



# *Heavy Trucks and Hydrogen: The Future of Heavy Trucks*

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**DAF**



**PACCAR** Inc

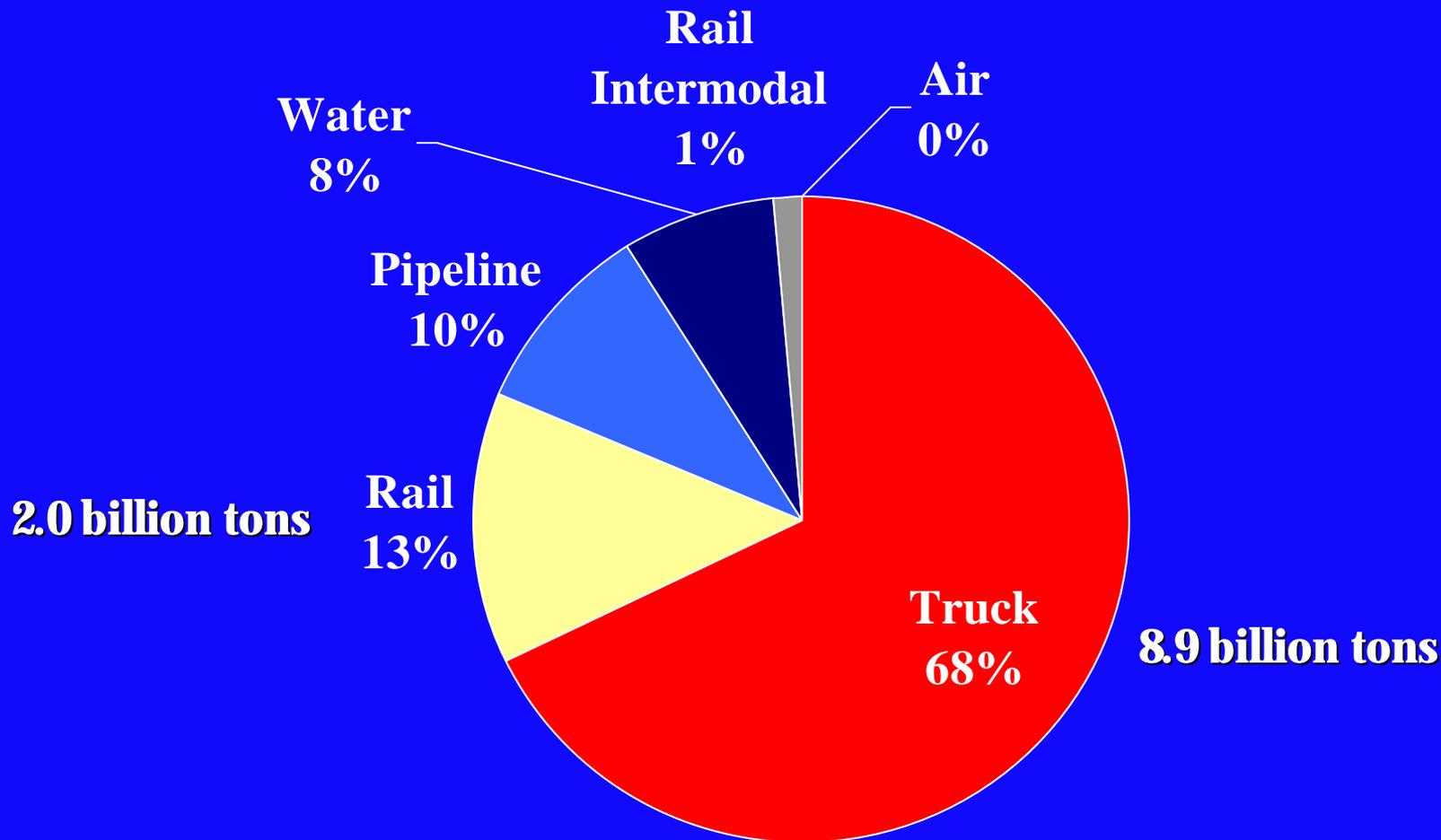




## Available today:

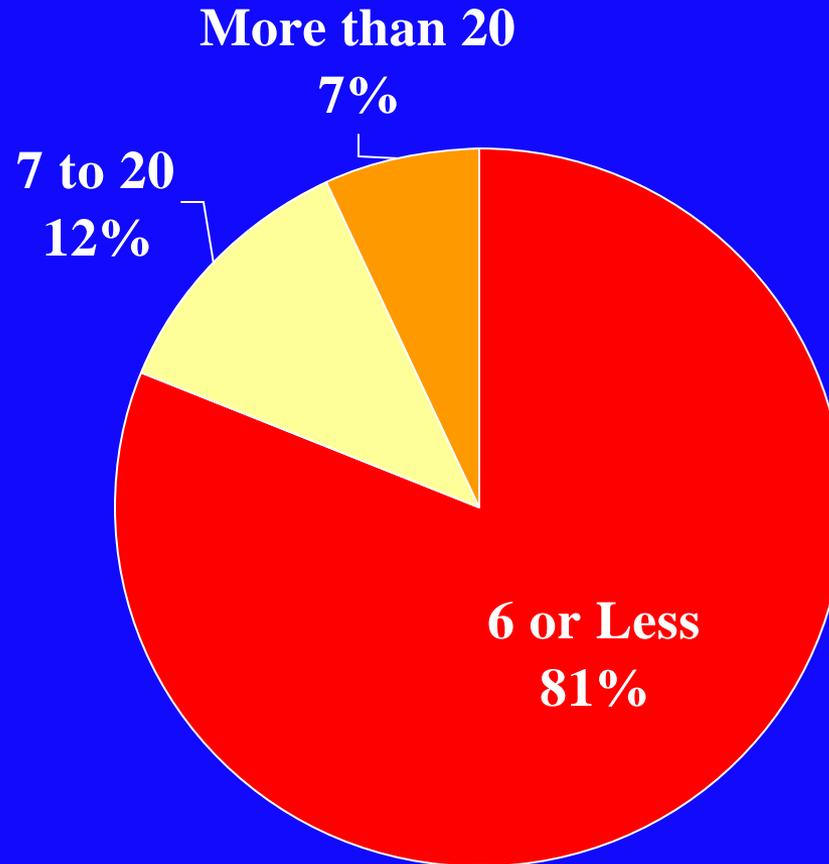
- **ABS**
- **Frontal airbags**
- **Electronic engines**
- **Up to 600 hp**
- **Automated transmissions**
- **Hotel features in sleeper**
- **Collision warning/adaptive cruise control**
- **Multiplexed electrical system**
- **Wireless communications**
- **Lightweight materials**
- **Aerodynamic tractor**

