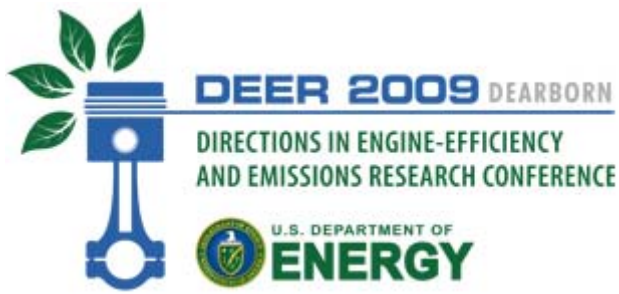
DETROIT DIESEL

# Reduction of Heavy-Duty Fuel Consumption and $CO_2$ Generation

## *What the Industry Does and What the Government Can Do*




Dearborn, Aug.5th 2009
Rakesh Aneja and David Kayes

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1 Daimler Trucks - Overview

2 Criteria Pollutants Reduction

3 What the Industry Does to Reduce Fuel Consumption

4 What the Government Can Do to Reduce Fuel Consumption

5 Conclusions

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# Daimler Trucks - Overview

- World's leading truck manufacturer
- Vehicle brands include **Mercedes-Benz, Freightliner, Western Star, Thomas Built Buses,** and **Mitsubishi Fuso**.
- Component brands include **Mercedes Benz, Detroit Diesel,** and **Mitsubishi Fuso**
- **33 production sites** in NAFTA region (16), Europe (7), South America (1), Asia (8), and Africa (1)
- Product range covers **light, medium, and heavy trucks** for local and long-distance deliveries and construction sites, as well as special vehicles for municipal applications
- Primary sales markets in 2008 were Asia (with 33% of unit sales), the NAFTA region (21%), Western Europe (18%), and Latin America excluding Mexico (13%)
- **Facts & figures:**
  - Daimler Trucks Headquarters — Stuttgart, Germany
  - Employees — 79,415 (December 31, 2008)
  - EBIT — EUR 1,607 million (FY 2008)
  - Revenues — EUR 28.6 billion (FY 2008)
  - Unit sales — 472,100 units (FY 2008)
  - Responsible Board of Management Member — Mr. Andreas Renschler

