



# OEM Perspective

SAE Fuels and Lubricants Meeting  
Toulouse  
June 9, 2004

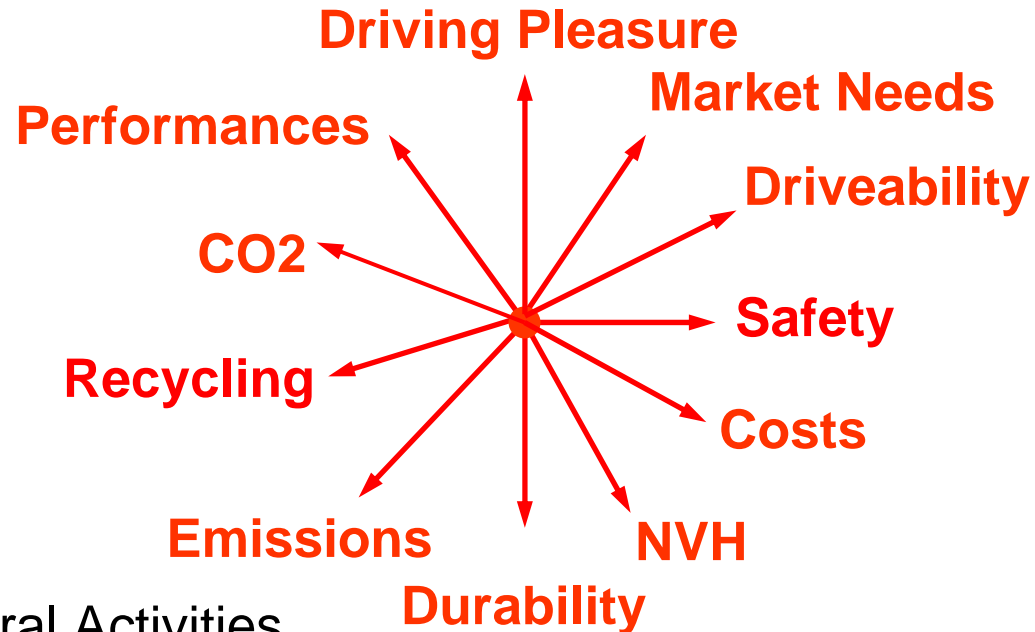
Kazumasa KATOH  
Senior VP, Powertrain Engineering  
RENAULT

# Outline of Presentation

- Introduction
- Today's Main Drivers :
  - CO2
  - Exhaust Emissions
- More Diesel in Future ?
- Car & Oil Industries' Collaboration
- Conclusion

# Our Challenges

- **Environment**
  - Emissions Regulations
  - CO2 and GHG
  - Recycling
- **Renewable Fuels**
  - CO2
  - Energy Security
  - Development of Agricultural Activities
- **Ever Increasing Customer Expectations ...**
  - Driveability
  - Reliability / Durability
  - Performances
- **... at constantly reducing purchasing price & maintenance cost while leading to a constant improvement**

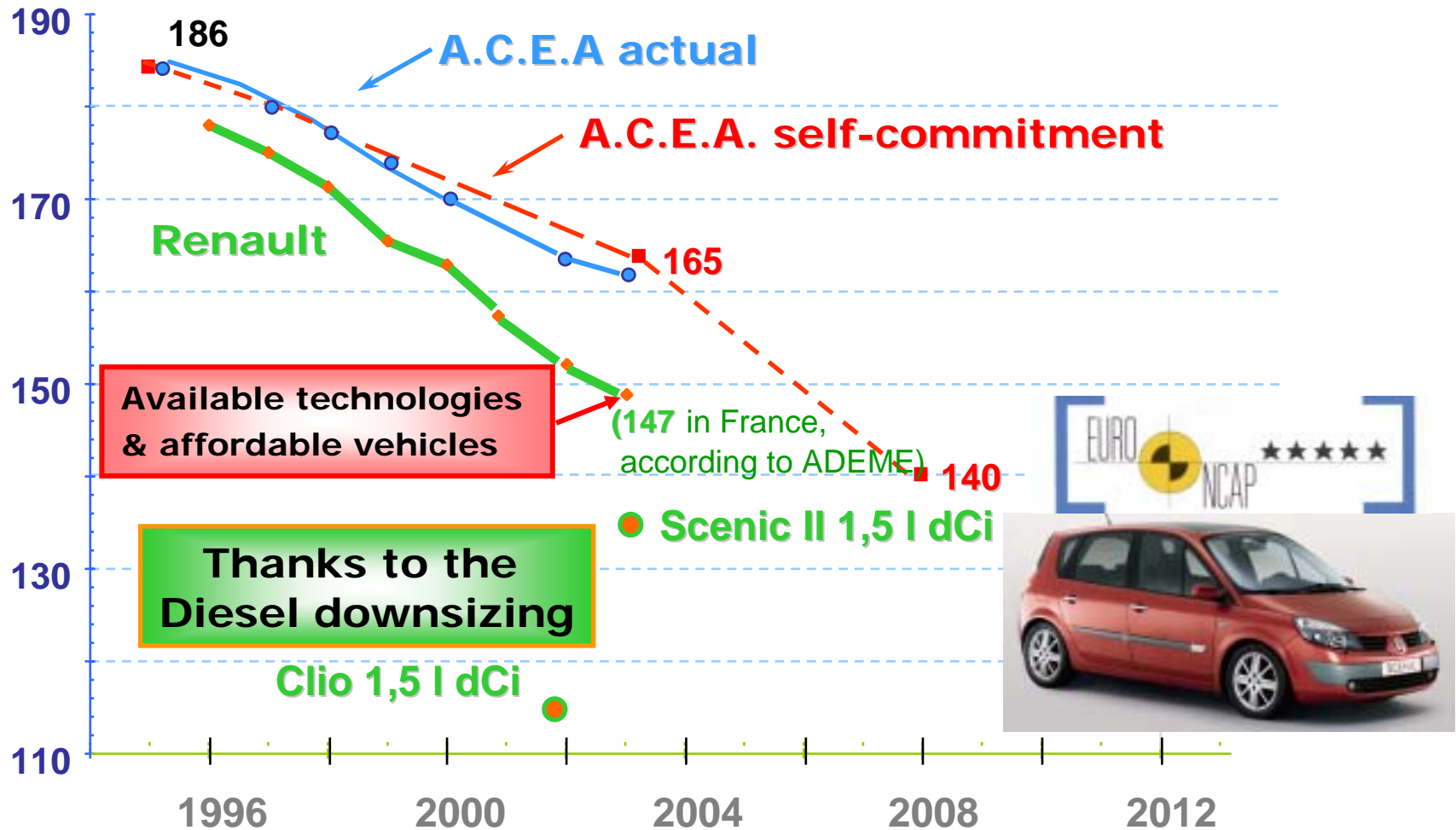


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# CO2 : ACEA self-commitment

CO2 (g/km)



