



Schaeffler, Reducing Emissions For Tomorrows Vehic

Presented by
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- 3** LUK Brand Products
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Schaeffler, 3 Strong Brands.

SCHAEFFLER














Company Overview

Automotive

 <p>Transmission</p>	 <p>Engine</p>
 <p>Chassis</p>	 <p>Aftermarket</p>



Industrial

 <p>Power Transmission</p>	 <p>Production Machinery</p>	 <p>Wind Power</p>	
 <p>Aerospace</p>	 <p>Motorcycles</p>	 <p>Railway</p>	 <p>Heavy Industries</p>
 <p>Fluids & Pneumatics</p>	 <p>Consumer Products</p>	 <p>Power Generation</p>	 <p>Industrial Aftermarket</p>



Company overview

A world map in a light grey tone with numerous small green dots scattered across various continents, representing the locations of Schaeffler's R&D centres. The dots are most densely clustered in Europe and North America, with smaller groups in Asia, South America, and Africa.

- **Schaeffler Group sales worldwide – 14.2 Billion Euros.**
- **Schaeffler Group employees worldwide – 92,500.**
- **Schaeffler employees in R&D worldwide – 8000 in 20 R&D centres.**
- **Schaeffler patents in 2018 – 2400**
- **Active patents & patents registered – 26,600**

Company Overview – Everything in the box.

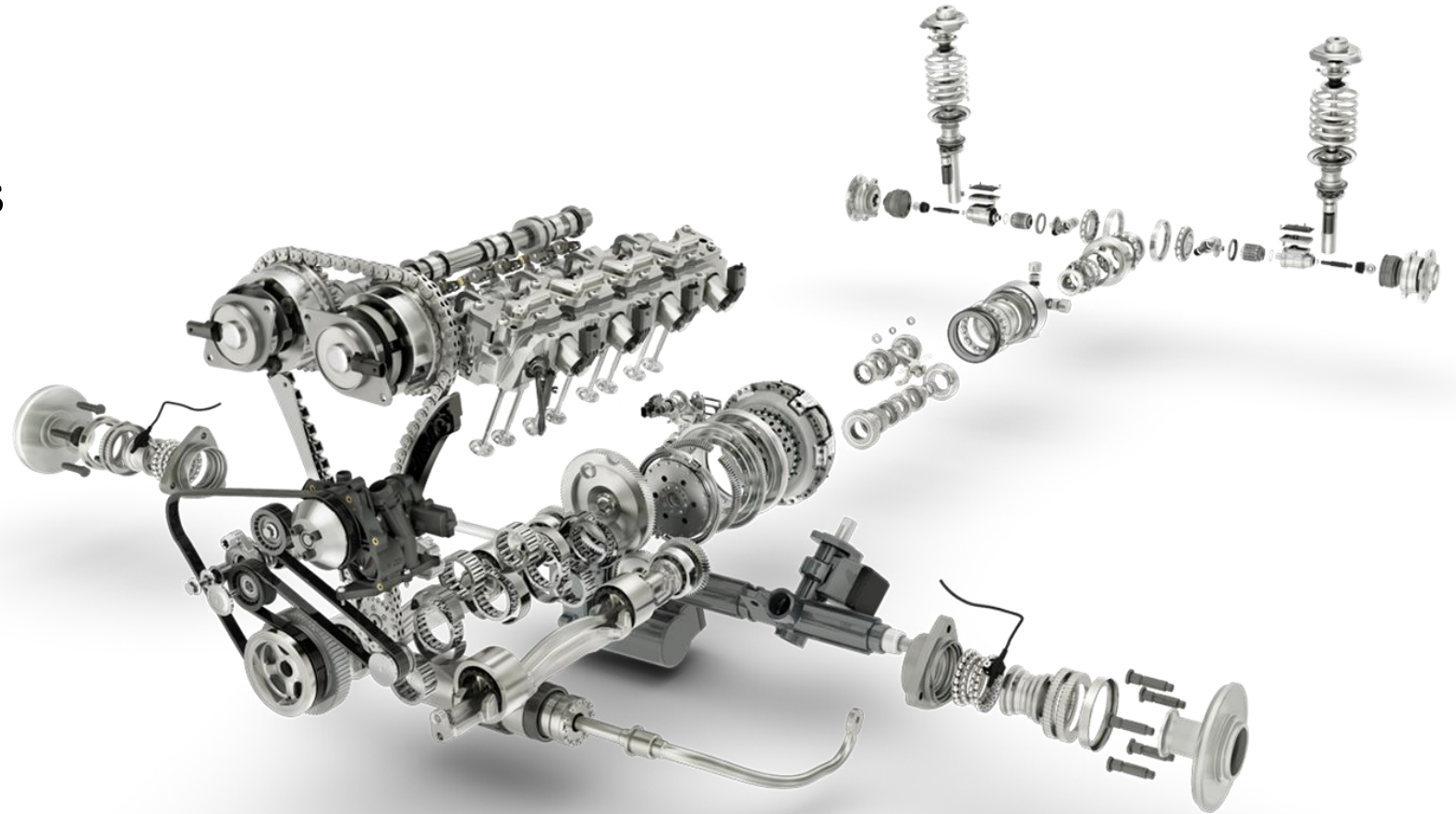


Company Overview – Everything in the box.



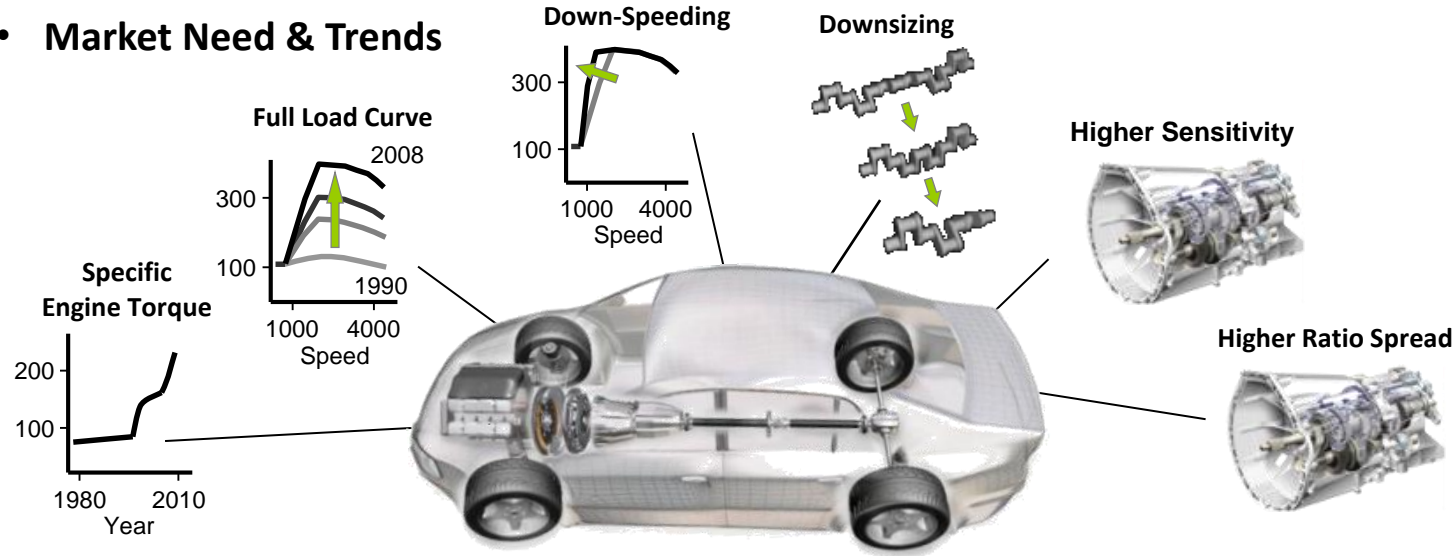
Company Overview

- ❑ Engine Systems
- ❑ Transmission Systems
- ❑ Chassis Systems

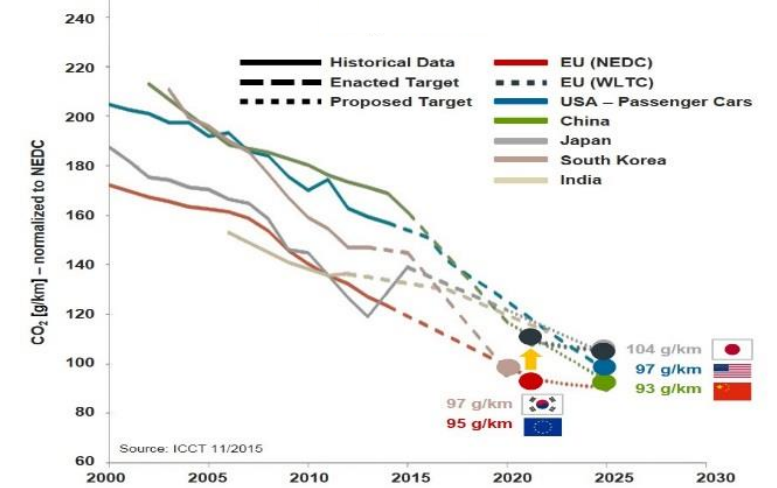


Manufactures Challenges and Trends

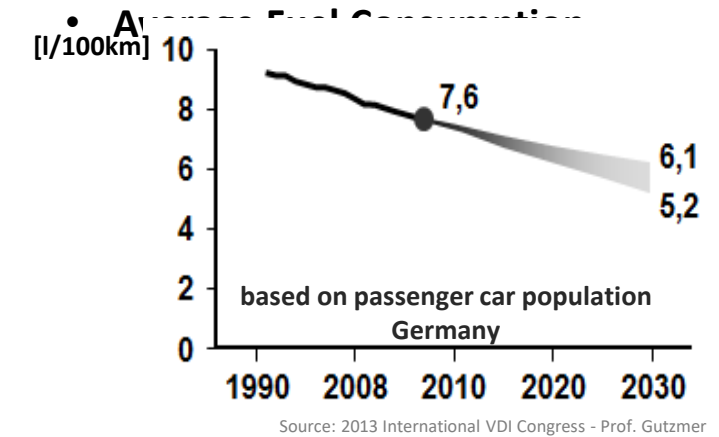
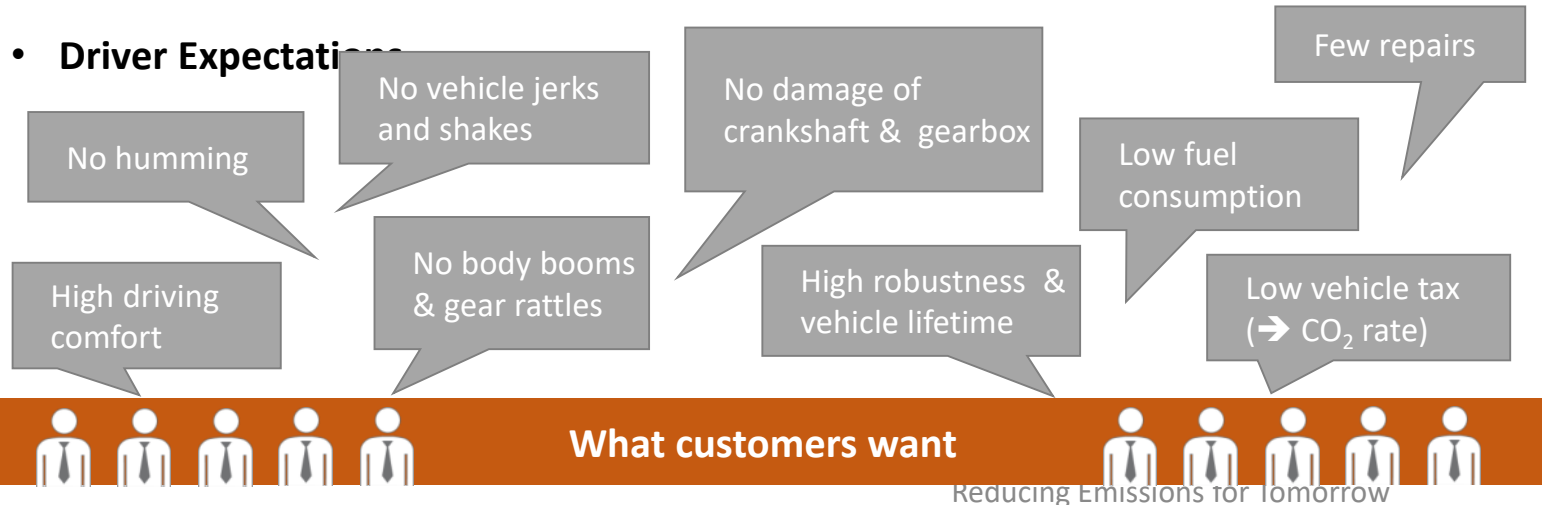
• Market Need & Trends



