

# **OPTIMIZING EFFICIENCY OF THE INTERNAL COMBUSTION VEHICLES**

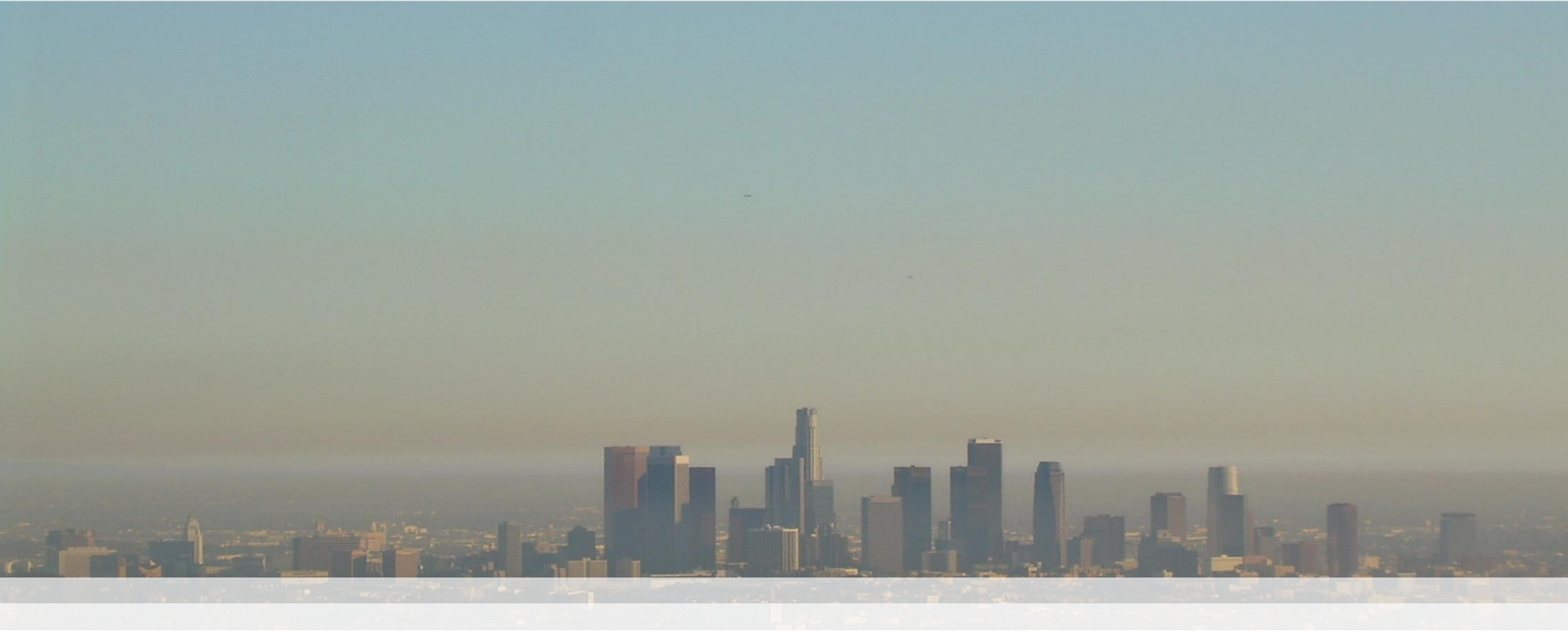
**US Energy Association**

April 16th, 2013

William Craven

General Manager Regulatory Affairs  
Daimler AG

# Los Angeles Smog



# Goal is Near-Zero Emissions - TIER III



Car emission over 100,000 miles is equivalent to spilling one cup of gas

# National CAFE/GHG Regulation

## Light Duty

May 2009

MY 2012 – 2016

July 2011

MY 2017 – 2025\*

## Heavy Duty

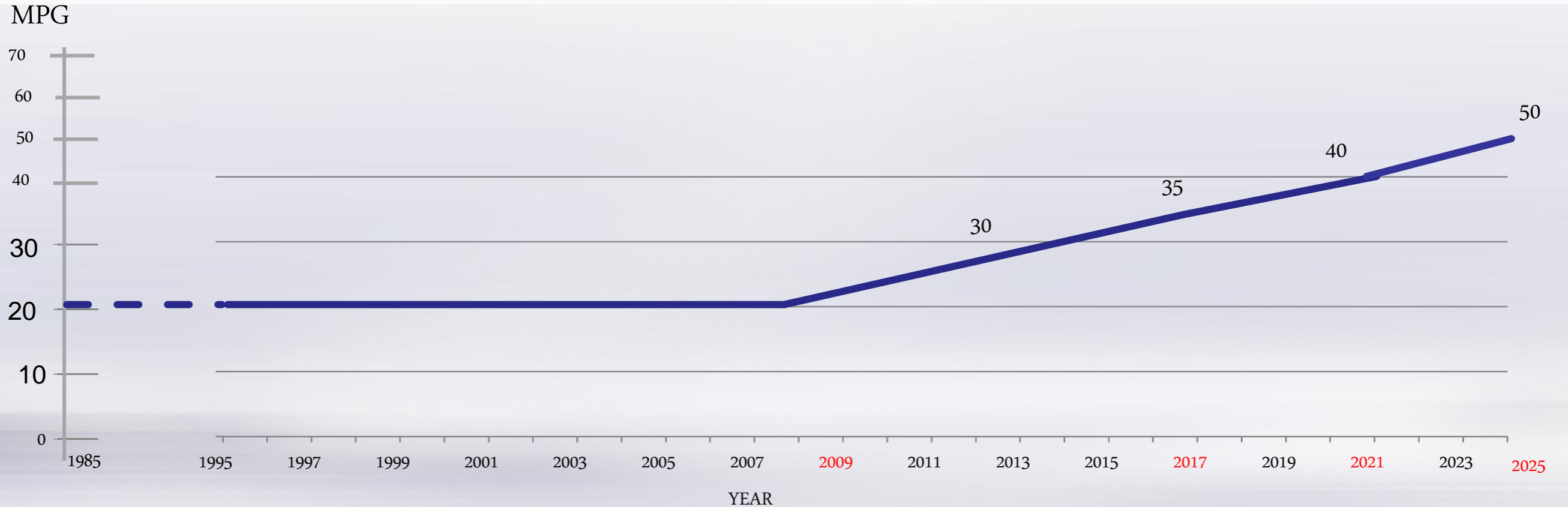
August 2011

