

BMW EfficientDynamics.

# BMW EfficientDynamics.

Less CO<sub>2</sub> | More driving pleasure | Simultaneously

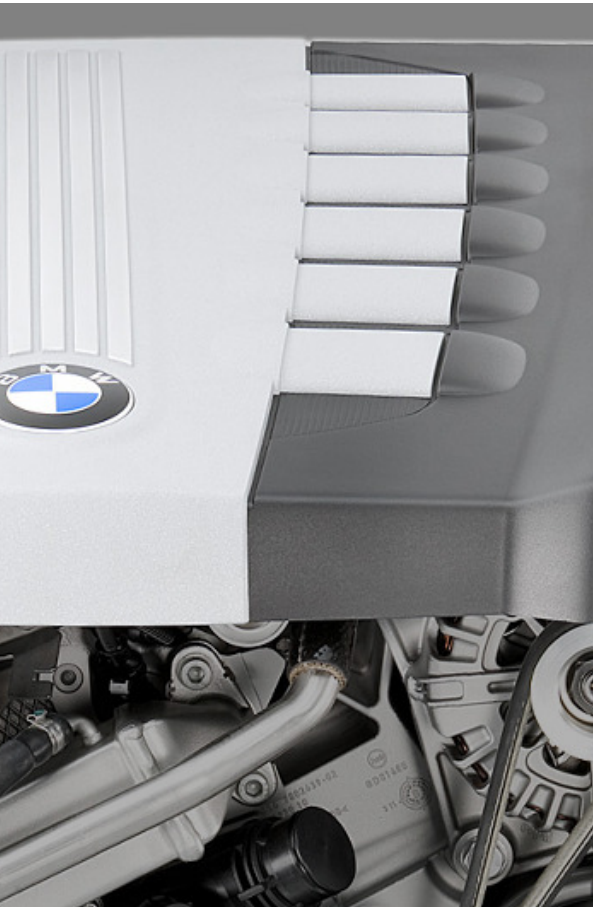


Munich, June 22<sup>nd</sup> - 24<sup>th</sup>, 2009.

BMW Group



# Powertrain innovations Update.



Munich, June 22<sup>nd</sup> - 24<sup>th</sup>, 2009.

Wolfgang Nehse,  
BMW Group  
Powertrain Development.



# various areas of application.



Improved  
engine &  
transmission  
efficiency



Intelligent  
management  
of energy flow;  
hybrid; electric



Intelligent light  
weight design



Aerodynamics,  
reduced friction

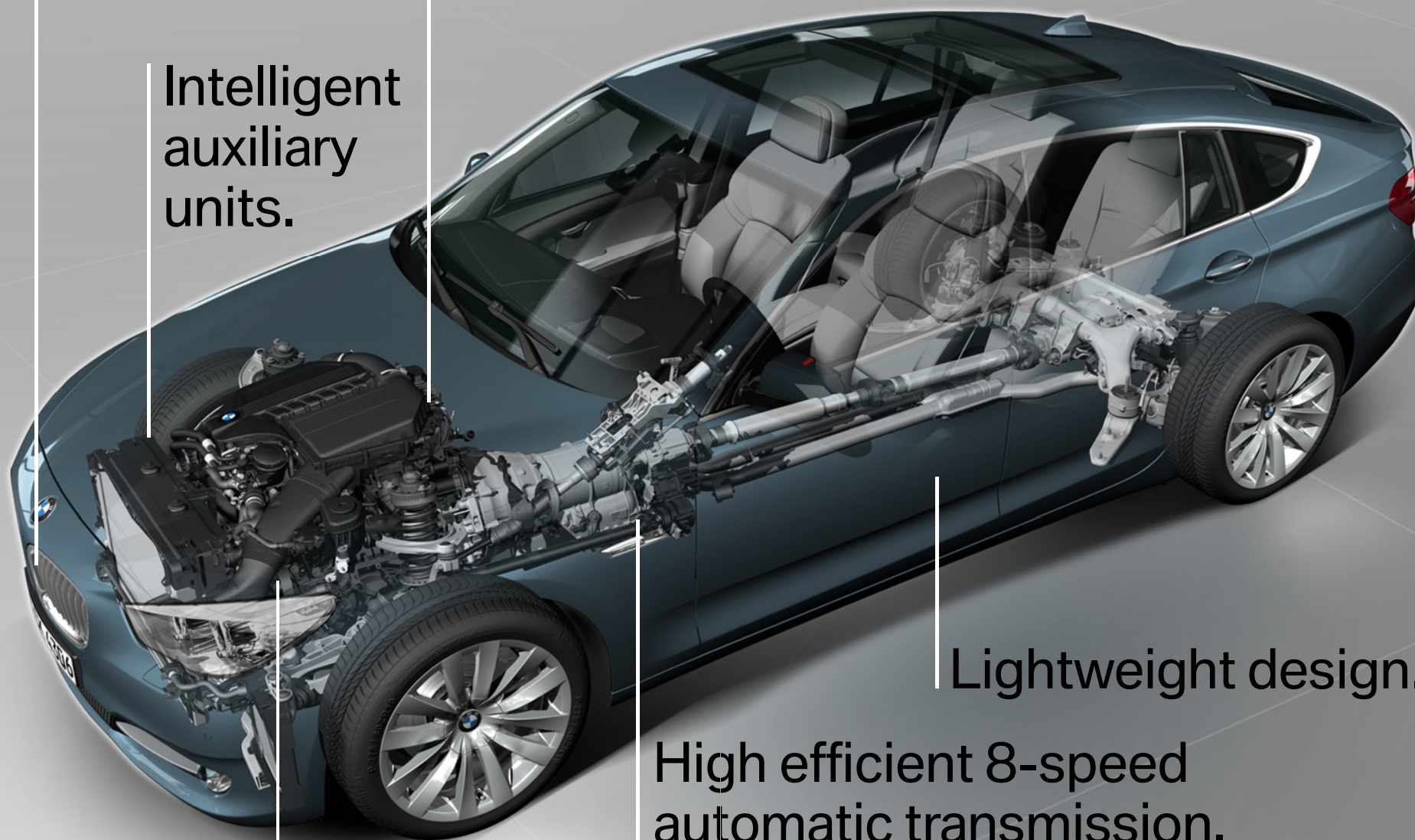
Hydro

# First to be seen in the BMW 3 Series Gran Turismo

Active  
aerodynamics.

6 cylinder gasoline engine with  
TwinPower Turbo and VALVETRONIC.

Intelligent  
auxiliary  
units.

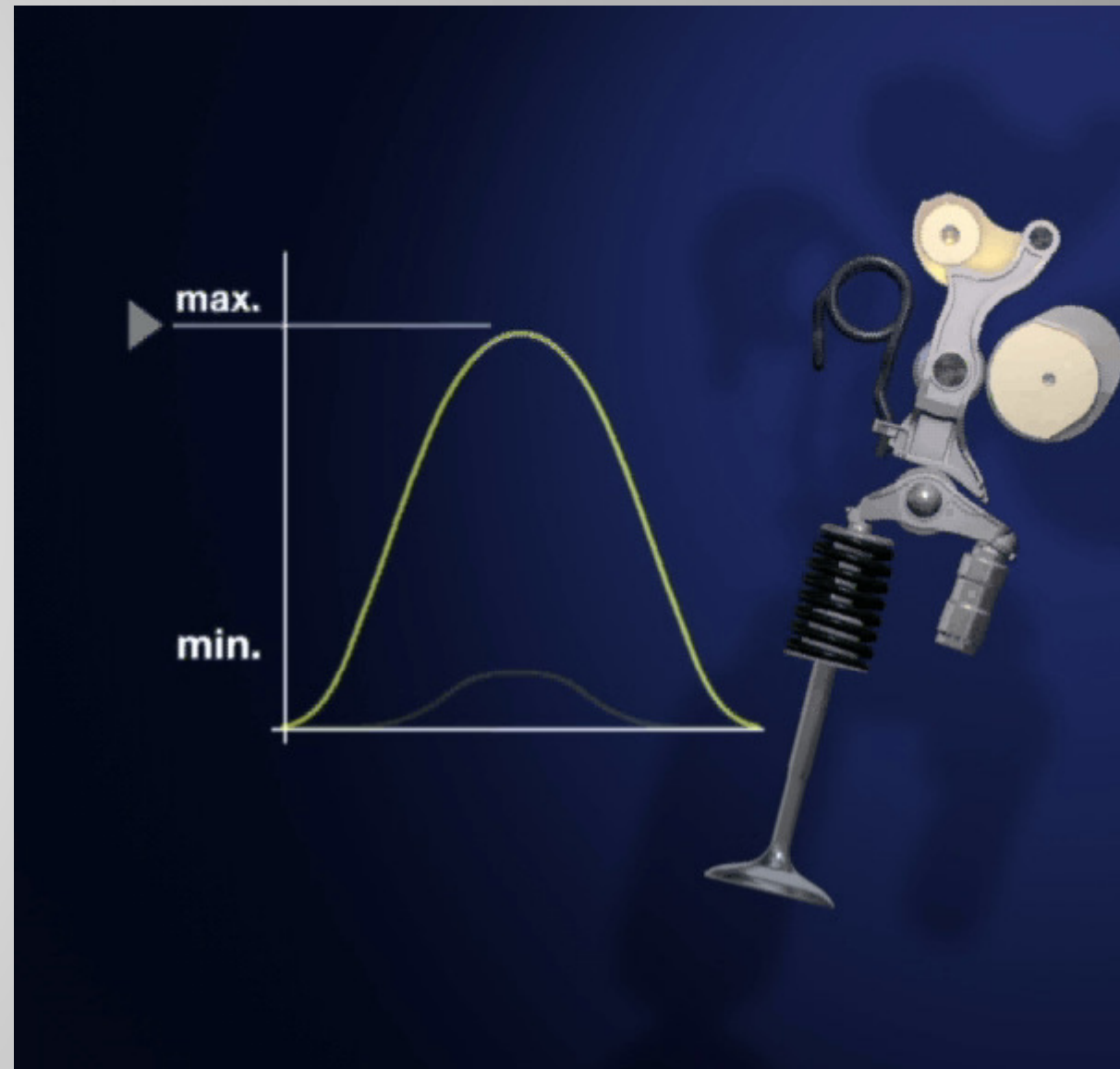
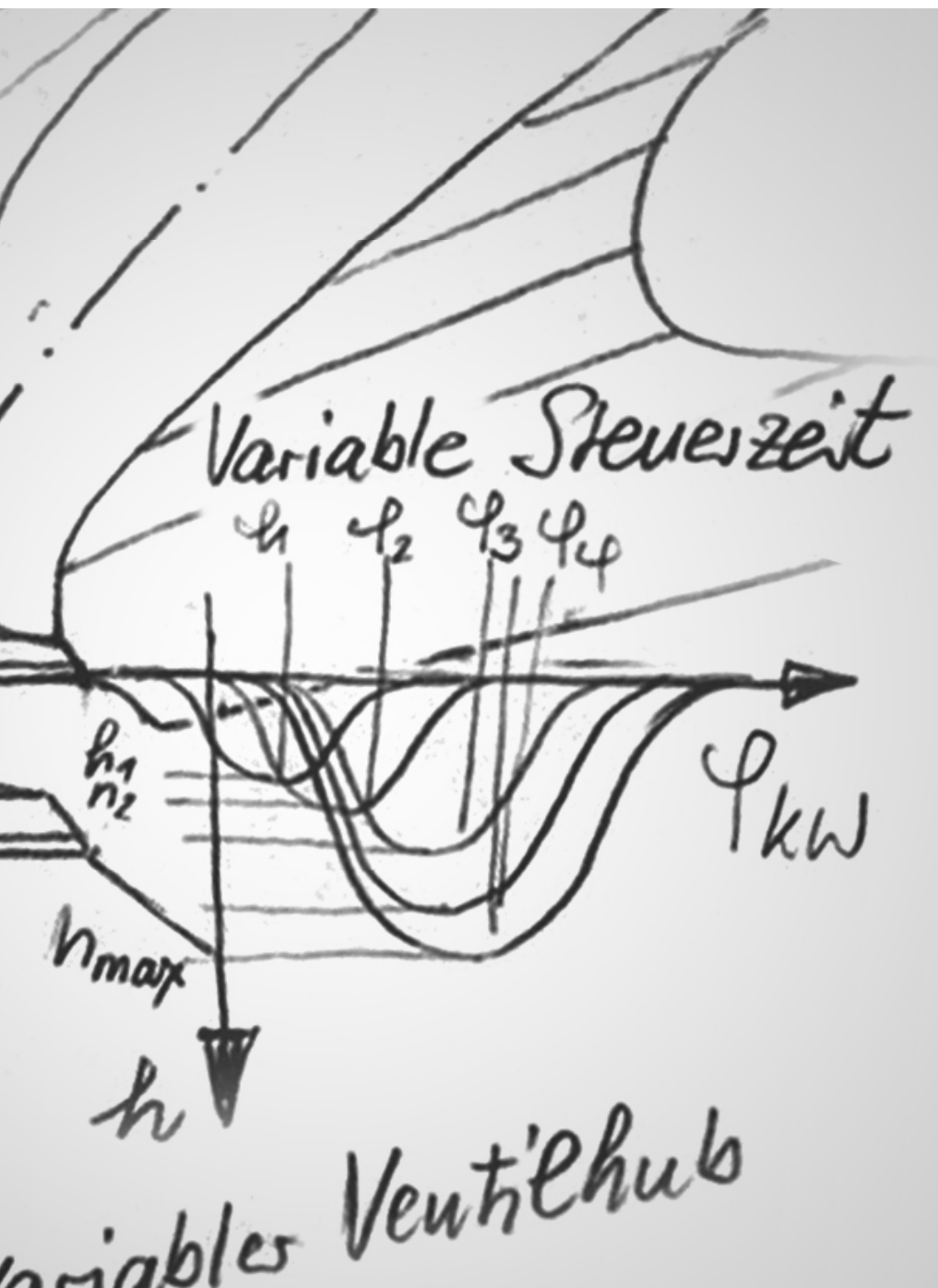


Lightweight design.

