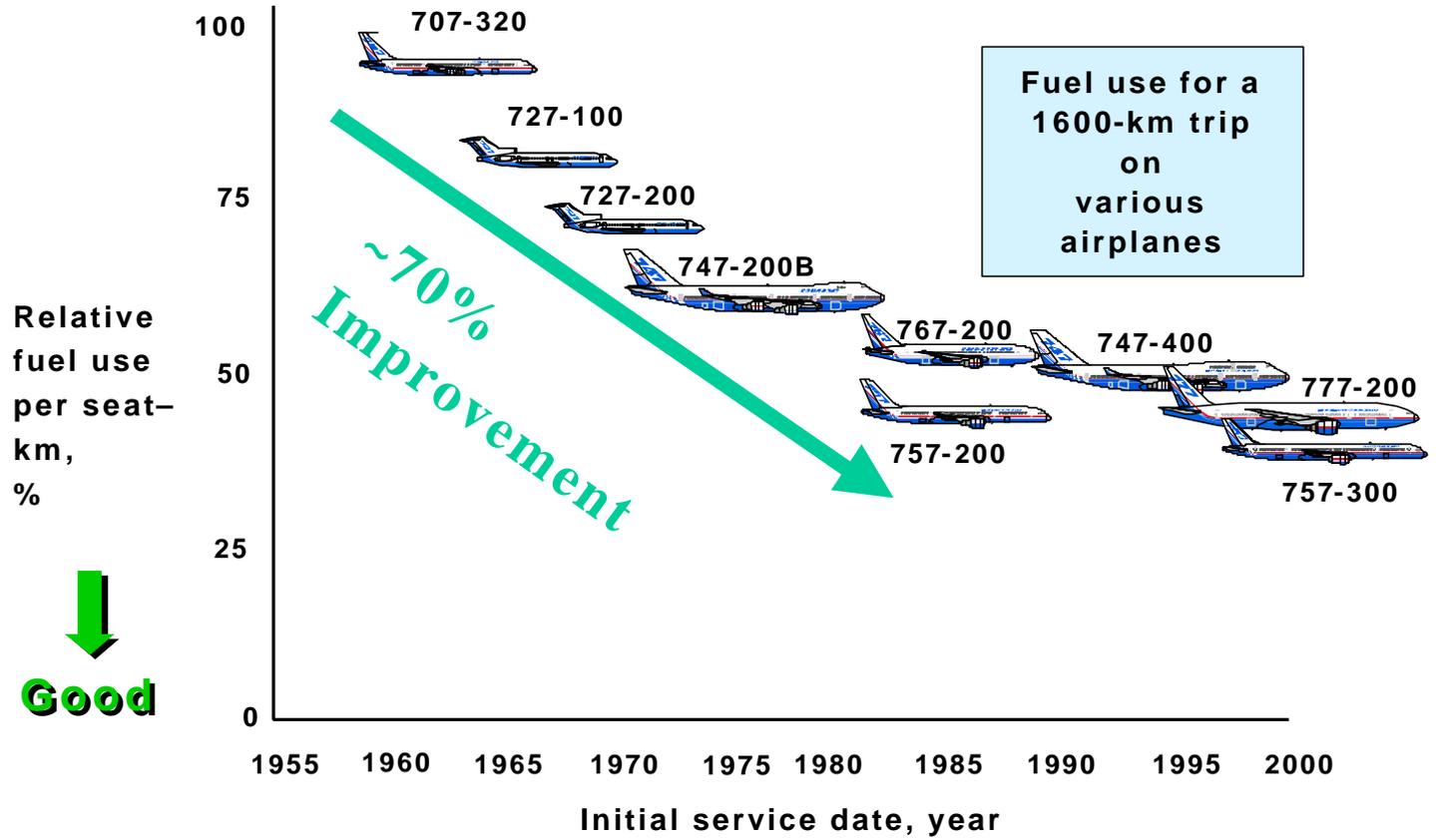
Mark Janes

Boeing Commercial Airplanes



Ottawa, 5-6 November 2002

# Airplane fuel use has decreased ...



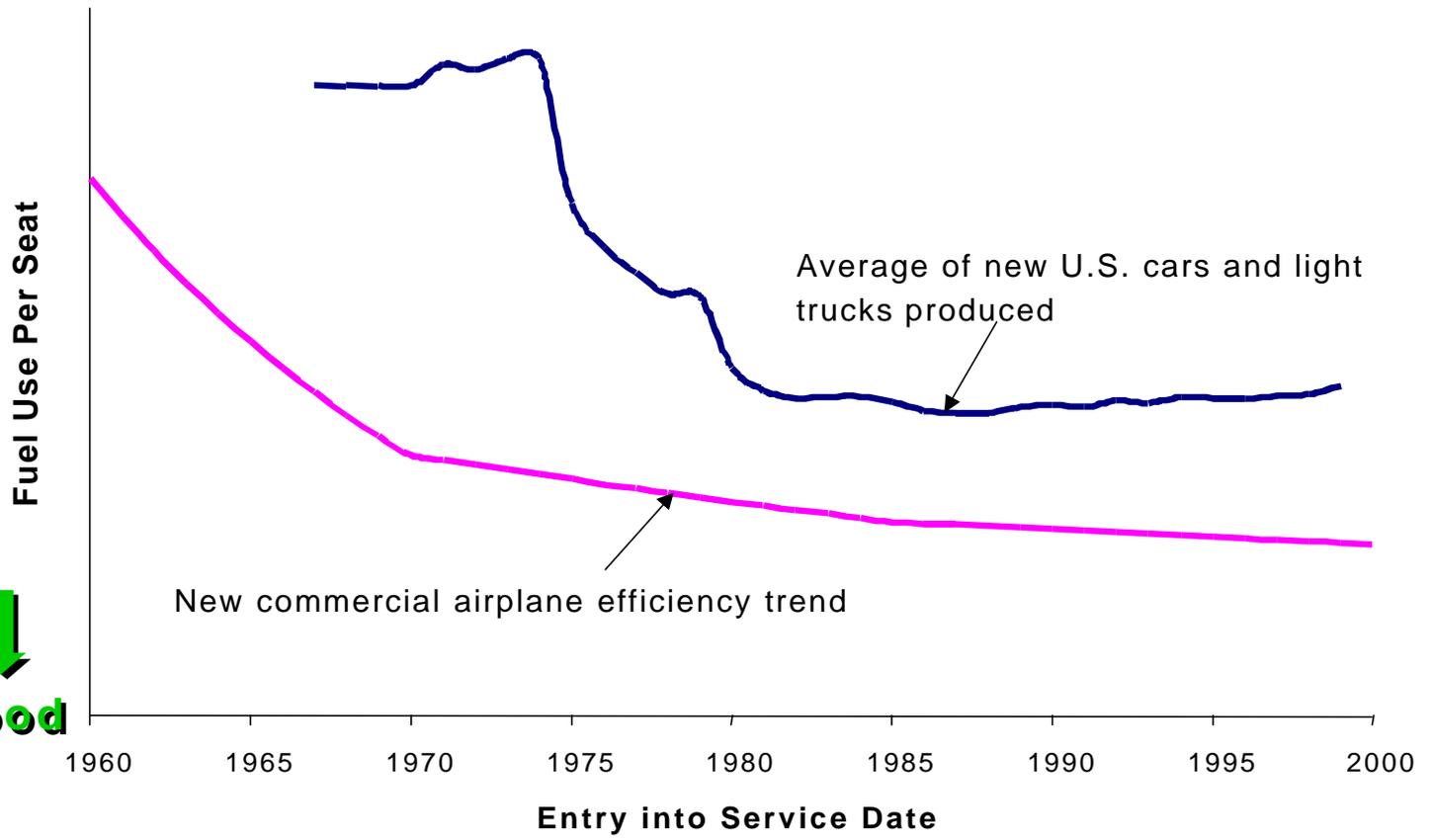
Relative fuel use per seat-km, %

↓  
