

CHANGAN

Evolution of BlueCore Powertrain

Integrating High-Efficiency Combustion with Advanced Electrification



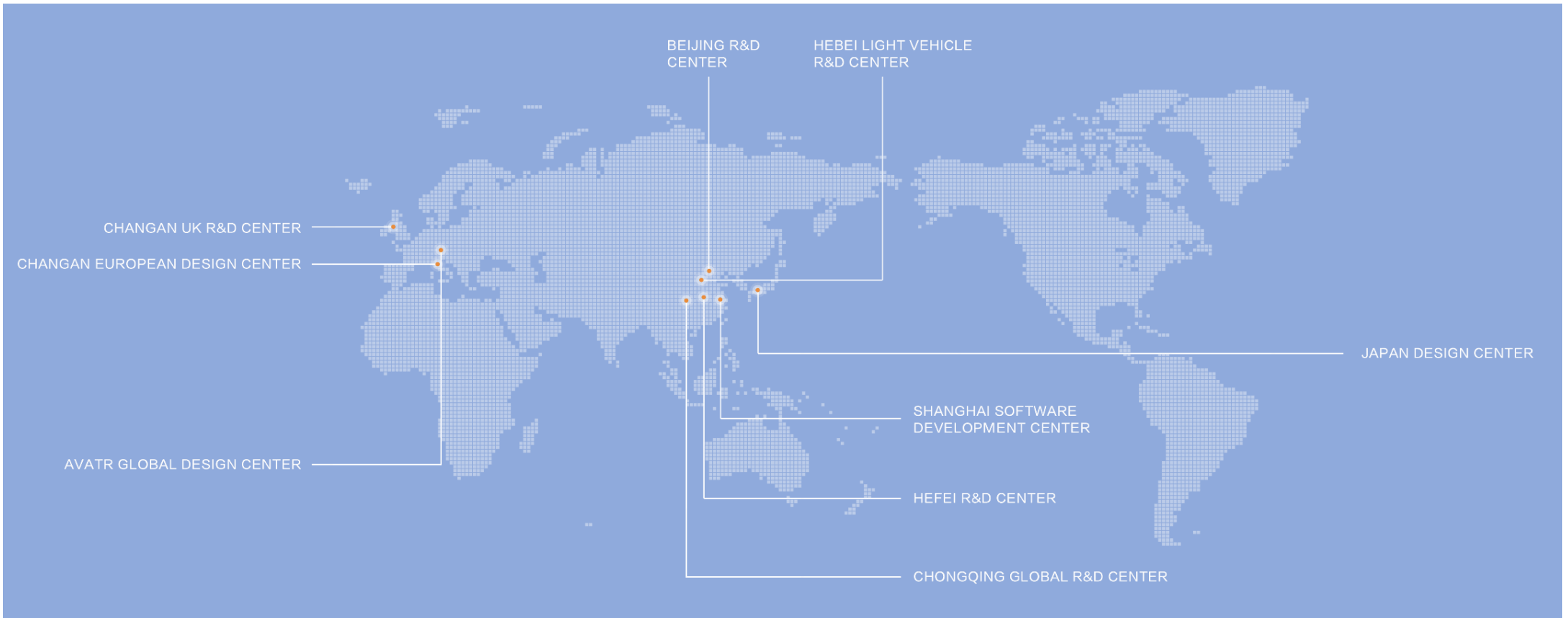
Gary Kirkpatrick | Changan UK R&D Centre

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- Changan Introduction
- Evolution of BlueCore Powertrain
 - Dedicated Hybrid Engine
 - Hybrid Powertrain System
 - Electric Drive System
- Carbon Management
- Summary & Questions

Changan Introduction

- One of China's top four automotive groups
- Headquartered Chongqing with global R&D network (~ 12,500 personal)
- UK Powertrain R&D centre and design centres in Germany, Italy and Japan



Changan Introduction

- Manufacturing passenger cars for more than 40 years
- Global sales ~ 2.9M units in 2025 including 38% New Energy Vehicle (NEV) share (~ 1.1M units)
- Launched in Europe late 2025, currently offering BEV and PHEV models under Deepal sub-brand



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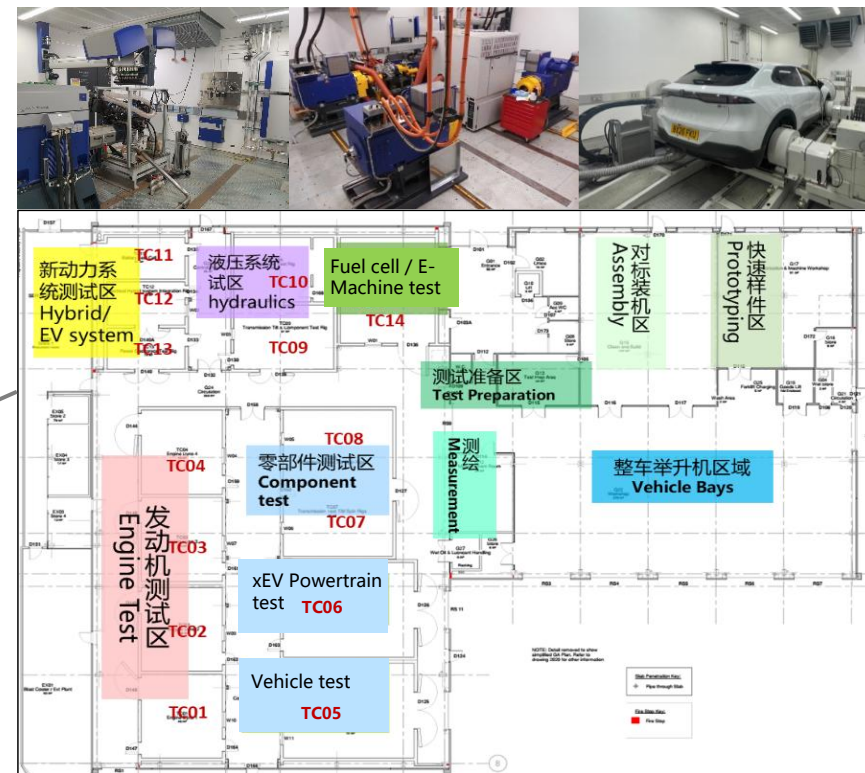
S07 (BEV)

S05 (BEV & PHEV)



