

Oerlikon Drive Systems Clean Mobility for Automotive and Off-Highway Applications

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E-Mobility Is Real and It Is Now



KEY DRIVERS:

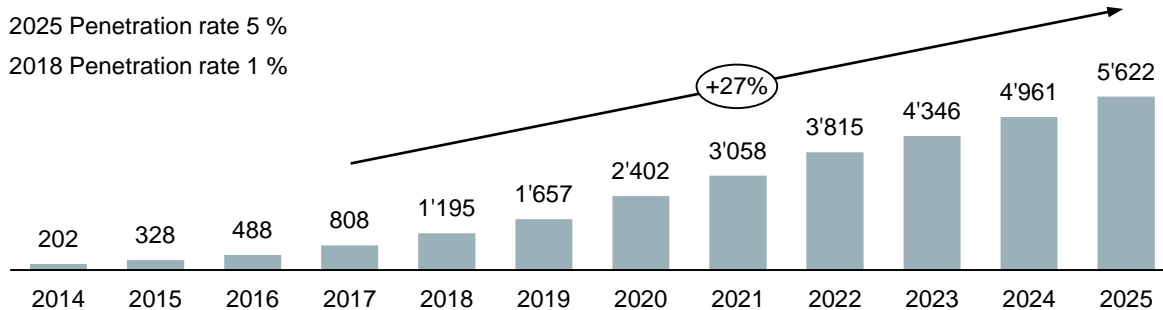
- Emission and other governmental regulations
- Subsidies and tax incentives
- Technology breakthroughs
- Electrification infrastructure builds
- Public-private and industrial partnerships as accelerators
- E-drive systems integration for size, simplification and costs



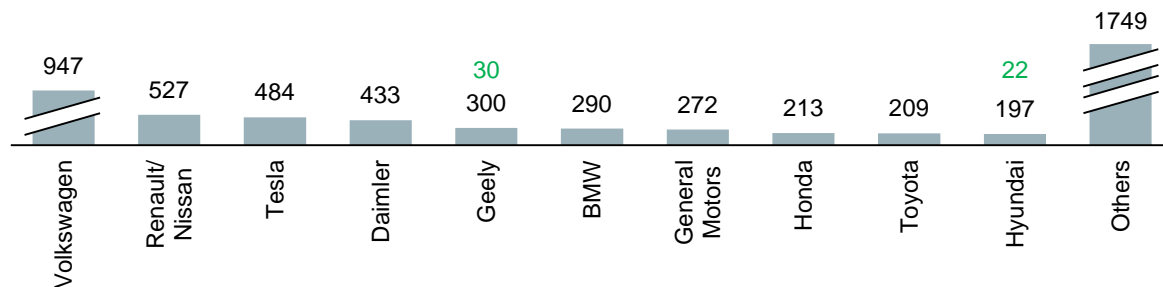
E-Mobility Is Real and It Is Now

ELECTRIC CARS GROWTH (VOLUME '000)

2025 Penetration rate 5 %
2018 Penetration rate 1 %

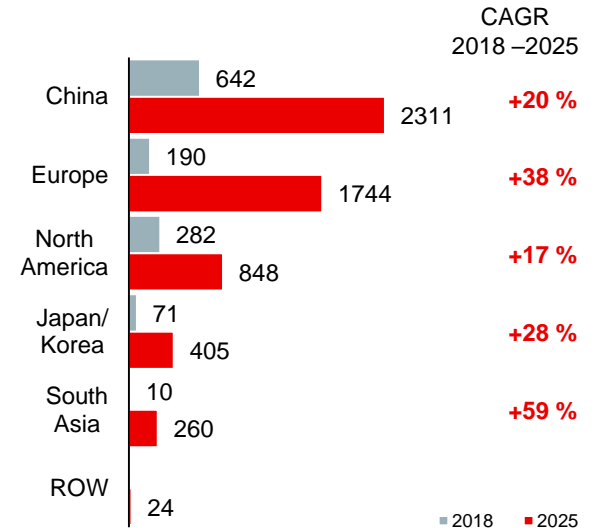


TOP 10 PLAYERS BY 2025 EST. ('000)



Source: IHS, EVVolumes

MARKET GROWTH 2018 – 2025 ('000)