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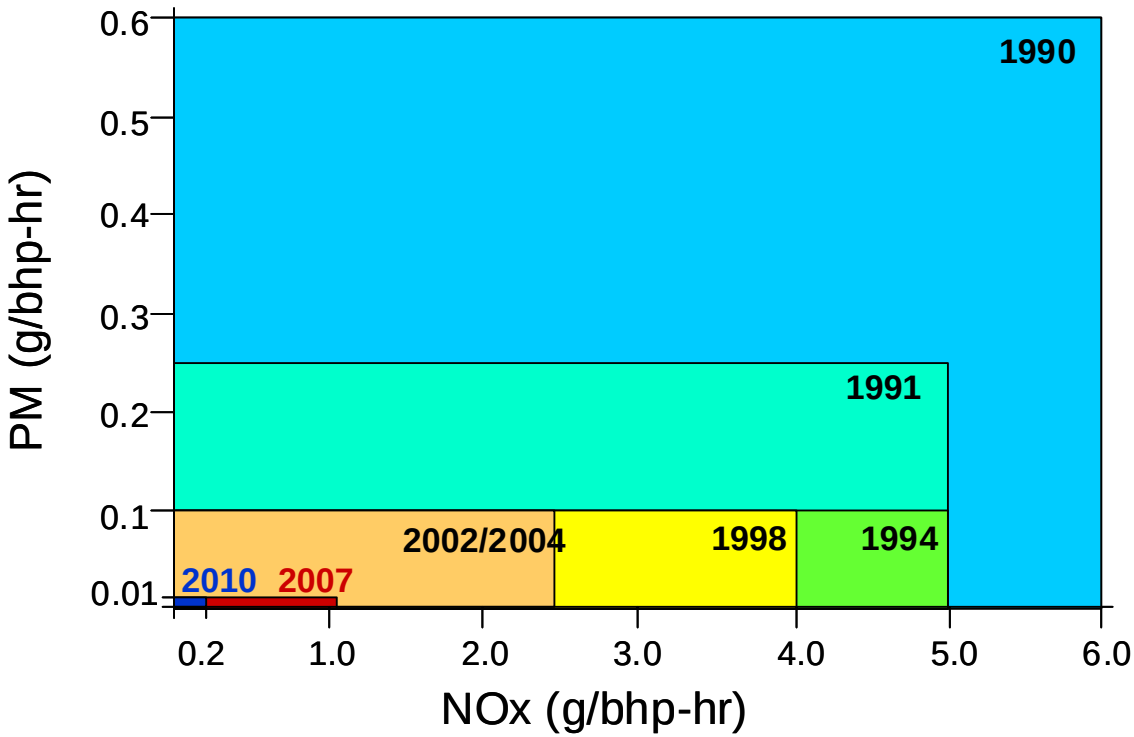