Available technologies & affordable vehicles

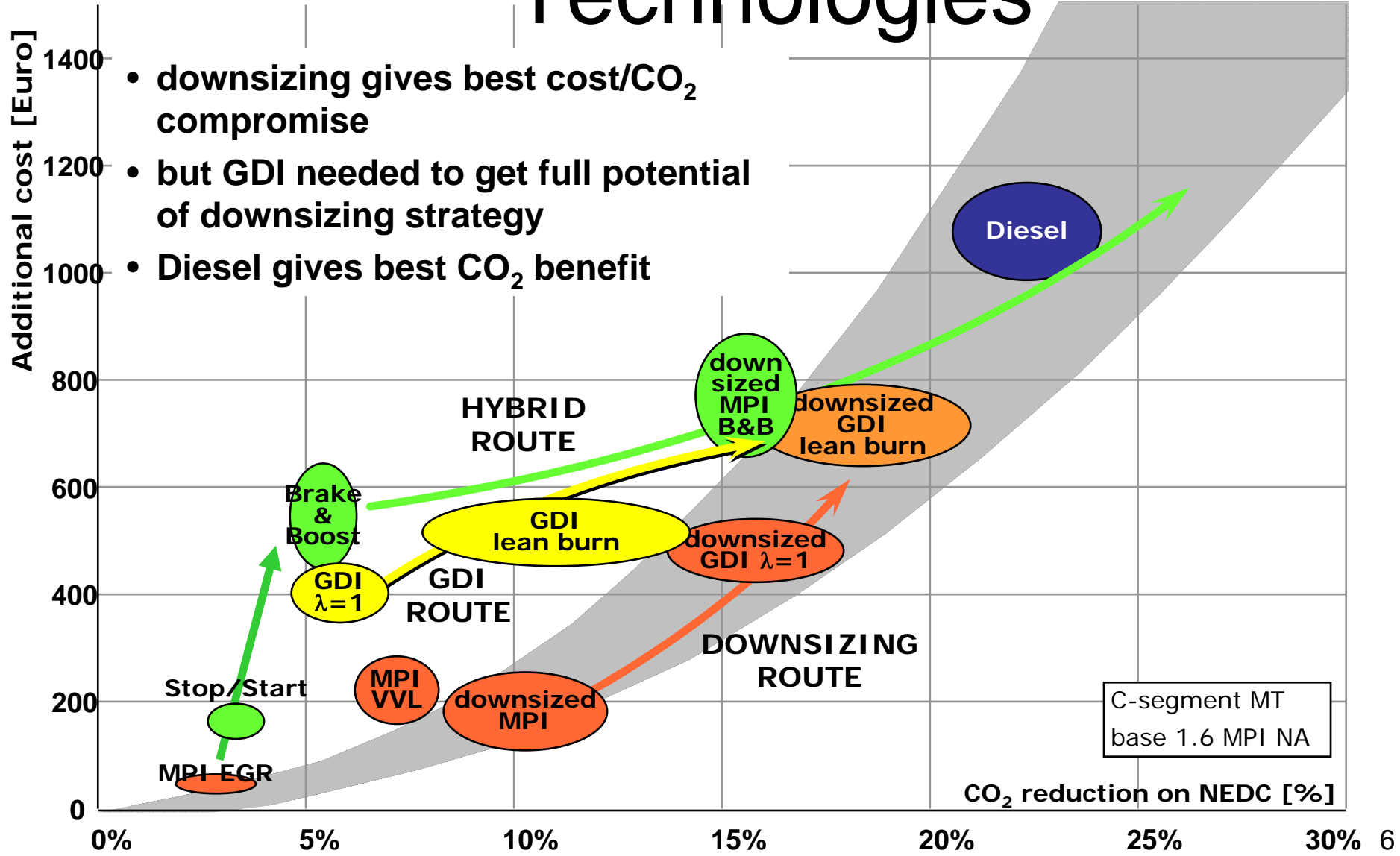
Thanks to the Diesel downsizing

Clio 1,5 l dCi

Scenic II 1,5 l dCi

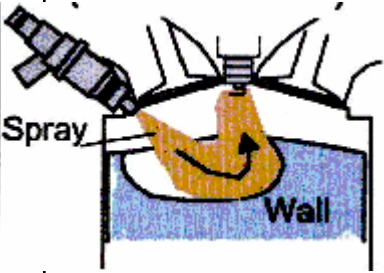
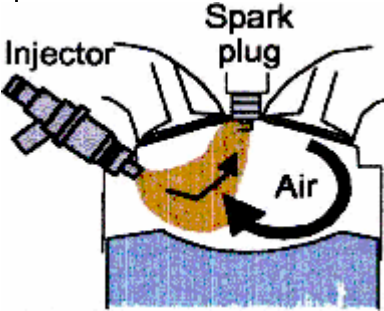
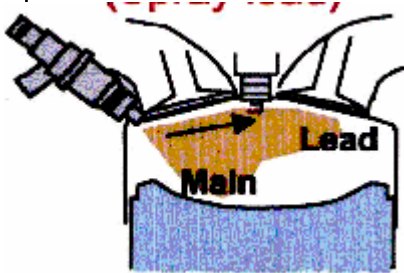
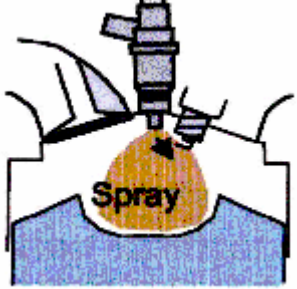


# CO<sub>2</sub> Levels by Various Technologies



# CO2 Reduction of Gasoline Engines

## 1- Gasoline Direct Injection – Stratified Charge

Concept	Wall Guided	Air Guided	Spray Leading	Spray Guided
Ref MPI $\lambda=1$				
→ CO2	93%	90%	88%	85%
↳ NOx	50%	50 %	35 %	25 %
Concern	<ul style="list-style-type: none"> <li>-Aftertreatment Cost</li> <li>-Small Gain of Fuel Consumption</li> <li>- High Speed Fuel Consumption</li> </ul>	<ul style="list-style-type: none"> <li>-Small Gain of Fuel Consumption</li> <li>- Robustness of Tumble Air Motion</li> </ul>	<ul style="list-style-type: none"> <li>- Robustness of Spray</li> </ul>	<ul style="list-style-type: none"> <li>-Higher fuel pressure for lower emission</li> <li>-Reliability of injector and plug</li> <li>-Engine Layout</li> </ul>

# CO2 Reduction of Diesel Engines

IDI N/A

IDI T/C

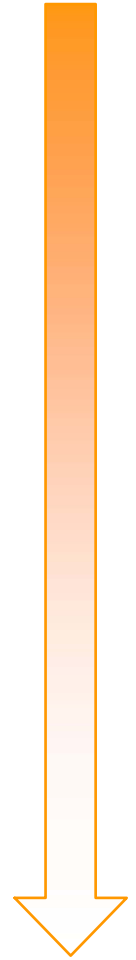
DI T/C



**DI T/C downsized**

**Today**

- Higher injection & in-cylinder pressure
- Low Compression Ratio
- Multi injection
- Limitation of fuel consumption degradation from regenerative exhaust aftertreatment
- Downsizing (higher turbocharging)
- HCCI combustion



