8th Diesel Engine Emissions Reduction (DEER) Conference
August 25-29, 2002
San Diego, California

Advances in Diesel Engine Technologies for European Passenger Vehicles

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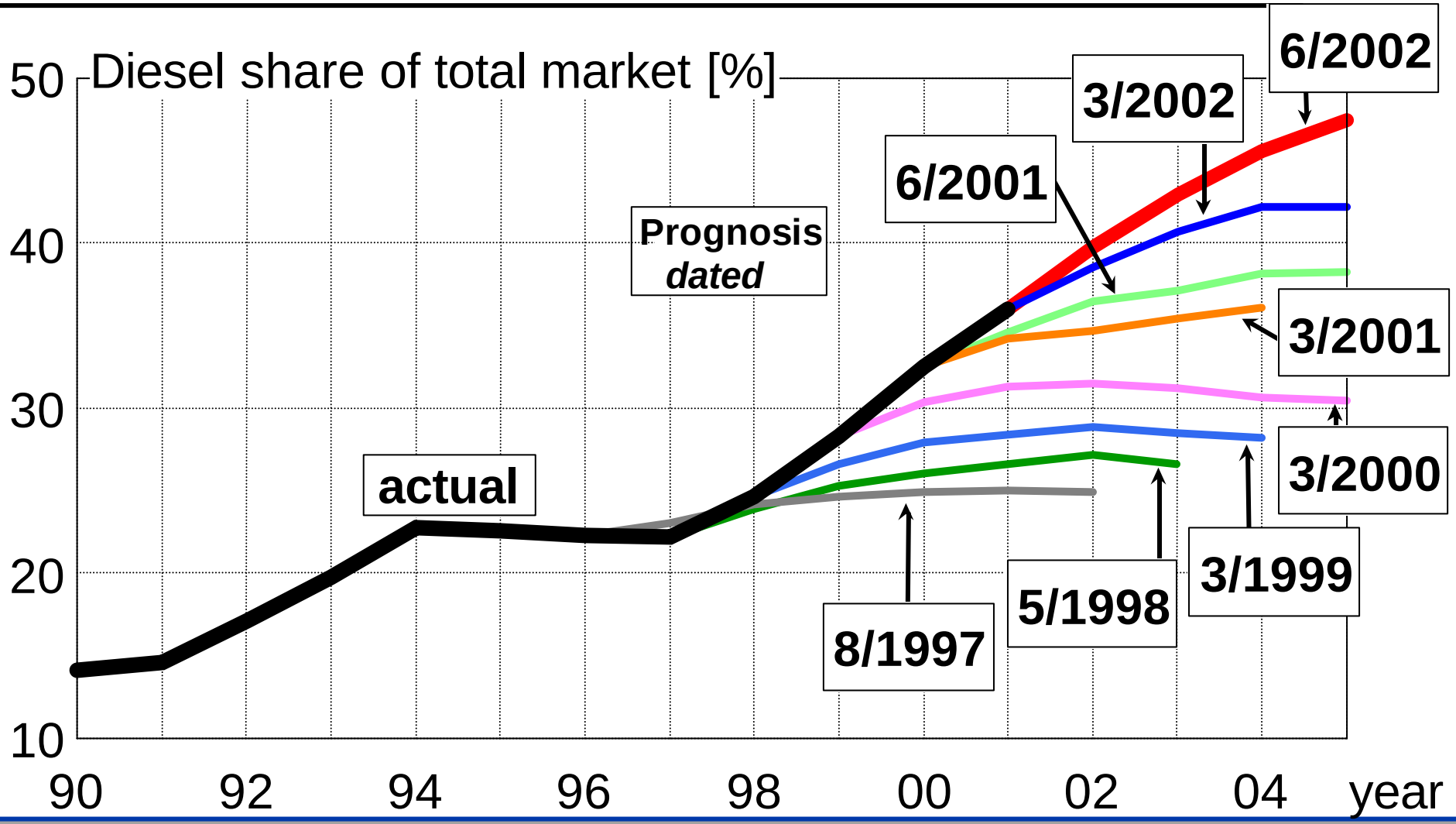
Content

1. Diesel market in Western Europe
2. Environmental relevant driving forces of vehicle development
3. Powertrain concepts: today and in the future
4. Outlook and conclusions

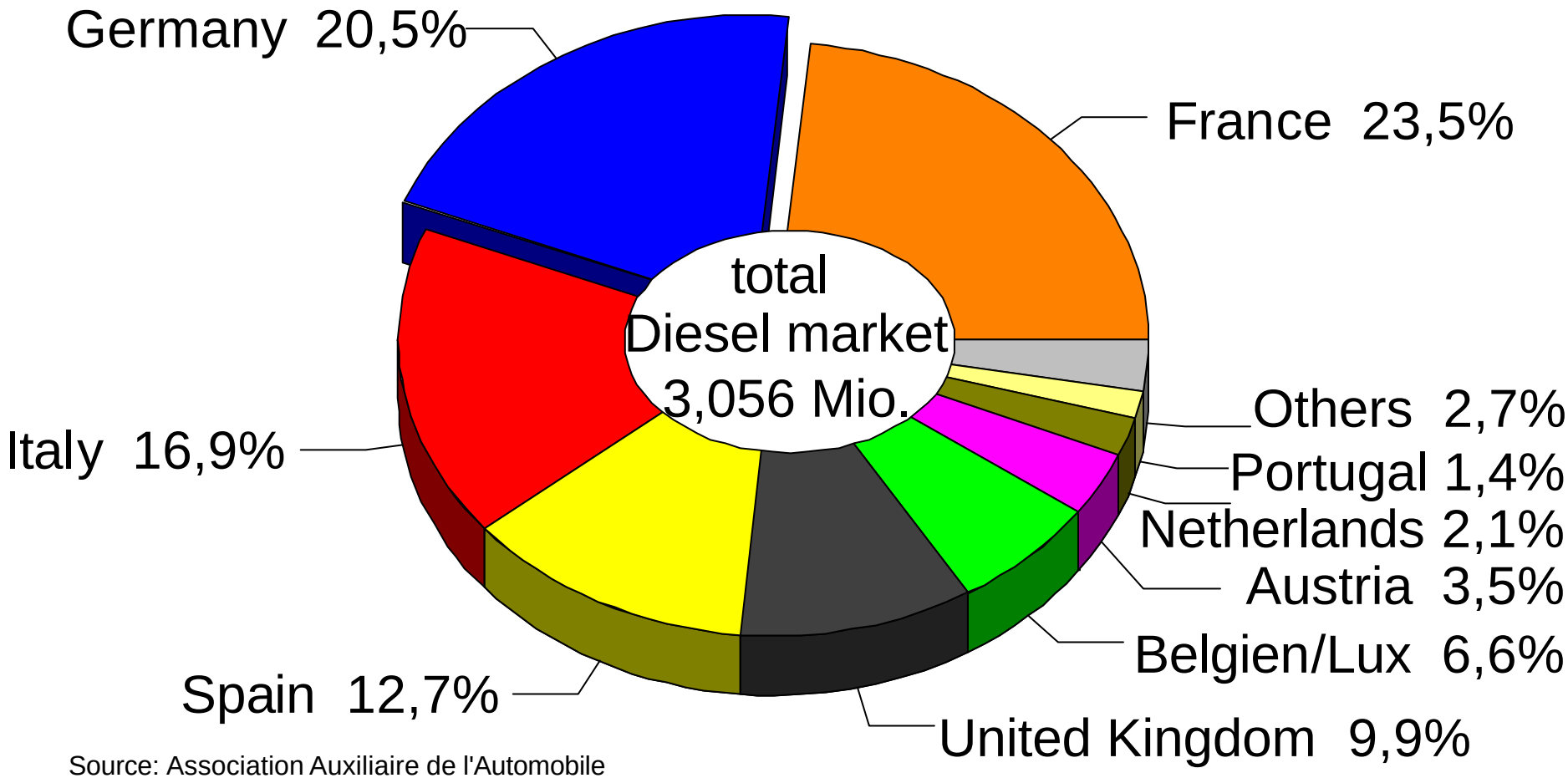
Diesel Share in Western Europe

Comparison of different prognosis (DRI)



