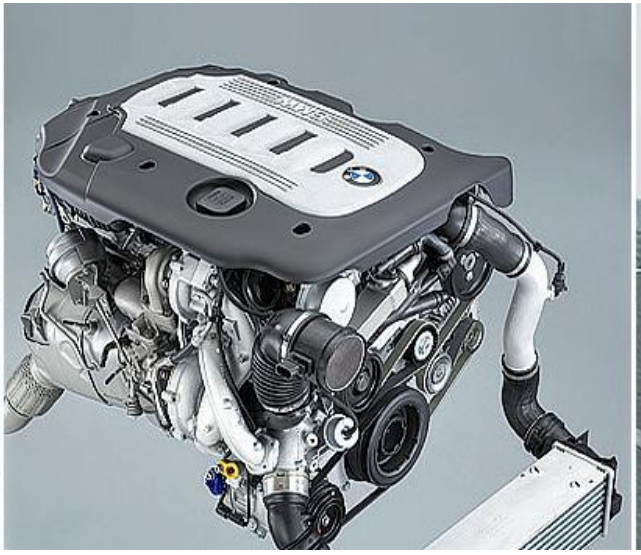
BMW Diesel.

14th DEER Conference, 4th-7th of August 2008 Detroit



BMW Diesel - Engine Concepts for Efficient Dynamics

Detlef Hiemesch

BMW Group

BMW Diesel.
Contents.

BMW Diesel.

Evolution of Diesel Performance.

BMW 524td

BMW 535d

1983
- 1st BMW 6Cyl. Inline Diesel
- 524td fastest diesel vehicle in it´s segment

1987
- First Digital Diesel Electronics (DDE)

1990
- First BMW Diesel with Oxy-Cat.

1998
- Introduction of DI Technology at BMW Diesels
- BMW 320d wins "24 Hours of Nürburgring"

1999
- First V8 Diesel Sedan in Premium Segment offered by BMW

2001
- 2nd Gen. Common Rail (1600 bar)

2004
- Variable Twin Turbo
- Diesel Particulate Filter of 2nd Gen.

2007
- 3rd generation Common Rail (2000 bar)
- Piezo injectors

Torque:
+ 170 %

Power:
+ 147 %

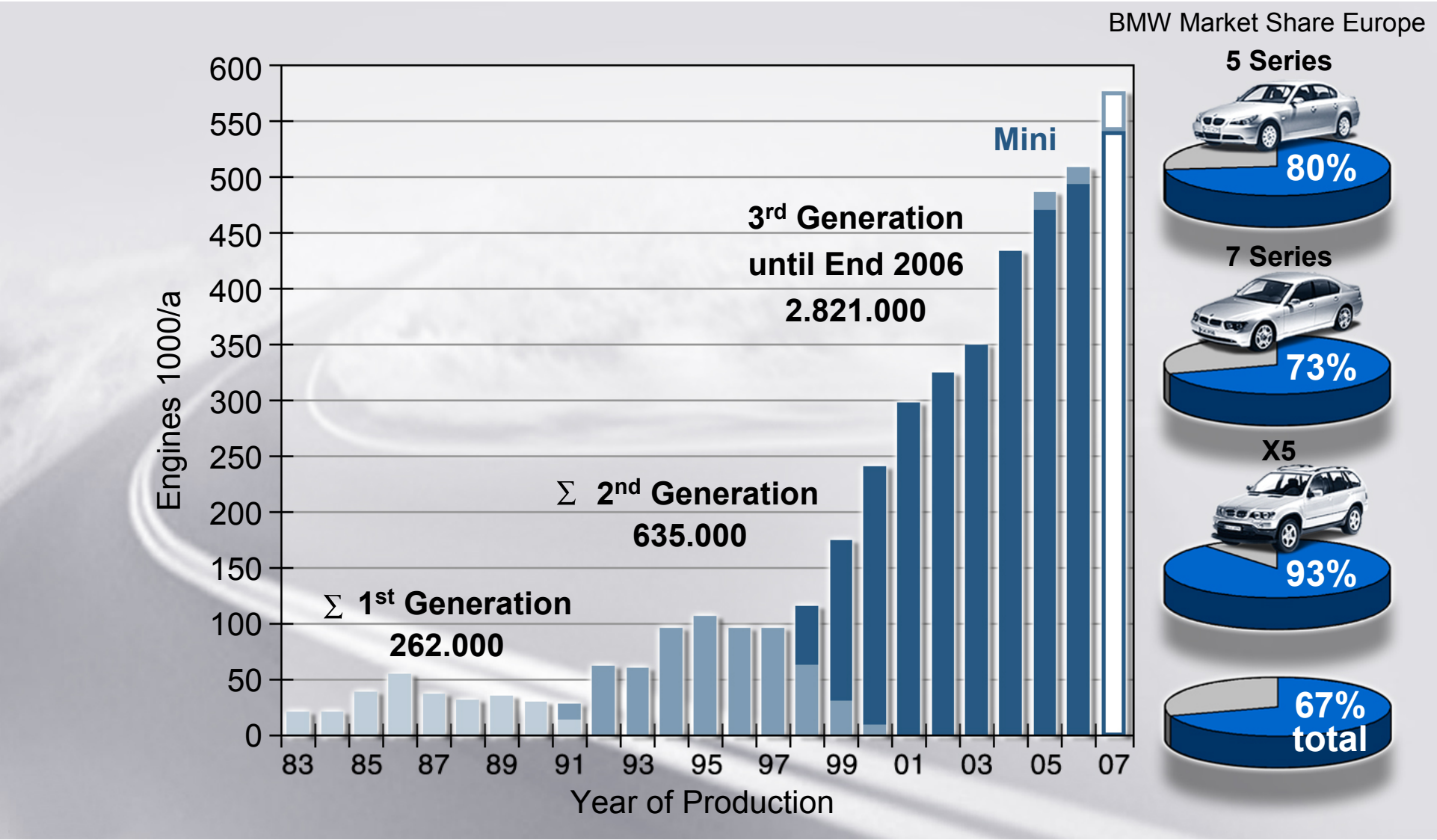
100 %

Consumption:
- 20 %

Emissions:
- 99 %

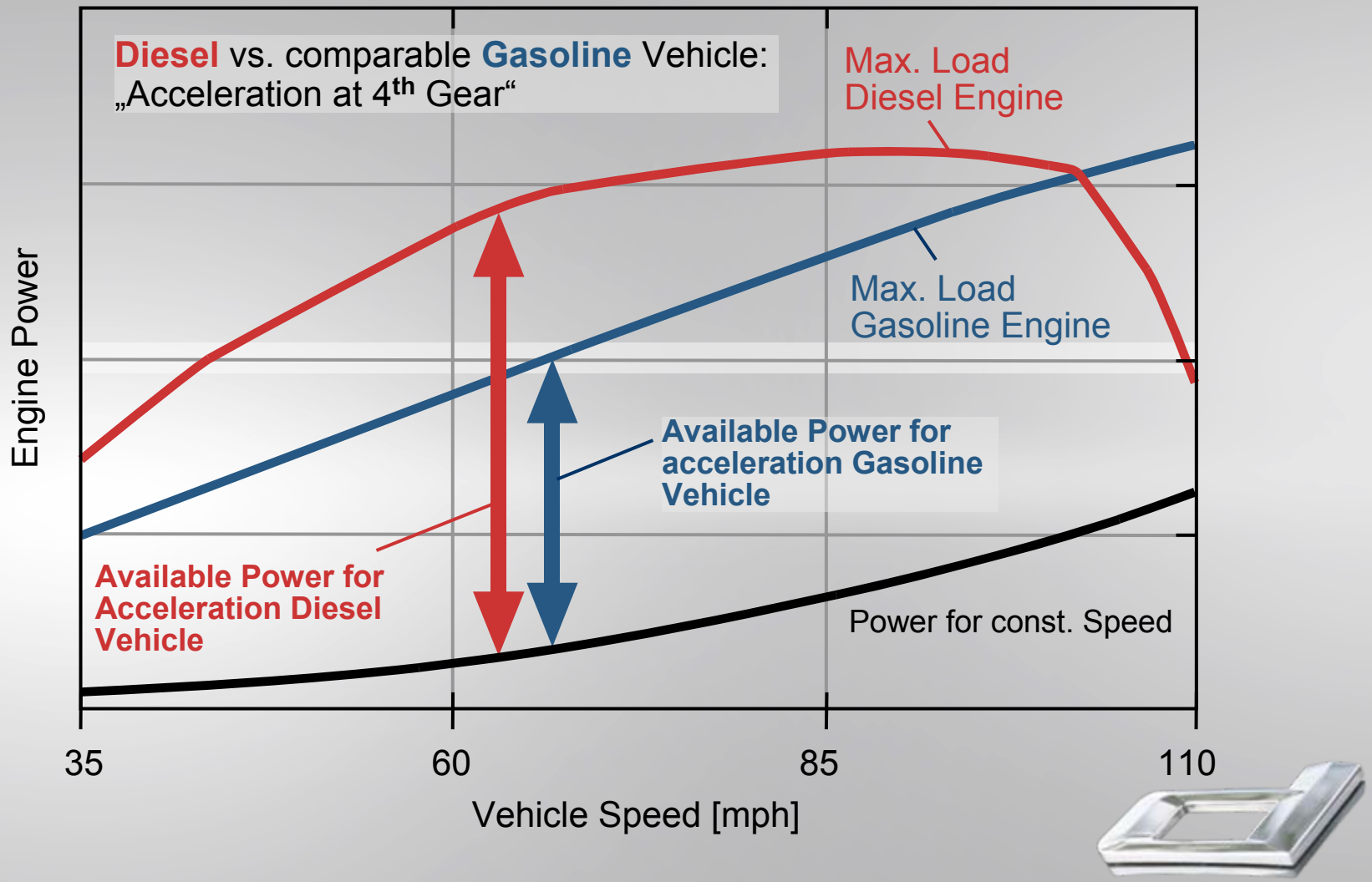
BMW Diesel.

Evolution of Diesel Performance.

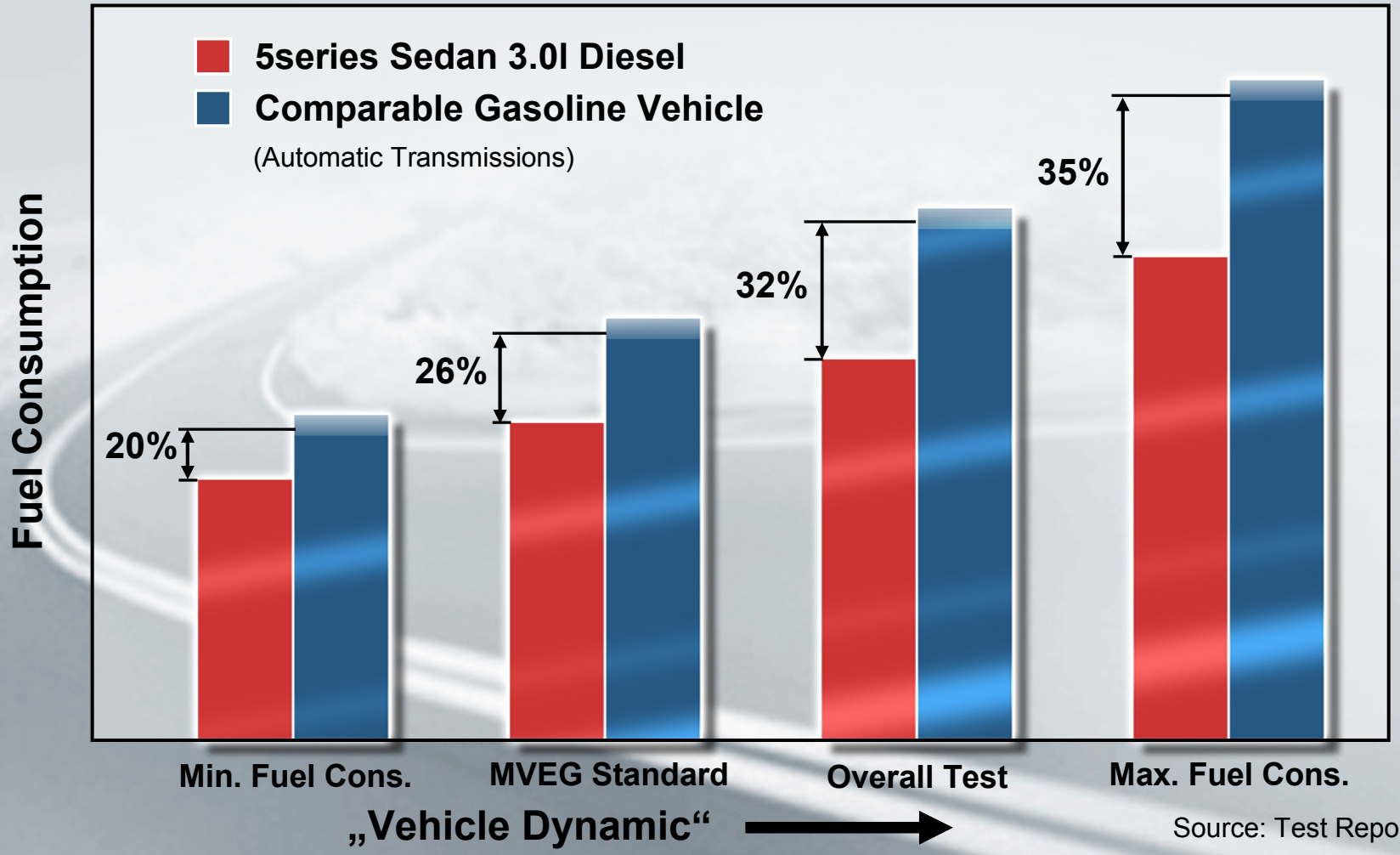


BMW Diesel.
Diesel Motivation.

BMW Diesel.
Diesel Motivation.