**Good**

Fuel use for a 1600-km trip on various airplanes

~70% Improvement

# ... and efficiency improvements continue



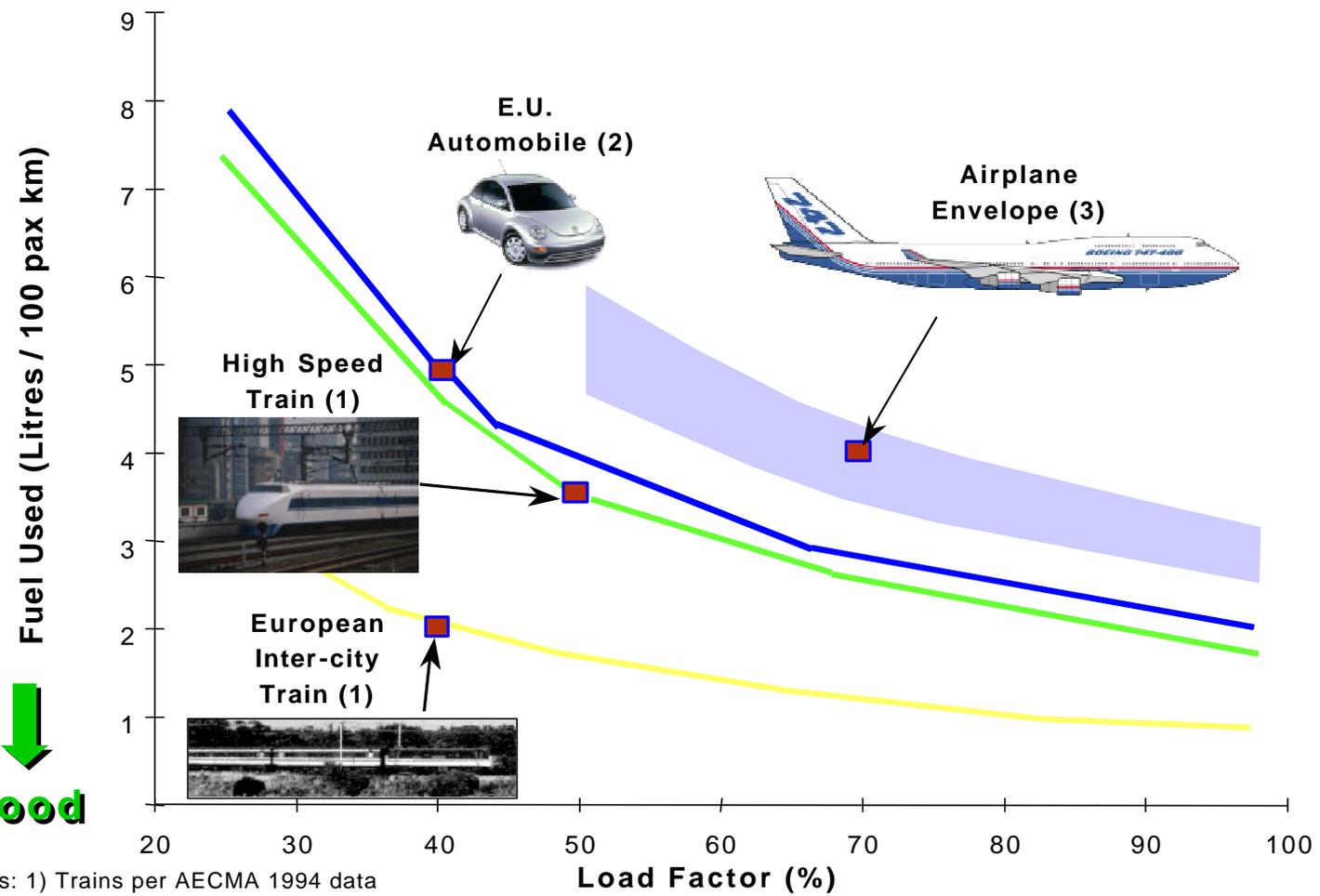
Good



1. Aircraft fleet are non-weighted, new type model trend lines
2. Vehicle fleet are for weighted, new gasoline car & light duty truck averages per EPA420-R-99-018
3. Aircraft data are based on a 70% load factor, 1,100 nmi trip, most popular seating configuration
4. Vehicle data are plotted with 1.5 passengers per car