Diesel market in Western Europe

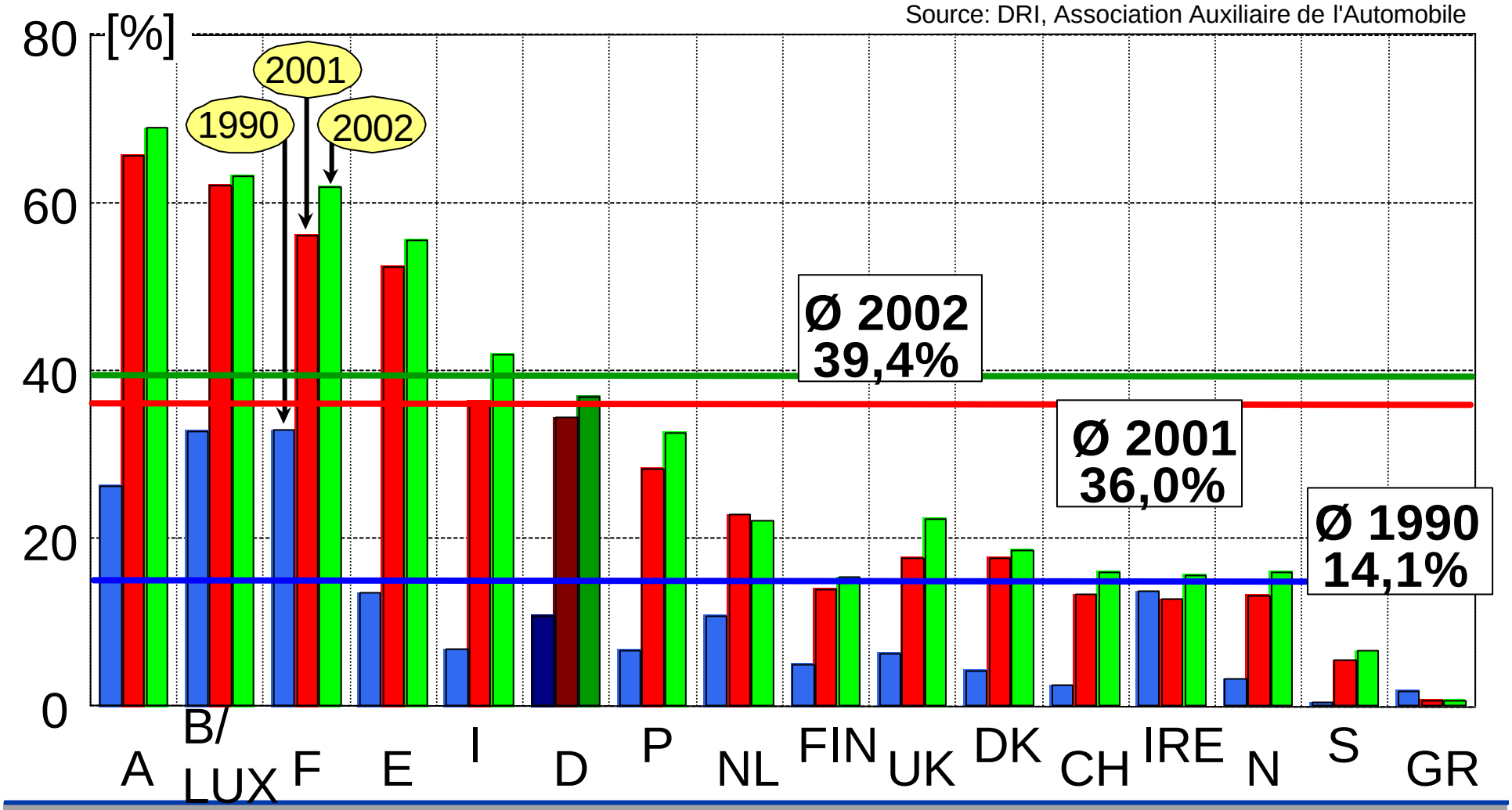
January – June 2002



Source: Association Auxiliaire de l'Automobile

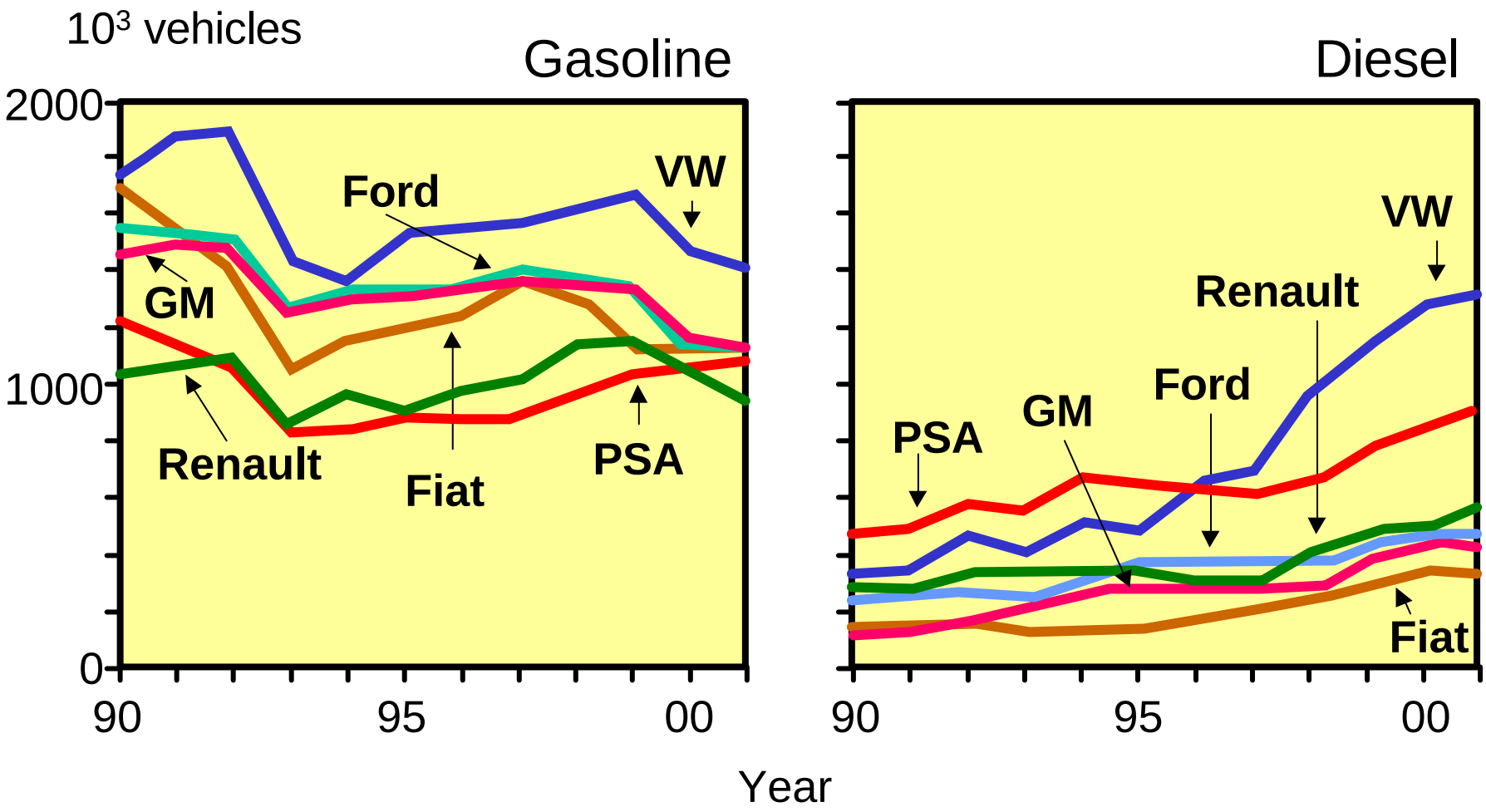
Western Europe

National Diesel Shares 1990 / 2001 / ½yr 2002



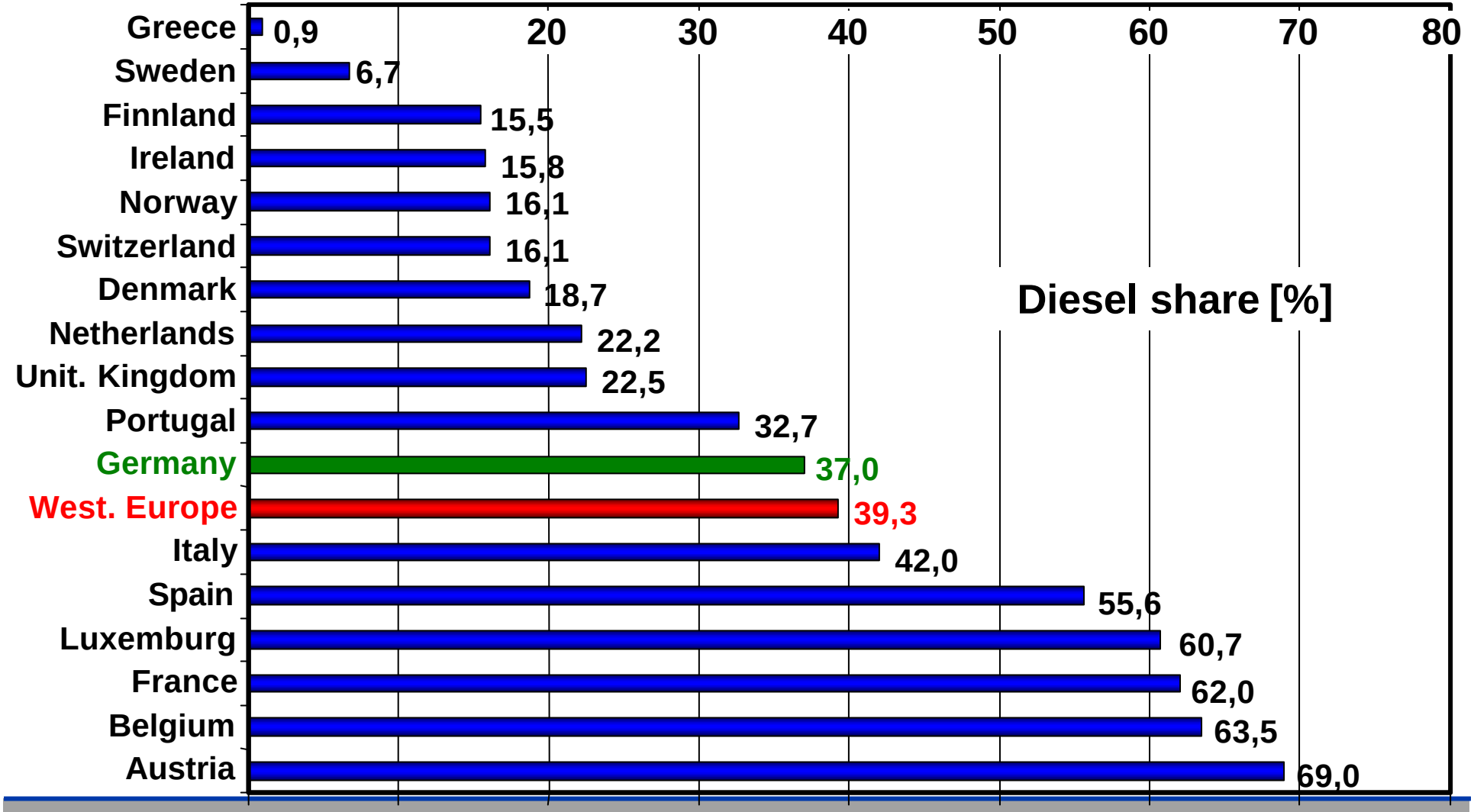
New registrations of Diesel passenger cars

Western Europe: 1990 - 2001



New registrations of Diesel passenger cars

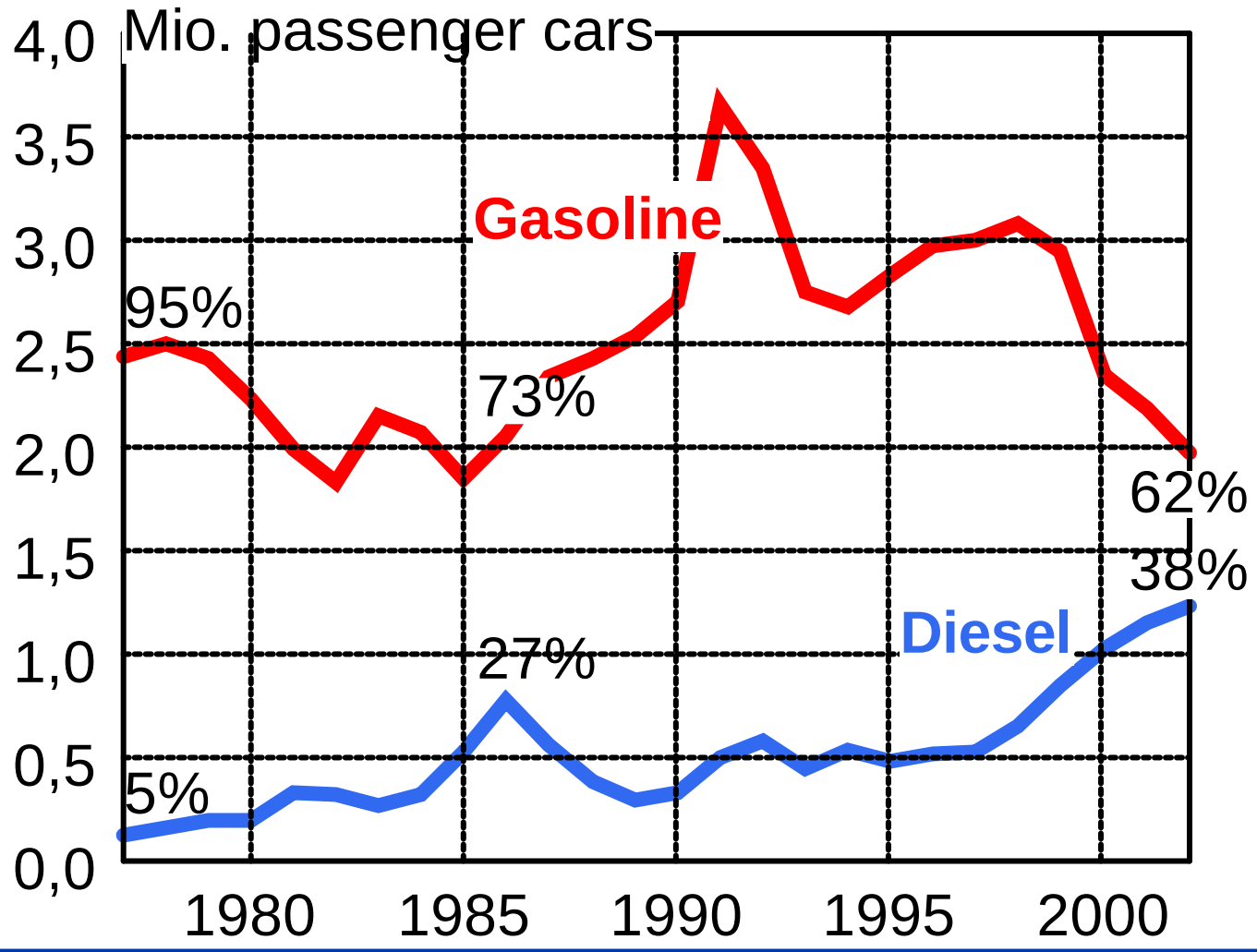
Western Europe: January - June 2002



European Status

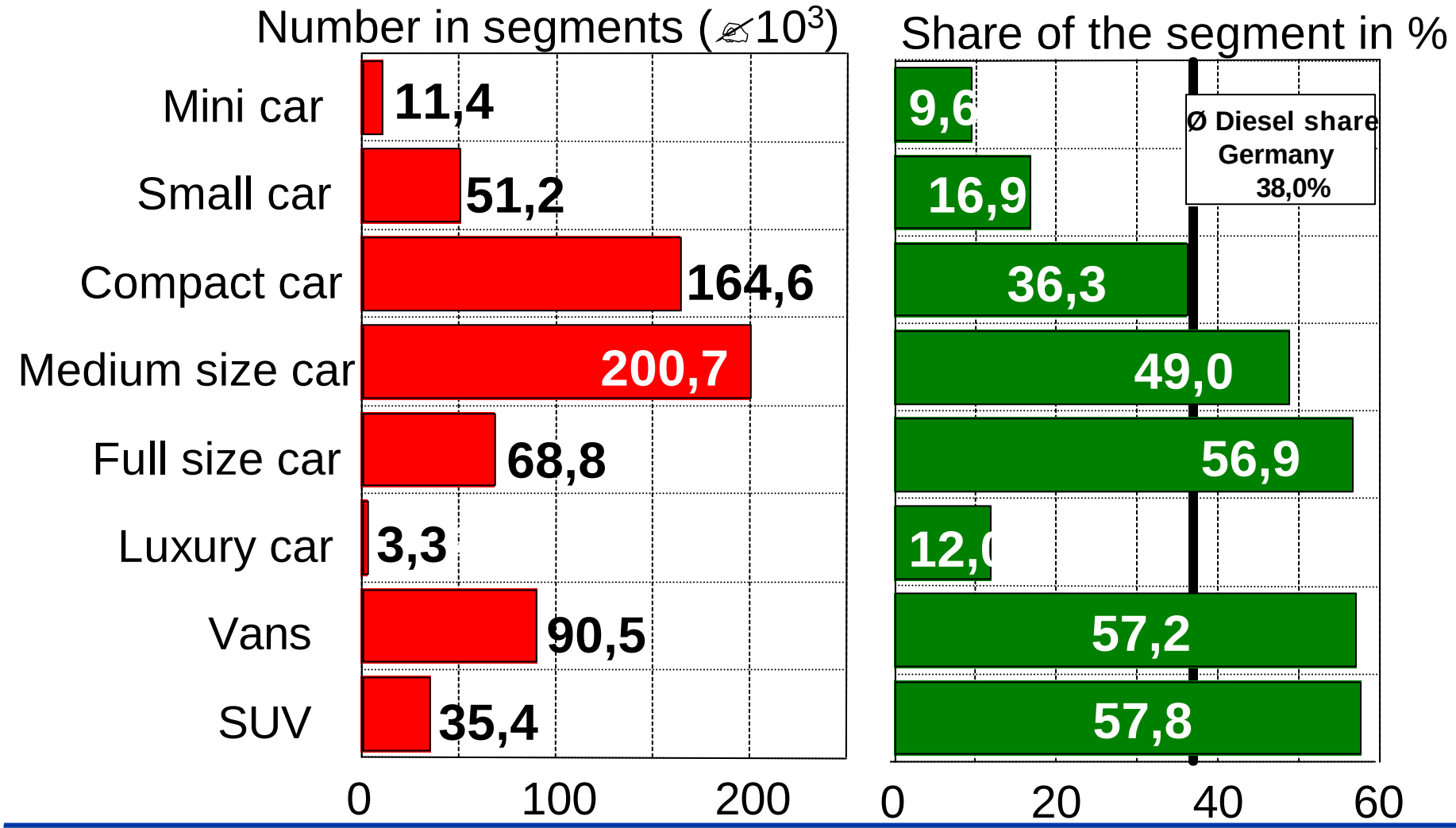
New registrations of passenger cars

Germany



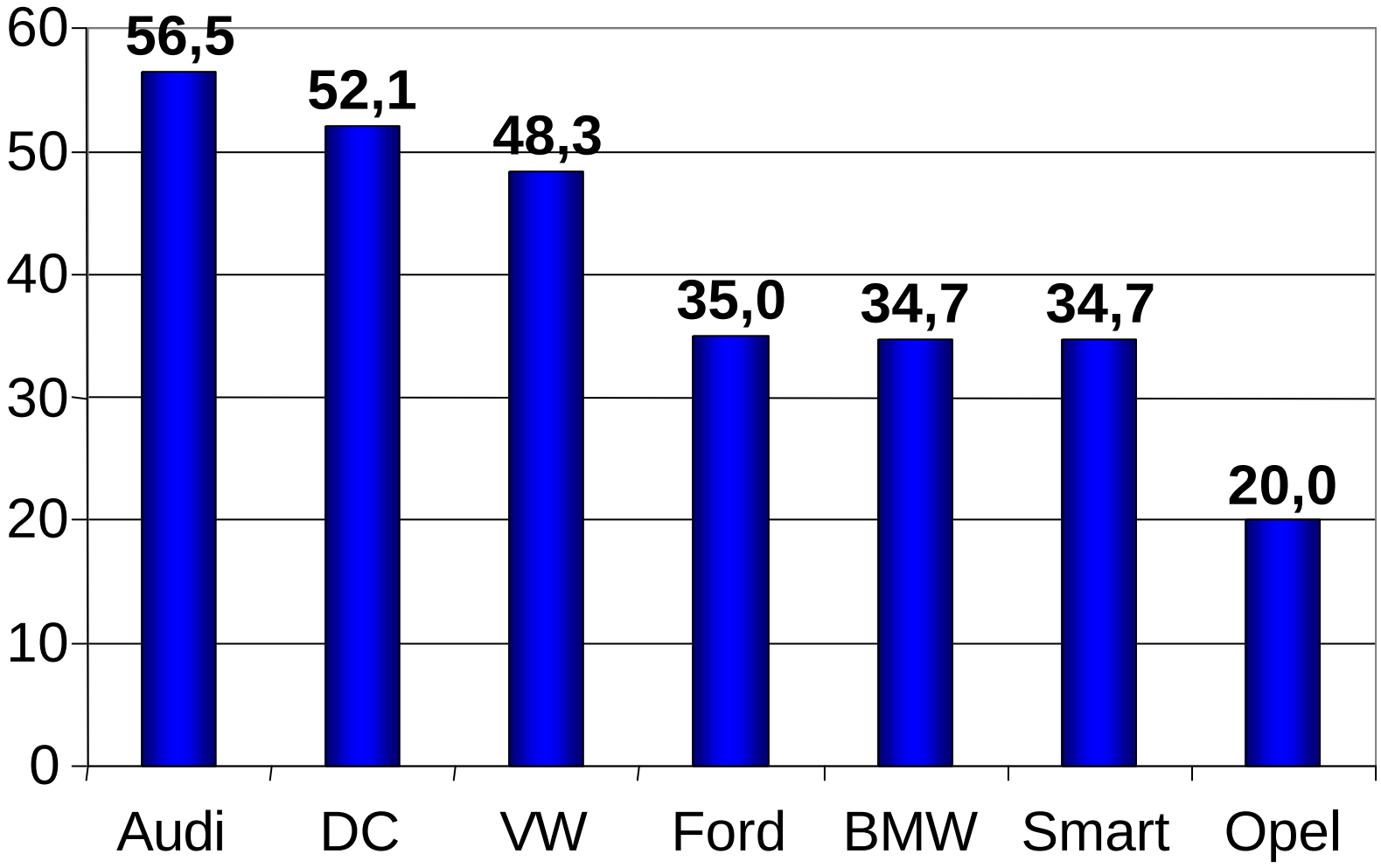
New registrations of Diesel passenger cars

Germany: January - June 2002



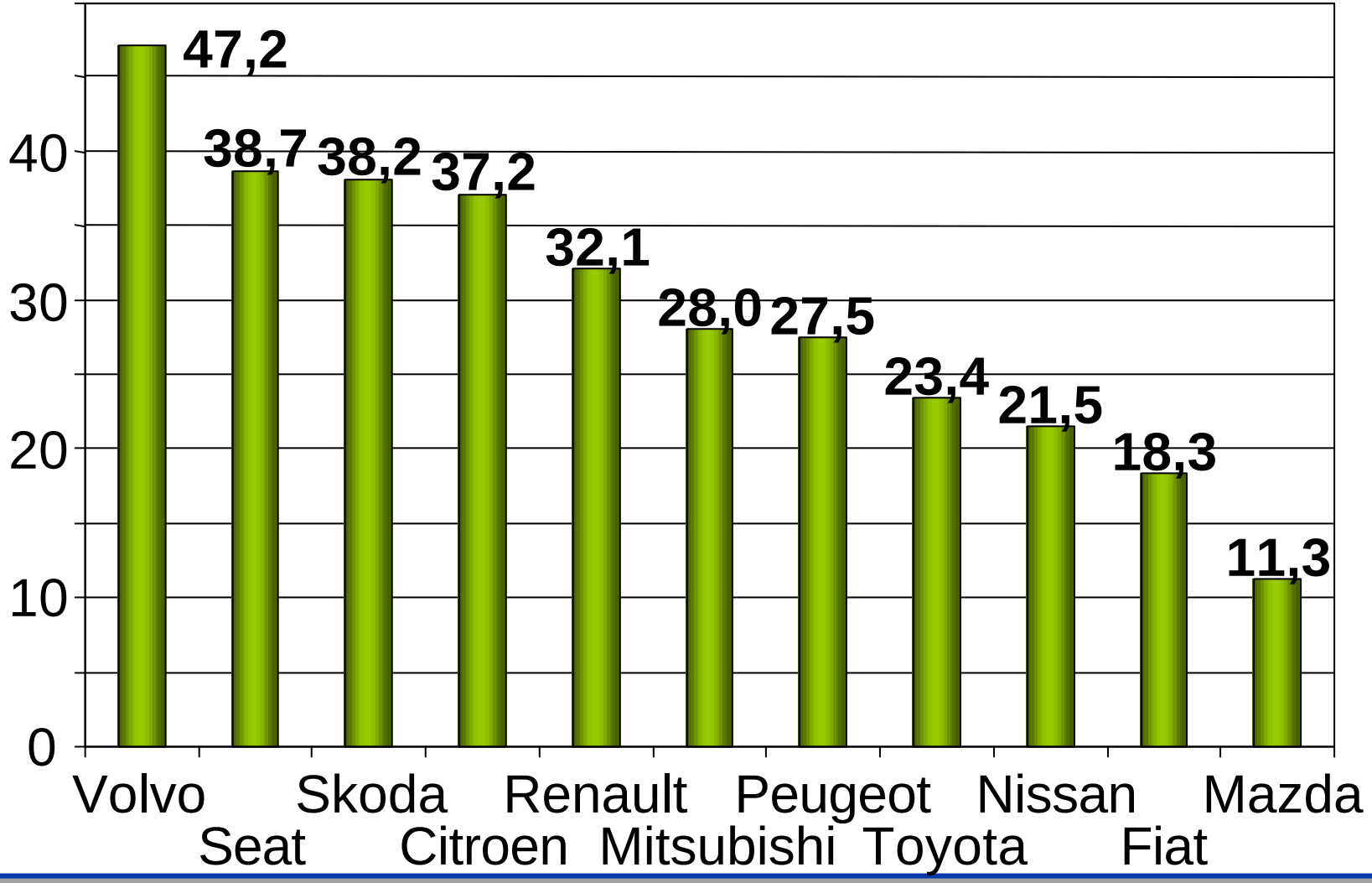
Diesel share in Germany

January to Juni 2002: German manufacturers



Diesel share in Germany

January to Juni 2002: Importers



Why do costumers in Europe buy the Diesel?

