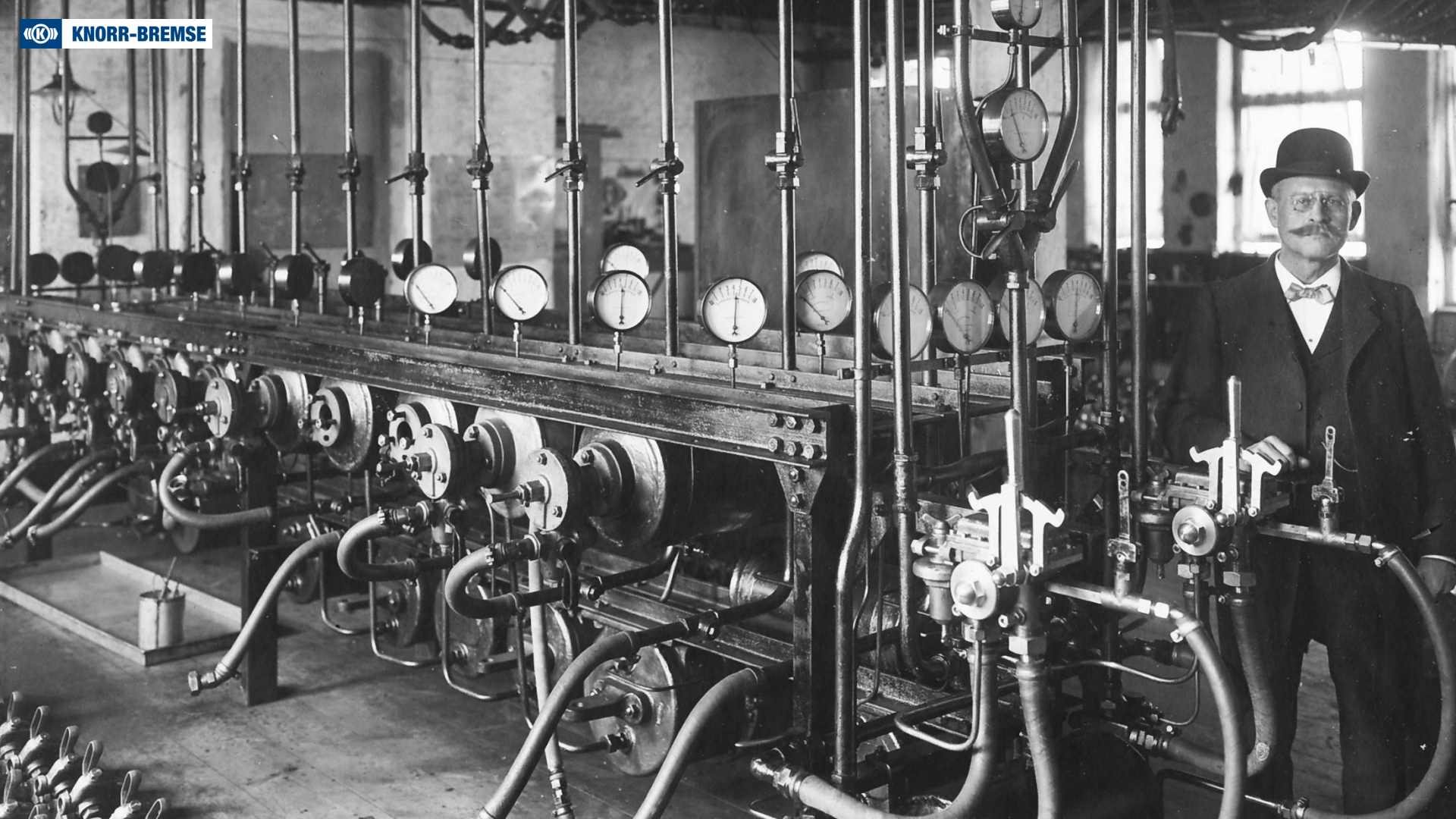
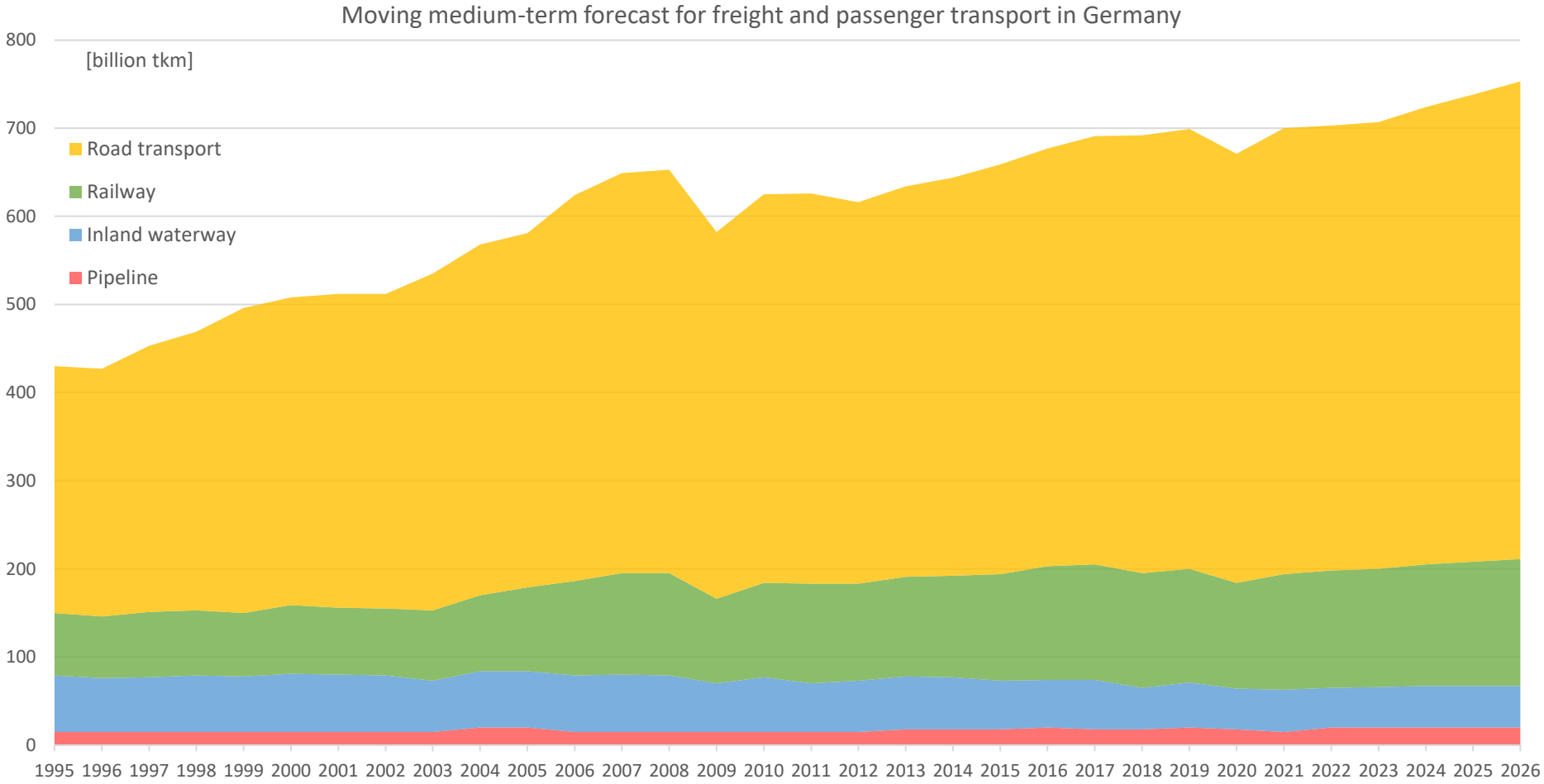
Disruptive Transformation of the Truck Industry