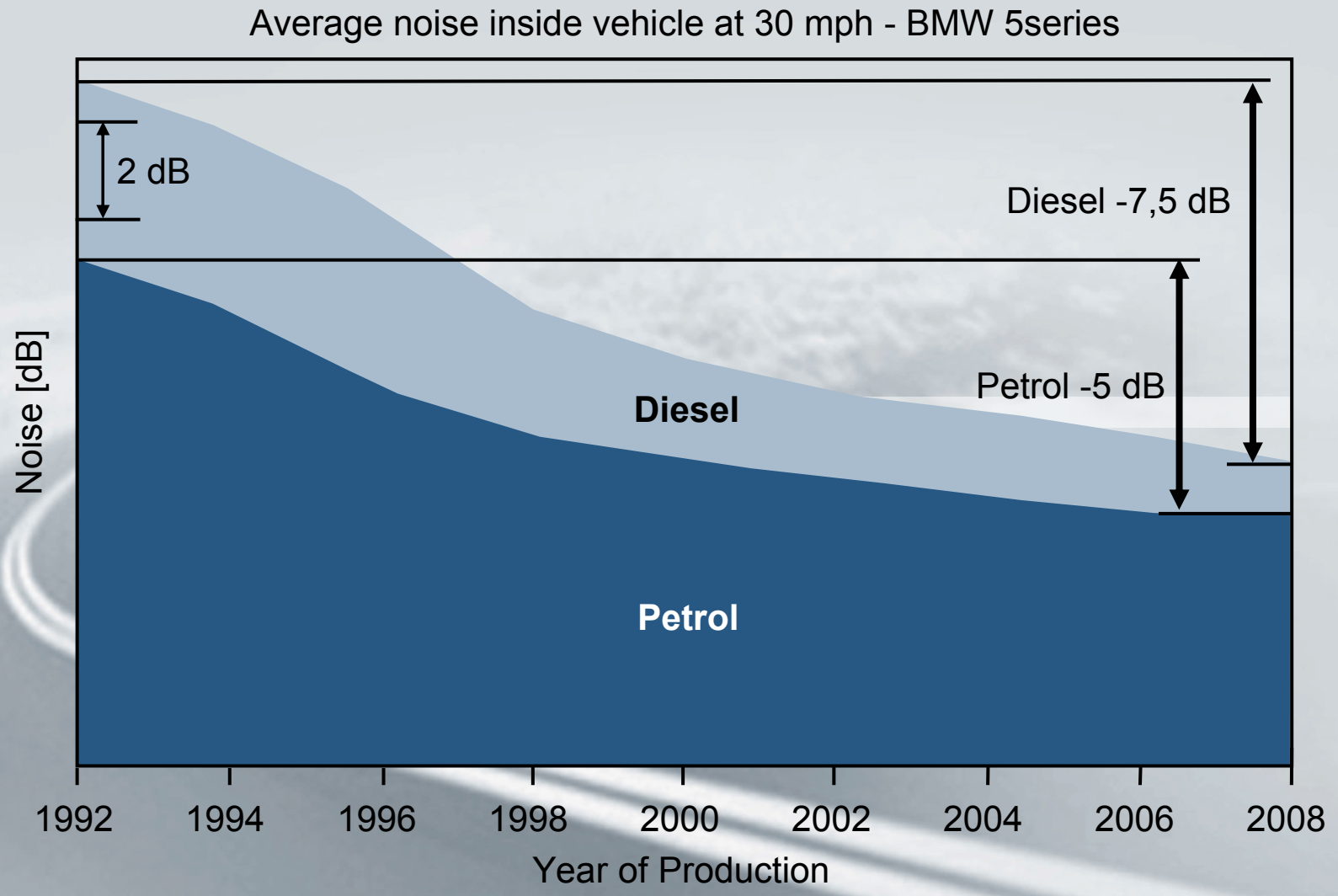


BMW Diesel.
Diesel Motivation.



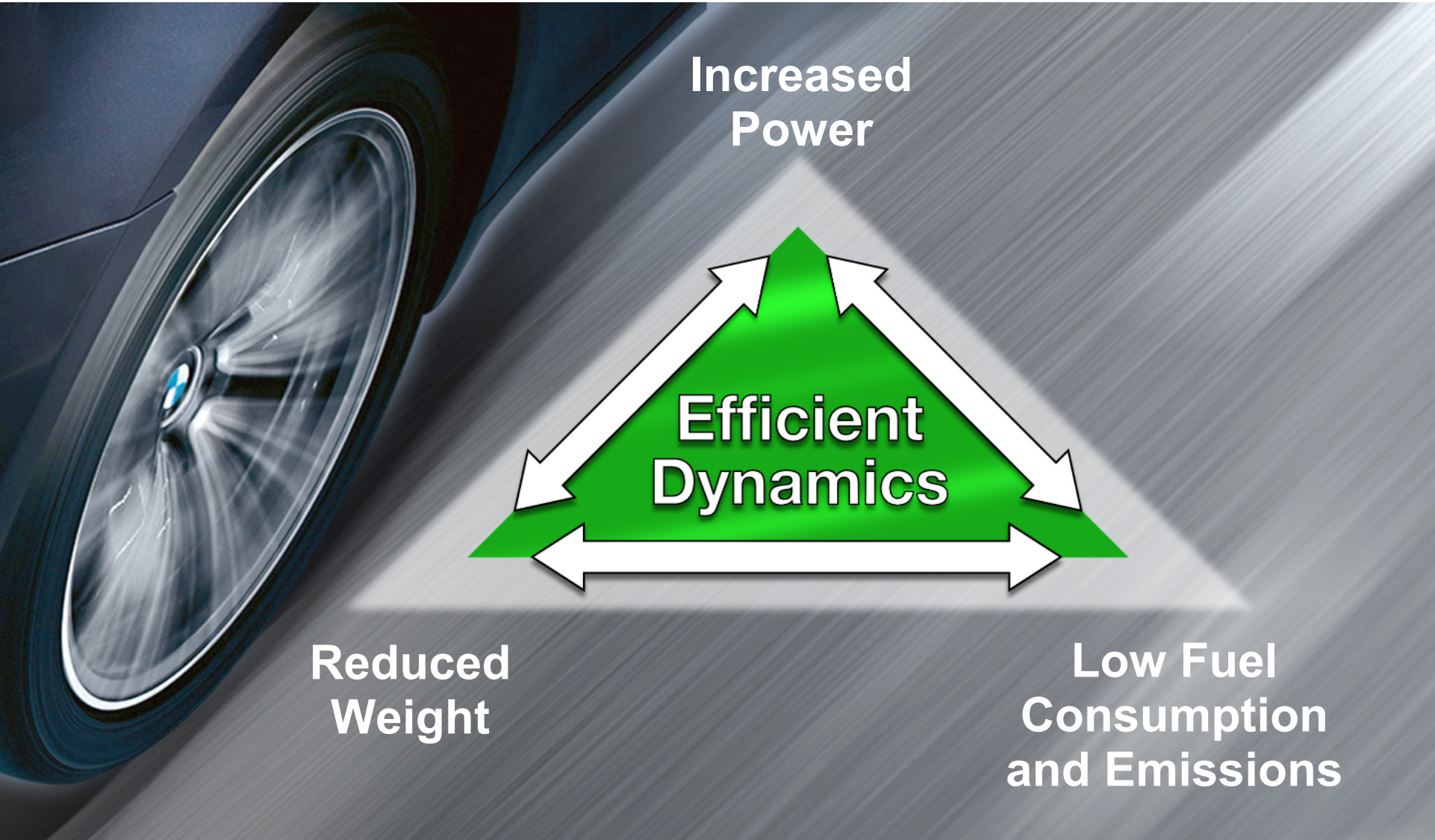
Source: Test Reports

BMW Dieselengines.
Diesel Motivation.

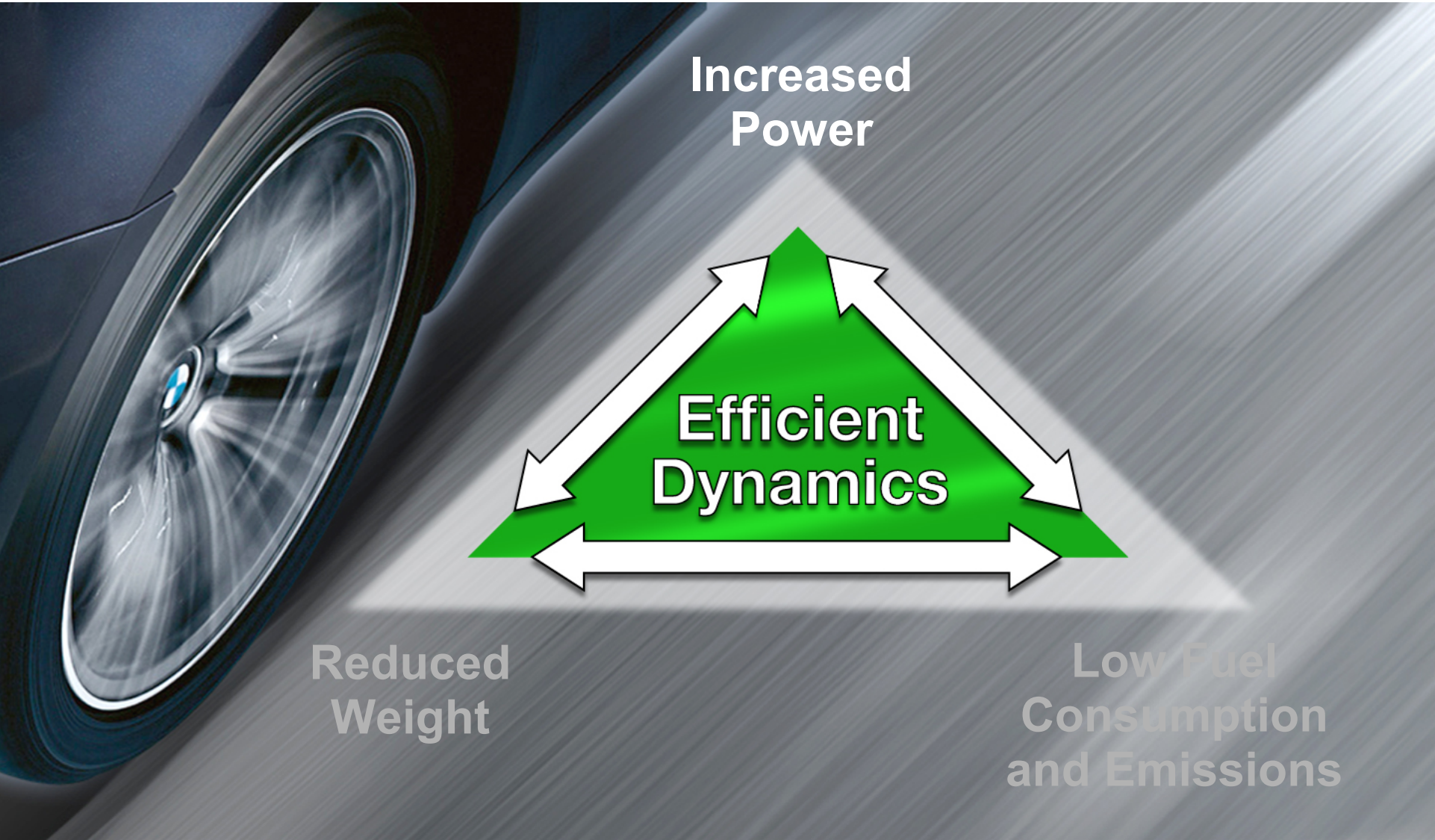


BMW Diesel.

Efficient Dynamics.

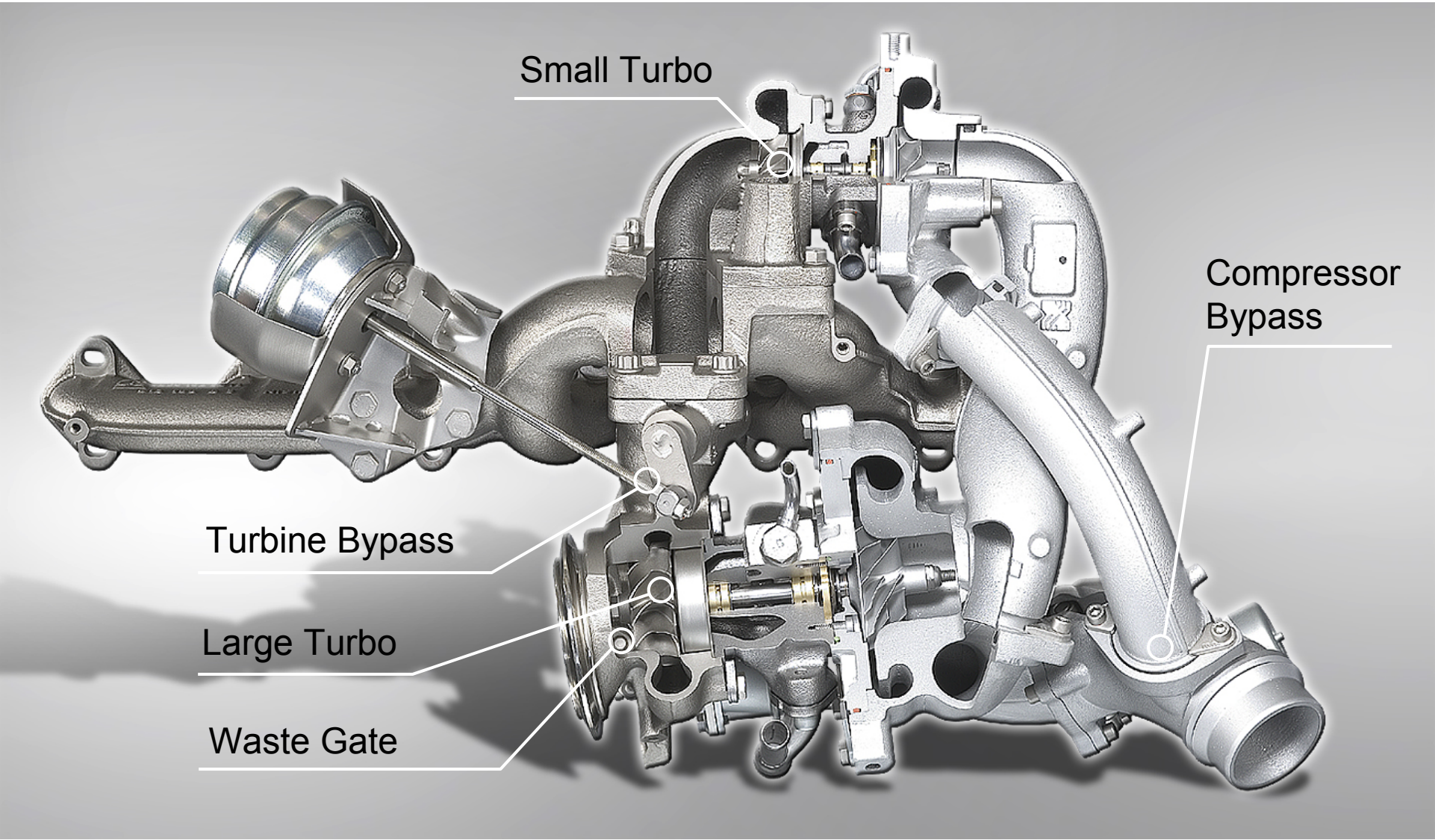


BMW Diesel.
Efficient Dynamics.