- the diesel closed the gap to the gasoline engine on:
  - performance
  - noise
- the diesel has reduced fuel consumption (CO_2 emissions)
- the diesel has lower operating costs

Operating costs of a Diesel vehicle

- during purchasing
  - vehicle price
  - purchase tax
  - VAT
- during operation yearly
  - annual vehicle tax
- during driving
  - fuel tax
  - maintance costs
- real costs from sophisticated calculation

But: costumers consider mainly the difference in gasoline and diesel fuel costs

Content

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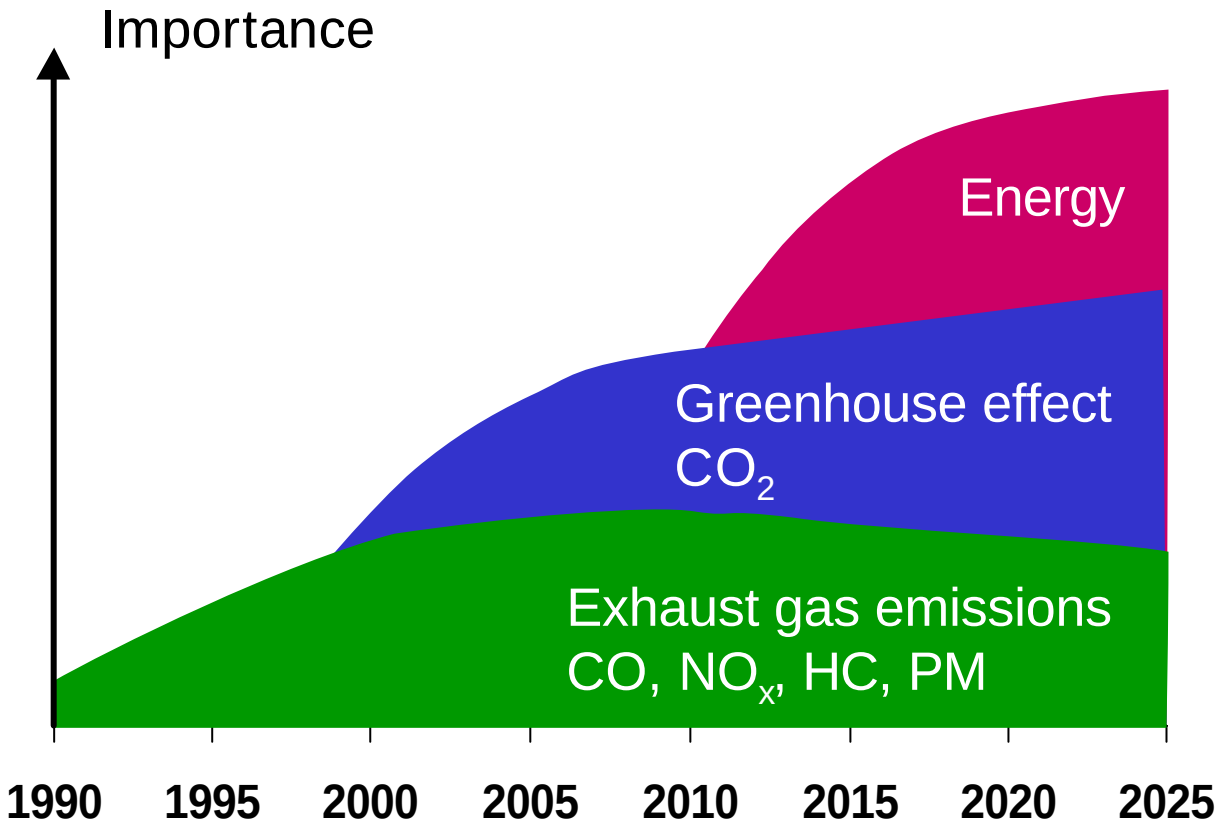
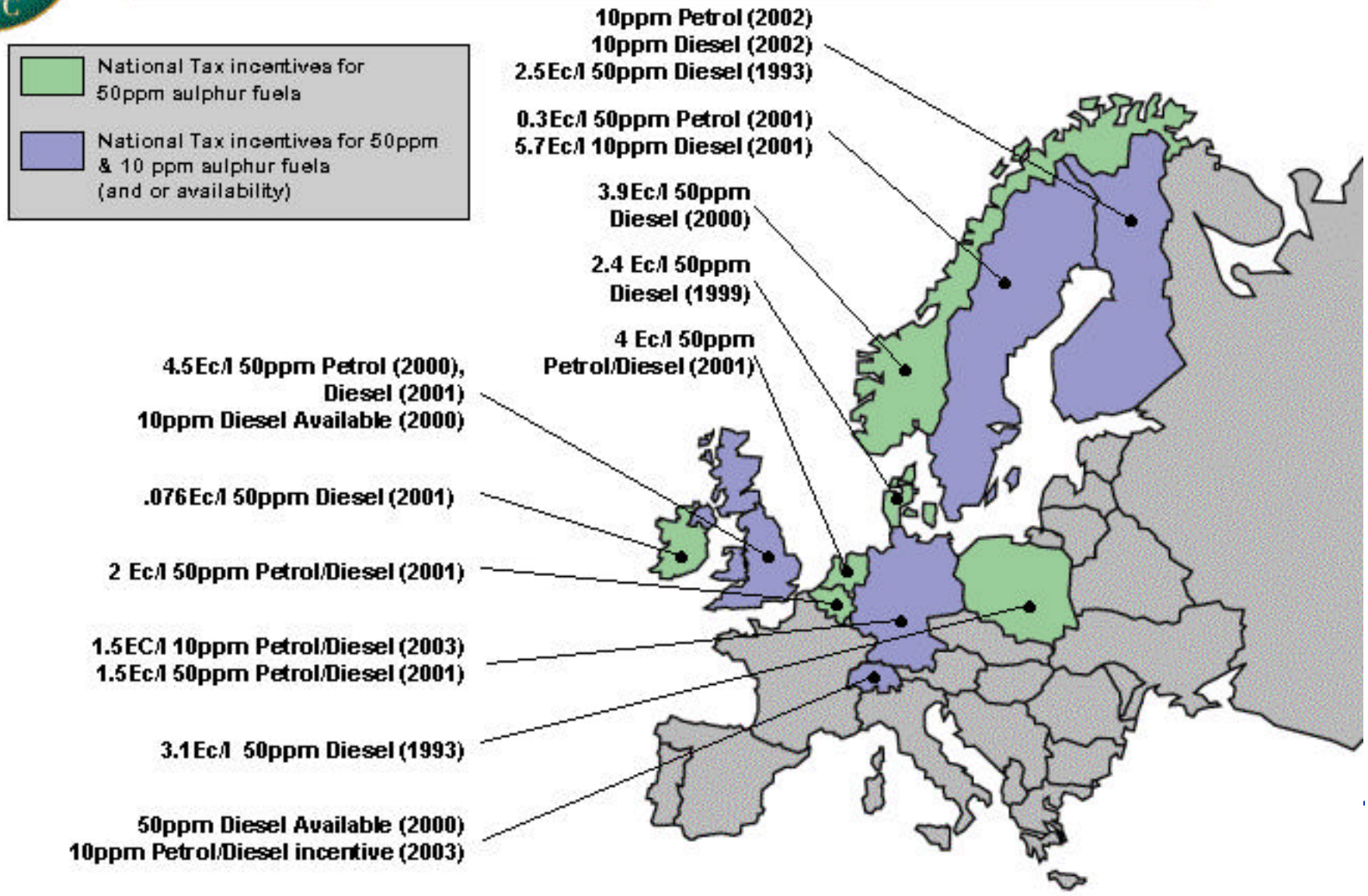
2. Environmental relevant driving forces of vehicle development

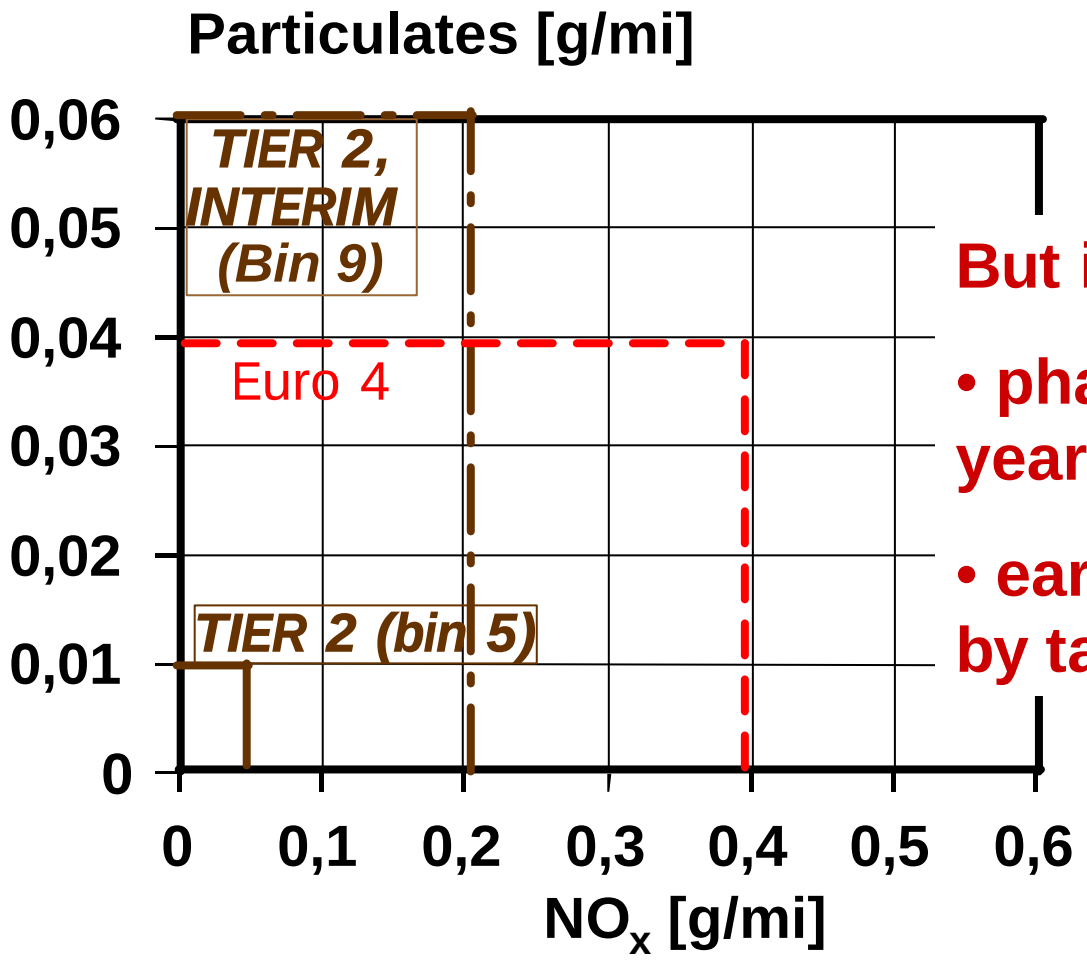
Environmental relevant driving forces of vehicle development



EU Member State Tax Incentives for 50 & 10ppm Sulphur fuels



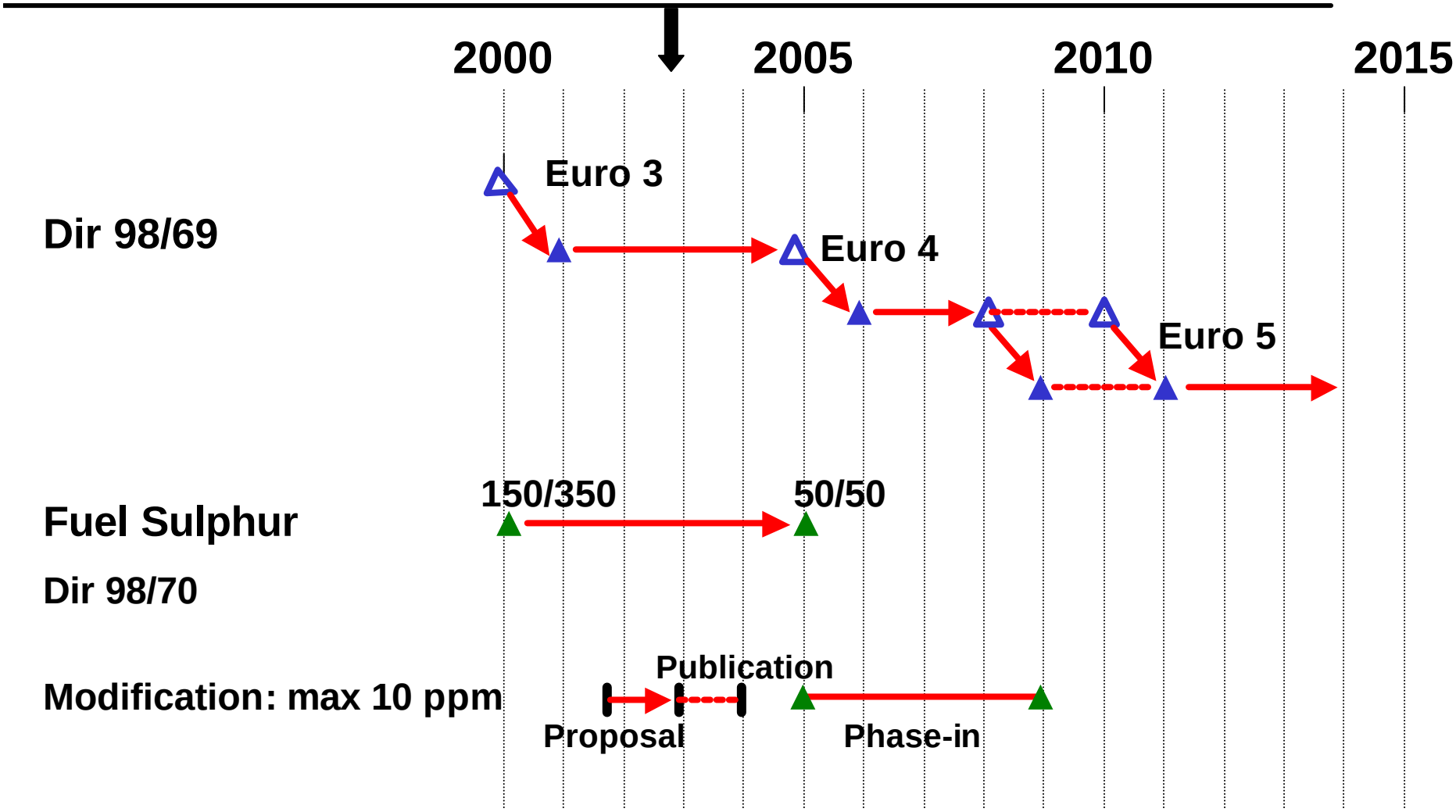
Comparison between EU and US legislation