• CO₂ Limits



• Driver Expectations



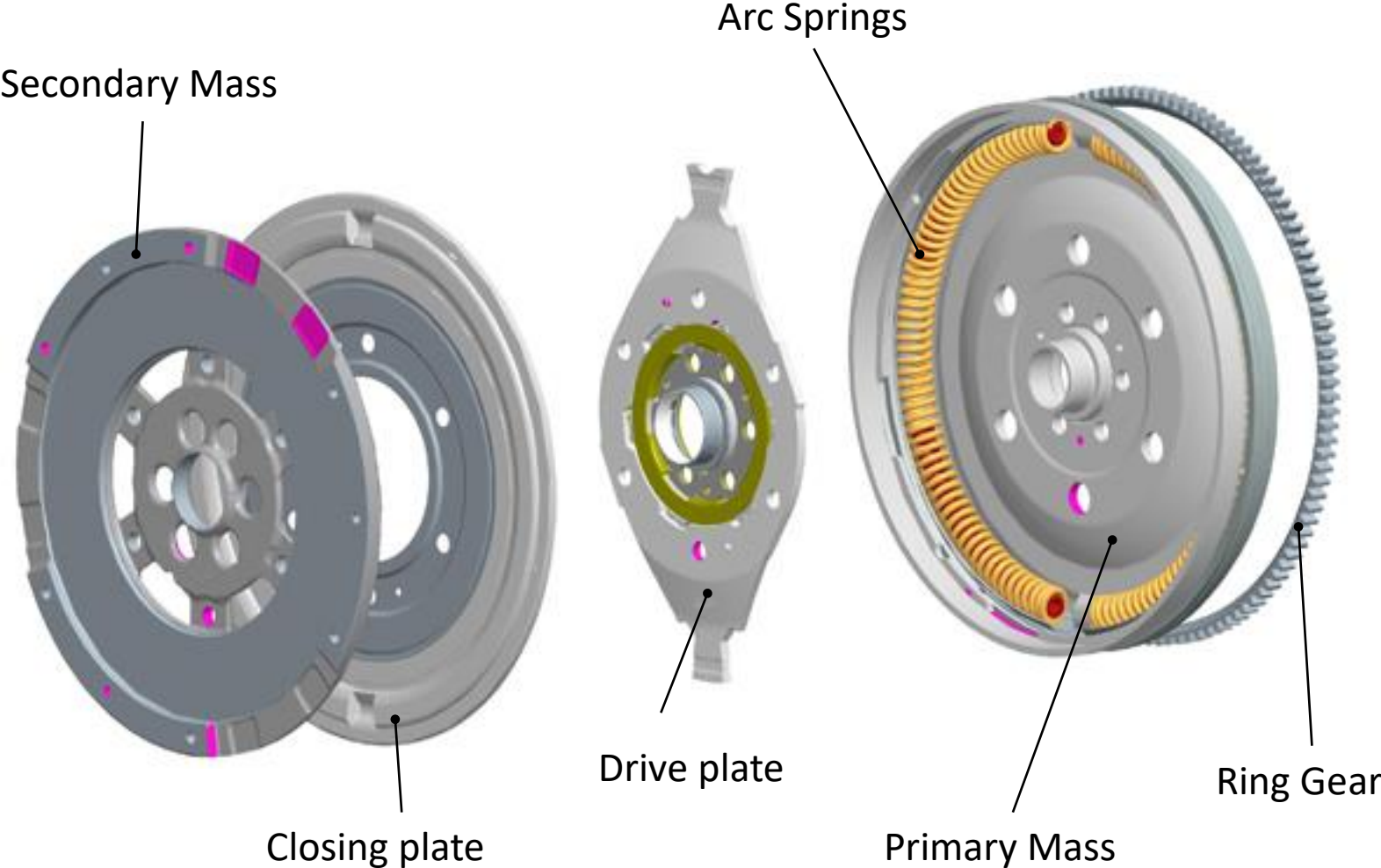
Luk Brand



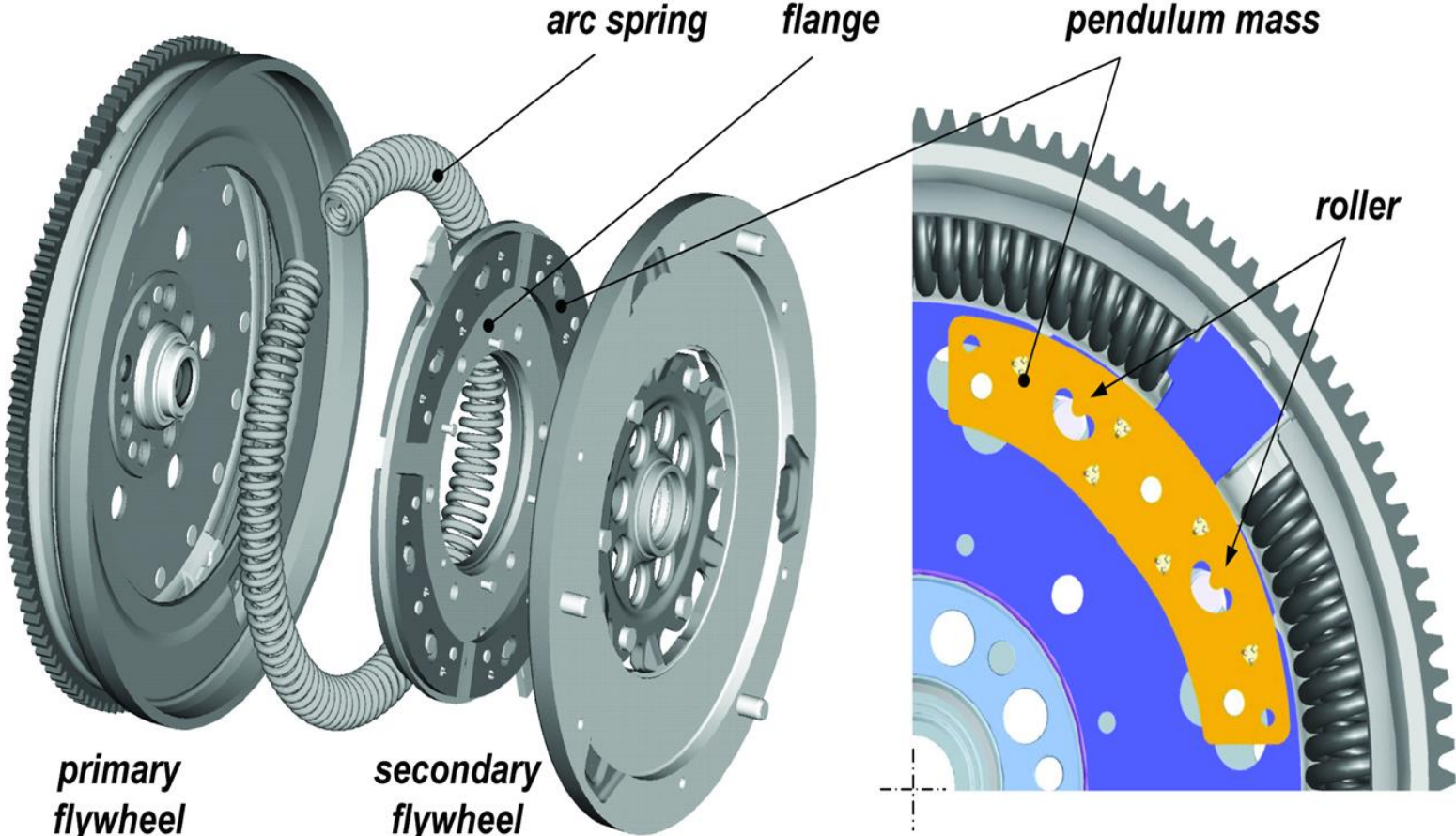
Luk Brand



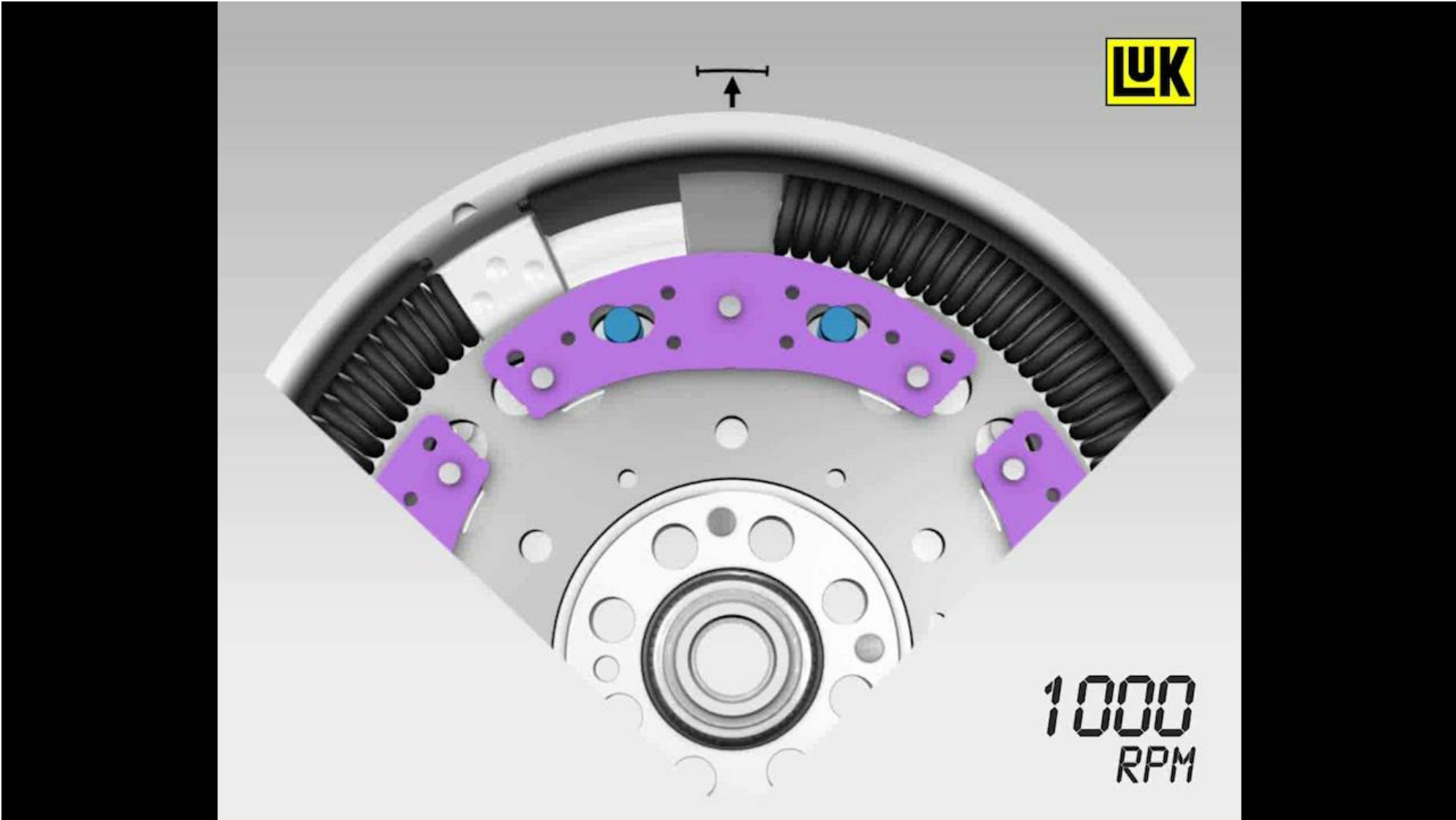
Luk Brand - Standard DMF



Luk Brand - DMF with CPA



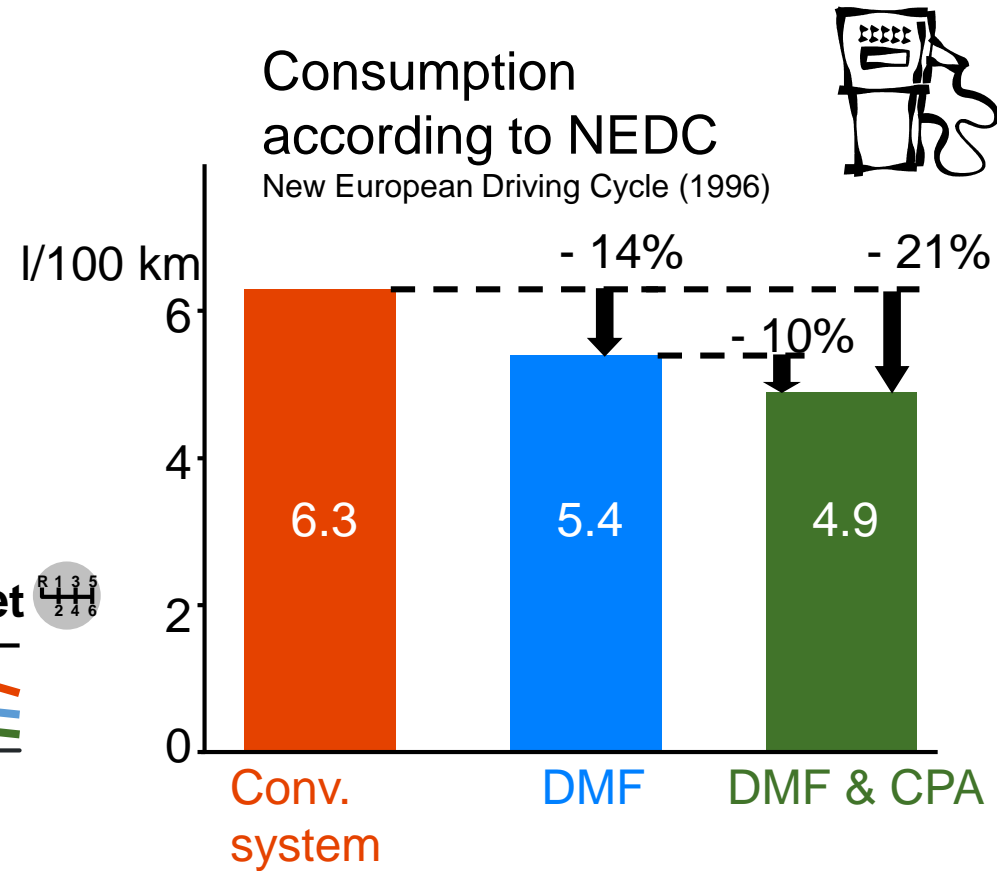
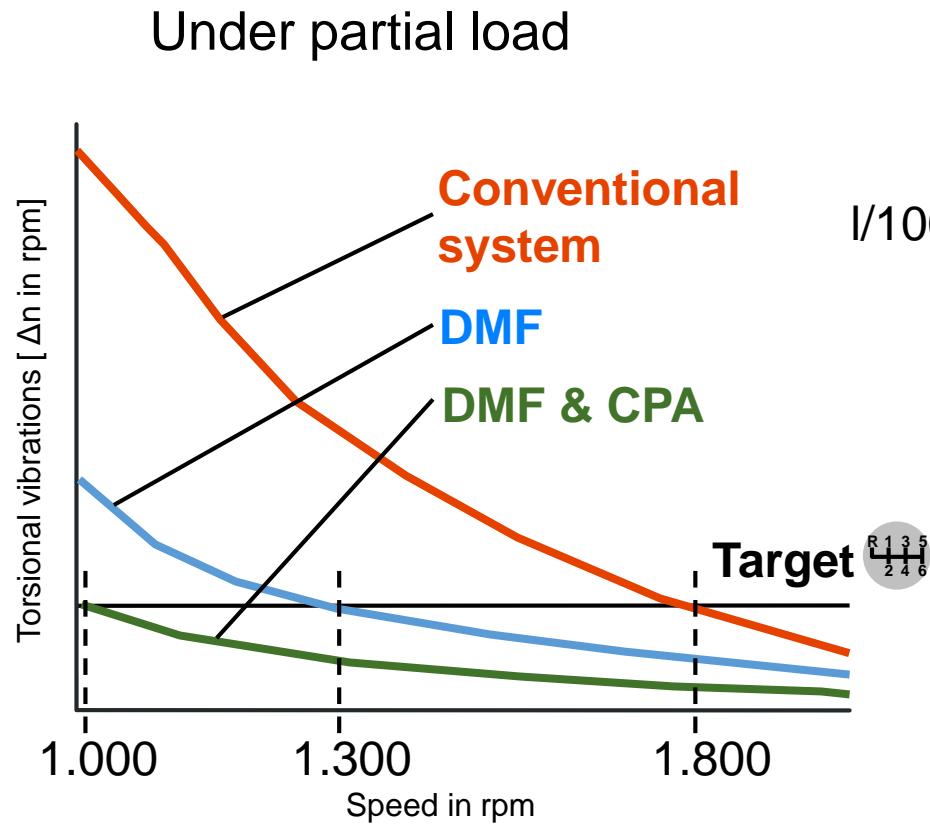
LUK Brand - DMF with CPA



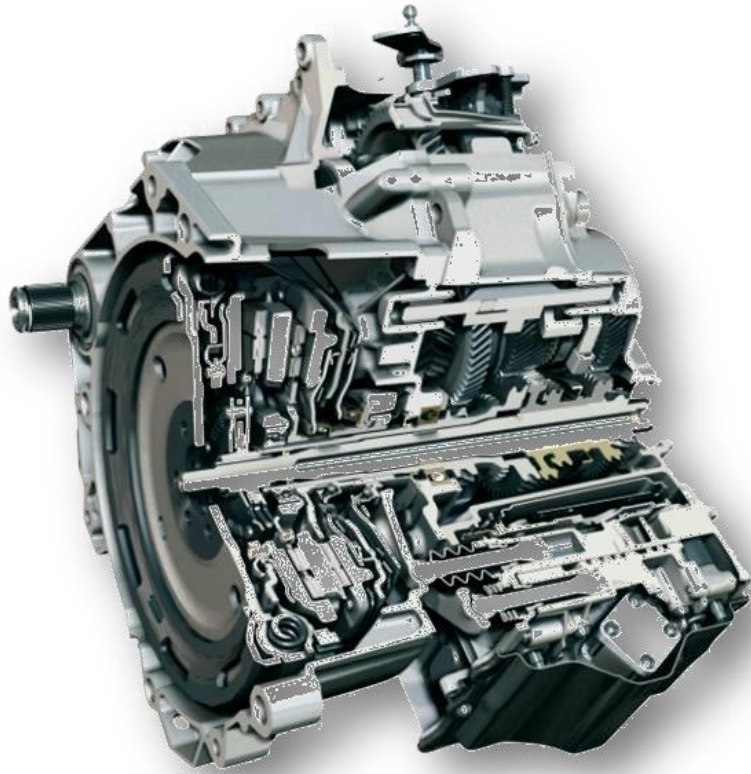
LUK Brand - CPA Clutch Plate



How DMF Technology Reduces Fuel Consumption



LUK Brand - Transmission Technology

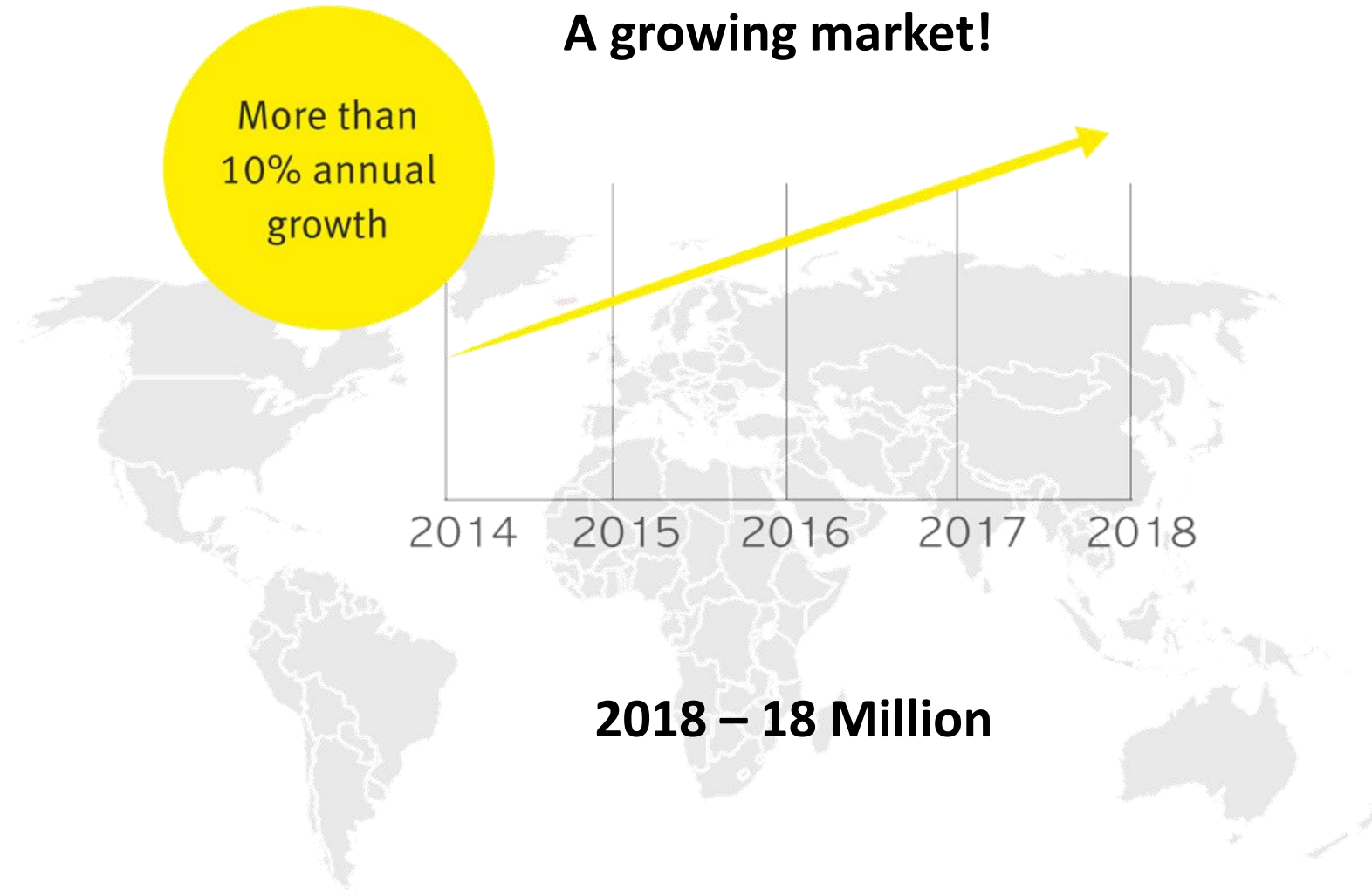


Double Clutch Transmission



Constantly Variable Transmission

LUK Brand - Dry Double Clutch Transmission



LUK Brand - E-Clutch Systems

MTplus	CbW	ECM
		
 <p data-bbox="545 719 805 753">MTplus actuator</p>	 <p data-bbox="1556 801 1824 872">Hydrostatic or mechanical MCA</p>	
<p data-bbox="958 996 1263 1033">Sailing & Efficiency</p>		

CbW:
Clutch by Wire

ECM:
Electronic Clutch Management

Comfort & Fun to Drive

Robustness & Safety



INA Brand - INA History



INA Brand



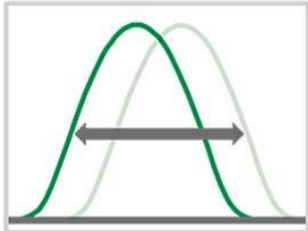
FEAD Kit



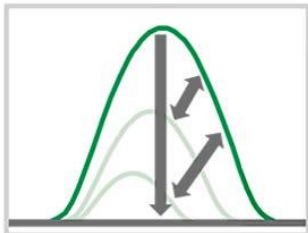
Primary Drive Kit

INA Brand

Feasible Variabilities



Phasing (Timing)