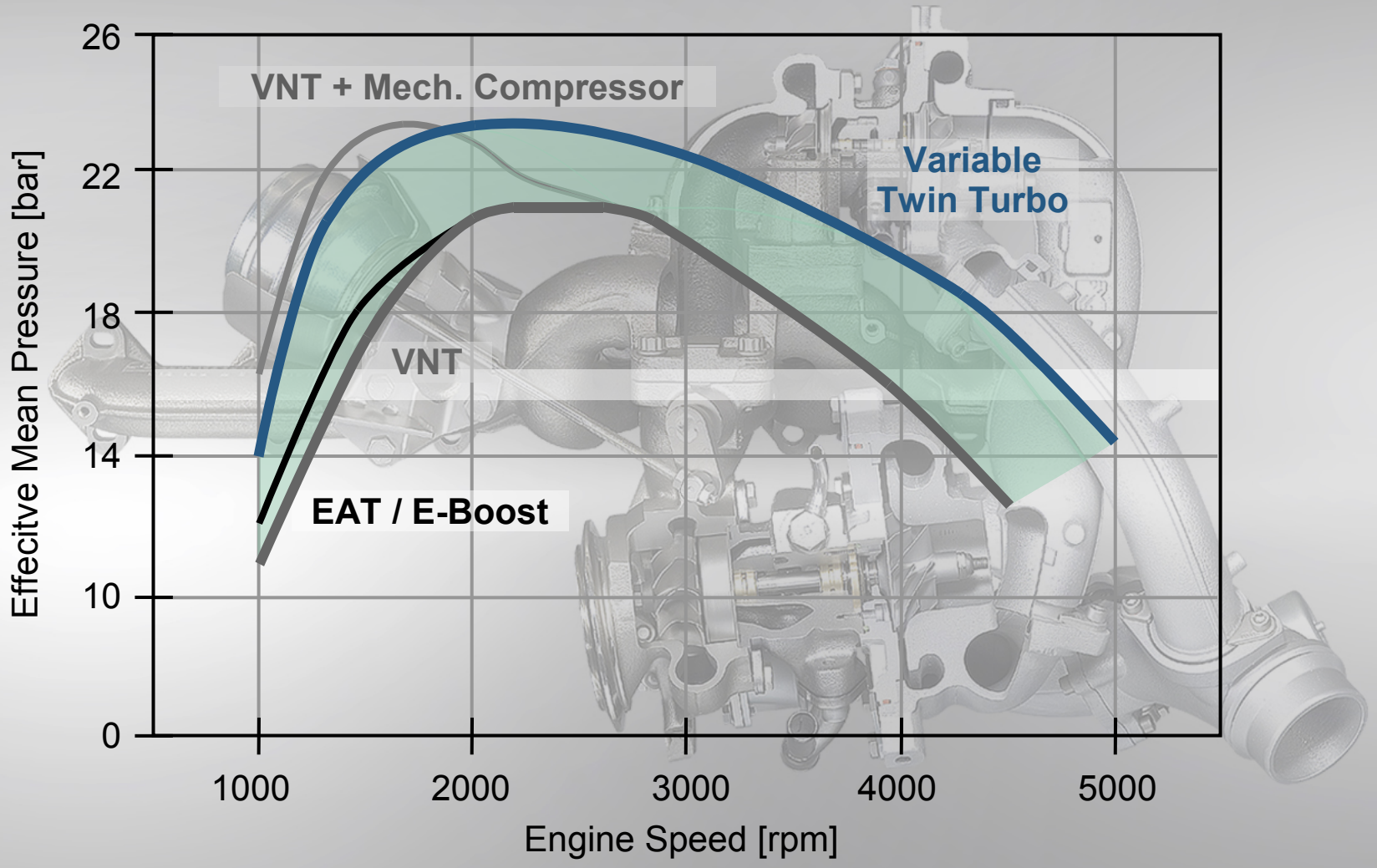


BMW Diesel.
Variable Twin Turbo.

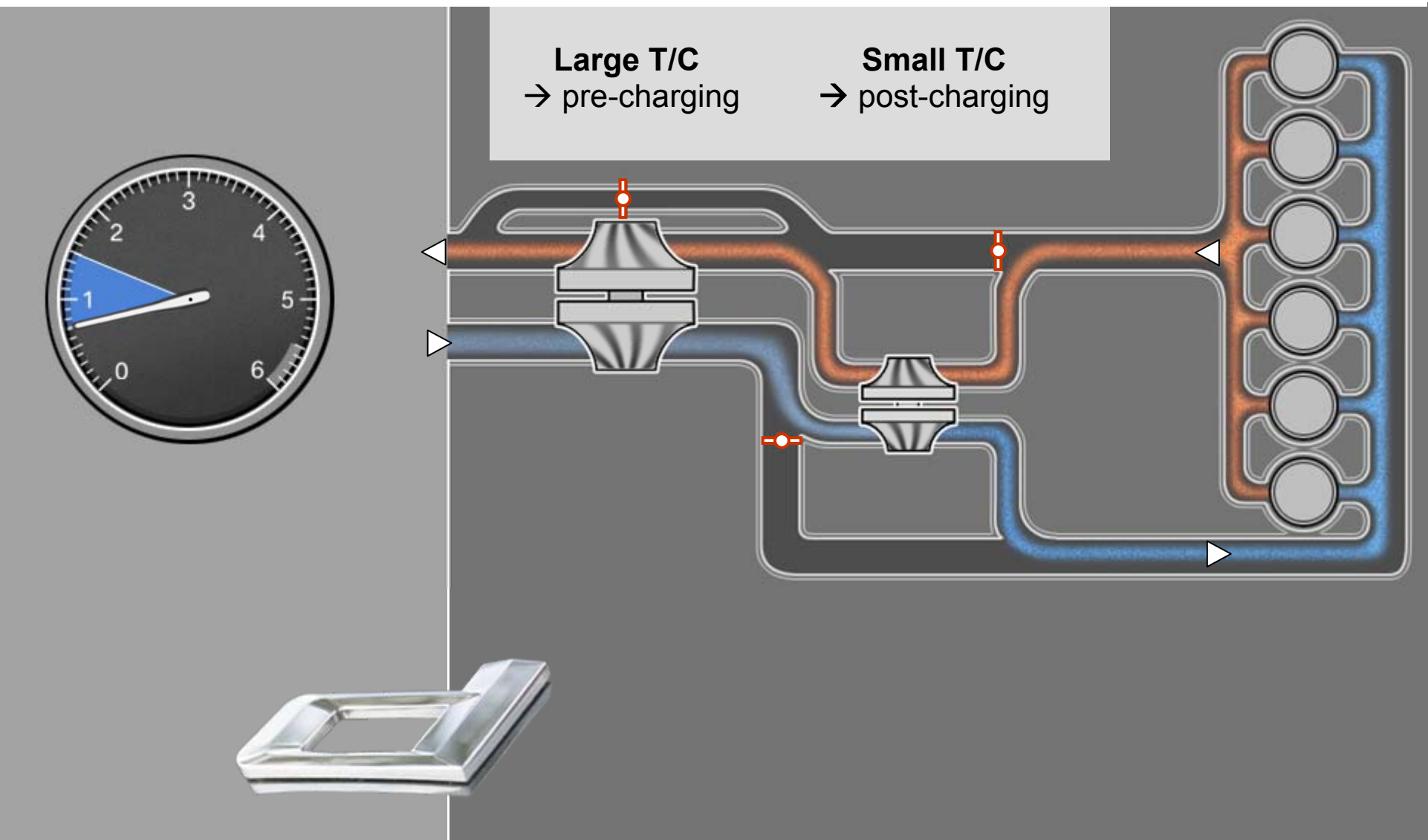
BMW Diesel.
Variable Twin Turbo.



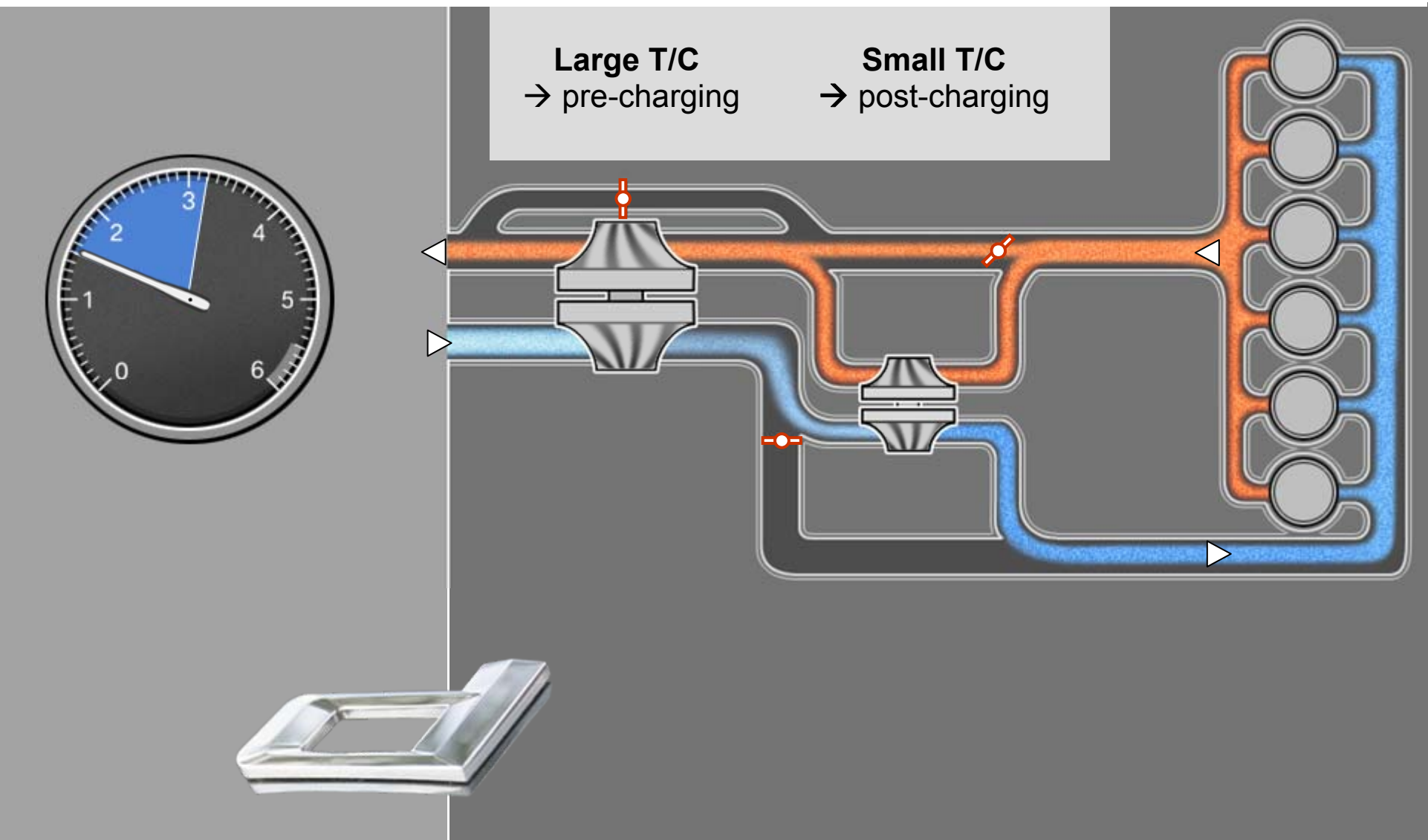
BMW Diesel.
Variable Twin Turbo.



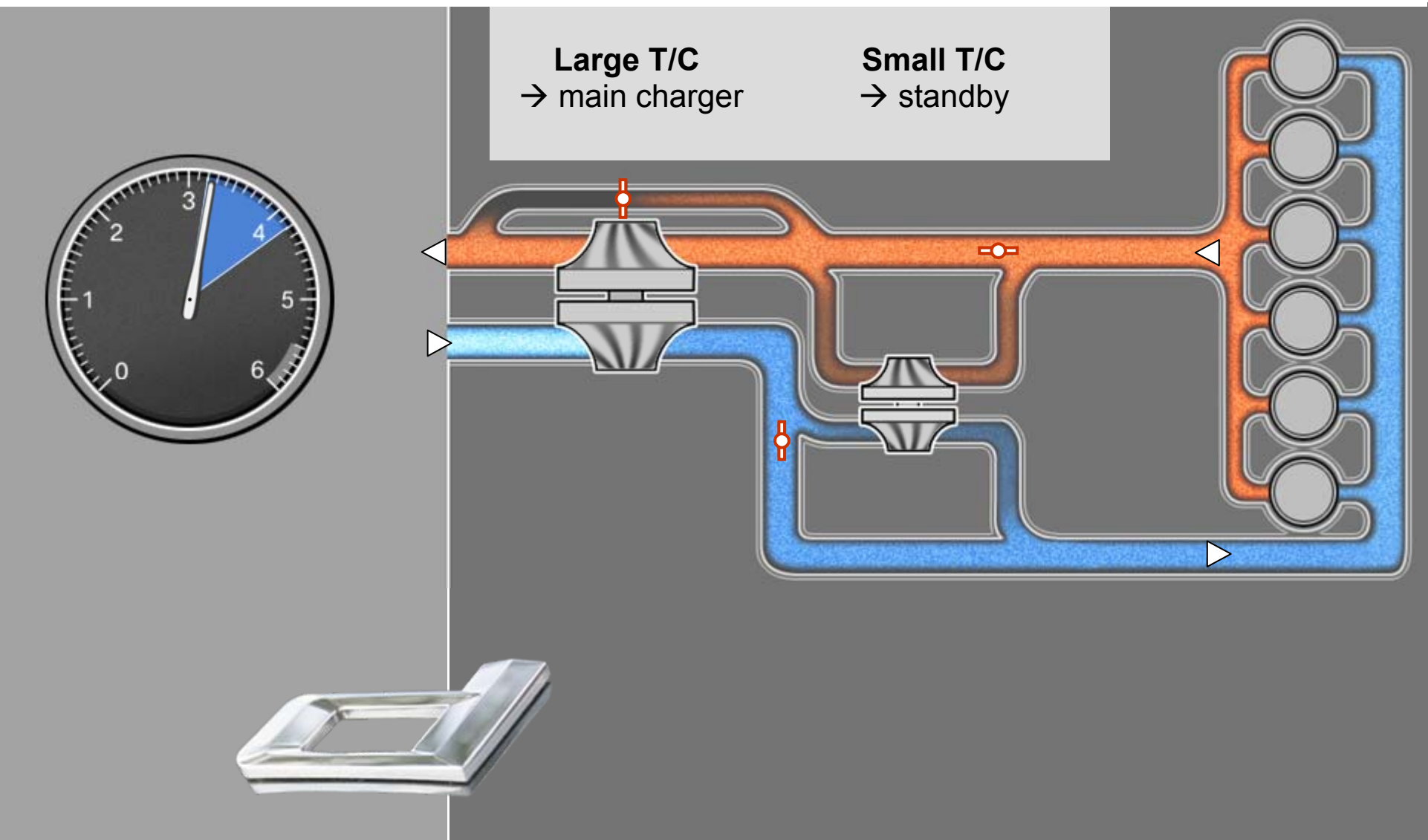
BMW Diesel.
Variable Twin Turbo.