MY 2014 - 2018



\*2017 Review the regulation for MY 2022 - 2025

# National CAFE Regulation Combined (PC+LDT)



EPA 2025 target 163 g/mi = 54.5mpg

CAFE 2025 target 50mpg

After credits = 44mpg

# Daimler's Road to Sustainable Mobility

today

tomorrow

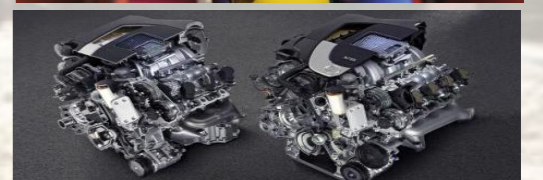
Electric/Fuel Cell

Hybrid Vehicles

Alternative Fuels

Improvement of Conventional Fuels

Optimization of Combustion Engine Vehicle



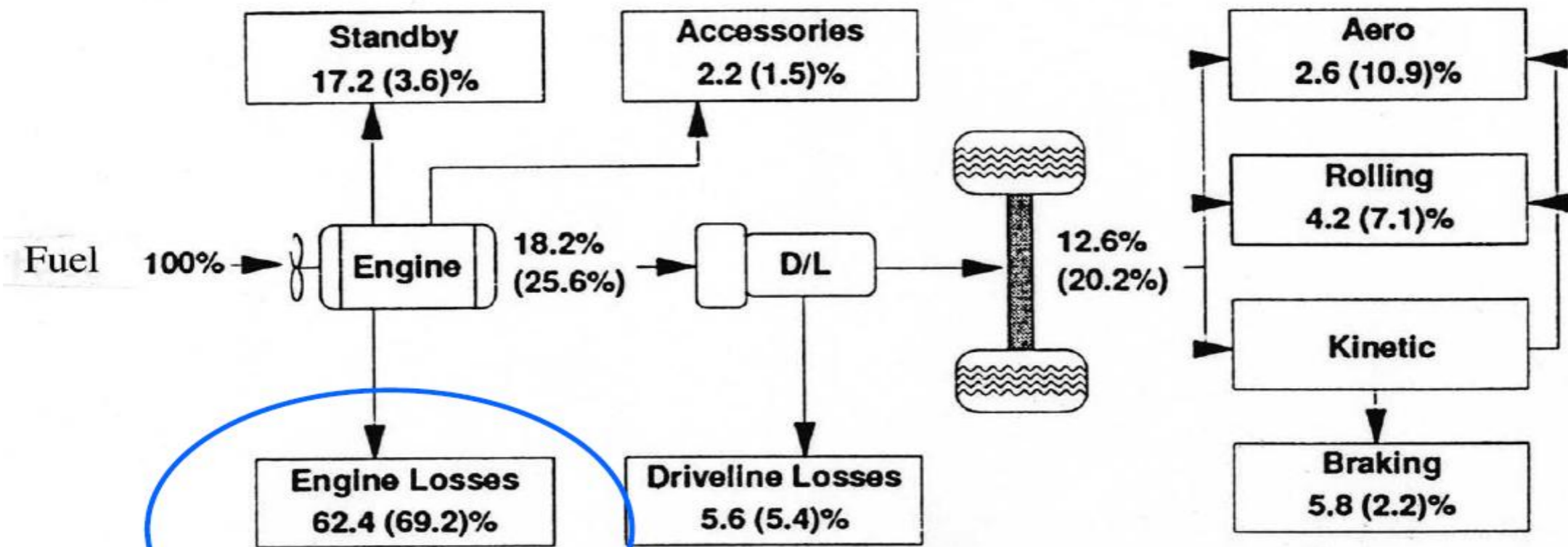
# 1886 Karl Benz Patented Worlds First IC Car