Switchable



Fully variable



Camphaser



Switchable pivot element



Switchable roller finger follower



Cam shifting system

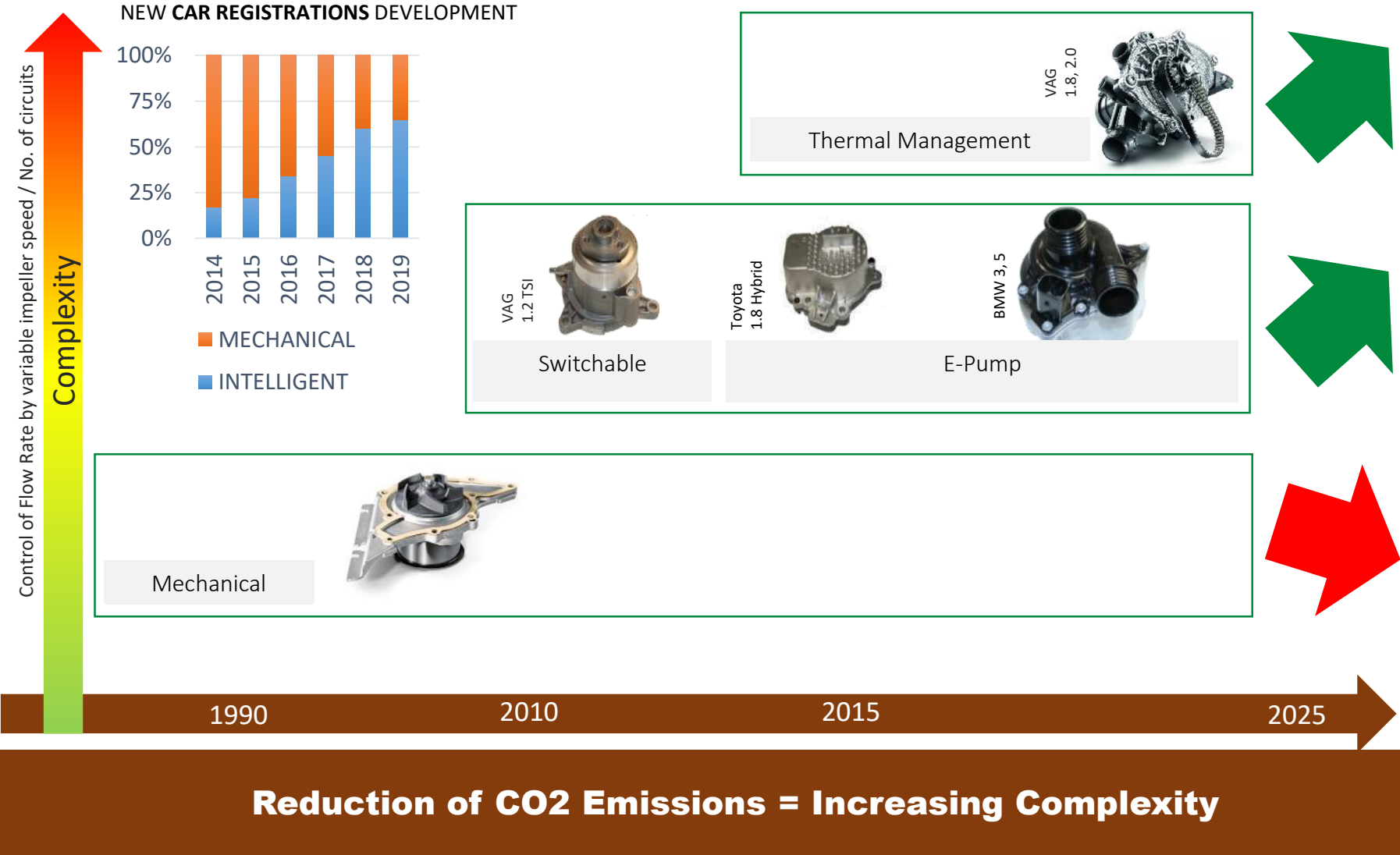


UniAir

Technologies



INA Brand – Thermal Management



INA Brand – Switchable coolant pumps.



INA Brand – Thermal Management



FAG Brand



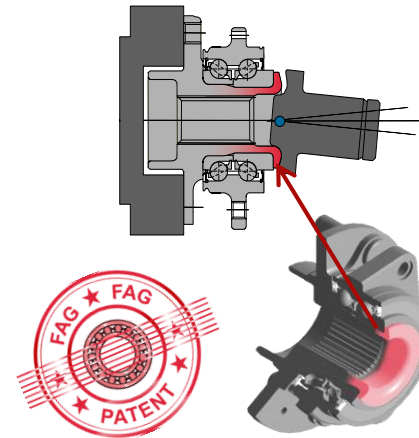
FAG Brand - Orbital Forming

more innovation

FAG is leading in product development and design.

FAG Orbital Forming

- ▶ Hub is gradually formed around the inner ring
- ▶ With integrated clamp force



Axial force during forming sets the preload and reduces mounting effort – hassle free repair!

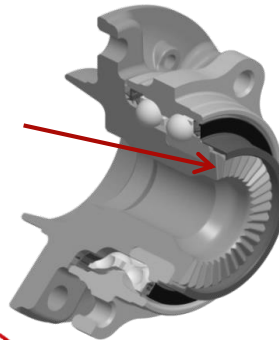
FAG Brand Face Spline & LFT Seals

more innovation

FAG is leading in product development and design.

FAG Face Spline

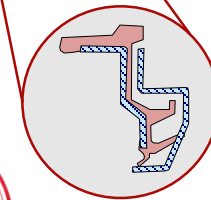
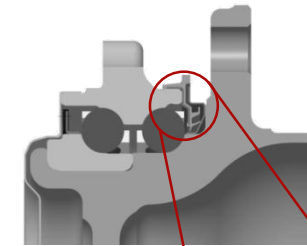
- ▶ More torque reserve (+50%)
- ▶ Stiffer bearing (+10%)
- ▶ Reduced weight (10% per wheel)



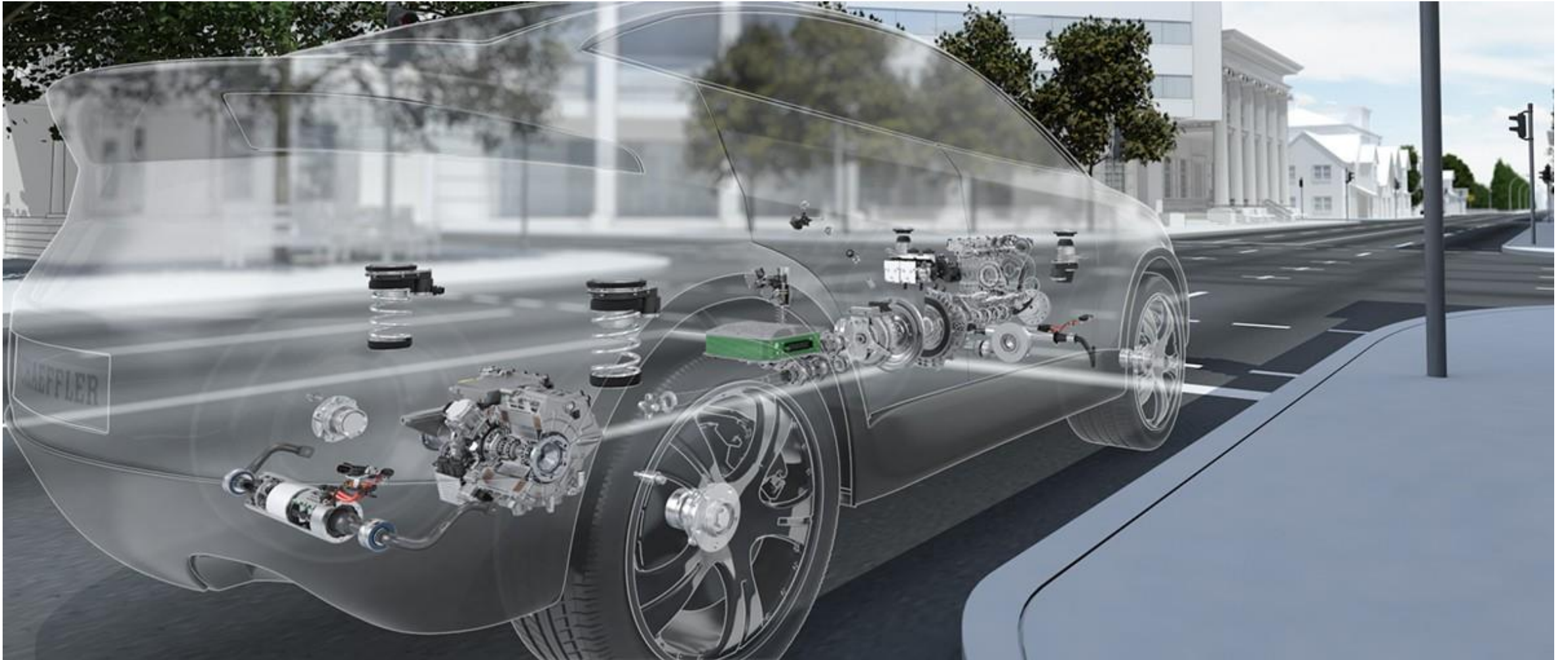
- ▶ Easy assembly and removal
- ▶ Less CO2 emissions
- ▶ Less fuel consumption
- ▶ Improved driving dynamics

FAG Low Friction Torque

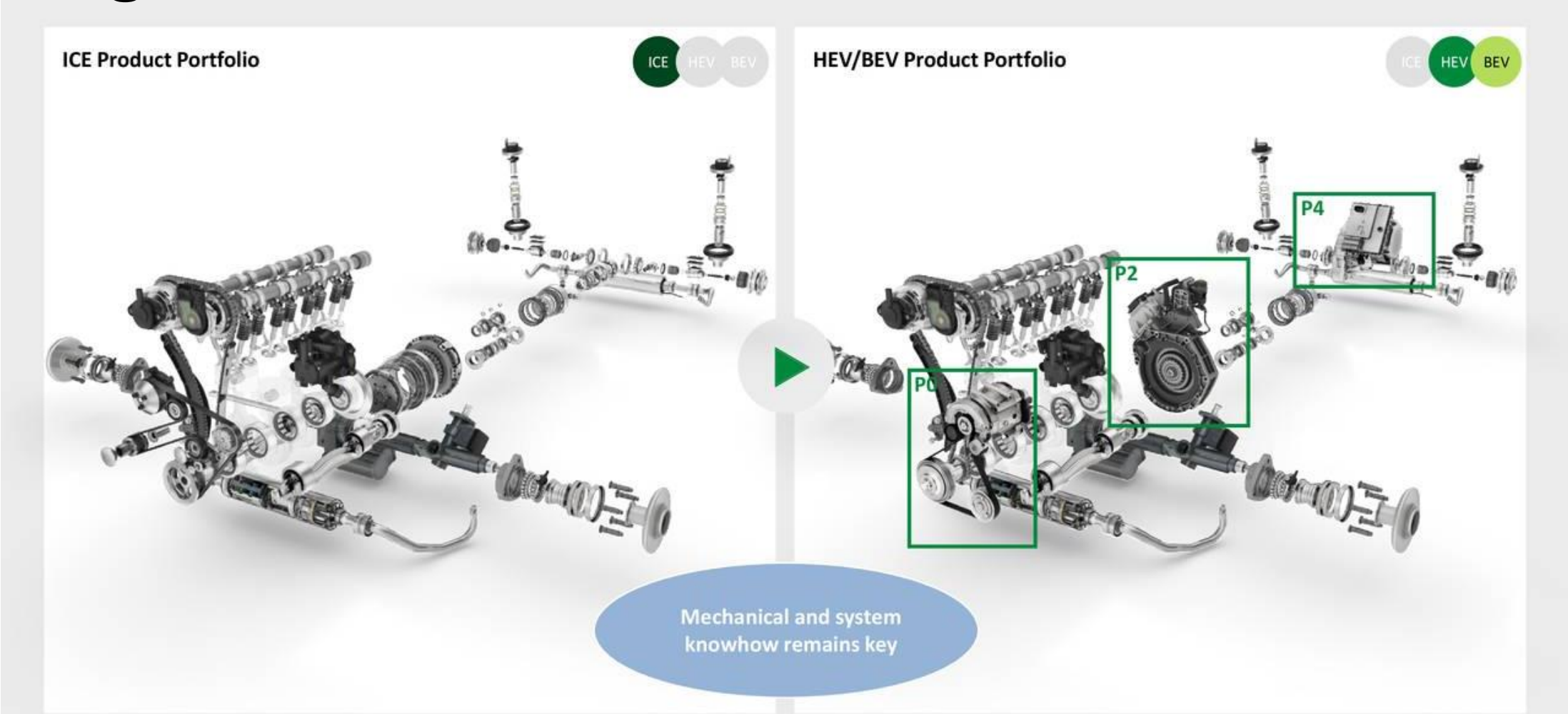
- ▶ Reduced overlap of sealing lips
- ▶ Reduced bearing friction by 50%
- ▶ Pre-sealing labyrinth integrated



Mobility for Tomorrow



Mobility for Tomorrow – Schaeffler’s portfolio changes.

