

BMW Diesel.

12th DEER Conference, August 20-24, 2006, Detroit

BMW Diesel Engines – dynamic, efficient and clean

Wolfgang Mattes



BMW AG

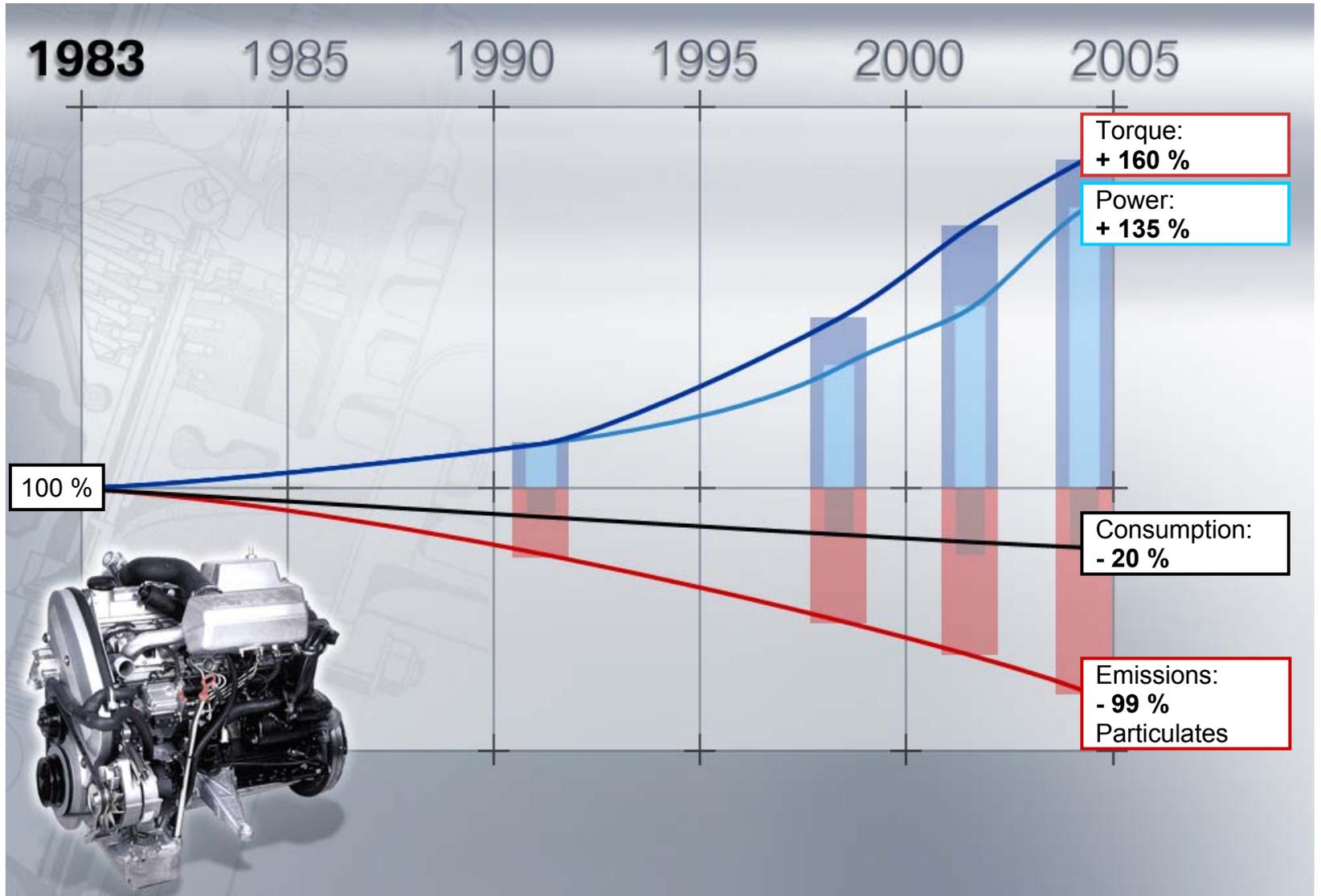


BMW Diesel.

Contents

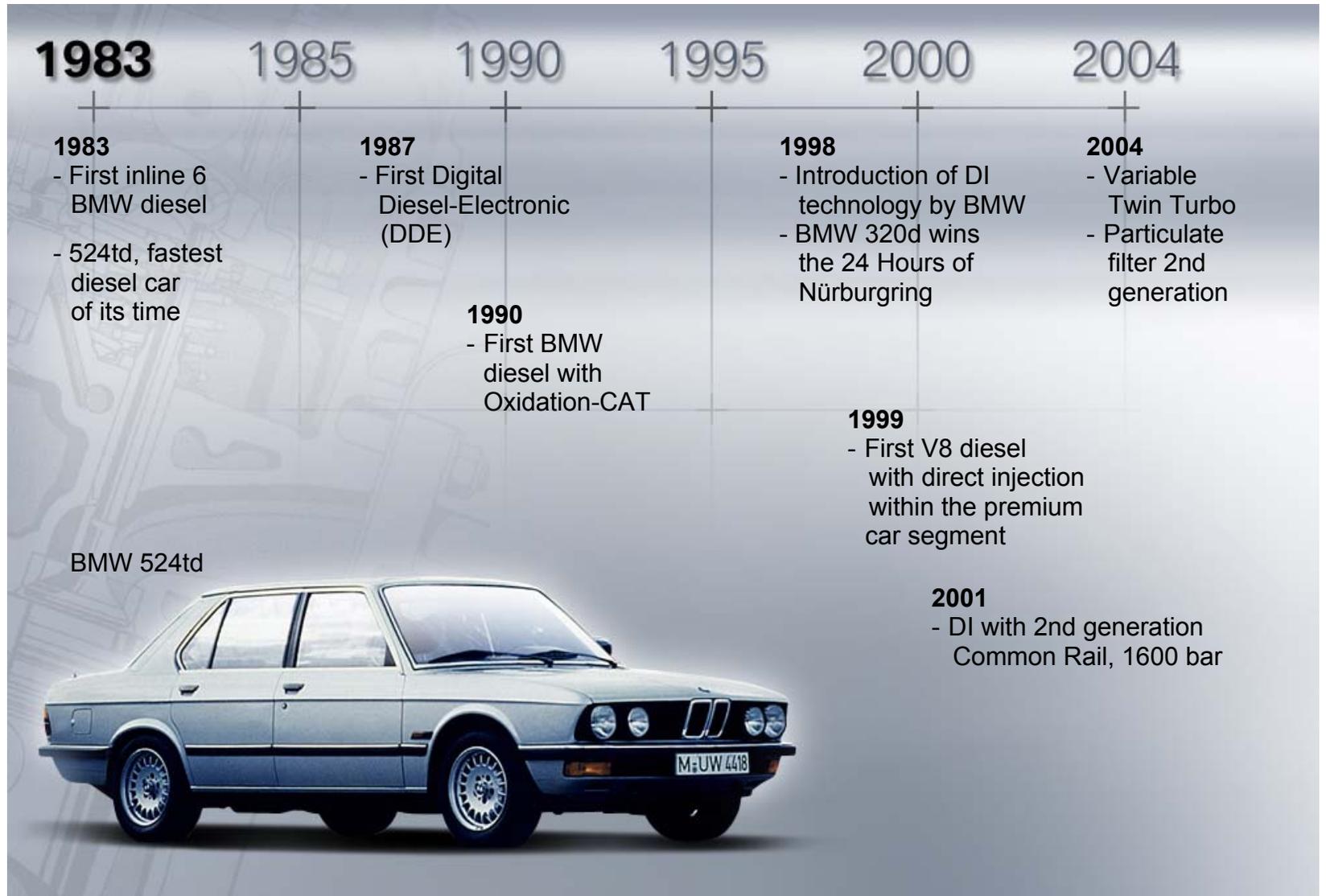
- **BMW Diesel history**
- **Engine portfolio and market success**
- **What do Diesel customers like ?**
- **Challenges in the US-market**
- **Emission concept for TIER2 BIN5**
- **Conclusions**

BMW Diesel. Dramatic evolution.

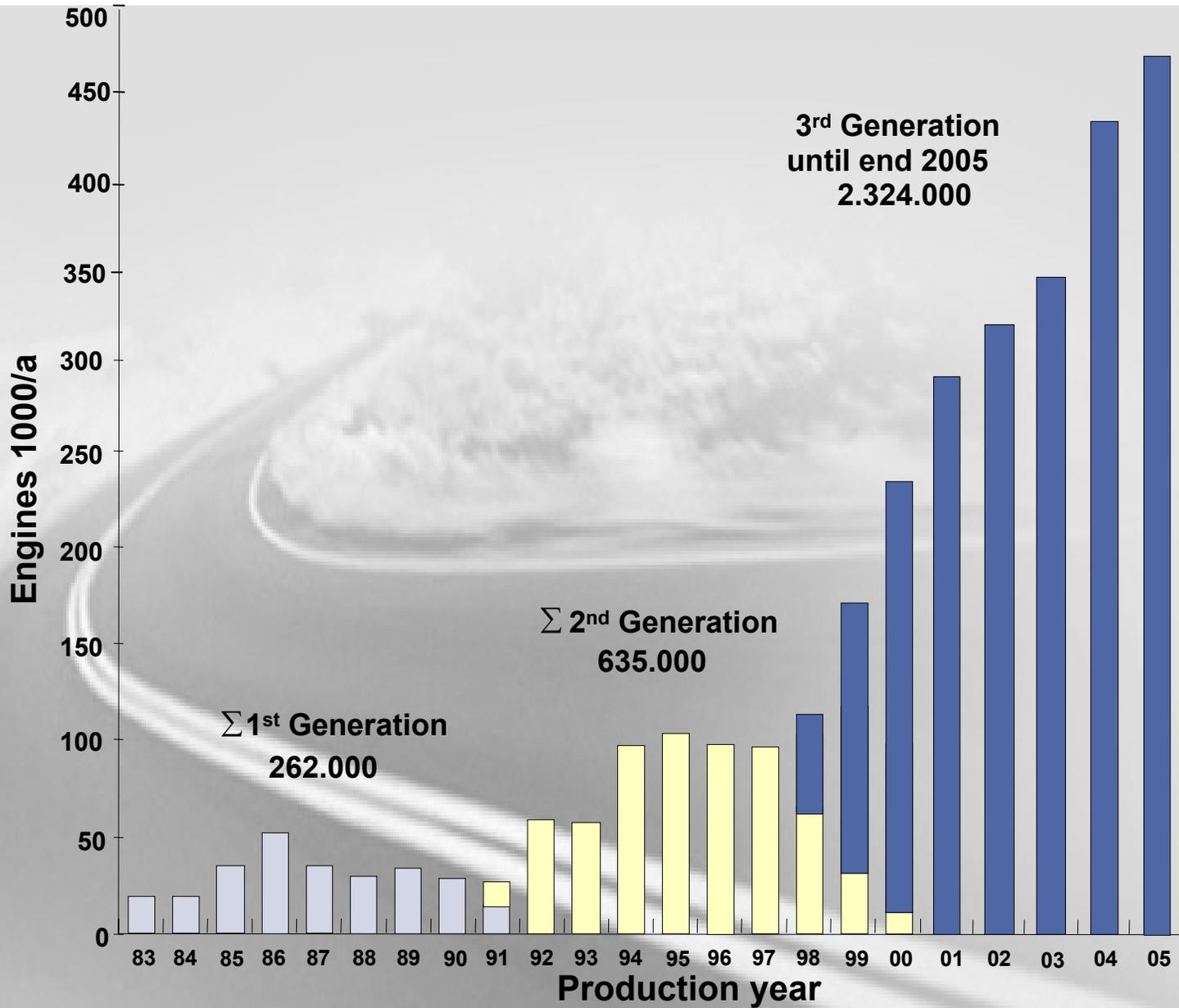


BMW Diesel.

Two decades of diesel competence.



BMW Diesel. Production Volumes.



BMW Diesel.

Diesel Models in Europe.