Péter Frank
Global Director of Business Unit Collaboration and Standardization,
Knorr-Bremse, October 16th, 2024

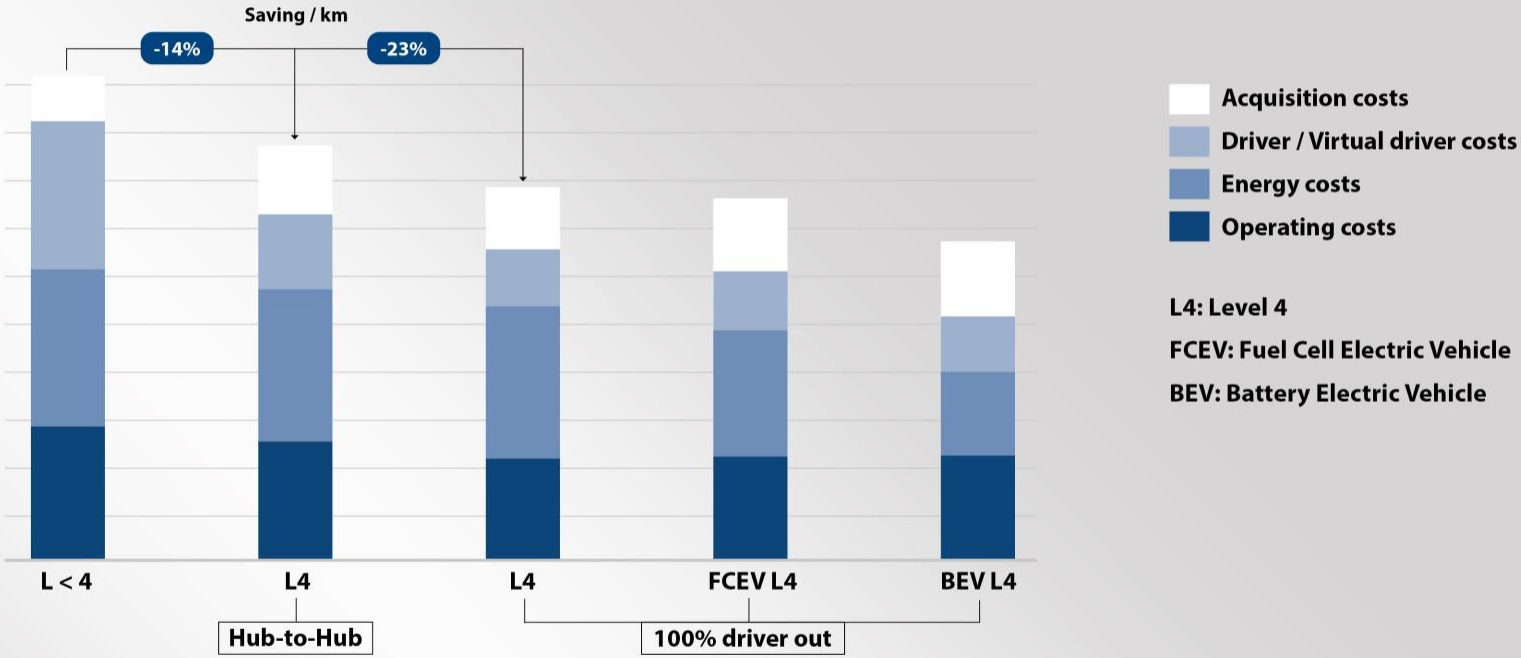

KNORR-BREMSE

KNORR-BREMSE


Moving medium-term forecast for freight and passenger transport in Germany
[billion tkm]
Road transport
Railway
Inland waterway
Pipeline
800
700
600
500
400
300
200
100
0
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026

Transition from SAE automation Level 2 to Level 3+ offers additional economical benefits and new business models

Total Cost of Ownership – Assumption for 2027 - 2030

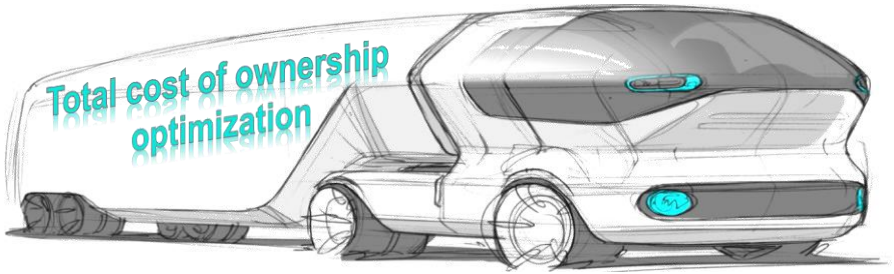


Significant TCO benefit for L4 operation

Automated trucks will create significant benefits for fleets

Fleet owner impact

Fuel costs	Safety	Hours-of-service	Vehicle uptime
Mileage improvements through better aerodynamics	Reduction/ Elimination of human error	Optimization of resting times for drivers	Less repair time due to fewer accidents



Driver shortage	Driver retention	Driver wellness	Driver distraction
More drivers can be attracted with enhanced roles	Reduced driving stress and fewer monotonous time periods	More rested drivers	Autonomous technology compensates for driver's lack of attention