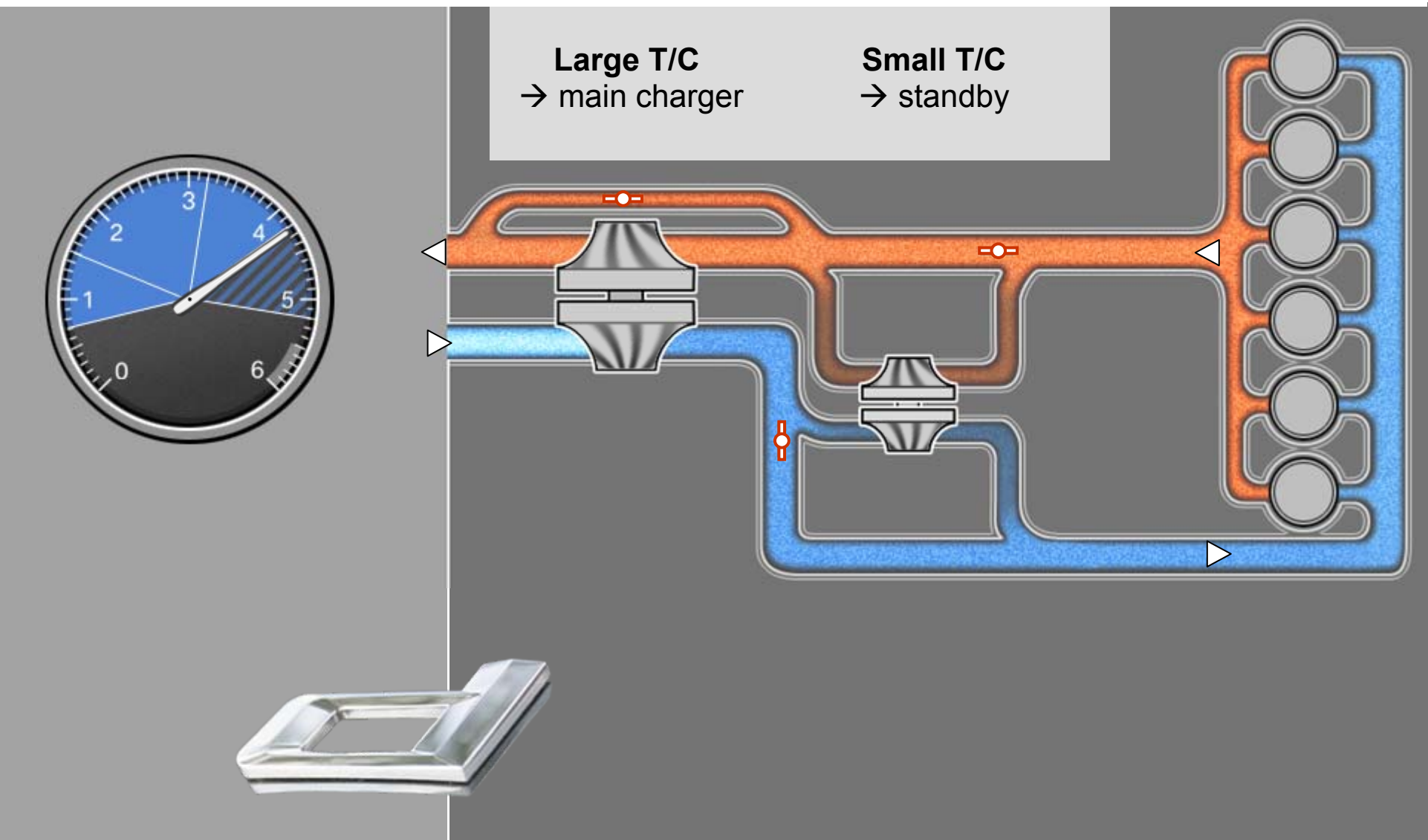
BMW Diesel.
Variable Twin Turbo.



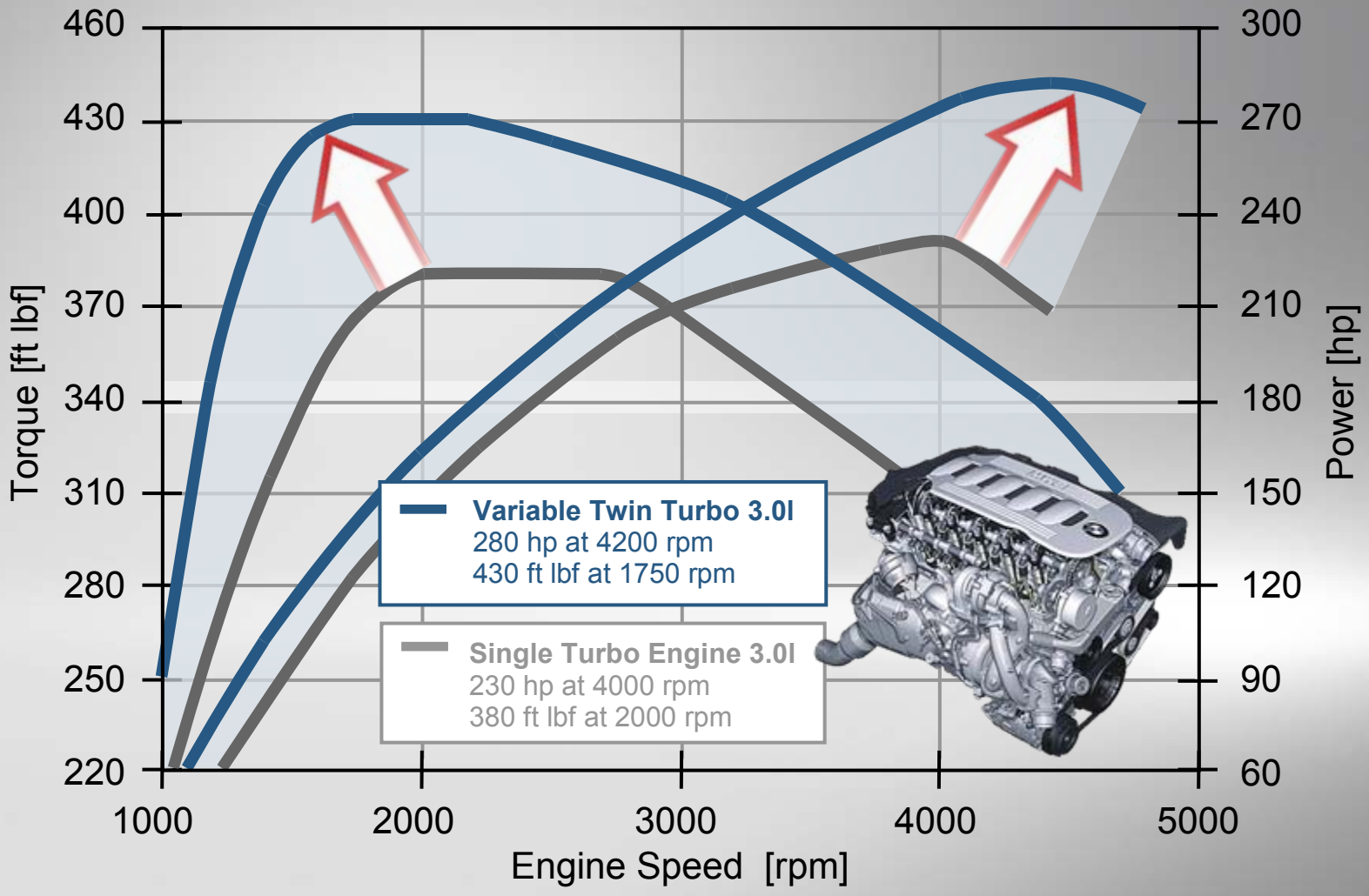
BMW Diesel.
Variable Twin Turbo.



BMW Diesel.
Variable Twin Turbo.

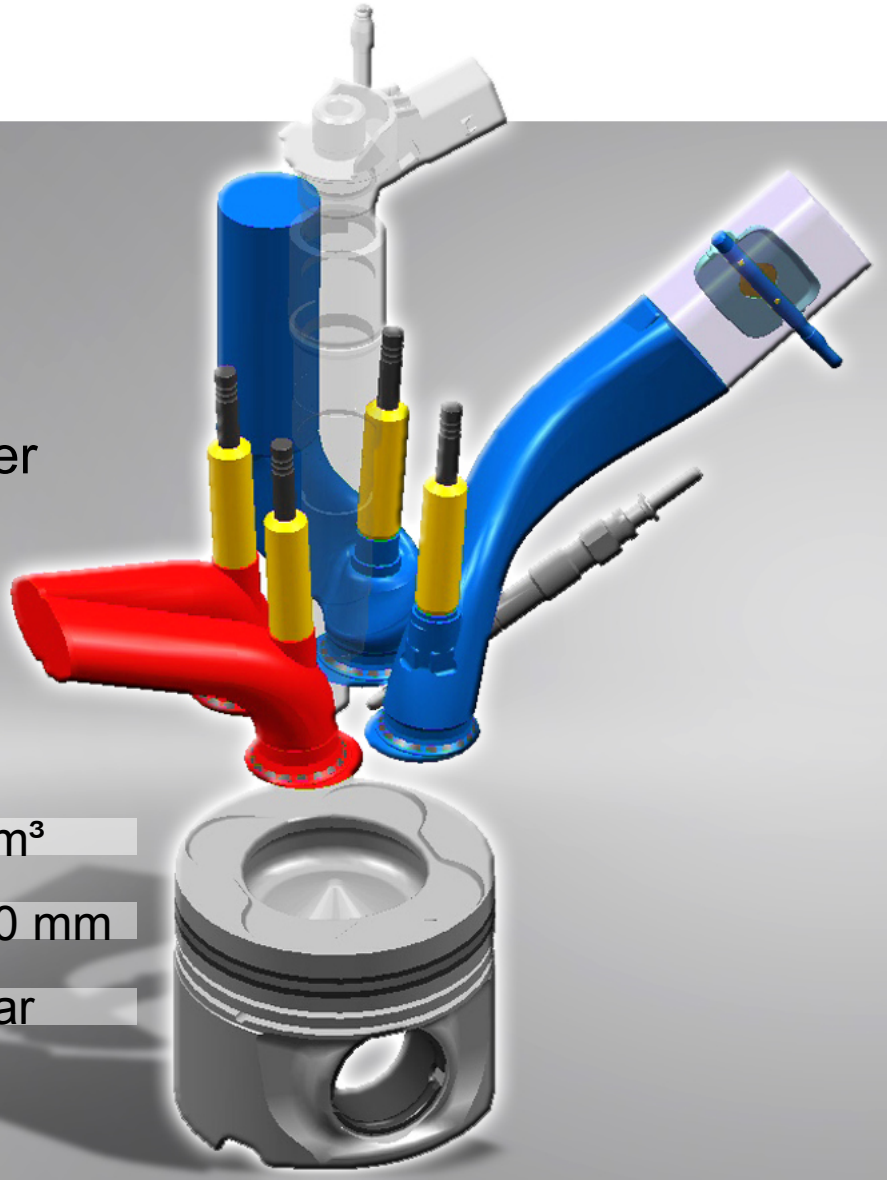


BMW Diesel.
Variable Twin Turbo.



BMW Diesel.
Combustion.