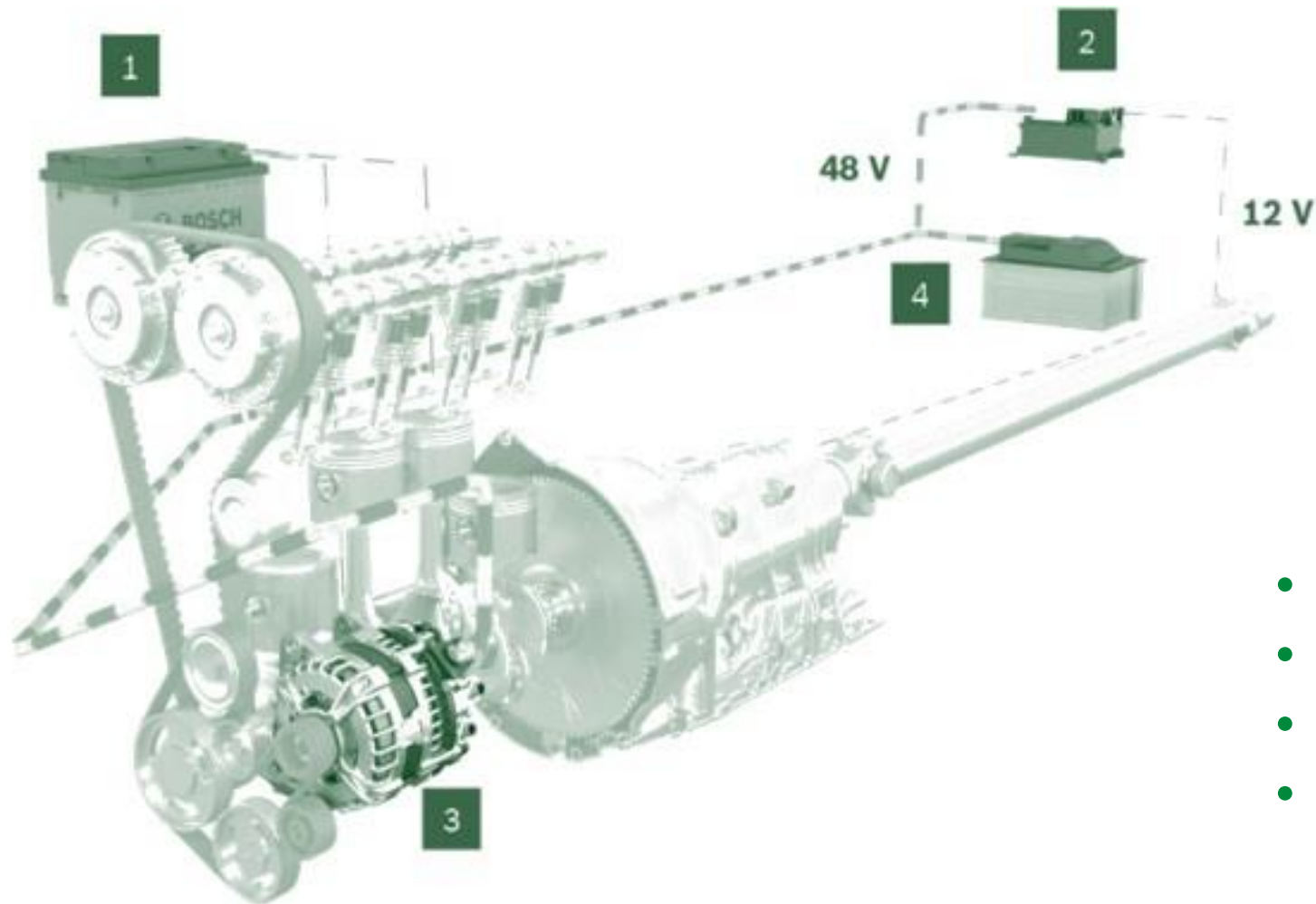


Schaeffler's P0 Mild Hybrid.



- P0 Mild Hybrid has gone from 12 volts to 48 volts, 3Kw – 12Kw.
- Why 48 Volts?
- P0 gives us Start via Belt Drive, Recuperation & Boosting.
- Used on HEV, PHEV, can be used for Start only.
- Low cost & simple to fit.

Schaeffler's P0 Mild Hybrid, low cost & simple to fit.



- 1 – 12 Volt Battery.
- 2 – DC/DC Converter.
- 3 – 48 Volt Starter Generator.
- 4 – 48 Volt Battery.

Schaeffler's P0 Mild Hybrid Challenges.



Schaeffler's P0 Mild Hybrid Challenges.



Pulley De-coupler



Switchable De-coupler

Schaeffler's P0 Mild Hybrid Challenges, Belt Tension.

Belt start or boost



Decoupling around E-machine axis



Recuperation



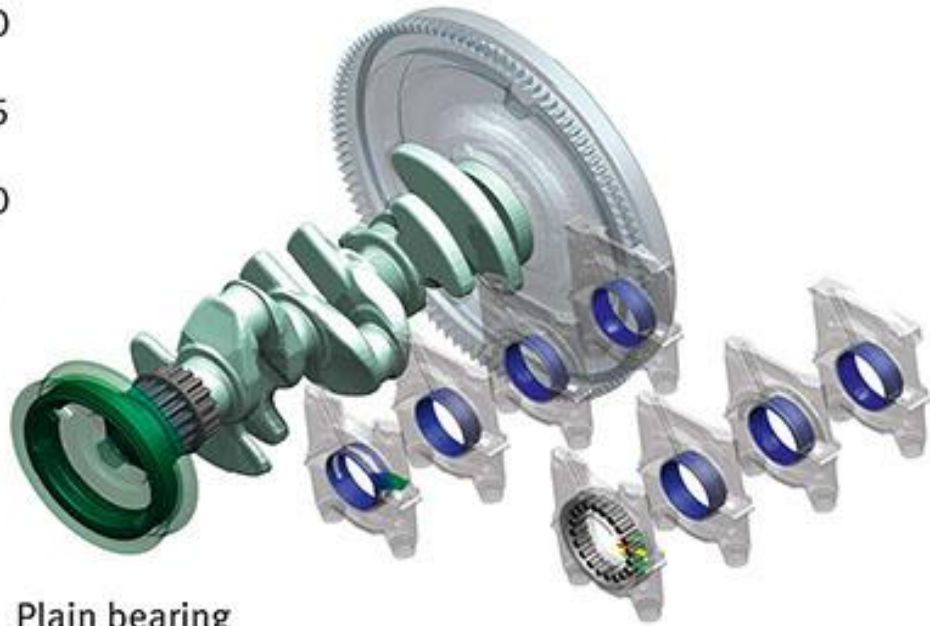
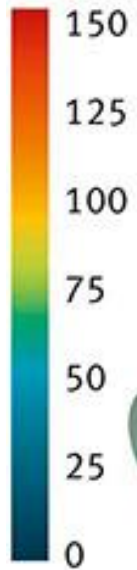
Schaeffler's P0 Mild Hybrid Challenges, Belt Tension.





Schaeffler's P0 Mild Hybrid Challenges.

Pressure
in MPa



Plain bearing
crankshaft

1st rolling
bearing

Crank Roller Bearings



Reinforced Drive Belts

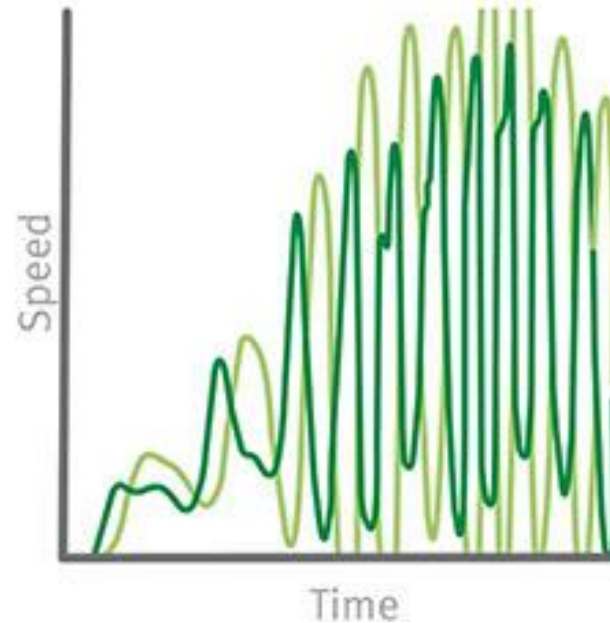


Minimum Pulley Diameter

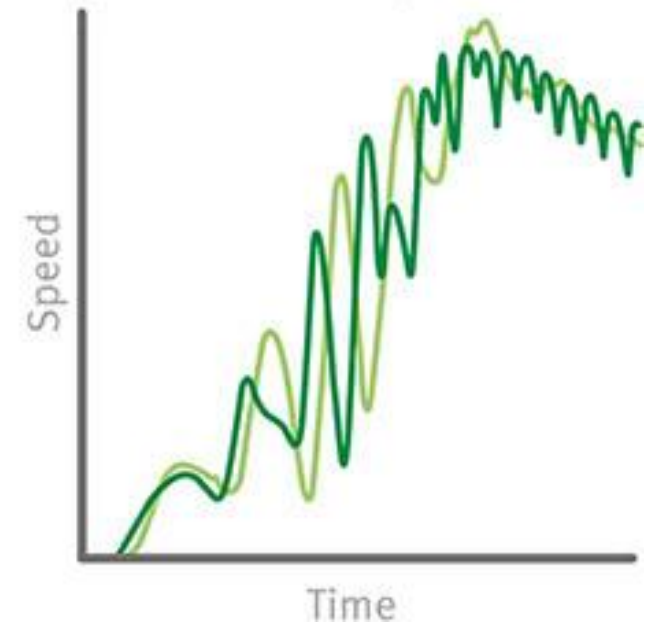
Schaeffler's P0 Mild Hybrid Challenges



BAS-start with resonance



BAS-start optimized

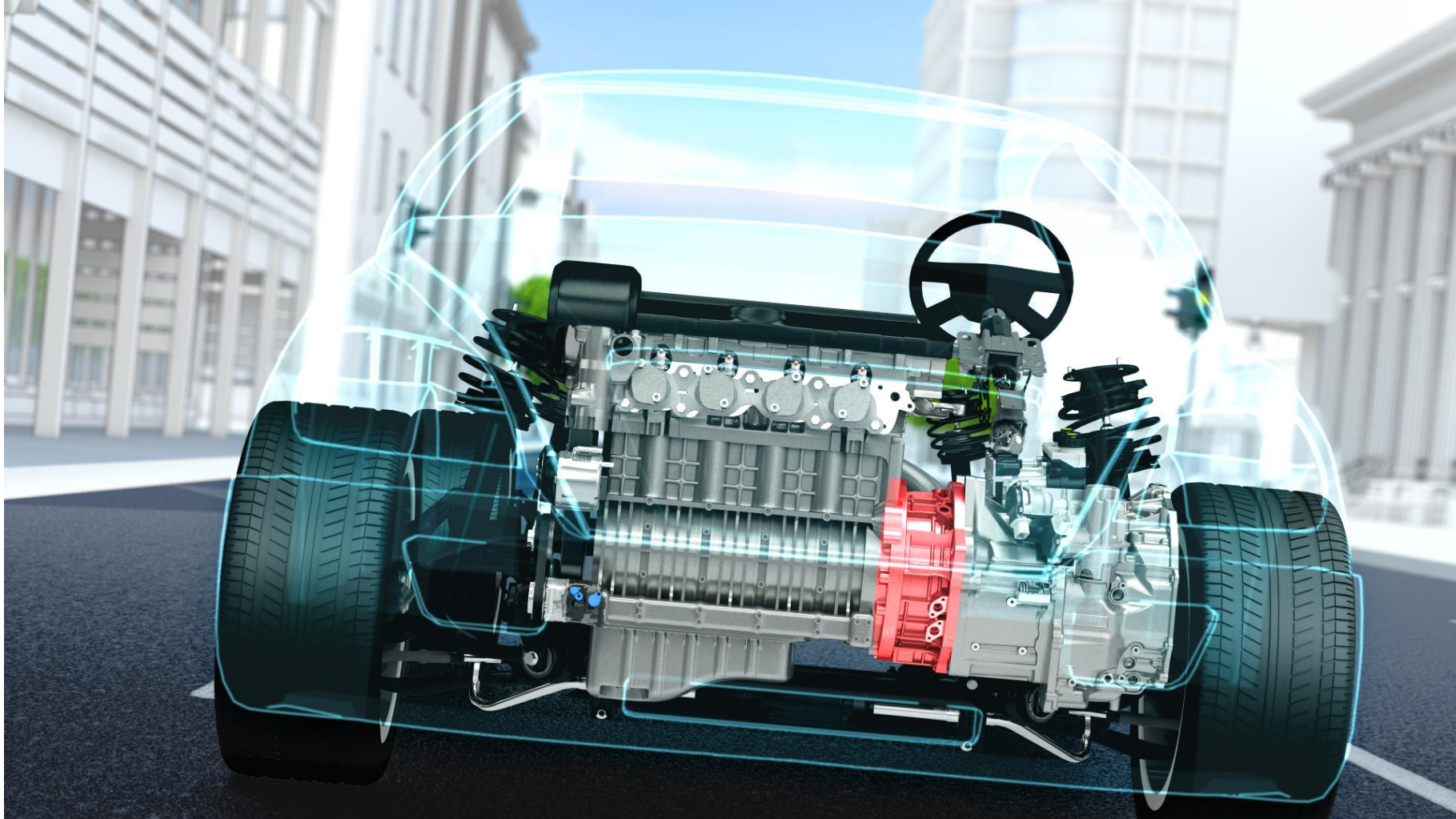


Schaeffler's P0 – Summary.