# Freight Transportation Modal Share (2002 Tonnage)



Source: *U.S. Freight Transportation Forecast...To 2014*  
Courtesy of ATA

# Distribution of Motor Carriers Operating a Given Number of Power Units



**About 1.2 million interstate and intrastate U.S. motor carriers**

# Truck Design Priorities

**Safety**

**Security**

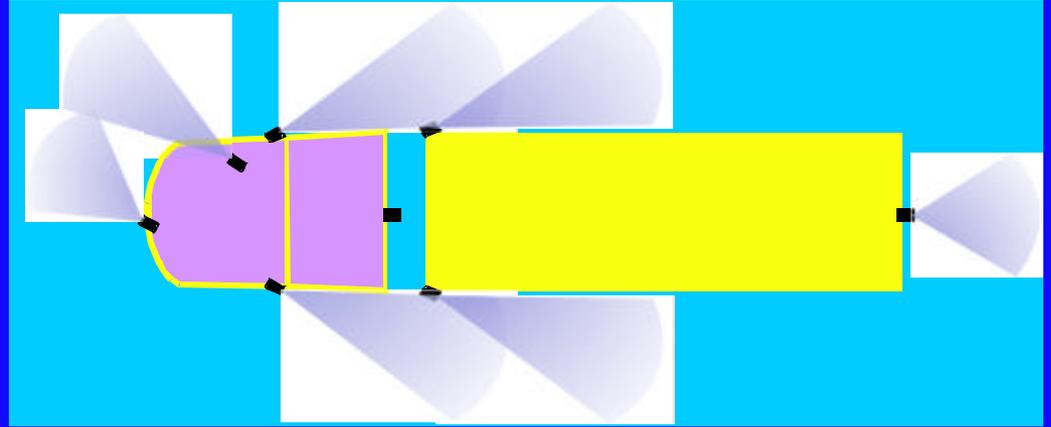
**Comfort and convenience**

**Environmentally friendly**

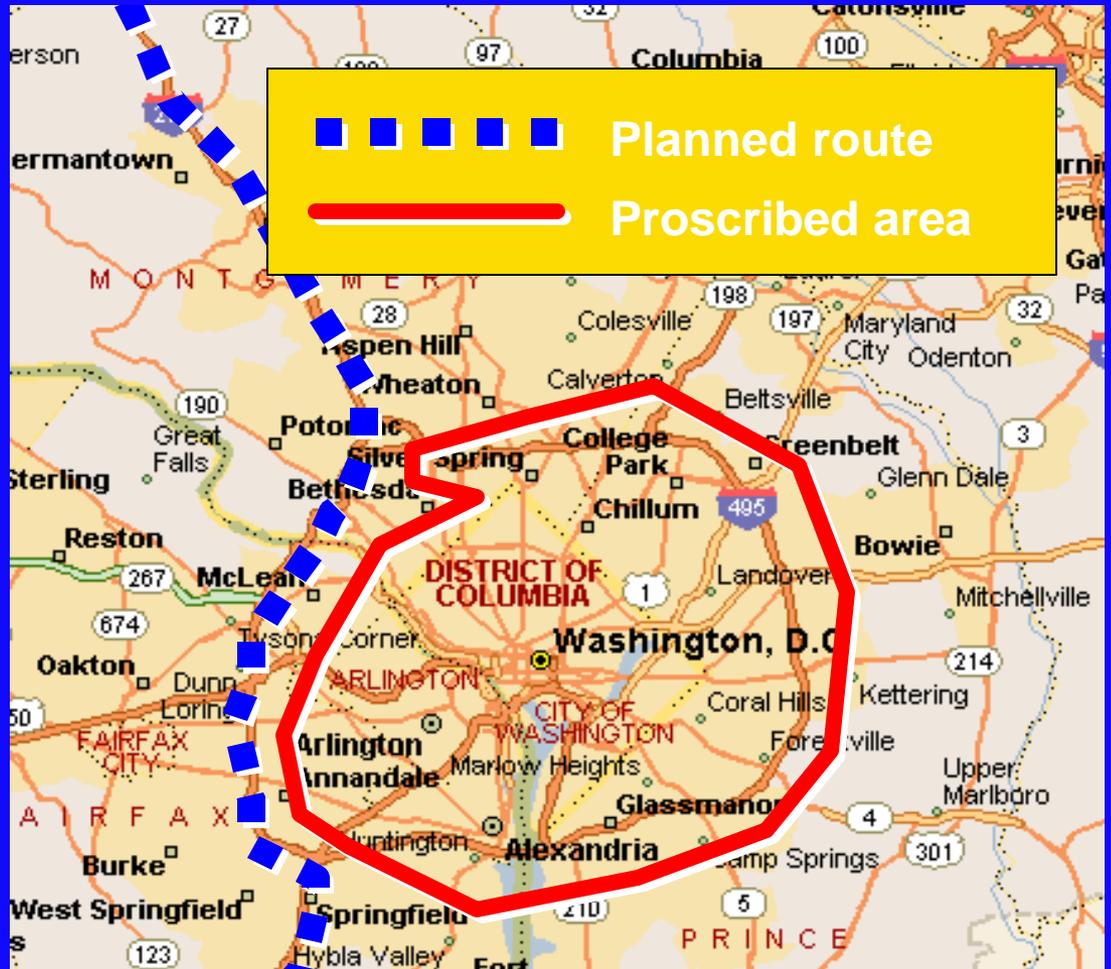