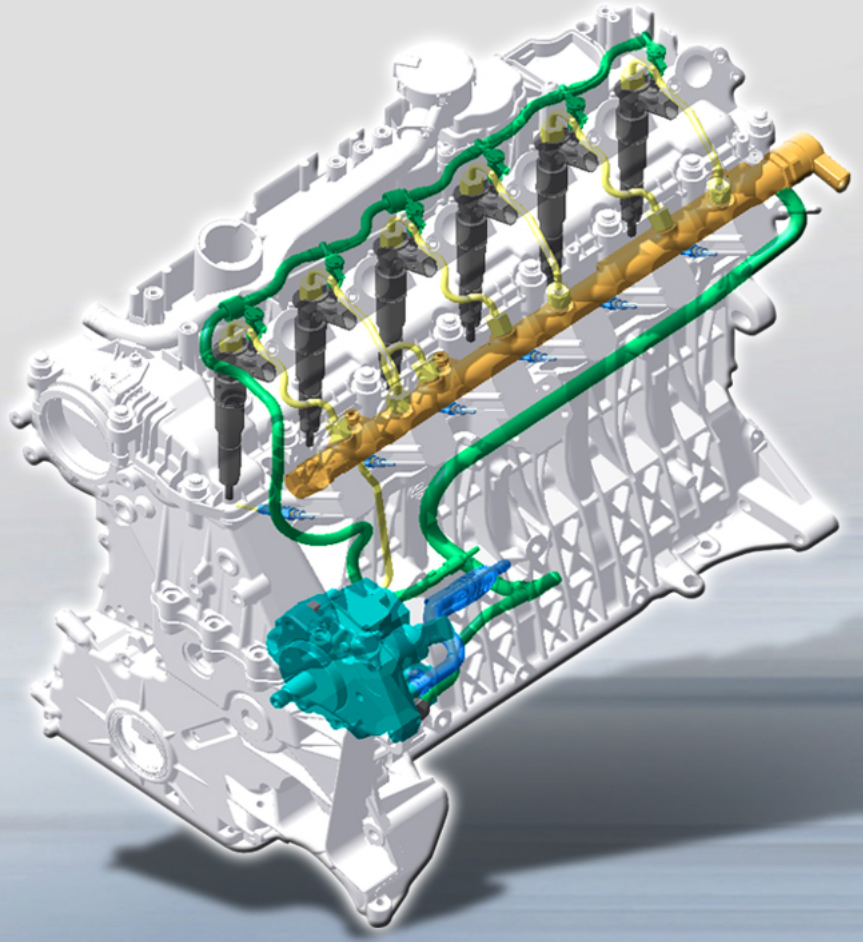
- 4 Valves per Cylinder
- Central Position of Injector
- Symetrical Combustion Chamber
- Variable Air Control

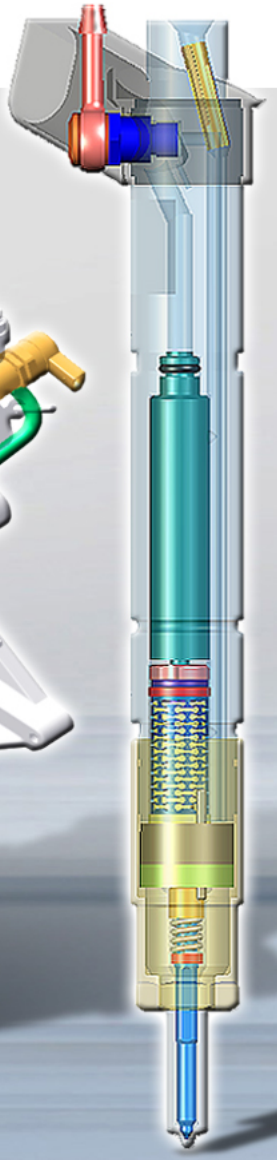


Cylinder Displacement:	499 cm³
Bore / Stroke:	84 / 90 mm
Max. Combustion Pressure:	180 bar

BMW Diesel.

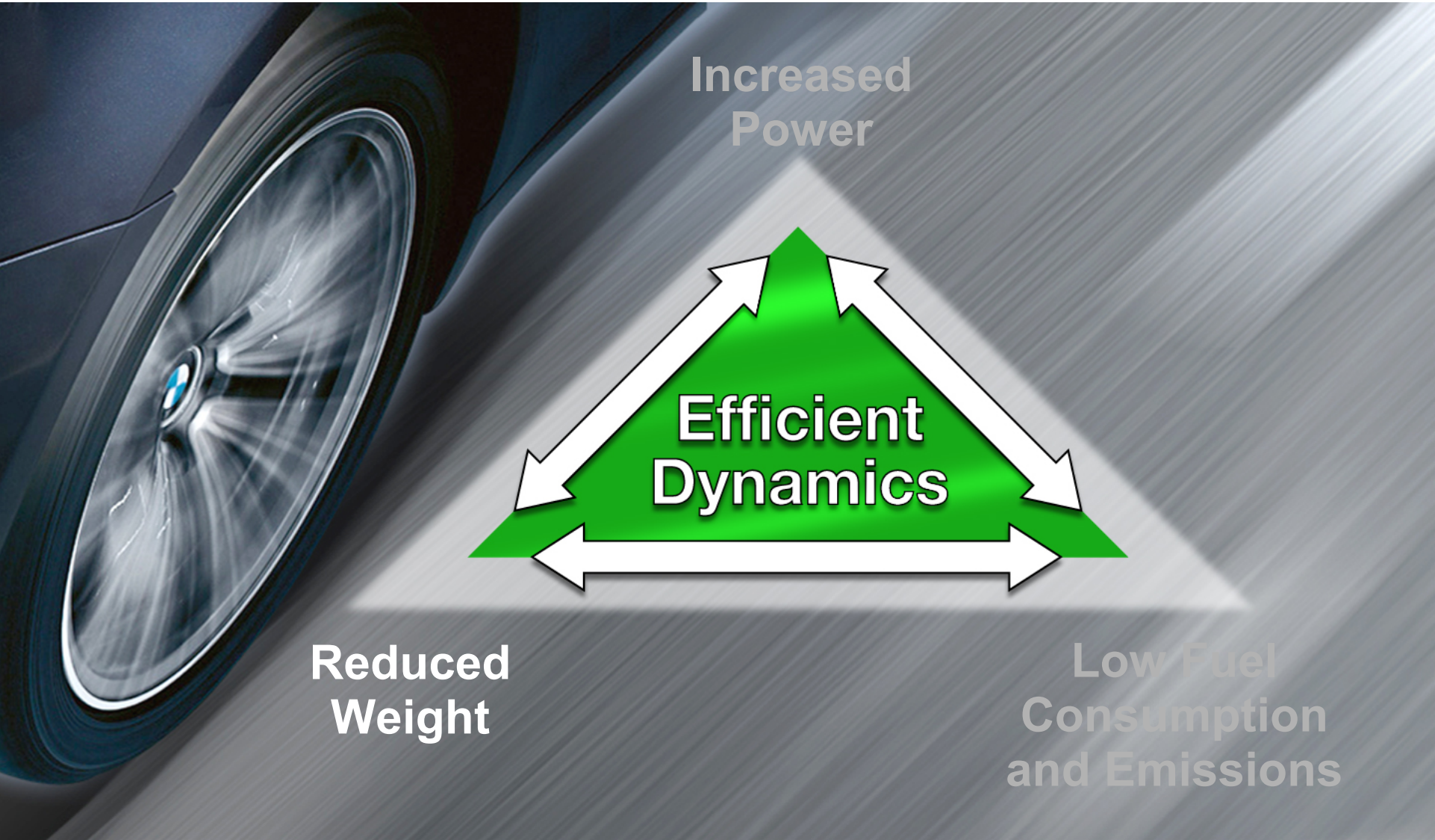
Piezo Common-Rail System.



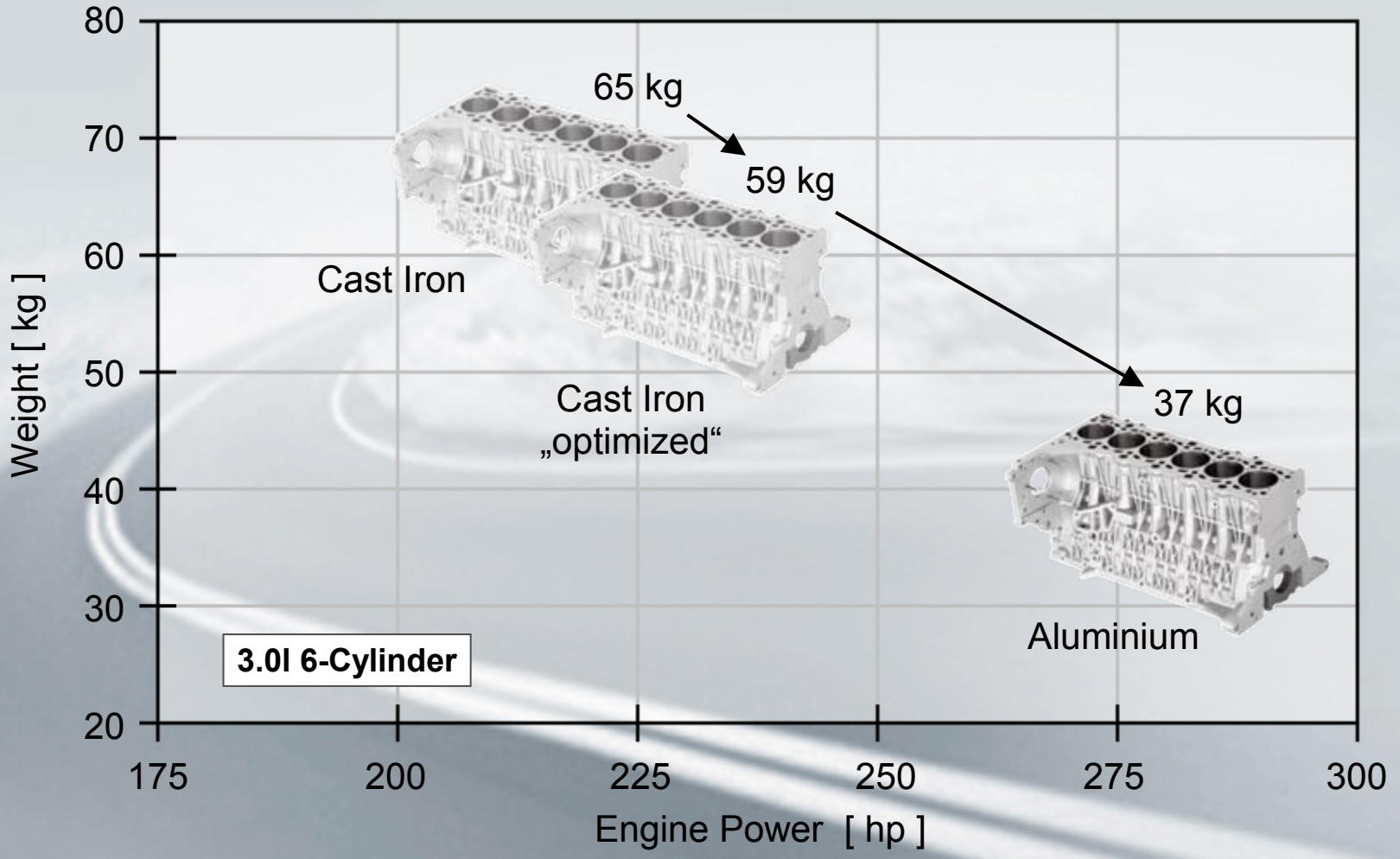


- Very quick Needle Opening and Closing for Effective Combustion
- Up to 5 Shots per Combustion Stroke
- Very low Tolerances for Injection Quantities
- Long term Learn Algorithm for Injection Control
- High Pressure Pump with Feed Volume Control

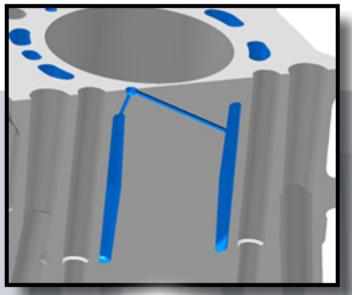
BMW Diesel.
Efficient Dynamics.



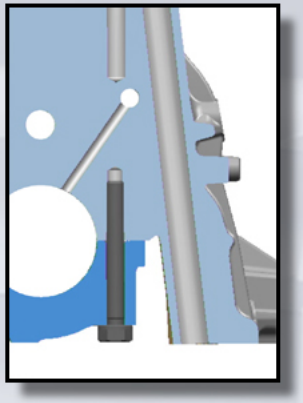
BMW Diesel.
Aluminium Crankcase.

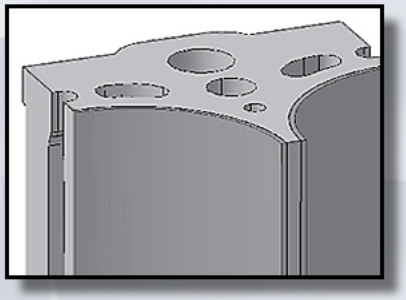


BMW Diesel.
Aluminium Crankcase.

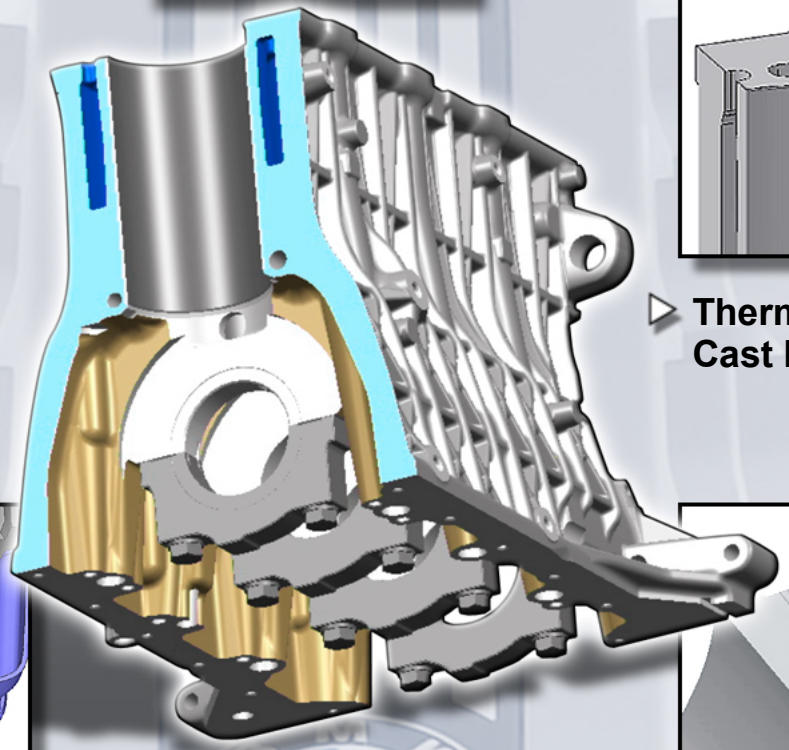


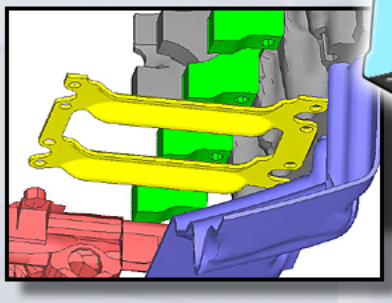
- Cooling Duct between Cylinder Walls

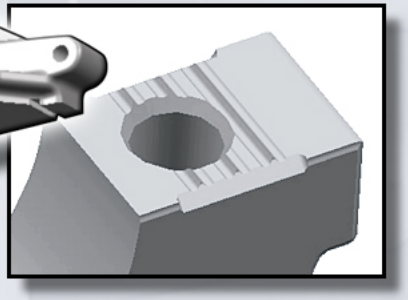




- Vertical armed „Deep Skirt“
- Formed Threads
- Deep Screw Linking
- Thermal fitted Cast Iron (GG) Liners