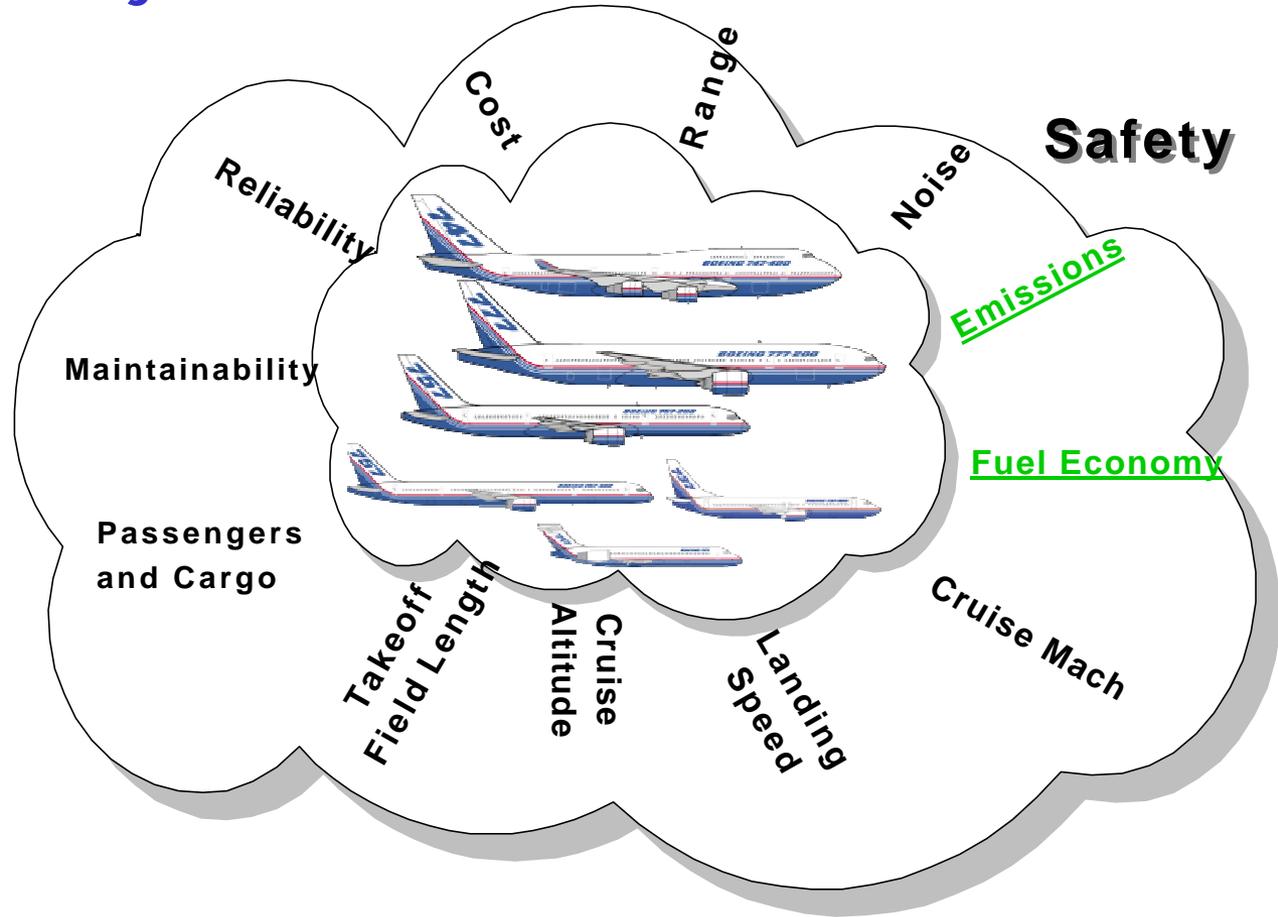
# Airplanes are very competitive on fuel efficiency



