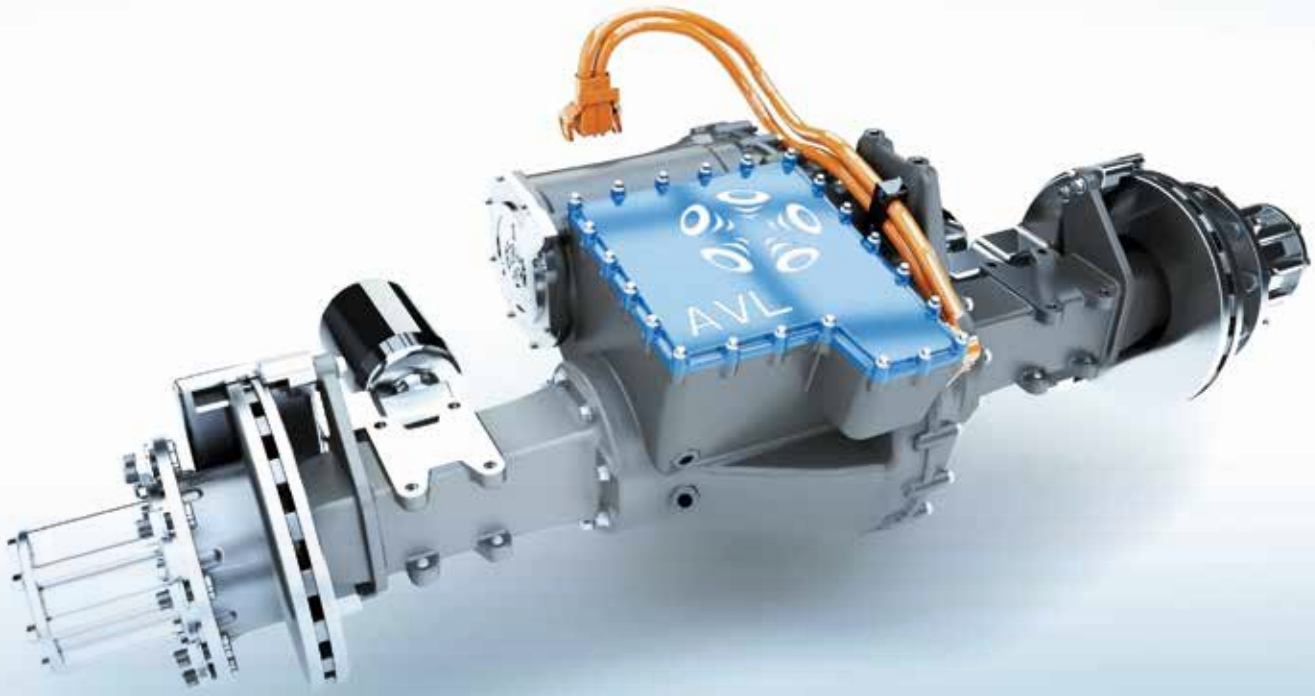

Integrated e-axle systems for HD urban truck application

Development from System Specification to SOP

CUSTOMER CHALLENGE

Zero-emission and low-noise zones are discussed for many urban areas worldwide

- New logistics for urban distribution of goods call for new vehicle concepts with emission-free driveline systems
- Limited development and product cost for small volumes
- The need for modular structures which allow conventional and electrical driveline systems on the same vehicle base
- Pure electric vehicles need to provide a sufficient driving range
- High demand for efficient driveline systems and sufficient battery capacity in the vehicle

AVL SOLUTION

AVL develops fully integrated e-axle systems for commercial vehicles:

- Compact packaging of all e-drive components (e-motor, transmission and inverter) to provide maximum packaging space for the battery system
- Permanent Magnet Synchronous Motor (PSM) with direct stator oil cooling for highest efficiency and power density
- Control function of transmission and electrically driven oil pump integrated into power electronics
- 2-speed transmission for highest vehicle performance (gradeability & top speed) at comparably small e-motor size and low product cost
- Advanced cooling system to meet the different temperature requirements of the components
- Low vehicle integration effort
- Lowest possible number of additional interfaces between e-axle and vehicle to ensure highest reliability

Integrated E-Motor

Integrated Transmission

Integrated Inverter

AVL SEVICES IN DETAIL

- Requirement definition of e-axle and components
- Matching of e-motor, power inverter and transmission by system simulations
- Concept, layout and detailed design of all e-axle components (e.g. e-motor, transmission, inverter, axle body) supported by in-house CAE
- Design, functional, thermal and electrical integration
- Structural optimization by FEA
- Optimization of cooling system by CFD
- NVH & EMC optimization
- System control based on AVL's proven modular software architecture
- Functional safety development
- Validation program definition (AVL DVP & Load Matrix)
- Functional and durability tests (testbed & vehicle)

KEY FEATURES OF THE INTEGRATED E-AXLE (8 - 16 TON GVW)

e-motor

Type	PSM
Continuous power	148 kW
Max. continuous torque	265 Nm
Max. speed	16.000 rpm
Cooling	Direct oil cooling of stator

Inverter

Voltage level	800 V
Technology	IGBT

Transmission

No. of speeds	2
Shifting type	Electro-mechanical
Lubrication system	Forced lubrication

ADDED VALUE

- Reliable e-axle system with high efficiency
- Reduction of system costs by integrating different components into one housing
- The existing design for PSM with direct oil cooling enables high power density and efficiency
- The existing e-axle concept facilitates smallest packaging and highest system performance as well as low number of vehicle interfaces that enable short time to market
- Design enables EOL testing of the complete e-axle module (logistics advantage)
- The modular arrangement of the e-axle components enables an individual adaption to customer vehicle boundaries (family concept possible)
- Optimized system thanks to advanced AVL development methods, simulation tools and production knowhow
- E-axle released for production thanks to AVL's validation methodology (DVP, Load Matrix, functional and durability testing on testbed and vehicle)
- Short time-to-market and low development costs due to in-house component and system testbeds for e-motor, power electronics, transmission and the entire e-axle

FOR FURTHER INFORMATION PLEASE CONTACT:

Georg Biegelbauer, AVL Commercial Driveline and Tractor Engineering GmbH,
Schönauer Straße 5, 4400 Steyr, Austria
Phone: +43 316 787 4432, email: georg.biegelbauer@avl.com, www.avl.com