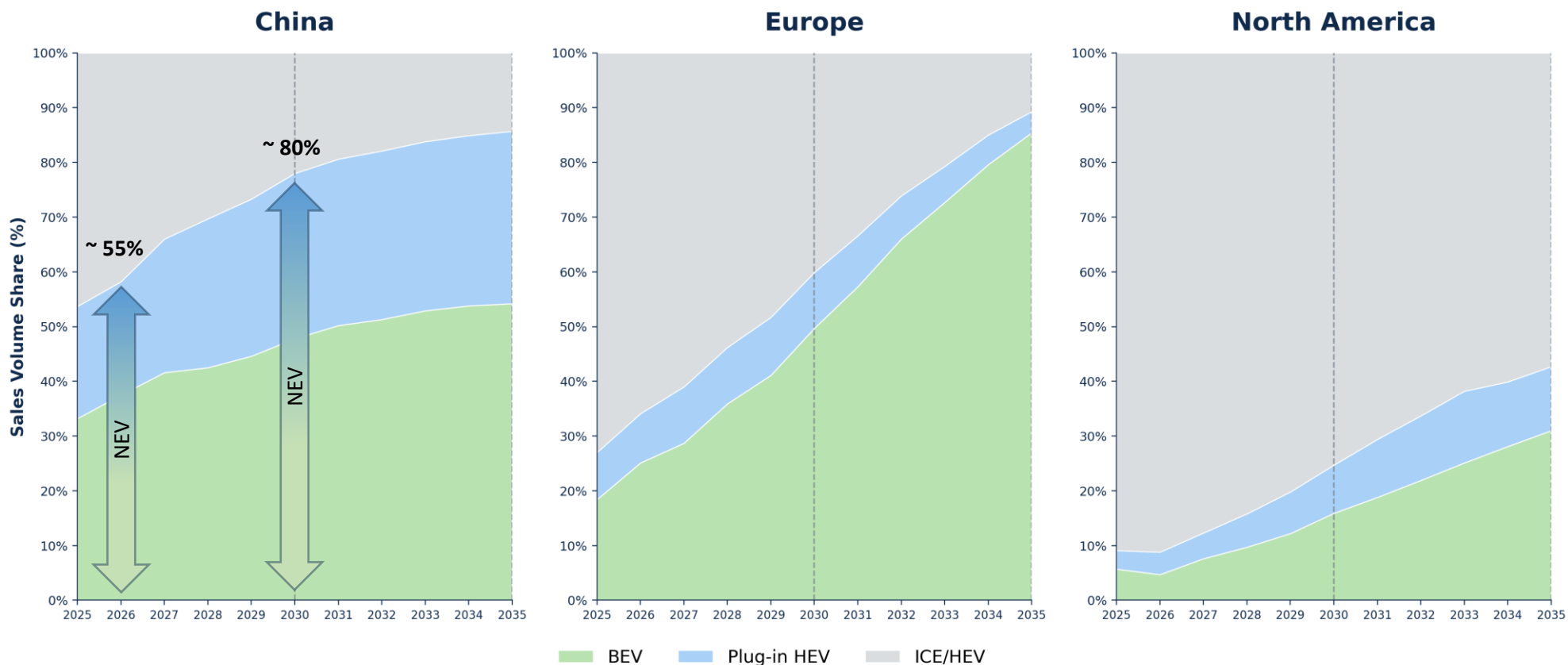
Changan UK R&D Centre

- A wholly-owned subsidiary of Changan Automobile
- Founded 2010, located to Birmingham 2015 – 4 office buildings and 1 test centre
- Powertrain system development inc. concept design, software, integration, calibration and testing
- Vehicle development inc. evaluation, chassis tuning, crash performance and intelligent system integration



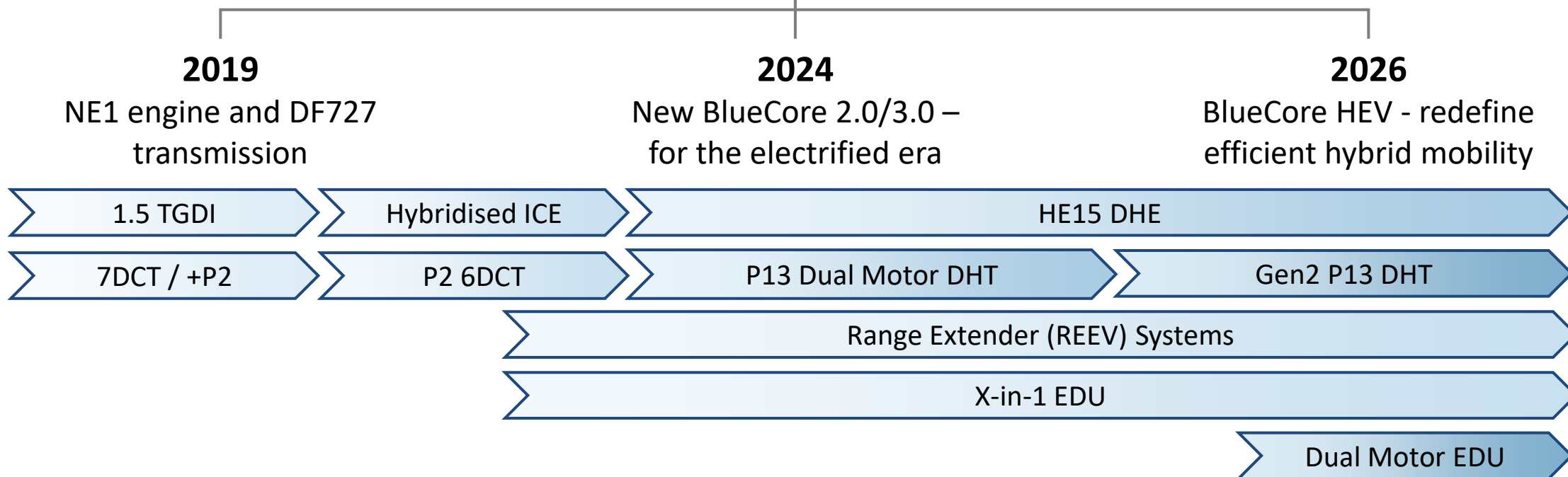
Evolution of BlueCore Powertrain

- China leads in electrification – building on early Li-ion technology capability with long term industrial policy and rapid product development cycles
- Still, diversity exists and growth rates uncertain → flexible and multi-energy powertrain strategy



Evolution of BlueCore Powertrain

- BlueCore established 2011, new combustion technologies to support Powerful, Clean and Quiet engines
- Enhanced R&D followed, 'all new' in house combustion, hybrid and electric powertrain systems



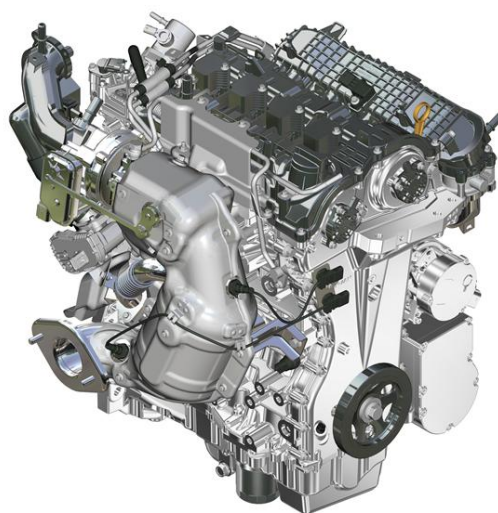
Dedicated Hybrid Engine

- Dedicated hybrid engine families with efficiency-first architecture and technology choices
- 1.5L engines in production and recently also launched in Europe (S05 PHEV)
- 2.0L dedicated hybrid engine family is under development