**Time**

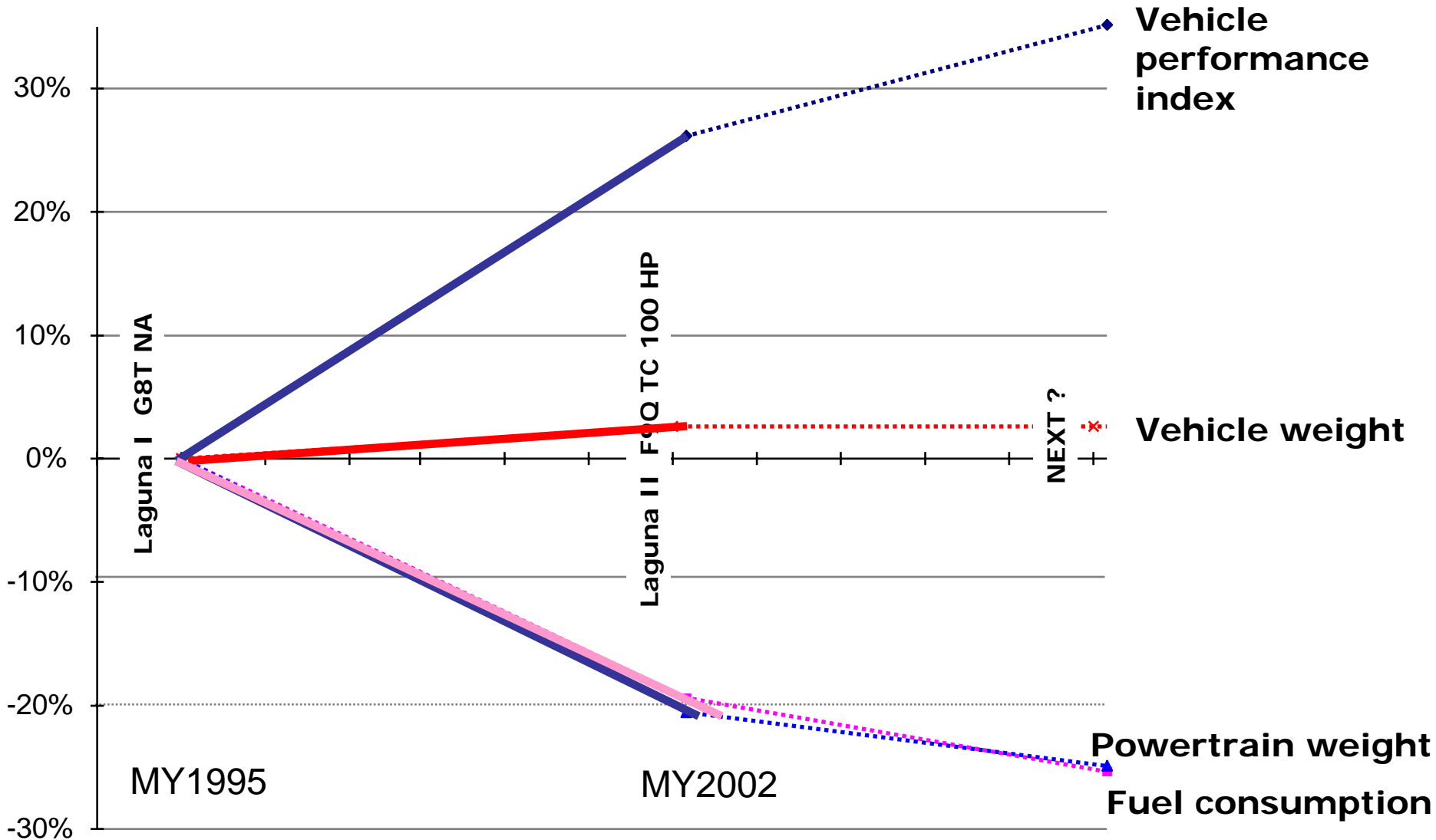


# CO2 Reduction from Vehicle Side

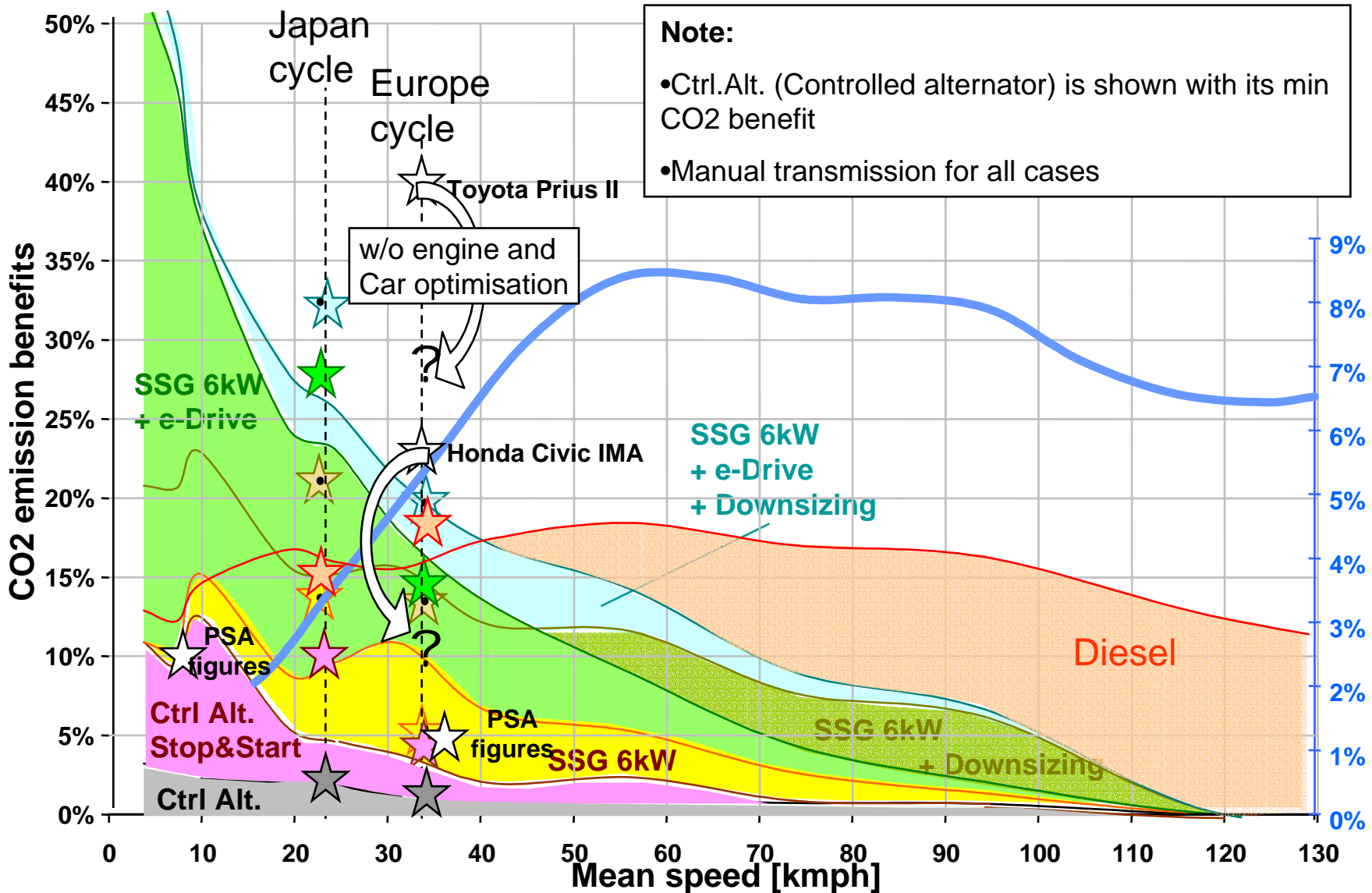
- **Weight Reduction**
- **Tire Rolling Resistance**
- **Aero Dynamics**
- **Air Conditioning Control**
- **Electric Consumption Reduction**
- **Driver Assistance.....**
  