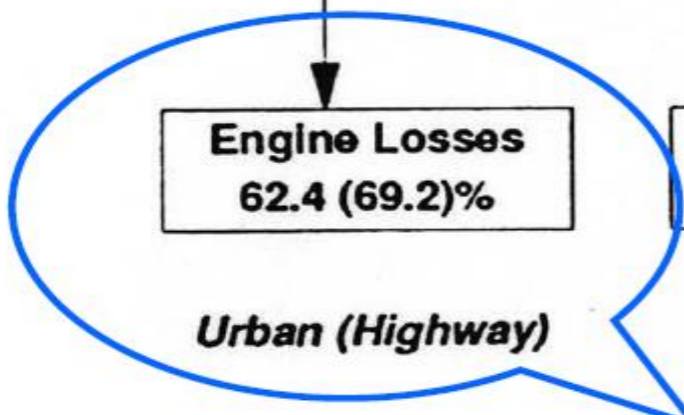
- Only about **15 percent** of the energy from the fuel you put in your tank gets used to move your car down the road.
- About **2 percent** of the energy gets used to move the people in the car.



# Energy Distribution in a Mid-Size Car (PNGV)



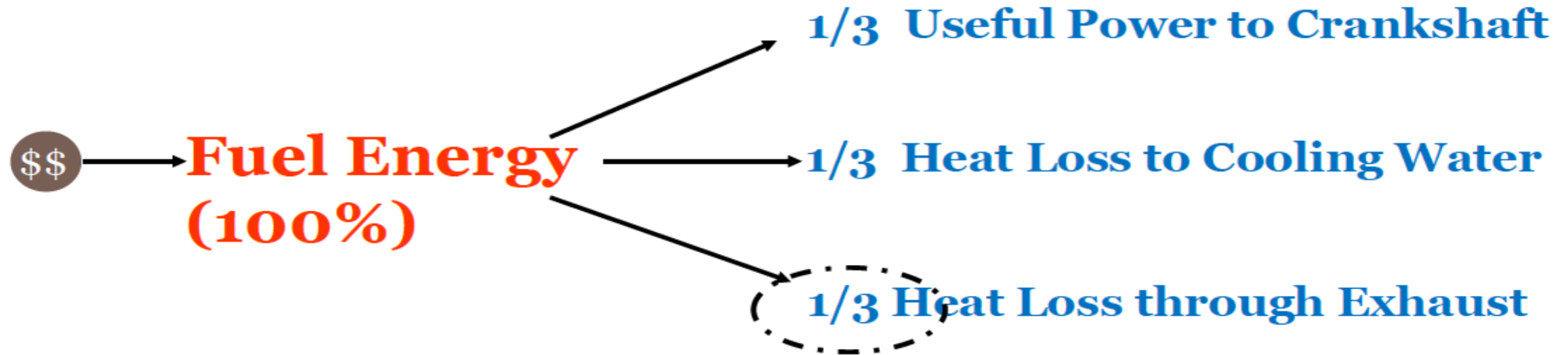
Hybrid:  
 Engine Loss  
 Standby  
 Braking



What makes up the engine losses?