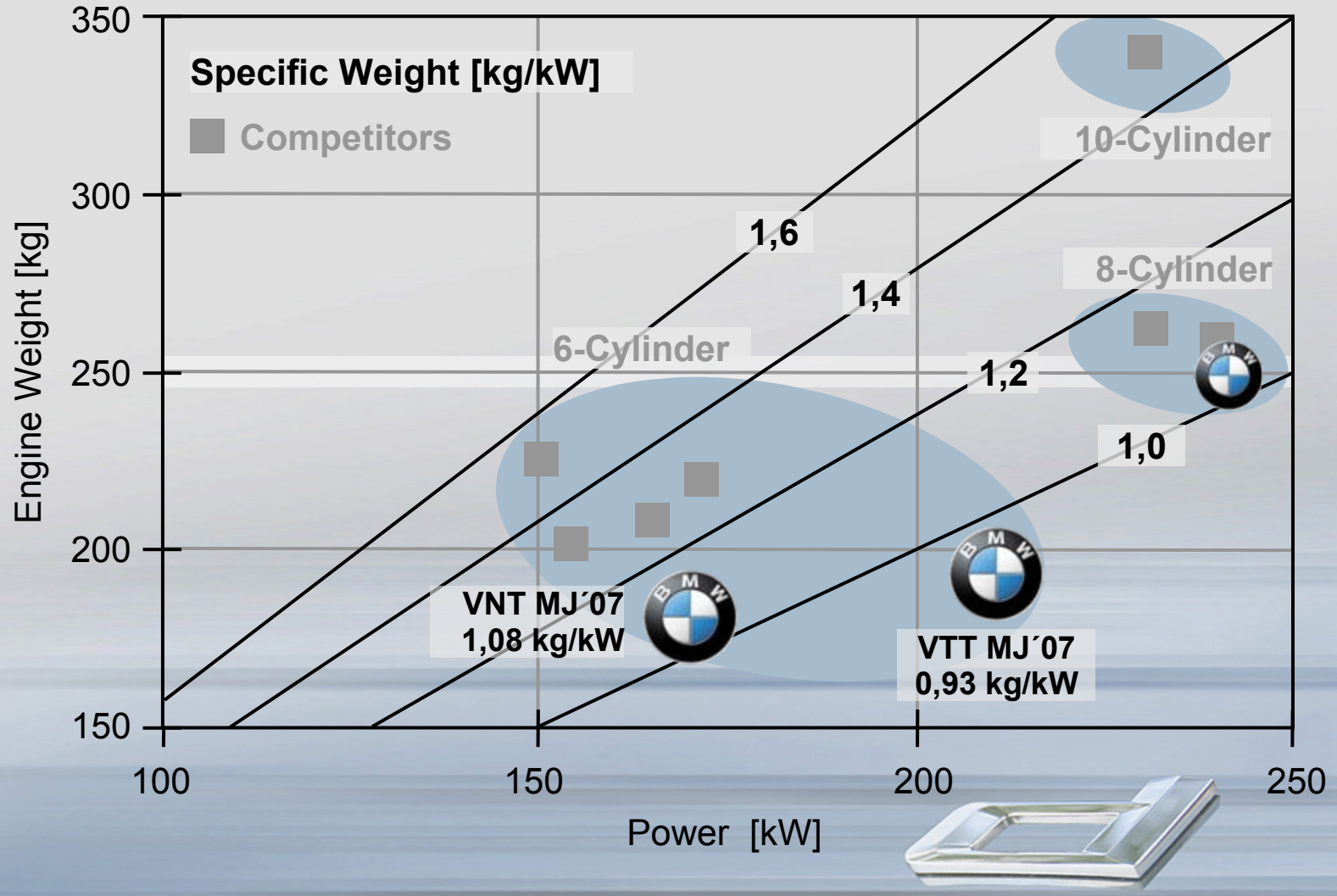




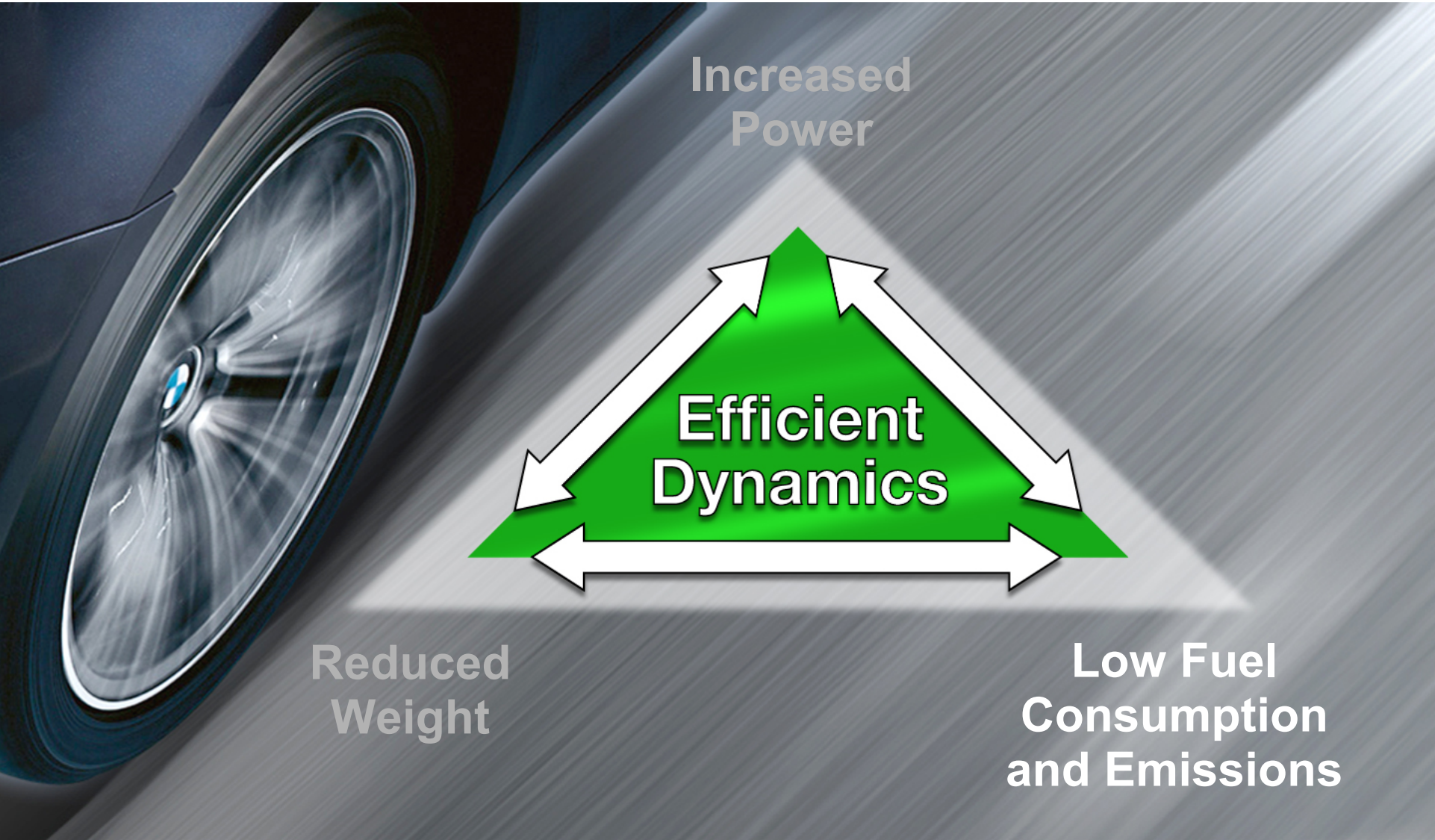
- Diagonal Crankcase Stiffening
- Embossed and shape-forced Bearing Caps („Sintermaterial“)

BMW Diesel.

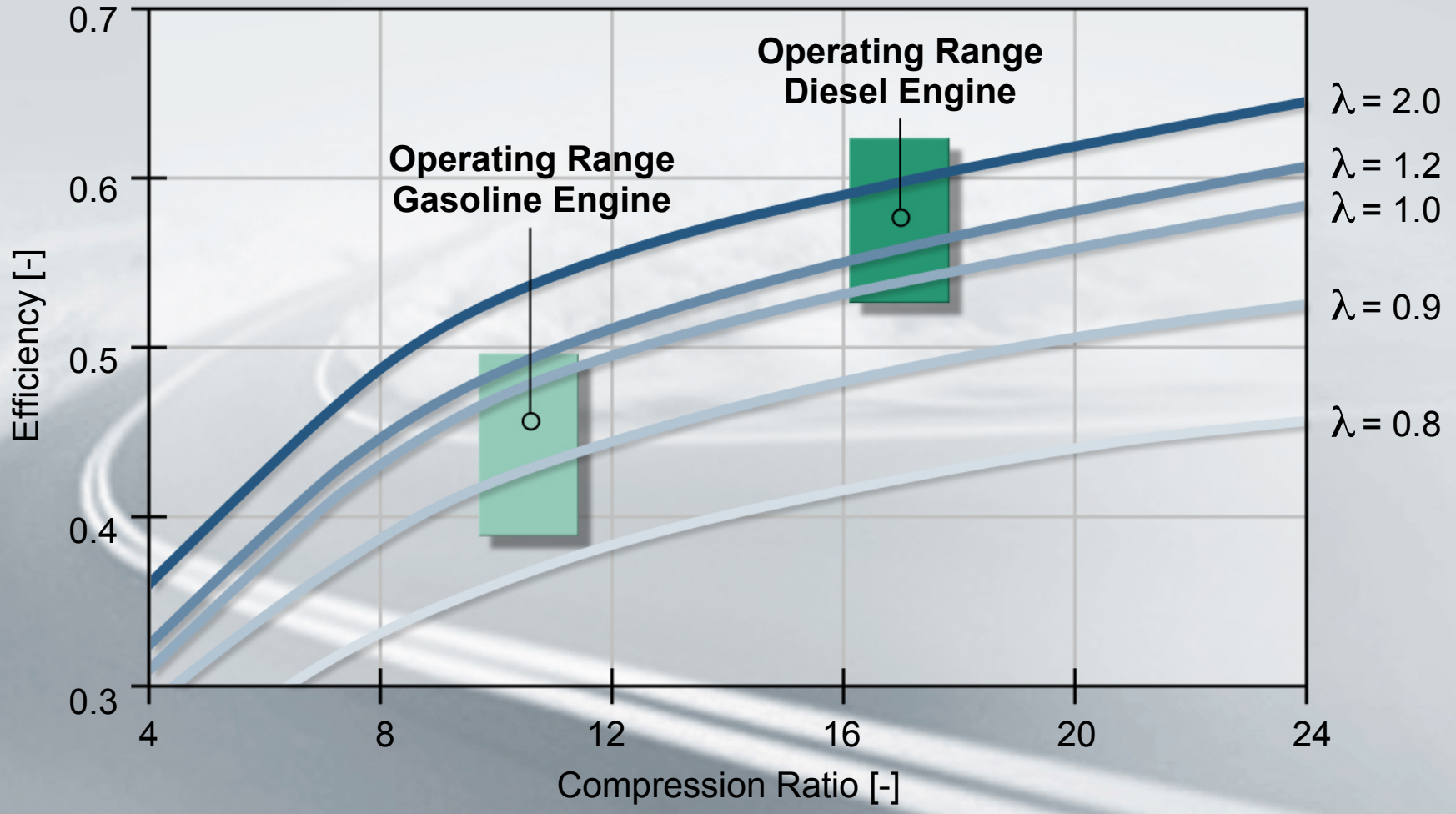
Specific Engine Weight.



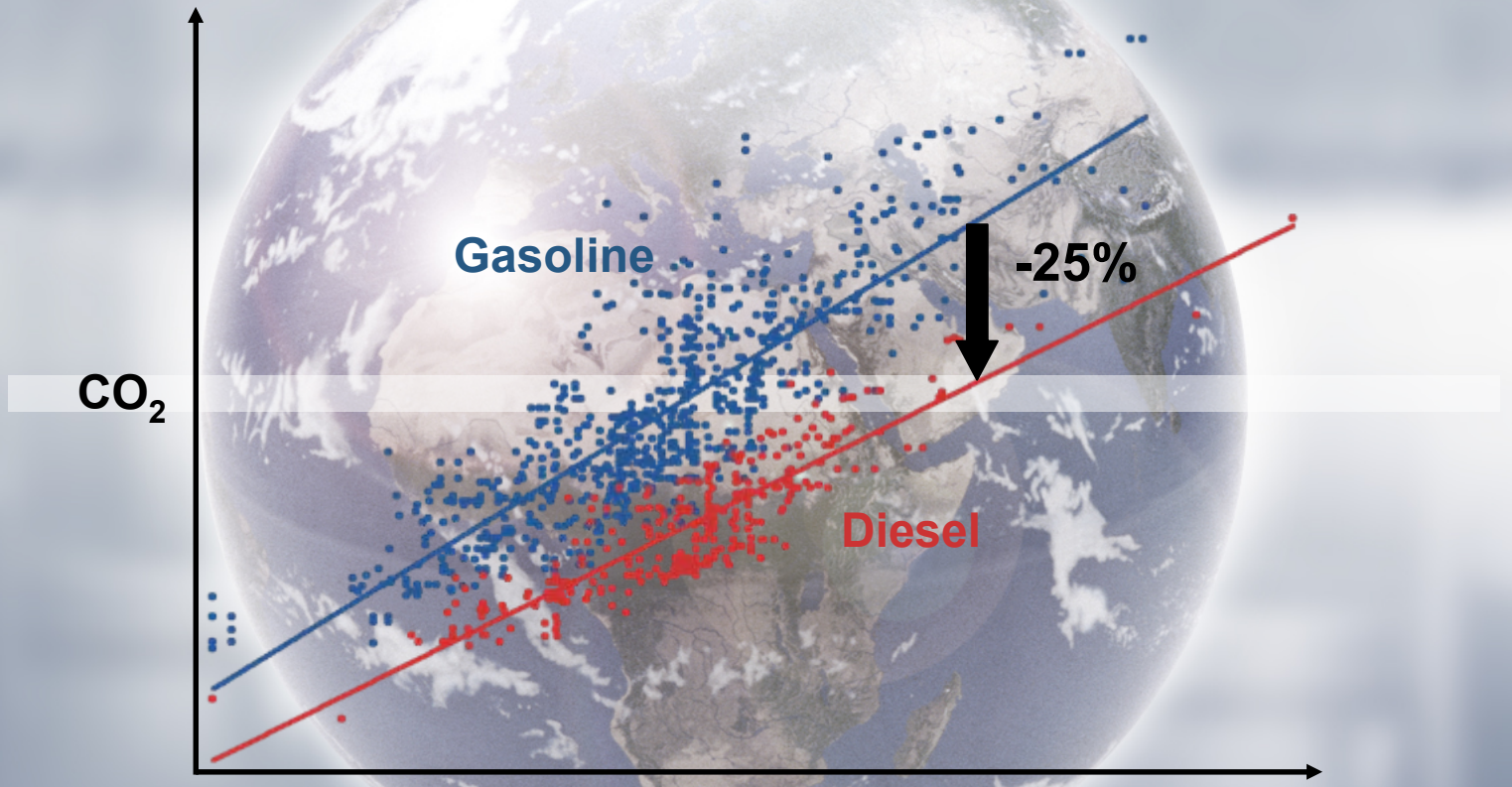
BMW Diesel.
Efficient Dynamics.