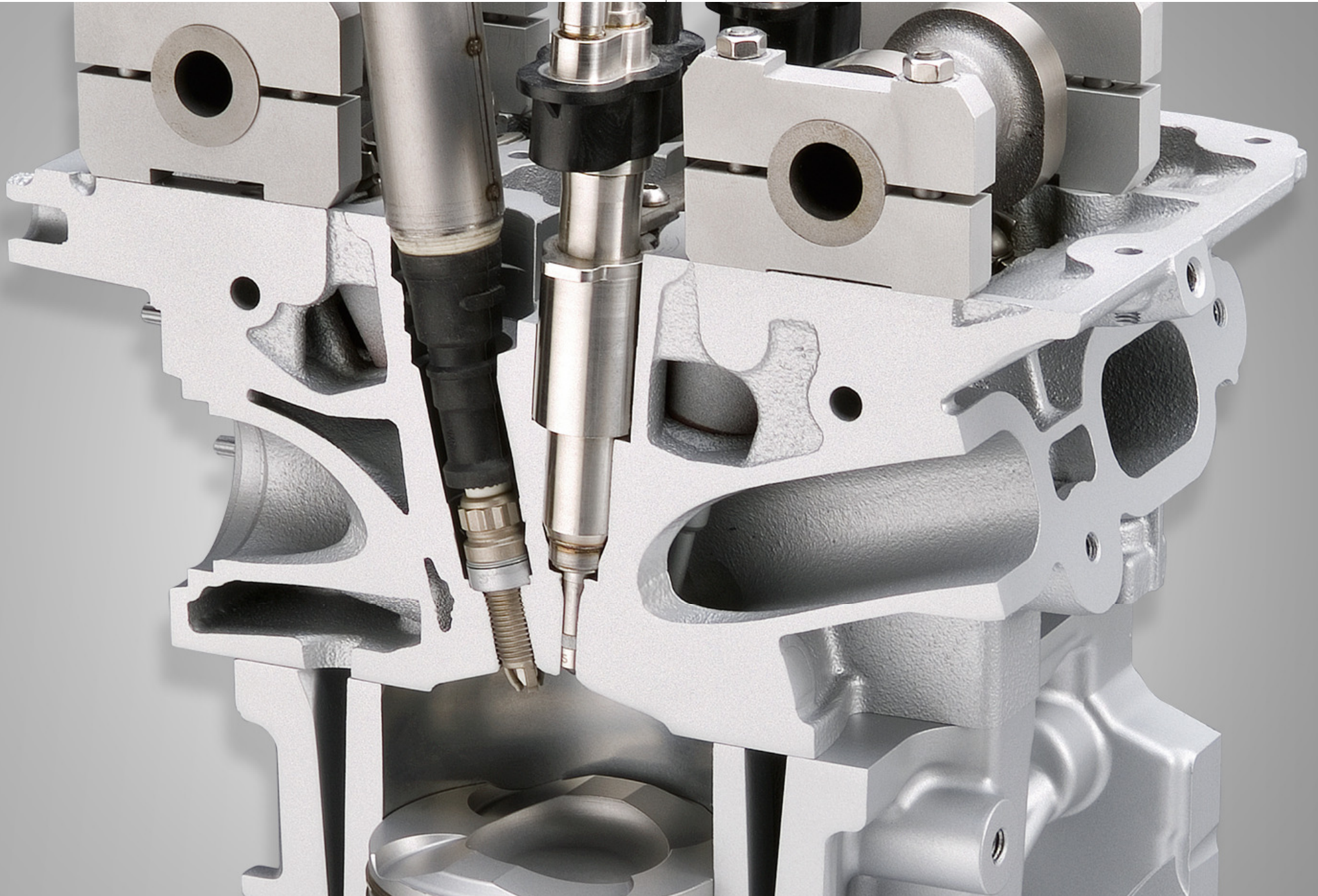
High efficient 8-speed  
automatic transmission.



# 2001. VALVETRONIC.

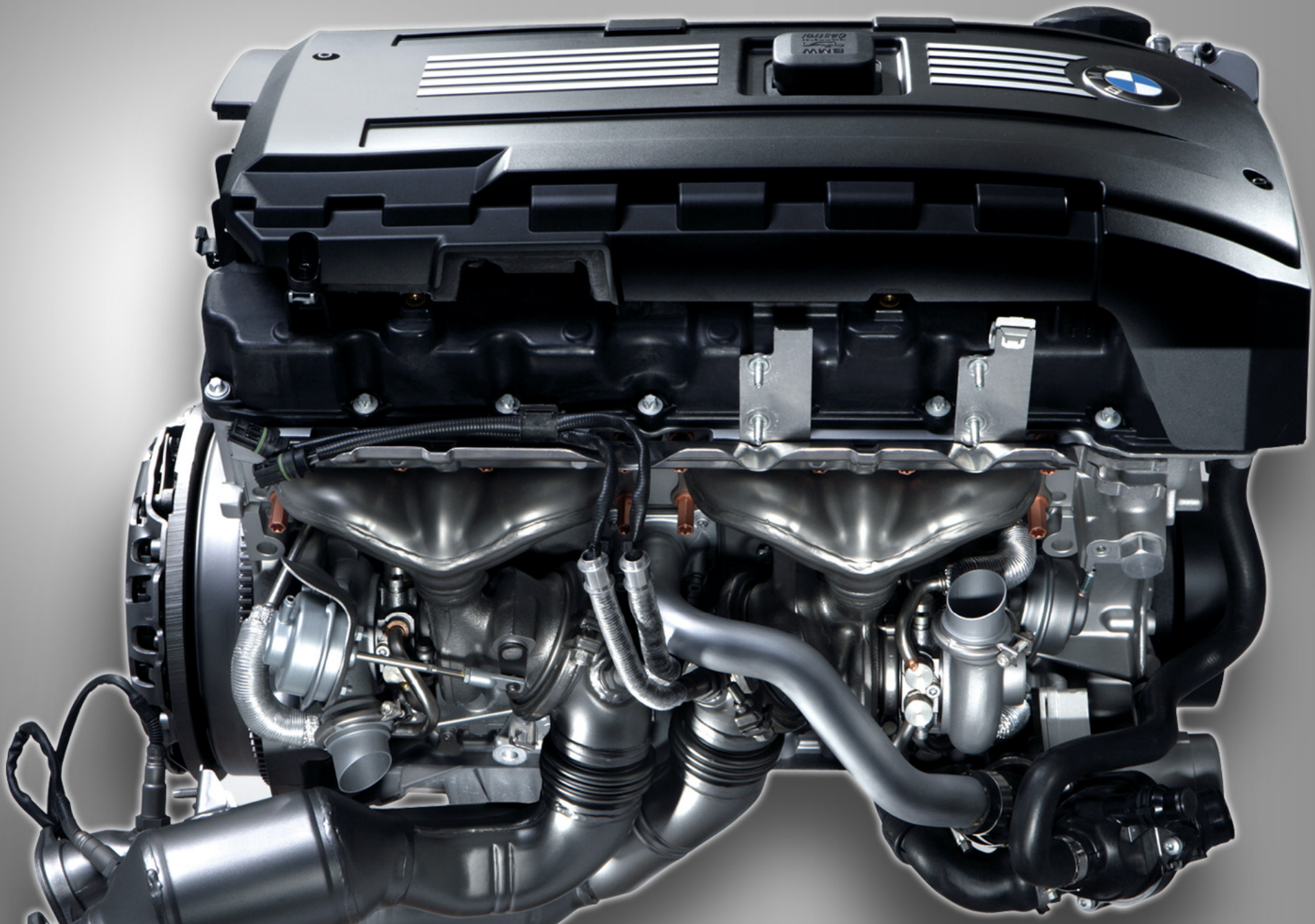


# 2000. High Precision Injection.



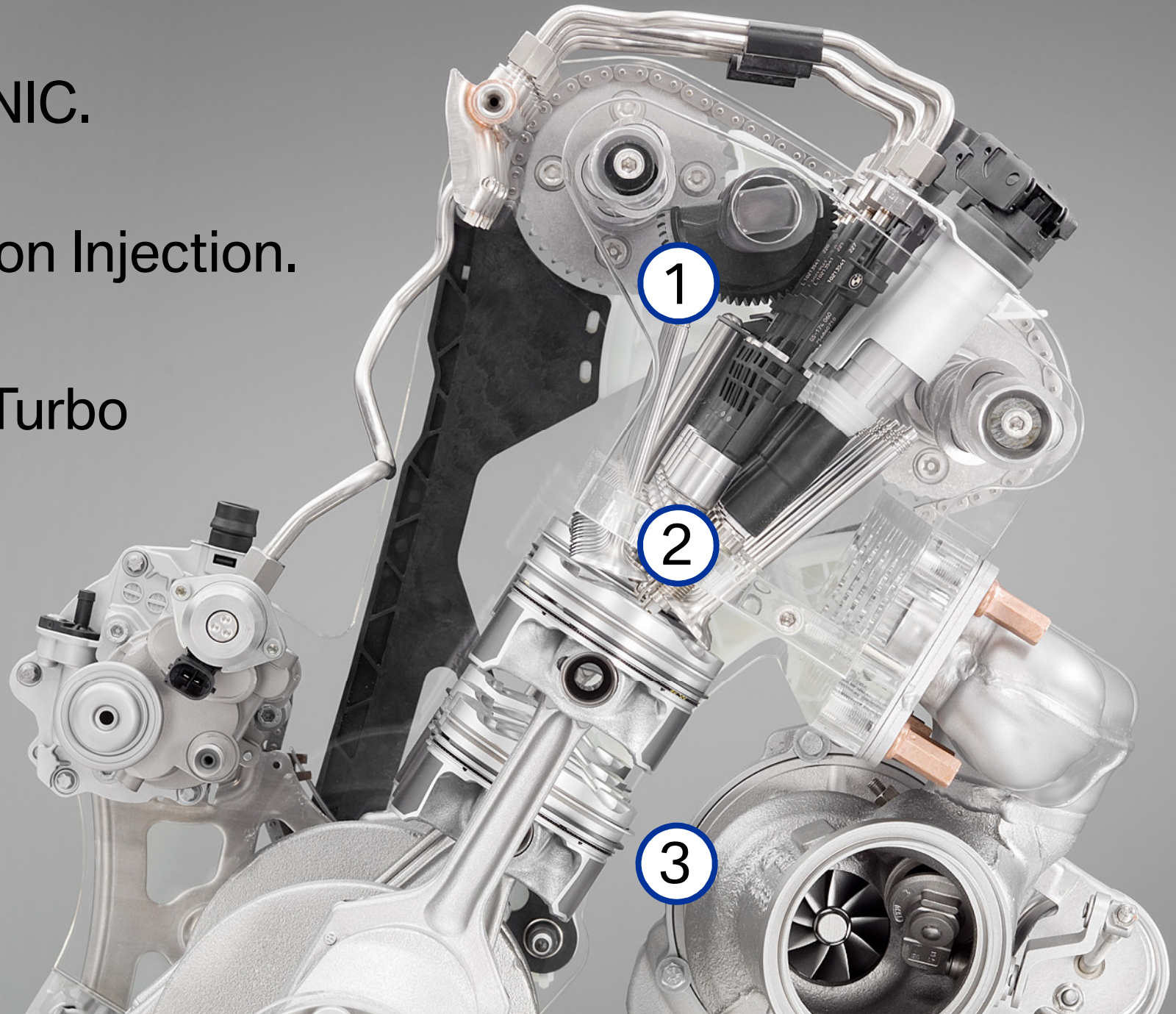


# 2000. High Precision Injection and Twin Turbo.





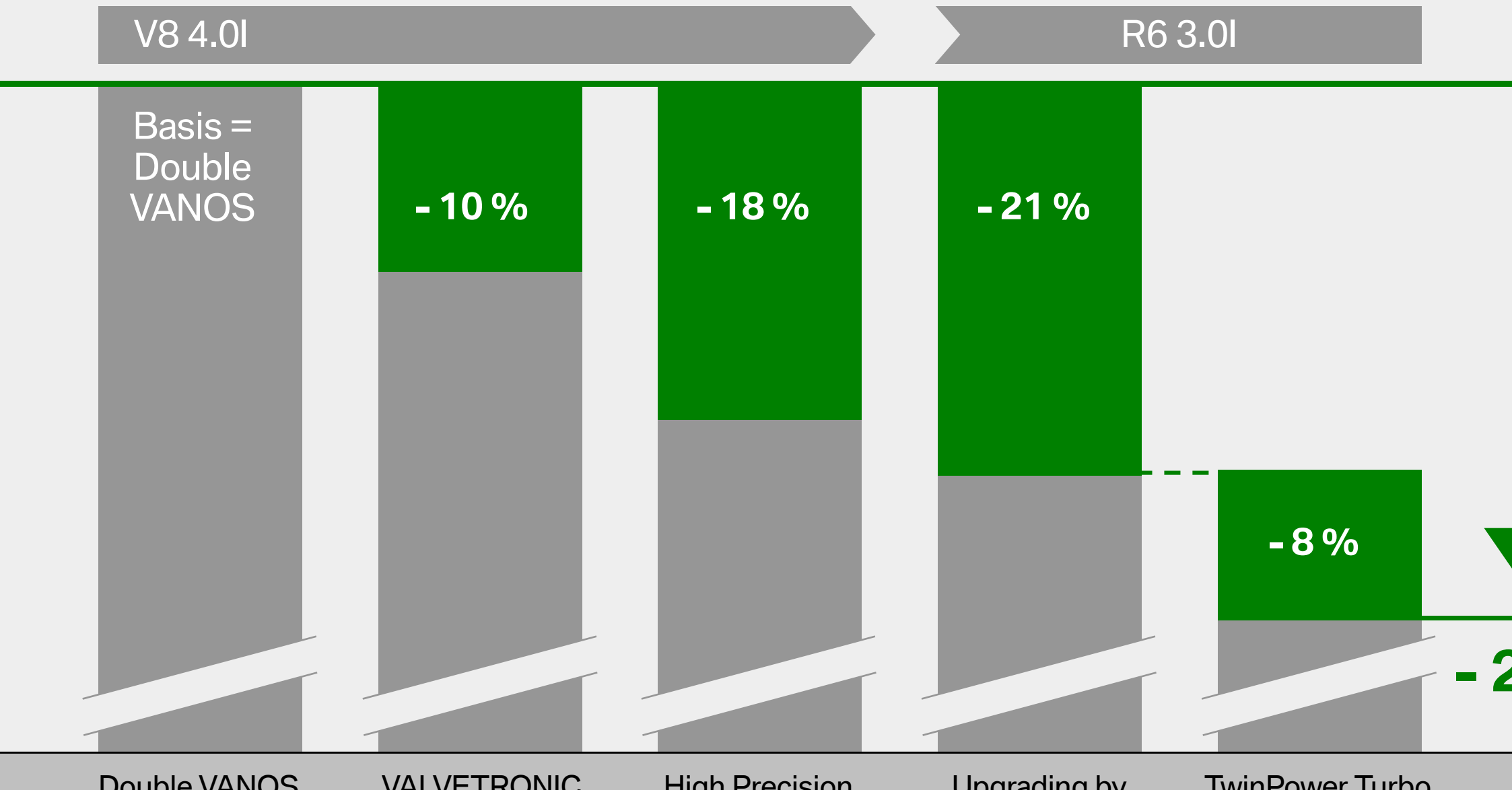
- ① VALVETRONIC.
- ② High Precision Injection.
- ③ TwinPower Turbo Technology.