# 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



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

# Engine Downsizing



Eight Cylinder



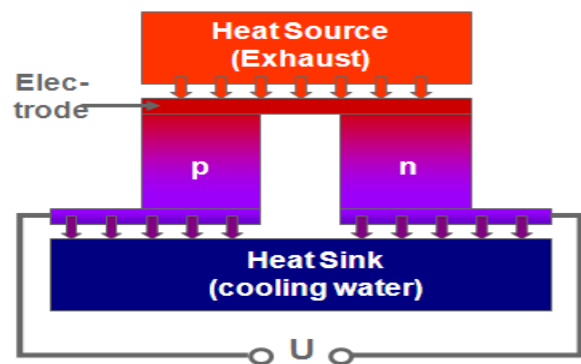
Turbocharge  
and  
Increase compression ratio



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)*

# Gasoline Engine Technology

## Technology overview of the MB 6cyl, 3.5 l gasoline engine

**new chain drive system**

**resonance pipe**

**direct injection**

**piezo injector**

**stratified charge combustion system**

**generator management**

**hybrid ability**

**stop / start direct start**

**adjustable oil pump**

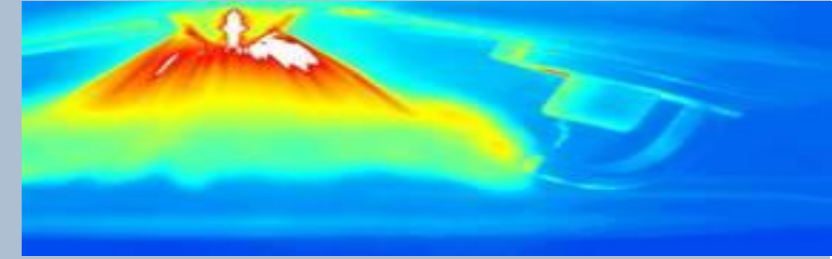
**new compact camshaft adjuster**

**In Europe Today**

**Standby loss 17.2%**

**M 276 DE 35 V6 60°**

Direct Injection Gasoline Engine



## CLS 350 CGI in Europe 2008:

Power +8%

Torque +4%

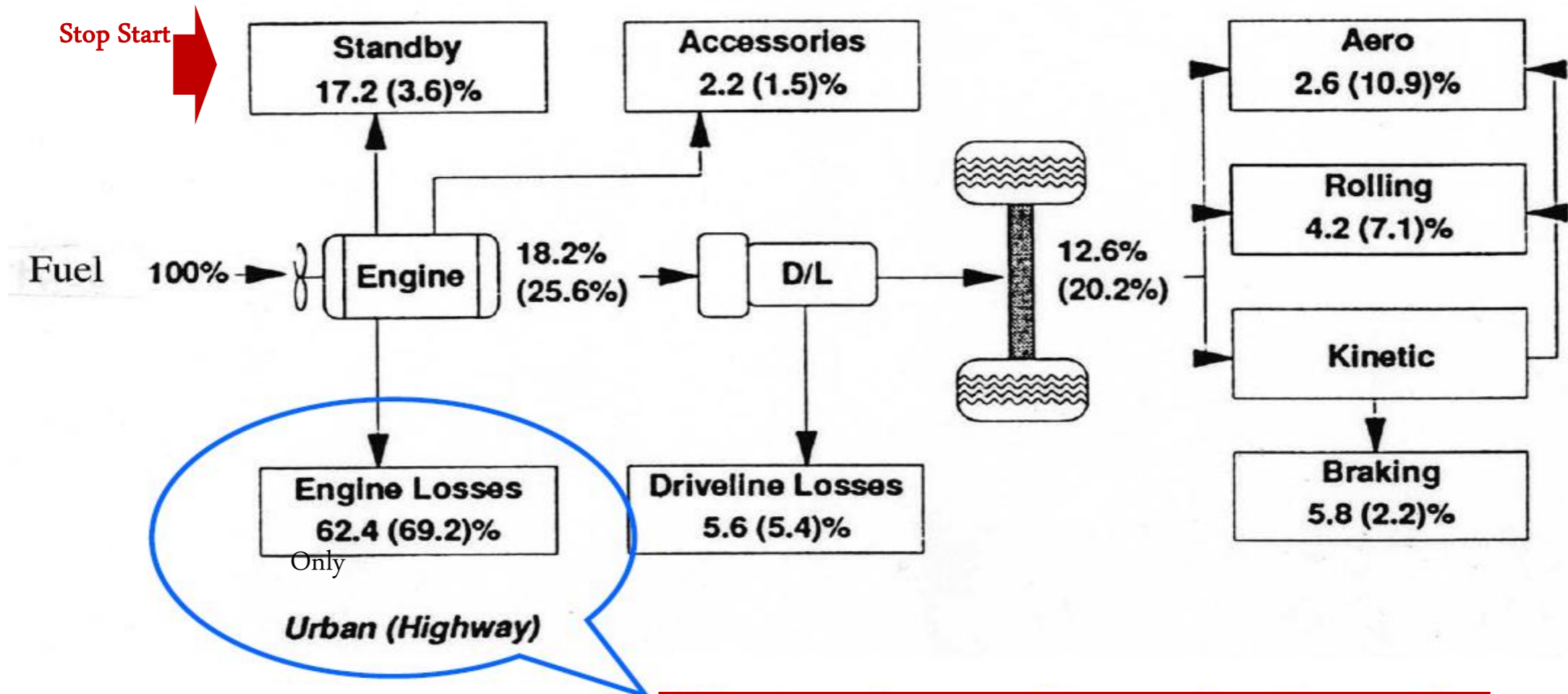
Fuel efficiency +10%



Sulfur-free fuel



# Energy Distribution in a Mid-Size Car (PNGV)



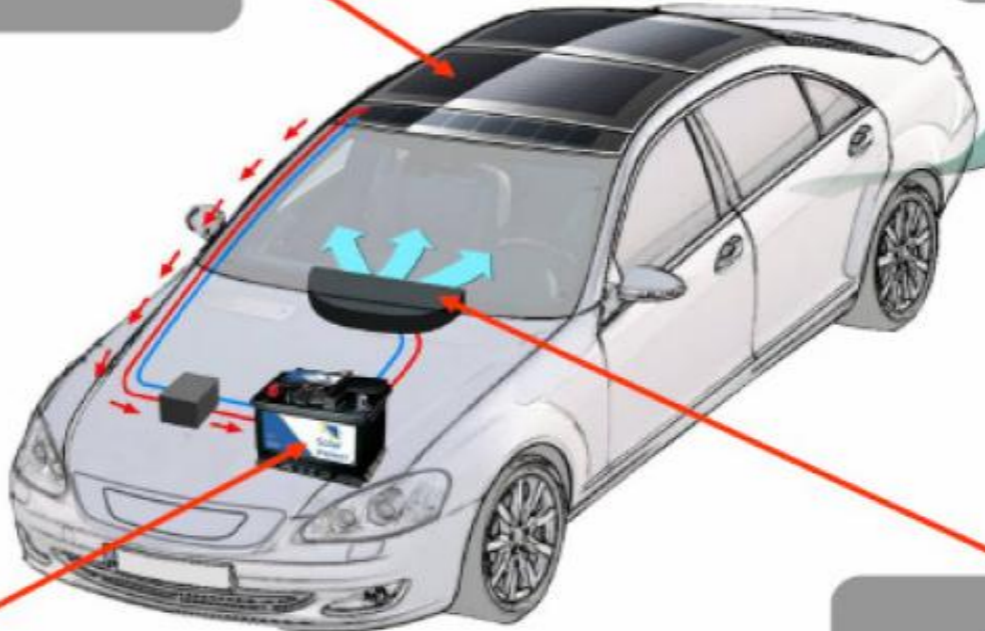
Turbocharged