BMW Diesel.
Engine Efficiency.

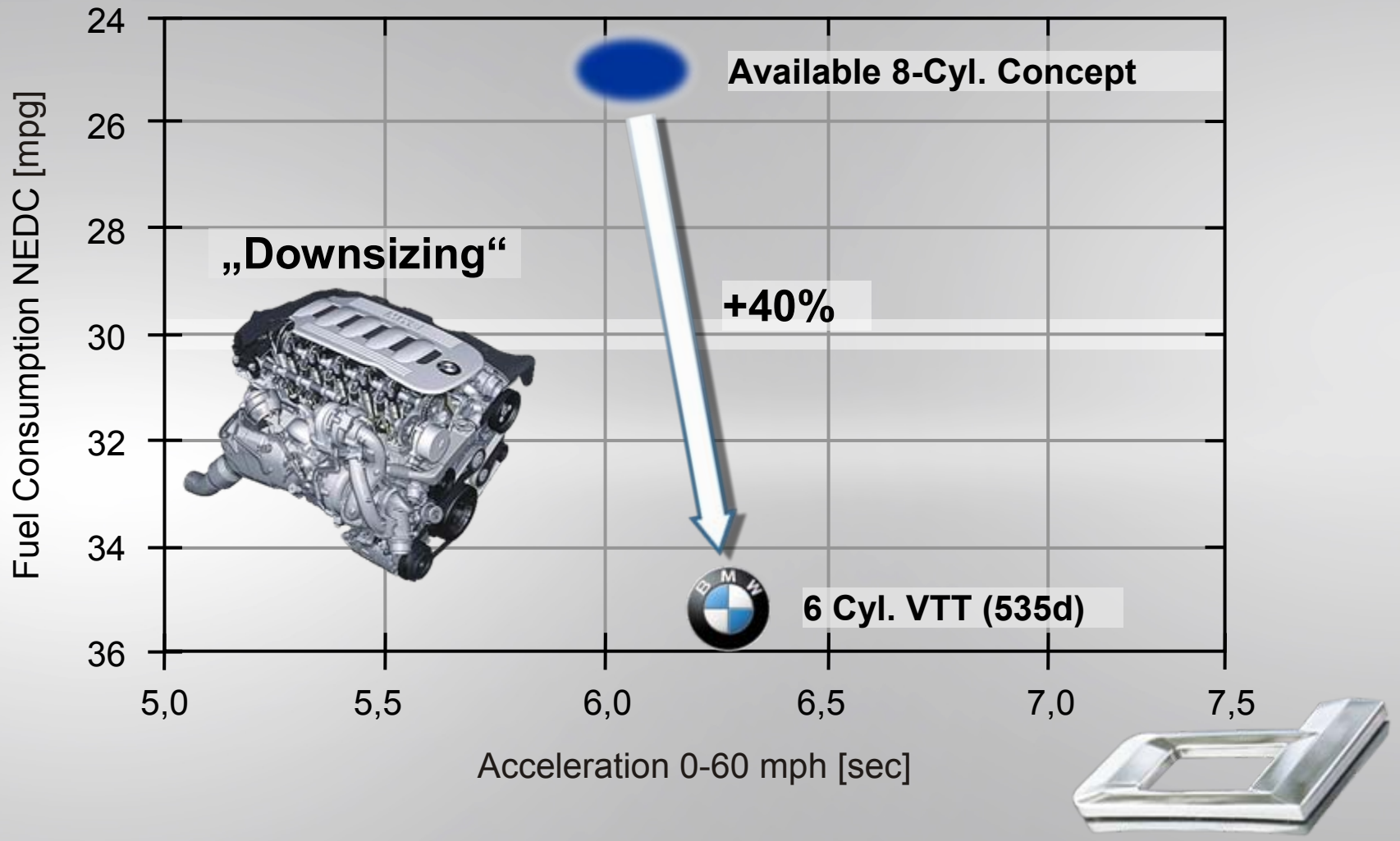


BMW Diesel.
CO_2 Emissions.



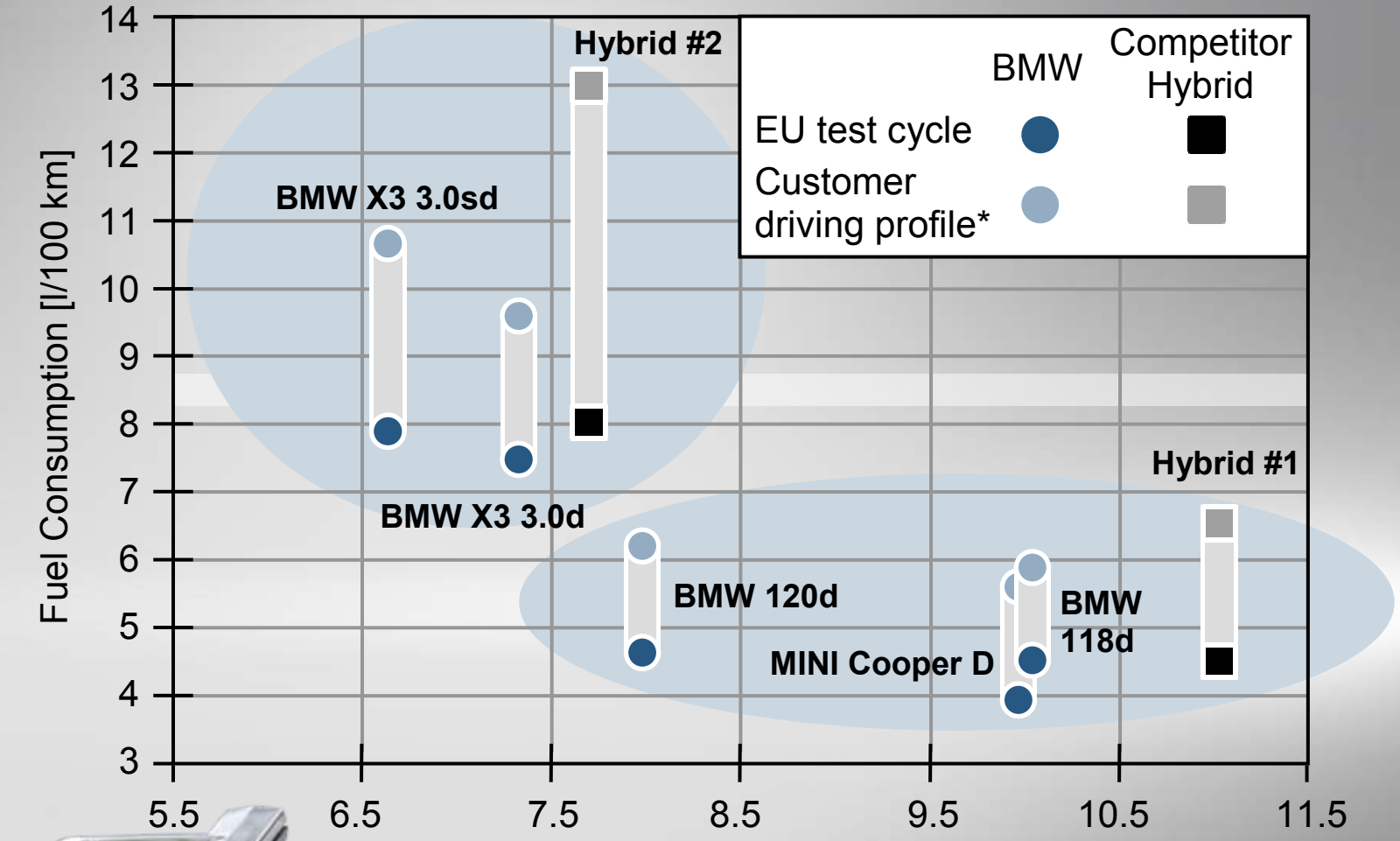
Source: VDA

BMW Diesel.
Fuel Consumption.



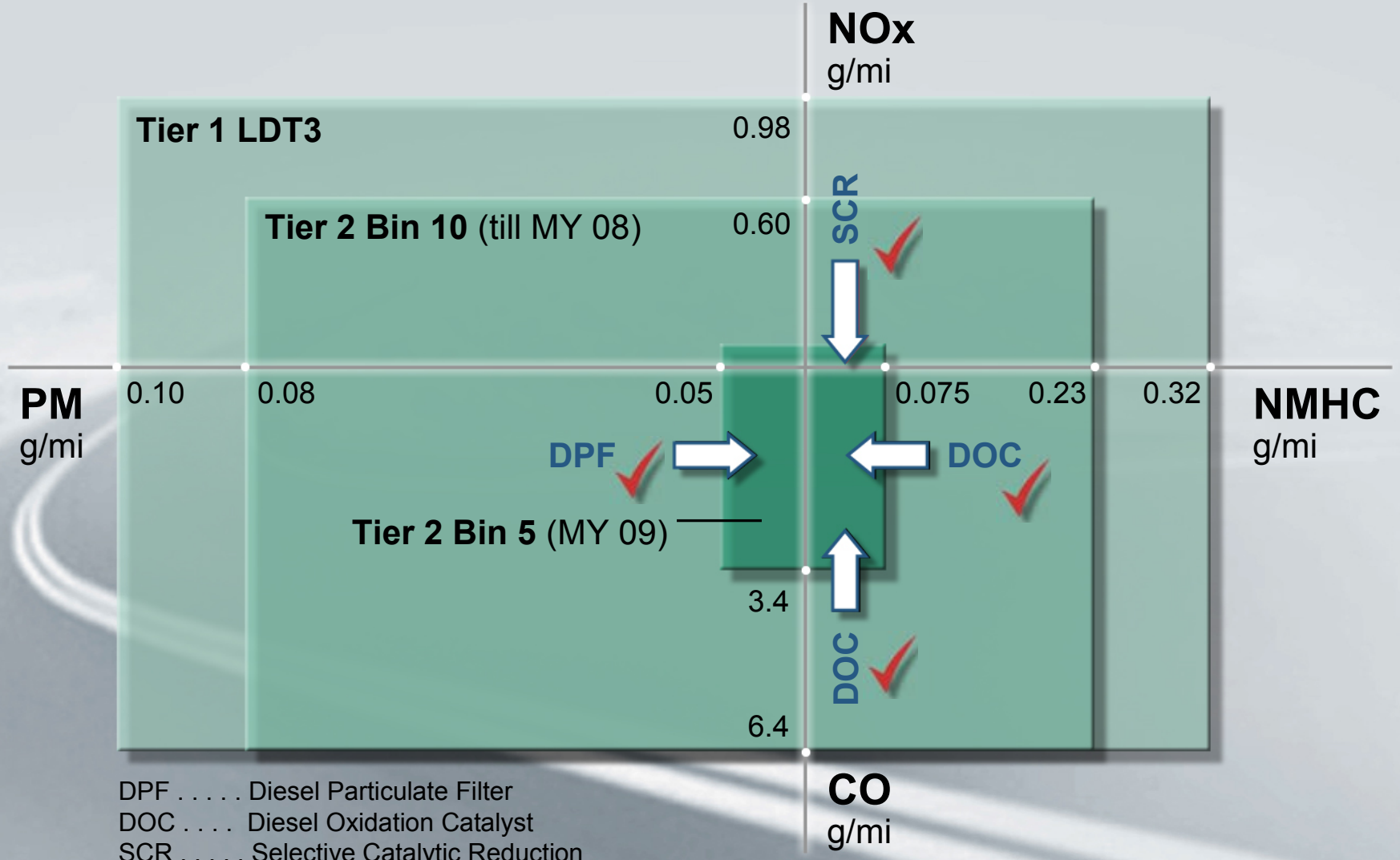
BMW Diesel.

Exceeding even today‘s Hybrid Concepts.



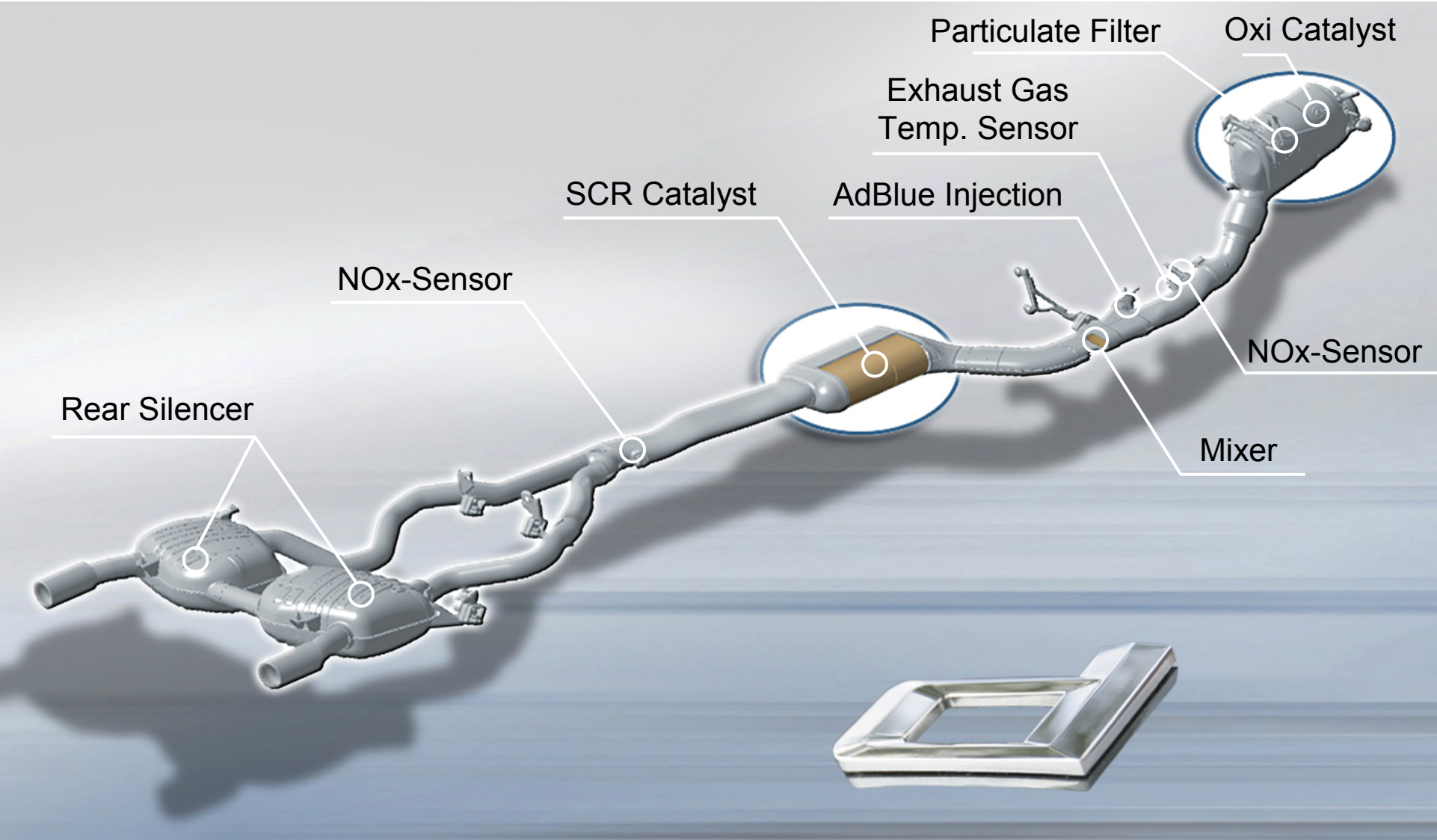
* Source: An increasing number of press test reports

BMW Diesel.
Emissions.