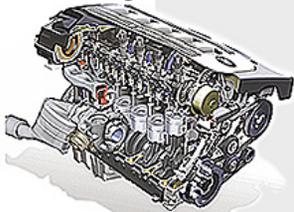


4-Cylinder



	Mini	1er	3er	5er	7er	X3	X5
4-Cylinder	One D	118d 120d	318d 320d 320cd	520d		X3 2.0d	
6-Cylinder			330d 330cd 330xd	525d 530d 530xd 535d	730d	X3 3.0d	X5 3.0d
8-Cylinder					745d		

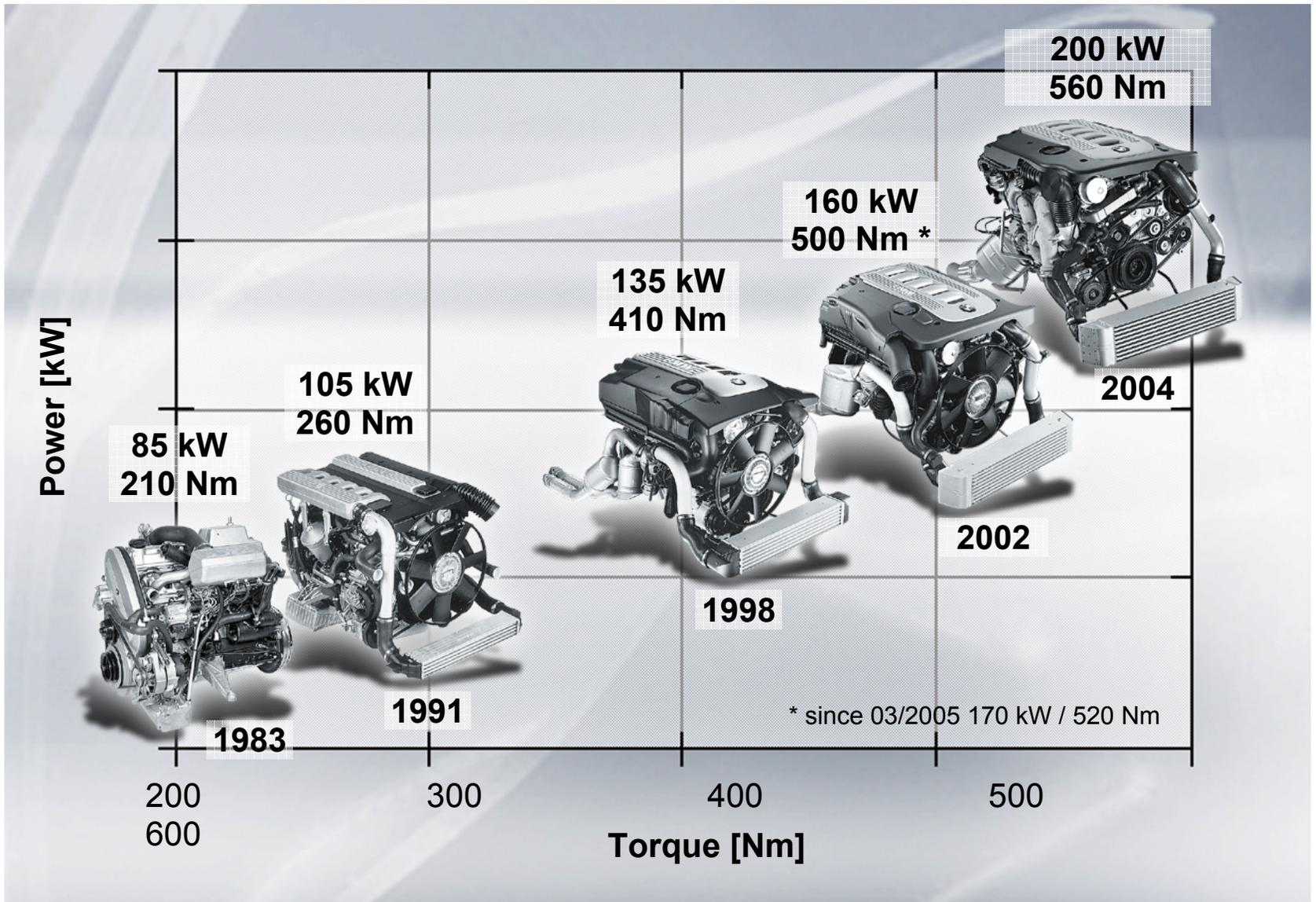
6-Cylinder



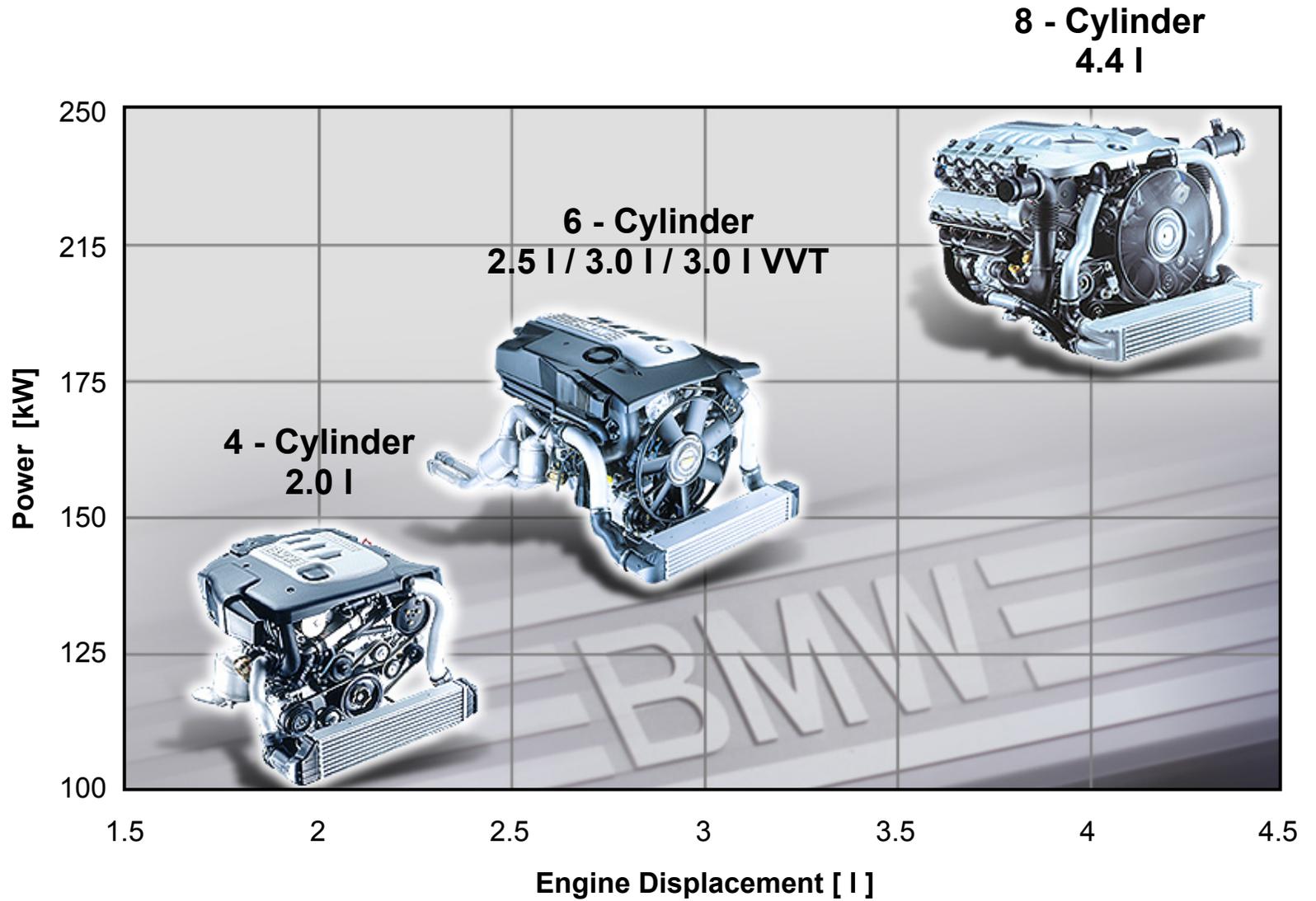
8-Cylinder



BMW Diesel. Development of 6-Cylinder Diesel-Engines.

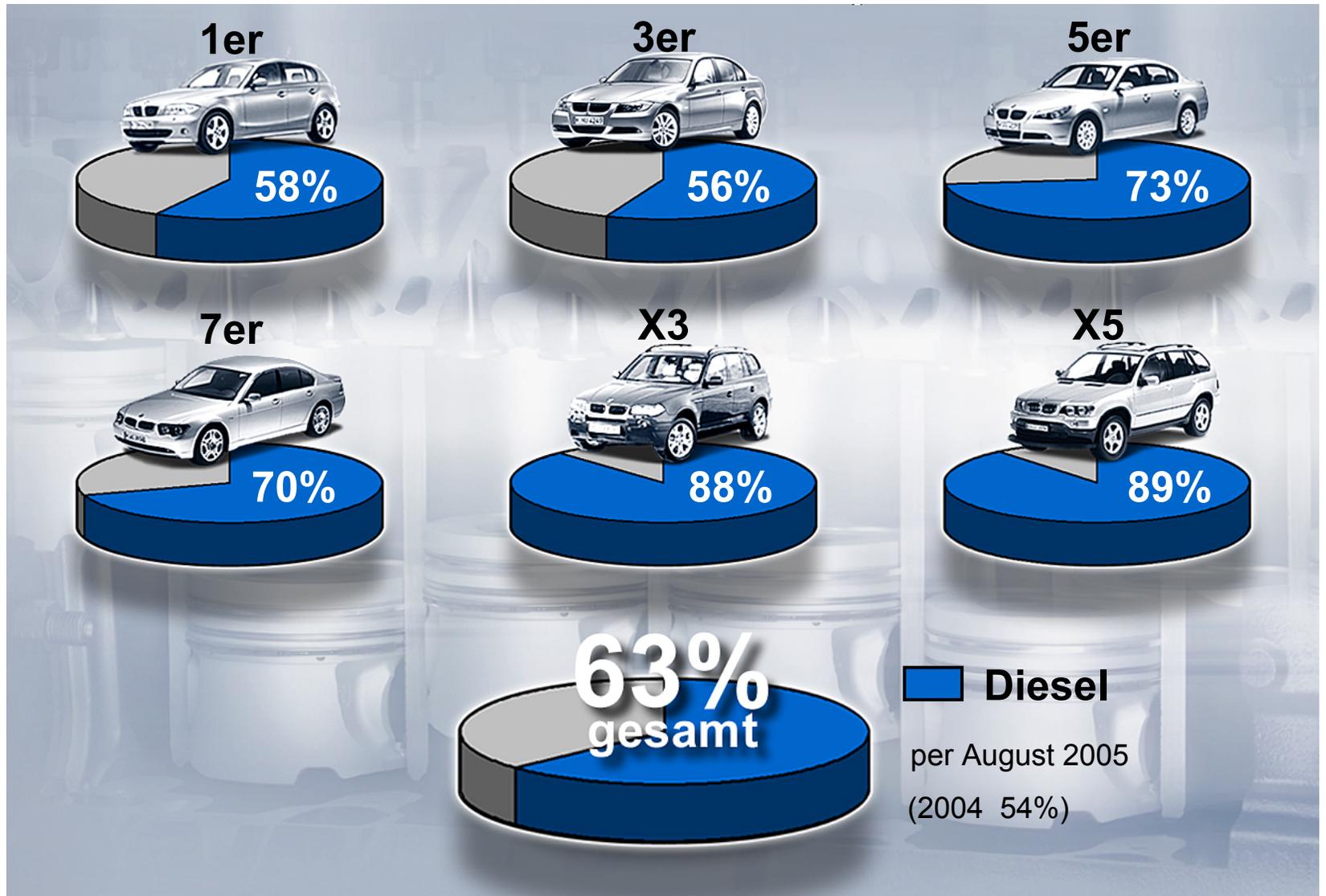


BMW Diesel. Engine Line up.