But in Europe:

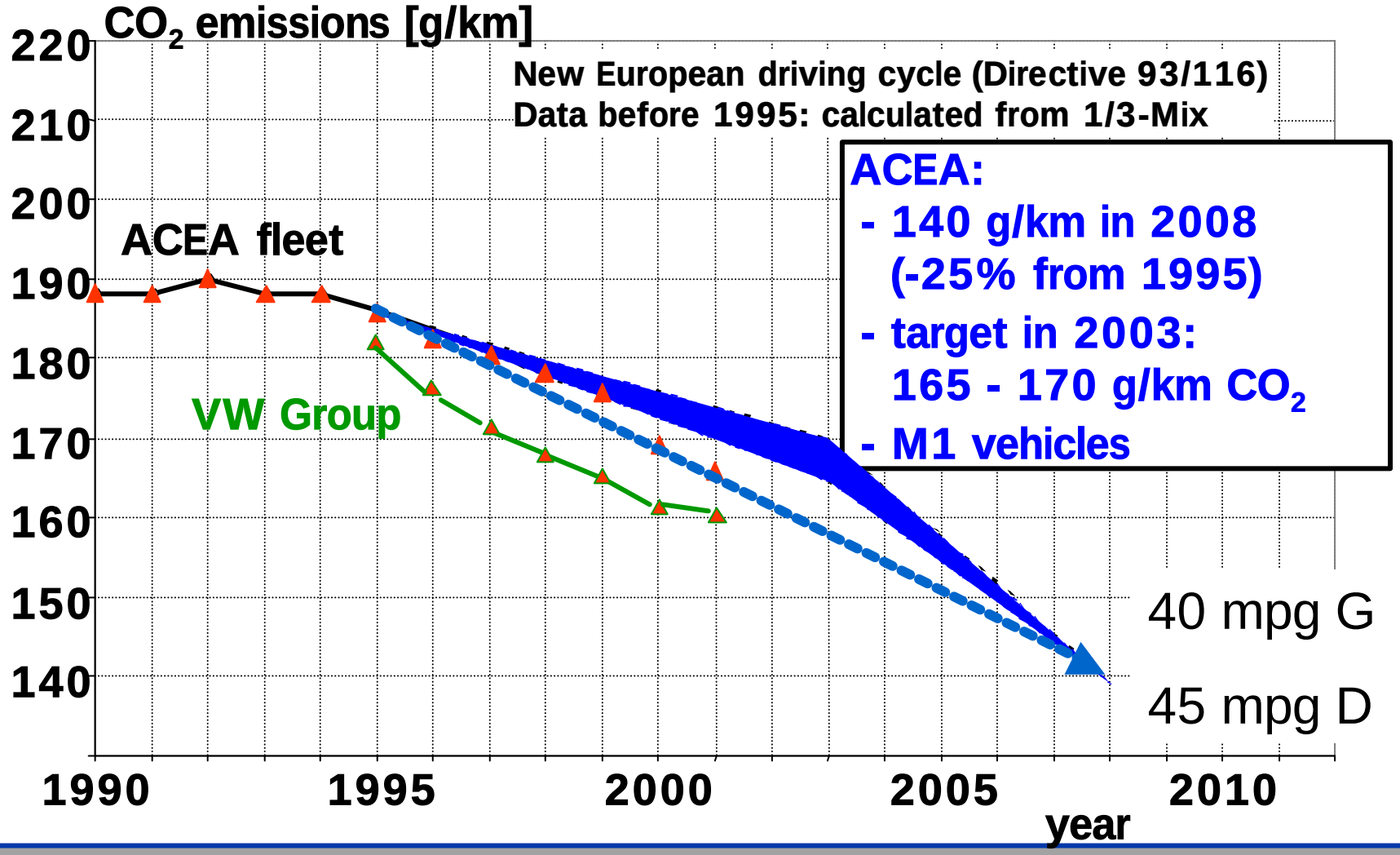
- **phase-in of only one year**
- **earlier introduction by tax incentives**

Scenario EU exhaust gas legislation

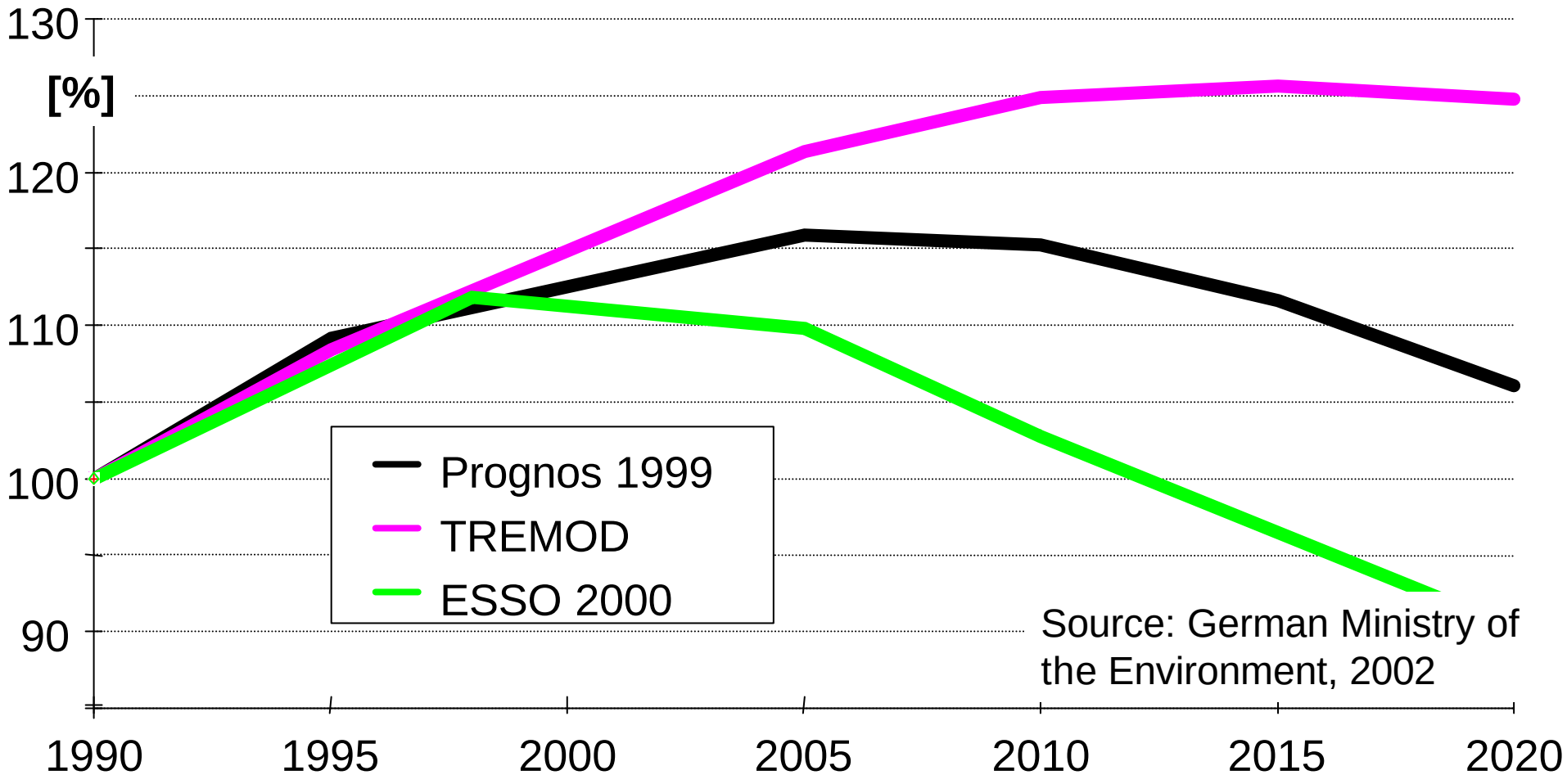


CO_2 Reduction in Europe

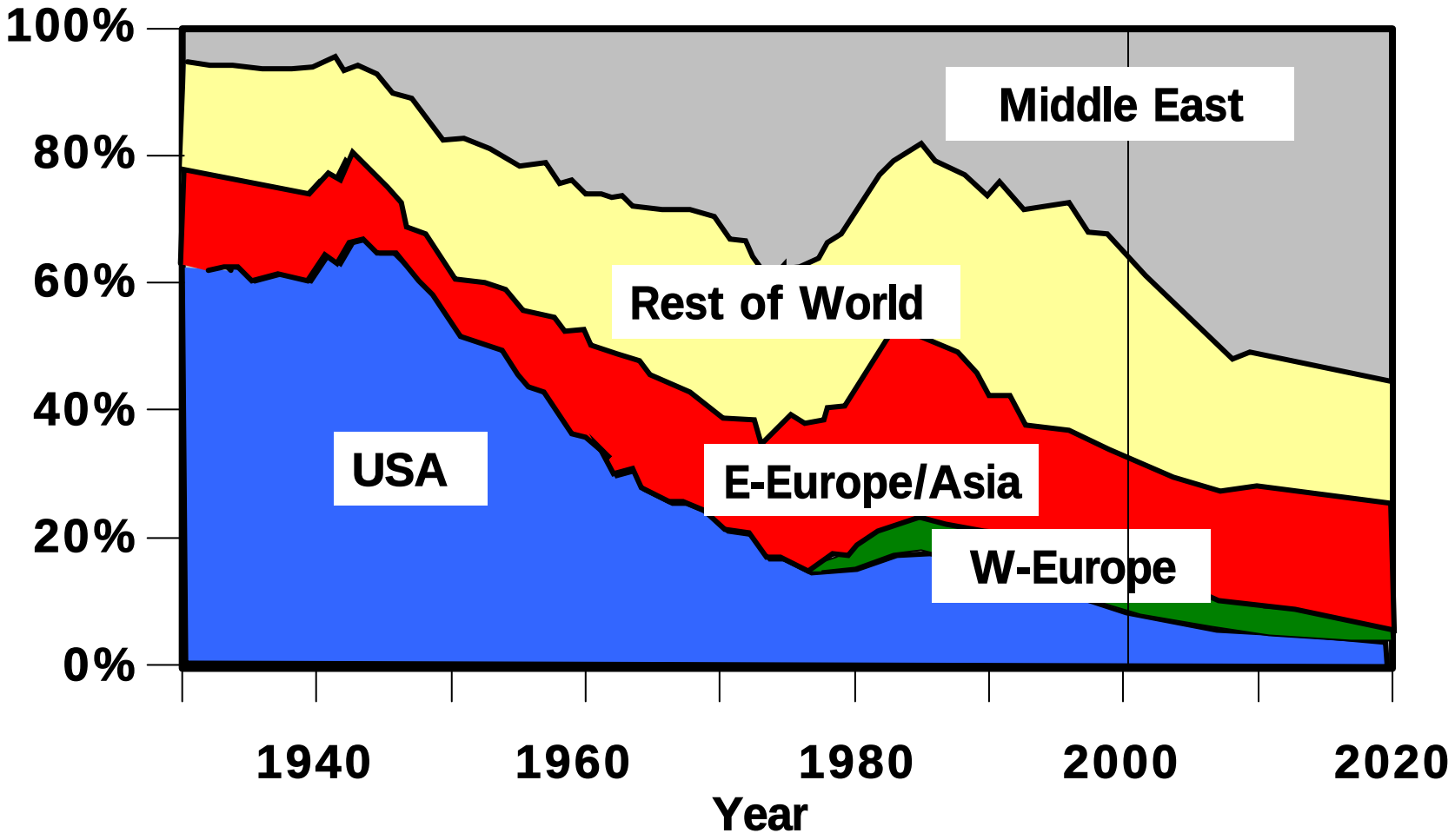
Agreement between ACEA and the EU Commission



Simulation of CO_2 emissions from traffic in Germany



Share of regional oil prodution 1930-2020



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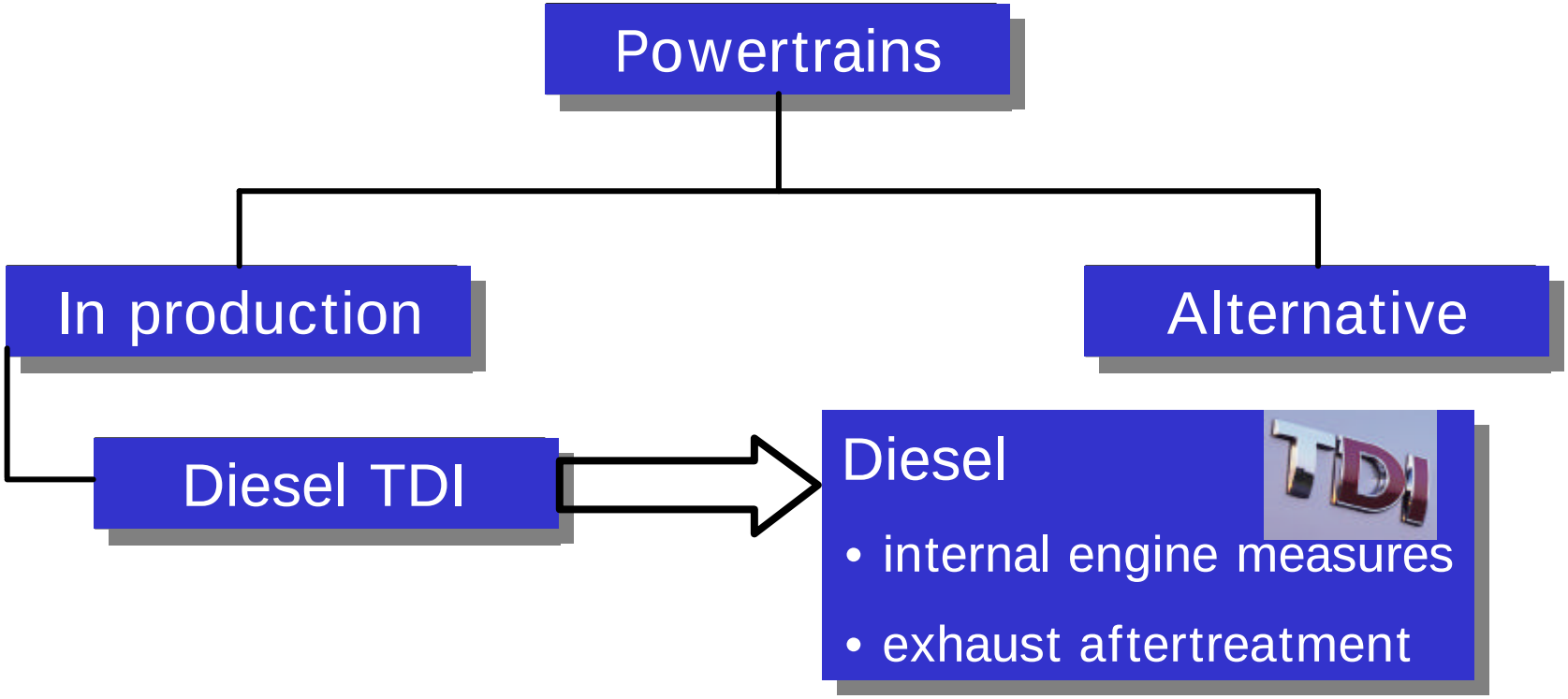
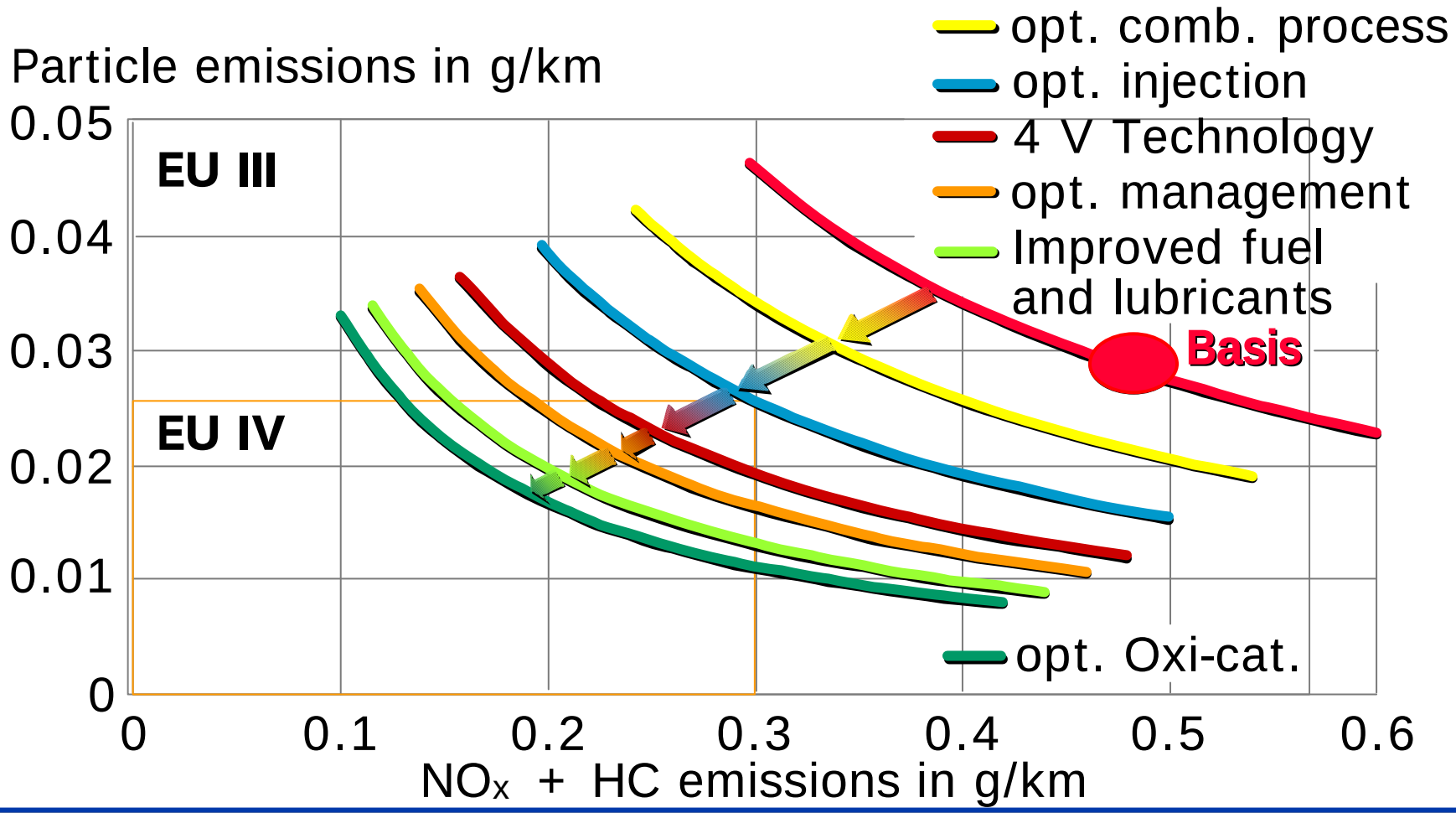
Approaches to maintain individual mobility