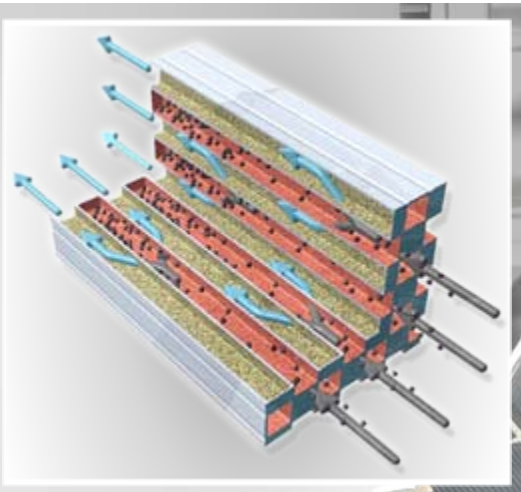
BMW Diesel.

Exhaust System Bin 5.



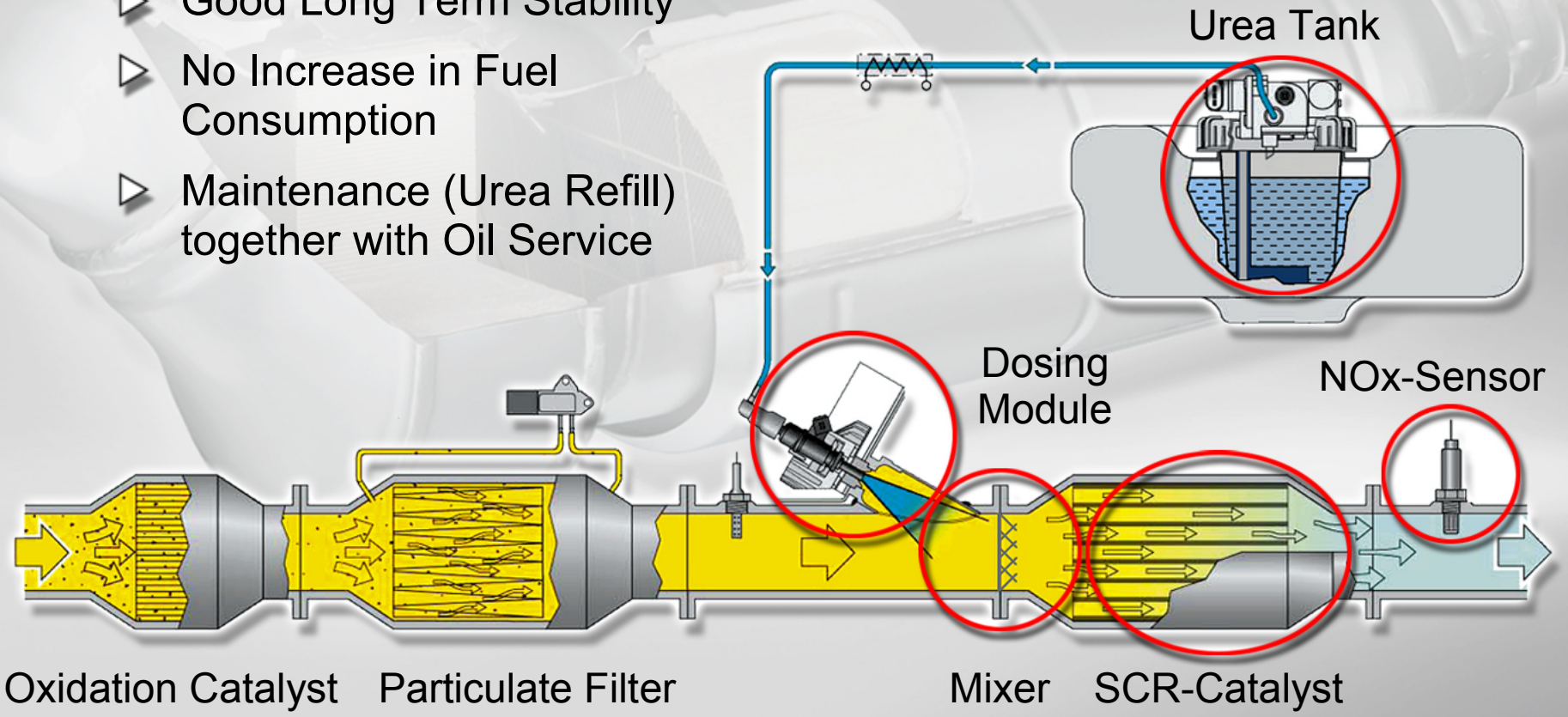
BMW Diesel.
Particulate Filter.

- Particulates are being filtered and frequently burned
- Permanent Reduction of Particulates
- Additional positive Effect on HC-/CO-Emissions
- No Loss in Engine Power
- No Increase in Fuel Consumption
- No Maintenance necessary



BMW Diesel.
SCR System.

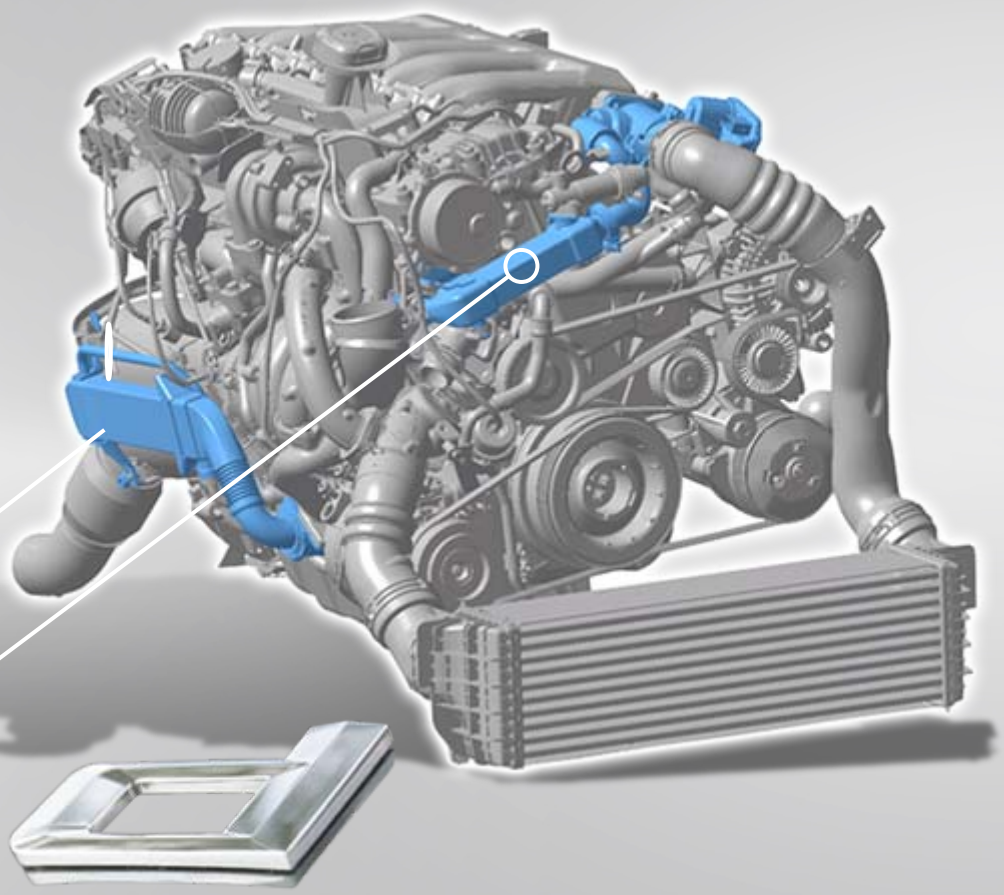
- High Efficiency
- Good Long Term Stability
- No Increase in Fuel Consumption
- Maintenance (Urea Refill) together with Oil Service



Source: Bosch

BMW Diesel.
EGR System.

- Further NOx Reduction 30%
- Reduced Charge Air Temperature
- Higher Boost Pressure and better Turbocharger Efficiency
- Improved Fuel Economy



EGR…Exhaust Gas Recirculation System

BMW Diesel.
US Market Introduction.

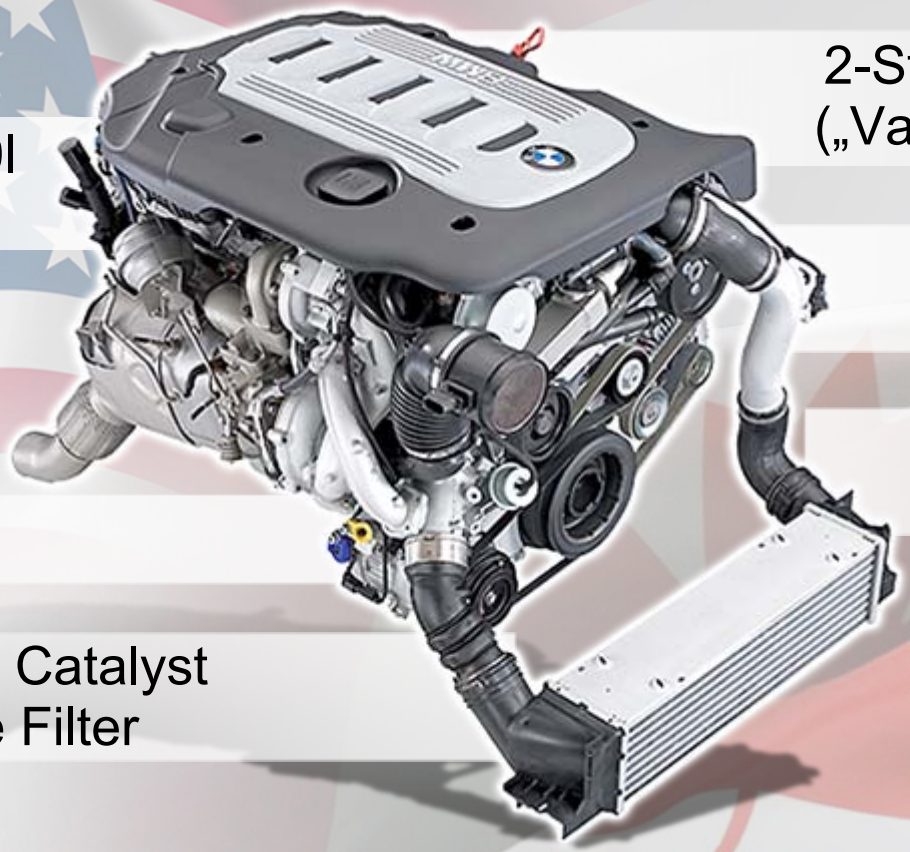
X5 xDrive 35d

- 265 hp, 425 ft lbf
- Emission Standard LEVII / Bin5
- 0-60 mph = 6,9 s
- Fuel Efficiency (Test Figures)
  City ≥ 25 mpg
  Hwy ≥ 36 mpg
  USC ≥ 29 mpg

335d

- 265 hp, 425 ft lbf
- Emission Standard LEVII / Bin5
- 0-60 mph = 6,0 s
- Fuel Efficiency (Test Figures)
  City ≥ 30 mpg
  Hwy ≥ 48 mpg
  USC ≥ 36 mpg

BMW Diesel.
US Market Introduction.



6 Cyl. Inline 3.0l
Diesel Engine

2-Stage-Turbo-System
(„Variable Twin Turbo“)

Piezo Common
Rail System

Aluminium
Crankcase

SCR System

Close Coupled Catalyst
and Particulate Filter

BMW Diesel.
Future Trends.

- Increased specific Power and Torque (>100 hp/dm^3)
  - 2-stage Turbocharging: NG Variable Twin Turbo – Technology
  - Common-Rail Injection System: Pressure >2000 bar
  - Improved Combustion
- Further improved Fuel Consumption (>15%)
  - Reduced Engine Friction
  - Optimized Combustion
  - Downsizing
  - Advanced Energy Management: „Hybrid Functions“
  - Optimized Powertrain: Transmission
- Reduced Engine Weight (>5 %)
  - Downsizing
  - Compact Design with high Intergration Level
  - Light Weight Materials

BMW Diesel.
Summary.

- Evolution of Diesel Performance is impressive
- Good Reasons for a high Diesel Motivation exist
- “Efficient Dynamics”-Philosophy is fundamental for all our Engine Concepts
- BMW´s US Market Introduction starts with X5 xDrive 35d and 335d, both featuring a 6 Cyl. 3.0l Variable Twin Turbo Engine
- Modern Diesel Technology can contribute a lot to guarantee Future Mobility
- Medium- and long-term Potentials to further increase Power and in parallel reduce Emissions und Fuel Consumption exist

BMW Diesel.

Thank you for your Attention.