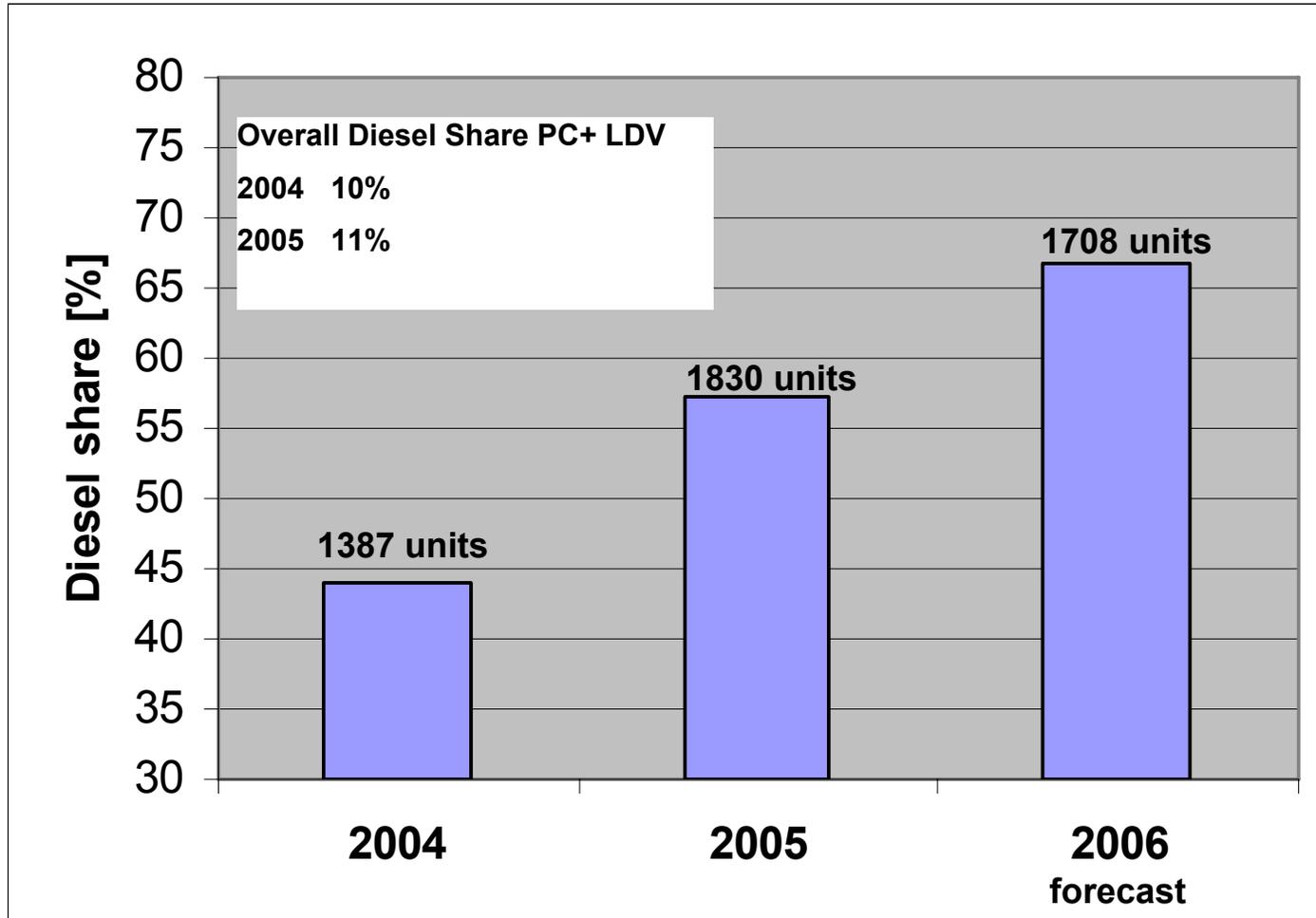
BMW Diesel.

BMW Diesel-Mix in Western Europe.



BMW Diesel.

Australia – development of X5 Diesel-share.



BMW Diesel.

Success factors for Diesel engines.

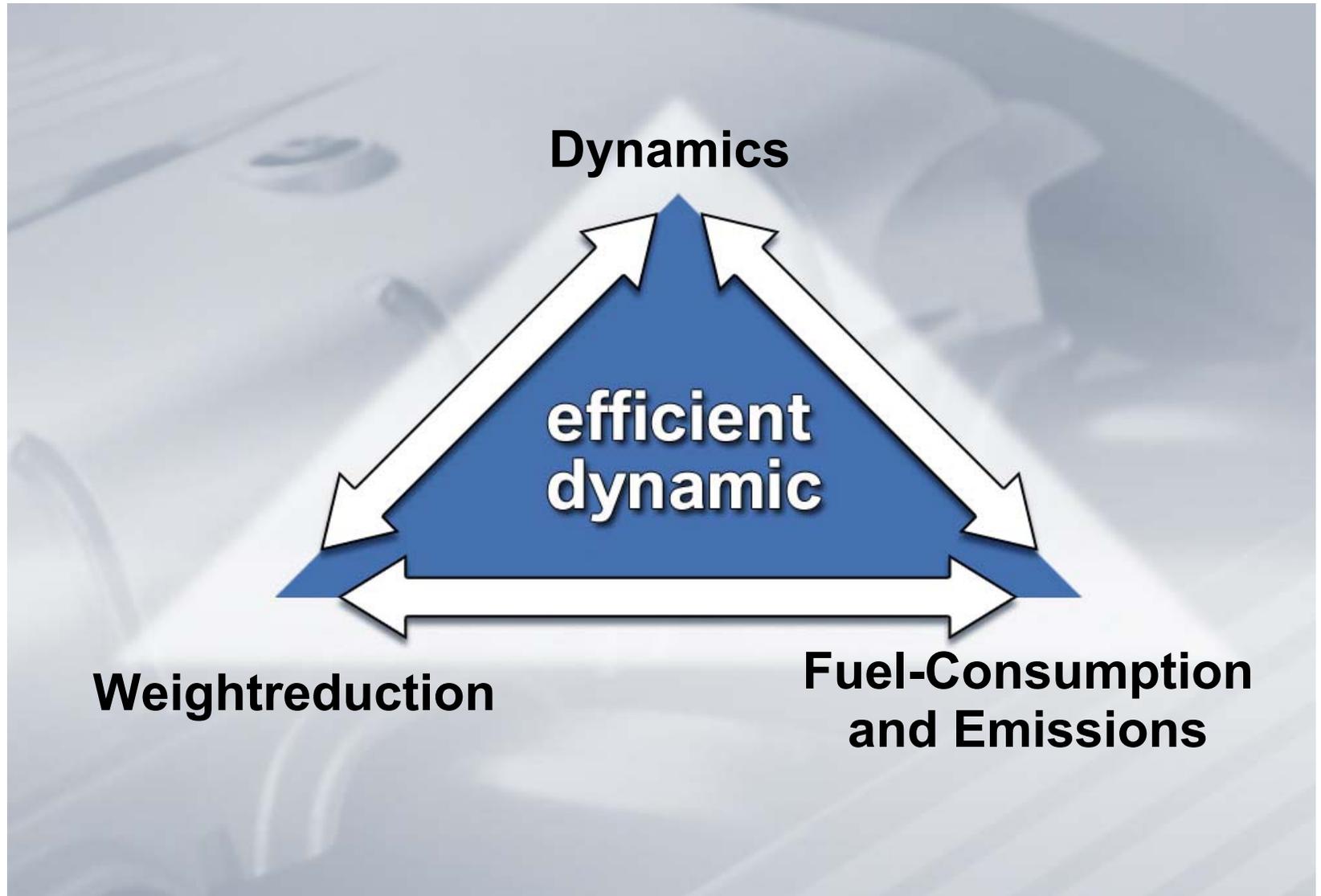
- **Fun to drive, outstanding torque characteristic**
 - relaxed cruising
 - torque on demand
 - good NVH due to low engine speed
- **Low fuel consumption**
 - 20-30 % below comparable Petrol cars
 - cost saving, sometimes supported by low fuel costs
 - high cruising range

→ **BMW focus: Sports Diesel**

**High power output and sporty drivability
combined with low FC under all driving conditions**

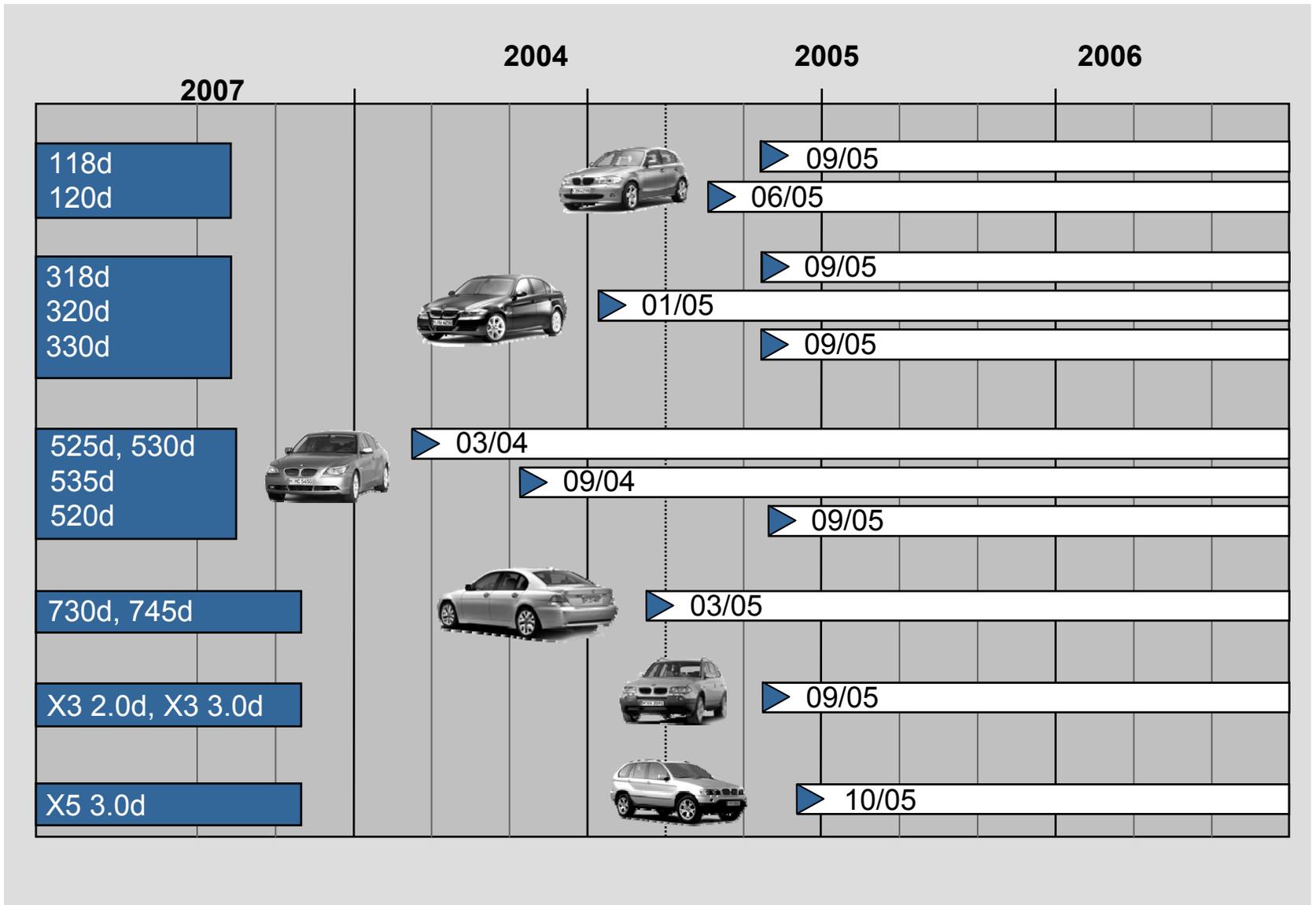
BMW Diesel.

Efficient Dynamics.



BMW Diesel.

Clean Diesel – Introduction of Particulate Filter.



