OPTIMIZING EFFICIENCY OF THE INTERNAL COMBUSTION VEHICLES

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William Craven
General Manager Regulatory Affairs
Daimler AG
Los Angeles Smog
Goal is Near-Zero Emissions - TIER III

99.97% reduction !! Without ZEVs.....

Car emission over 100,000 miles is equivalent to spilling one cup of gas
National CAFE/GHG Regulation

Light Duty

July 2011      MY 2017 – 2025*

Heavy Duty
August 2011    MY 2014 - 2018

*2017  Review the regulation for MY 2022 - 2025
National CAFE Regulation Combined (PC+LDT)

EPA  2025 target 163 g/mi  = 54.5 mpg
CAFE  2025 target 50 mpg
After credits = 44 mpg
Daimler’s Road to Sustainable Mobility

- **today**
  - Improvement of Conventional Fuels
  - Alternative Fuels
  - Hybrid Vehicles
  - Electric/Fuel Cell

- **tomorrow**
  - Optimization of Combustion Engine Vehicle
1886 Karl Benz Patented Worlds First IC Car
• Only about **15 percent** of the energy from the fuel you put in your tank gets used to move your car down the road.

• About **2 percent** of the energy gets used to move the people in the car.
Energy Distribution in a Mid-Size Car (PNGV)

What makes up the engine losses?

Hybrid:
- Engine Loss
- Standby
- Braking
Energy Available for Boosting

For our purposes, we will assume an engine of average thermal efficiency and typical heat losses through exhaust and cooling water.

Fuel Energy (100%)

1/3 Useful Power to Crankshaft
1/3 Heat Loss to Cooling Water
1/3 Heat Loss through Exhaust

Turbocharging improves efficiency by using exhaust gas energy that would otherwise be lost.
Engine Downsizing

Eight Cylinder

Turbocharge and
Increase compression ratio

Two Cylinder Turbocharged

Fuel Improvement = Higher Octane 98+ (ethanol)
Exhaust Heat Recovery: Thermoelectric Generator

Technology Description:
- The thermoelectric generator converts a part of engine heat into electricity.
- The higher the temperature difference, the higher the amount of electricity that can be generated.
- The additional energy generated is fed directly into the vehicle’s electricity supply.

Projected Savings: 2.5%

Weight Impact: 7 kg (15 lbs)
Technology overview of the MB 6cyl, 3.5 l gasoline engine
CLS 350 CGI in Europe 2008:
Power +8%
Torque +4%
Fuel efficiency +10%
Sulfur-free fuel
Energy Distribution in a Mid-Size Car (PNGV)

Fuel 100% → Engine 18.2% (25.6%) → D/L 12.6% (20.2%) → Aero 2.6 (10.9)%

Engine Losses 62.4 (69.2)%
Driveline Losses 5.6 (5.4)%

Stop Start

Urban (Highway)

Rolling 4.2 (7.1)%
Kinetic
Braking 5.8 (2.2)%

Turbocharged
Solar Panel On The Car Roof

Mögliche Benefits eines Solardachs

- Light weight solar panel on the roof
- Electric power supply to the battery during driving and parking
- Ventilation of passenger compartment
LED Headlights

Substitution of today's halogen headlights by LED headlights with same performance

Projected CO₂ Savings:

2-3 g/mi

Weight Impact:

None
New Generation Automatic Transmission

Efficiency improves from 89% today to 94%

6 speed → 9 speed
Vehicle weight reduction

10% reduction in vehicle weight = up to 8.0% energy savings
Weight Reduction Potential

body completely from aluminum

Weight reduction: 80 kg
Carbon Fiber –
Reduce vehicle weight by as much as 60% (cost $$$)
Human weight increasing
Improvements in Vehicle Aerodynamics
a 25% reduction over 15 years
Rolling Resistance
Potential for fuel consumption improvement with energy efficiency improvements in gasoline engine technology.
Autonomous Driving
Thank You!!