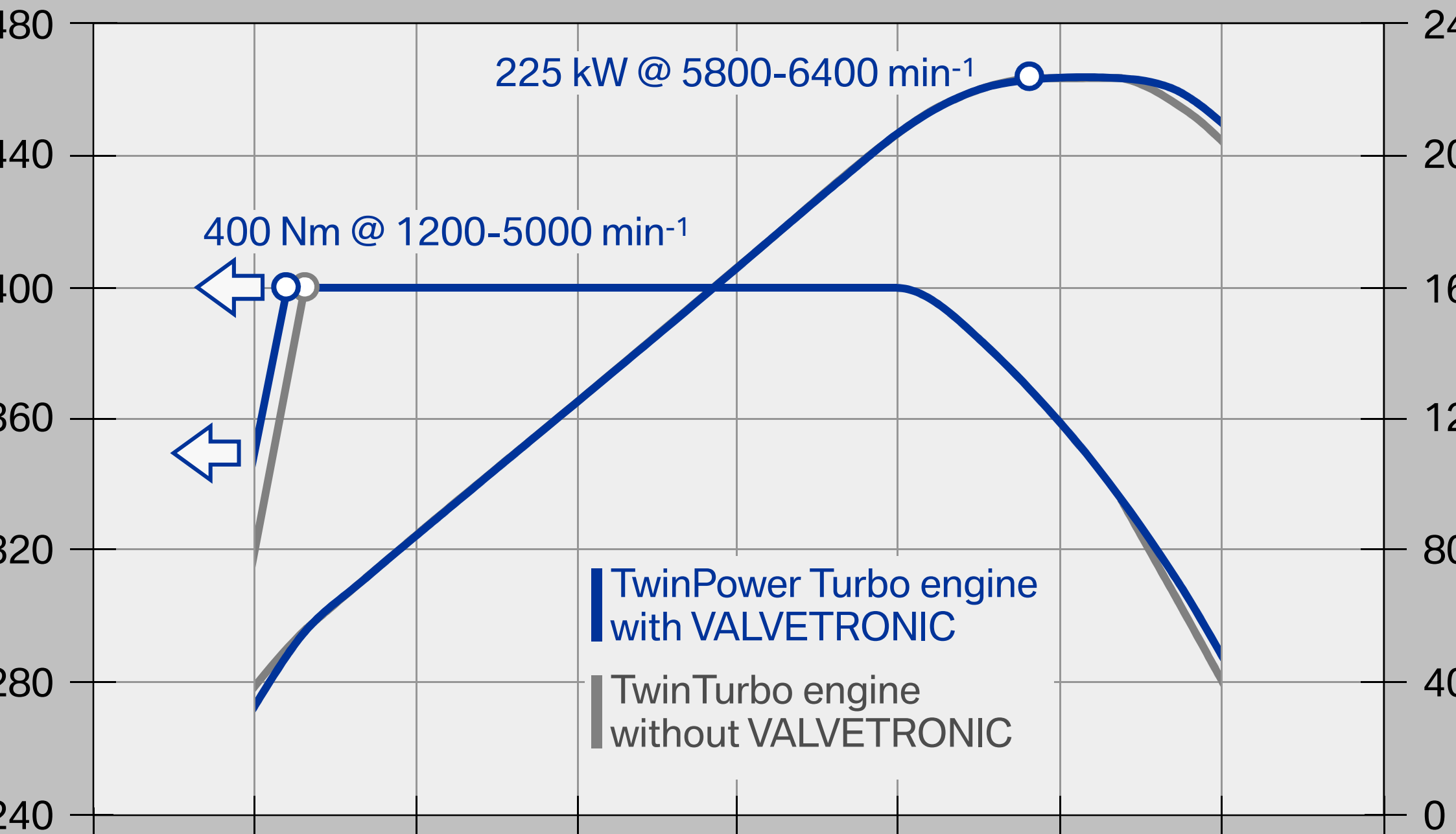


# The next step in a logical row.

► Fuel efficiency gains by the various technology generations\*.

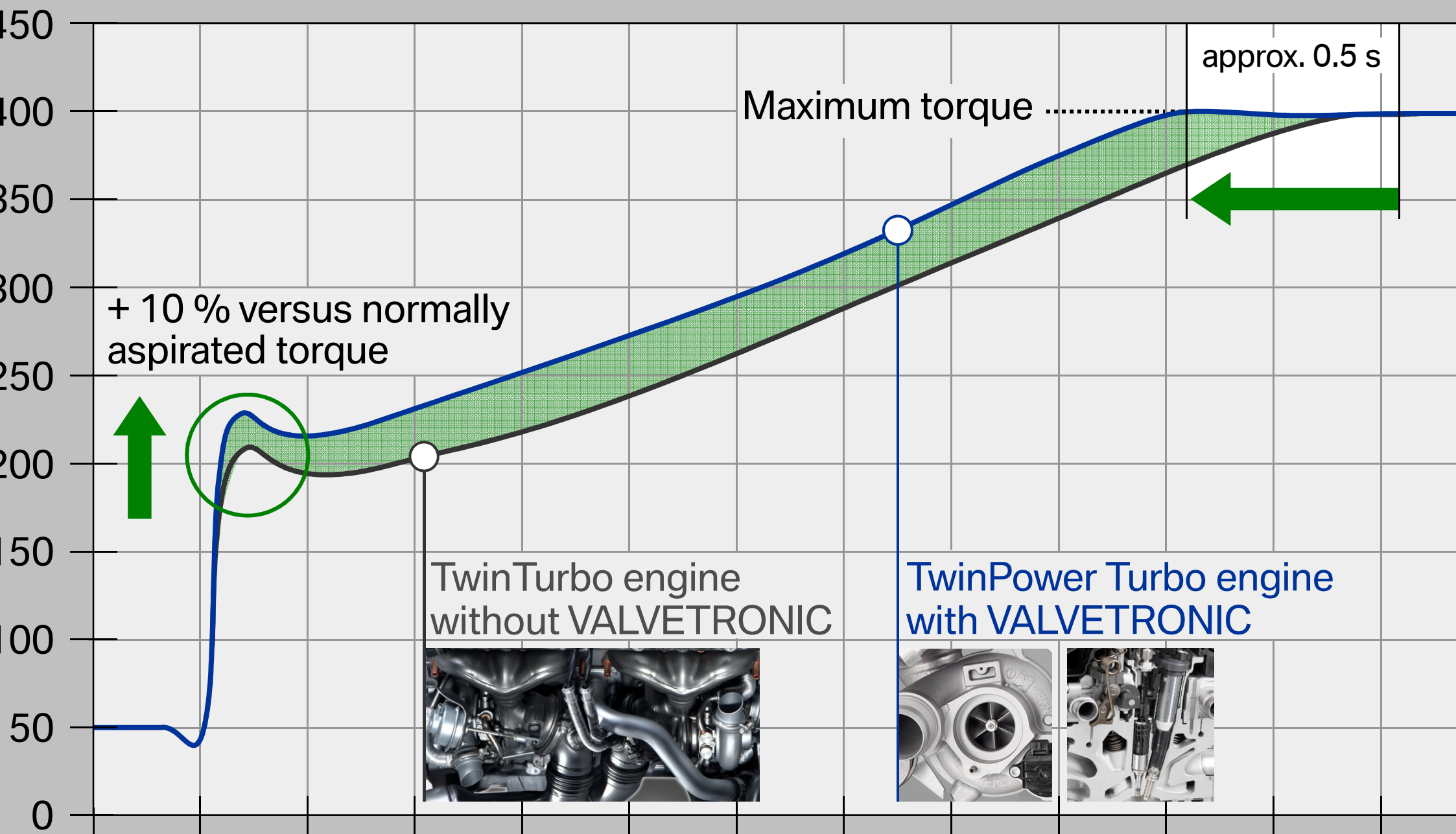


Same performance at even lower rpm.



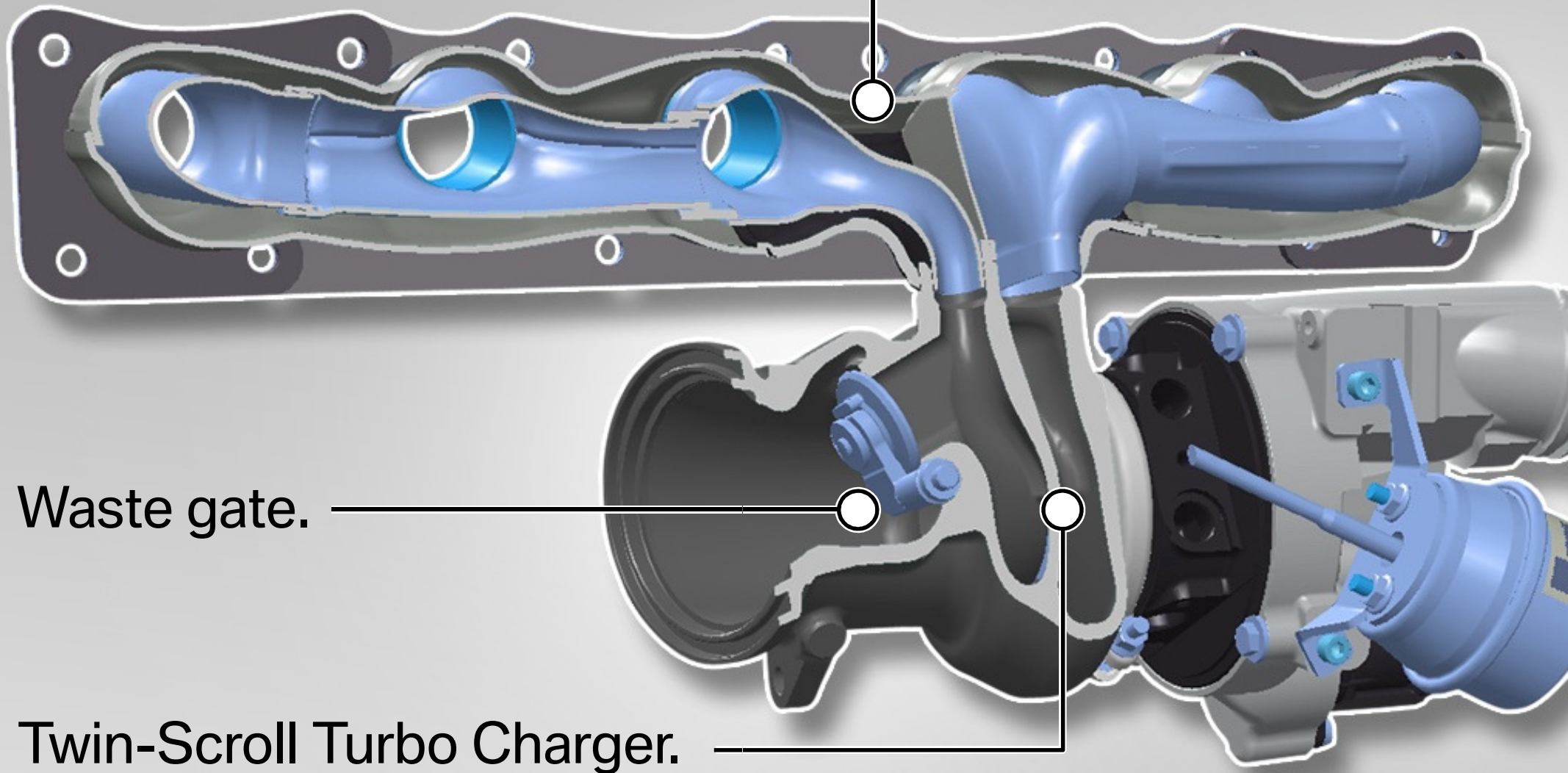


# And even better response.



We call it TwinPower Turbo.

Air gap isolated exhaust manifold.



Waste gate.

Twin-Scroll Turbo Charger.



# The evolution of VALVETRONIC.

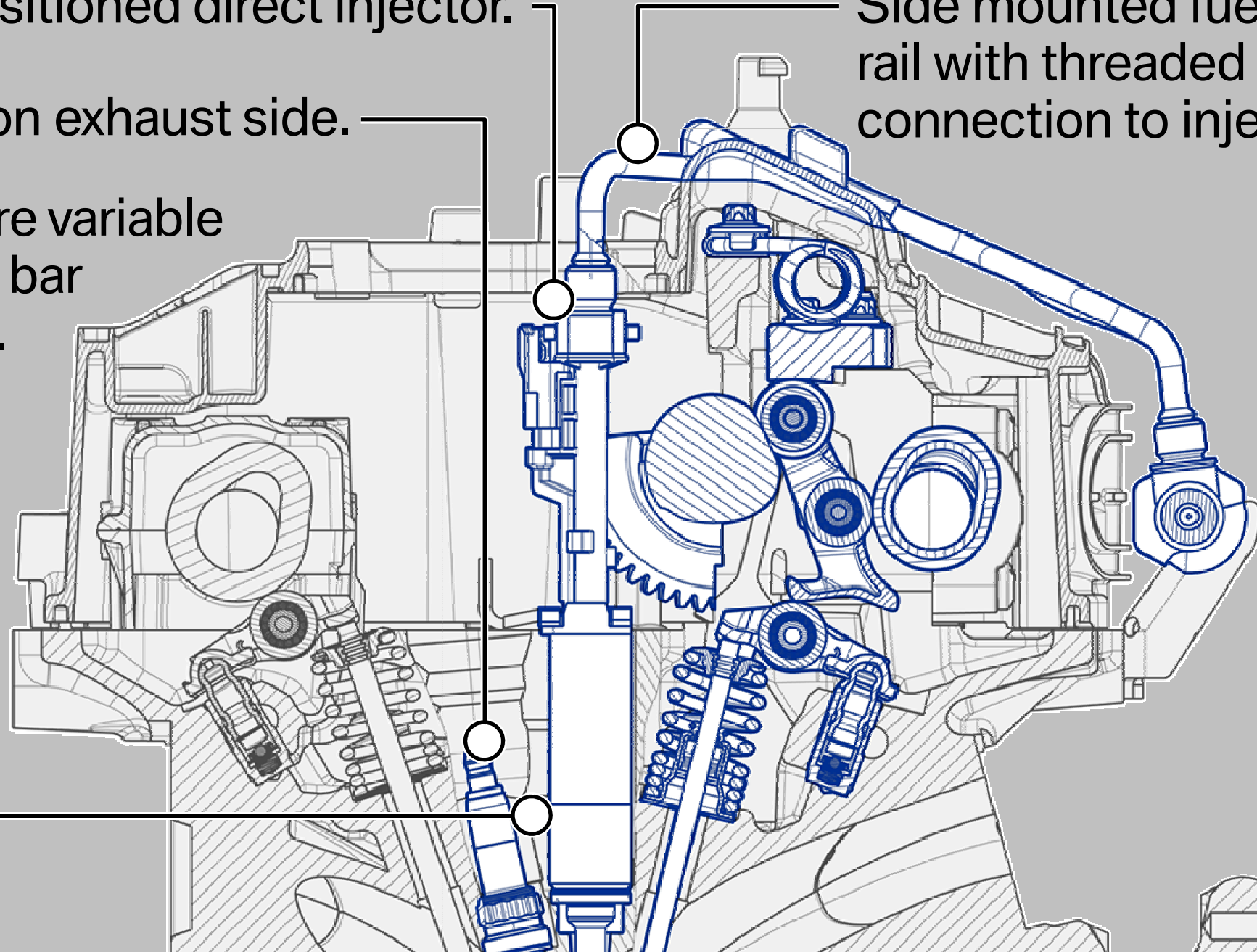
Centrally positioned direct injector.

Spark plug on exhaust side.

Fuel pressure variable  
between 50 bar  
and 200 bar.