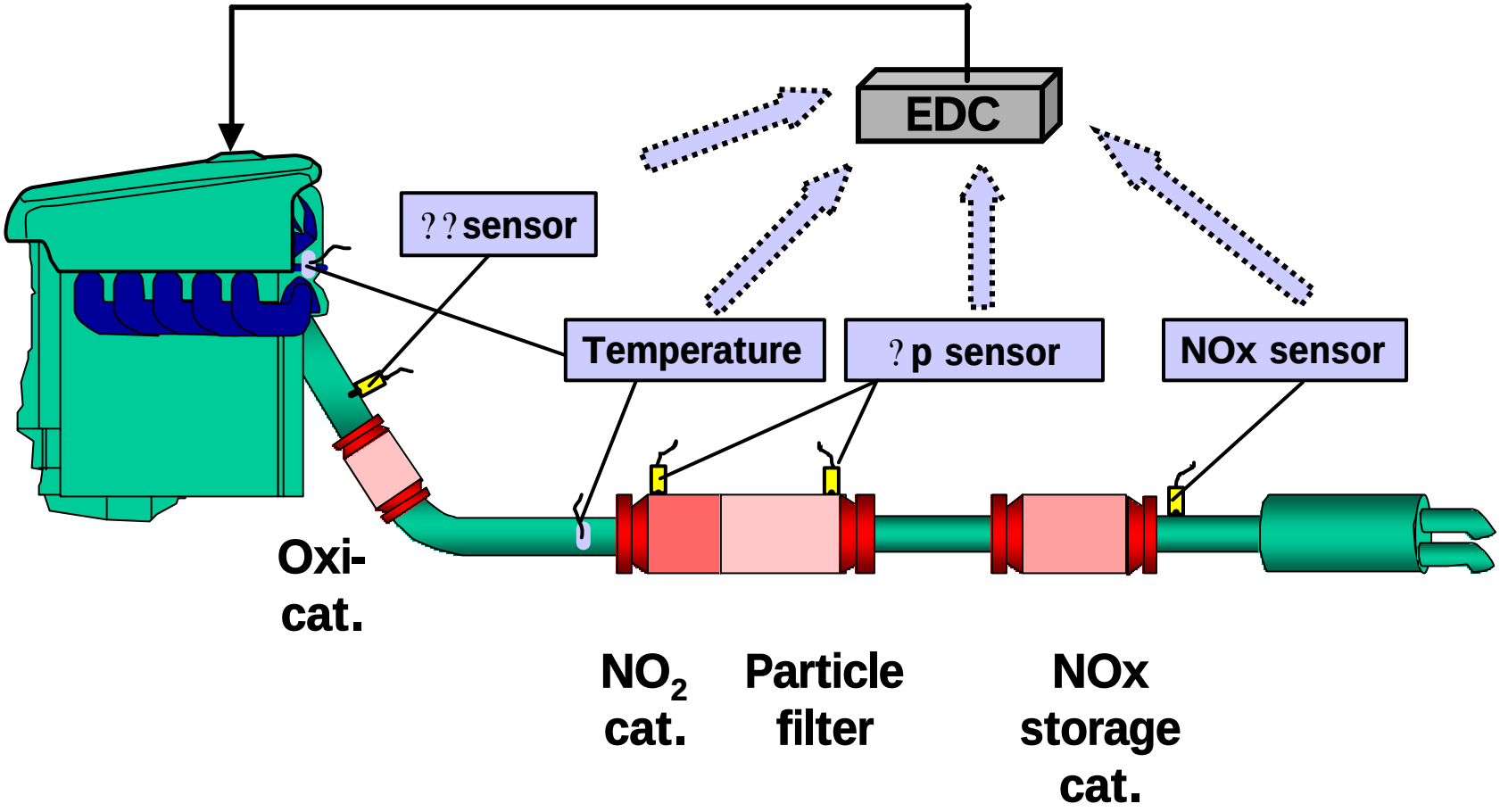


Estimate of potential

85 kW vehicle, Golf category, NEDC

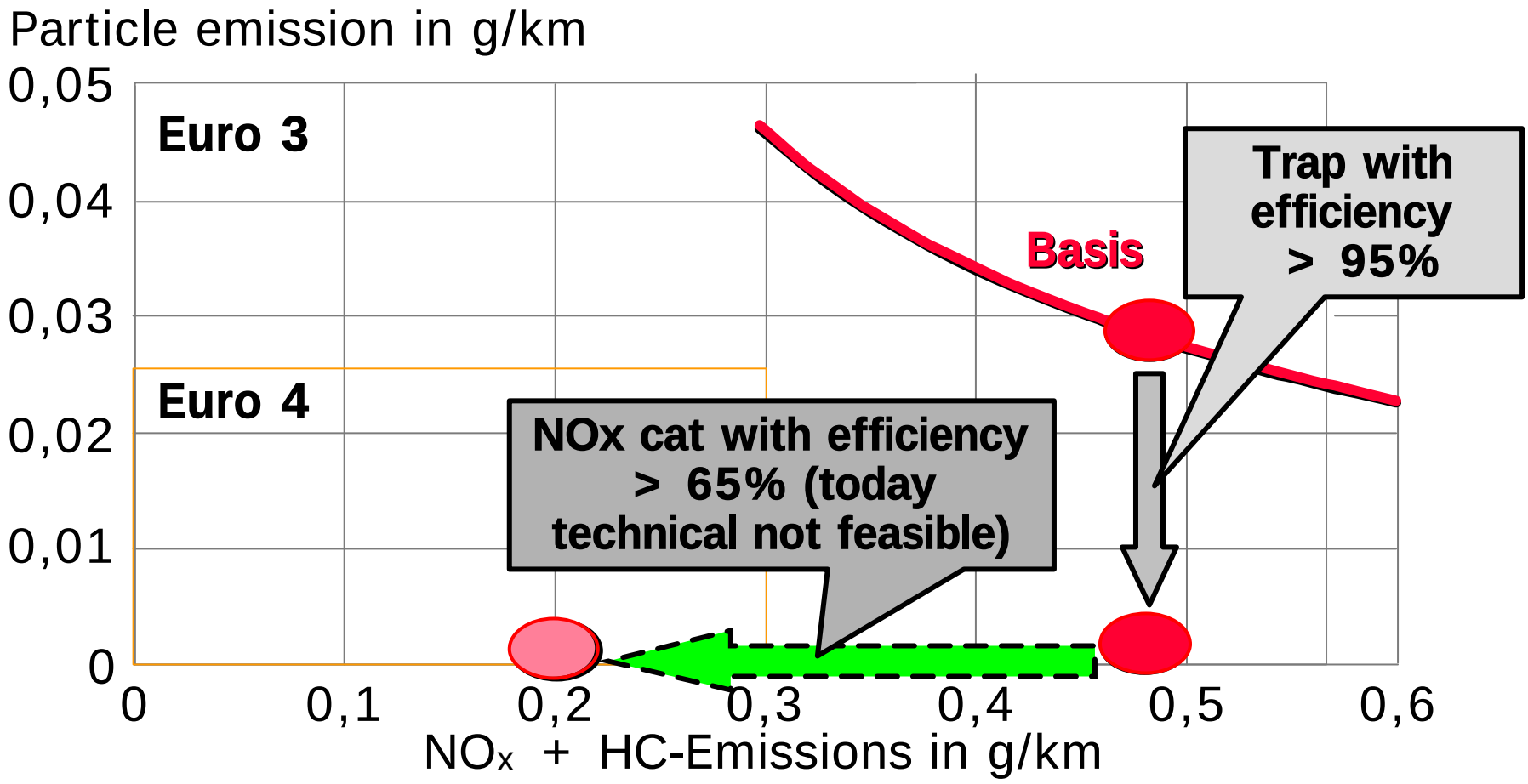


VW exhaust aftertreatment systems: particle filter system & NOx storage catalytic converter



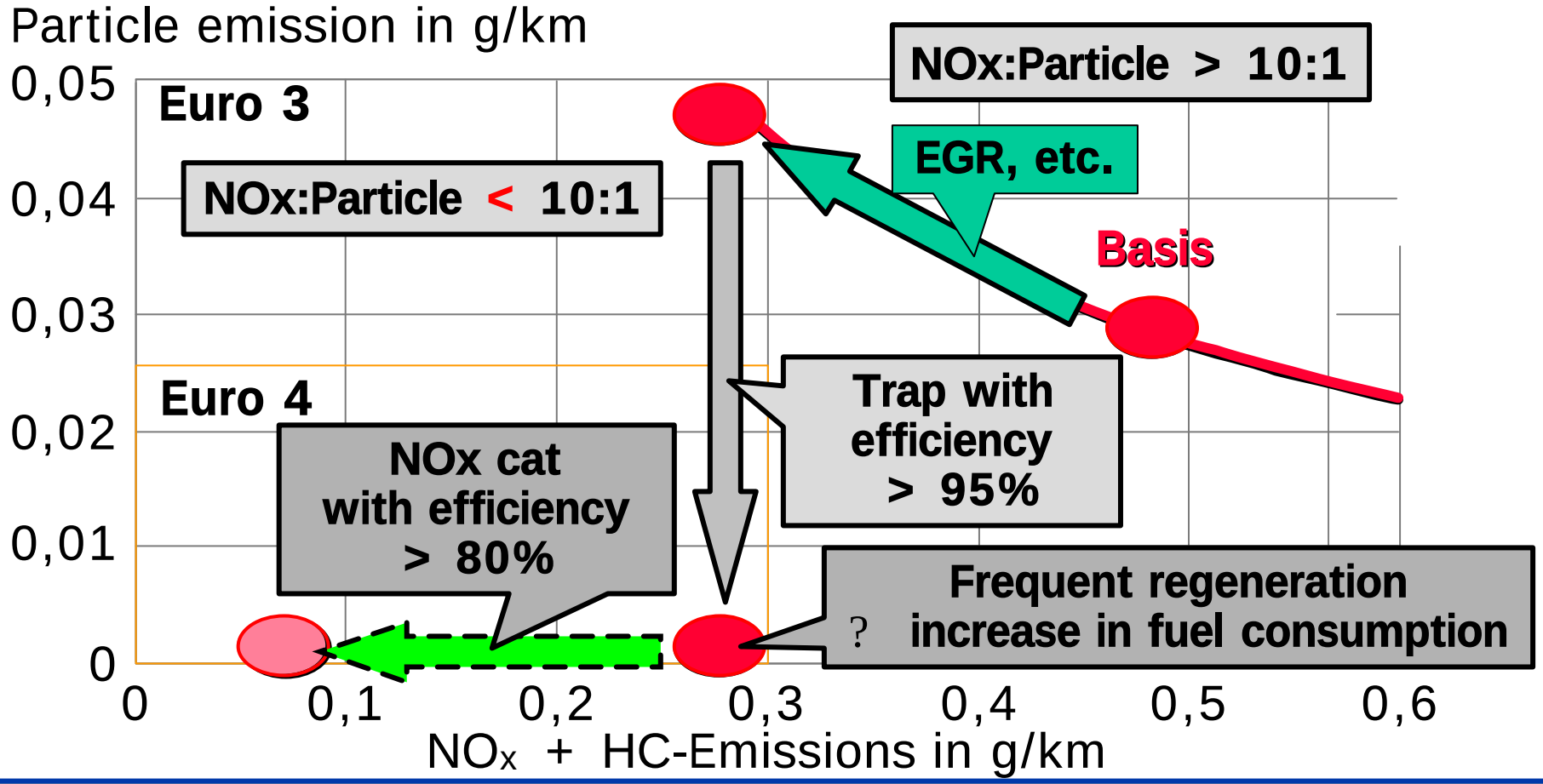
Strategies for future diesel development

Version 1



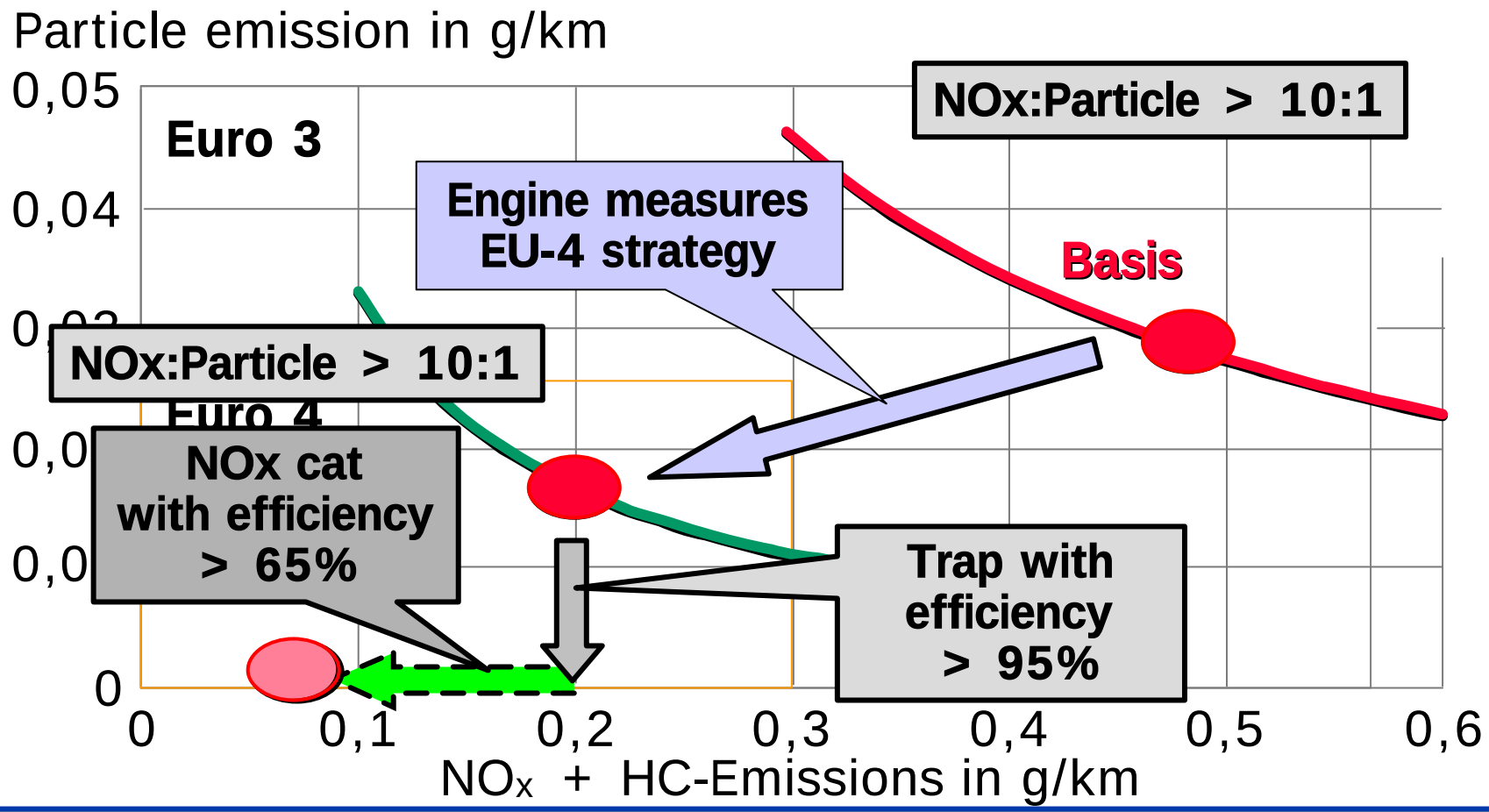
Strategies for future diesel development