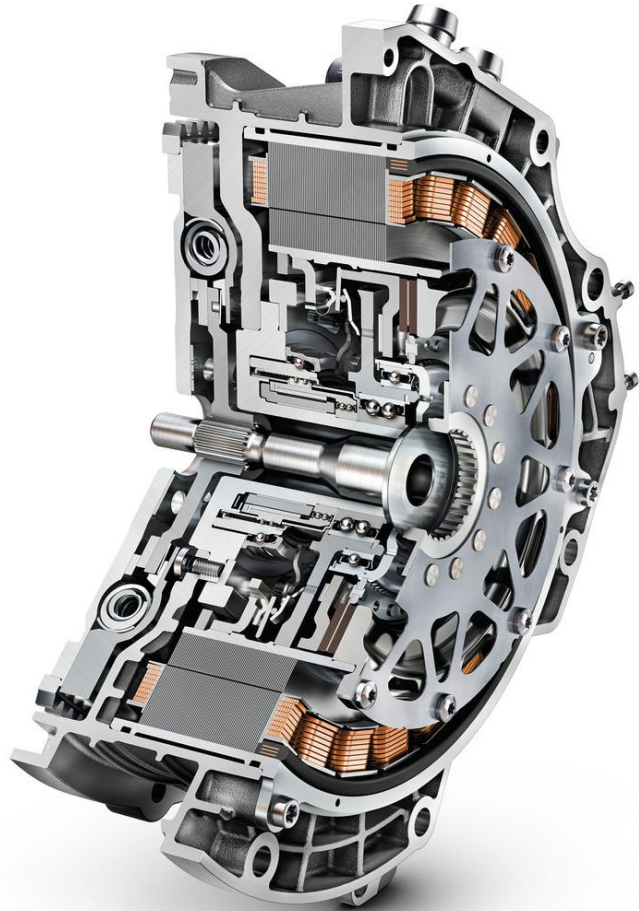


- **P0 – Up to 7% fuel saving.**
- **P0 – Low cost & easy to install.**
- **P0 – 15 to 25 bhp E Boost.**
- **P0 – Pulley de-coupler good for 1 million start/stops.**

P2 Hybrid Module.

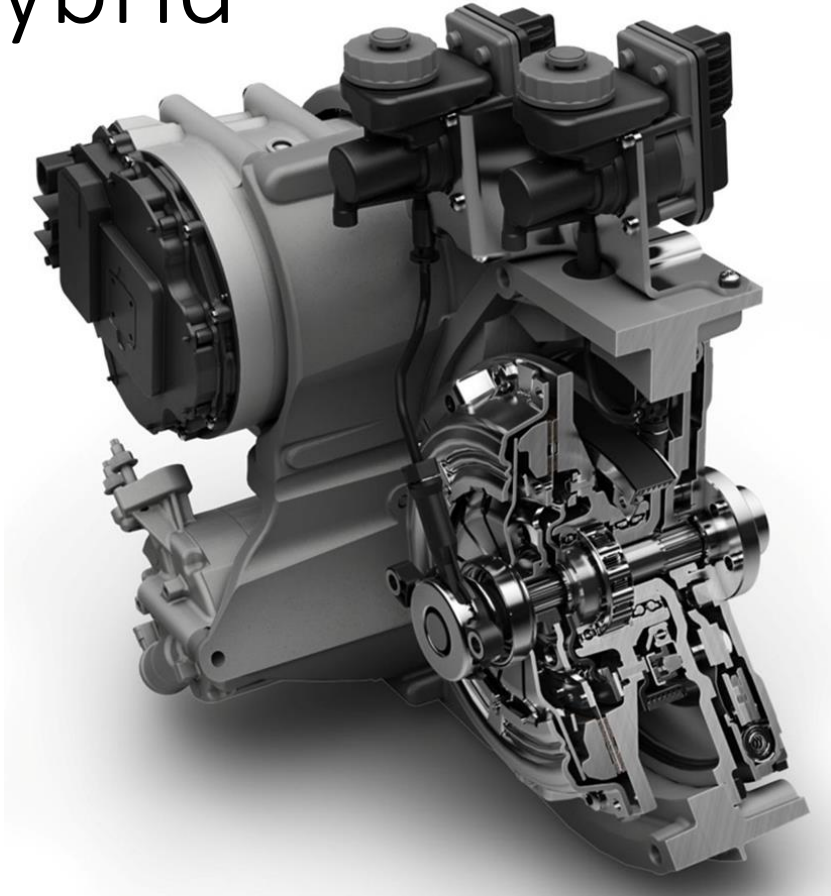


Schaeffler's P2 High Voltage Drive.

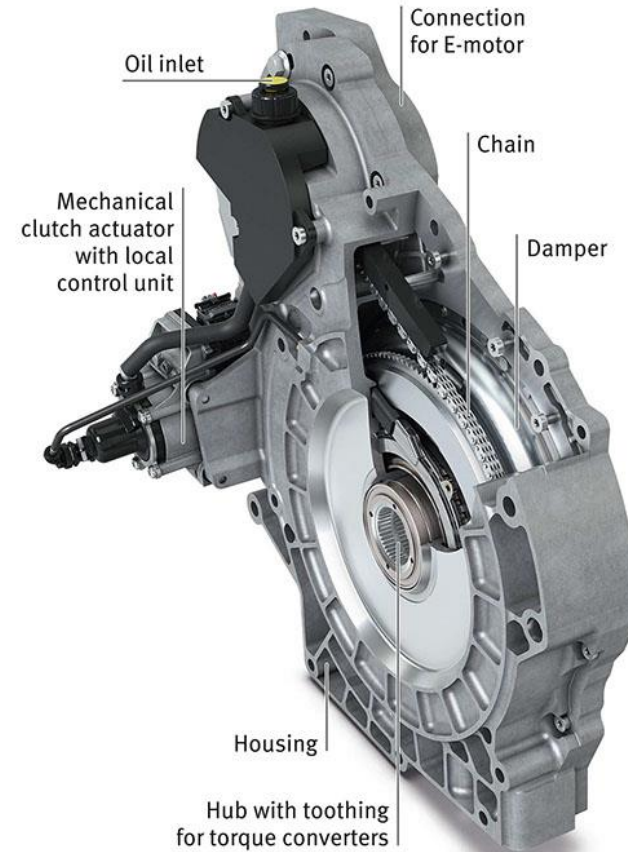


- **P2 – Up to 800 Nm torque.**
- **P2 – Used for 48 Volt & High voltage applications.**
- **P2 – Mechanical damper & electrical damper.**
- **P2 – Easily coupled to automatics & DCT.**
- **P2 – Easily adapted for car manufactures.**
- **P2 – Integrated clutch.**

Mobility for Tomorrow – P2 48 Volt Mild Hybrid

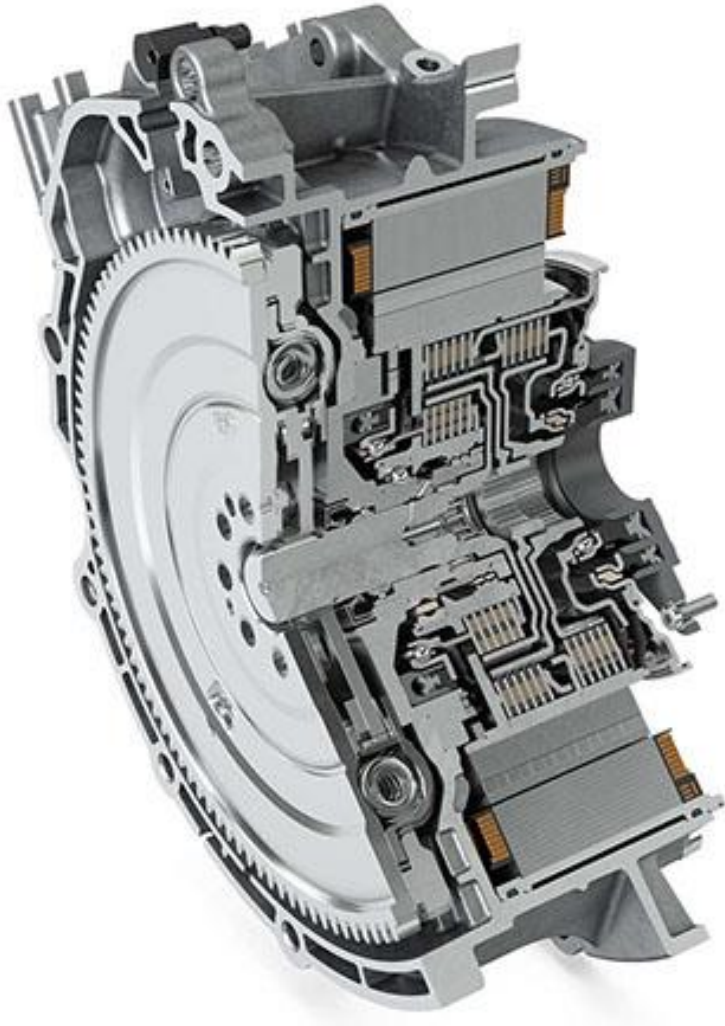


Generation 1



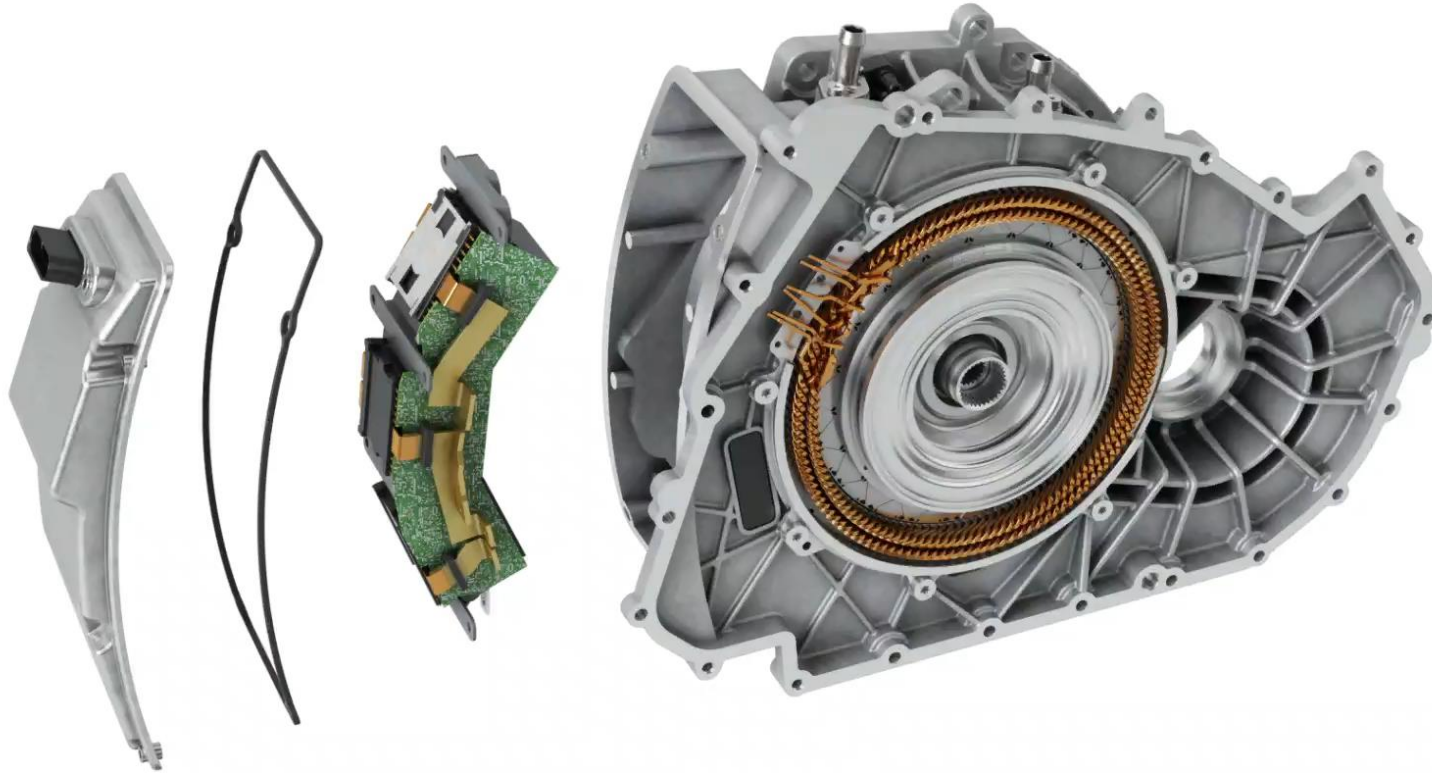
Generation 4

P2 High Voltage Hybrid Module with Disconnect Clutch.

