DEEP DIVE E-MOBILITY – THE TRATON PERSPECTIVE

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DR. ATIF ASKAR, HEAD OF BUSINESS DEVELOPMENT, STRATEGY AND M&A
DR. ANDREAS KAMMEL, STRATEGY AND BUSINESS DEVELOPMENT
OUR BRANDS FOCUS ON E-MOBILITY LEADERSHIP

SINCE 2020
Common modular electric powertrain toolkit, used in the first series produced all-electric city buses from Scania and MAN.

BY 2025
Electrified vehicles will account for around 10% of Scania’s total vehicle sales volumes in Europe. Half of MAN’s new buses will run on alternative drives.

BY 2030
Electrified vehicles will account for 50% of Scania’s total vehicle sales volumes. At least 60% of MAN’s delivery trucks and 40% of long-haul trucks will be emission-free.
TRATON INCREASES R&D INVESTMENT IN E-MOBILITY TO €1.6 BILLION

TRATON invests €1.6 billion in R&D for e-mobility from 2021 to 2025

All brands are shifting budgets from conventional drives to e-mobility

Share of product development\(^1\) for e-mobility will be doubled until 2025

Less than 20% of product development budget for conventional drivetrains in 2025

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1 Product development budget comprises the share of primary R&D costs, that could be assigned to specific product projects or product project roadmaps before start of production. Product development budget does not include efforts for general base research or R&D support after start of production (i.e. for quality assurance or product cost optimization during the lifecycle).

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EXPECTED IMPACT OF ELECTRIFICATION ON TCO/TOE BREAKDOWN

- Reduction of CO₂ footprint in line with future emission targets
- Zero noise emission in sensitive areas
- Gaining experience and capabilities in operating electrified vehicles
- Crucially: lower fuel cost and meaningfully better TCO/TOE (mid-to-long-term)

ENERGY IS THE MOST IMPORTANT COST DRIVER – ENERGY COST ADVANTAGE KEY TO ADOPTION OF NEW TECHNOLOGIES

1 Chart representative for German HDT market; indicative - depending on usage pattern. 2 Non exhaustive.

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BATTERY COST DEVELOPMENT OVER TIME

Historically, battery cost has fallen ~2.5x faster than predicted.

5 years ago, few expected BEV concepts to apply in long-haulage.

The prospects of commercial BEV vehicles have improved markedly.

View on BEV in long-haulage, mid 2010s

“A truck capable of going 1000 km hauling 27t [...] would need a battery weighing 25t, and could only carry about 2t of cargo. And because a heavy-duty truck battery is so heavy and large, charging takes too long – typically 12 hours or more.”

www.energyskeptic.com, 2016
BEV have a markedly higher system efficiency than FCEV.
BEV ARE EXPECTED TO BE MORE COST-EFFICIENT THAN EITHER DIESEL OR FCEV

DELTA TOE: LONG-HAUL HEAVY DUTY – EUROPEAN AVERAGE, MID CASE¹, INCL. REGULATORY EFFECTS

Key takeaways:
• Battery & fuel cell costs ultimately of lower importance – energy cost delta decisive, with BEV profiting most from regular long-distance applications
• Both BEV and FCEV are likely to ultimately beat Diesel on cost – but FCEV are unlikely to reach parity with BEV
• Strong deviation from some recent long-haul TCO studies by inclusion of a) fast charging, b) commercial EU electricity rates and c) known & expected advances on battery specs, including life cycles

¹ Middle-ground scenario regarding build-up of a hydrogen economy and charging infrastructure.

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NORDICS & WESTERN EUROPE LIKELY TO SEE EARLIEST BEV TOE PARITY
DRIVEN BY FAVORABLE ENERGY COST & REGULATORY ENVIRONMENT | TOLL EFFECTS SIGNIFICANT

TOE PARITY BEV LONG-HAUL FOR MAJOR MARKETS

INCLUDING TOLLS, CO2 FEES & SUBSIDIES

Key regulatory factors by market

- Tolls
- CO2 fees
- Subsidies

ILLUSTRATIVE

Early

Late
BEV HAS A STRONG COST ADVANTAGE OVER FCEV AT REGULAR HIGH RANGE

COST-WISE, LONG-RANGE DRIVING IS THE REALM OF BEV, IF USED REGULARLY OR WITH FULL INFRASTRUCTURE

LONG-HAUL ANNUAL TOE BEV VS. FCEV – AVERAGE DAILY RANGE VS. DAILY VARIABILITY OF RANGE

### Annual TOE long-haul BEV vs. FCEV

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<th>Avg. daily range</th>
<th>0%</th>
<th>25%</th>
<th>50%</th>
<th>75%</th>
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<td>800 km</td>
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### Key takeaways:

- **High daily range increases** the annual cost advantage of BEV over FCEV, if mostly used regularly.
- It is not high range, but **high variability of range** that is less favorable towards BEV, by:
  - reducing the share of energy cost
  - slowing amortization of a large battery
  - and, most importantly, **severely increasing payload losses**
- Still, the BEV cost advantage only **breaks down when high daily range is combined with**:
  - very high variability in daily range
  - and (local) absence of fast-charging infrastructure

=> Long-haulage favors FCEV over BEV only in case of **highly variable long-distance requirements** without full fast-charging infrastructure.

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THE BEV MARKET SHARE IS SENSITIVE TO CHEAP PRICES FOR GREEN H2
SYNERGY EFFECTS YIELD IMPROVING FCEV AND BEV CASES FOR ABUNDANT LOW-COST HYDROGEN

BEV/FCEV/OTHER MARKET SHARE – NAÏVE VERSION

MARKET SHARE INCL. BEV-FCEV SYNERGIES

Synergies between abundant low-cost hydrogen and electricity yield challenging BEV-FCEV cost & market share parity
MOST LONG-TERM ADVANTAGES LIE ON THE BEV SIDE

FCEV WILL BECOME MORE COMPETITIVE WITH BEV IN THE 2020s ...

- Cost degression on components
- Significant subsidies
- Emerging H2 economy

... BUT MAJOR LONG-TERM TRENDS TEND TO FAVOR BEV STRONGLY

- Lightweight, cheap batteries
- Autonomous Driving
- Increasing grid storage
APPLICATIONS WHERE FCEV CAN BE A COMPLIMENTARY SOLUTION (EUROPE)

Non-stop at high consumption

- Time-critical two-driver operations, with low price elasticity
- Significant auxiliary requirements or remote operations, both w/o local infrastructure

Inhomogeneous usage

- Irregular long-distance requirements, e.g. due to low predictability
- High-flexibility vehicles, e.g. augmentation in regularly operated fleet

Severe payload restrictions

- Applications beyond feasible battery impact, e.g. certain heavy transports & axle configurations
- Use cases with severe payload impact, e.g. long-distance coaches with two drivers

Regions with low running costs

- Local operation subsidies, e.g. with Swiss toll exemptions
- Local cheap H2, e.g. around local cheap renewables, at steel plants or near import harbors
SYNTHESIS – KEY TAKEAWAYS

**BEV** will become competitive with Diesel no matter the scenario

This will happen **earlier and faster** than previously expected

Just fulfilling current **EU emission regulations** is not sufficient

**Infrastructure** is by far the most critical enabler for a smooth transition

**OEMs will require** **FCEV** as a **complementary solution** for certain use cases & markets

**BEV will be mainstream** across all major applications including **long-haul**