Side mounted fuel  
rail with threaded  
connection to injector

Spark plug  
and injector  
transversely

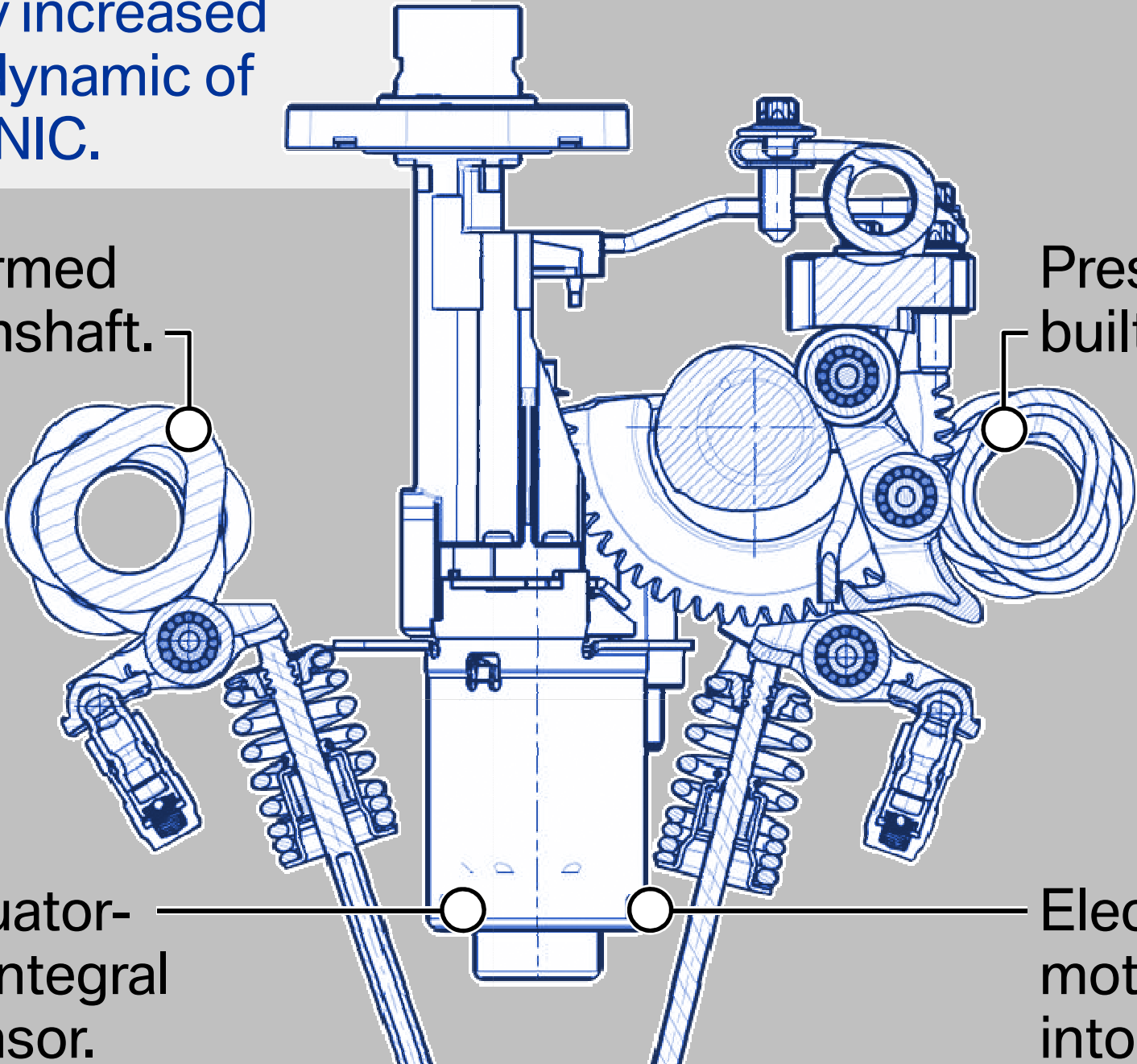


# The evolution of VALVETRONIC.

Significantly increased speed and dynamic of VALVETRONIC.

Pressure formed built-up camshaft.

Pressure form built-up camsh



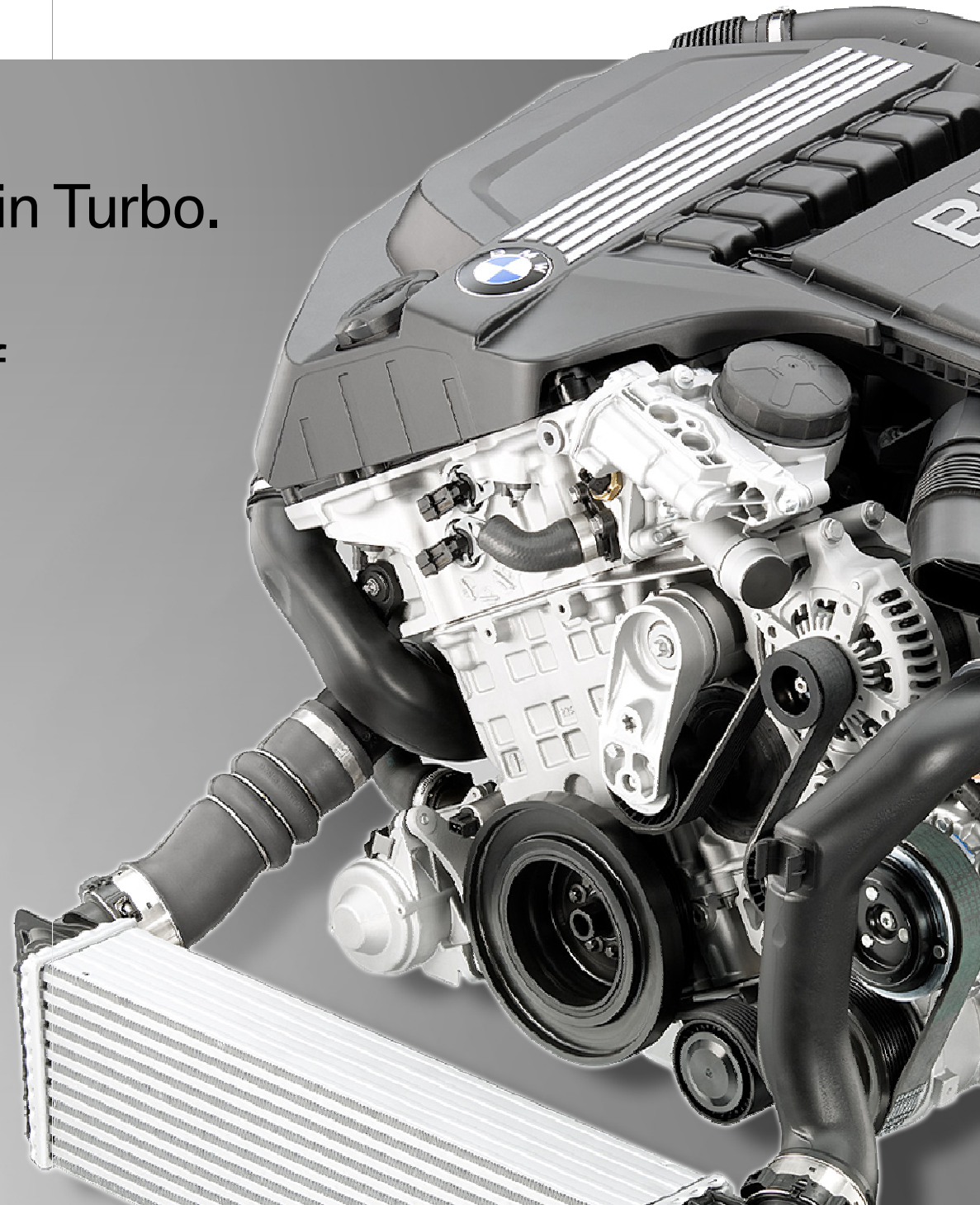
Electric actuator-motor with integral position sensor.

Electric actuator motor integrated into cylinder head

# With TwinPower Turbo.

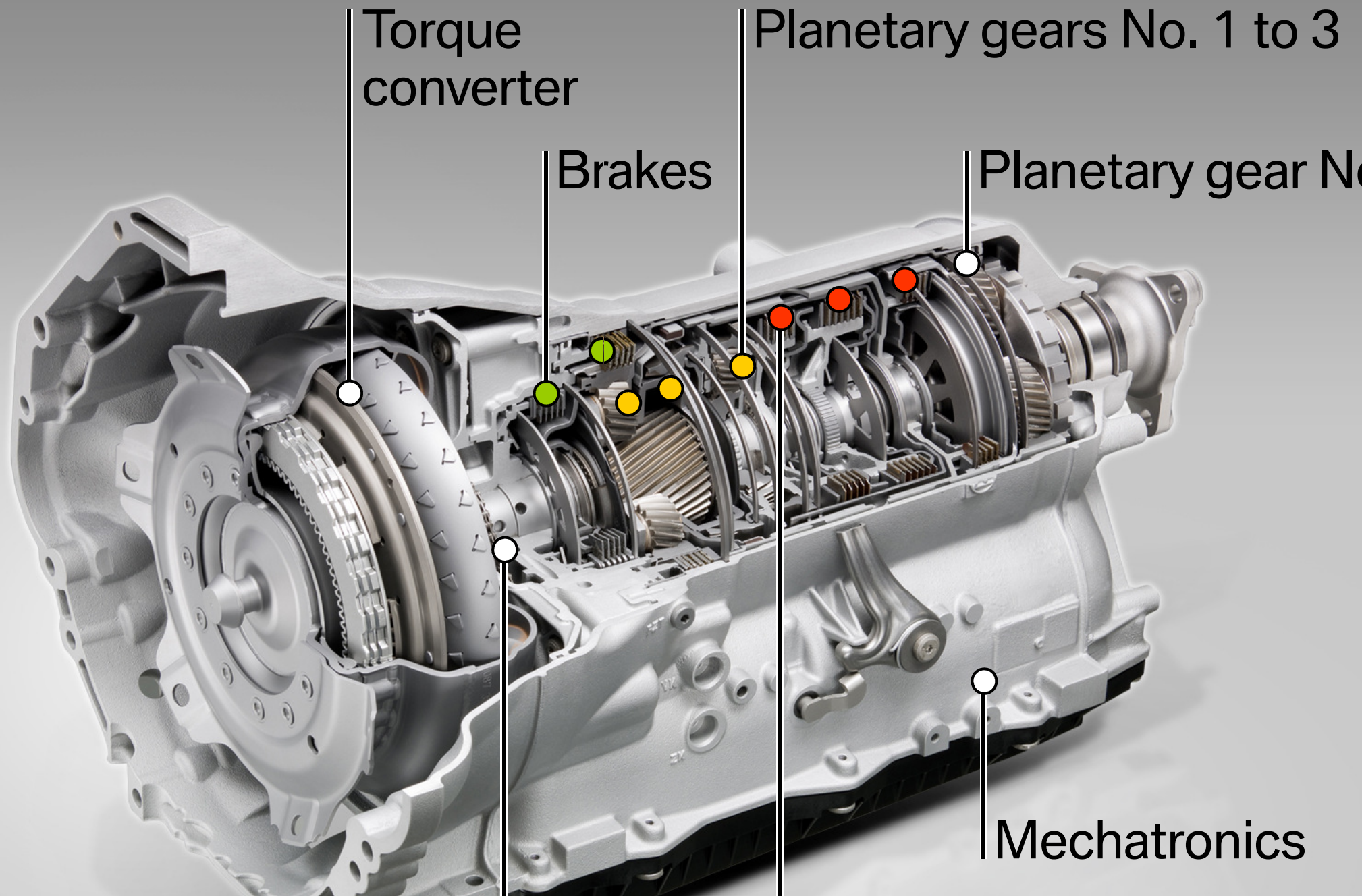
## Summary.

- ▶ The basis:  
The highly awarded BMW Twin Turbo.
- ▶ The new engine:  
First time ever combination of
  - Direct injection
  - Turbo charging
  - Fully variable valvetrain.
- ▶ The result:  
Again best in segment  
performance and efficiency.
- ▶ Enjoying the same power as  
a big V8 now in a compact,  
light weight 6 cylinder with  
low fuel consumption.



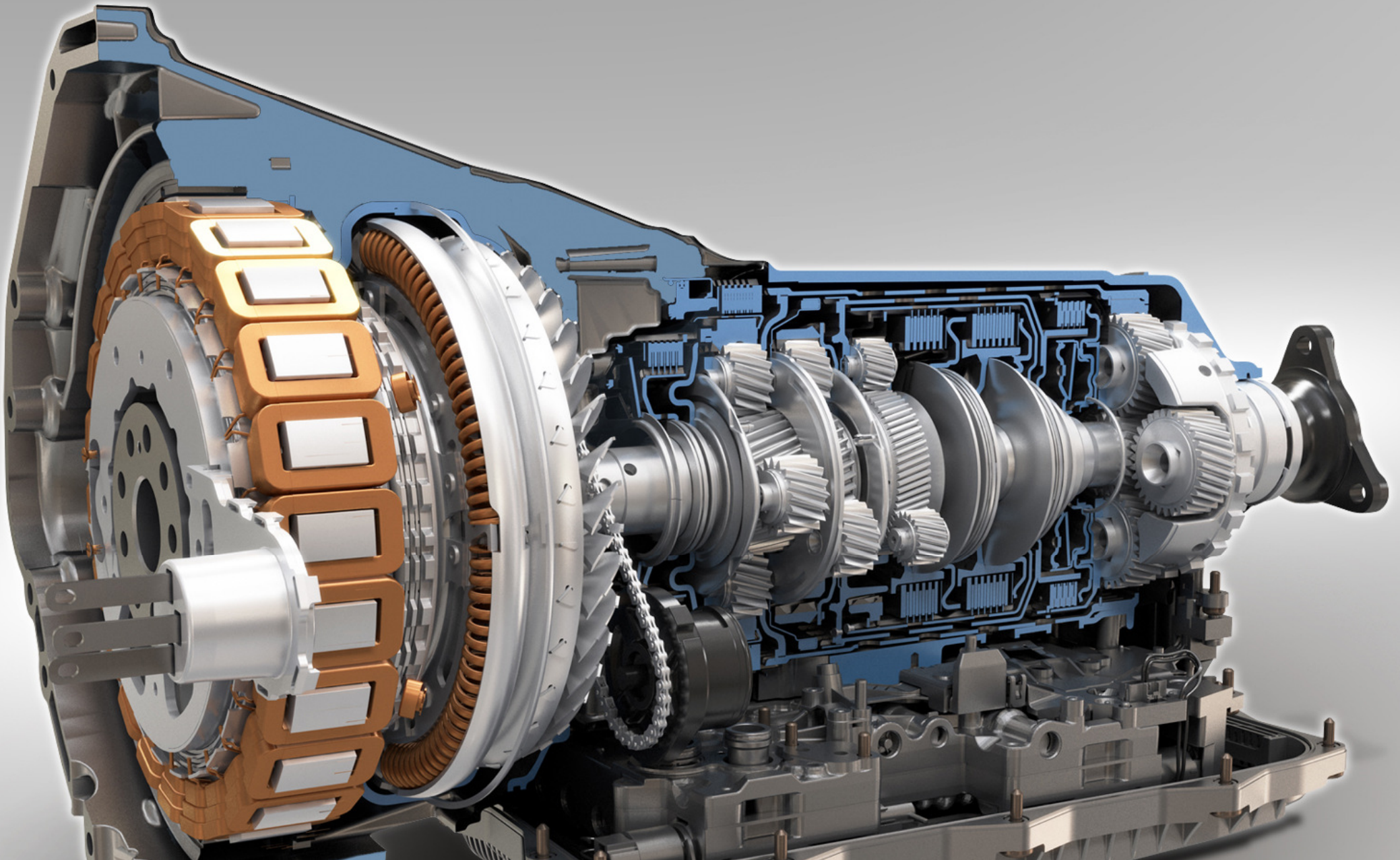


**Better comfort, better acceleration.  
Better fuel economy, while same weight and size**

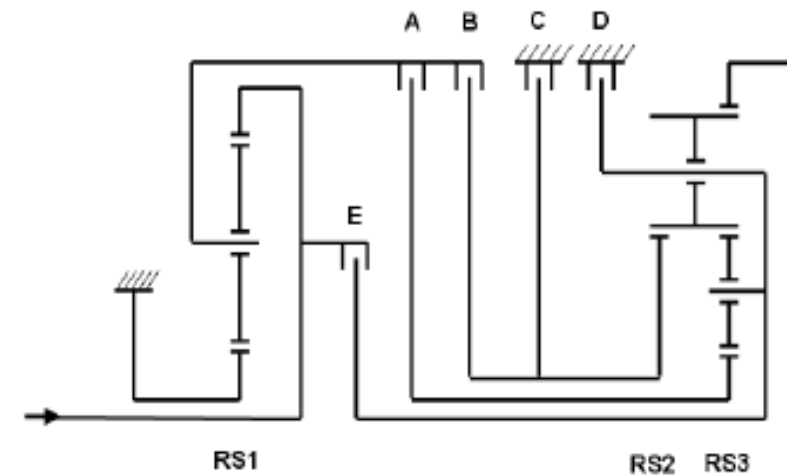
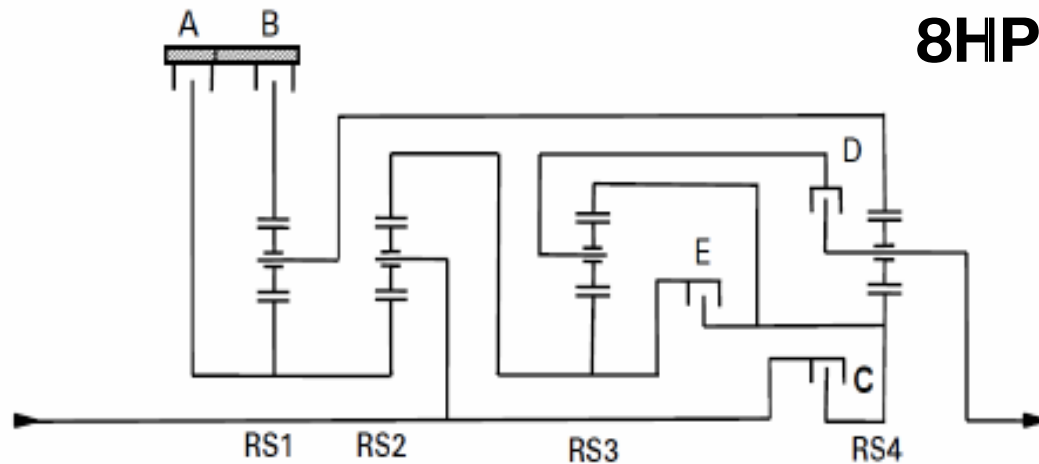




Prepared for Hybrid, xDrive  
and Auto Start Stop Function.