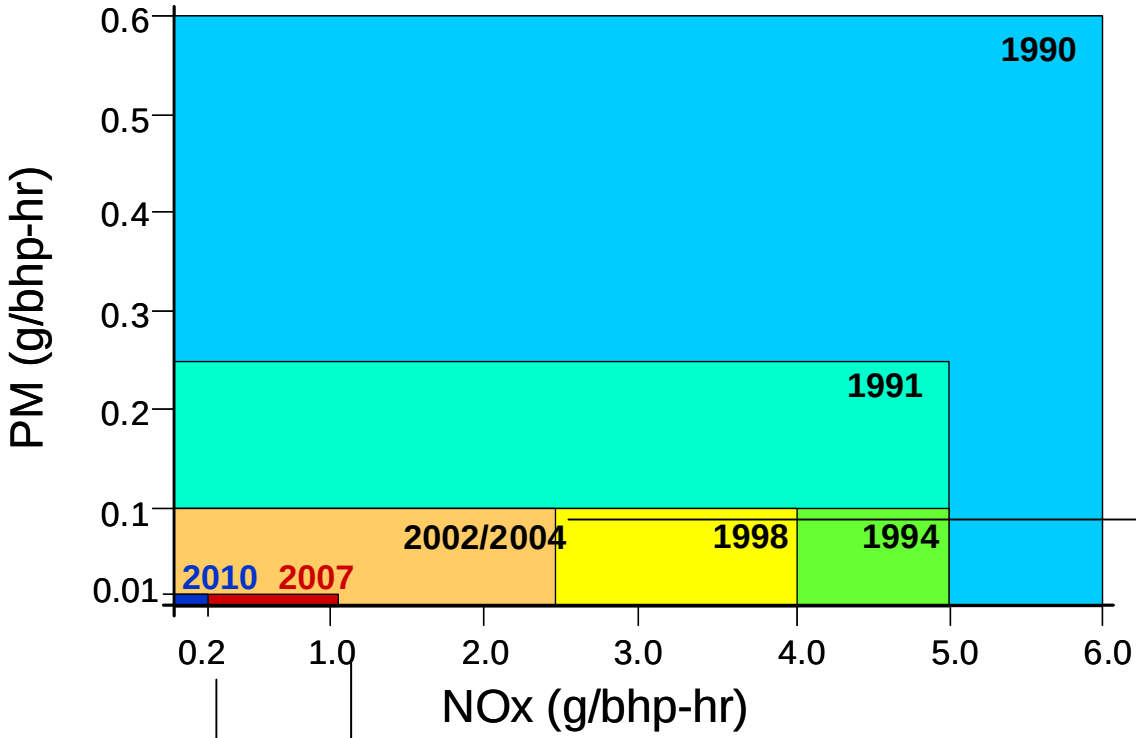
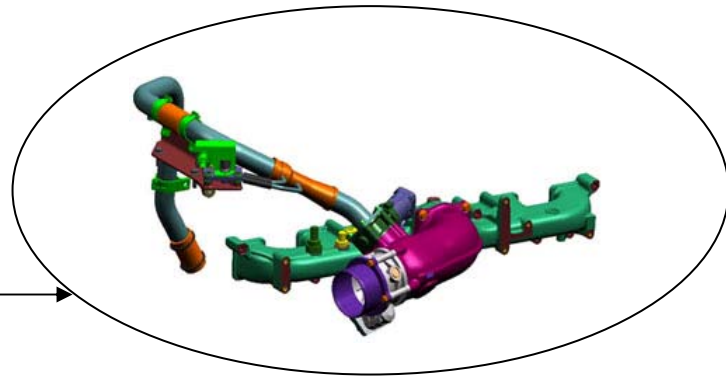
# Criteria pollutants reductions over time