Version 2



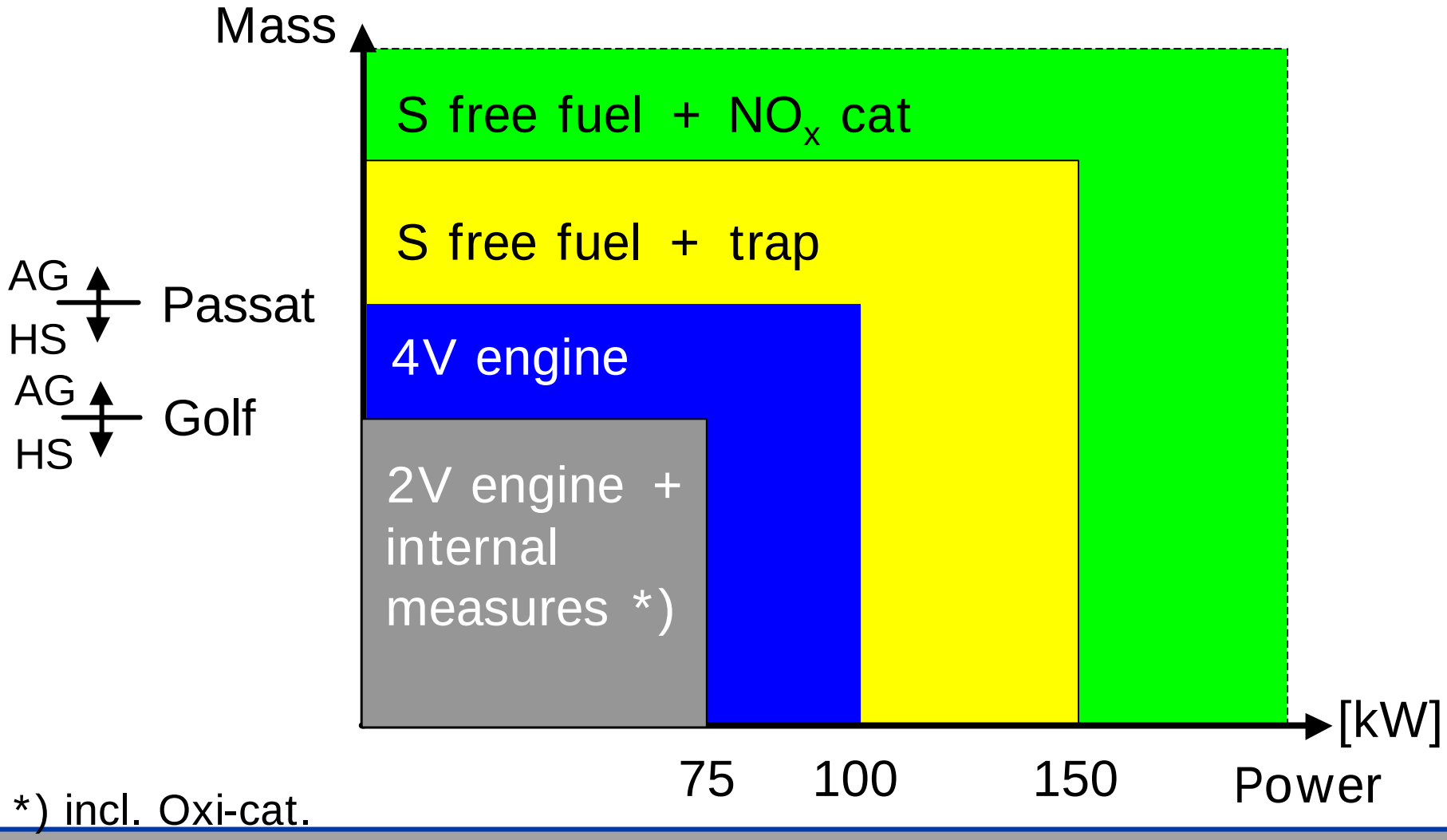
Strategies for future diesel development

Version VW



VW-Reduction strategy for Euro 4

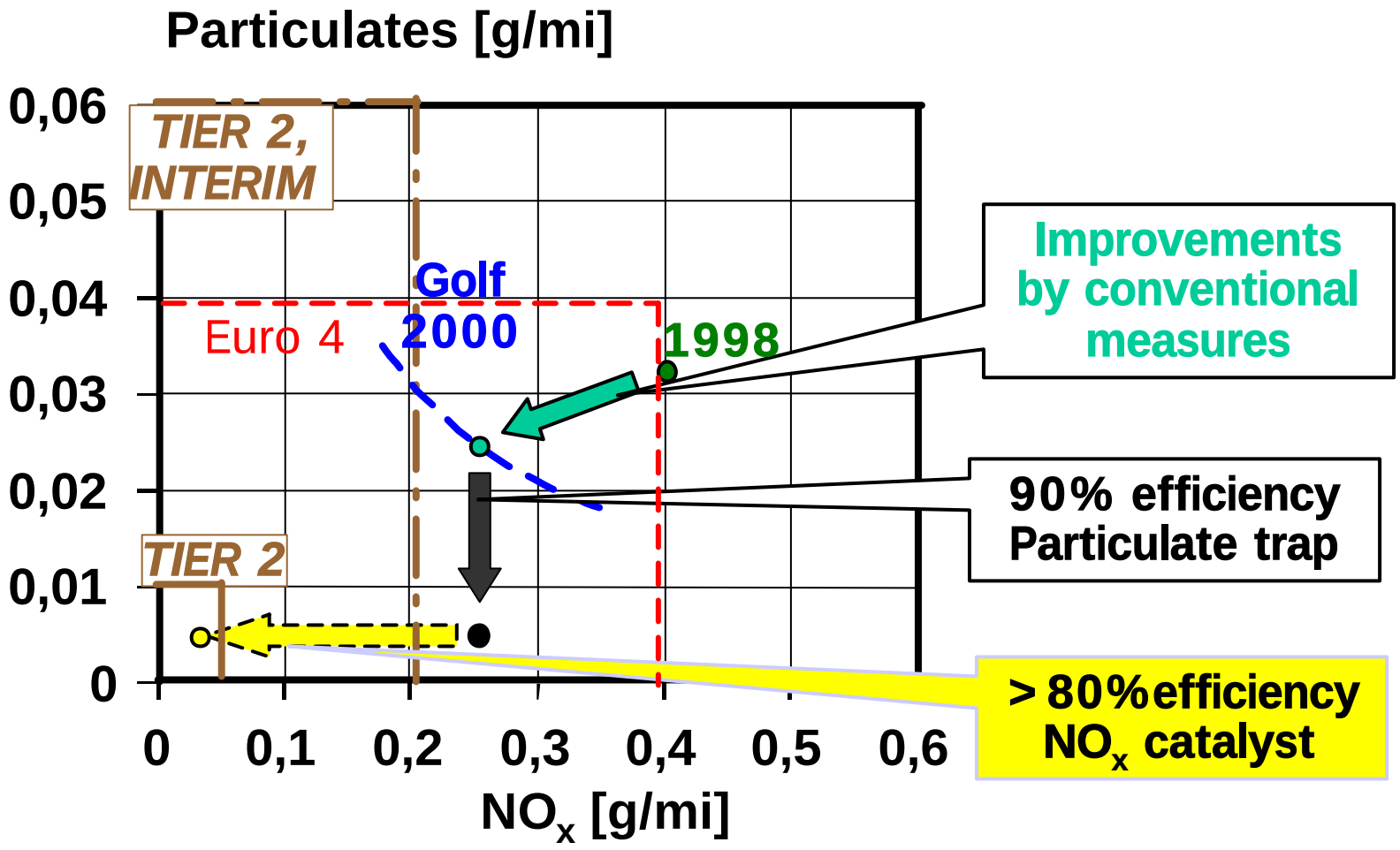
in combination with improved fuels



*) incl. Oxi-cat.

Potential for reduction of emissions

Example for a Golf with manual transmission



The first 3L vehicle in production

VW Lupo 3L TDI

- 1.2 l TDI engine with unit injection
- 45 kW (61 PS)
- 2,99 l/100 km
- Euro 4 limits

Volkswagen 1-litre car (235 mpg)

four wheels, low height, two seats in tandem

Volkswagen 1-litre car (235 mpg)

carbon-fibre-reinforced outer skin over a Mg spaceframe

Volkswagen 1-litre car (235 mpg)

impact and roll-over protection like a GT racing car

Volkswagen 1-litre car (235 mpg)
Technical data

Volkswagen 1-litre car (235 mpg)
Technical data

Performance / consumption	
Top speed	120 km/h
Consumption	0.99 litres / 100 kilometres
Body, wheel, tyre dimensions	
Length x width x height	3,646 x 1,248 x 1,110 mm
Wheelbase	2,205 mm
Track front / rear	1,000 / 810 mm
Fuel tank volume	6.5 litres
Vehicle weight	290 kg
Luggage space volume	80 litres
Drag coefficient c_d / area	0.159 / 1.0 m^2
Tyres front / rear	95/80 R 16 / 115/70 R 16

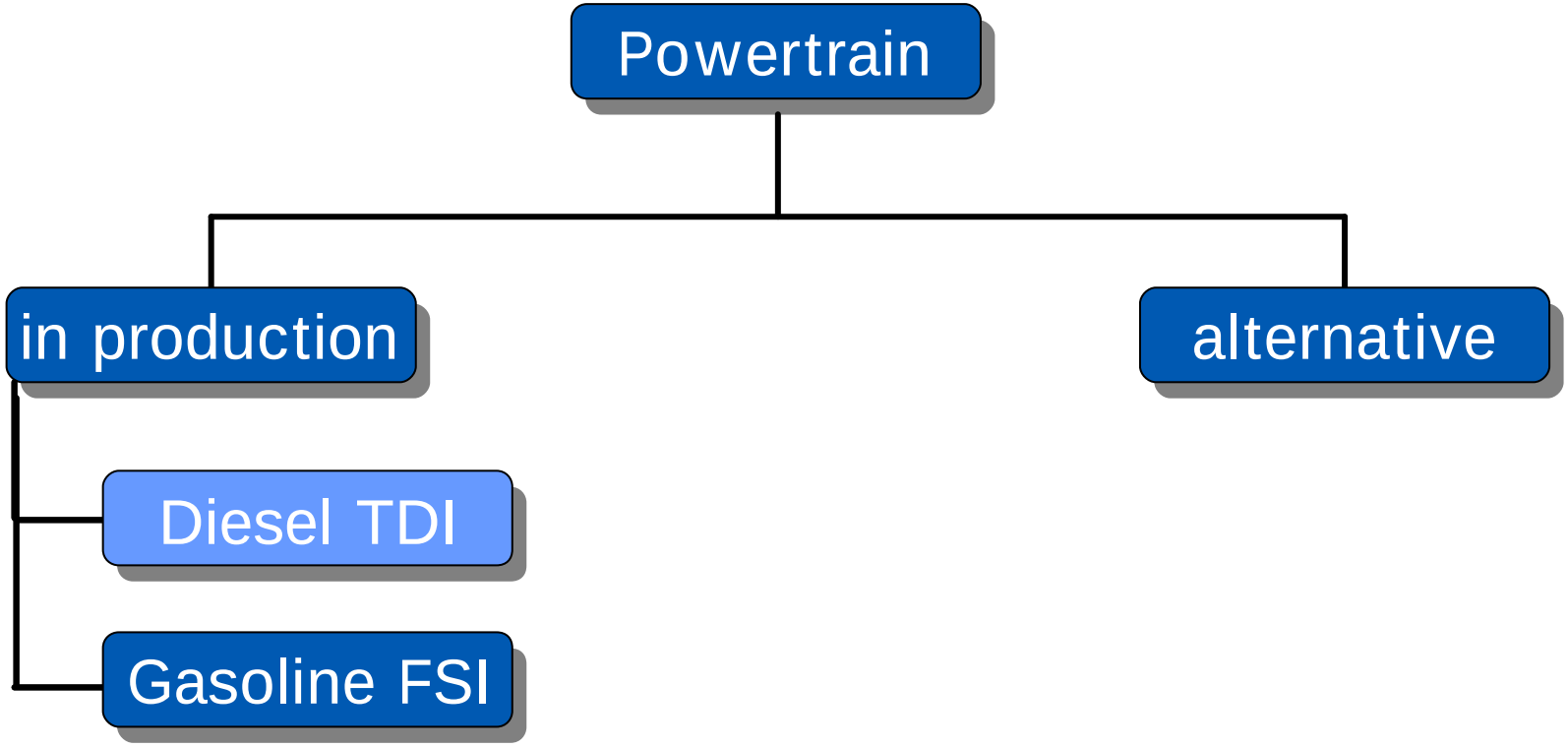
Volkswagen 1-litre car (235 mpg)
Technical data

Engine	
Principle	1-cylinder naturally-aspirated diesel with unit injector, aluminium monobloc
Volume	299 cc
Bore x stroke	69 mm x 80 mm
Compression ratio	16.5: 1
Valves per cylinder	3
Valve timing	Twin overhead camshafts
Engine weight (dry)	26 kg
Output	6.3 kW (8.5 bhp) at 4,000 rpm
Torque	18.4 Nm at 2,000 rpm

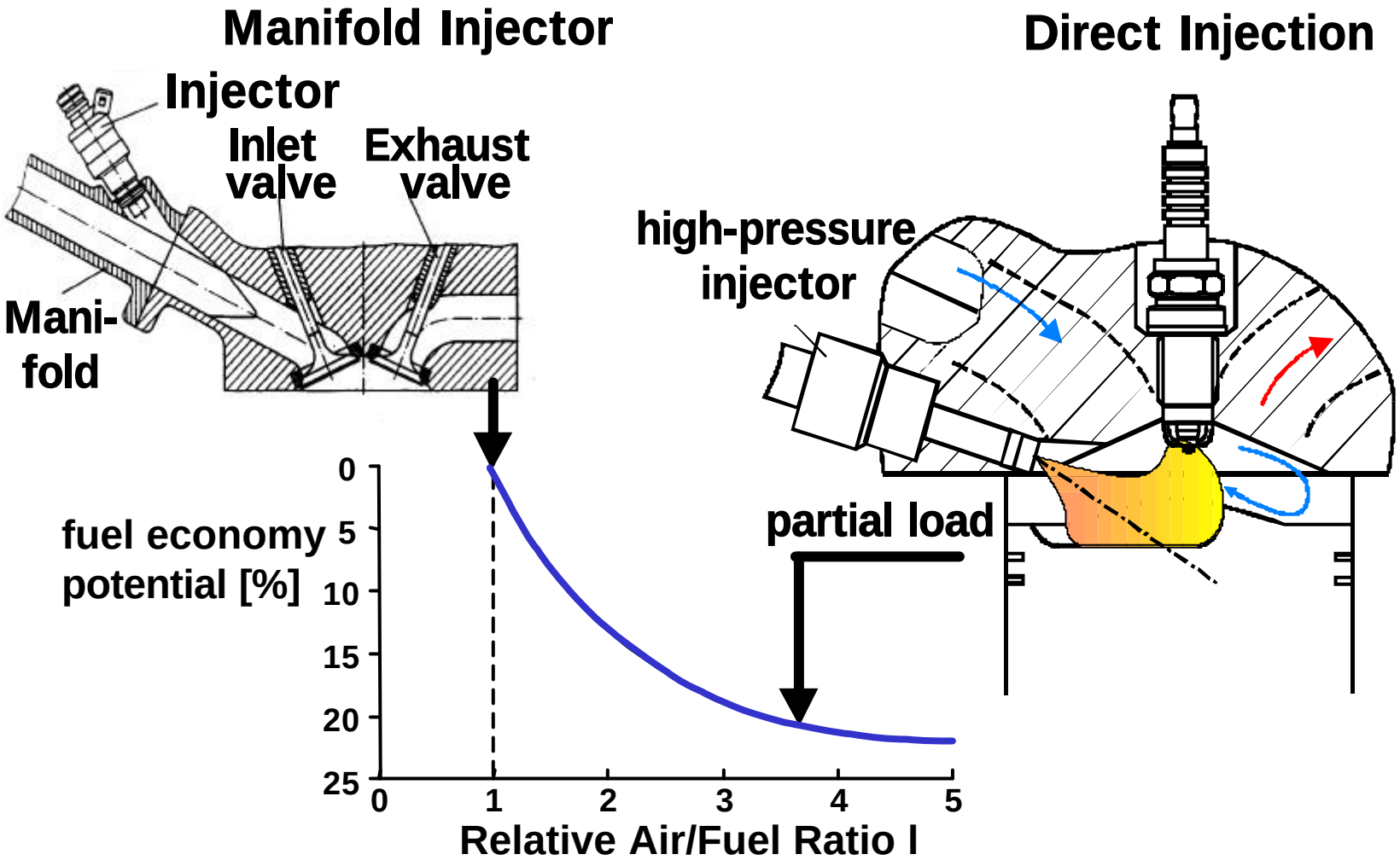
Volkswagen 1-litre car (235 mpg)
Technical data

An idea for a possible new family of vehicles, which could cover new requirements ranging from the ultra-economical vehicle, through the low-lost everyday touring vehicle for young people to the high-performance sports supercar.