HE15 (1.5L 4-Cyl.) Engine Family

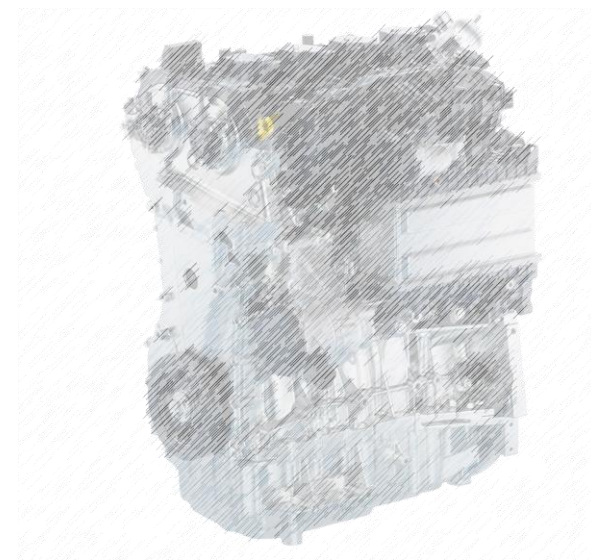


1.5L NA; 70kW
LIVC ('Atkinson')-PFI
16:1 CR



1.5L TC; 105kW
Miller-TGDI, 500 bar DI
15:1 CR

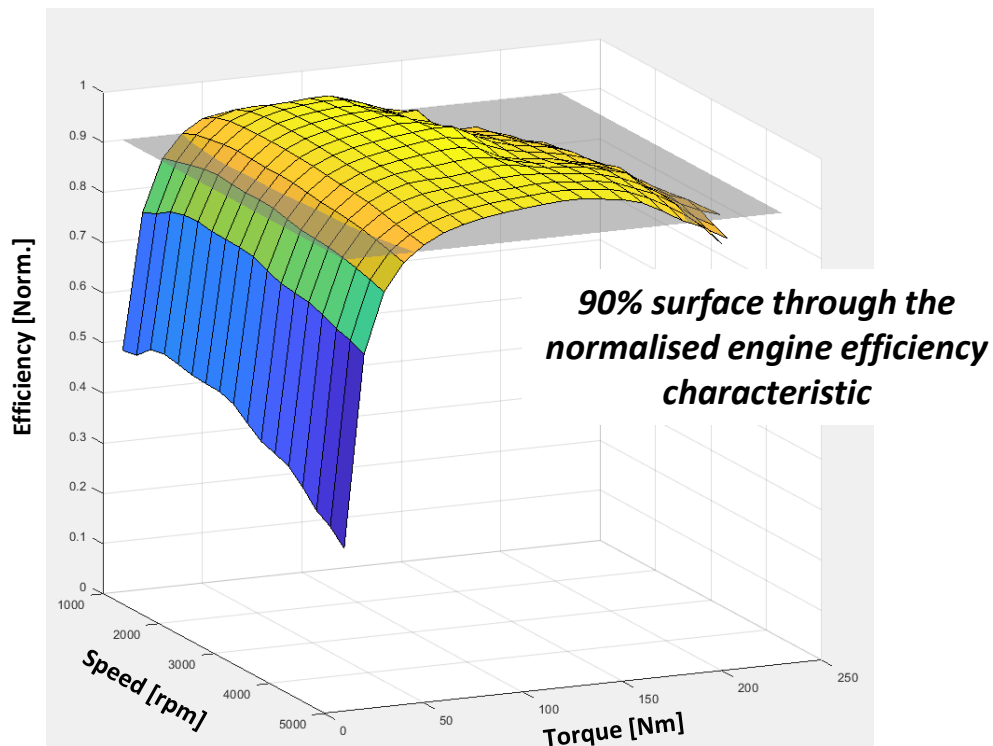
2.0L Engine Family (Development)



2.0L NA & TC

Dedicated Hybrid Engine

- Architecture, low friction and high EGR rate contribute to high efficiency
- Broad efficiency characteristic supports excellent fuel consumption and NVH

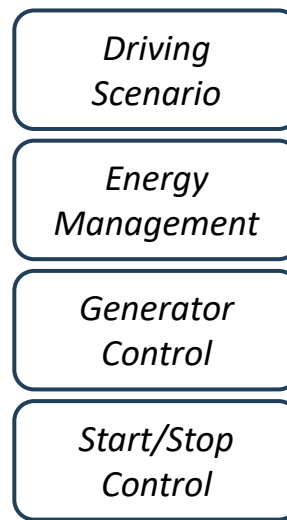


- Design and technologies further contribute to NVH including lightweight piston and con rod, silent timing chain, high strength cylinder head and TVD/flywheel design
- Active generator control further improves NVH
- Driving experience comparable to a pure BEV

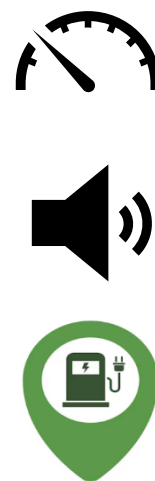
Hardware Design



Software Features

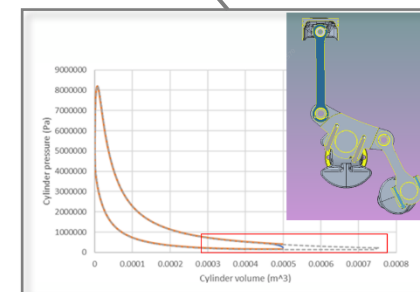
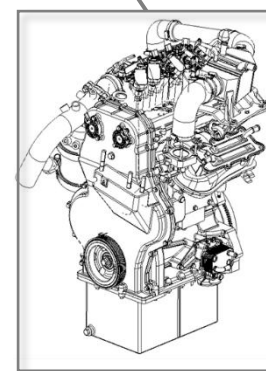
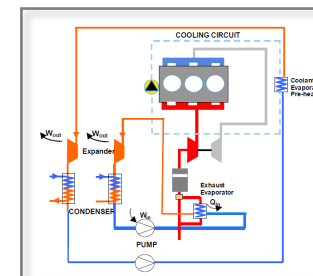
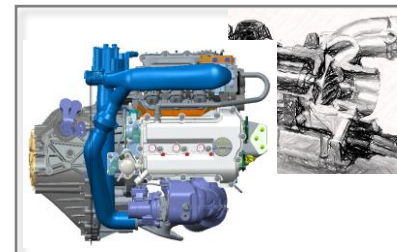
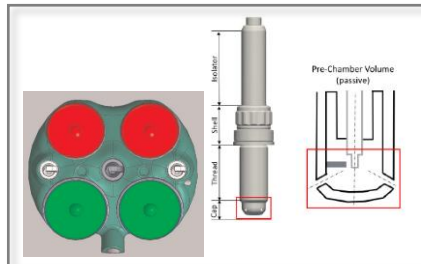
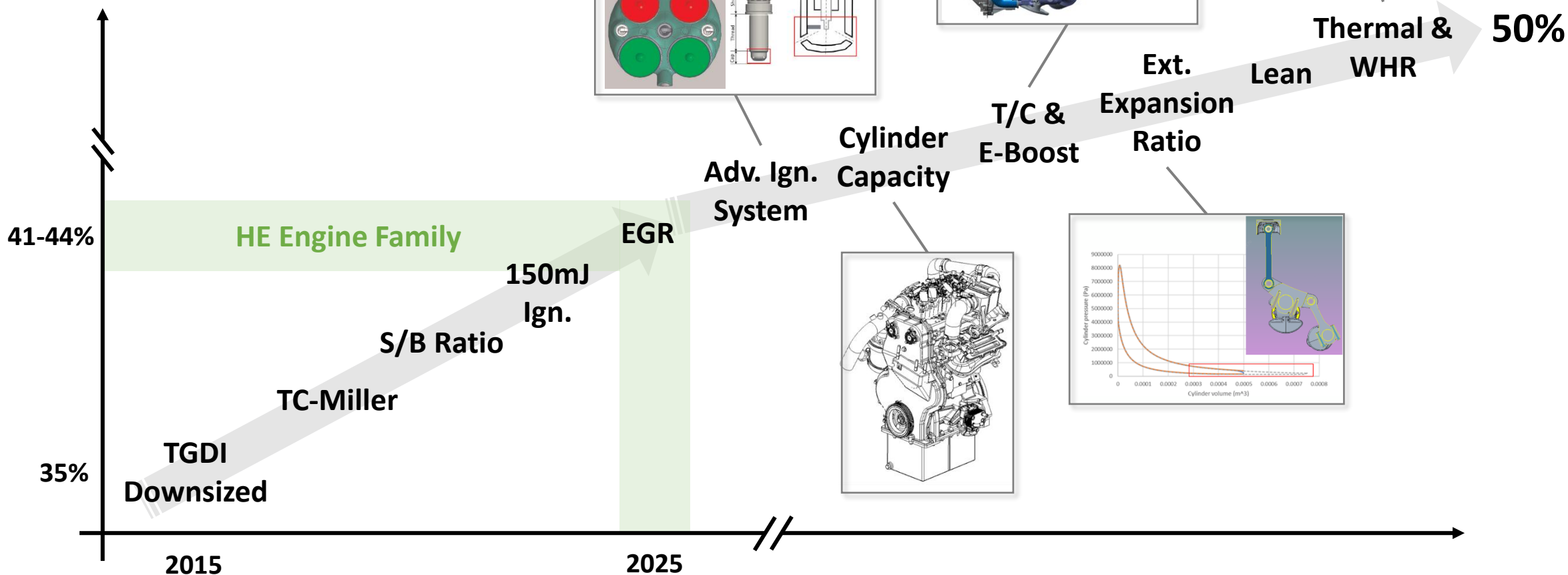