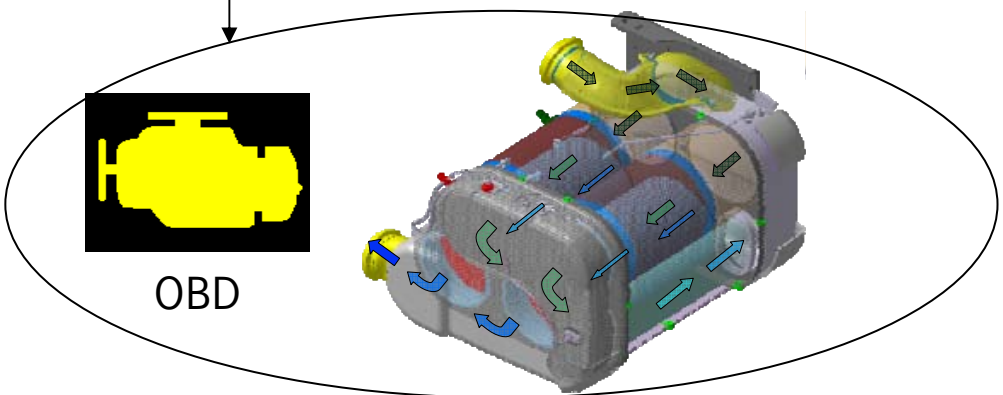


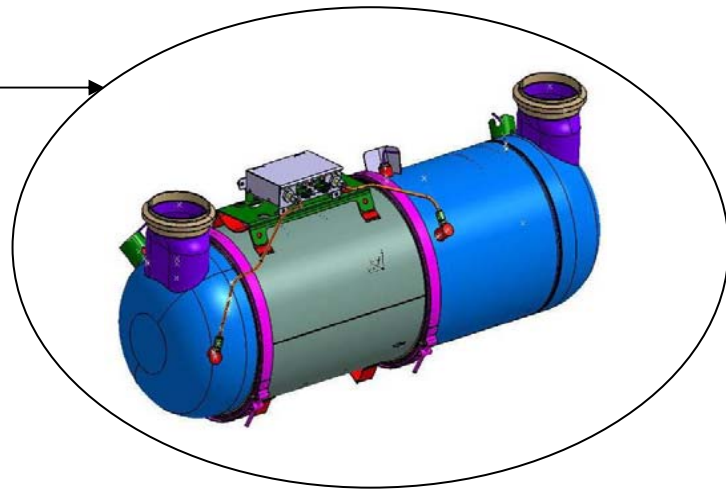

Source: http://www.aqmd.gov/news1/Archives/History/50th_photos.htm

# Criteria pollutants reductions over time





DETROIT DIESEL

DETROIT DIESEL BLUETEC DD13™

DETROIT DIESEL BLUETEC DD15™

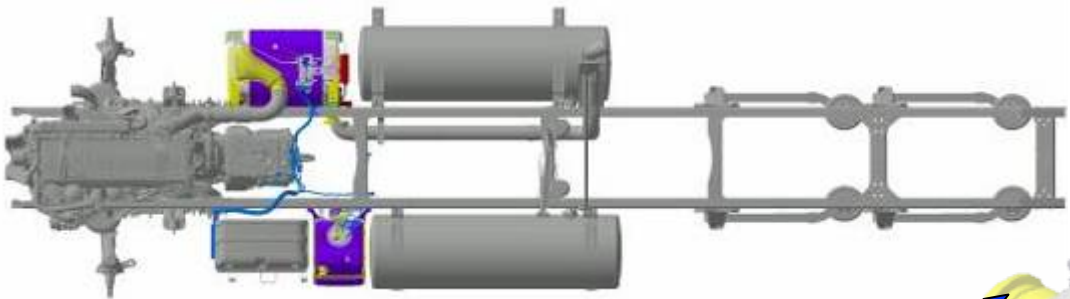
DETROIT DIESEL BLUETEC DD16™

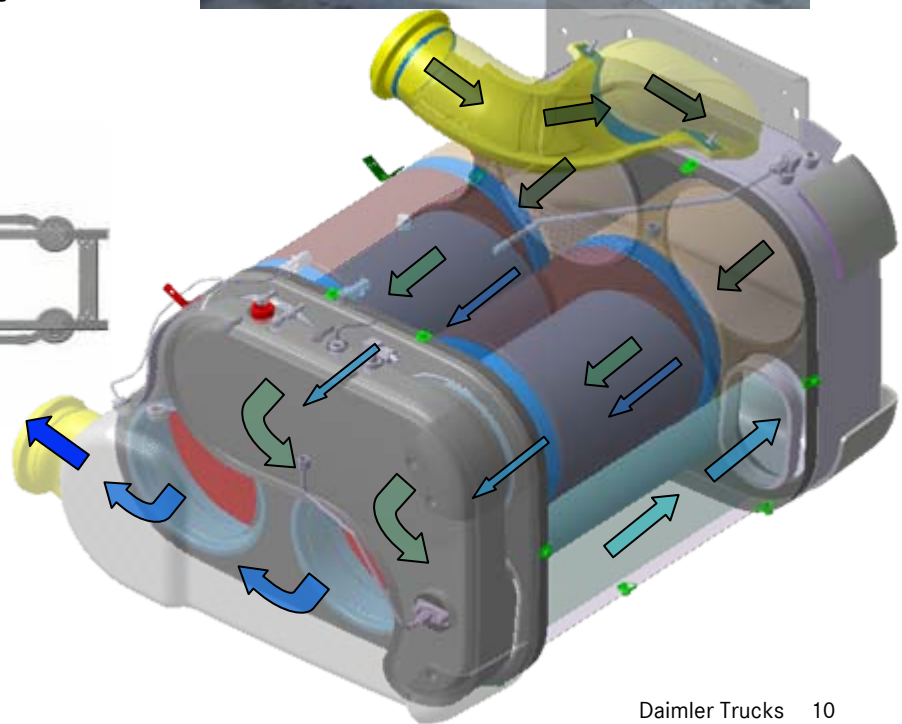
# DDC's 1-Box BlueTec Aftertreatment System (ATS)