**Fuel efficiency**

**Transportation efficiency**

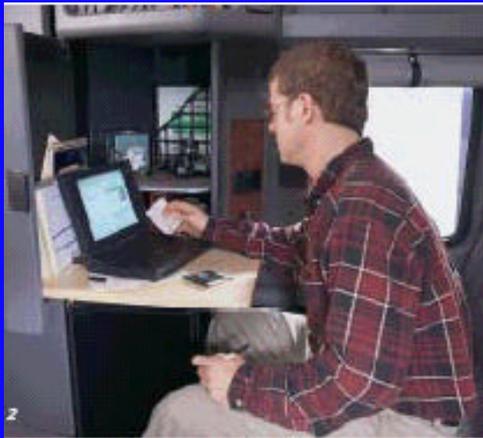
# Safety



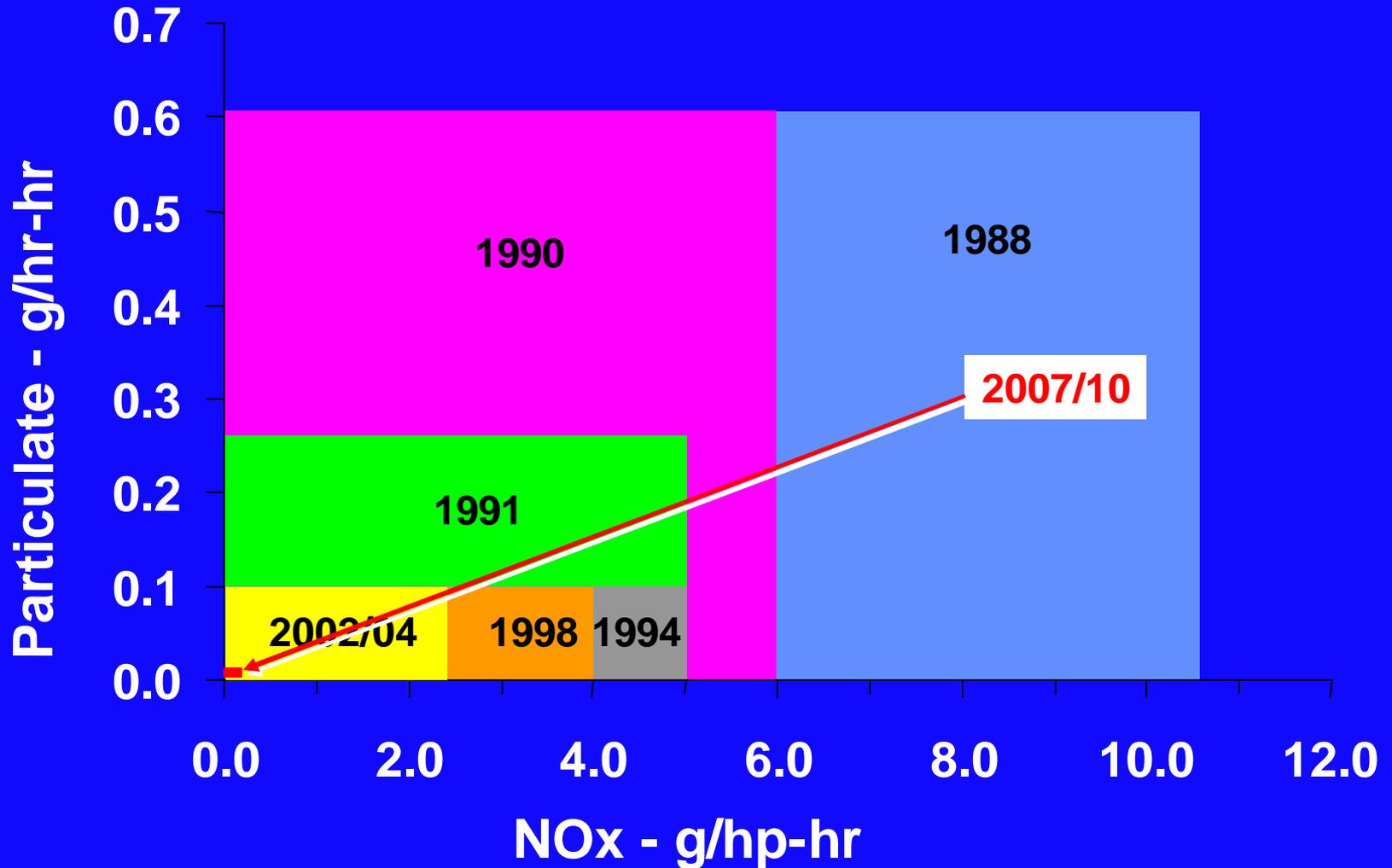
# Security



# Comfort and Convenience



# 2007 Emissions

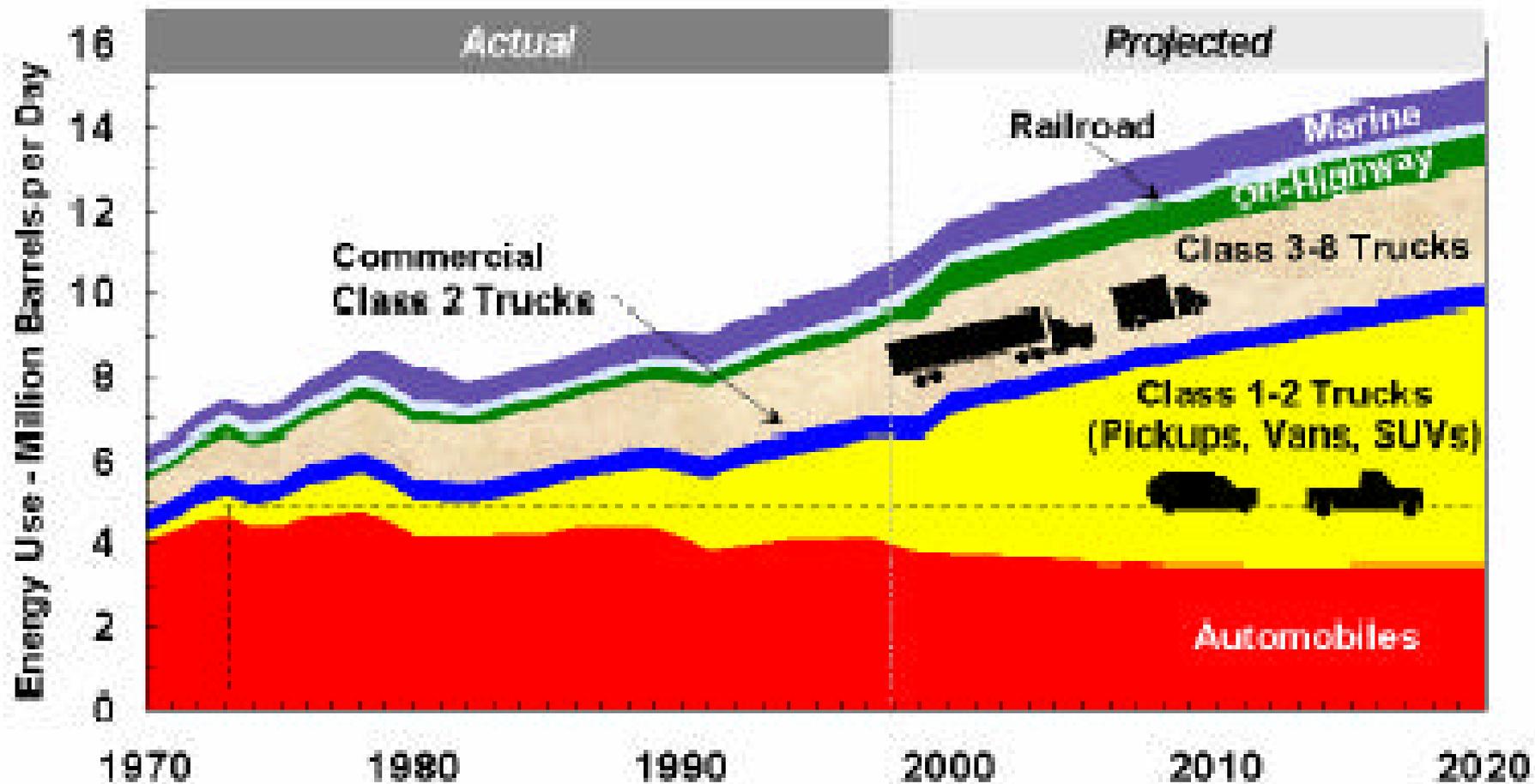