Maintaining individual mobility



Spark-ignition engine with direct injection
Fuel Economy Potential



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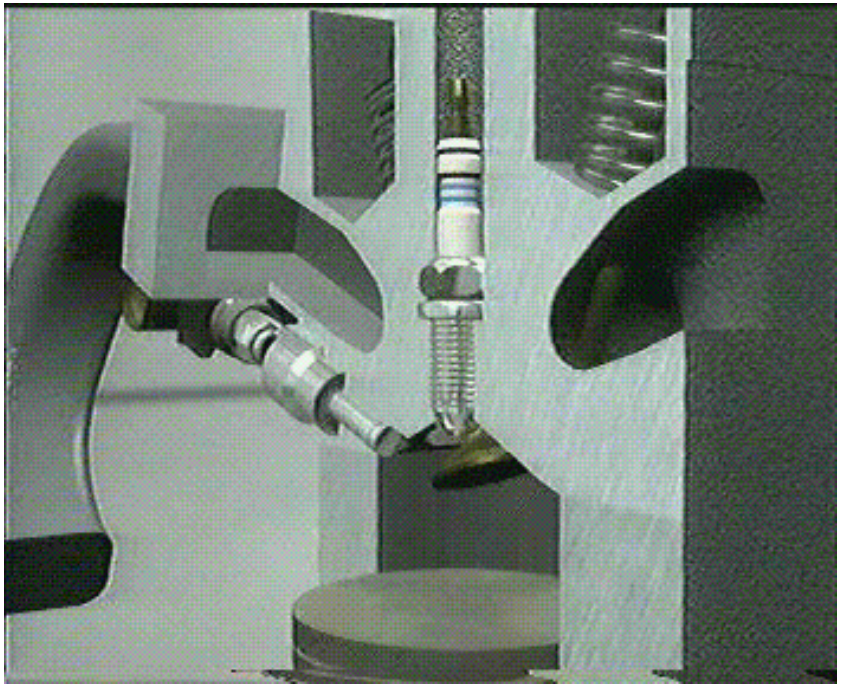
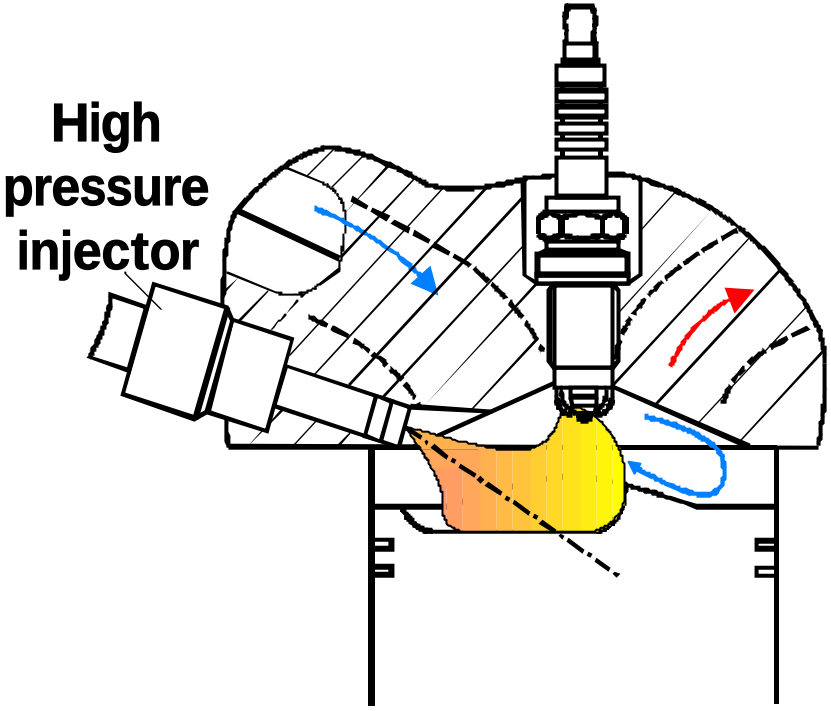
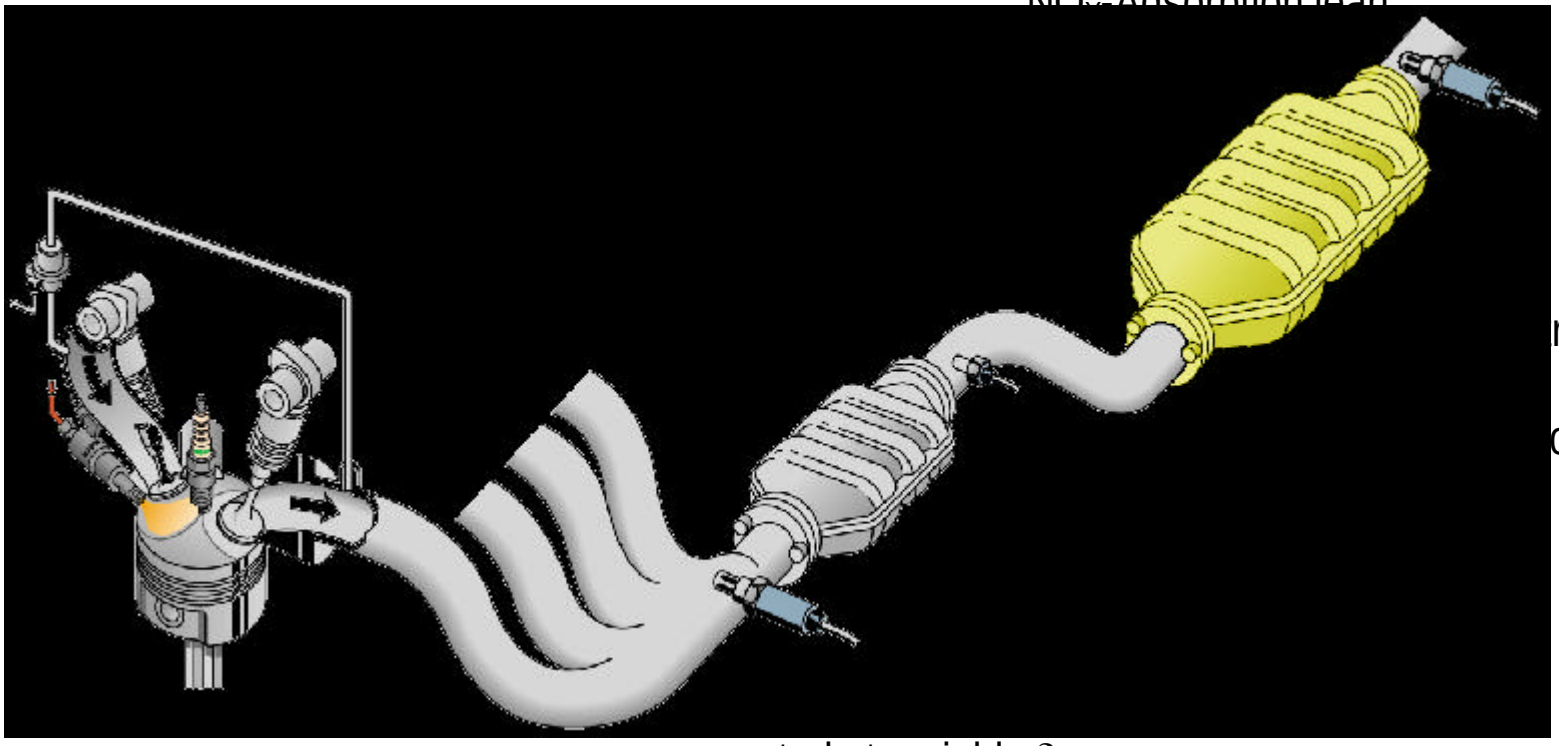


Direct injection



FSI: Exhaust gas aftertreatment

Main Cat.
NO_X-Adsorption lean



rol at

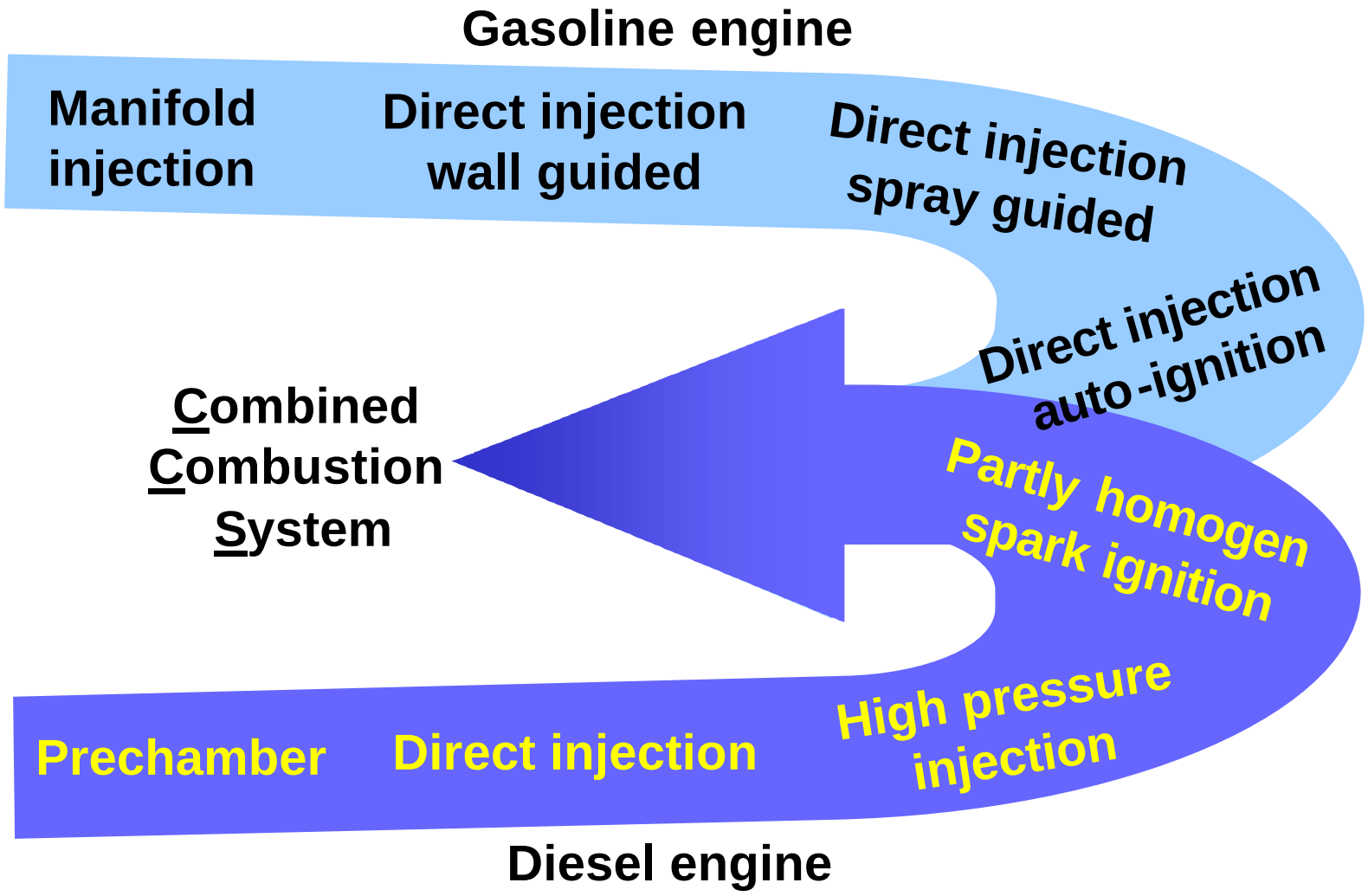
osis

control at variable ? ,
control regeneration NO_X -cat.

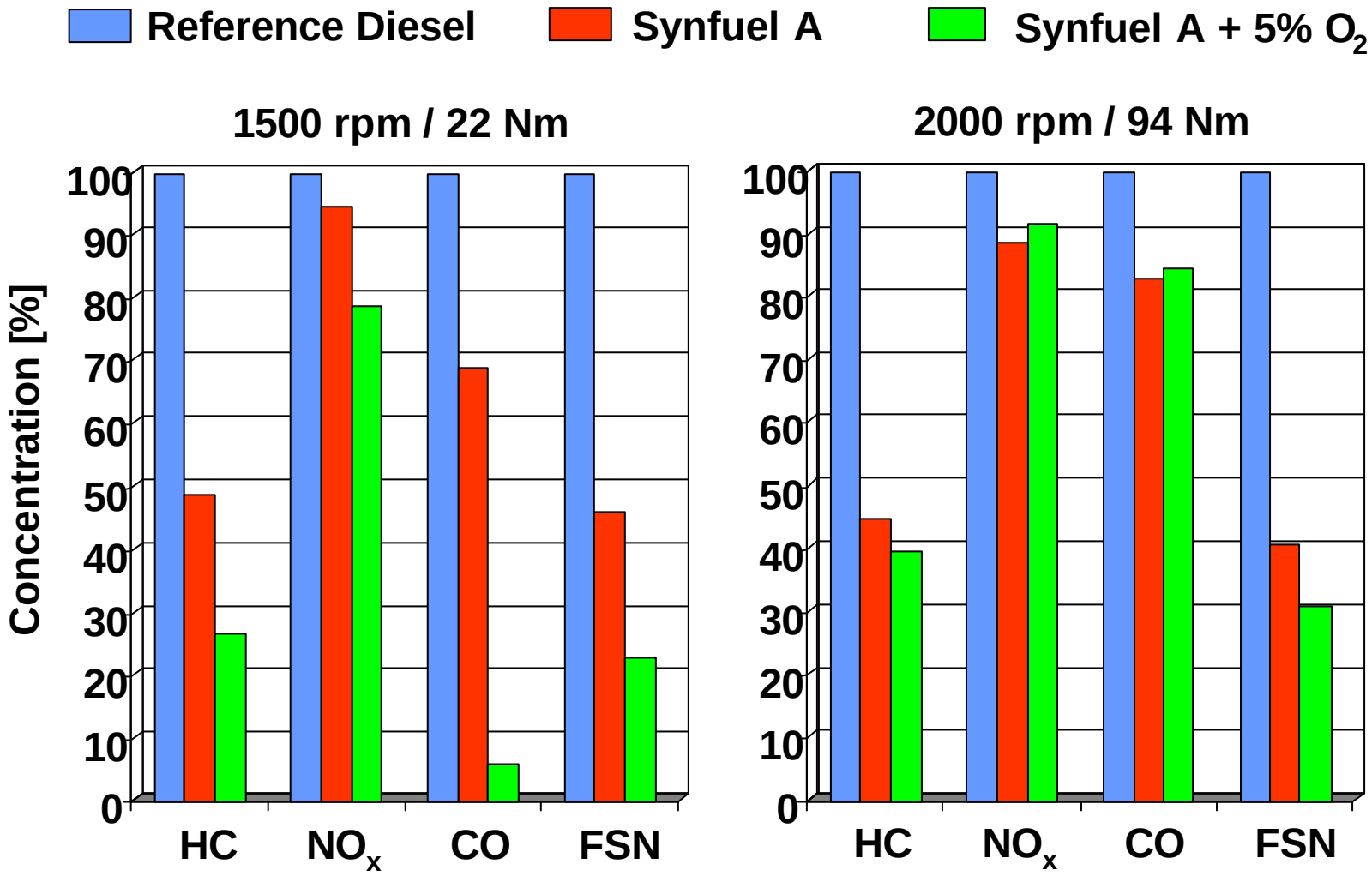
Gasoline direct injection
VW Lupo 1.4 l FSI (Fuel Stratified Injection)