# 8HP



	Bremse		Kupplung			Übersetzung	
	A	B	C	D	E	8H	P
1.Gang	●	●	●	○	○	4,714	
2.Gang	●	●	○	○	●	3,143	
3.Gang	○	●	●	○	●	2,106	
4.Gang	○	●	○	●	●	1,667	
5.Gang	○	●	●	●	○	1,285	
6.Gang	○	○	●	●	●	1,000	
7.Gang	●	○	●	●	○	0,839	
8.Gang	●	○	○	●	●	0,667	
R-Gang	●	●	○	●	○	-3,295	-3,317
P	●						
N	●						
Spreizung						7,07	

☐ Schaltelement offen

• • • • •

	Kupplung			Bremse	
	A	B	E	C	D
1.Gang	●	○	○	○	●
2.Gang	●	○	○	●	○
3.Gang	●	●	○	○	○
4.Gang	●	○	●	○	○
5.Gang	○	●	●	○	○
6.Gang	○	○	●	●	○
R-Gang	○	●	○	○	●
P					●
N					●
Spreizung					

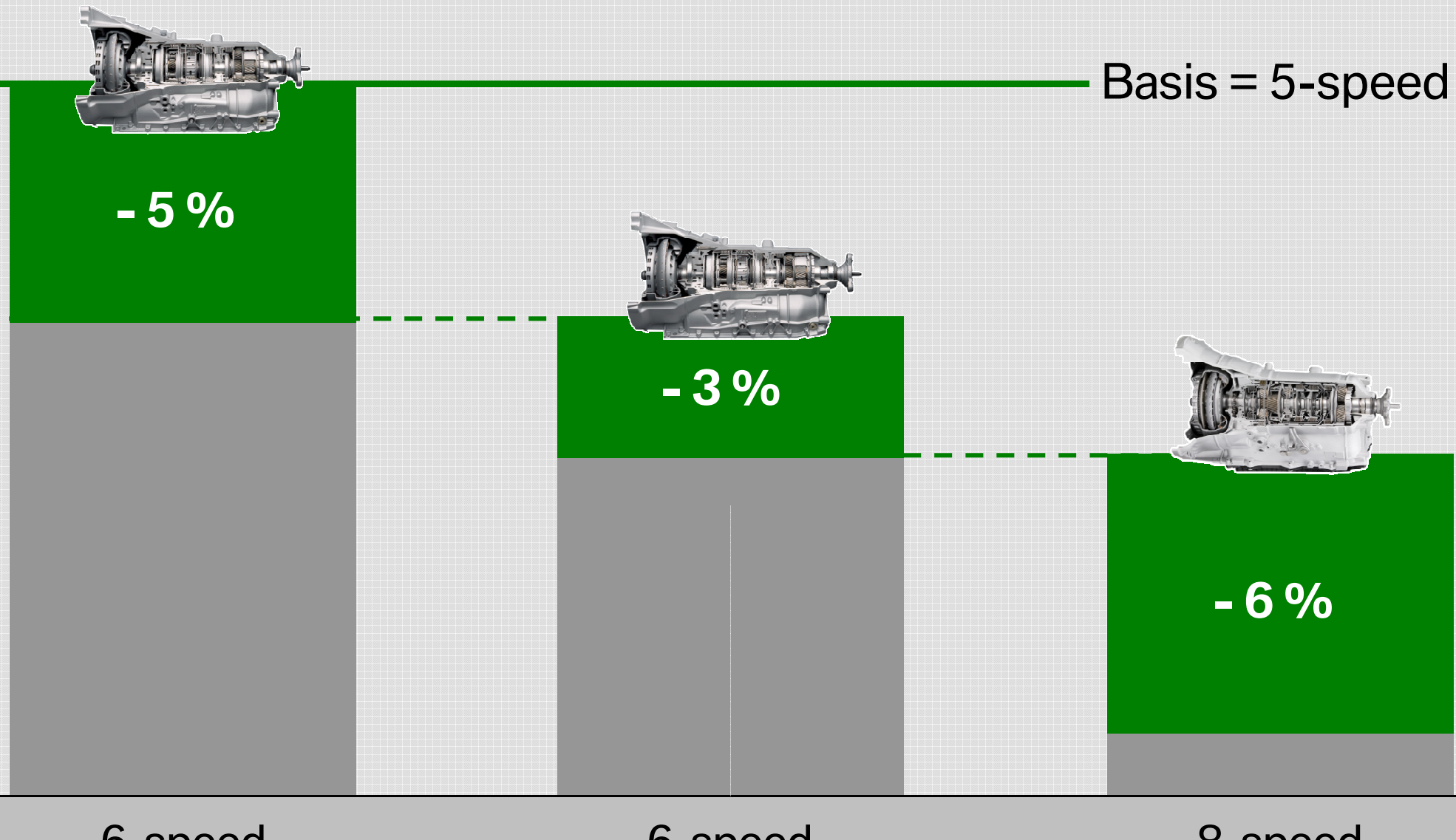
☐ Schaltelement offen

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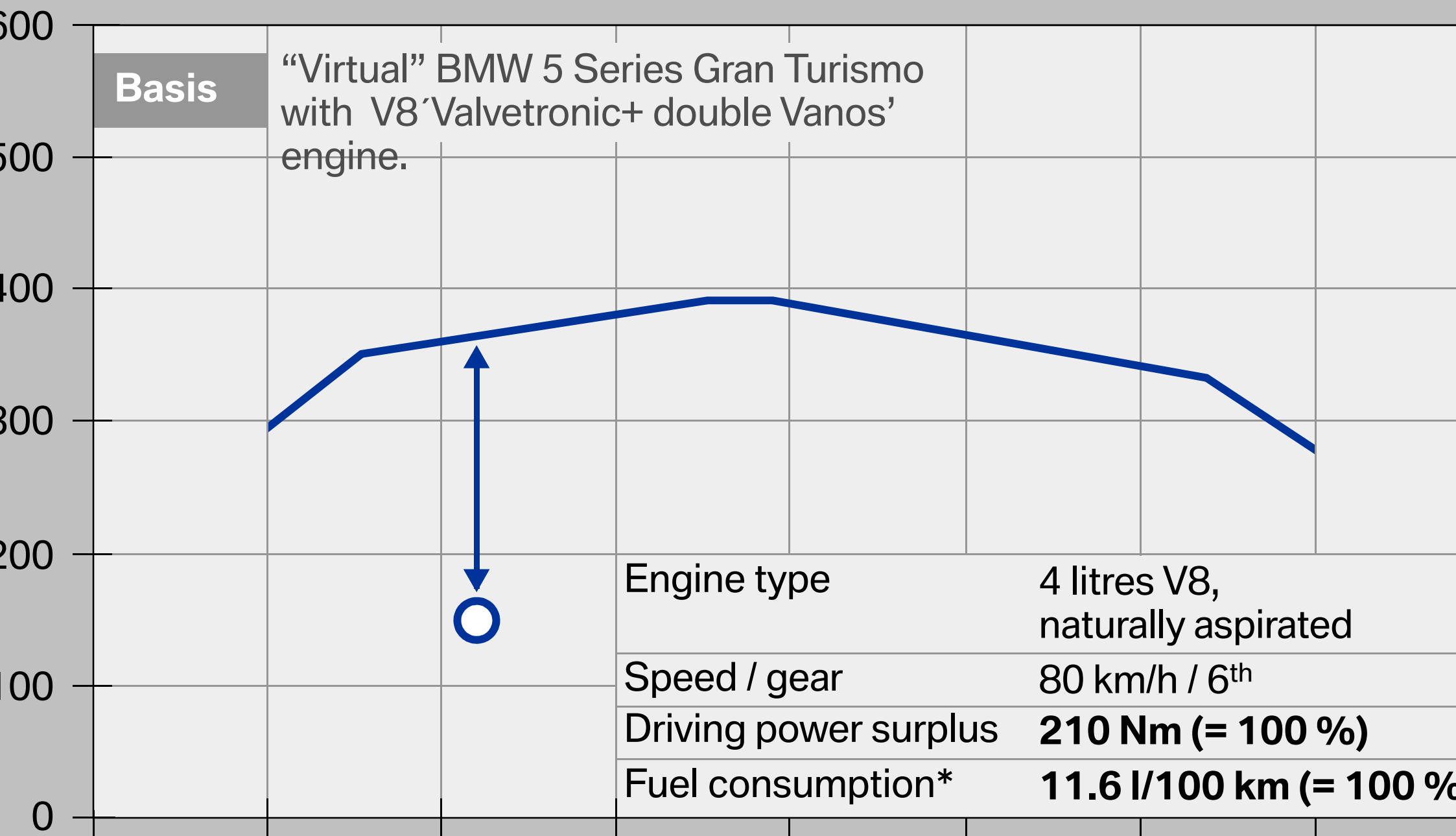
# The logical next step.

- ▶ Fuel efficiency (in EU test cycle) gains over time.



# 8 speed transmission work perfectly together.

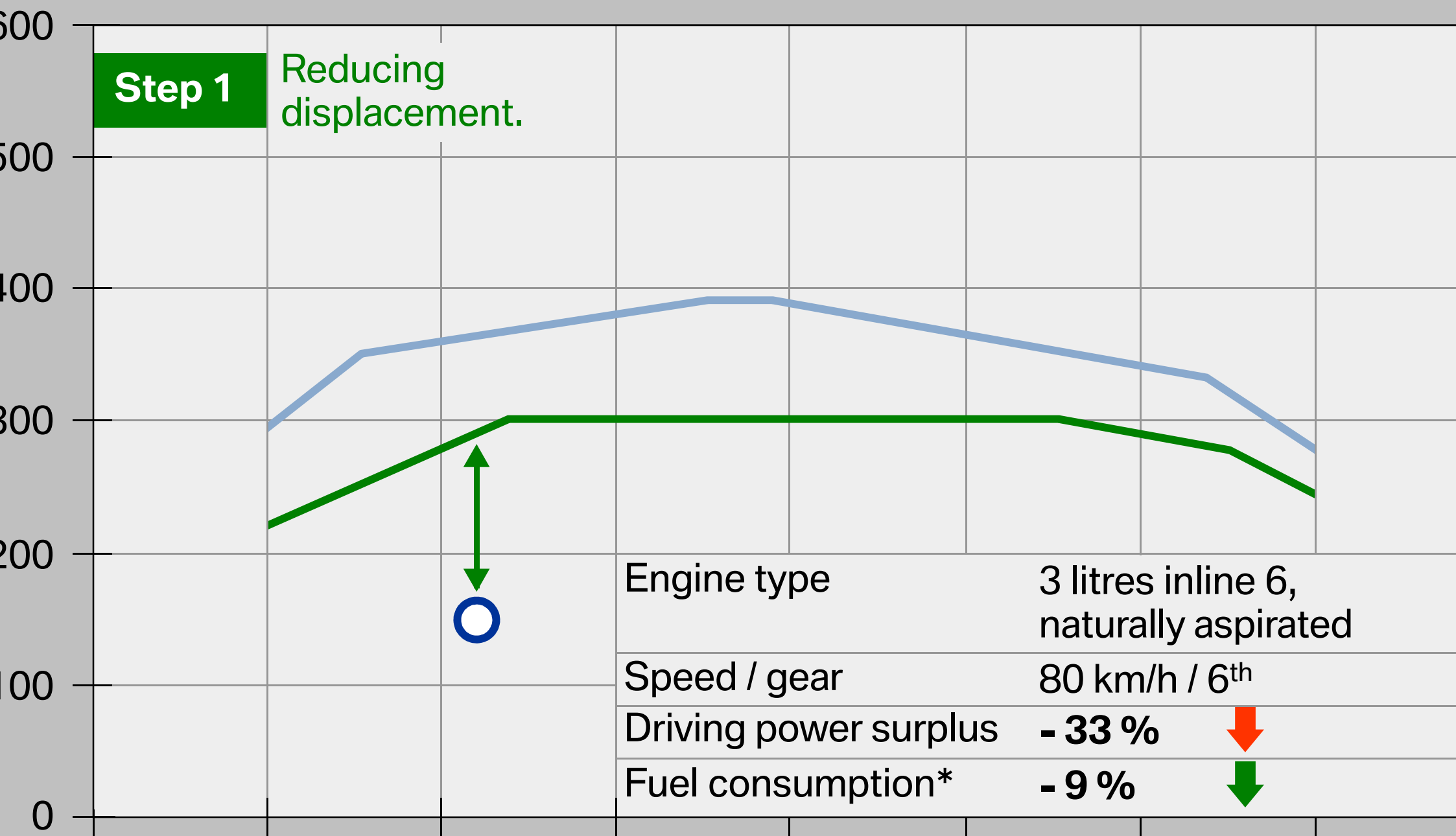
## 3 steps to a new BMW drivetrain philosophy.