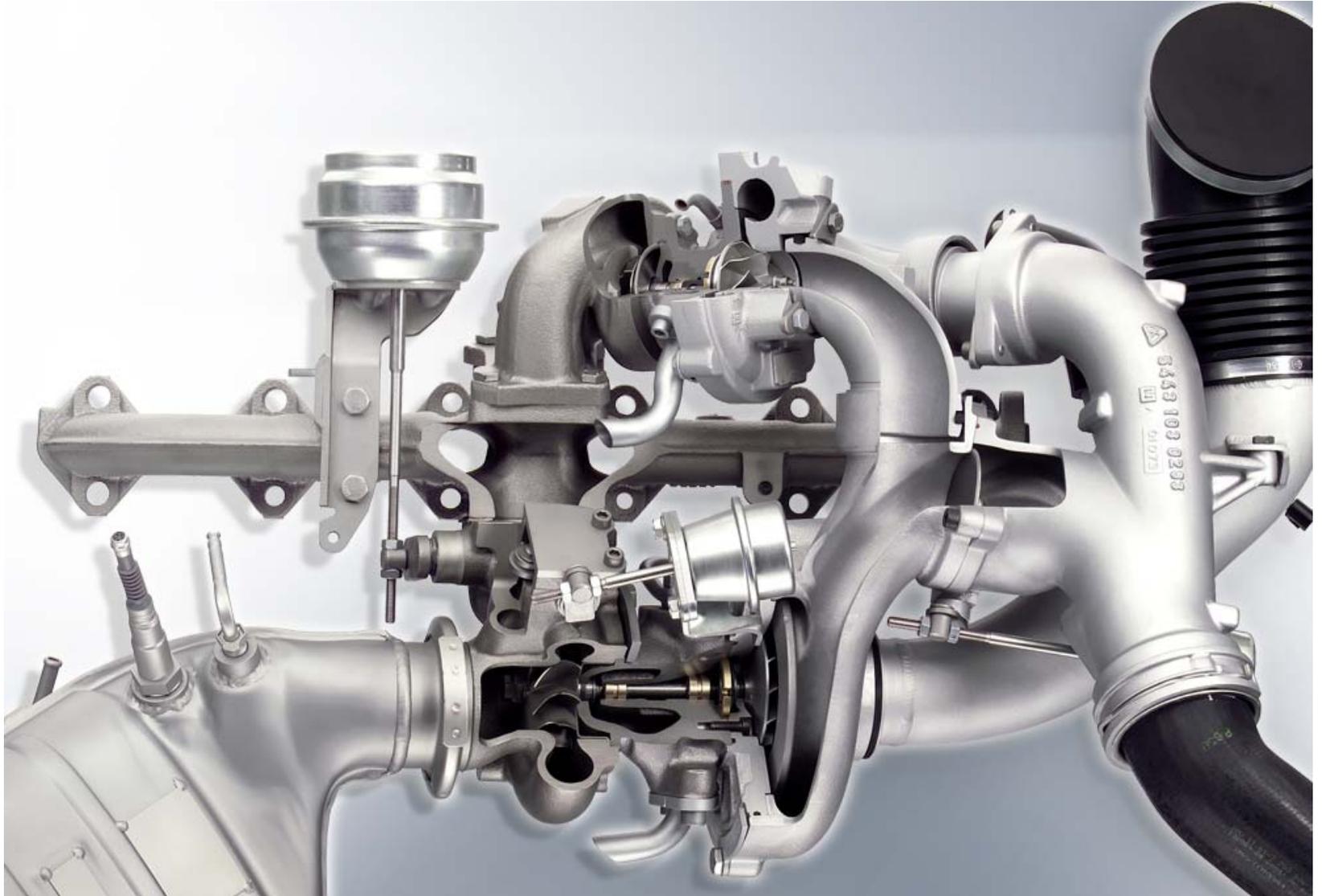
BMW Diesel.

Leading edge engine technology.



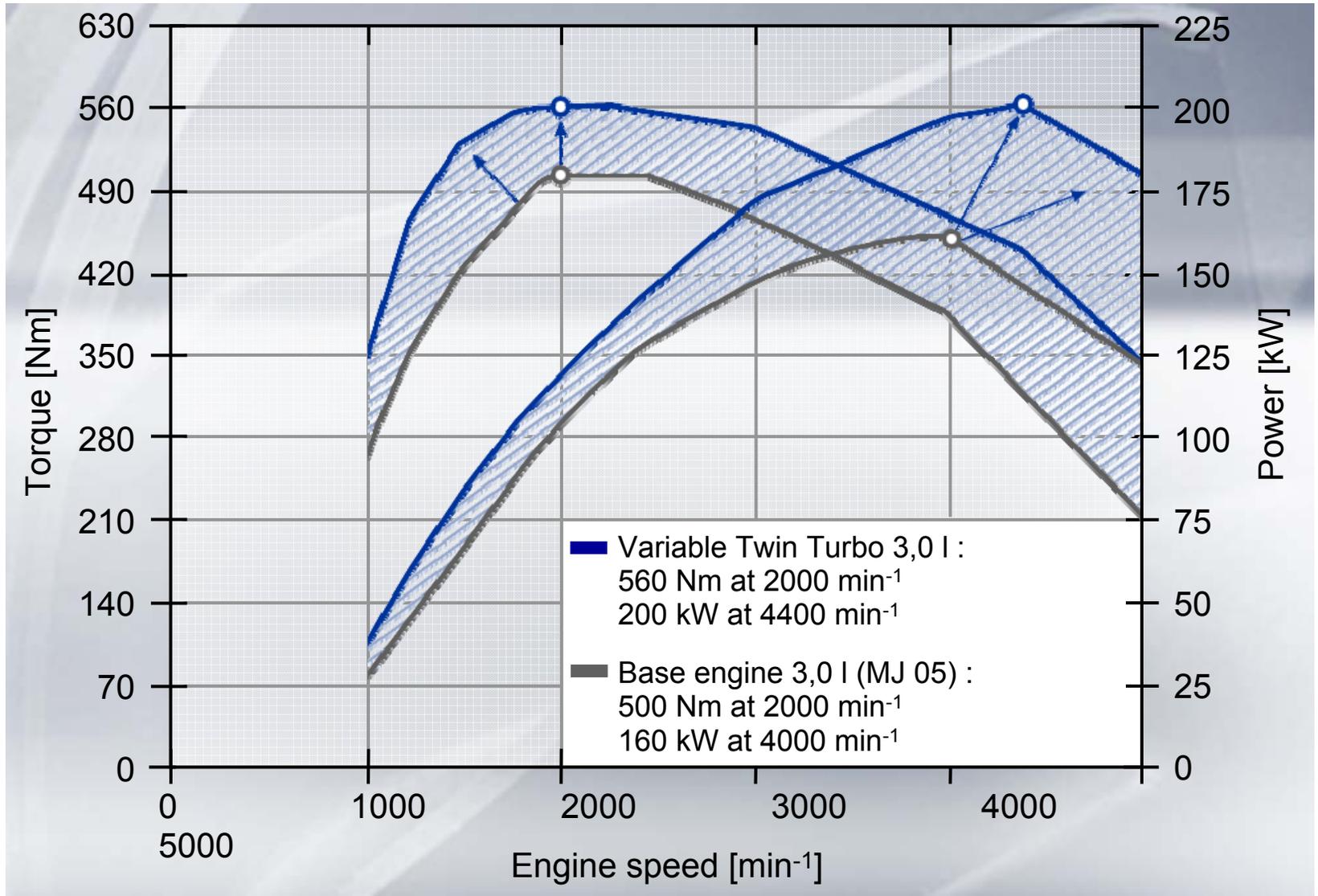
BMW Diesel.

Variable Twin Turbo technology – a new milestone in diesel history.



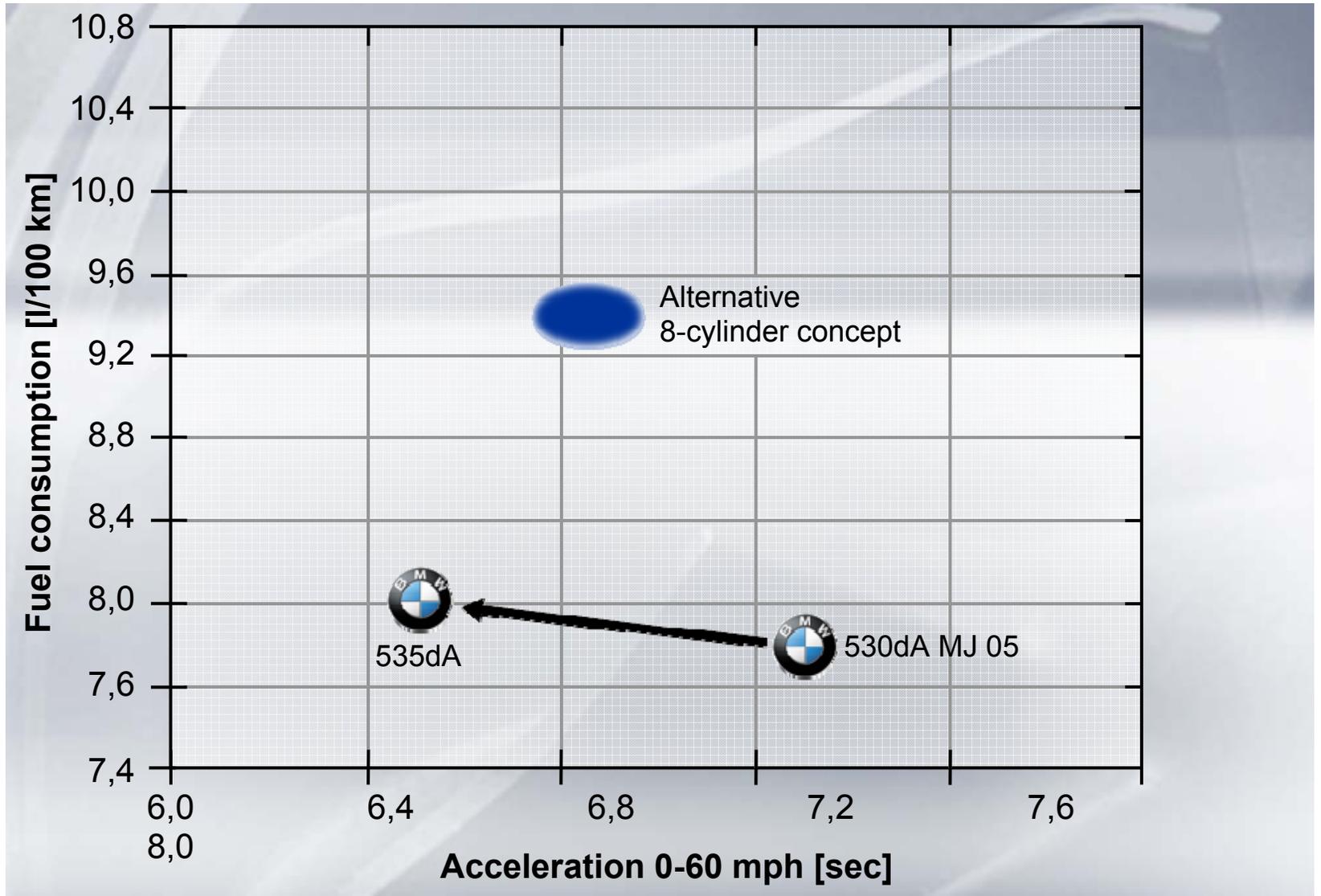
BMW Diesel.

Variable Twin Turbo technology - even more powerful.



BMW Diesel.

Variable Twin Turbo technology combines
V8-dynamics with R6 fuel consumption.



BMW Diesel.

Technology proofed in Rally Sport.