Notes: 1) Trains per AECMA 1994 data  
 2) Typical EU Car per Eurostat (12.6 km/ltr, 1.7 passengers)  
 3) Planes on 1500nmi mission, 70% LF, most popular seating config., best operating conditions

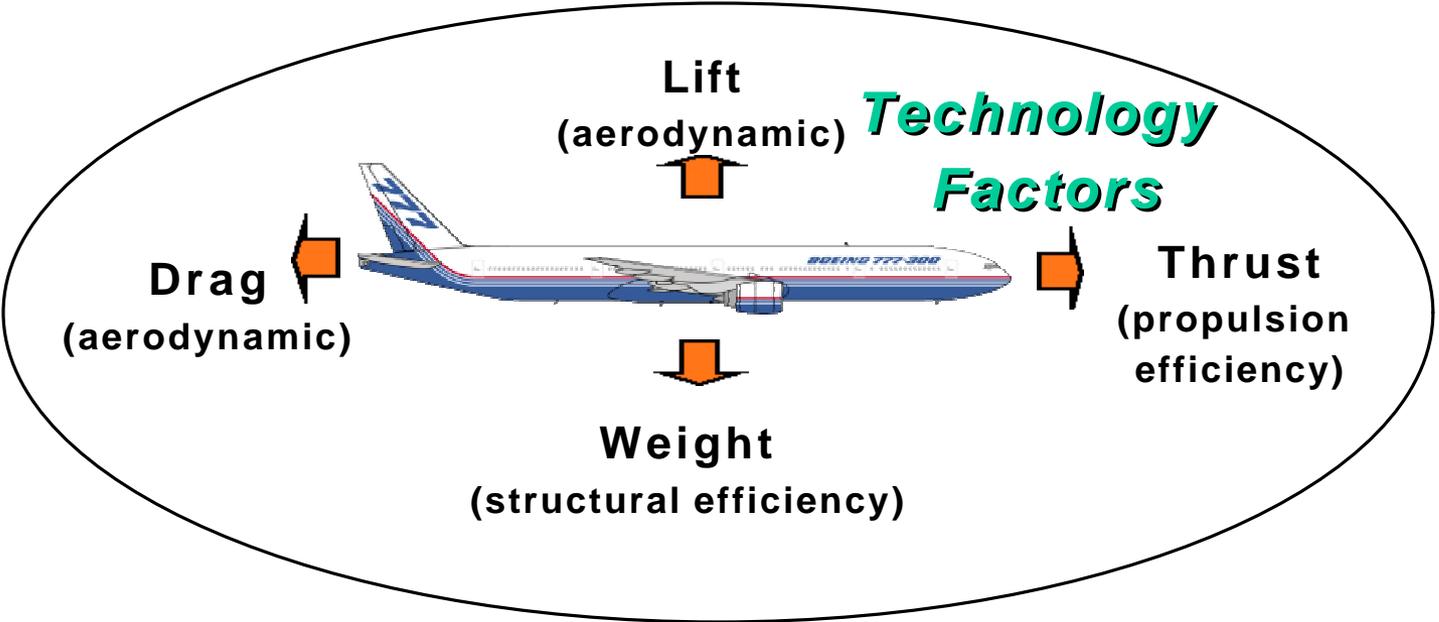
■ = Typical Load Factors