# 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

**Image**  
„wow-factor“, „green image“

**CO2-reduction**  
+ reduced penalty cost?



**Economy**  
Energy vs solar cost

**Comfort**  
Pre-ventilation / -cooling



# LED Headlights



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

*Projected CO<sub>2</sub> Savings:*

2-3 g/mi

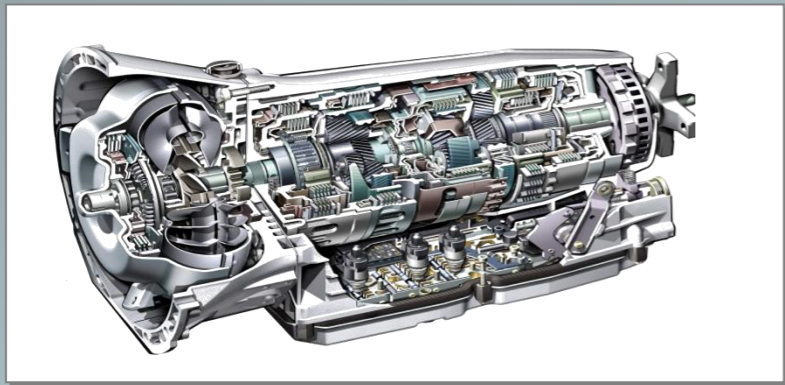
*Weight Impact:*

None

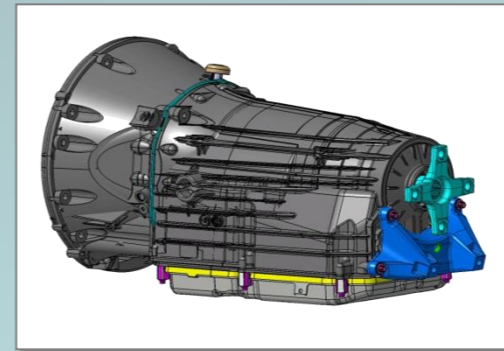
# New Generation Automatic Transmission

Efficiency improves from 89% today to 94%

6 speed



9 speed