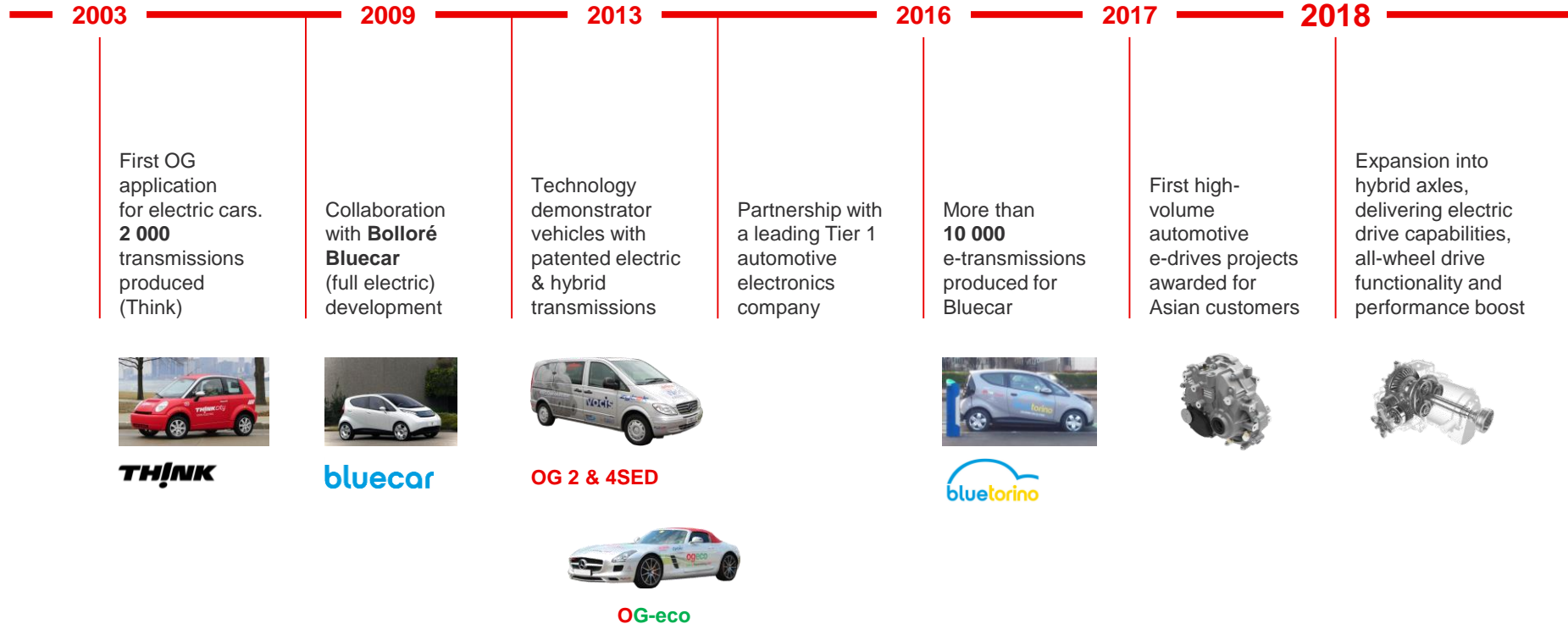


ADDITIONAL OPPORTUNITIES:

China mini EVs

- 2017: 1 million
- 2025E: 6 million

Oerlikon Drive Systems Journey to Automotive e-mobility



Oerlikon Drive Systems e-Drives Automotive Electromobility

DIFFERENTIALS



- High-volume EV applications
- Modular and flexible design & manufacture
- Minimized backlash, optimized NVH behavior

e-DRIVE TRANSMISSIONS



- Single- and multispeed solutions
- Proprietary shift actuation and controls
- Platforms from 140 Nm up to 600 Nm
- Compact design, light weight
- Silent with excellent efficiency

HYBRID AXLES



- Add-on hybridization
- Single- and two-speed variants
- Up to 25 % fuel efficiency improvement
- All-wheel and full electric drive functionality
- Integrated, electronically controlled differential

48 V e-DRIVES & DOUBLE 100



- Single- or two-speed low-cost e-drives
- Low cost mild hybrids with 15 % fuel efficiency improvement
- Full electric sub-compact vehicles

Oerlikon Drive Systems e-Drives Commercial Vehicle Electromobility

LIGHT VEHICLE e-POWERTRAINS



- Fully integrated e-drive
- 30 % efficiency improvement
- 1/3 the size and weight
- Superior performance at competitive cost
- Platform concept to address all light e-vehicles