1-Box ATS installed on a truck

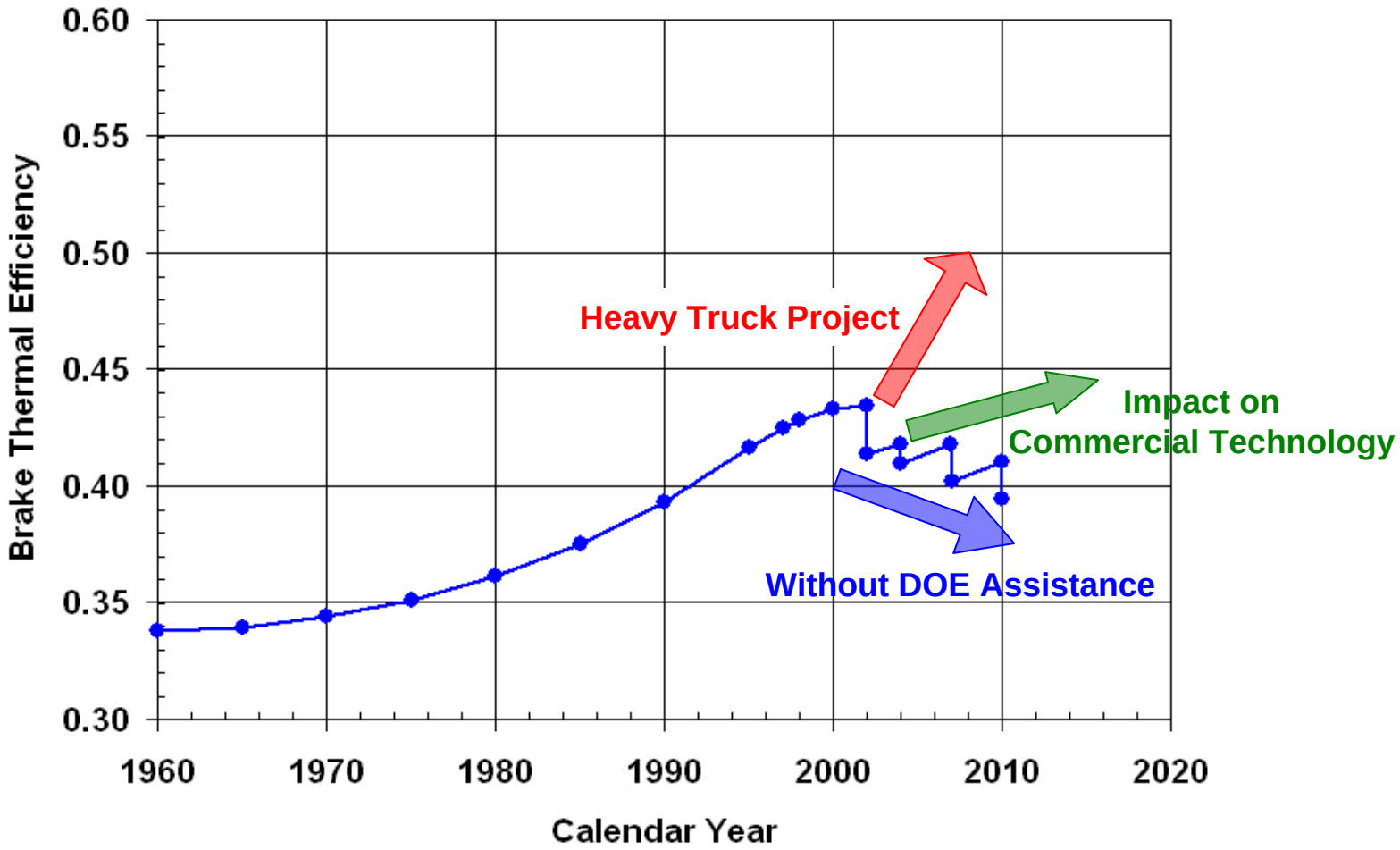
1-BOX Clean-sheet design to optimize performance, fuel economy, and truck packaging

Control algorithms to optimize DPF regeneration and minimize aging impact





# Government helping to offset adverse FE impact of criteria pollutants regulation



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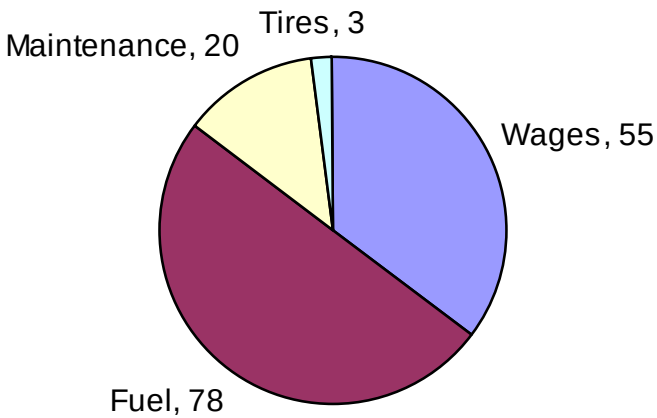
# Market forces drive efficiency

## Variable costs (c/mi)

(not including insurance, taxes)




## Total fuel costs: effect of 0.1 mpg improvement

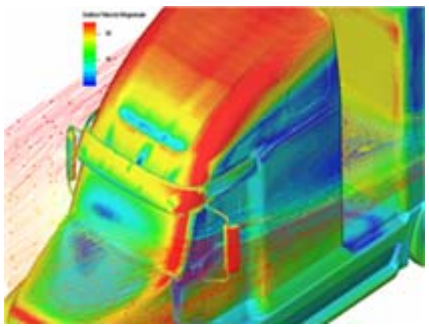
- For passenger cars:
  - Assume 30 mpg, 12,000 miles per year, $3 / gallon
  - 0.1 mpg → $4 / year savings (~0.01% of per capita income)
- For an owner-operator:
  - Assume 6 mpg, 120,000 miles per year, $3 / gallon
  - 0.1 mpg → $1,000 / year savings (~2% of income)
- For a fleet:
  - Steve Graham, director of fuel and tire systems for Schneider, said to *Heavy Duty Trucking*, April 2006, that 0.1 mile per gallon was worth $8 million / year to his company. (Fuel price in April 2006: ~$2.70, per DOE data.)