Engine : BMW inline 6 cylinder diesel
with Variable Twin Turbo

Power : about 270 HP

Torque : over 600 Nm

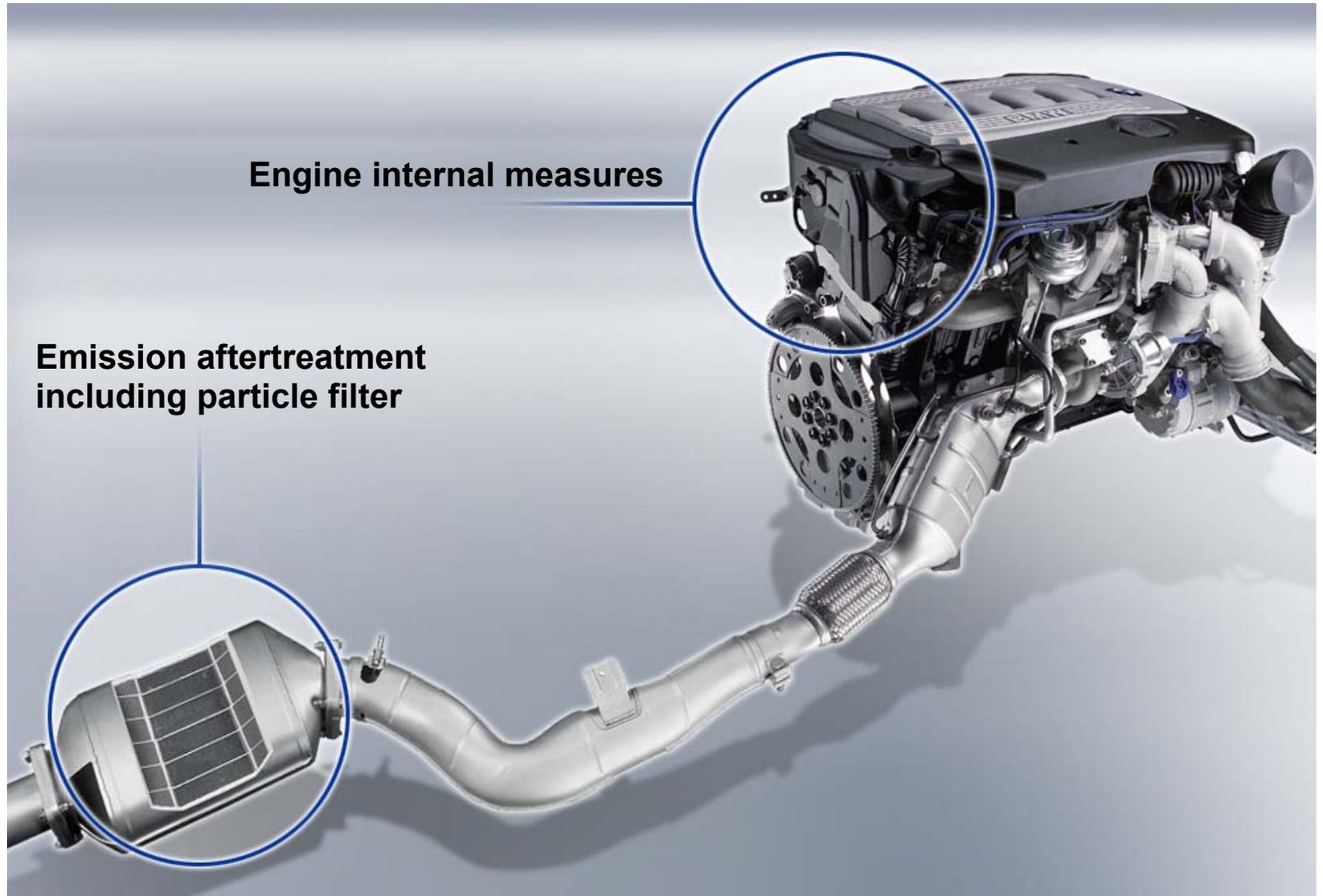
→ Winner of the Diesel category in the 2003 and 2004 Paris-Dakar Rally.

→ First Diesel to win a special stage



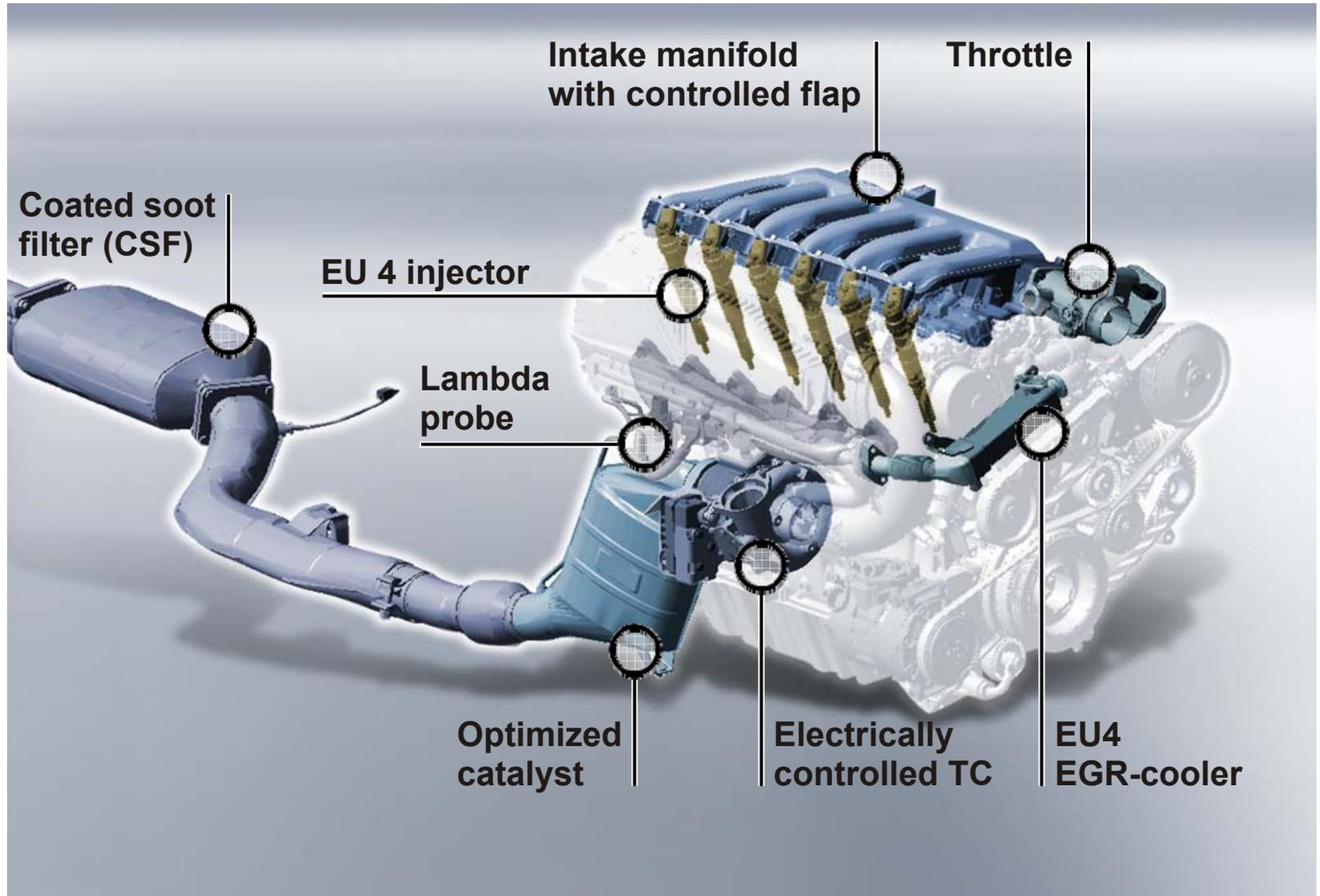
BMW Diesel.

The package for EU4 emission regulations.



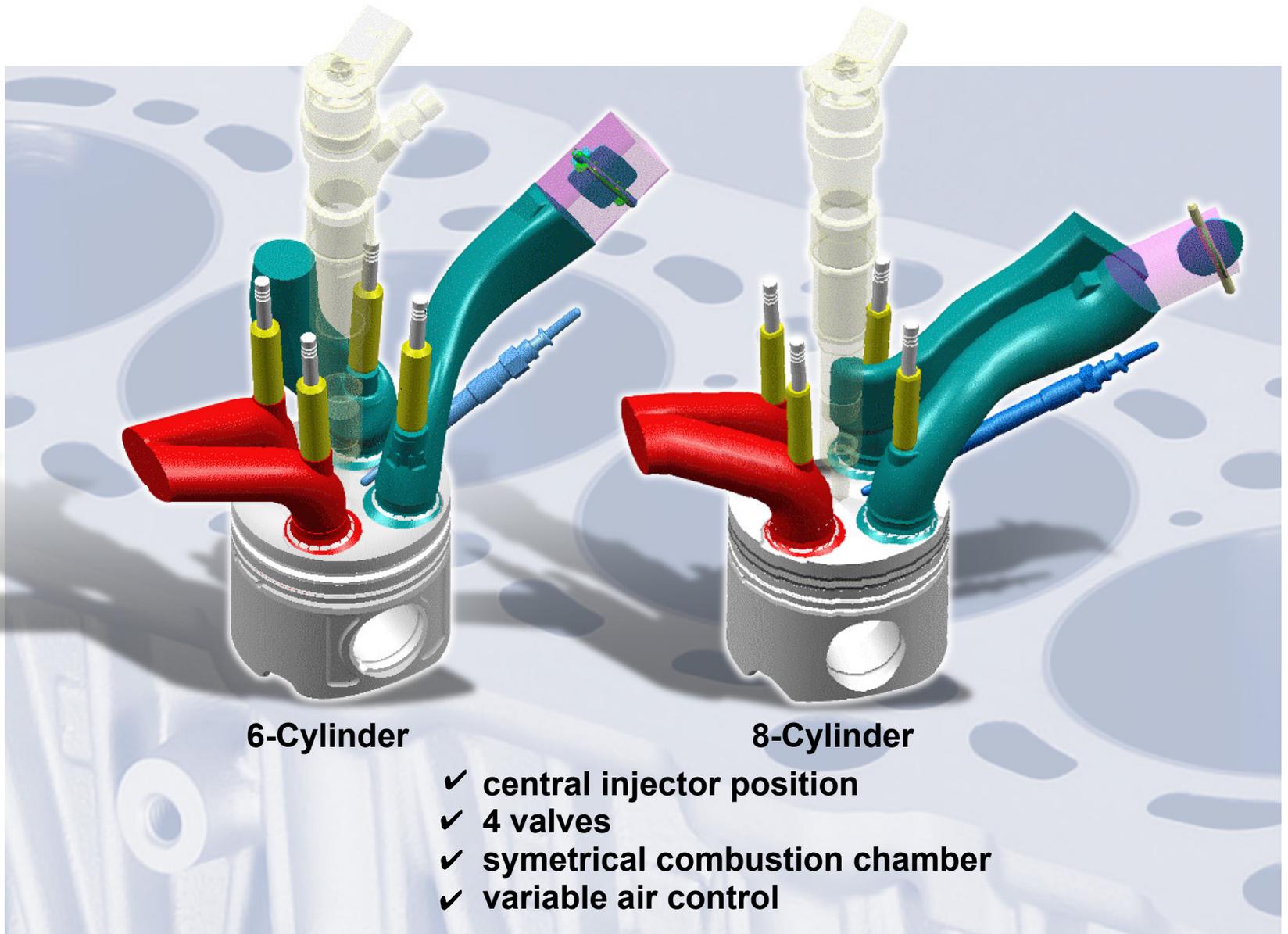
BMW Diesel.

The package for EU 4 emission regulations.



BMW Diesel.

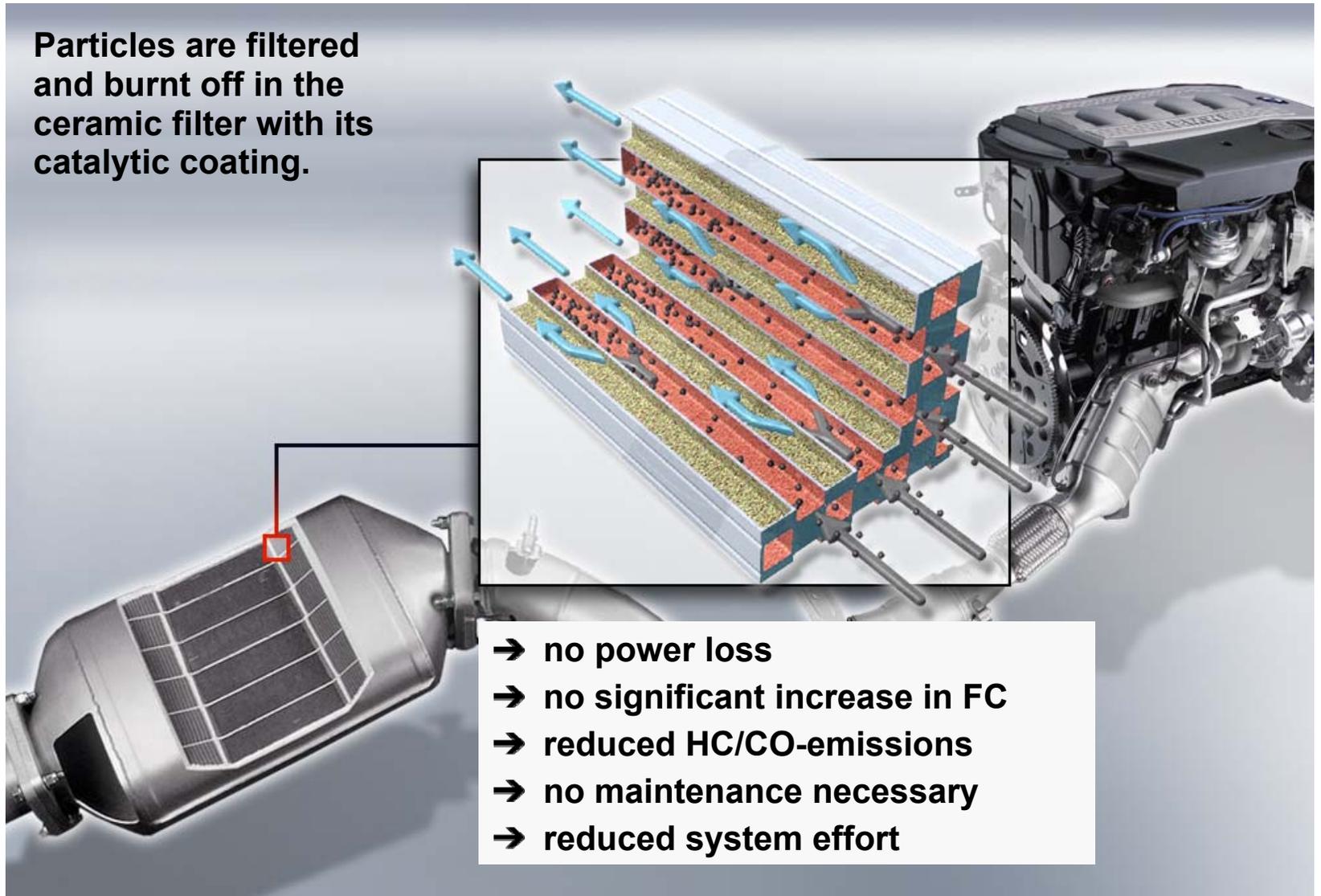
Combustion Chamber Configuration.