- Progress slowed by cost and partly compensated by of reduction of noise and increase of safety and comfort requirements



# Weight Reduction: Example



# Hybrid Gasoline / Diesel Engine comparison



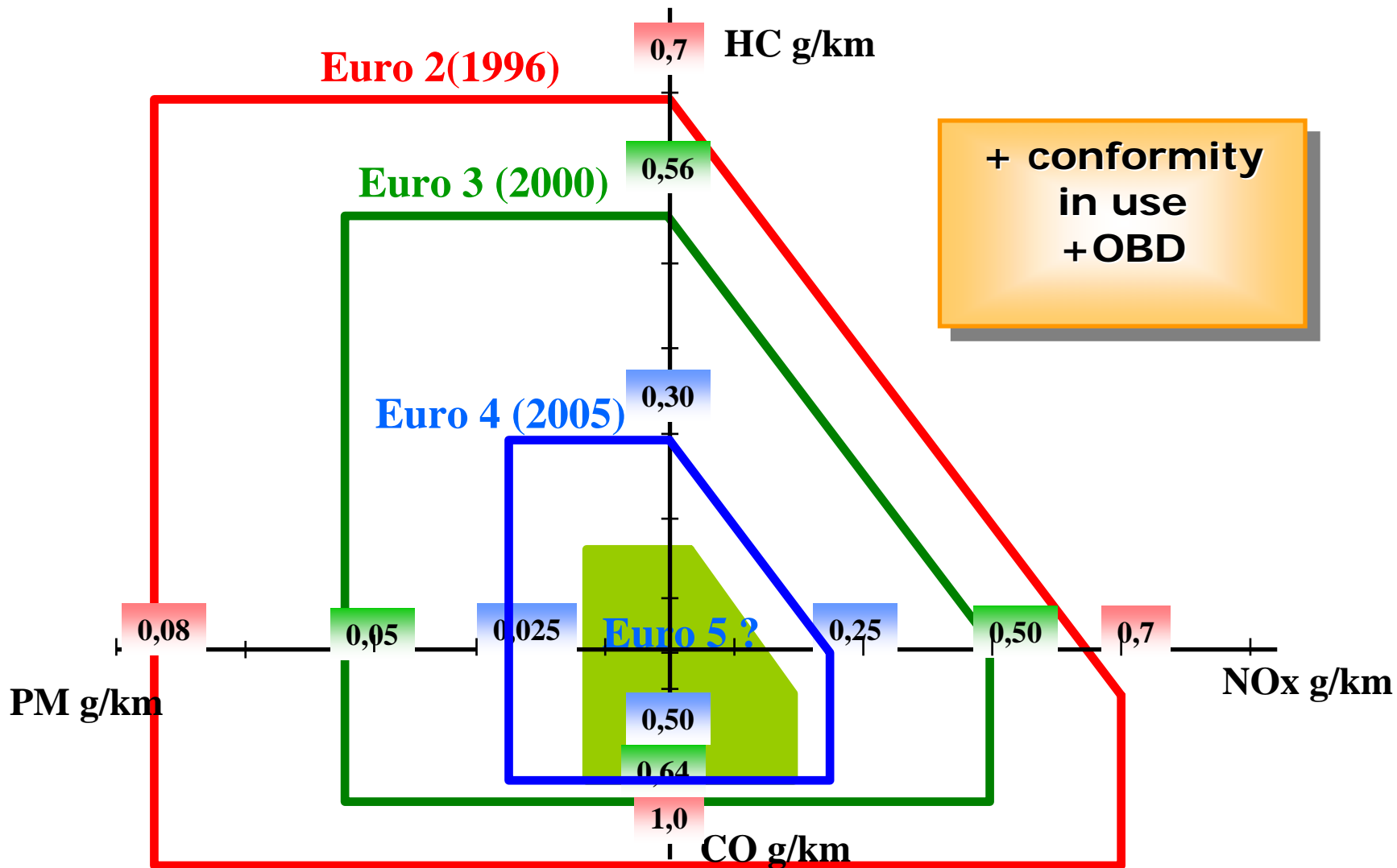
European Customer distance ratio vs mean speed



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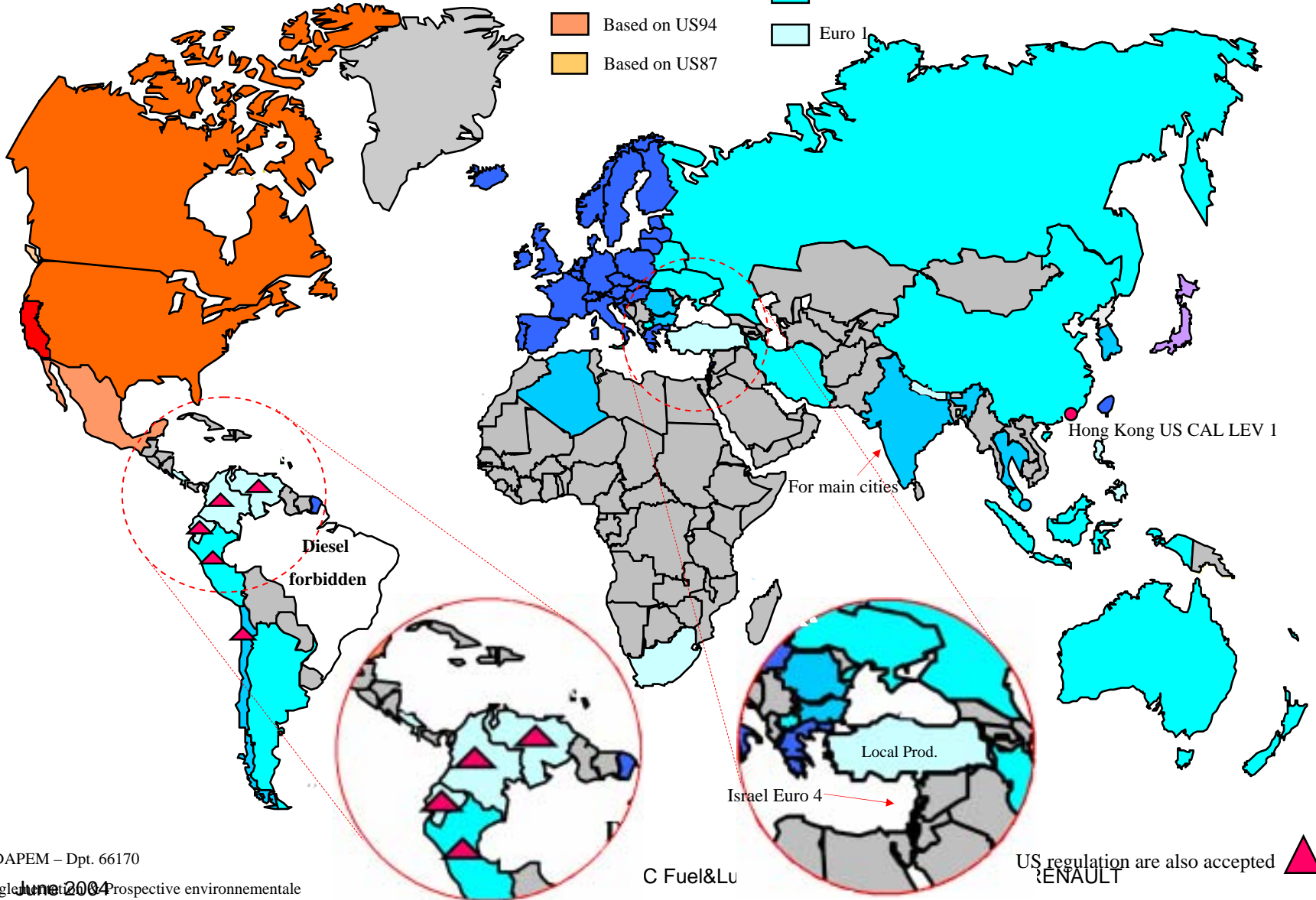
# Diesel Exhaust Emission Standards in Europe