Sources:

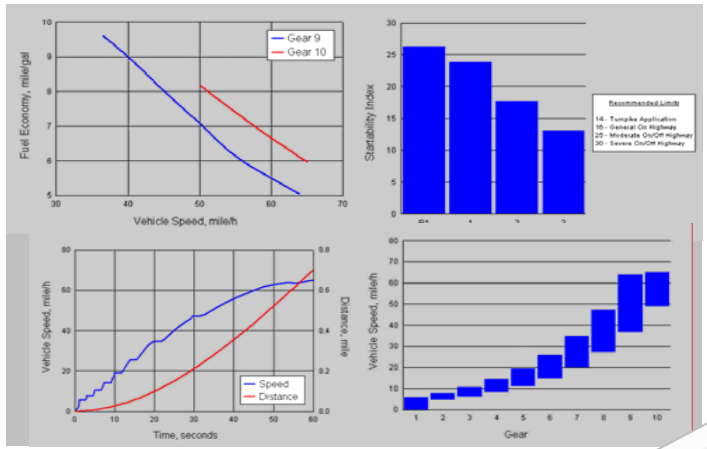
- **Driver wages = 55 cents/mile.** *Re: Data based on DOT figures, reported by ATA in "American Trucking Trends 2005 - 2006," 2006, p. 17.*
- **Fuel (at $4.70 / gal and 6 mpg) = 78 c/mi** *Re: Transport Topics, "Diesel and Gasoline Prices...," 2 June 2008, p. 1.*
- **Maintenance = 20 c/mi** (down to as little as 15 c/mi for a well-run fleet). *Re: Heavy Duty Manufacturers' Assn., "Heavy Duty Truck Maintenance in the U.S.A. 2005," May 2005.*
- **Tires = 2 to 3 c/mi.** *Re: Transport Topics, "Calculating Cost Per Mile," Equipment and Maintenance Update, March/April 2007, p. 6.*

# What manufacturers and fleets do to optimize FE

## Technology optimization

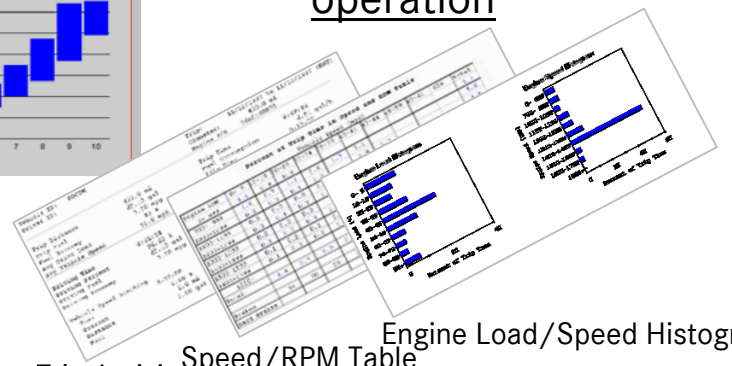



## Vehicle/operation matching




Vehicle specification data from DDC "Spec Manager" with sample vehicle configuration, for illustration only.

## Feedback on design and operation



Trip Activity

Speed/RPM Table

Engine Load/Speed Histogram

- Many configurations based on application
  - *Note:* even many "SmartWay" fleets choose different HP, transmissions, rear axle ratios, fuel tanks, tires, hood/cab/sleeper models because of their unique applications, routes, etc.
- Speed limiting, logistical improvements, fuel efficiency rewards for drivers