Attribute



Dedicated Hybrid Engine

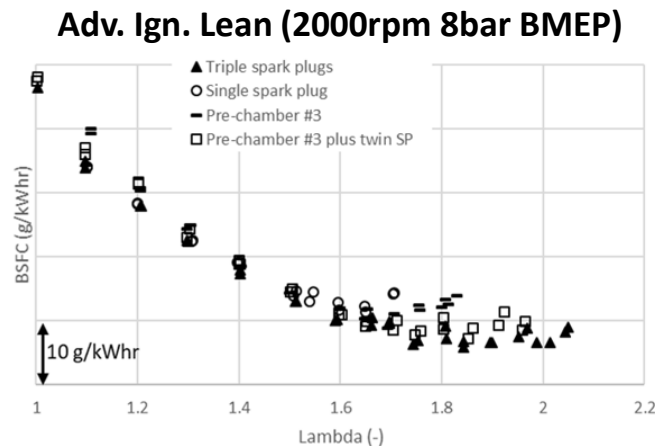
- Further combustion R&D in coordination with hybridisation



Dedicated Hybrid Engine

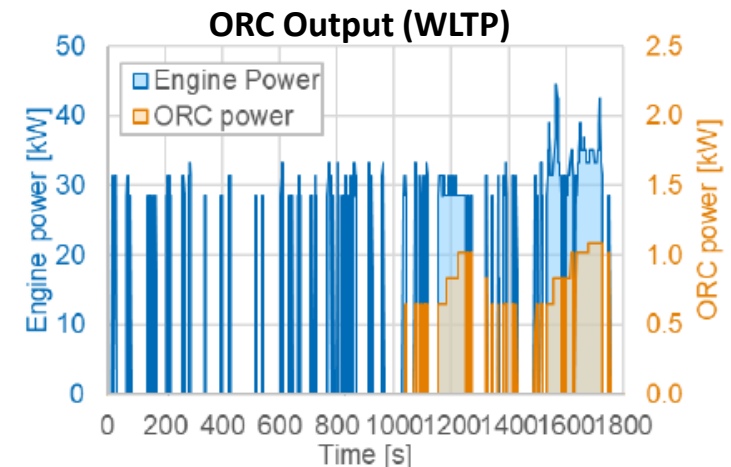
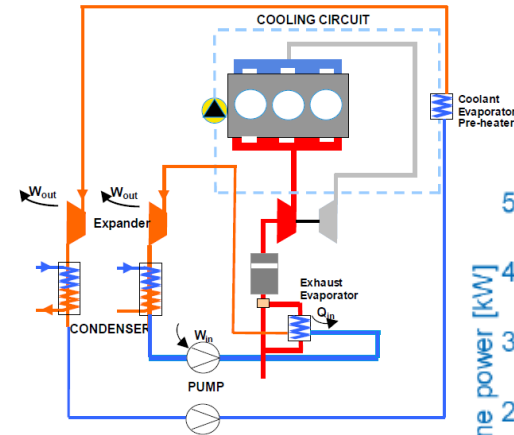
Advanced Ignition Systems

- Pre-chamber and triple-spark ignition
- Triple-spark beneficial under various operating conditions
 - Combustion speed (esp. 0-10% MFB)
 - Combustion stability
 - Dilution tolerance ($\rightarrow \lambda > 2$)
 - Combustion efficiency
 - $\rightarrow$ Fuel consumption



Waste Heat Recovery (WHR)

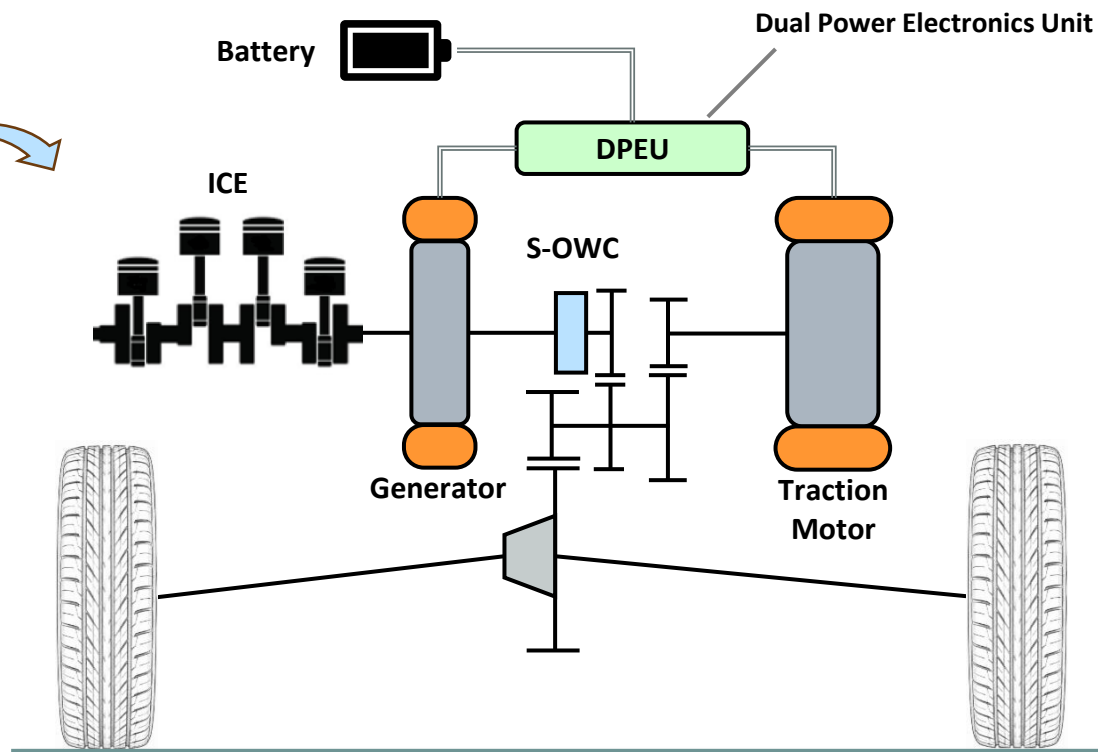
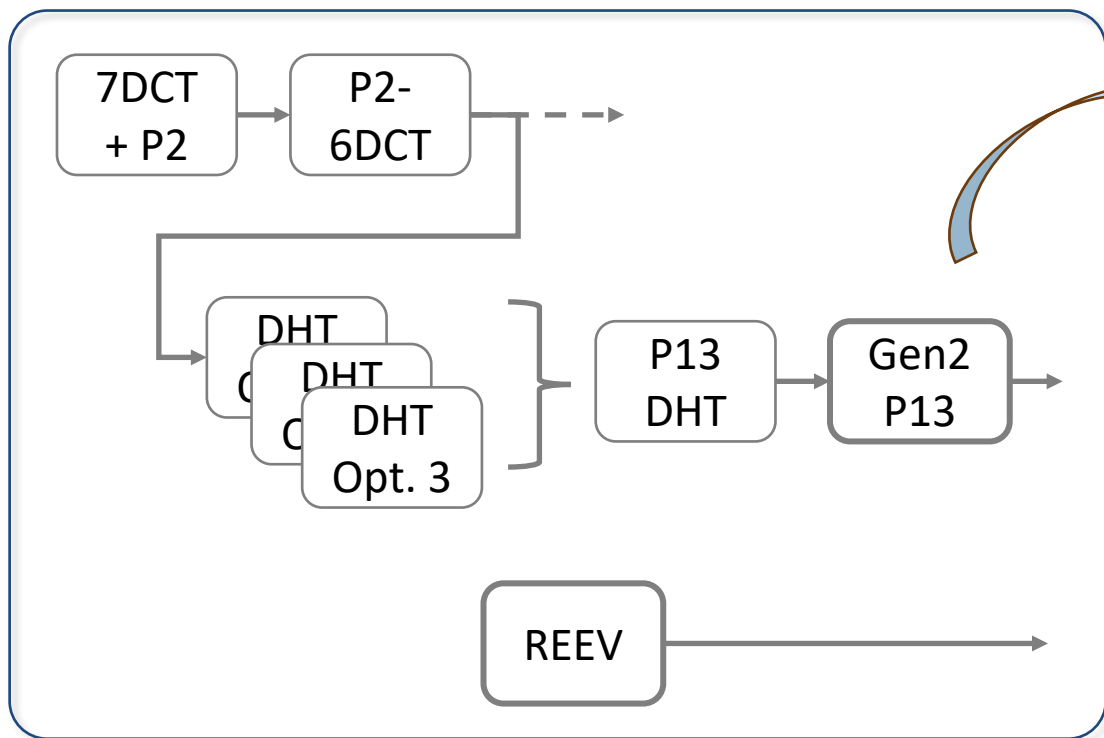
- Research into heat recovery methods
- Organic Rankine Cycle $\sim$ 3-12% output generation
- Fuel consumption $\sim$ 2-3% (WLTP) due to operating conditions and thermal inertia
- Complexity a challenge