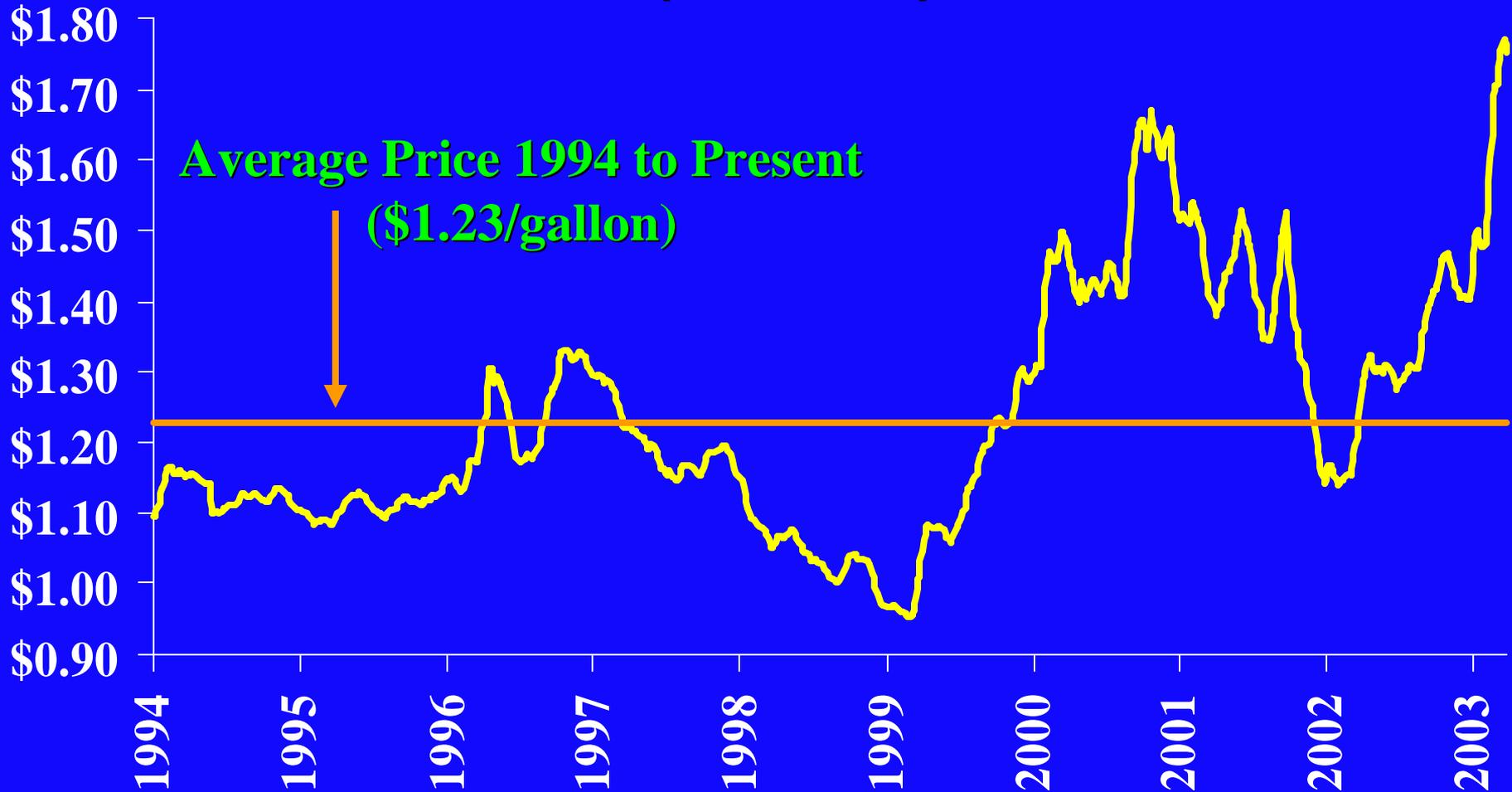
Courtesy of ATA





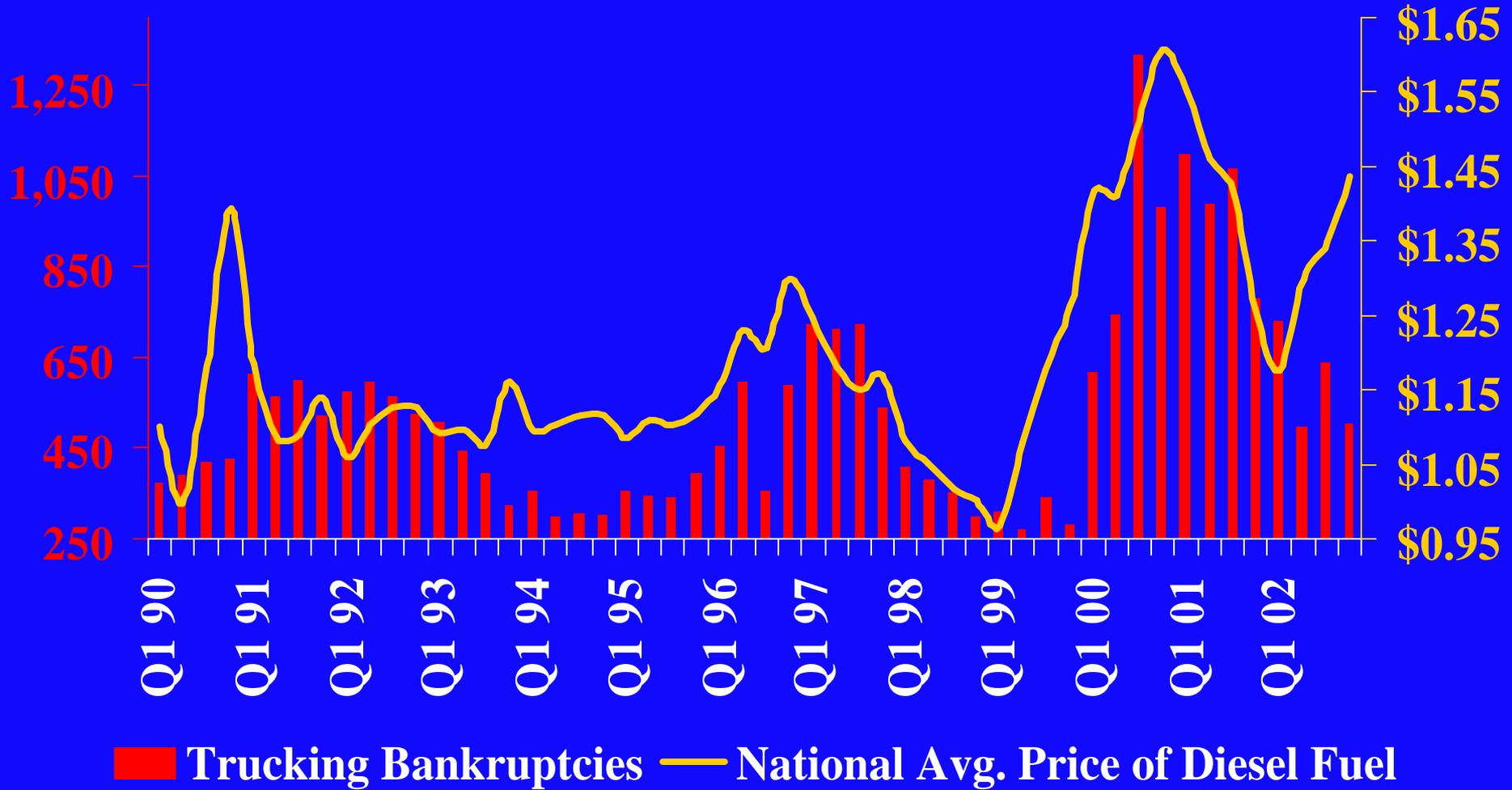
Transportation Energy Data Book, 2000

# National On-Highway Average Diesel Fuel Price (\$/Gallon)



Average Price 1994 to Present  