- 1.4 l Gasoline FSI
- 77 kW (105 PS)
- 4,99 l/100 km (47 mpg)
- Euro 4 (2005)

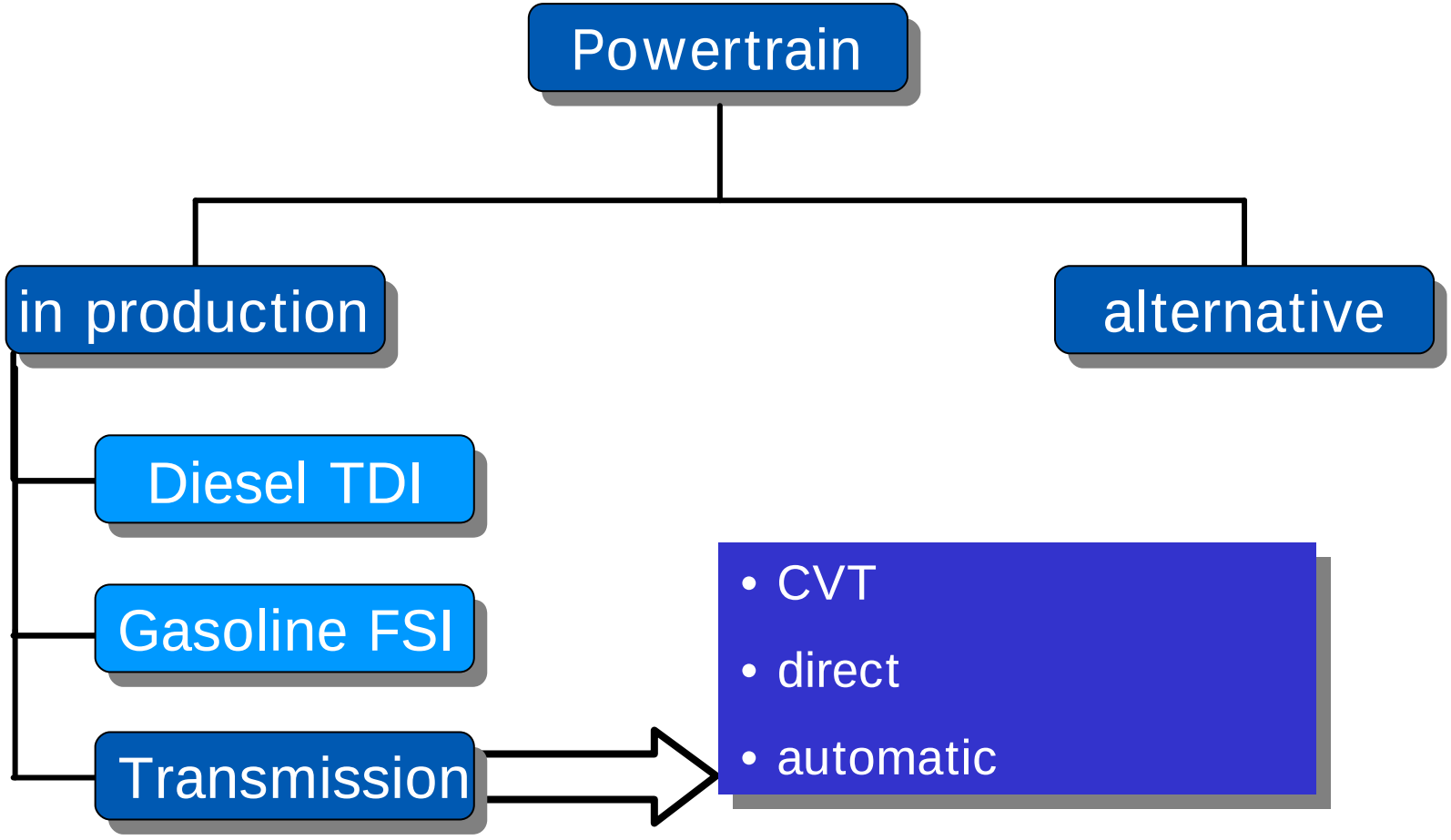
Further development of internal combustion engines



Reduction of exhaust gas emissions by using a SynFuel



Maintaining individual mobility



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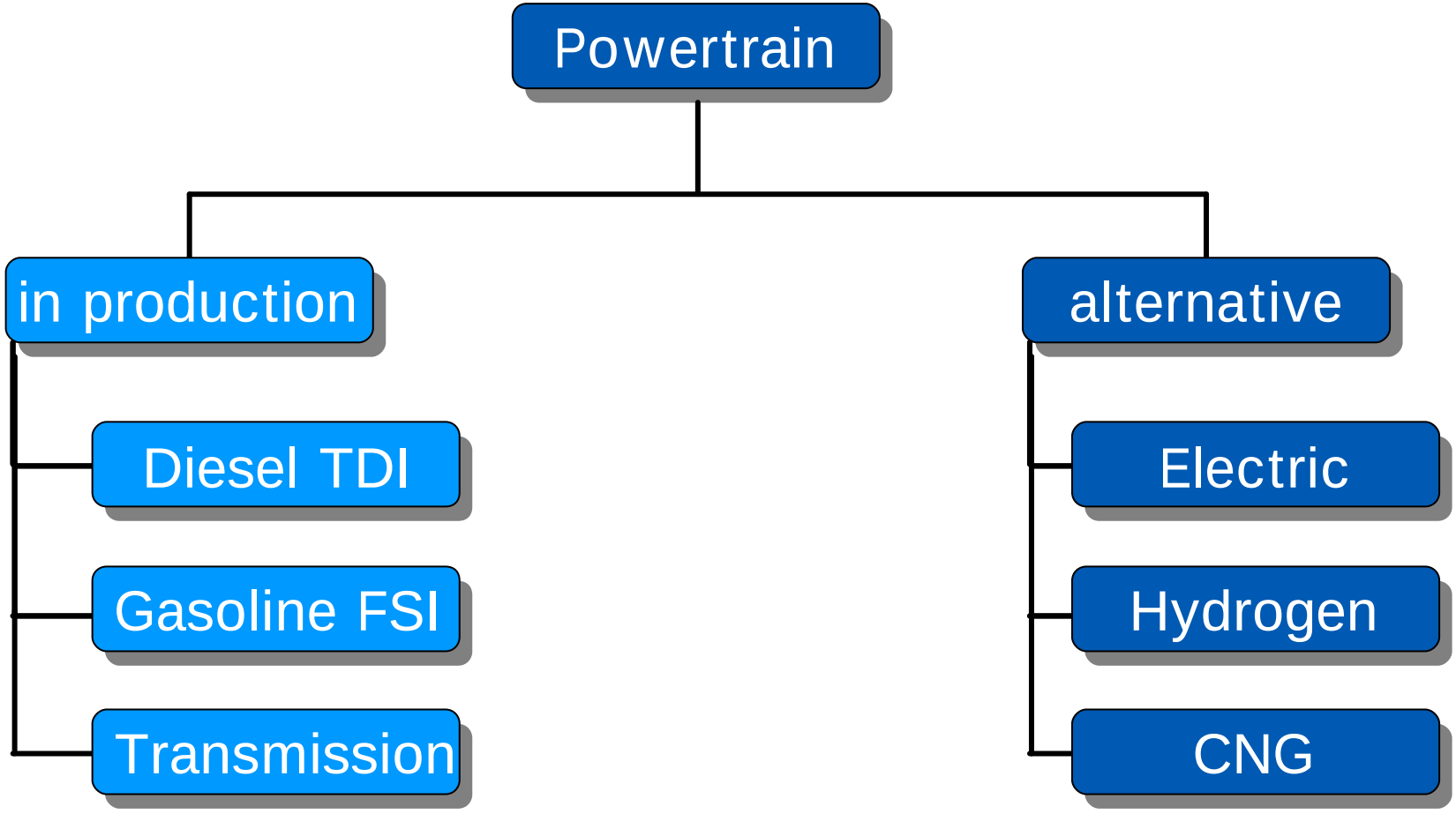
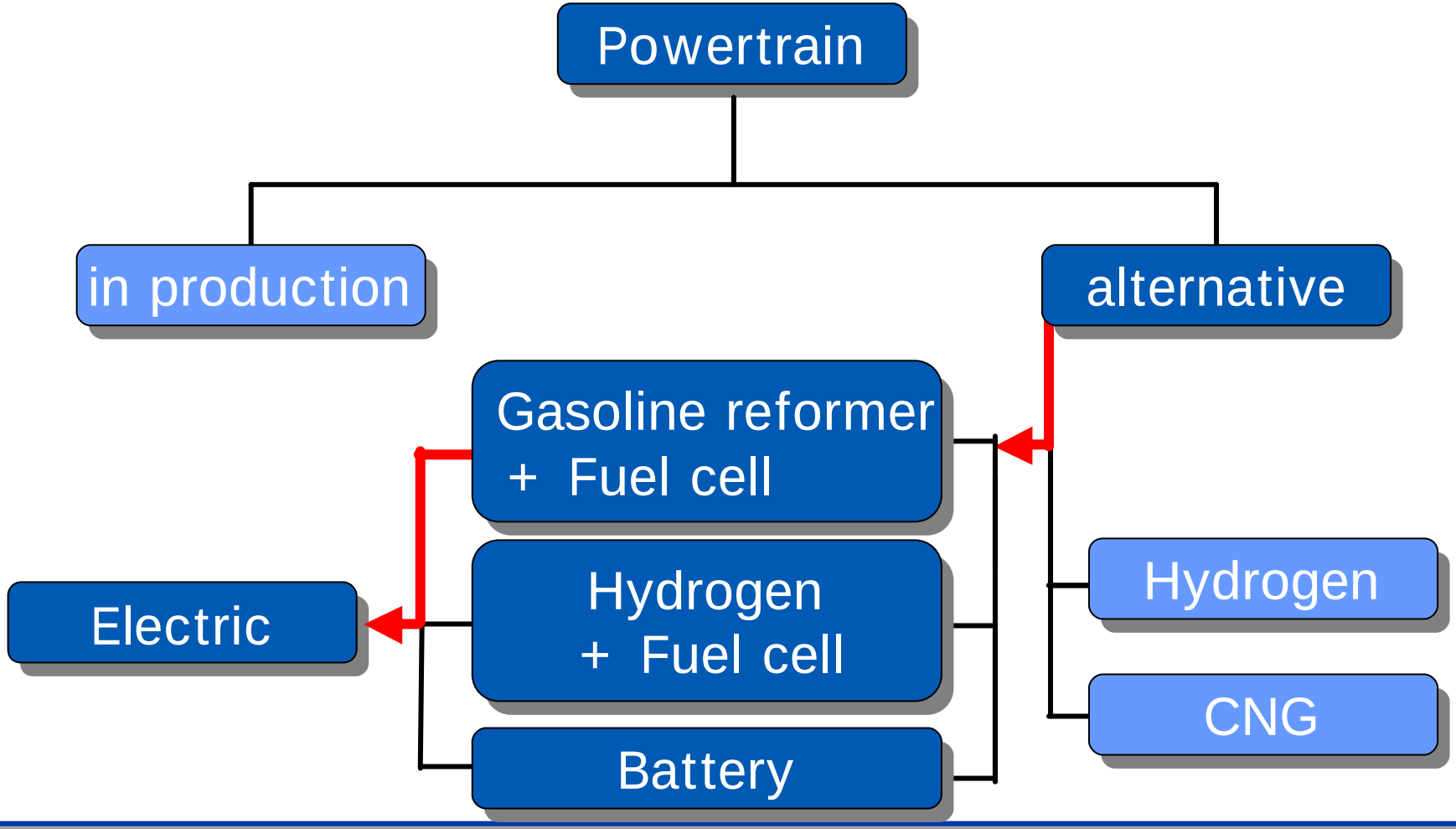
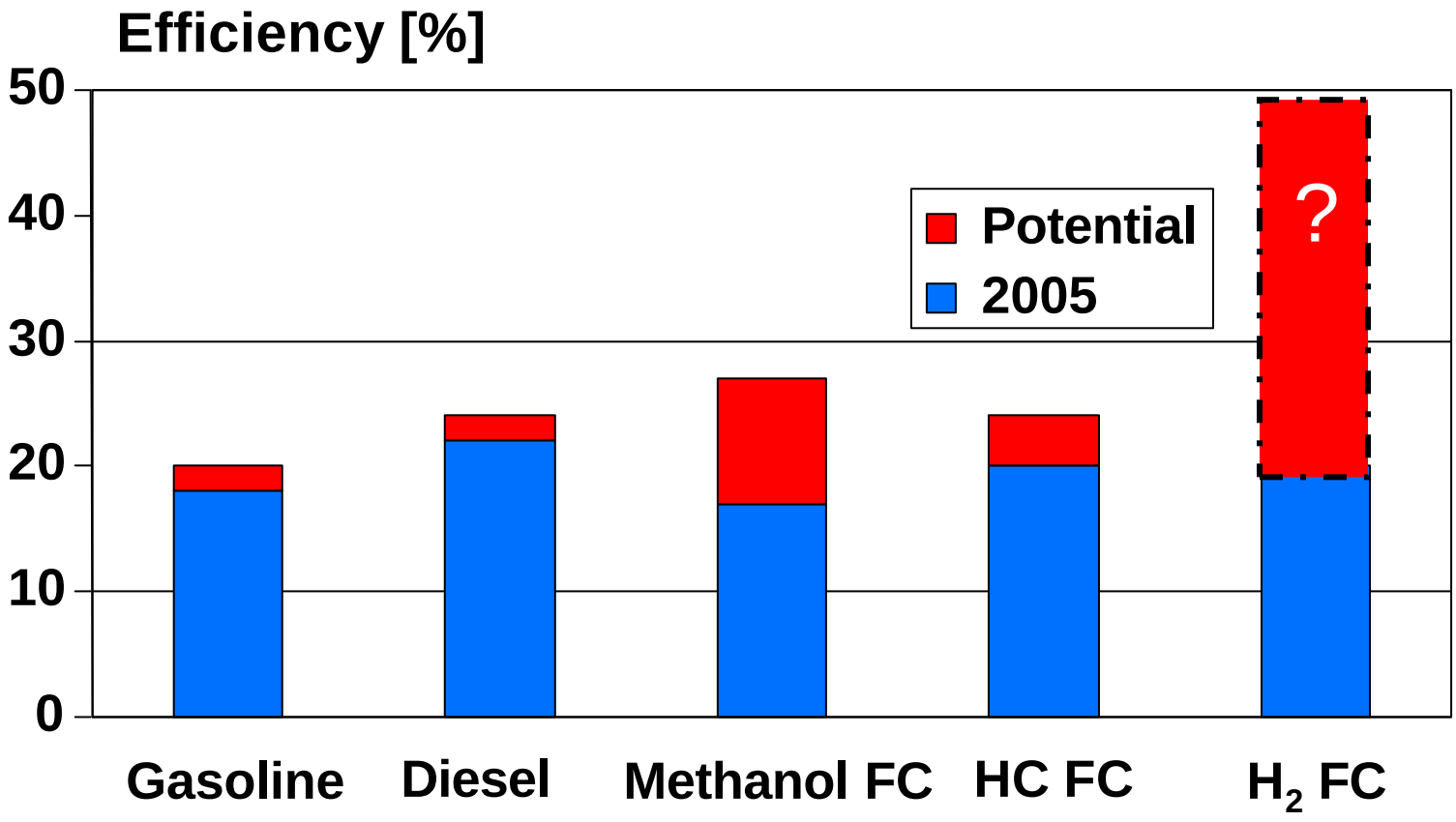


Maintaining individual mobility



Comparison of modern propulsion concepts

Total efficiency incl. fuel production, transport and vehicle operation