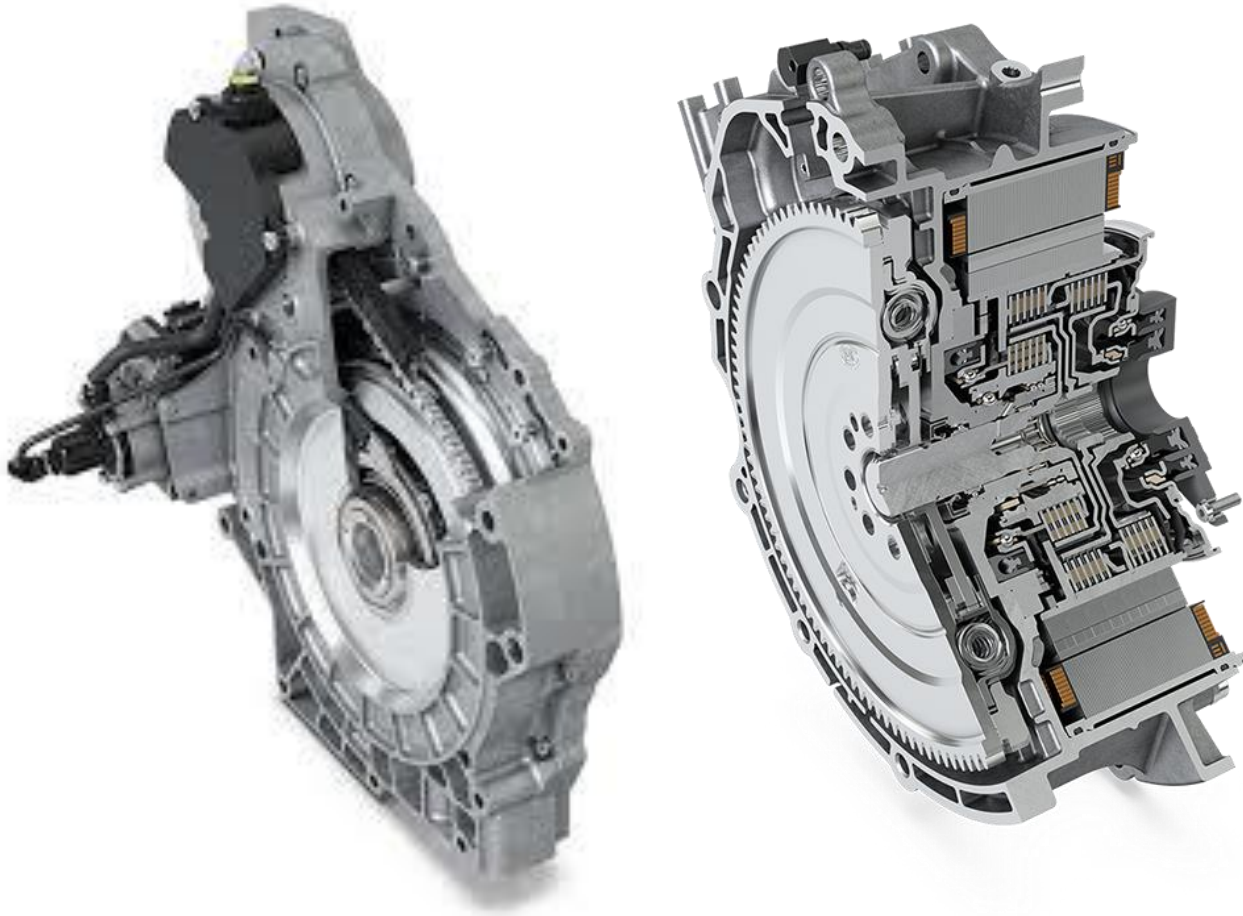


- **P2 – 100 kW Output.**
- **P2 - Producing 350 Nm Torque.**

P2 High Voltage Hybrid Module



Schaeffler's P2 – Summary.



- **P2 – Easily adapted for car manufactures.**
- **P2 – Up to 22% fuel saving.**
- **P2 – Up to 800 Nm torque.**
- **P2 – Coasting up to 100 Mph.**
- **P2 – One way clutch to improve efficiency.**

Schaeffler P4 – e axle.

Electrified drive architectures

The entire field of electric mobility – which includes electric and hybrid vehicles – will determine tomorrow's mobility. From high-voltage hybrid modules through to electric axles and visionary wheel hub drives – Schaeffler offers a wide range of products for the age of electrified drive architectures.

HYBRID MODULE
Plug-in hybrids can also operate using electric power only and therefore make local emission-free driving possible. Schaeffler offers technologies for this, such as the high-performance **hybrid module for 48-volt and high-voltage applications** – systems that ensure efficient future mobility thanks to the perfect interplay of electric motor, power electronics, battery, and additional internal combustion engine.

Power electronics
P2 hybrid module

WHEEL HUB DRIVE
Schaeffler's **E-Wheel Drive** is an innovative technical solution for tomorrow's mobility. The highly-integrated drive enables completely new vehicle concepts. The wheel hub drive provides advantages in terms of space utilization, maneuverability, driving dynamics, and active safety, which make it particularly suitable technology for future, automated driving.

E-Wheel Drive

SCHAEFFLER

ELECTRIC AXLE
With the **electric axle**, Schaeffler has developed a modular system solution for hybrid vehicles and all-electric cars. The all-electric drive is available in a coaxial or parallel axis design, it is installed on the front and rear axle and can, if required, be supplemented with functions such as torque vectoring or parking lock.

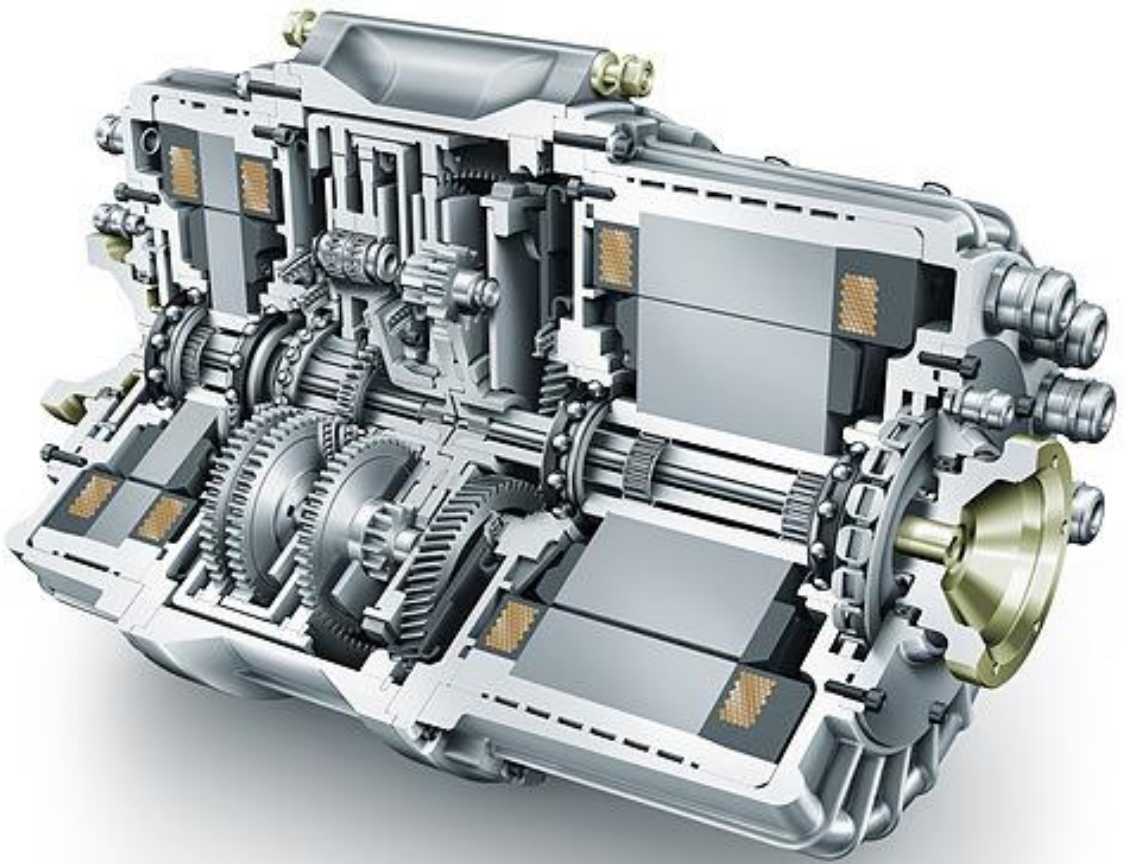
Battery
Power electronics
Electric axle
TMM module

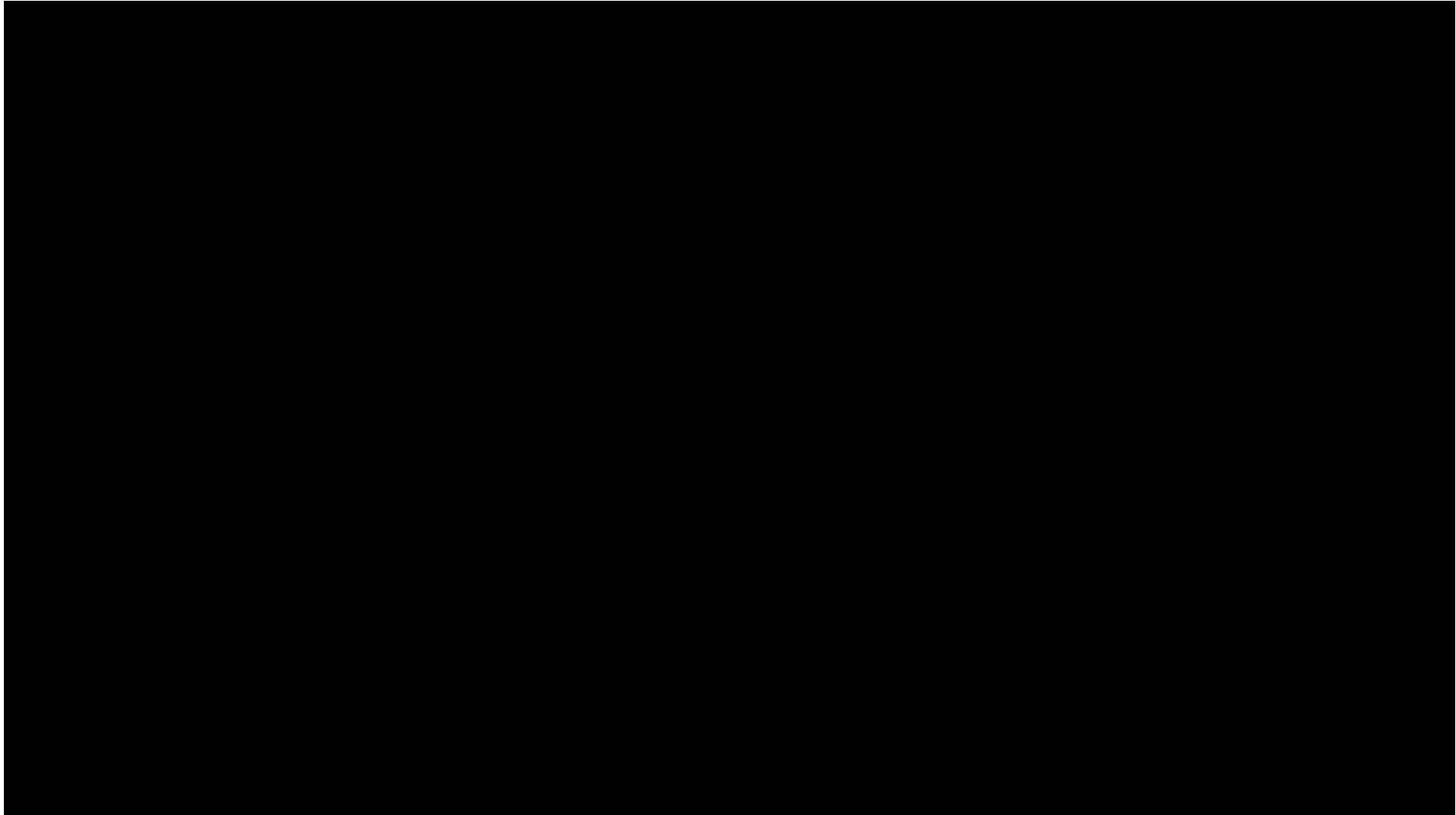
Schaeffler P4 – e axle.