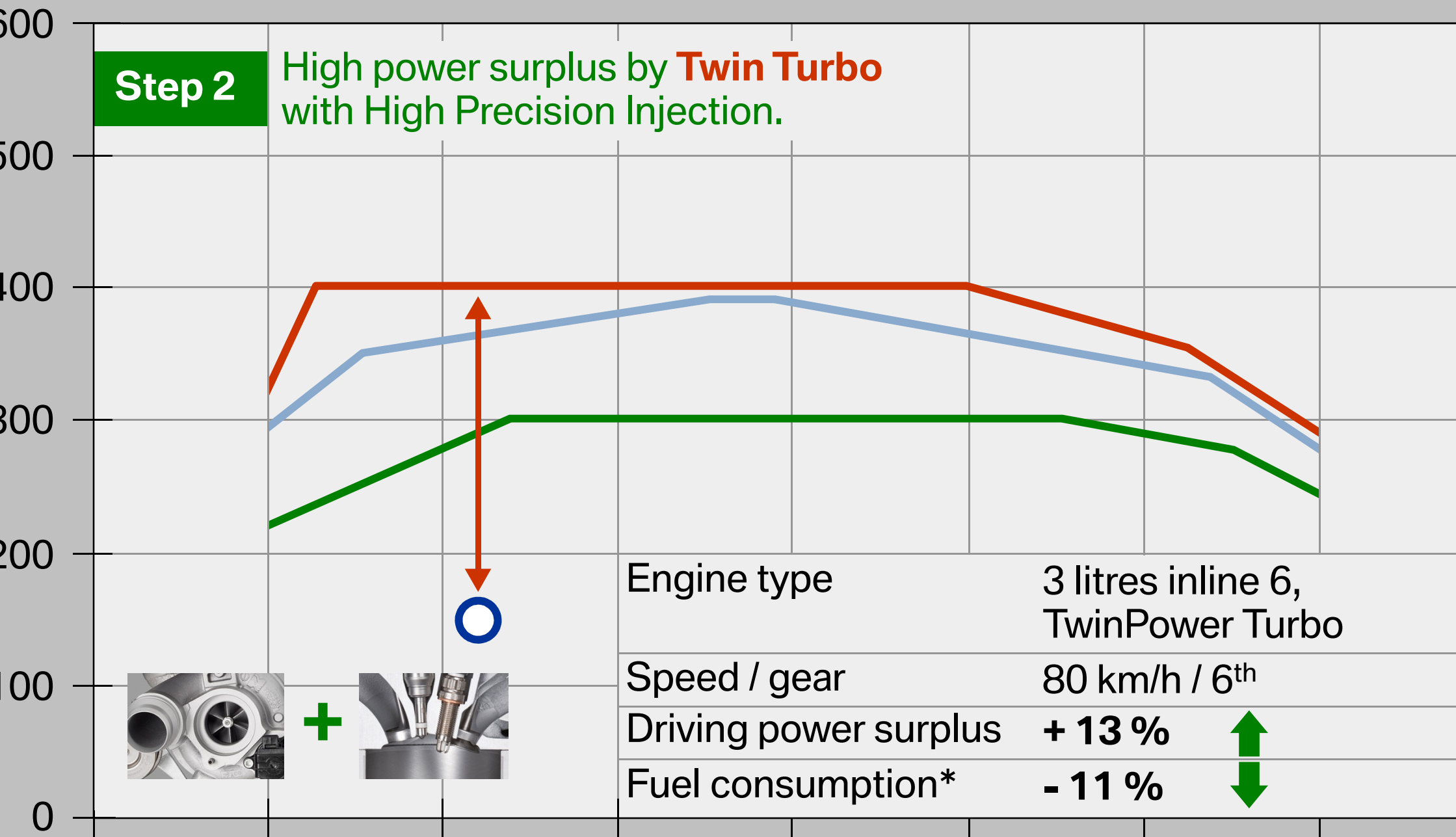
# 8 speed transmission work perfectly together.

## 3 steps to a new BMW drivetrain philosophy.



# 8 speed transmission work perfectly together.

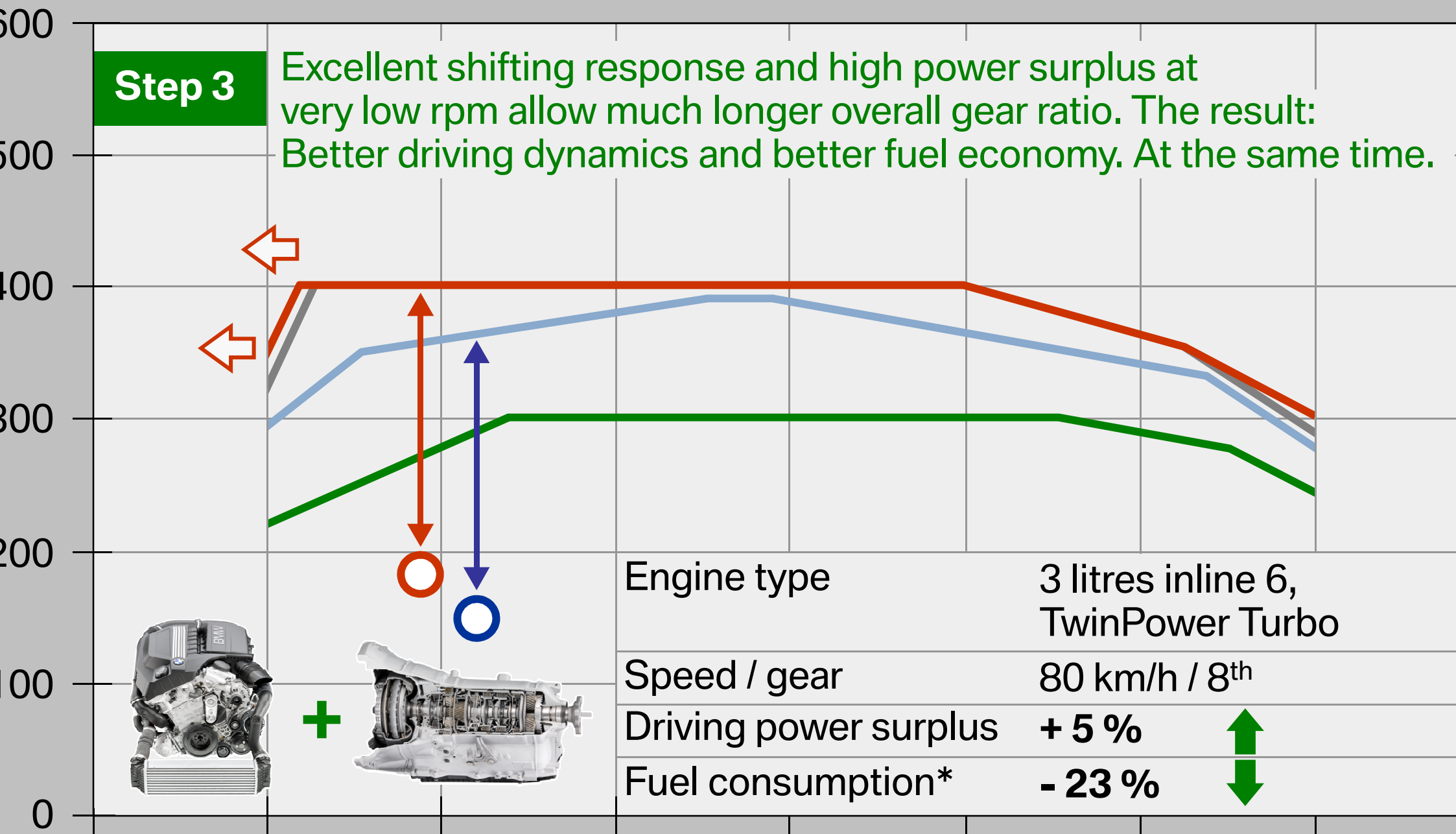
## 3 steps to a new BMW drivetrain philosophy.





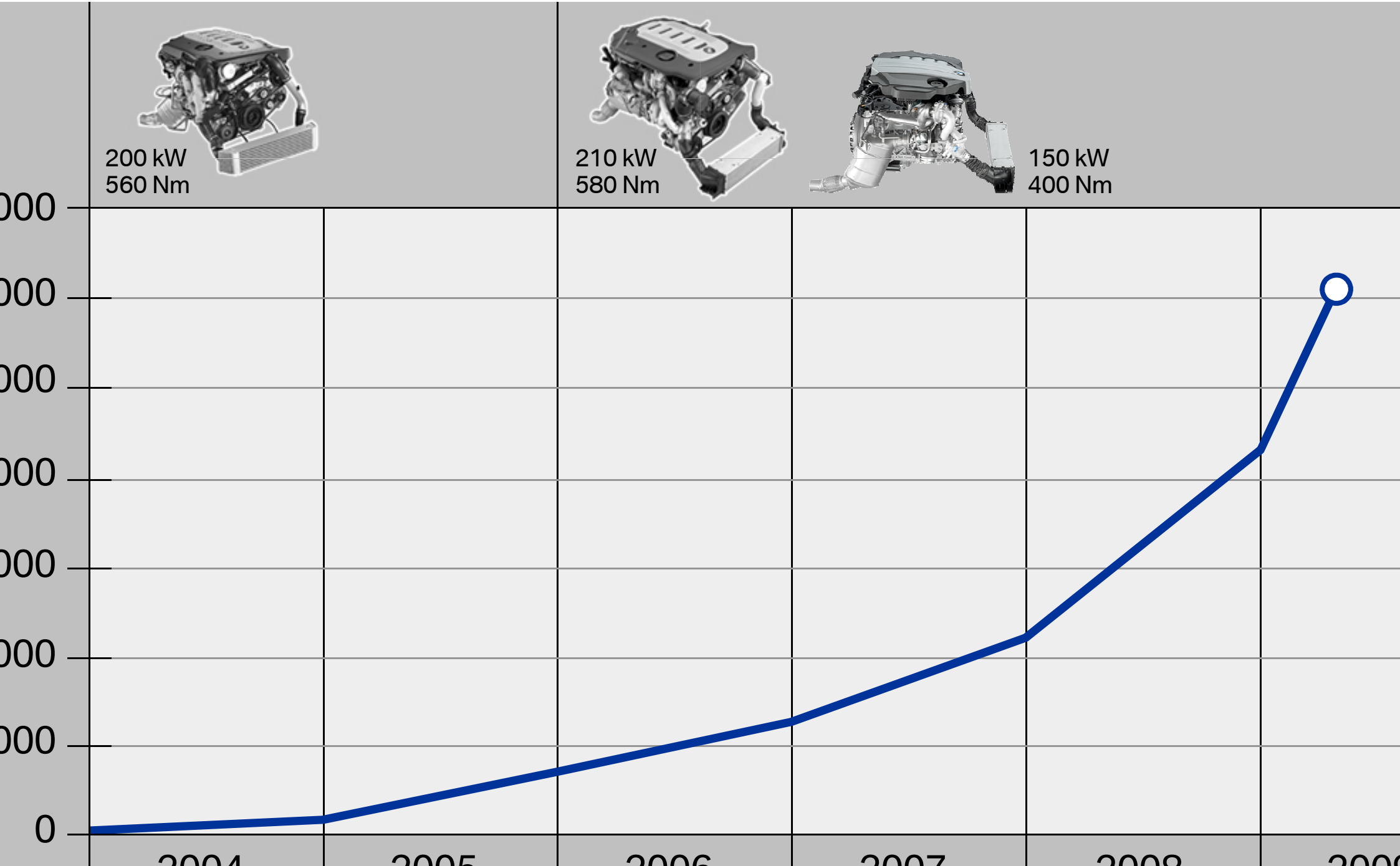
# 8 speed transmission work perfectly together.

## 3 steps to a new BMW drivetrain philosophy.



# TwinPower Turbo diesel.

## Development of sales numbers.





# TwinPower Turbo diesel.

## Further evolution of a big success story.

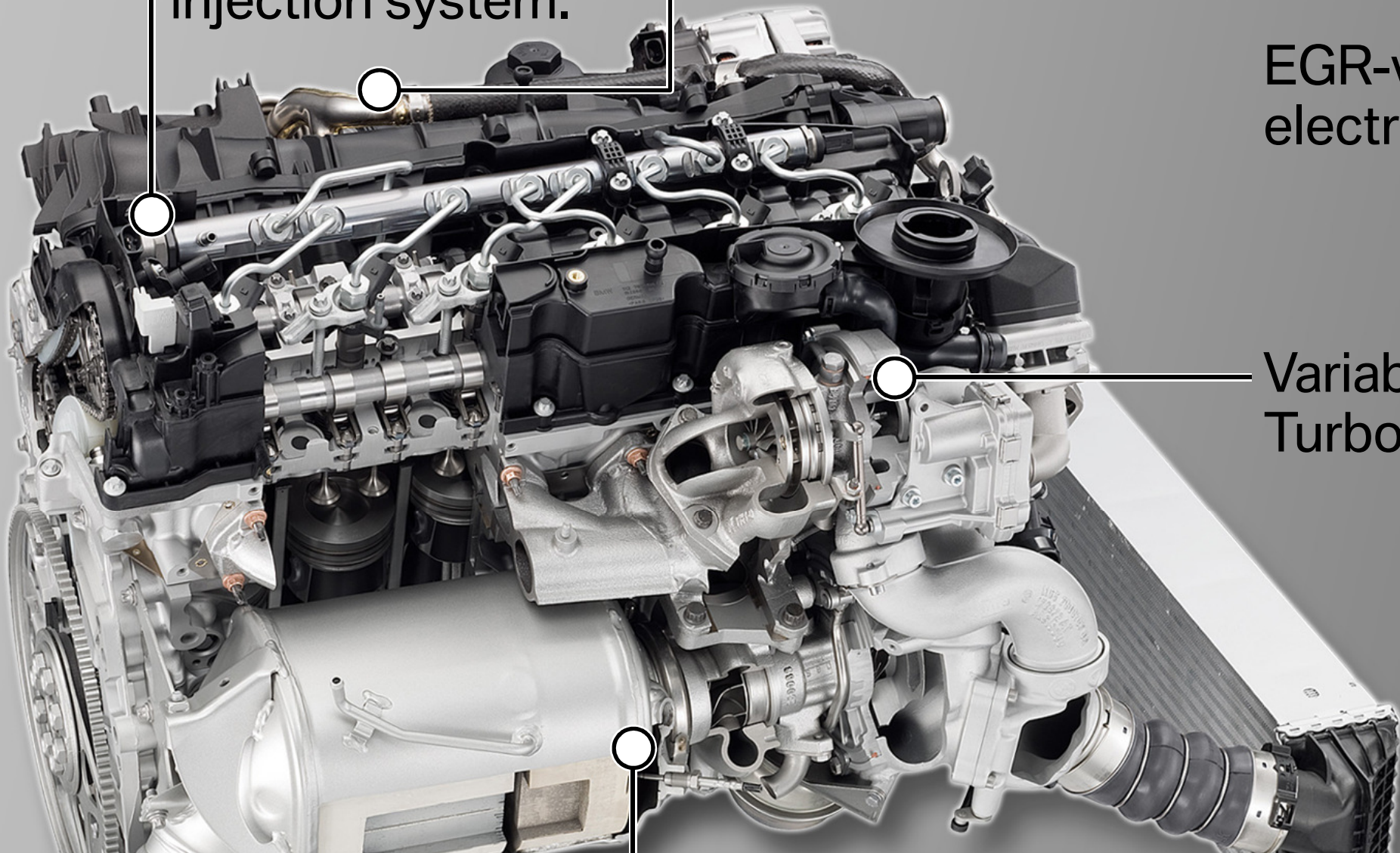
Latest generation  
common rail  
injection system.

Inlet manifold with  
variable intake-swirl.

Efficient  
EGR cooling.

EGR-valve with  
electric throttle

Variable Twin  
Turbo system.