Hybrid Powertrain System

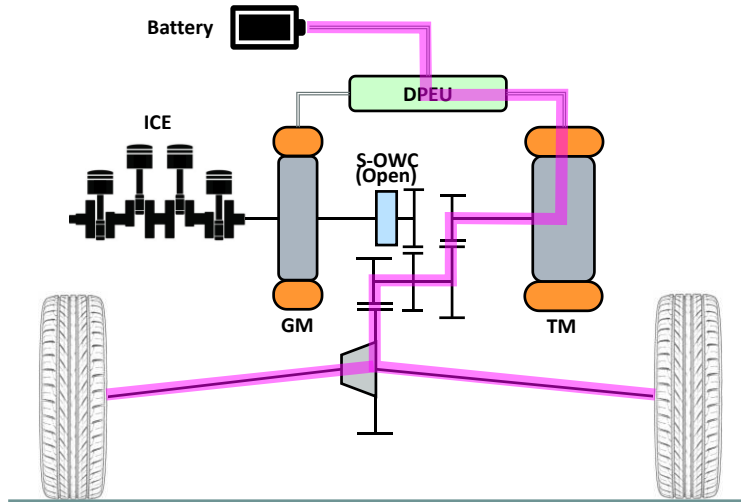
- “P13” hybrid architecture → flexible operation and high efficiency across wide operating conditions
- Now in 2nd generation, enhanced efficiency through E-machine development, on-demand cooling / lubrication and Selectable One-Way Clutch (S-OWC) ‘parallel drive’ system

Hybrid System Development Route

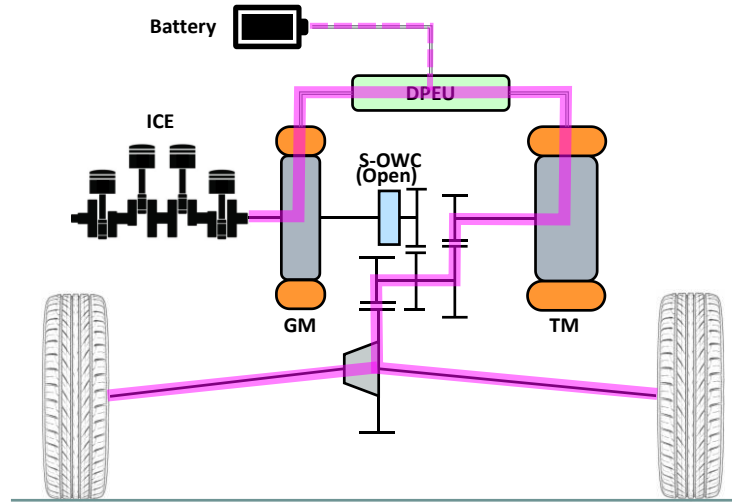


Hybrid Powertrain System

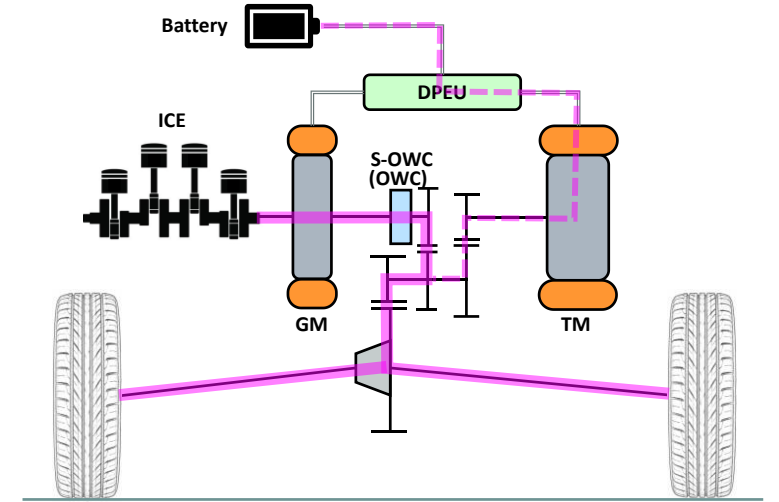
- 3 driving modes with load shifting
- E-machine size and gear ratio variation depending on HEV/PHEV, vehicle class, engine power
- System will be launched globally including HEV for Europe



E-Drive



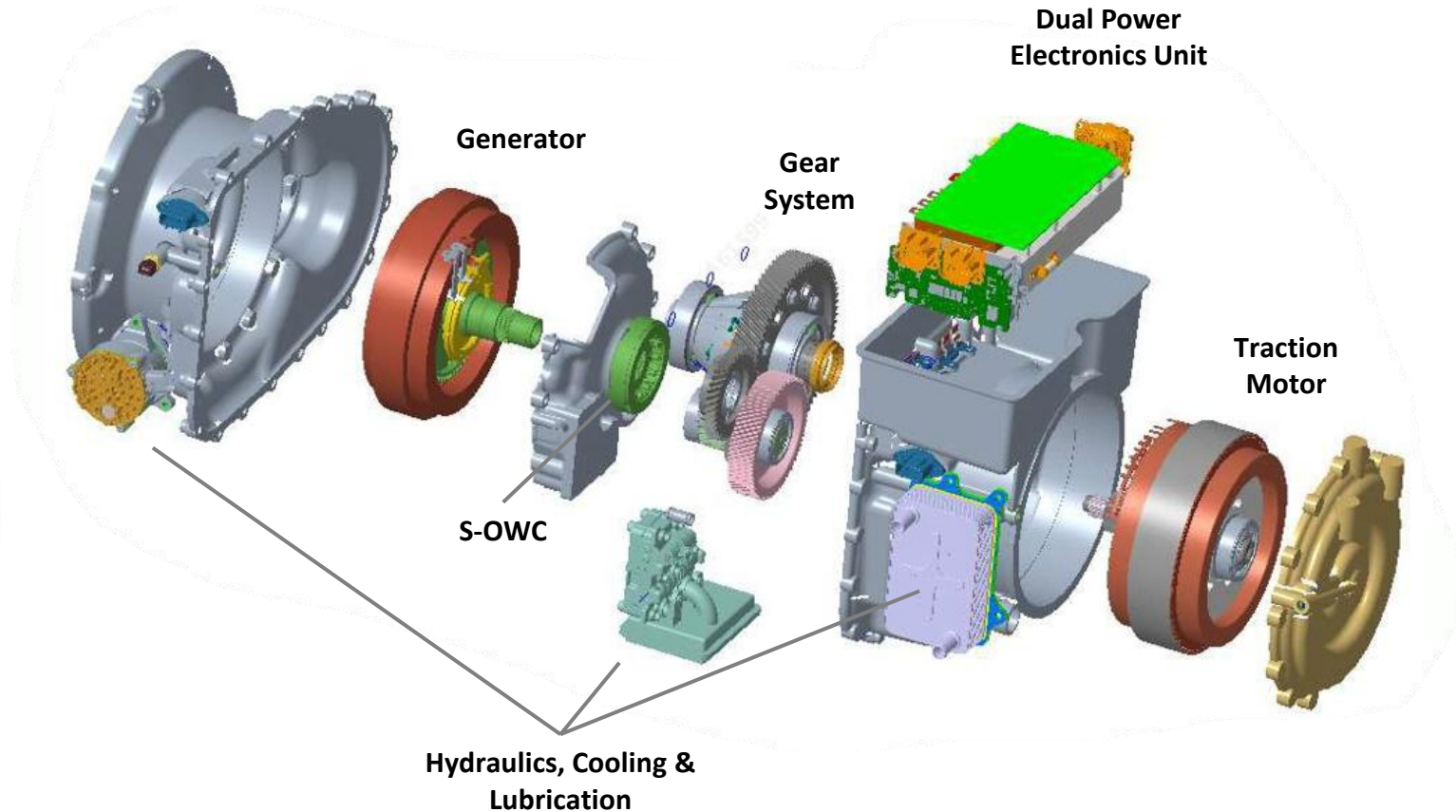
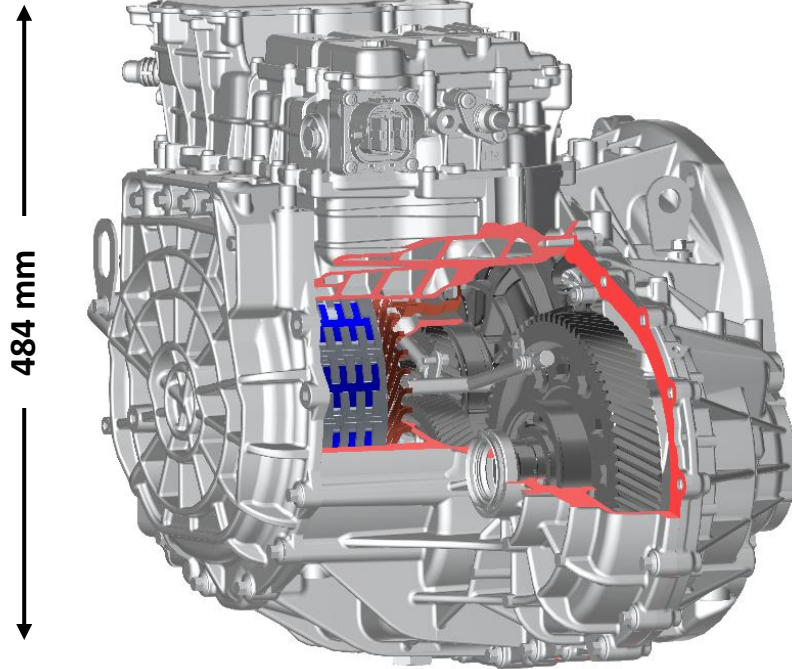
Series Hybrid Mode
(with / without load shifting)