BMW Diesel.

BMW Diesel Particulate Filter.

Particles are filtered and burnt off in the ceramic filter with its catalytic coating.



BMW Diesel.

What do Diesel customers like .

General Attitude towards Driving & Cars



When I buy a new car, the fuel consumption is very important for me, even if it means spending more money for this lower fuel consumption I couldn't imagine life without a car

A car has to be at the cutting edge of technology

A car's eco-friendliness is of the greatest importance for me

For me a car is simply a functional object

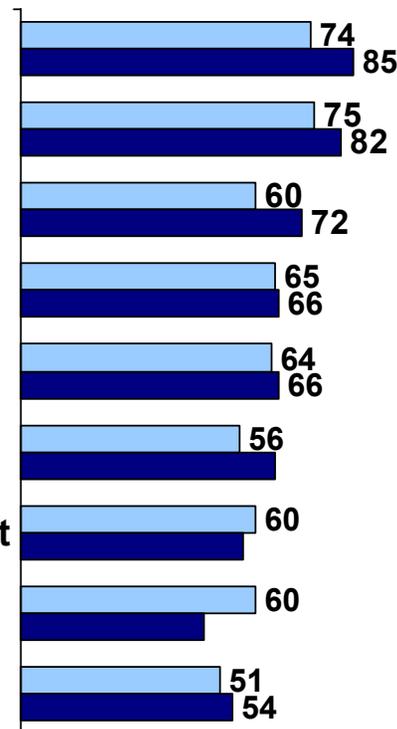
For me a car is of particular interest if it is a very innovative and advanced model

Cars are a major problem for the environment

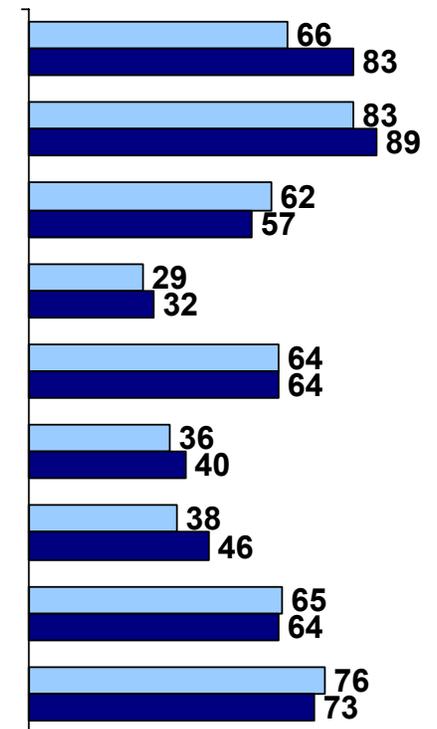
When I buy a car, the price is the absolutely decisive criterion

I can get really enthusiastic about cars

■ Petrol drivers (n=598)
■ Diesel drivers (n=420)



■ Petrol drivers (n=676)
■ Diesel drivers (n=329)



Data in %

Diesel Systems

Source : BOSCH

BMW Diesel.

What do Diesel customers like .

Timing of Engine Choice

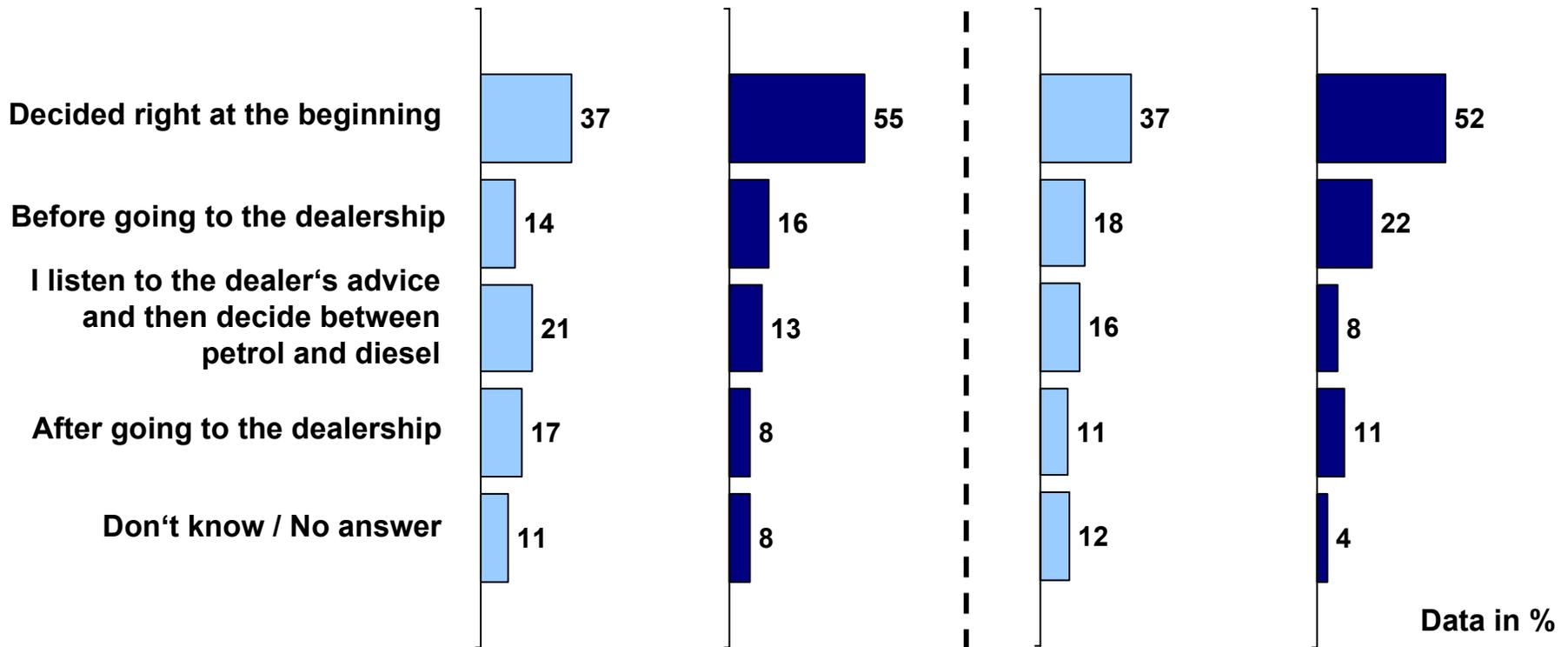


Petrol drivers
(n=598)

Diesel drivers
(n=420)

Petrol drivers
(n=676)

Diesel drivers
(n=329)



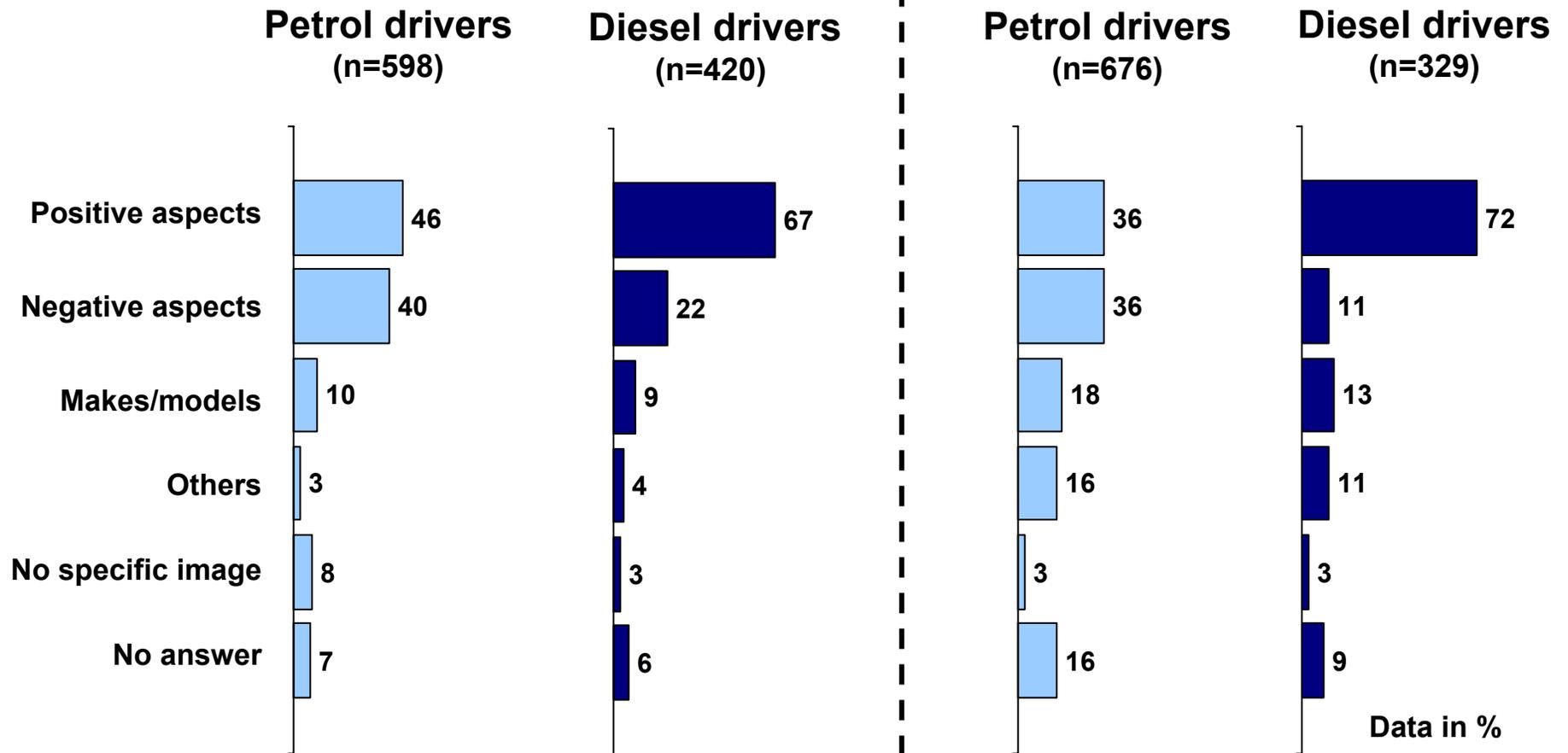
Diesel Systems

Source : BOSCH

BMW Diesel.

What do Diesel customers like .