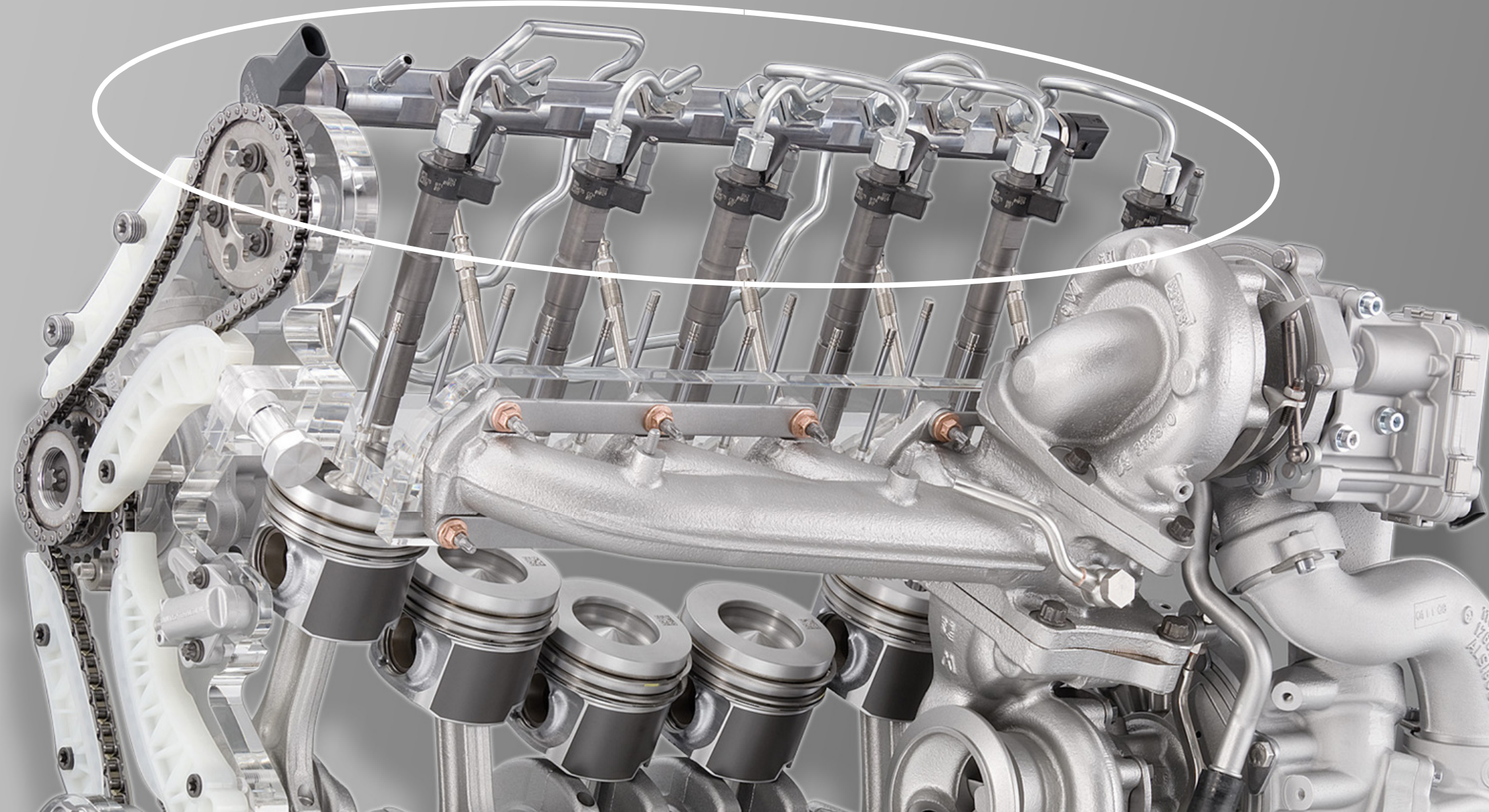




# TwinPower Turbo diesel.

## The injection system.

- ▶ Common rail injection system (2000 bar; piezo injectors).

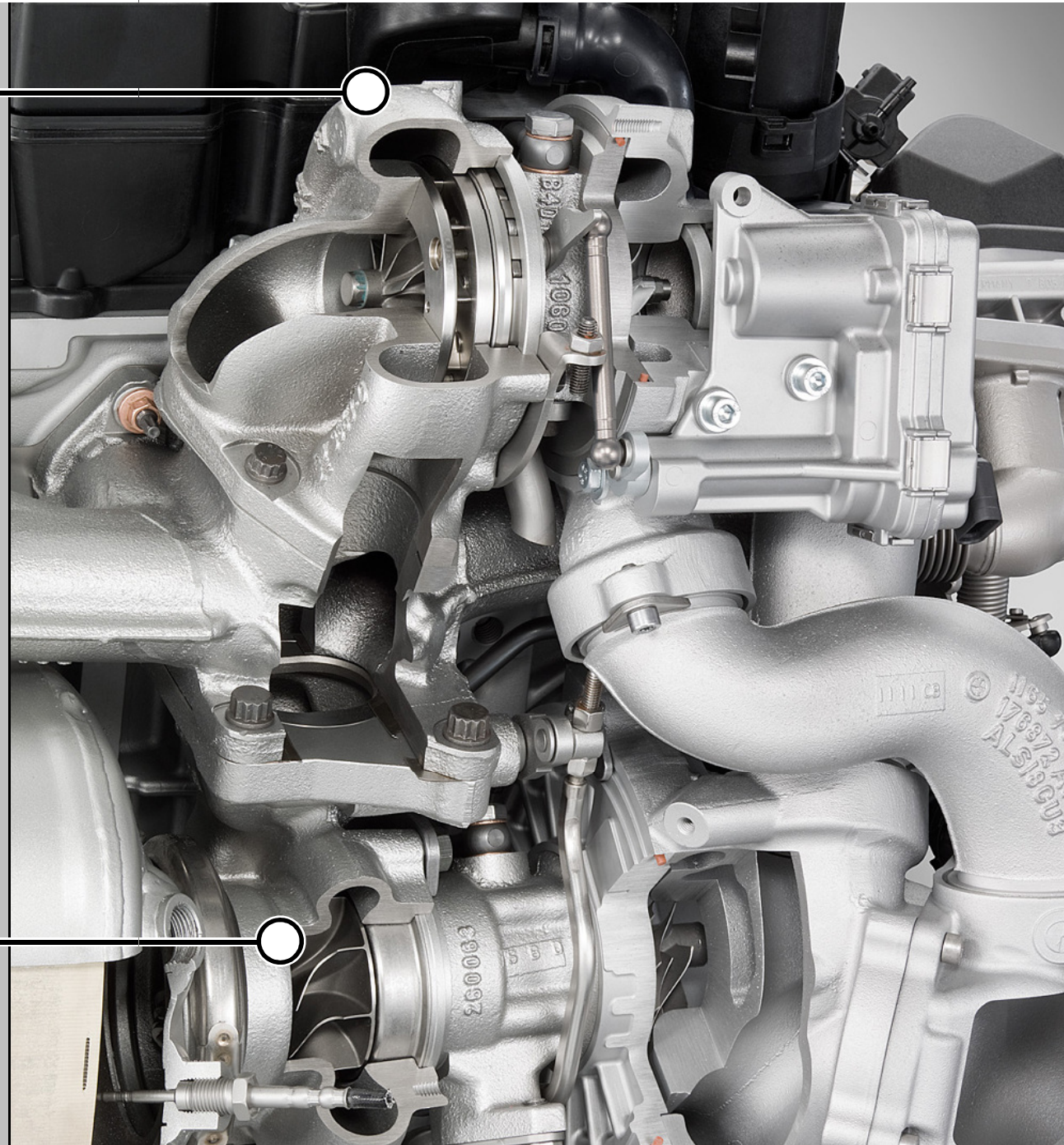




# TwinPower Turbo diesel.

## The turbo charger system.

- ▶ 1<sup>st</sup> diesel engine worldwide with variably controlled 2 stage charging system and variable nozzle turbine (VNT) for high pressure turbocharger.
- ▶ Low pressure turbo.

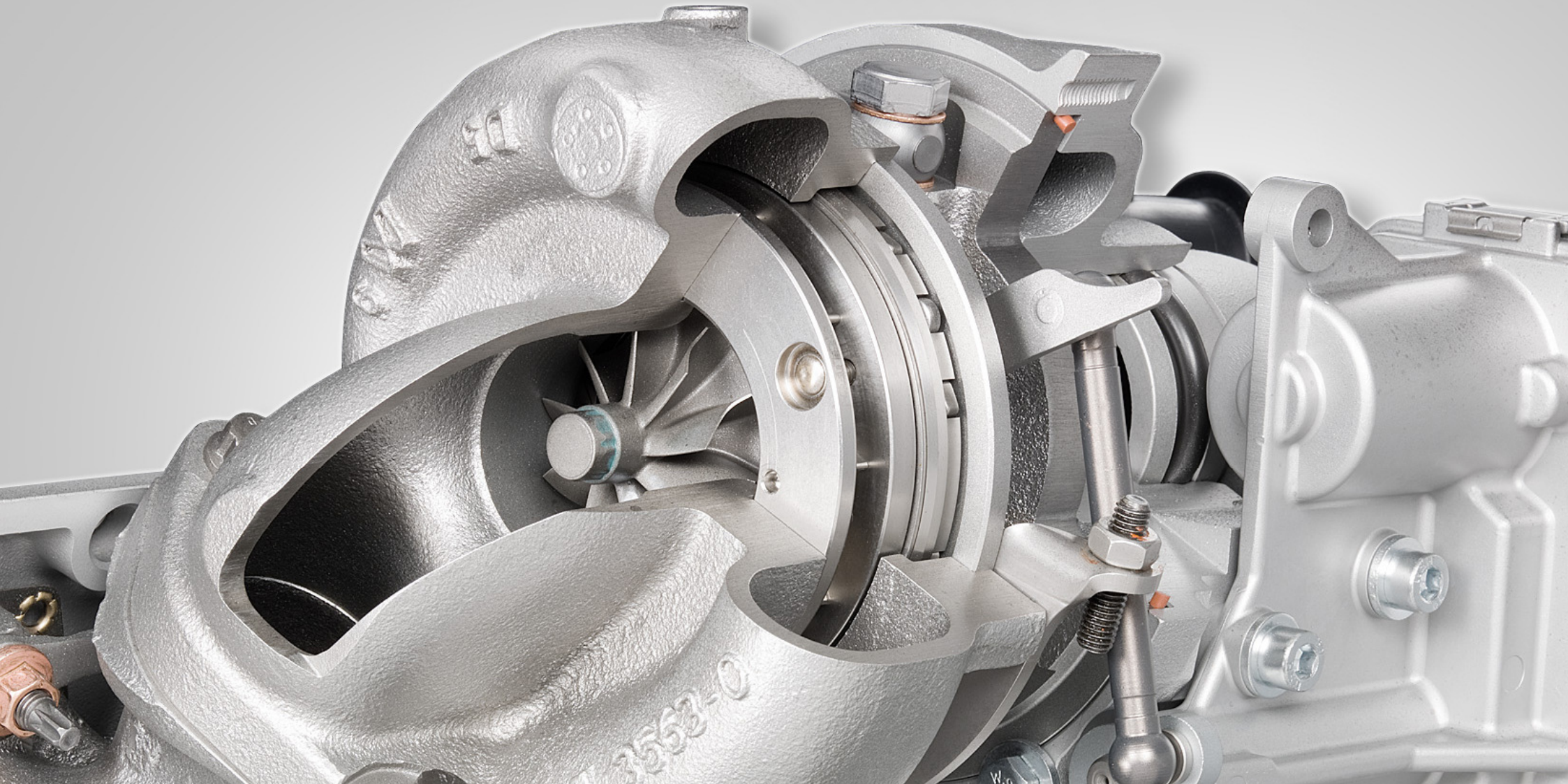




# TwinPower Turbo diesel.

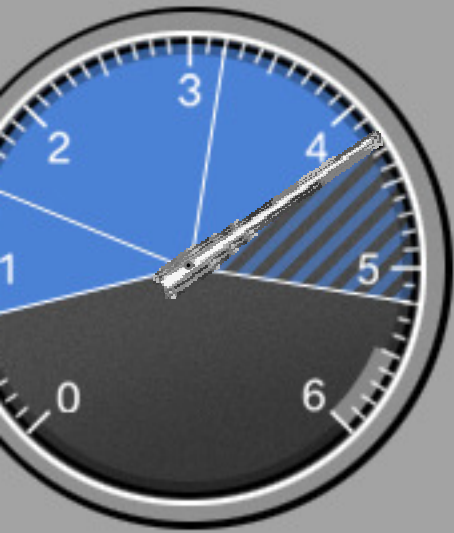
## The turbo charger system.

- ▶ High pressure turbocharger with variable nozzle turbine and electric actuator.



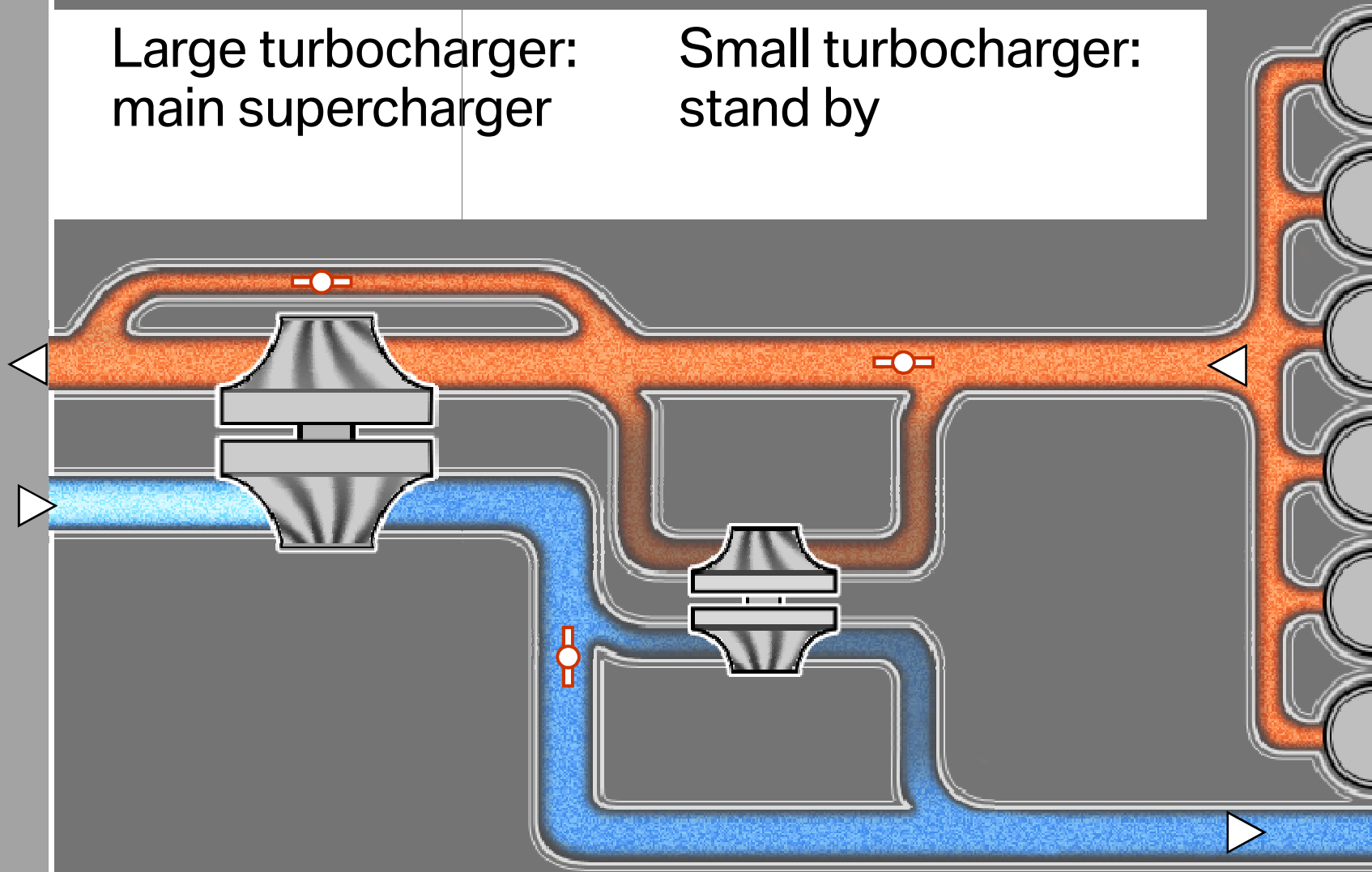
# TwinPower Turbo diesel.