Parallel Hybrid Mode
(with / without load shifting)

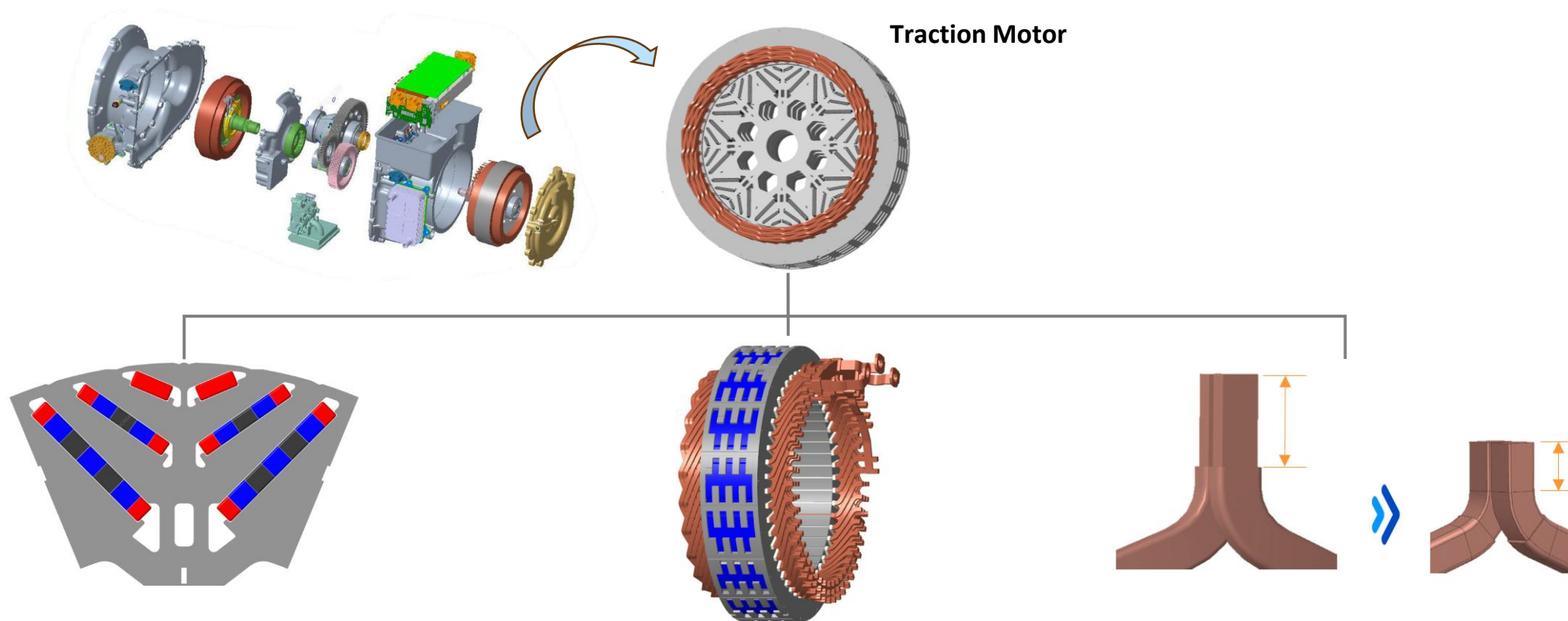
Hybrid Powertrain System

- Compact design; 3-axis, 6-gear coaxial layout with volume of 107L and weight of 97kg
- Flat design to support package and crash performance