# Exhaust emissions regulations for Diesel Passenger Vehicles in 2005



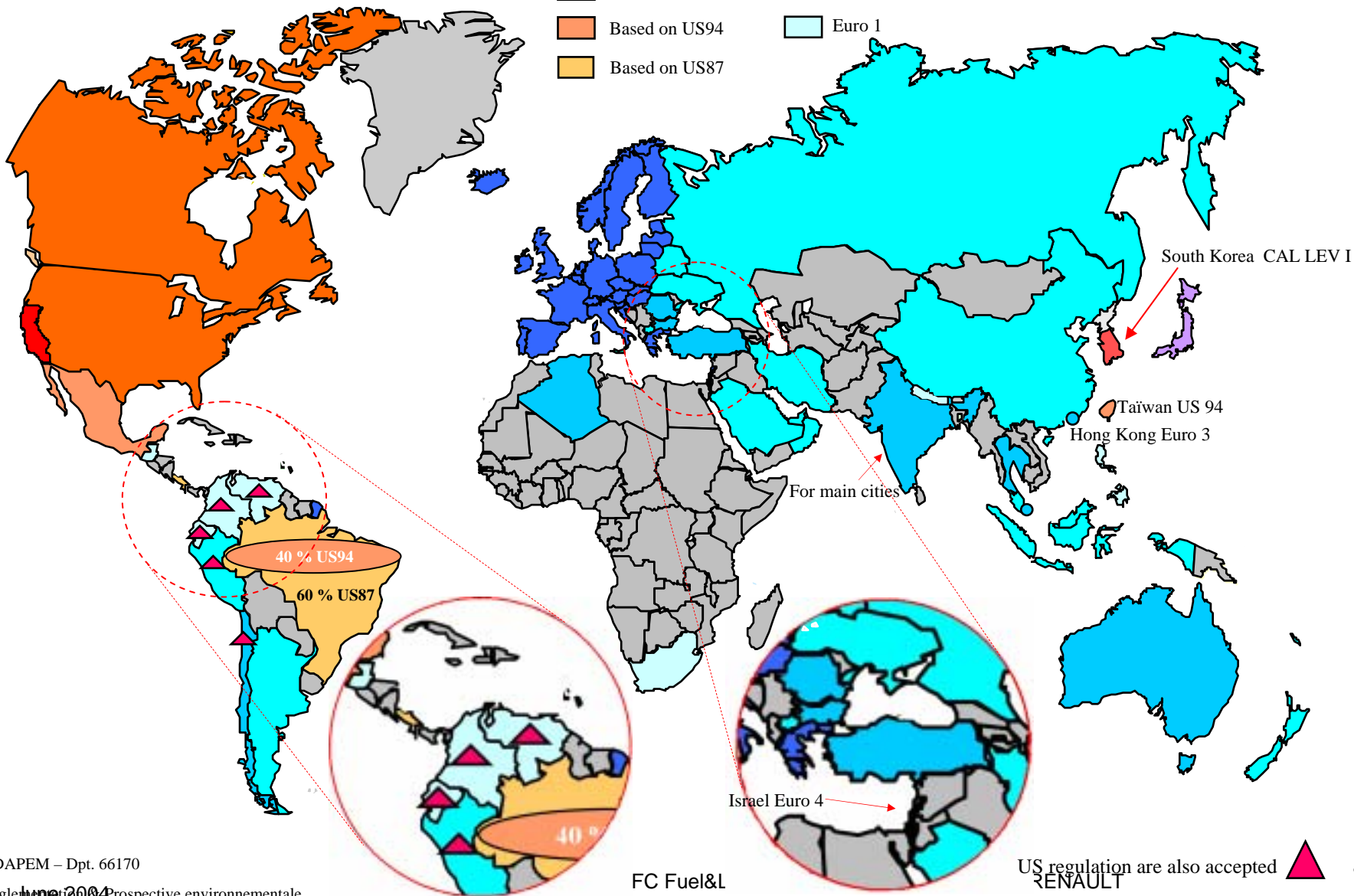
- California LEV 2
- Euro 4
- Japan
- Low regulatory requirements
- Based CAL LEV I
- Euro 3
- US Tier 2
- Euro 2
- Based on US94
- Euro 1
- Based on US87