## The turbo charger system.



Large turbocharger:  
main supercharger

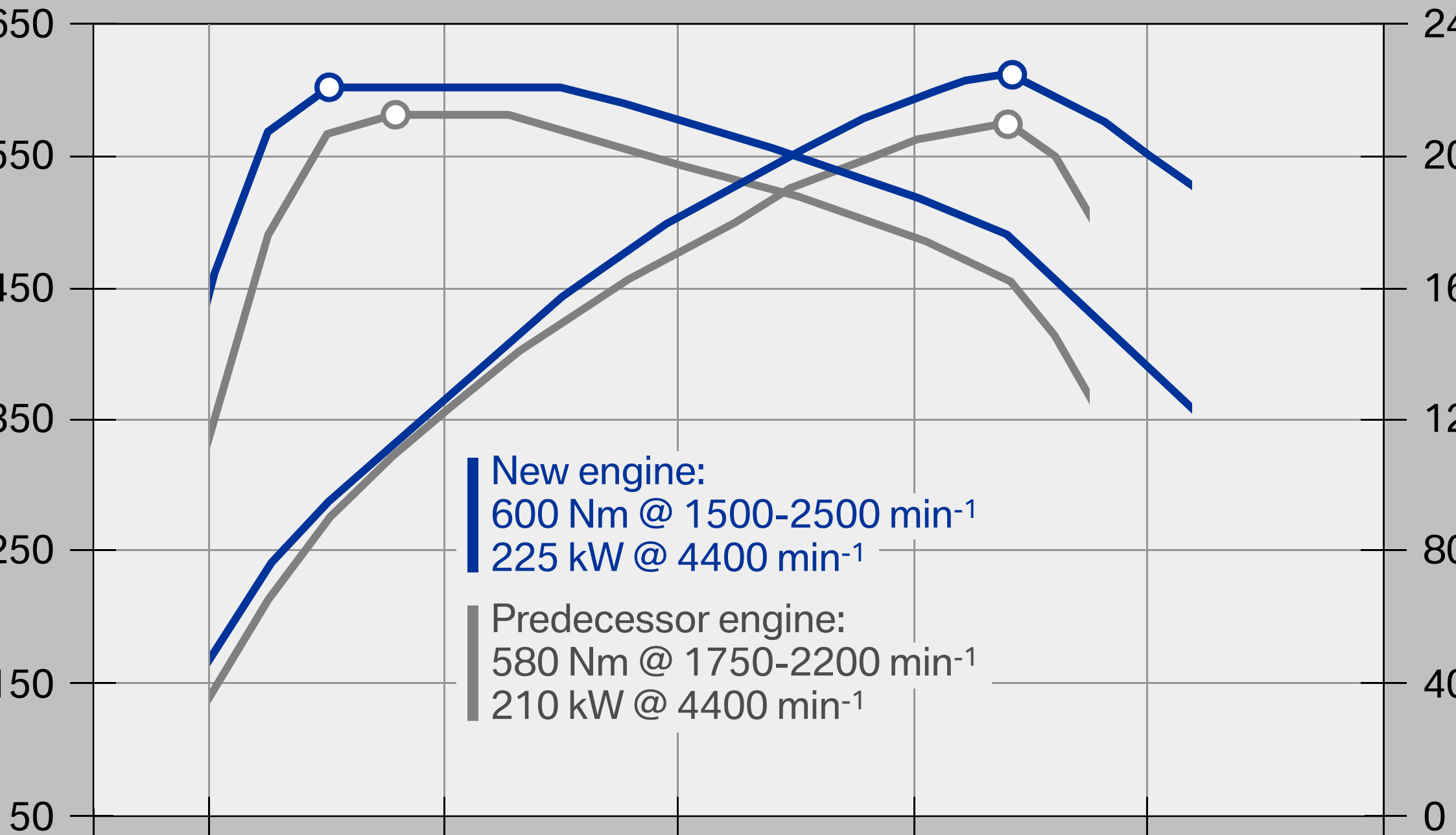
Small turbocharger:  
stand by





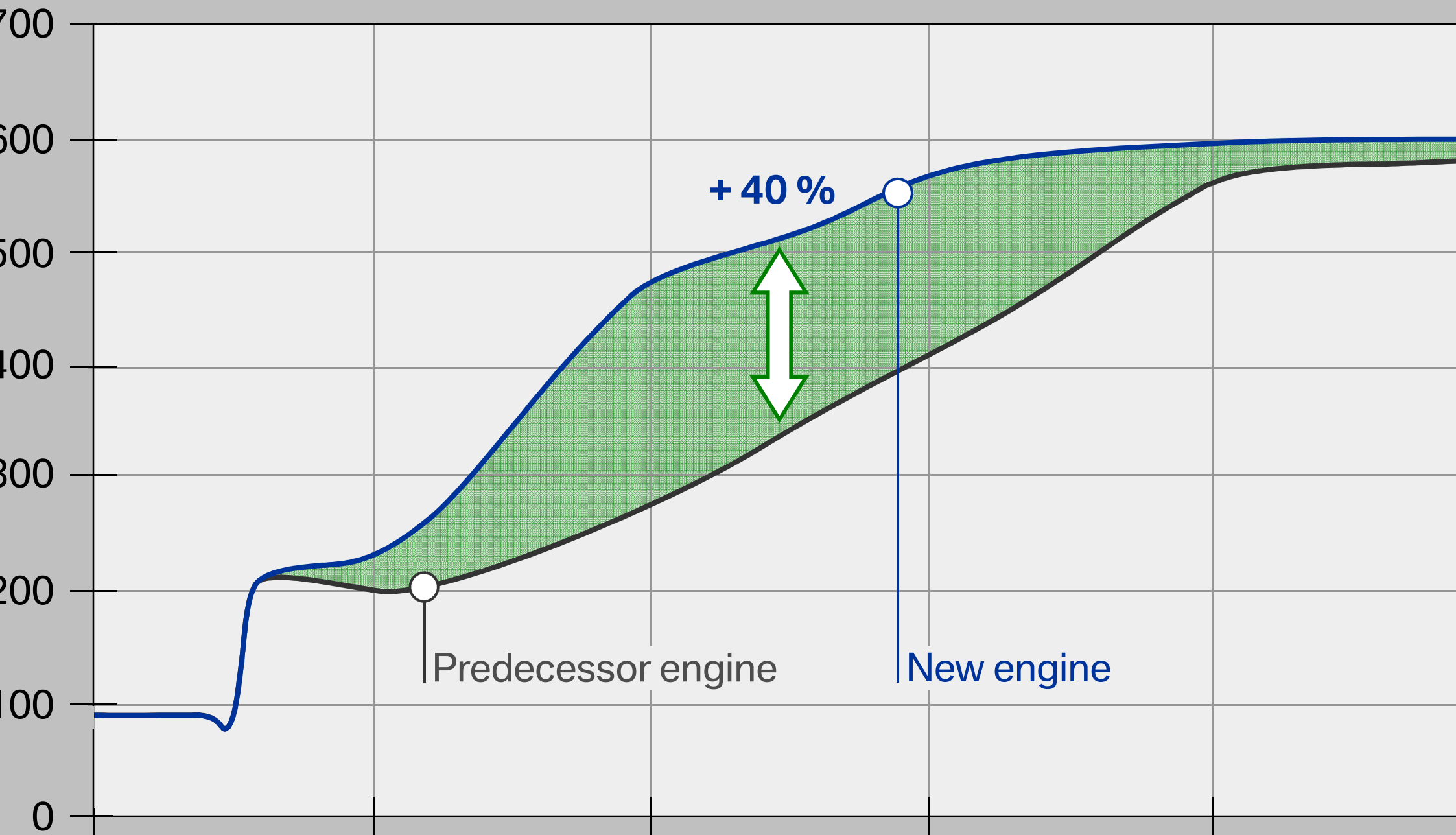
# TwinPower Turbo diesel.

## The result: better performance...



# TwinPower Turbo diesel.

...and even better response.

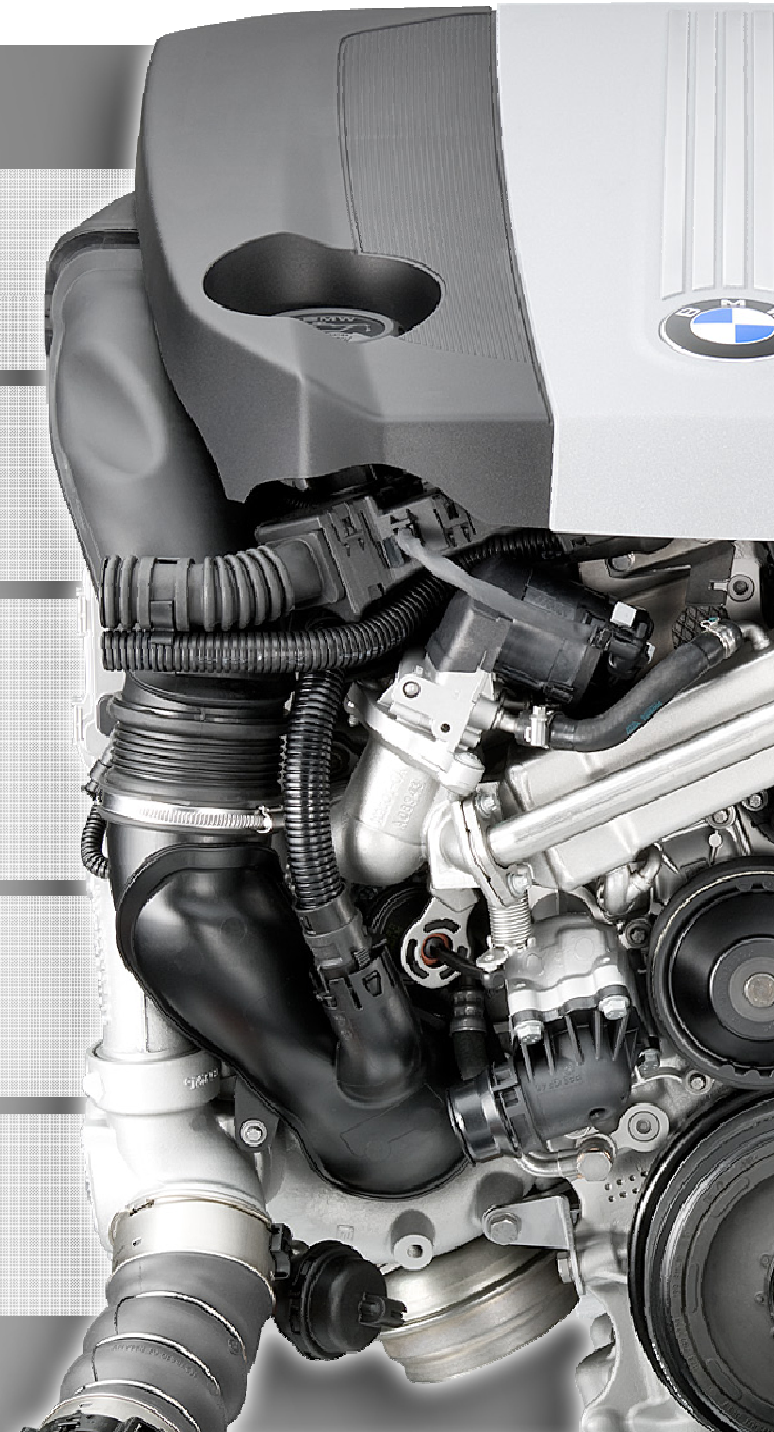


# TwinPower Turbo diesel.

## First application in the BMW 740d.

Output [kW/hp]	225/306	+ 7.1 %*
Torque [Nm]	600	+ 3.4 %*
Consumption in EU test cycle [l/100 km]	6.9	- 23 %**
CO <sub>2</sub> [g/km]	181	- 23 %**
Emission category	EU5	

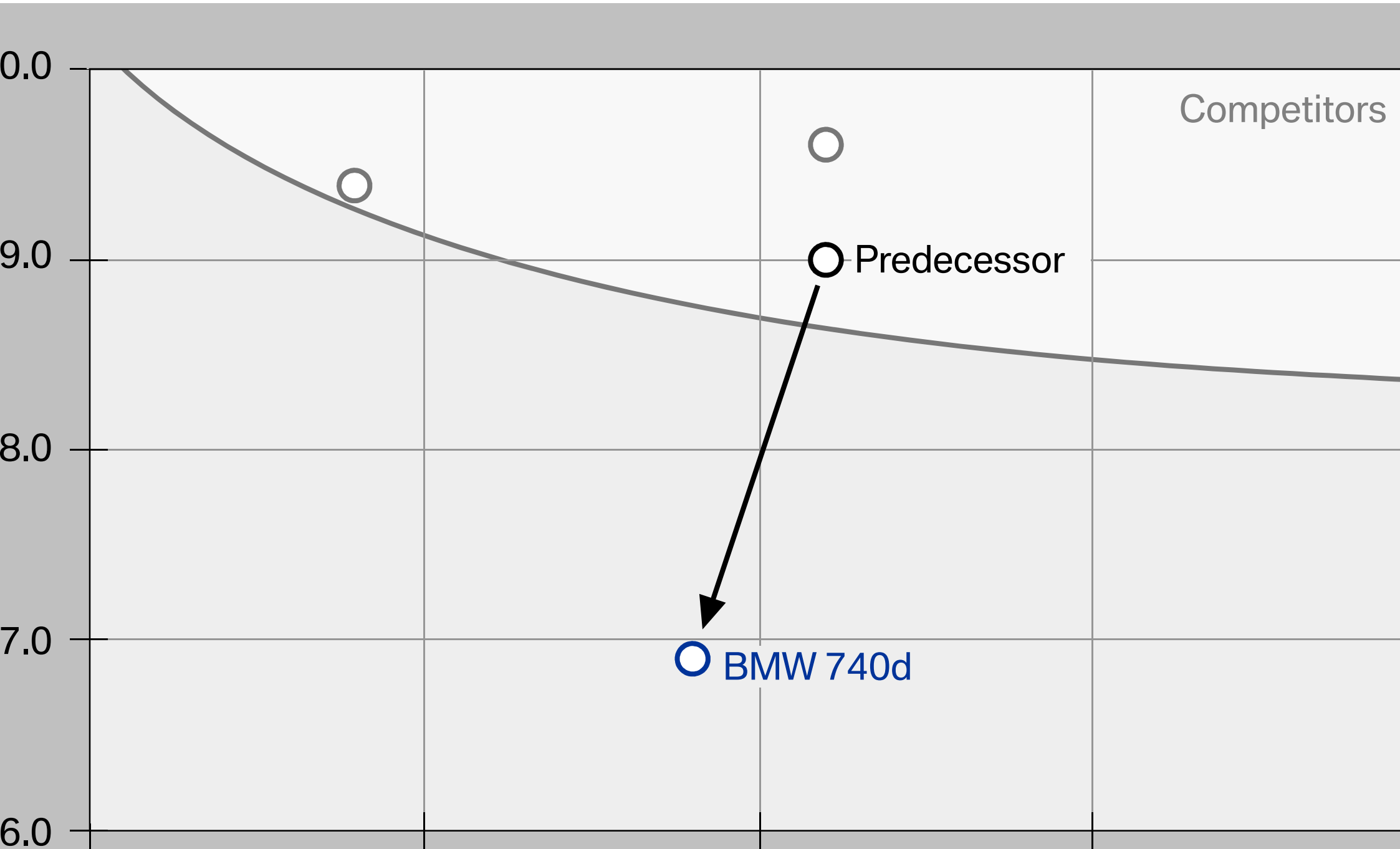
\* Improvement over predecessor engine.





# TwinPower Turbo diesel.

## BMW 740d versus competitors.



# TwinPower Turbo diesel.

## Summary.

- ▶ Basis: The best selling engine concept in competition.
- ▶ The new engine: The most powerful and most efficient engine in competition.
- ▶ First time ever two stage turbo charging with variable turbine geometry.
- ▶ 4<sup>th</sup> generation Common Rail Injection with 2000 bar piezo injectors.
- ▶ All aluminium crankcase.  
3 kg weight savings.
- ▶ EU5 emission level.
- ▶ Particulate filter
  - maintenance free over lifetime.
  - always standard for all markets.
- ▶ Highest power output in



**BMW EfficientDynamics.  
Powertrain Innovations Update.**

**BMW EfficientDynamics.**   
Less CO<sub>2</sub> | More driving pleasure | Simultaneously