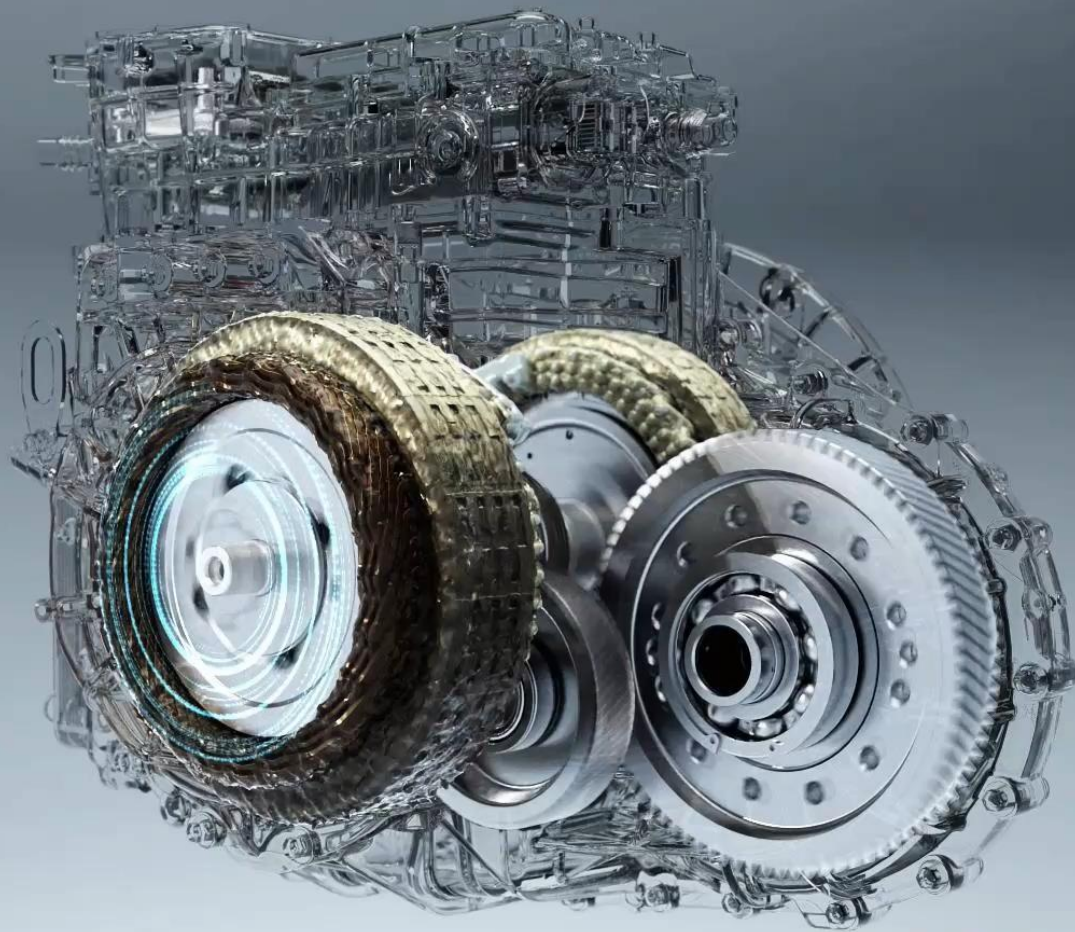


Hybrid Powertrain System

- High speed, high efficiency traction motor with compact package requirements
 - 20,000 rpm, > 98% peak efficiency and 9.9 kW/kg power density (up to 180 kW)
- 3V segmented IPM with back-iron and end-winding cooling, 0.2mm silicon steel and short weld hairpin



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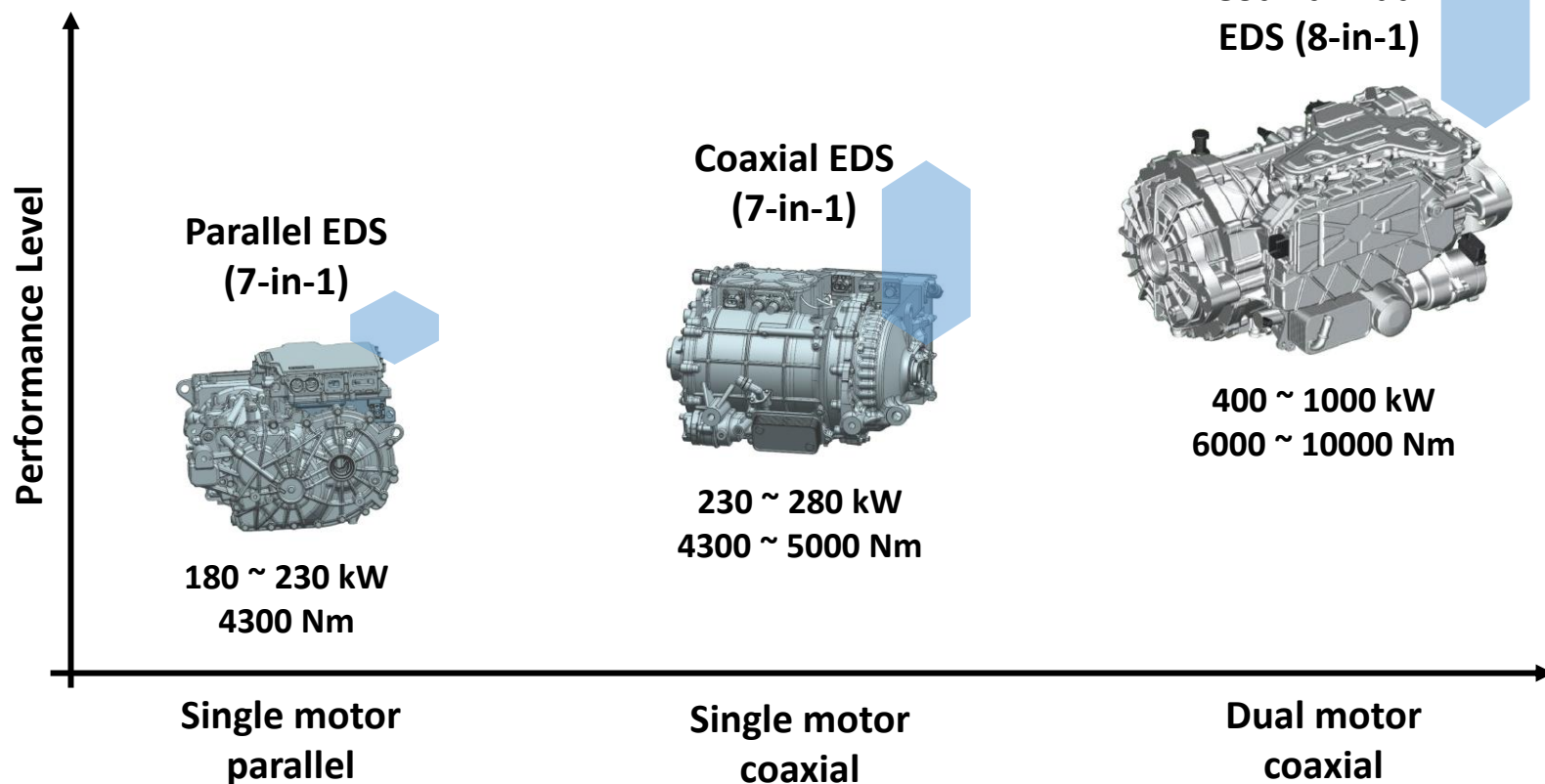
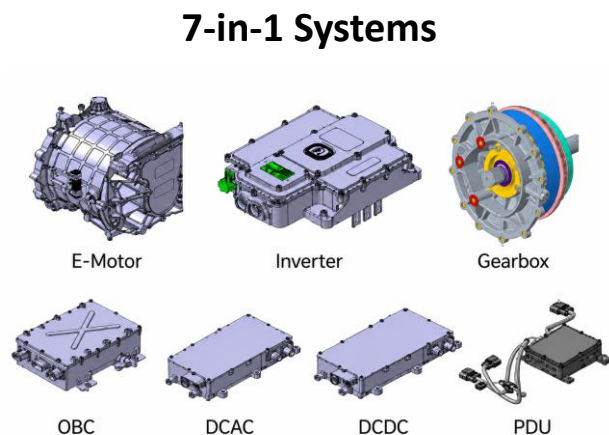


驱动电机最高转速20000rpm

功率密度9.9kW/kg，峰值功率180kW

Electric Drive System

- A range of high performance, compact and efficient X-in-1 drive systems
- Parallel axis, coaxial and dual motor options to suit wide application requirements