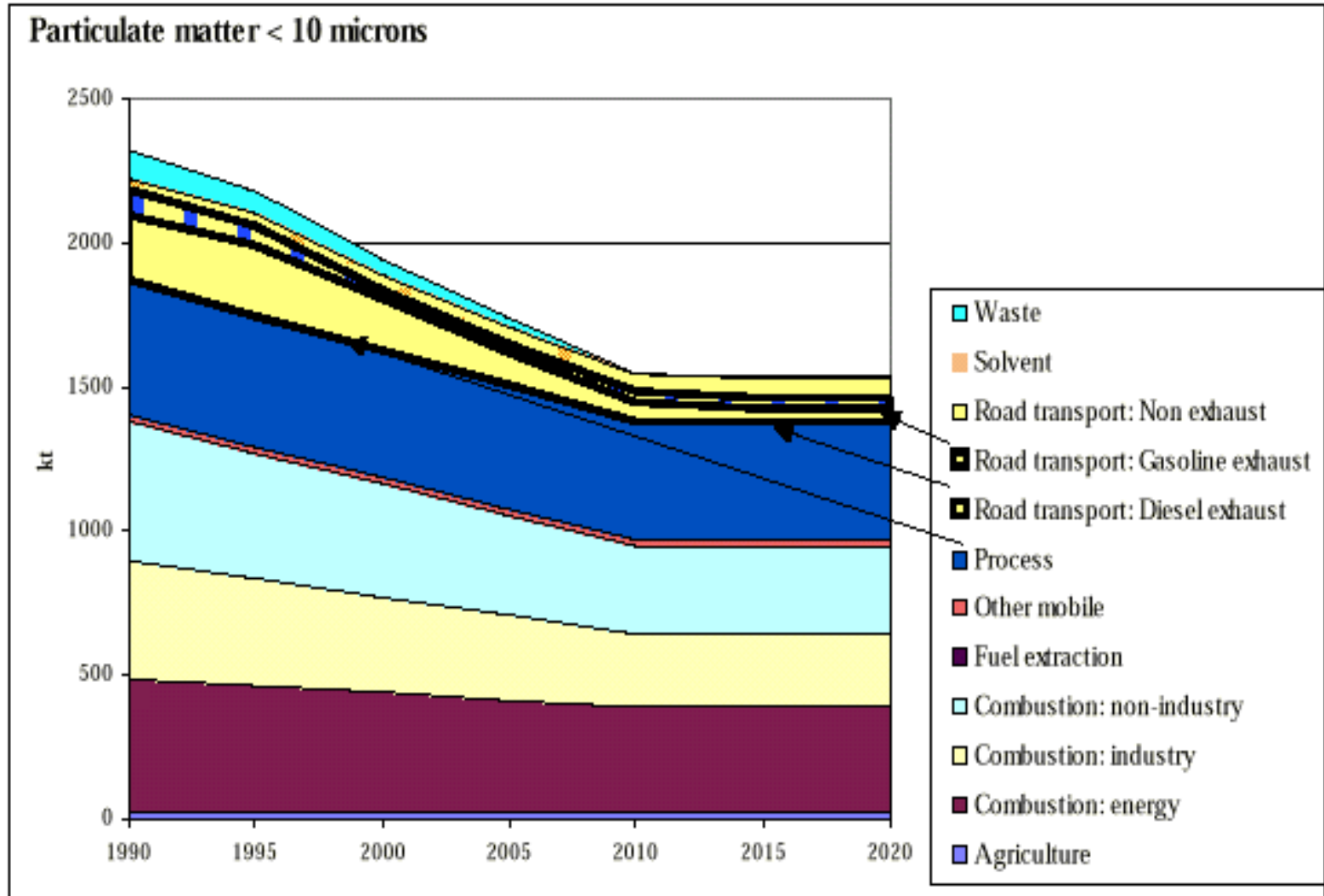
# Exhaust emissions regulations for gasoline Passenger Vehicles in 2005



- California LEV 2
- Euro 4
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- Low regulatory requirements
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# PARTICULES (PM) from Various Sources in Europe (in ktons)





# CSF System

## CATALYTIC SOOT FILTER

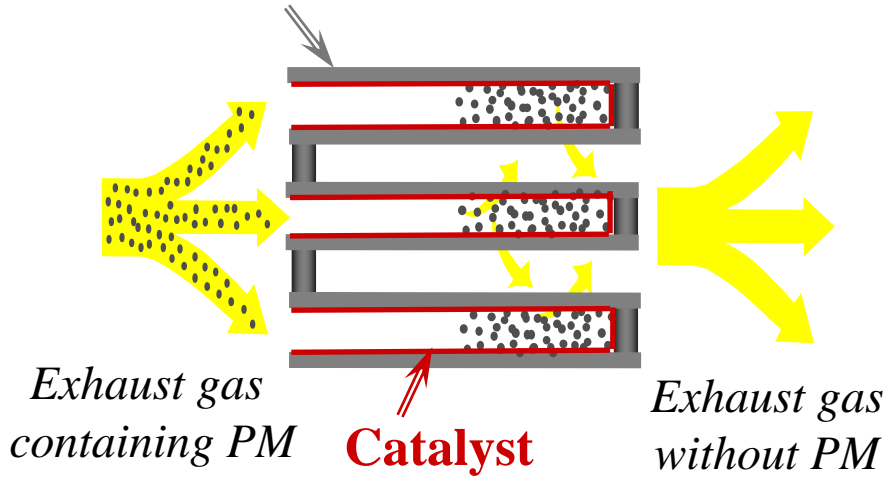
PM Trapping



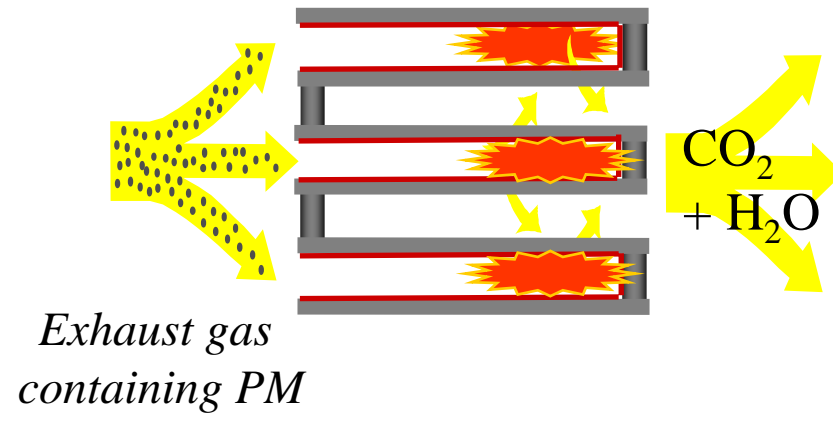
Filter Regeneration

PM accumulation into the filter

Filtration Material



PM combustion



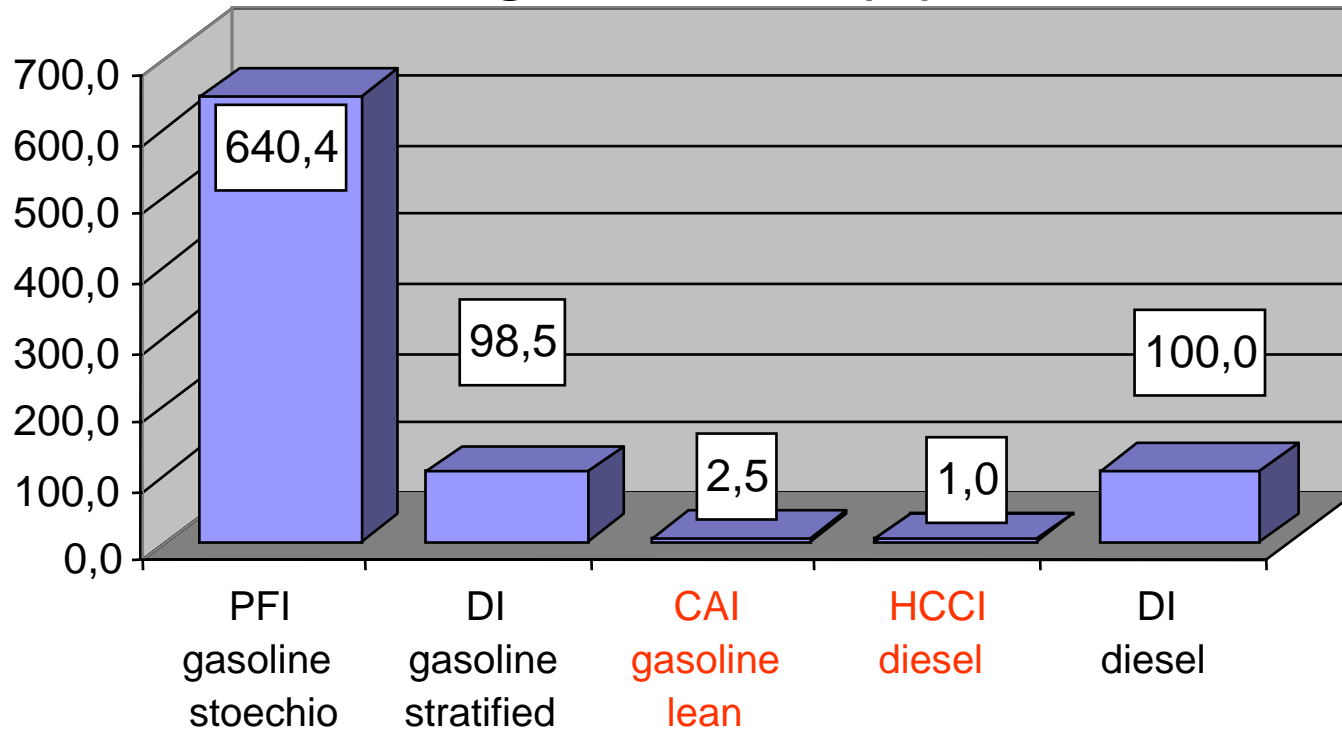
↗ Exhaust gas temperature with engine management