PLANETARY e-DRIVES



- Integrated e-motor, inverter and controller
- 30 % efficiency improvement
- 1/3 the size and weight
- Unlimited in- and outdoor use
- Superior performance at competitive costs
- Modular concept for all off-highway applications

ELECTRIC BUS-DRIVES



- Leading provider of portal axles for central e-motor driven low-floor city buses in Asia
- Simplified fully integrated e-portal axle

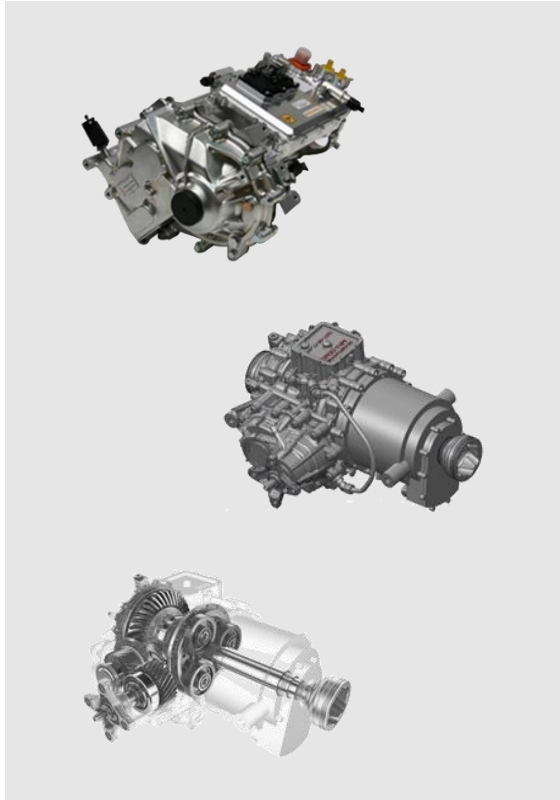
HYBRID DRIVES



- Hybrid drives for construction machines and agricultural equipment
- 15 % to 20 % more fuel efficient
- Simplified integrated systems

Automotive Electric Drives

Innovative Partner of the Automotive Industry

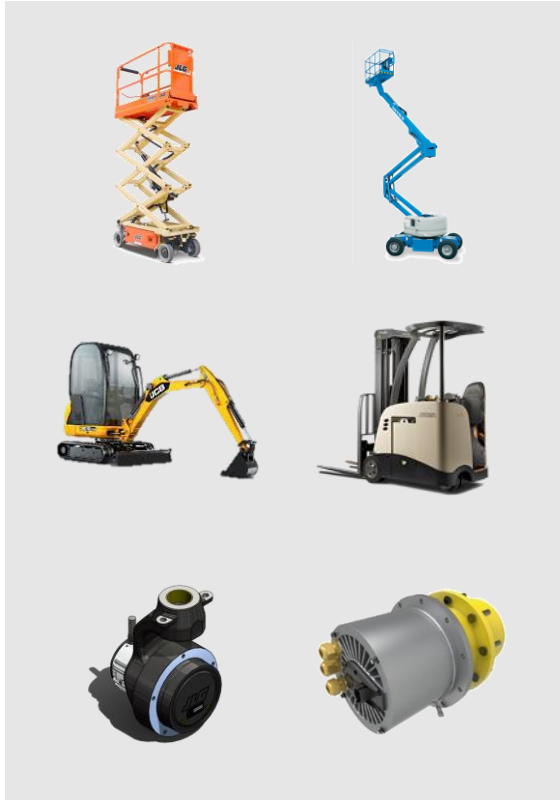


- High-volume programs with key customers in Asia
- 2019: start of production
- Strategic partnership with leading Tier 1 electronics supplier

PRODUCT BENEFITS

- Emission-free driving
- Compact, fully integrated systems
- Excellent noise and vibration performance
- Excellent mechanical efficiency (> 97 %)
- Multi-speed solutions for system efficiency improvements
- Hybrid axles:
 - Easy vehicle integration
 - All-wheel drive functionality
 - Up to 25 % fuel savings
 - Instant electric torque
 - Extremely responsive e-differential (<70 ms)
 - Suitable for high performance applications (>280 kph)