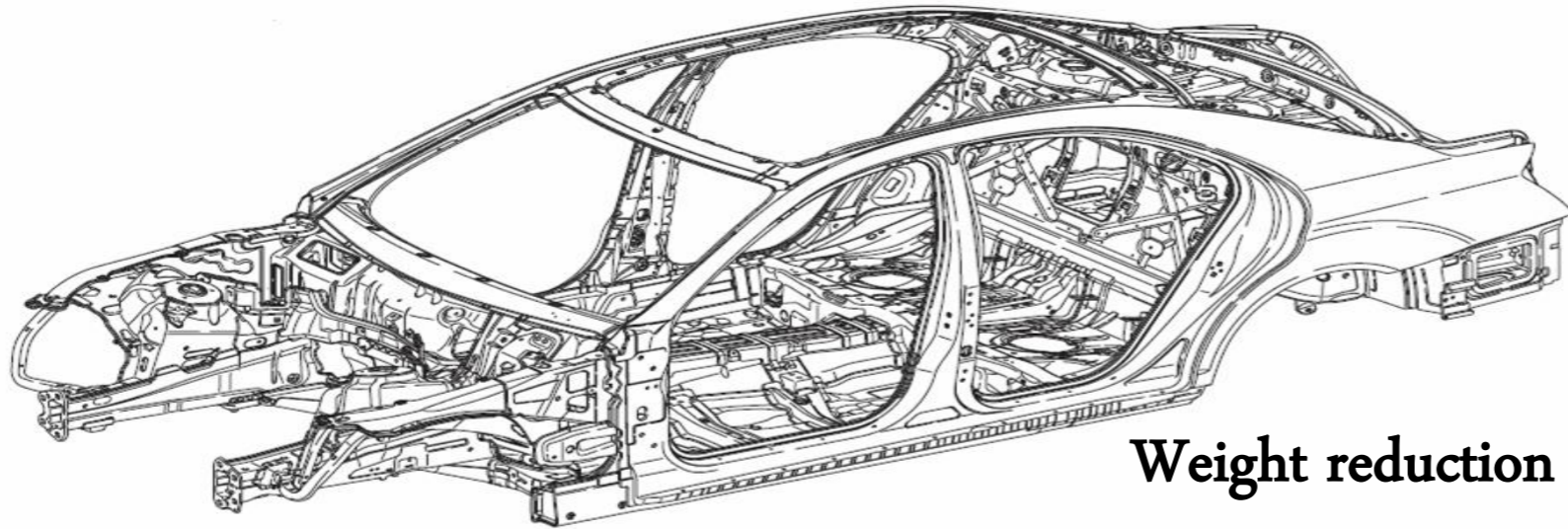
# Vehicle weight reduction

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

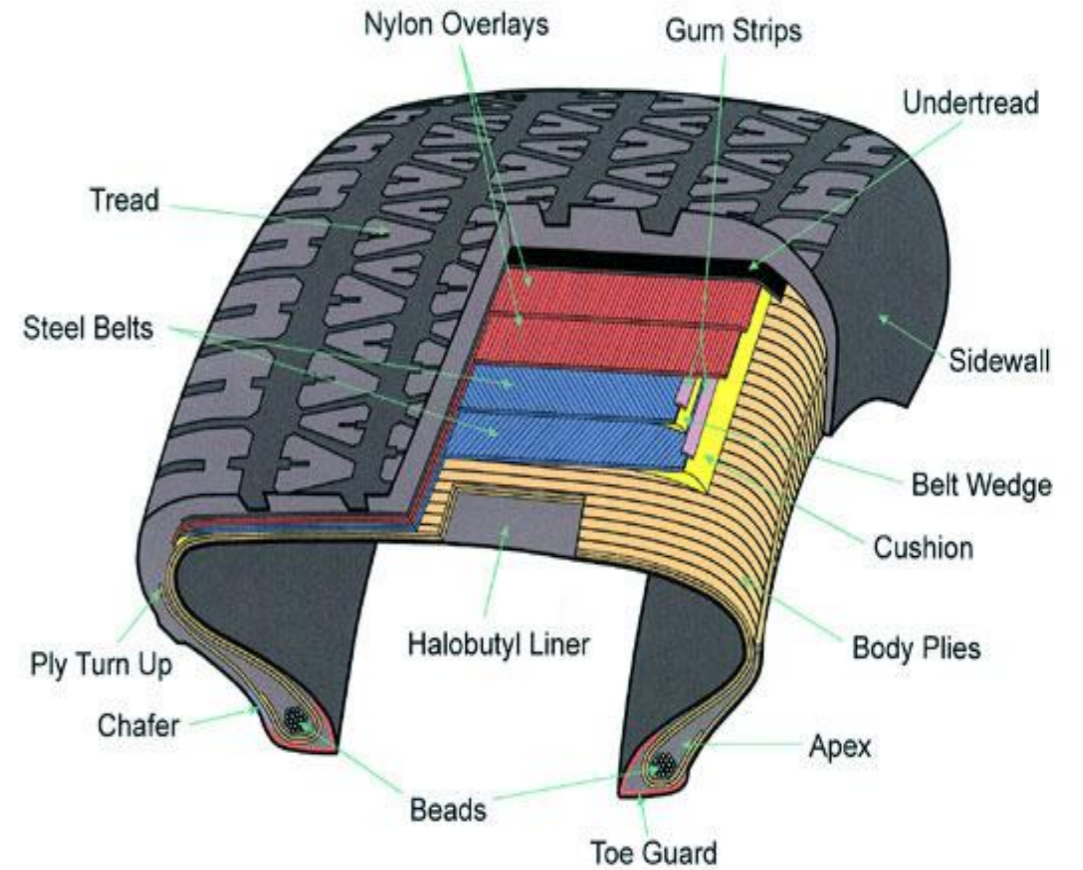
CAR

# Improvements in Vehicle Aerodynamics

a 25% reduction over 15 years



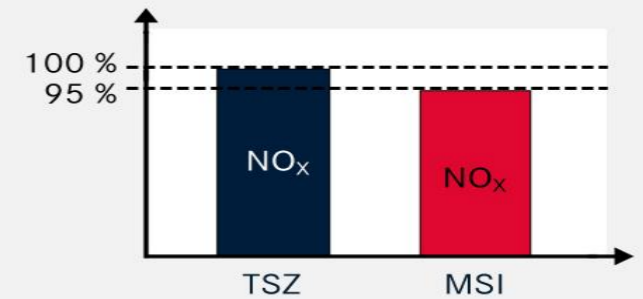
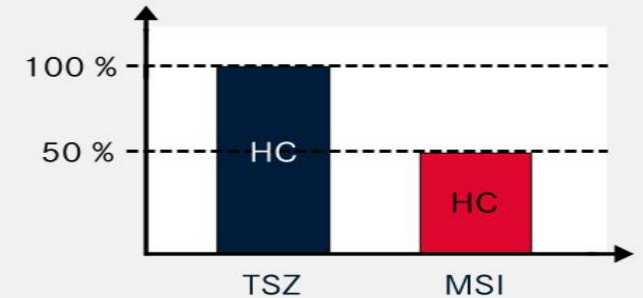
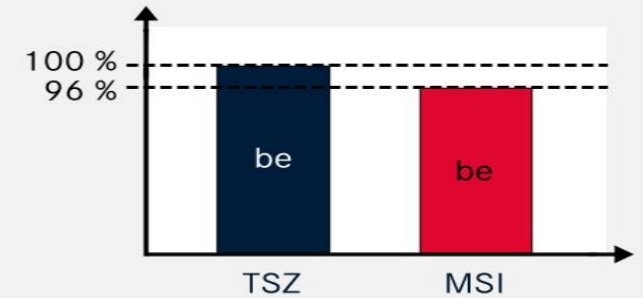
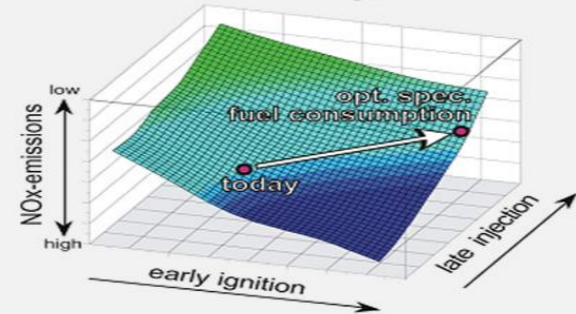
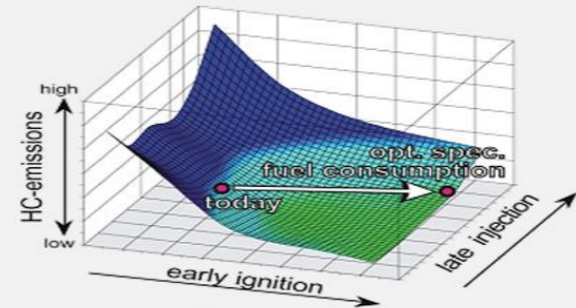
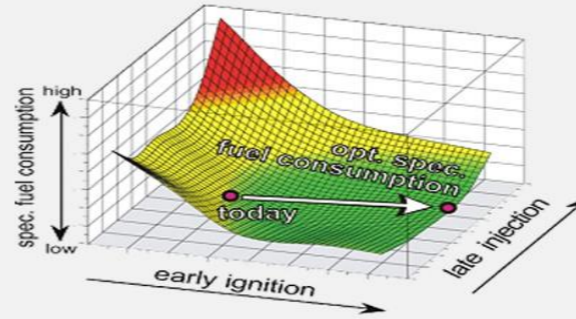
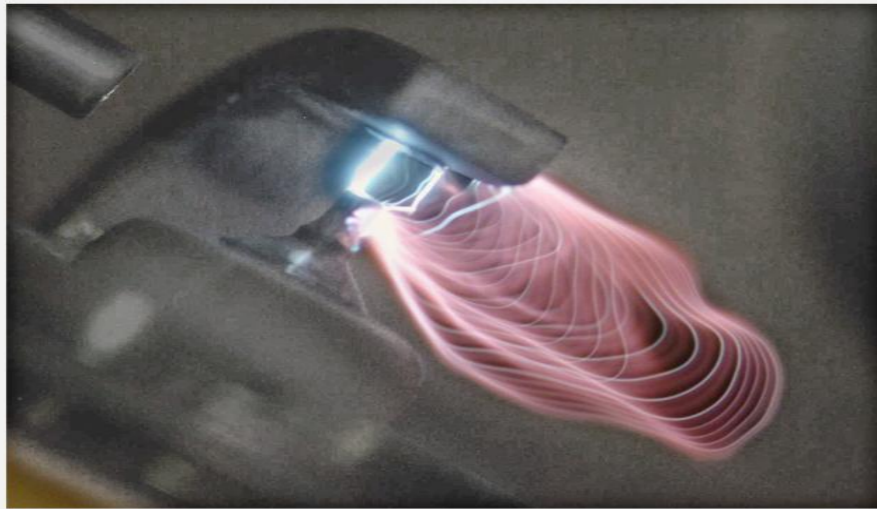