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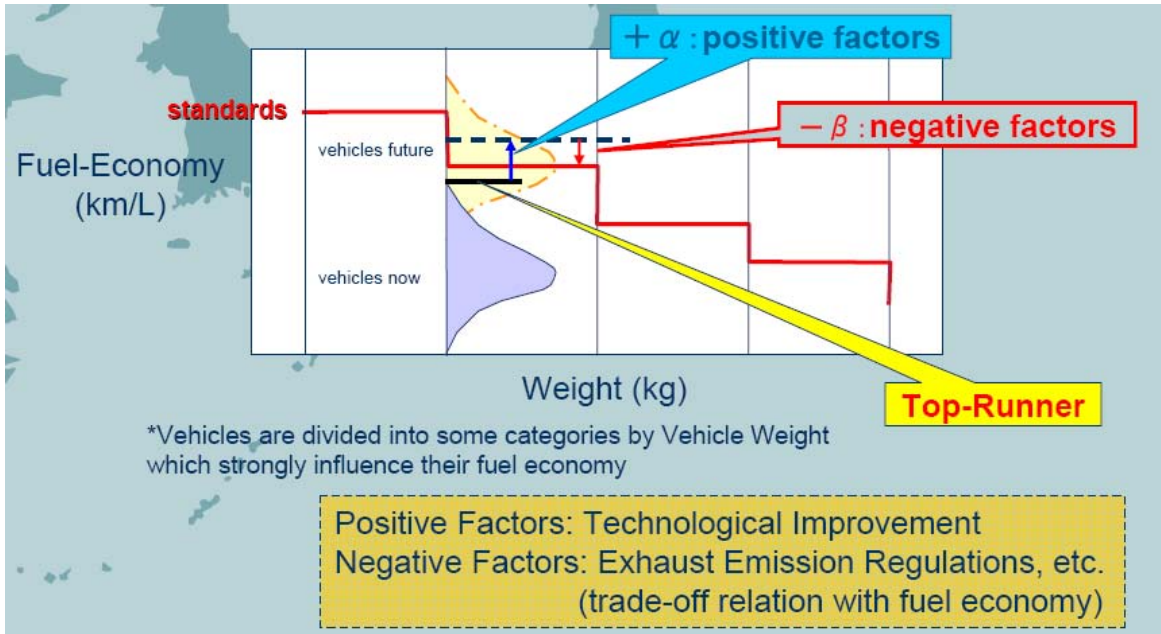
# FE Regulations: Japanese Top Runner program




Source: K. Wani, Ministry of Land, Infrastructure and Transport, Japan, presentation, June 2007.

Powertrain info
- Vehicle factors (gear ratios, tire size, gear efficiency,...)
- Engine fuel consumption map

Running resistance info
- $C_dA$, RR preselected

→ Fuel flow model → FE (km/L)

Model-based program, validated by limited testing but does not recognize vehicular differences (*e.g.*, Cd)

# Smart vehicle regulations for the US



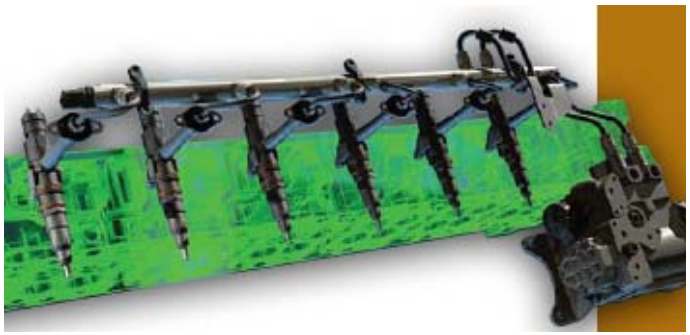

- What makes regulations smart?
  - Recognition of the differences between vehicles for different applications
  - Practicability
  - No adverse impacts on total fuel consumption
- What must be involved?
  - Starting with “big hitters” (linehaul, regional haul, P&D)
  - Using modeling and simulation, validated by limited testing
  - Rewarding “eco-innovations” not impacting test/model results
  - Comparing FE results only to similar vehicle applications