Society impact

Emission reduction | Accident mitigation | Road safety

source: ATRI, Roland Berger

Conclusion on HAD Vehicle & Subsystem Technologies and Challenges

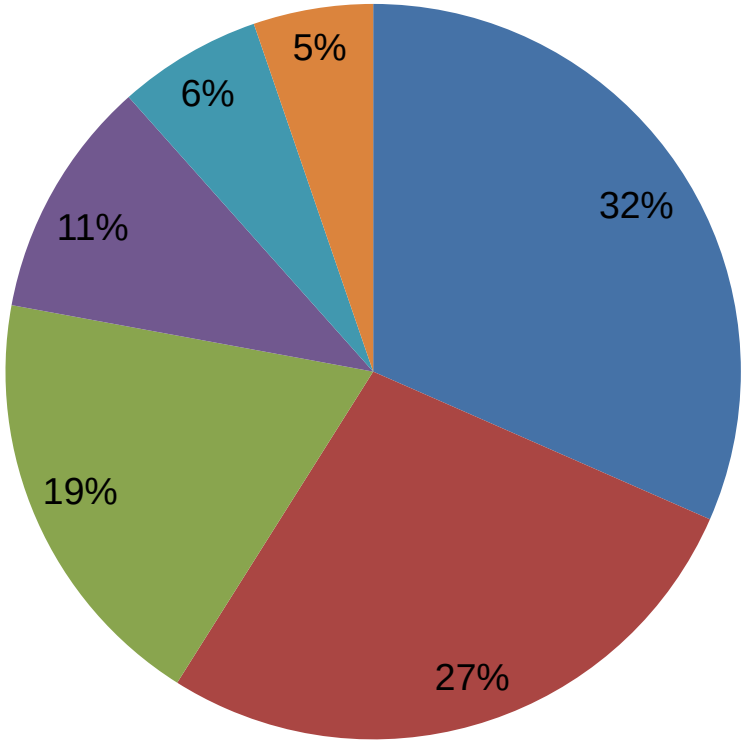
Main Take aways

Redundant Systems	An electric redundancy for all fail active systems in L4 vehicles is mandatory*. Steering & braking will require also a redundant power supply system
Truck Trailer Combination	L4 driving shall be possible with existing trailer (target), although additional features to increase the availability of the trailer (health monitoring, fail active brakes, etc.) may be requested in future
Sensor Architecture & Truck	All sensor architectures generally target a redundant 360-degree coverage with a combination of (radar, camera and lidar) up to 40 sensors
Cyber Security & OTA**	Mandatory to follow regulations is highly important and relevant, because non-compliance can lead to disastrous consequences
Synergies pass car & CVs	CVs are focusing to L4, pass cars to L3/L2. Strong synergies between PC & CVS except motion controlling (different vehicle physics) and actuation (different technology)
Release process	Overall vehicle type approval by manufacturer, suppliers be required to demonstrate meeting requirements. Standards for release scenarios are evolving but are not yet final.

*Except of special use cases, where non-electric redundancy may be applied (e.g. AYM)

**OTA – Over the Air update

Total Cost of Ownership (TCO)



■ Fuel ■ Wages ■ Overhead ■ Depreciation ■ Vehicle Insurance ■ Other

Acquisition costs	Upcharge 100k€ for L4 system 50k€ for FCEV/BEV
Truck driver cost	Up to 72 k€ per year. Driver shortage will increase costs Virtual driver costs of 1k€ / month considered
L4 costs	Constrained autonomy: 5 trucks monitored per operator (2540 € / month)
Fuel cost	2.5% improvement in fuel efficiency and fuel cost on the driverless portion of route,
Maintenance	20% additional cost in vehicle maintenance due more complex technology and increased mileage vs. lower wear & tear from automated operation
Insurance	No change: increased safety vs. new technology
Depreciation	L4 drivers out with no resell value (1 Mio km lifetime)
Annual miles driven	Non-autonomous 115.000 km p.a. Autonomous vehicle up to 200.000 km p.a.
Toll	Same for all. No special toll reduction for 0-emission vehicles expected

Chart shows the typical cost element shares of TCO of a conventional (ICE, non-autonomous) truck.

MÁSHOL RUTIN.
NÁLUNK ALKOTÁS.

KNORR-BREMSE

RESEARCH AND DEVELOPMENT CENTER