# Performance of CAI & HCCI developed by IFP



PME 3 bar, 1500 RPM

### Engine out NOx (%)



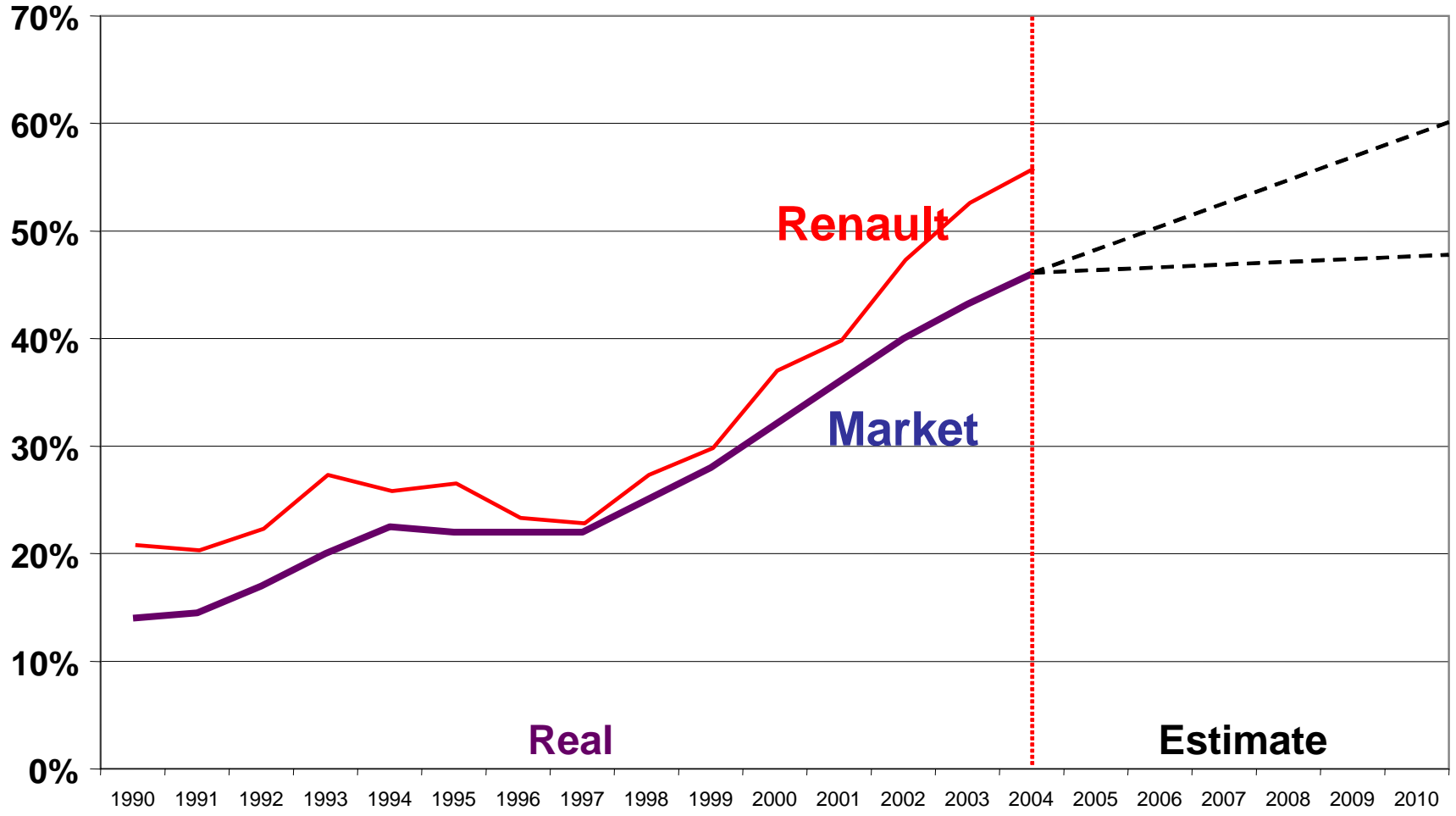


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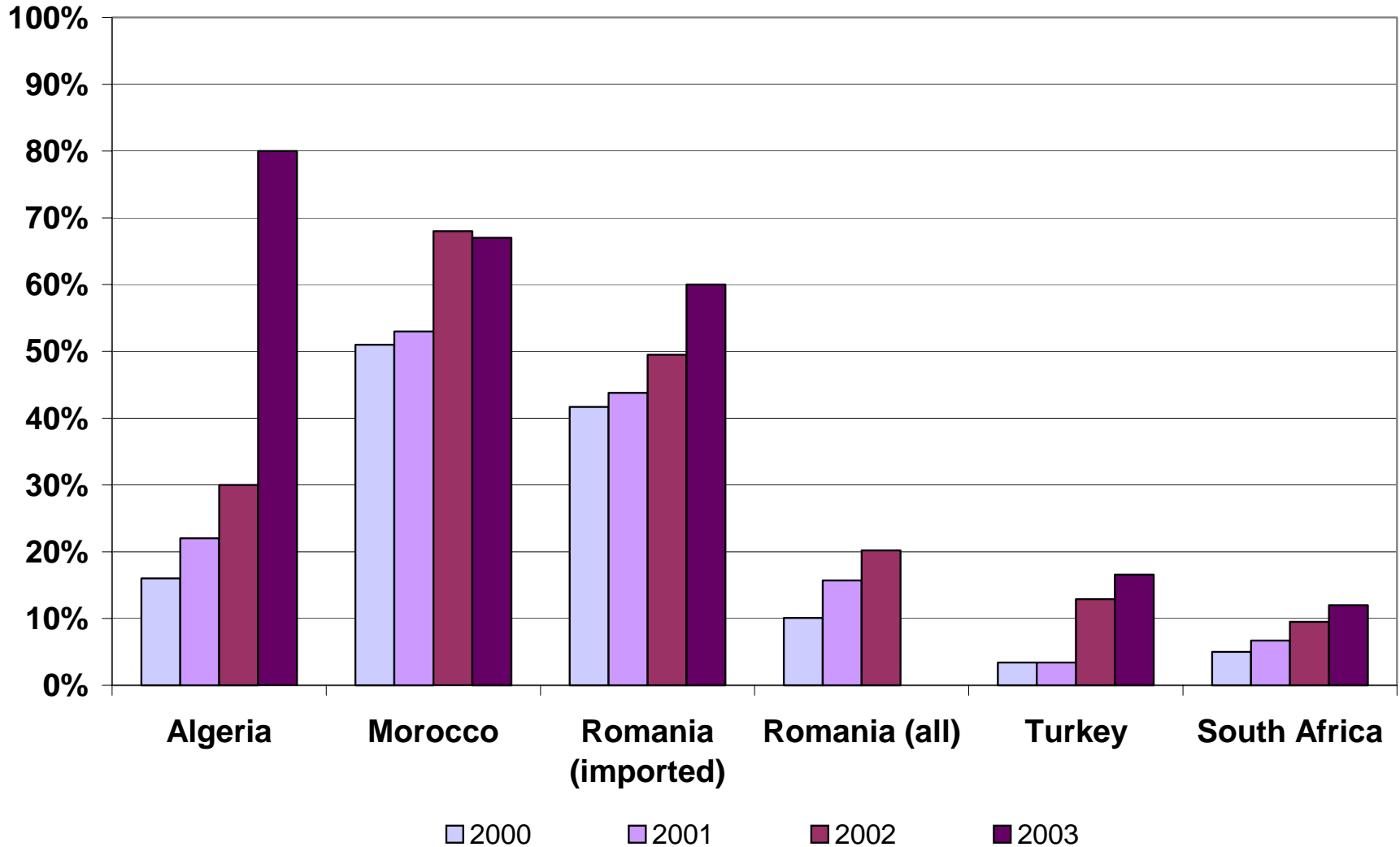