(\$1.23/gallon)

# Higher Diesel Prices Lead To More Trucking Bankruptcies





# *Enhanced Freight Transportation*



*Courtesy of CCJ*



*Courtesy of Transportation Technology*

# *Commercial Truck Fuel Cells*

## *Key Technical Benefits*

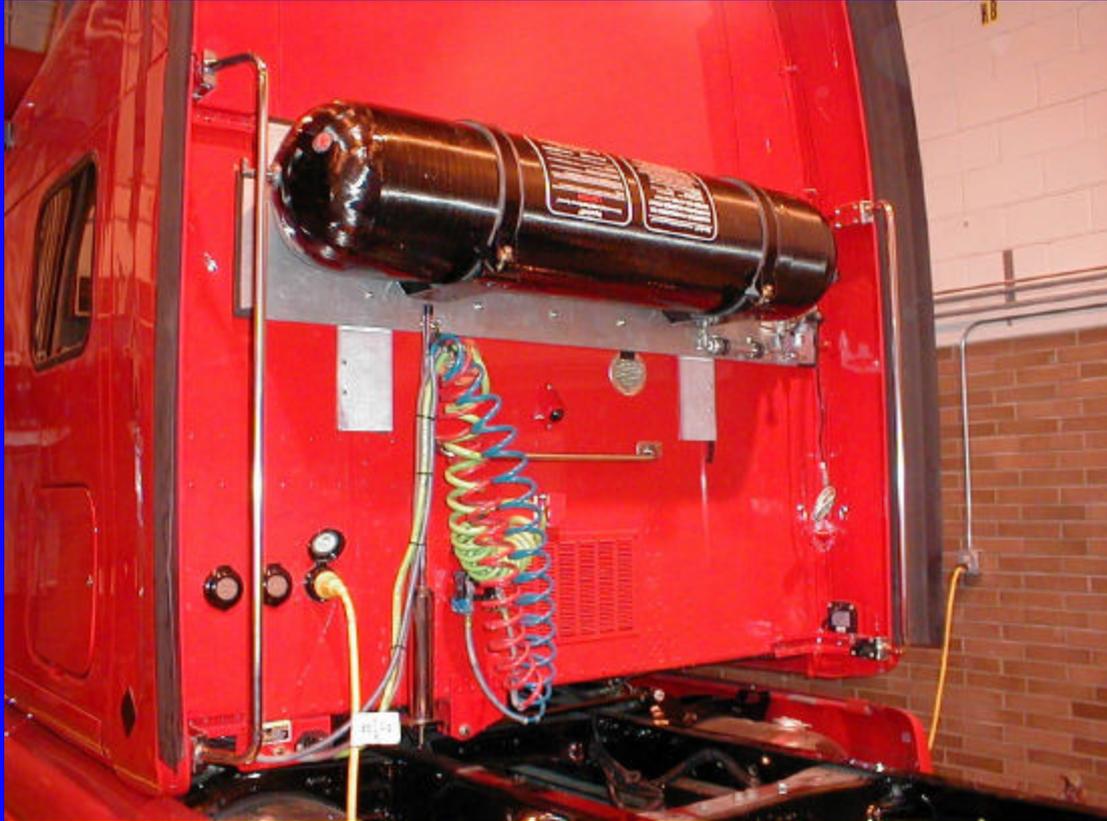
- Clean, quiet, efficient auxiliary power
- Potential for efficient electric power generation
- Use of reformat in engine aftertreatment
- Potential to supplement hybrid technology