Spontaneous Associations with Diesel



Data in %

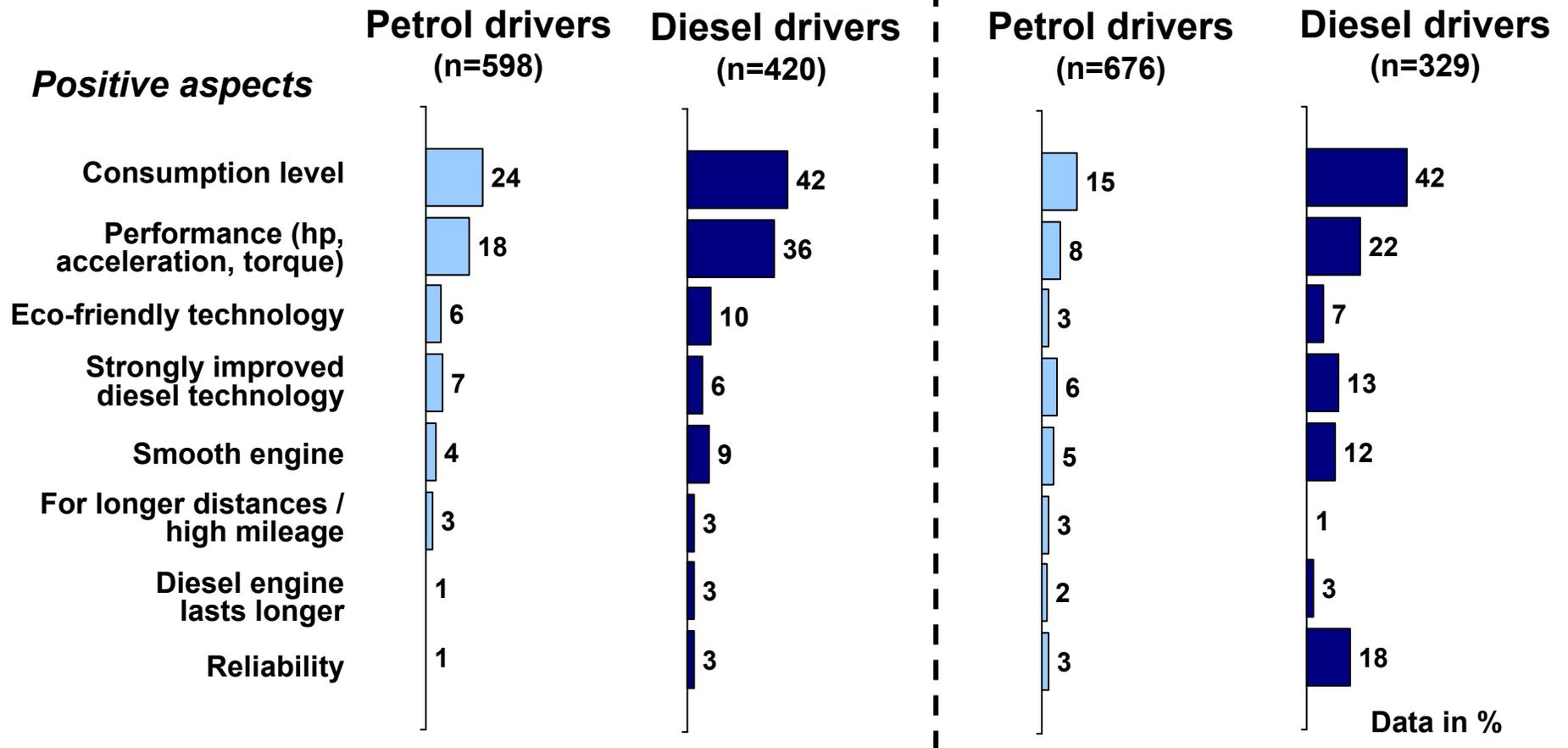
Source : BOSCH

Diesel Systems

BMW Diesel.

What do Diesel customers like .

Spontaneous Associations with Diesel



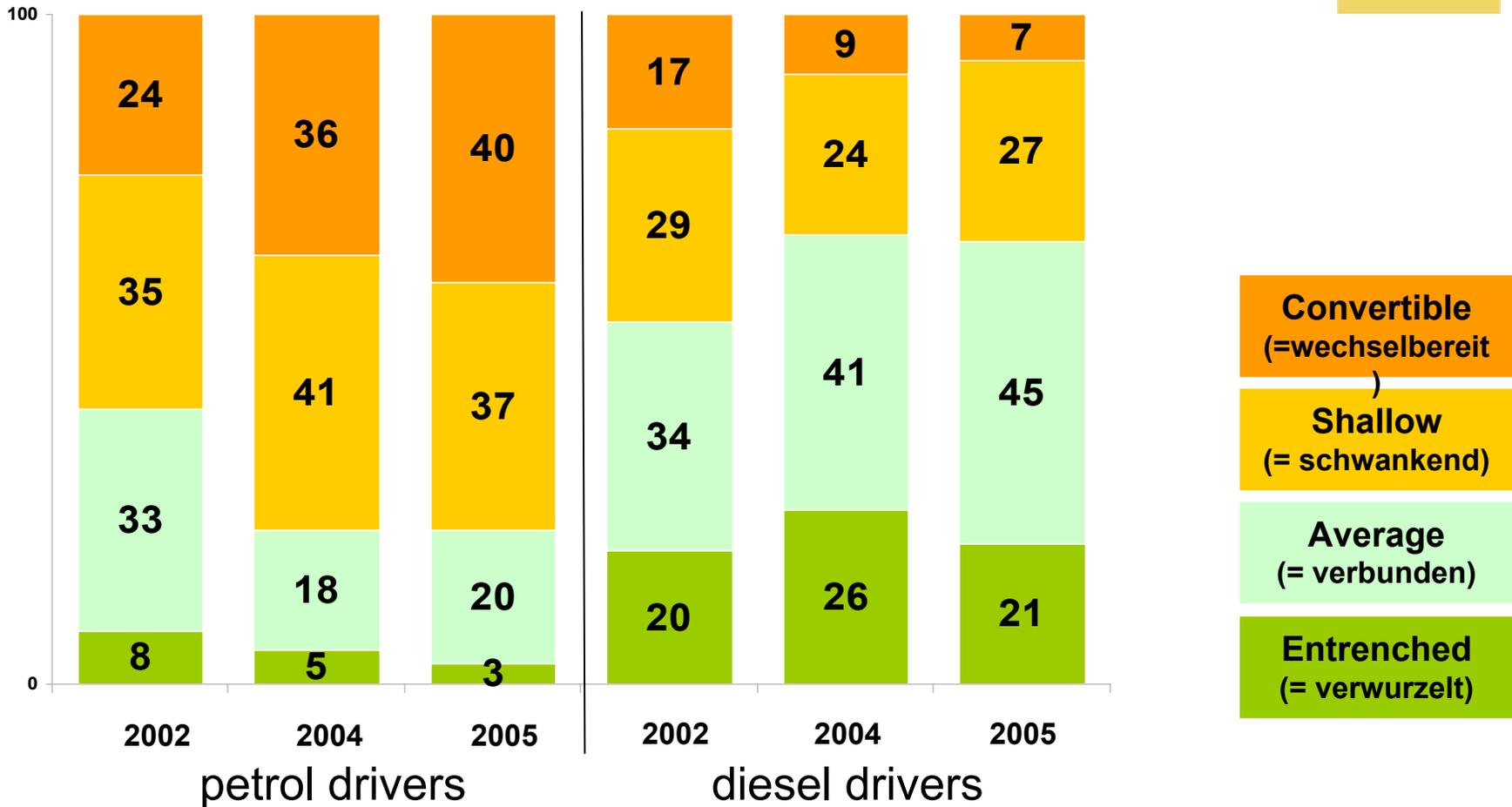
Diesel Systems

Source : BOSCH

BMW Diesel.

What do Diesel customers like .

Willingness to change – Germany 2002/2004/2005



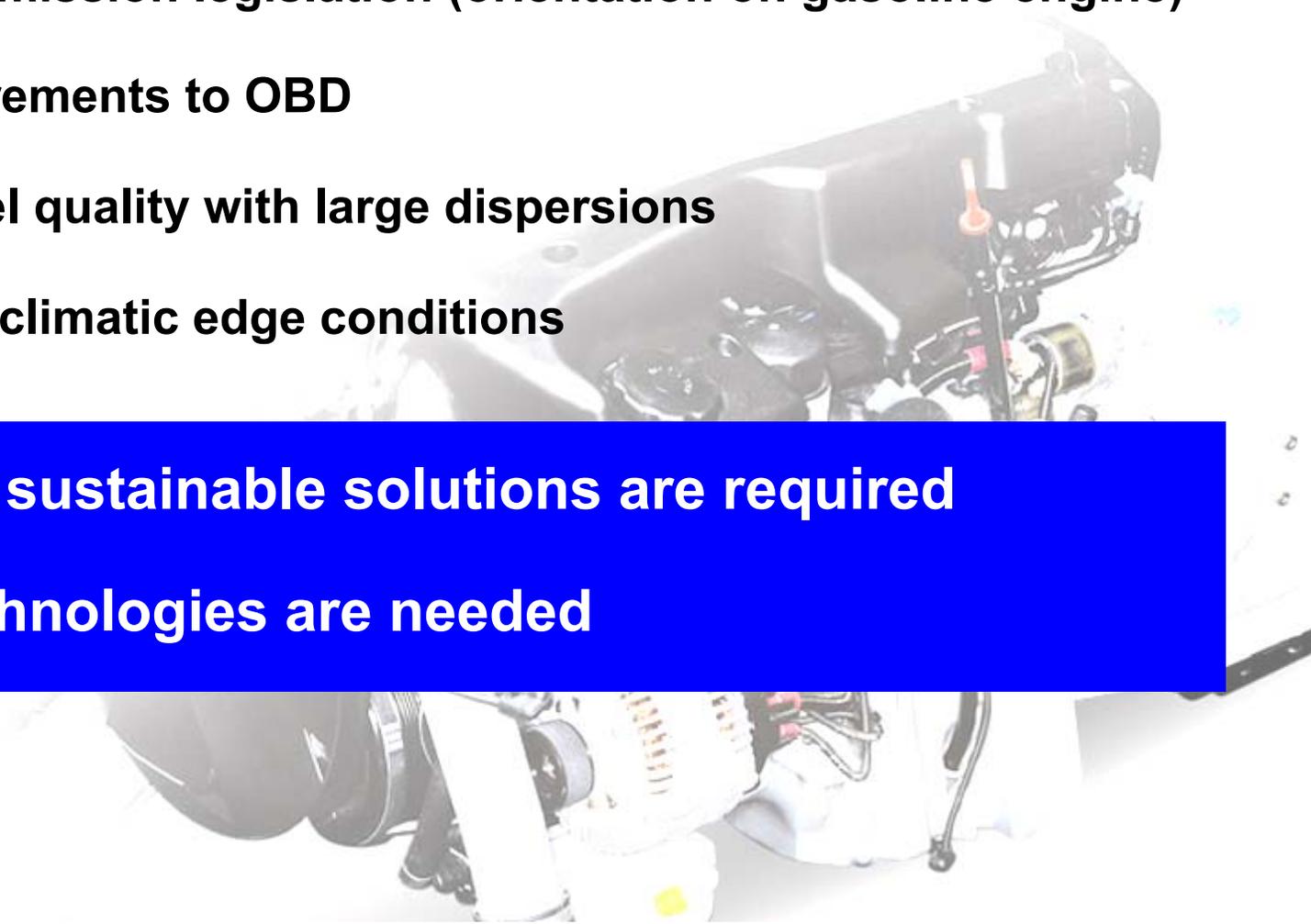
Source : BOSCH

BMW Diesel. Challenges in the US market.