Off-Highway Electric Drives Breakthrough Innovations



- Integrated wheel drives (e-motor and transmission)
- Modular design with full product range offering
- Systems solution from a single source
- Multiple customer projects
- 2019: start of production

PRODUCT BENEFITS

- Highly efficient and very compact
- Simplified remote machine controllability
- Unlimited in- and outdoor use: no exhaust emissions or noise
- Higher machine utilization rates
- Disruptive electric motor technology:
 - Up to 30 % more efficient
 - 1/3 of the size and weight

CURRENT STANDARD SOLUTION: ADD-ON ELECTRIC MOTOR

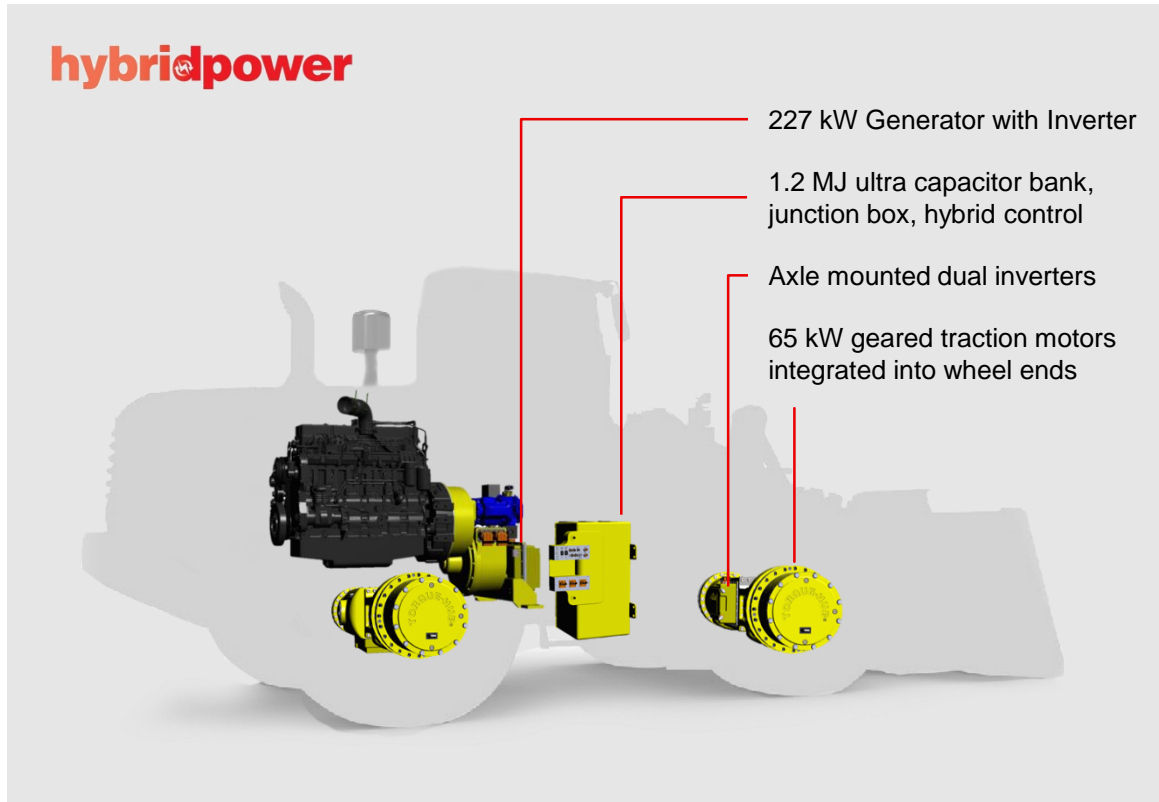


STEP 1: Integrated electric motor

STEP 2: Integrated electric motor, inverter and controller

KEY CUSTOMER BENEFITS

- Better performance
- 30 % more efficient
- Cost competitive
- Ease of vehicle integration
- Robustness and reliability



KEY CUSTOMER BENEFITS

- Better vehicle controllability
- 15 to 20 % more fuel efficient
- Ease of vehicle integration



e-MOBILITY IS A REALITY

**e-MOBILITY IS OUR CORE
COMPETENCE**

**e-MOBILITY IS MORE THAN
PASSENGER CARS**

- Construction equipment
- Agricultural machinery
- Material handling
- Trucks and buses
- Light utility and all-terrain vehicles
- Motorcycles

Thank you.