# *Automotive Fuel Cells*

## *Key Technical Challenges*

- Hydrogen Storage
- Fuel Infrastructure
- Start-up (Fuel Processing)
- Cost/Affordability
- Reliability/Durability
- Air/Thermal/Water Management

# Hydrogen Challenges



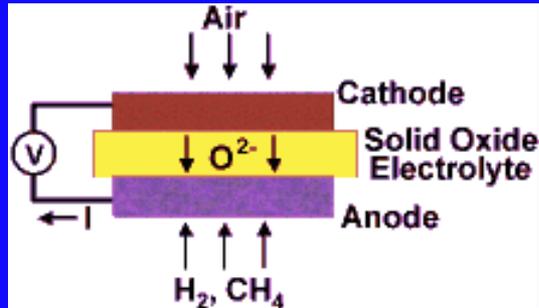
- Storage volume
- Second fuel
- Purity
- Safety
- Cost

# *PEM Fuel Cell Challenges*

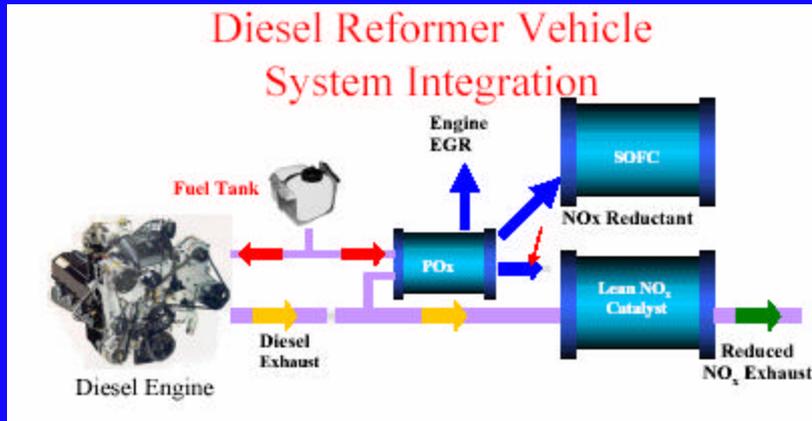


- Packaging
- Complexity
- Cost
- Durability

# SOFC Benefits and Challenges

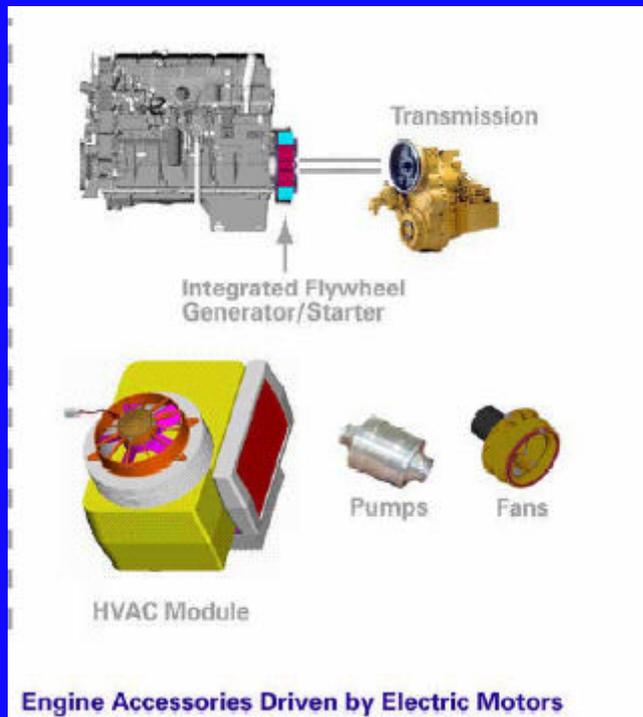


- High temperatures
- Durability
- Stack sealing
- Fuel reforming



# Vehicle Integration

## Caterpillar MorElectric system



Courtesy of Caterpillar



# Questions and Discussion