# 2000-2003 Diesel Market Share for Passenger Cars - EUROPE





# 2000-2003 Diesel Market Share for Passenger Cars – OUTSIDE EUROPE



# Alternative Fuels in Europe

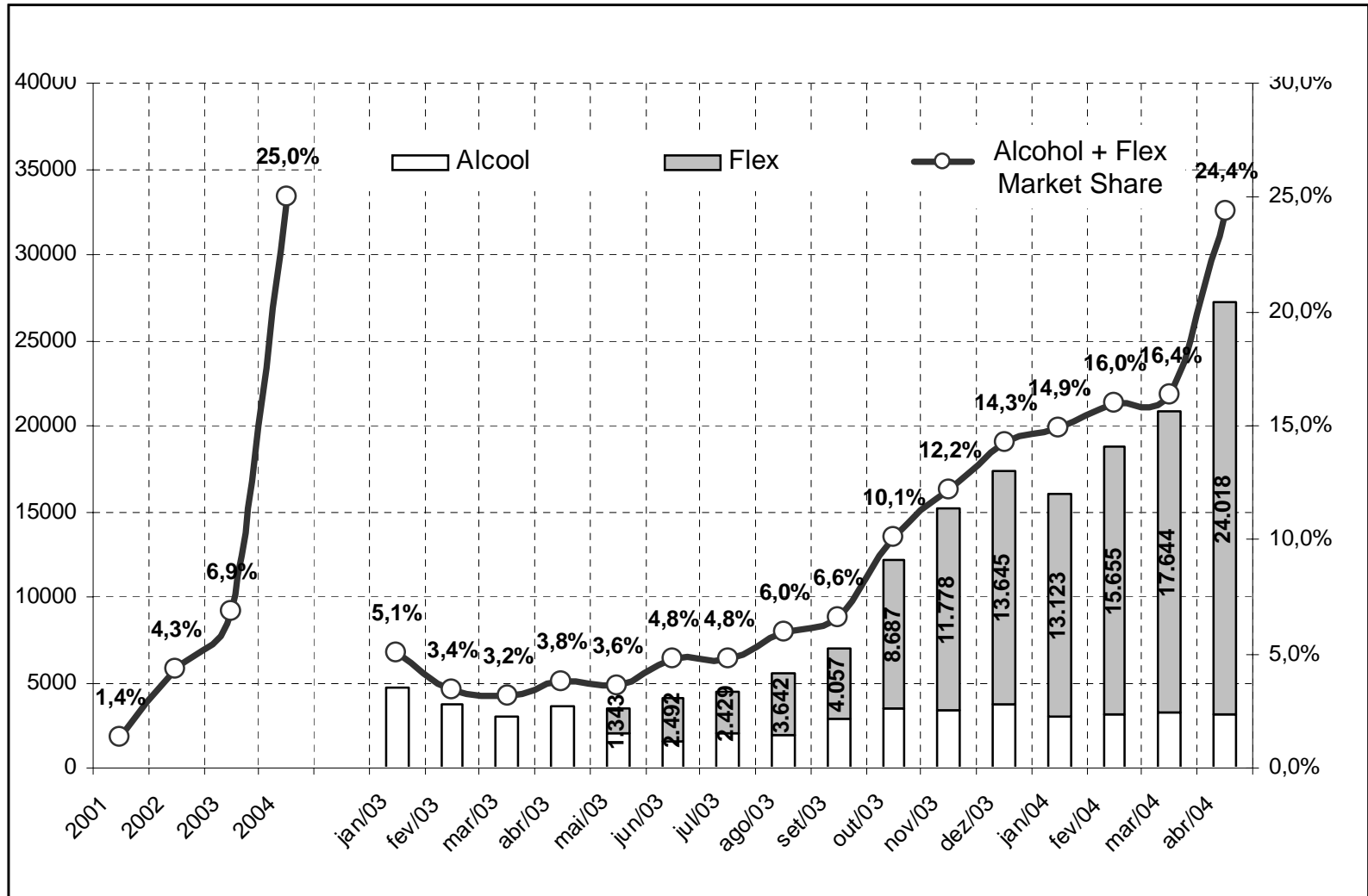
## **Bio-fuels :**

- **Ethanol**
- **Fatty Acid Methyl Esters (FAME)**

## **Synthetic Fuels :**

- **Gas-to-Liquid (GTL)**
- **Di-Methyl Ether**

# Alcohol + Flex Fuel Sales - BRAZIL





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# Evolutions of Fuels enabling Emissions Reduction



- Cold Start Emission
- Engine Out Emission

- Common Rail DI
- 1300 bar
- Turbocharger
- EGR Cooler
- Elect. EGR

- Aftertreatment Improvement
- VVT & VVL
- GDI

- CR with Piezo
- 1600 bar
- Multi-Injection
- VN Turbo
- DPF/CSF

- Downsizing & Turbocharging
- GDI + Turbo
- Hybrid

- 1800-2000 bar
- NOx Trap
- Downsizing
- HCCI



**EURO 3**  
2000

**EURO 4**  
2005

**EURO 5**  
2010 ?



- Pb Phase-out
- S < 150 ppm
- Arom Content
- Volatility
- S < 350 ppm
- Cetane No., ....

- S < 50/10 ppm
- Detergency
- S < 50 ppm
- Lubricity
- Cleanliness
- Anticorrosion
- Detergency

Low\_SAPS lubricants for DPF

- Sulfur Free
- Sulfur Free

Availability of Euro 4 Fuels Outside of Europe



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# CONCLUSION

- European approach till now well balanced between local emissions abatement and global warming control,
- Look for cost effective and affordable solutions,
- Modern European Diesel engine is a valuable solution and is expanding its share throughout the world.



THANK YOU