- **210 Kw per motor = 282Bhp.**
- **Torque distribution & vectoring giving improved vehicle safety.**

Schaeffler P4 – e axle.





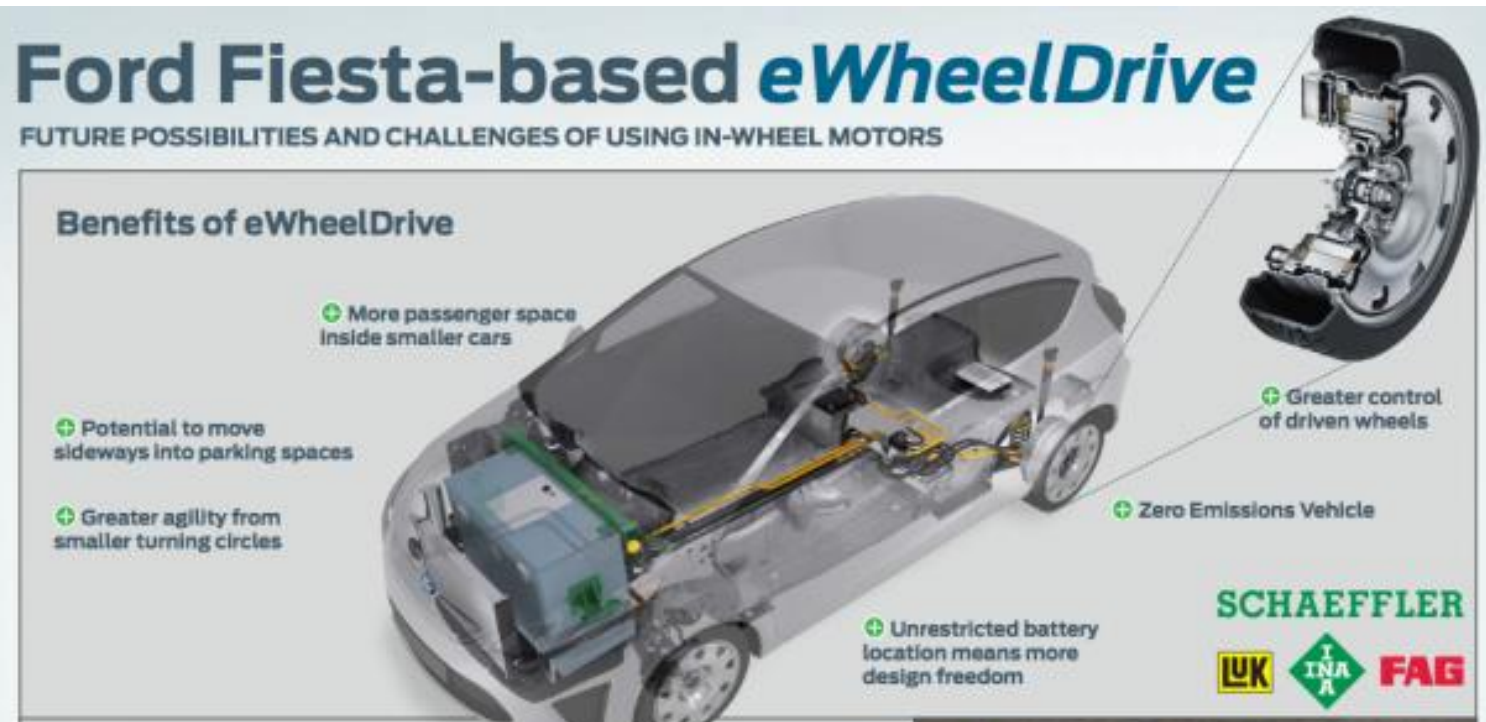
Schaeffler P4 – e axle



Mobility for Tomorrow – e Wheel Drive

Ford Fiesta-based eWheelDrive

FUTURE POSSIBILITIES AND CHALLENGES OF USING IN-WHEEL MOTORS





Benefits of eWheelDrive

- More passenger space inside smaller cars
- Potential to move sideways into parking spaces
- Greater agility from smaller turning circles
- Greater control of driven wheels
- Zero Emissions Vehicle
- Unrestricted battery location means more design freedom

SCHAEFFLER
LUK **INA** **FAG**

Challenges for eWheelDrive

- Minimise high speed effects of heavier wheels
- Ensure noise and vibration is minimal
- Deliver required torque
- Improve braking performance
- Optimise suspension performance



Mobility for Tomorrow – Schaeffler “Mover”

One platform – many possibilities

The Schaeffler Mover with **wheel-hub drive** provides a flexible and zero-emissions platform for diverse vehicle concepts. All drive and suspension modules are installed in a single unit, the **“Schaeffler Intelligent Corner Module.”** The module is easily scalable in terms of vehicle length and width as well as for maximum space for new cabin concepts.

SCHAEFFLER

Maximum maneuverability

The Schaeffler design permits a steering angle of up to 90°. This results in enormous agility of the vehicle and also makes parking maneuvers possible with minimal space requirements.

Intelligent Corner Module

- Steering motor with transmission
- Yoke
- Spring and dampers
- Wheel-hub drive

Variable vehicle concepts

The vehicle’s platform, the **“Rolling Chassis,”** houses the entire drive technology. Various body versions for passenger and cargo transportation can be installed on top of this platform without any modifications of the drive system and suspension.

various body versions

“Rolling-Chassis”

Graphic: www.josekdesign.de

Mobility for Tomorrow



Schaeffler Mover

Mobility for Tomorrow



Mobility for Tomorrow

With the world champion's powertrain

The Schaeffler 4ePerformance concept car uses powertrains from Formula E to demonstrate how quickly engineering from motorsport can move into production-based powertrain architectures. Engineers use the vehicle as a test laboratory for the development of efficient and powerful electric mobility technologies.

Formula E as a development laboratory

Formula E is an ideal field for the development of modern powertrain technologies. This is where Schaeffler engineers gather valuable data and experiences that are transferred from the race track into the development of powertrains for production vehicles.

Technology transfer

At Schaeffler, the experiences gained in racing are fed into production development. The product range – of diverse voltage levels – extends from **components for belt-driven starter-generator systems and hybrid modules** to **e-axles and electric wheel hub drives**.

High-performance powertrains

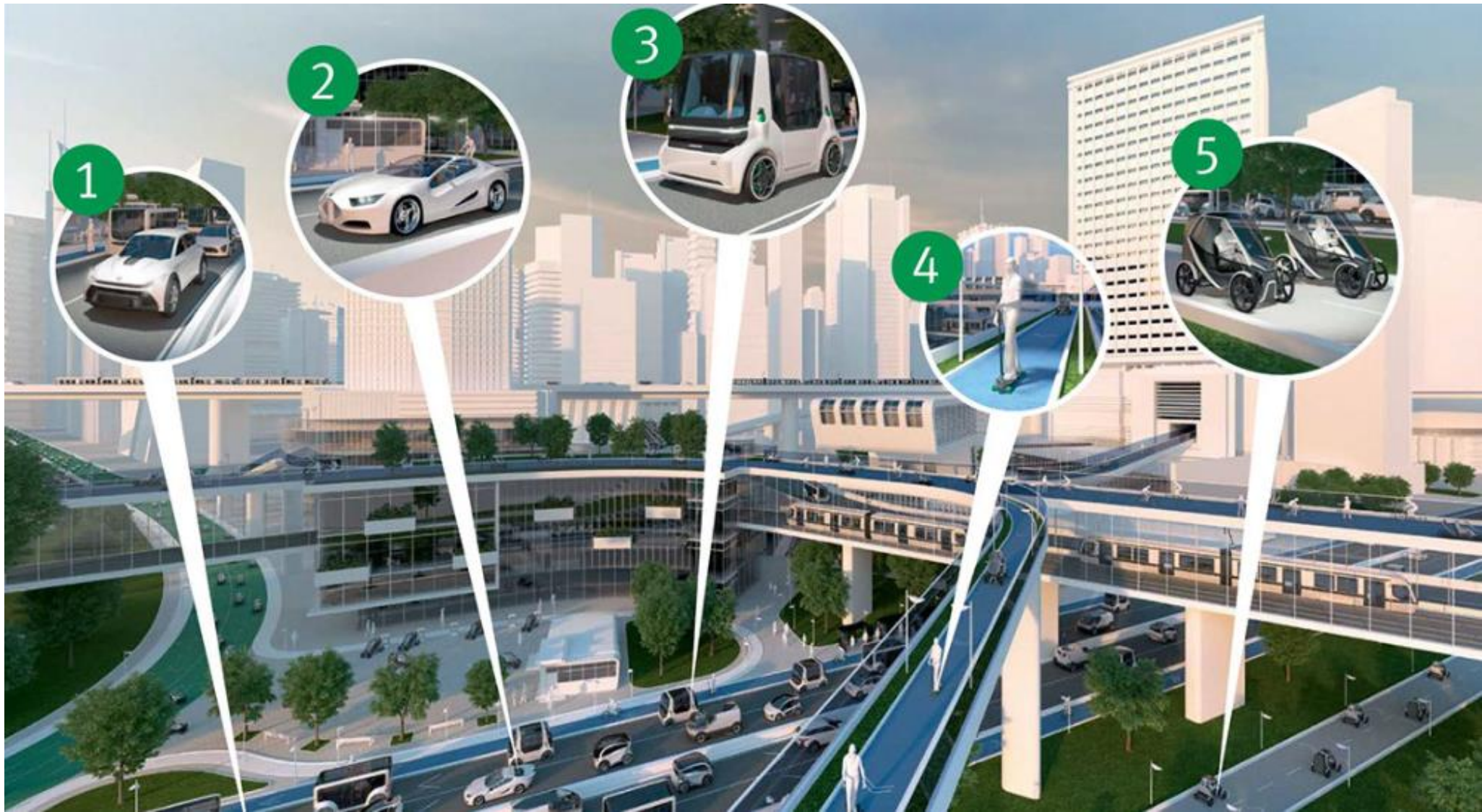
The Schaeffler 4ePerformance car is propelled by four Formula E traction motors, each delivering 220 kW. As a result, a total power output of up to 880 kW (1,200 hp) is available. Each individual motor is directly connected to a wheel by means of a spur gear transmission. Two motors share the same transmission housing respectively, thereby forming an electric "twin axle". This architecture makes wheel-selective torque control (torque vectoring) possible. The required energy is supplied by two batteries with a total capacity of 64 kWh.

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Twin axle, ECU, Battery, Twin axle, E-machine (220 kW), E-machine (220 kW), Battery, E-machine (220 kW), E-machine (220 kW)



Mobility for Tomorrow - 2050



- **Thank you for your time.**
- **Any questions?**

SCHAEFFLER
REP>XPERT