- **Stringent emission legislation (orientation on gasoline engine)**
- **High requirements to OBD**
- **Various fuel quality with large dispersions**
- **Intensified climatic edge conditions**

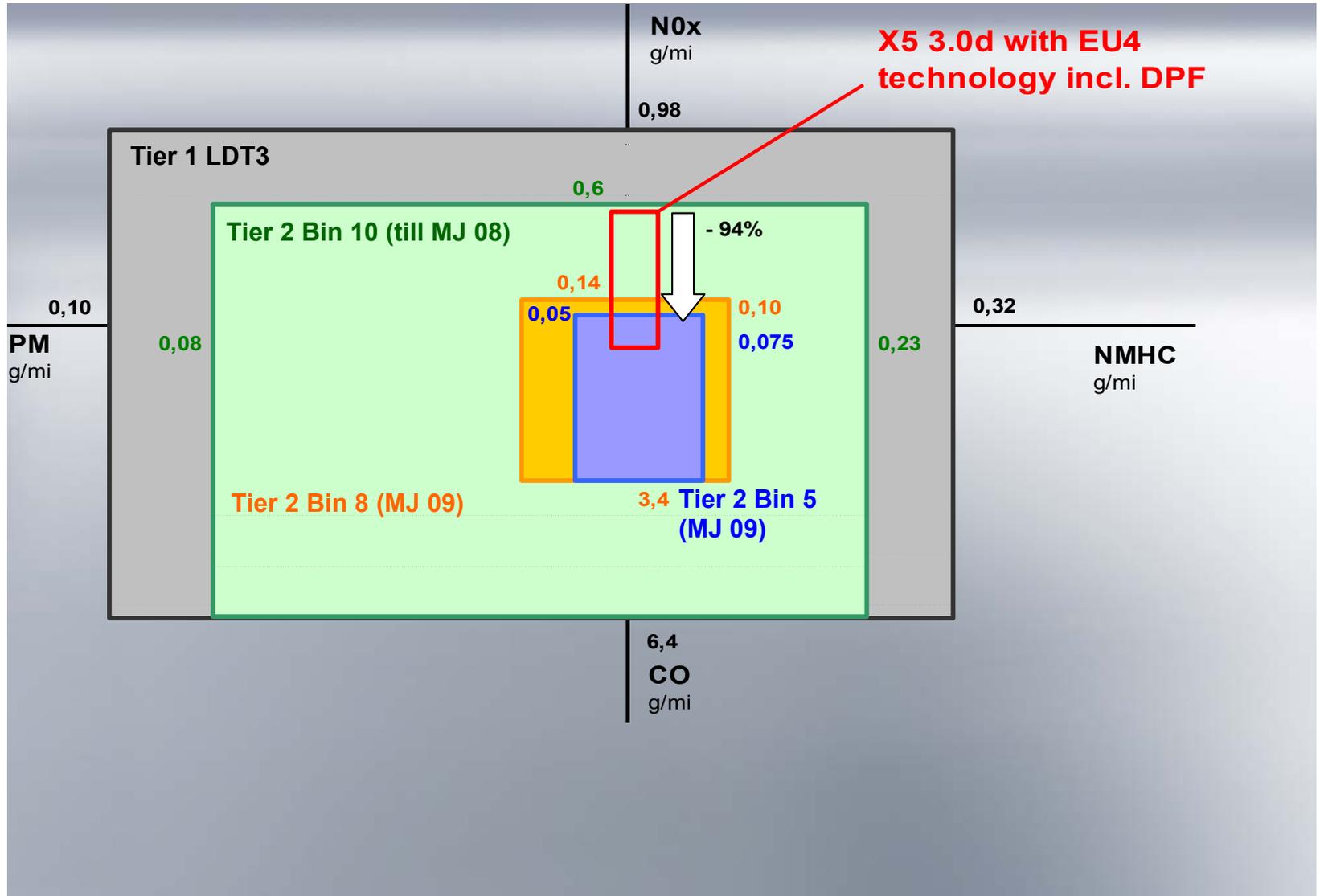
→ Robust, sustainable solutions are required

→ New technologies are needed



BMW Diesel.

NOx challenge BIN 5.



BMW Diesel.

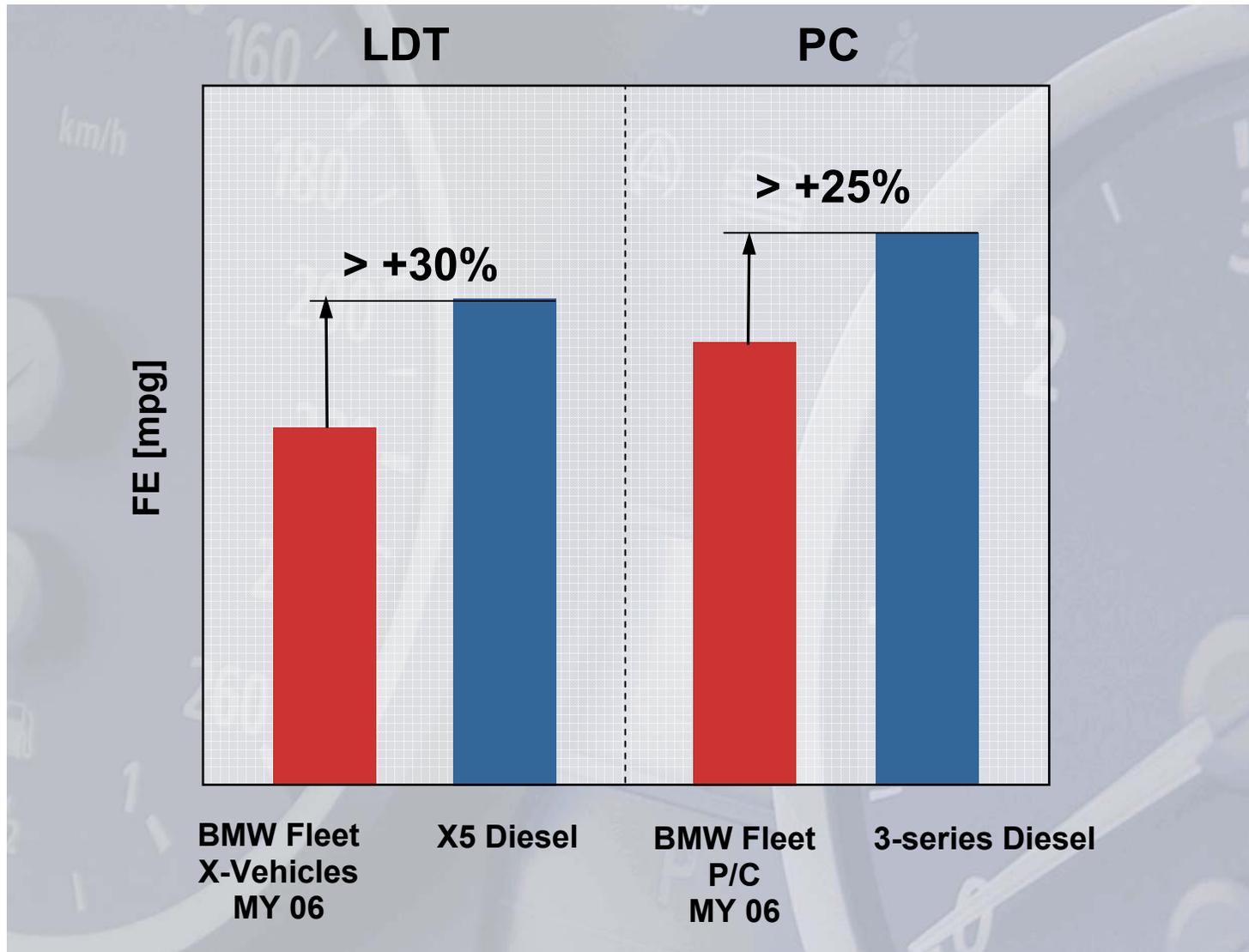
TIER2 BIN 5 concept.

- **Modified combustion**
- **Advanced EGR- system**
- **Adapted fuel injection system**
- **Electrical control devices**
- **Additional sensors**
- **OBD functions**
- **Diesel Particulate Filter (DPF)**
- **SCR-System (Selective Catalytic Reduction)**



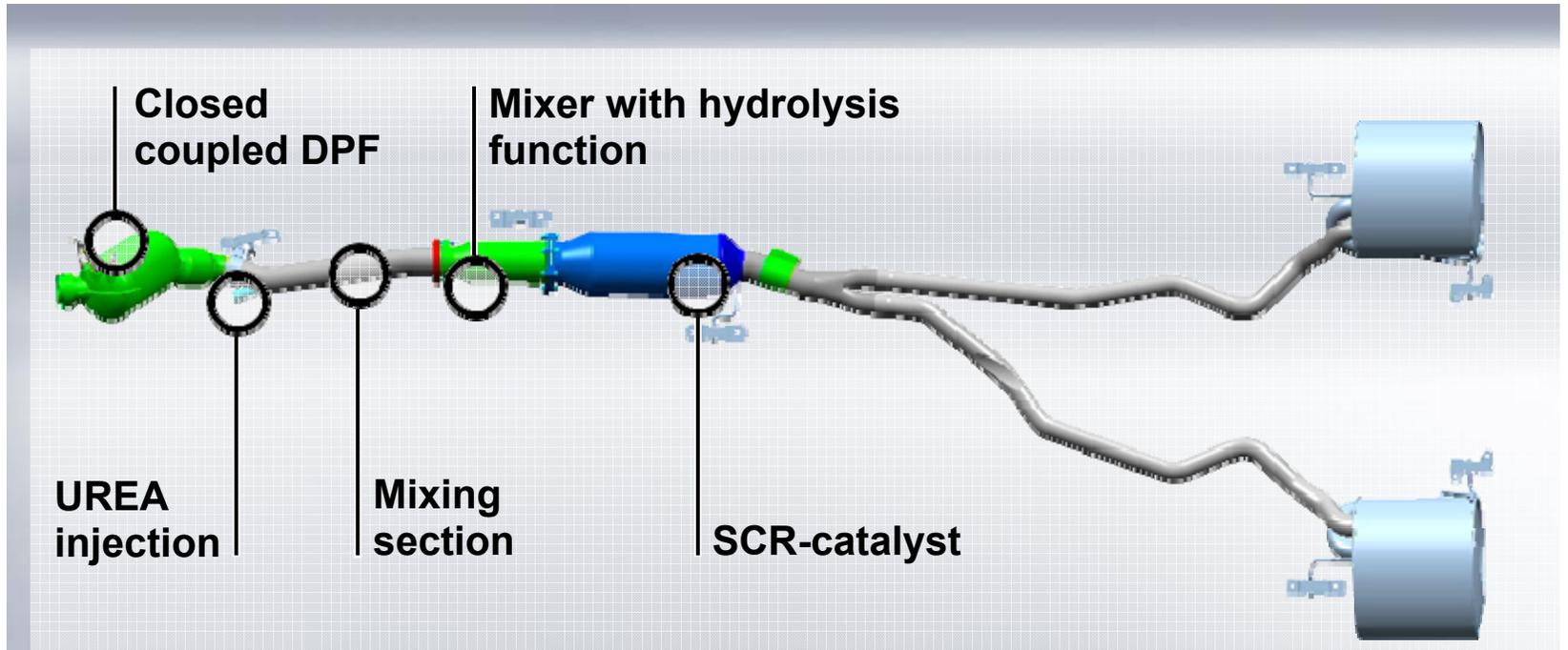
BMW Diesel.

Fuel Consumption – Diesel efficiency.



BMW Diesel.

DPF + SCR-system layout.

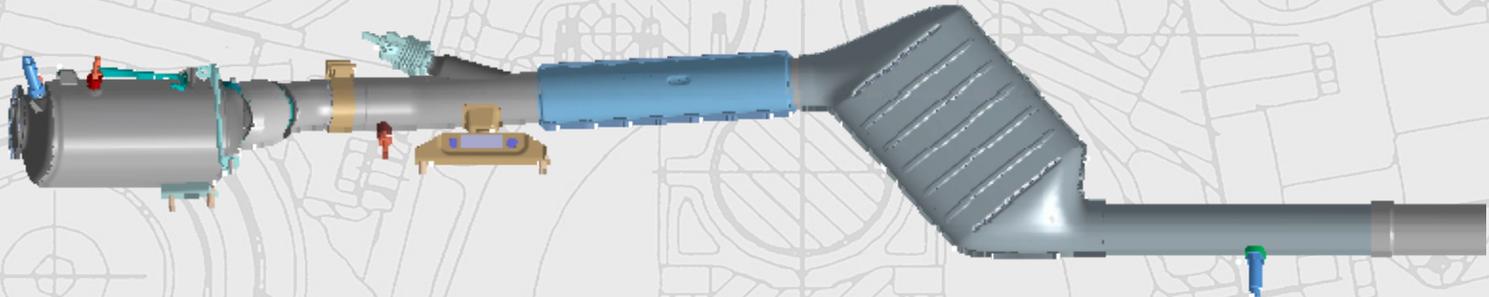


Additional requirements:

- heated tank with fluid-level indicator (OBD)
- heated Urea pipes from tank to dosing unit

BMW Diesel.

SCR system – chemical reactions



BMW Diesel.

Characteristics of SCR system.

Advantages

- High NO_x-efficiency up to high engine loads
- Long term emission stability
- No increase in fuel consumption

Challenging requirements

- UREA infrastructure → common efforts necessary
- OBD

SCR systems are available for trucks in Europe and Japan

→ BMW judgement: long term solution for diesel engines

BMW Diesel. Conclusion.



- **Portion of BMW Diesel passenger cars in Europe has significantly increased within the last decade**
- **BMW Diesel philosophy is “efficient dynamics”**
- **BMW at leading edge of diesel technology**
- **BMW target for US is to fulfil 50 state legislations**
- **Technology concept for BIN 5 defined, but still challenging**
- **Compromisses to Diesel necessary (i.e. phase-in`s)**

→ BMW Diesels: dynamic, efficient and clean

BMW Diesel. Ready for the future.

Thank you very much
for your attention!