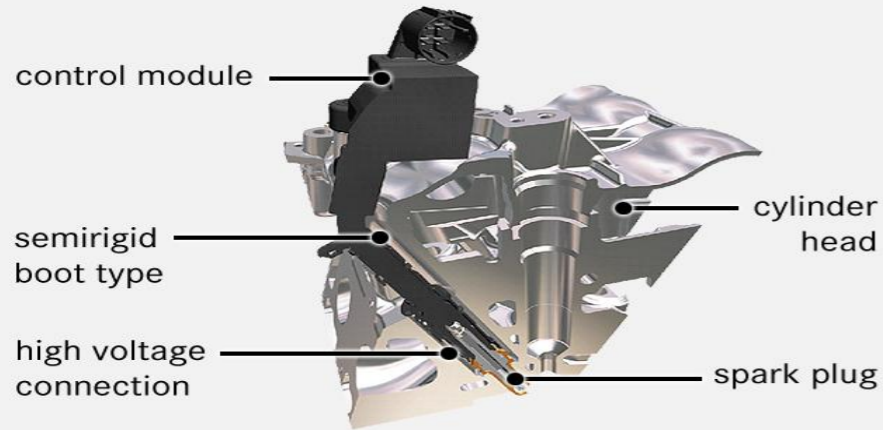
# Rolling Resistance





# Gasoline Engine Technology

## Potential for fuel consumption improvement with.....



# Autonomous Driving



## INTELLIGENT DRIVE HOW IT WORKS

Active blind-spot assist

360° camera

ATTENTION ASSIST

STEER ASSIST

Active lane-keeping assist

NIGHT VIEW ASSIST PLUS with spotlight function

PRE-SAFE BRAKE with pedestrian detection and urban braking function

COLLISION PREVENTION ASSIST

Adaptive high-beam assist

BAS PLUS with cruise-traffic assist

YBD-033

Thank You!!