# Airplane design is always a balance amongst various objectives

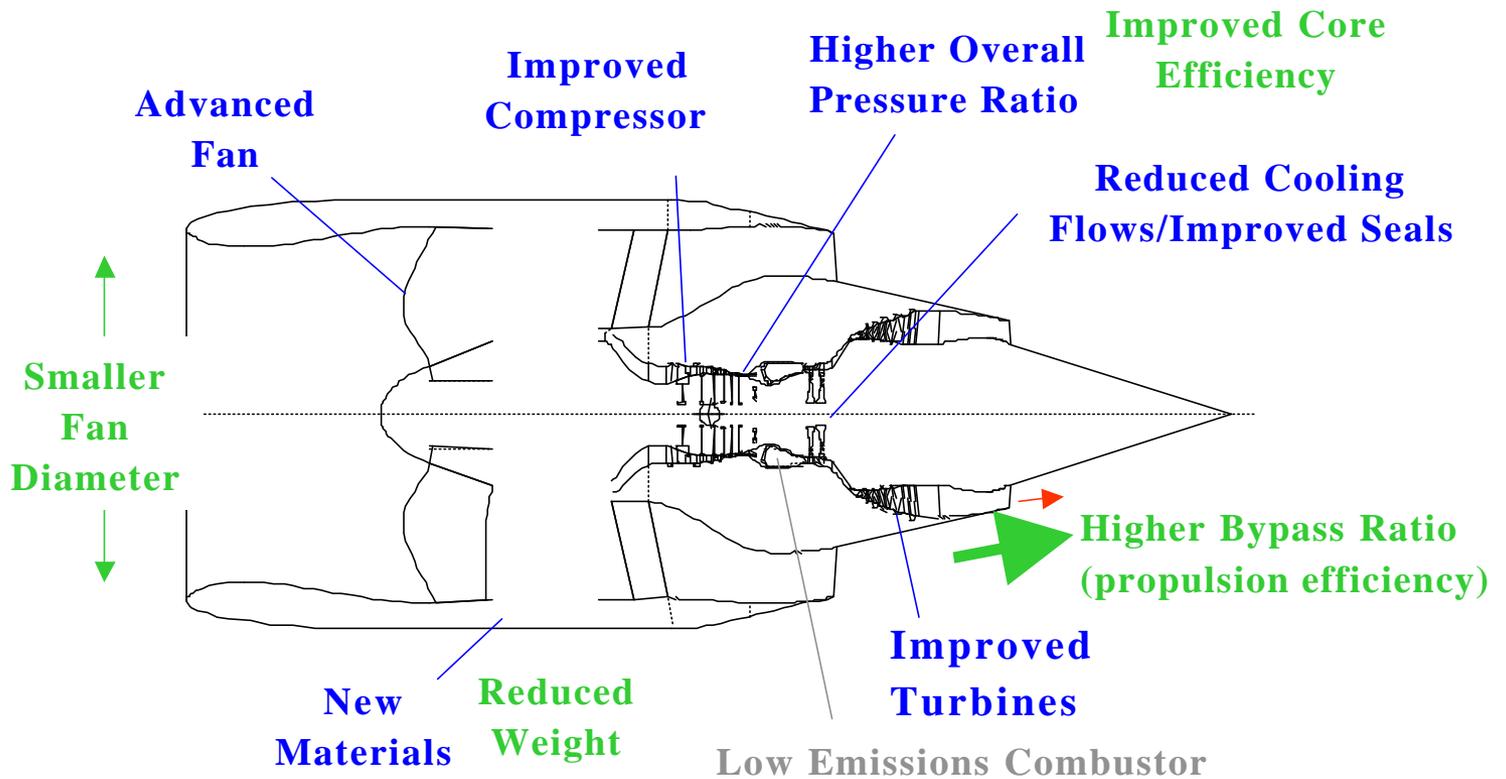


# Factors affecting fuel economy

## *Operational Factors*



# Engine companies and Airframers work together to improve fuel efficiency ...



# Engine integration determines optimal By Pass Ratio and best airplane fuel efficiency