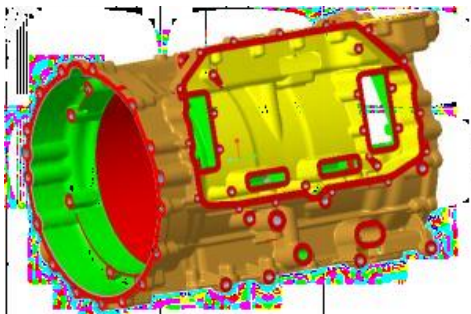


Electric Drive System

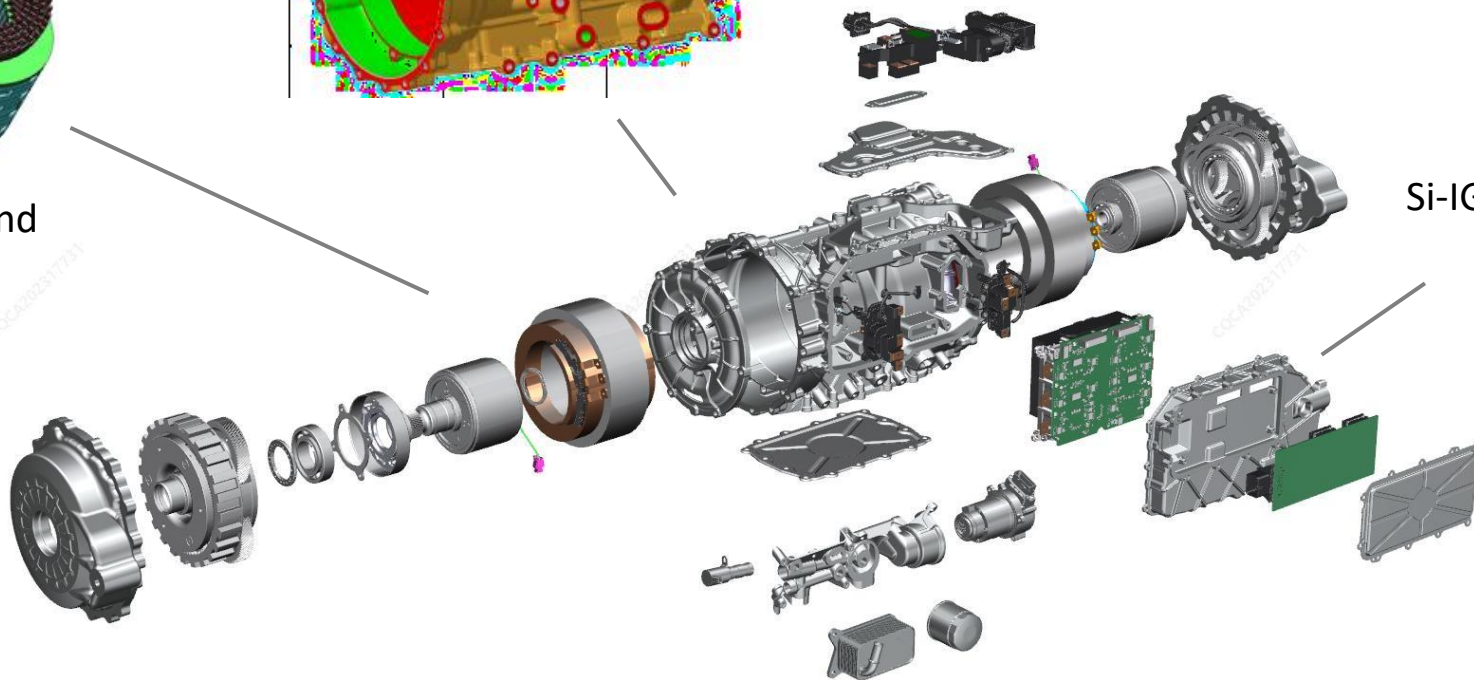
- Distributed E-Drive system, 3 performance levels “Eco” / “Performance” / “Ultra”
- Wide performance options meet the diverse requirements of different brands at various price points



Voltage level, stack length and
winding configuration
120/200/500 kW



Shared main housing, reducers, cooling & lubrication
systems are optimised for weight and efficiency



Si-IGBT and SiC MOSFET
400/800/1200V

Carbon Management

- Actively responds to the national dual carbon strategy, fully integrates climate change considerations
 - Goal of achieving carbon peaking by 2029 and carbon neutrality by 2050
- 3 strategic directions in response to climate risks and opportunities
- Corporate Level** – energy efficiency, plant electrification, green energy usage and generation
 - By 2025 already achieved ~ 30% CO2 reduction vs 2020 level
 - Grid-connected PV installation capacity 288 MW
- Product Level** – accelerate the supply of green and low carbon products
 - By 2025 already achieved ~ 20% reduction in vehicle life cycle carbon footprint vs 2020 and reached 38% NEV share
 - Green product technologies include lightweight design and materials, vehicle and powertrain efficiency measures
- Supply Chain Level** – green, low-carbon and sustainable supply chain, actively guide suppliers in carbon reduction planning and research
 - By 2025 reductions in carbon emissions from material sourcing, production and logistics reached 10-25%, 6-30% and 1-2% respectively

Targets

Corporate Level

2030

Reduce CO₂ emissions per RMB 10,000 of output value by 35% by 2030 compared with 2020

↓ reduce
35%

Product Level

2030

Reduce vehicle lifecycle carbon emissions by 30% by 2030 compared with 2020

↓ reduce
30%

Supply Chain Level

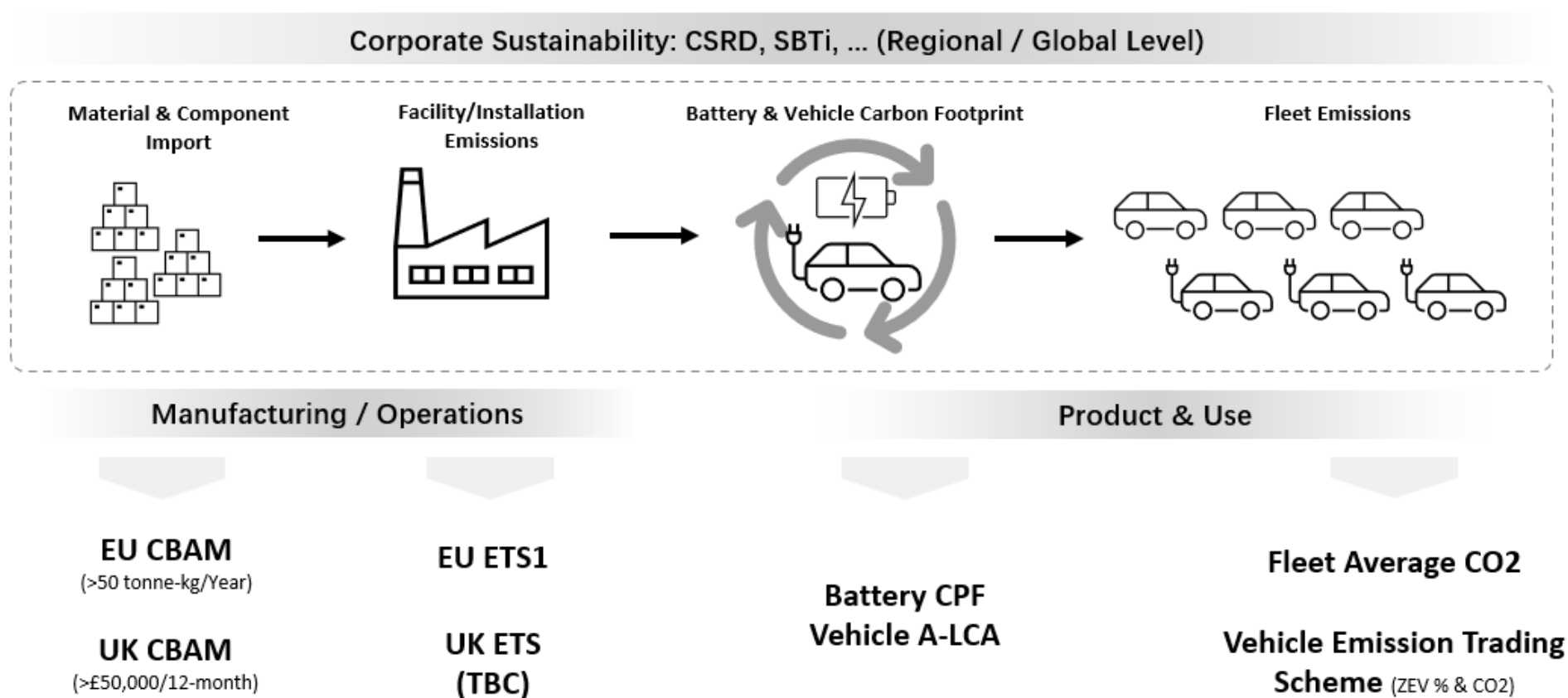
2030

Reduce supply chain carbon emissions by 30% by 2030 compared with 2020

↓ reduce
30%

Carbon Management

- European Carbon Management task force for all carbon-related legislation activities (UK & EU)
- Expecting to out-perform fleet carbon targets in European markets with electric-first strategy



Summary

New BlueCore powertrains offer powerful, efficient, quiet and compact solutions across the full range of electrification levels

Flexibility for global markets and support Changan's goals in the transition to net zero

Changan is open for supply and co-development discussions across all powertrain solutions



CHANGAN

Smart Your Future