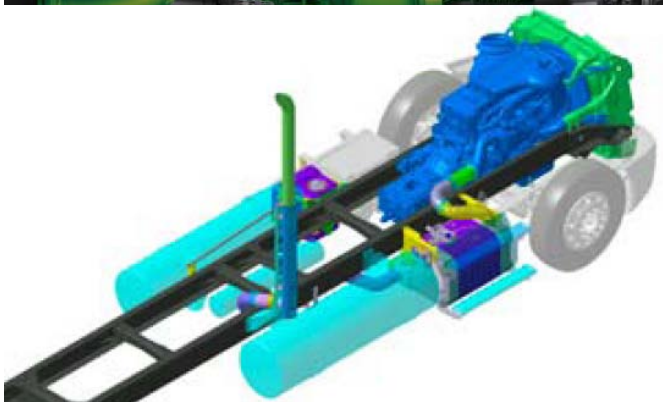




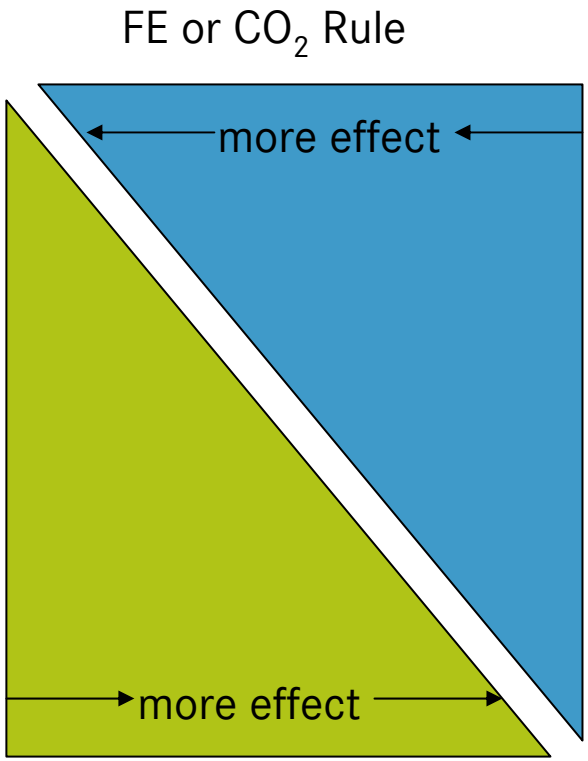



# Funding for advanced engine, powertrain, and vehicle projects






# Additional things the government can do to lessen fuel consumption




Engine

Vehicle

Operation (*e.g.*, LCVs, idle reduction, driver training, …)

Infrastructure (*e.g.*, congestion mitigation, electrified parking,…)

*Concept borrowed from Mr. Byron Bunker, EPA. Used with permission.*

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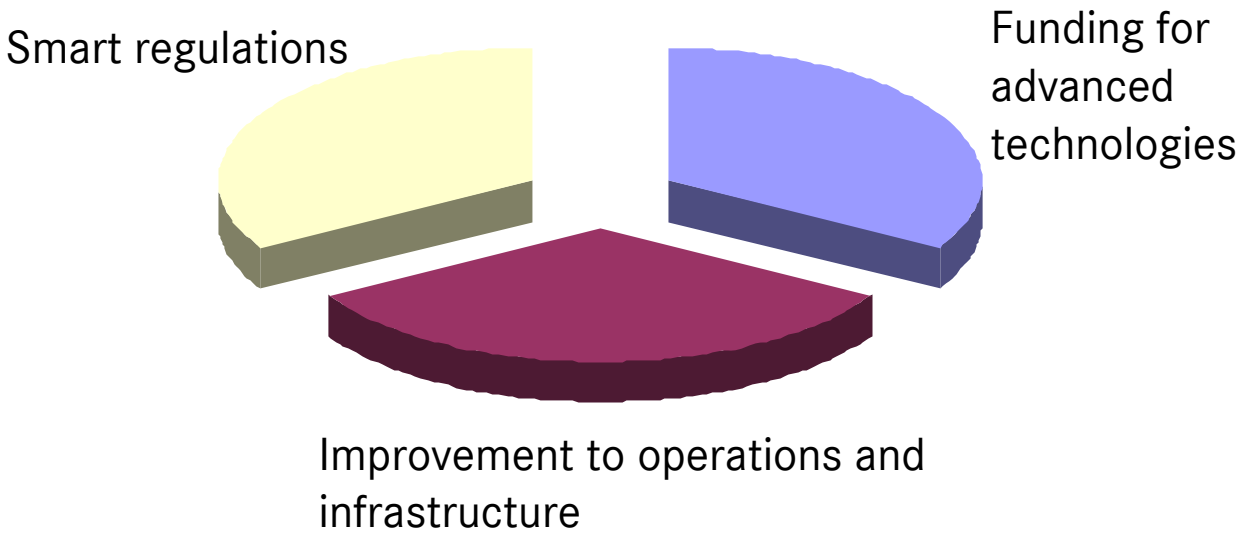


All three play role in reducing fuel consumption!