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DEEP DIVE E-MOBILITY – THE TRATON PERSPECTIVE

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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 development¹ for
e-mobility **will be doubled**
until 2025

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



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).

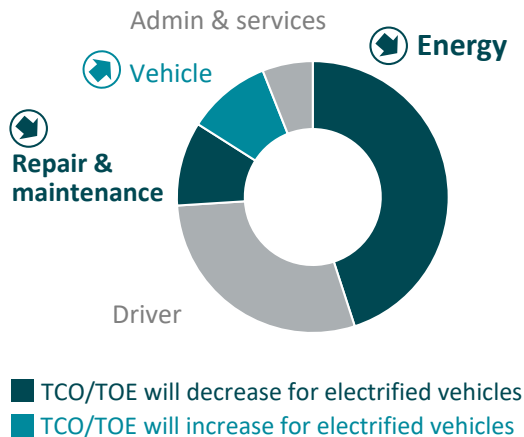
ADOPTION OF NEW DRIVETRAINS IS DRIVEN BY COST AND THE REGULATORY ENVIRONMENT

TRUCKS ARE CAPITAL GOODS – PURCHASE DECISION VIA TCO/TOE



Customer focus	Cost of ownership
Usage pattern	Homogeneous
Annual mileage	~130,000 km
Fuel consumption	~30-35 l/100 km
Product lifecycle	>10 years
Vehicles sold	~3 mn p.a.

EXPECTED IMPACT OF ELECTRIFICATION ON TCO/TOE BREAKDOWN¹



"Total operating economy" (TOE) augments "total cost of operation" (TCO) by other cost-relevant factors like payload effects, stand times...

EXPECTED CUSTOMER VALUE²

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

THE PROSPECTS OF COMMERCIAL BEV VEHICLES HAVE IMPROVED MARKEDLY

VIEW ON BEV IN LONG-HAULAGE, MID 2010s

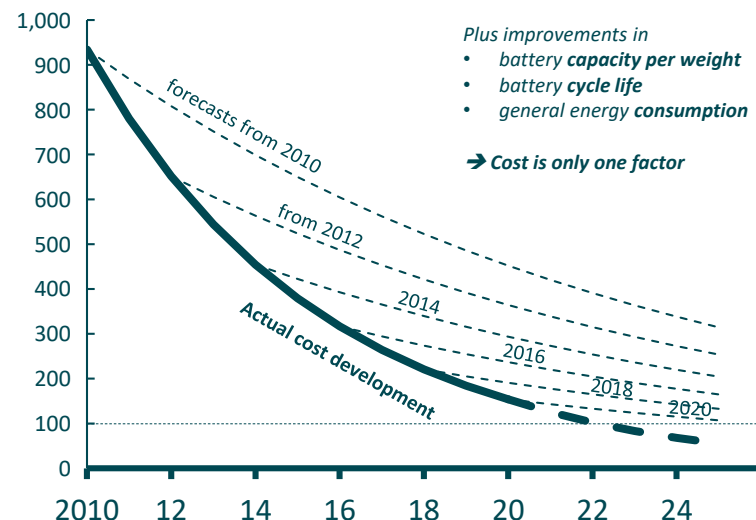
“A truck capable of going **1000 km** hauling 27t [...] would need a **battery weighing 25t**, and could only carry about 2t of cargo.
And because a heavy-duty truck battery is so heavy and large, charging takes too long – typically **12 hours or more.**”

www.energyskeptic.com, 2016



BATTERY COST DEVELOPMENT OVER TIME

Battery pack cost, illustrative¹ [EUR/kWh]

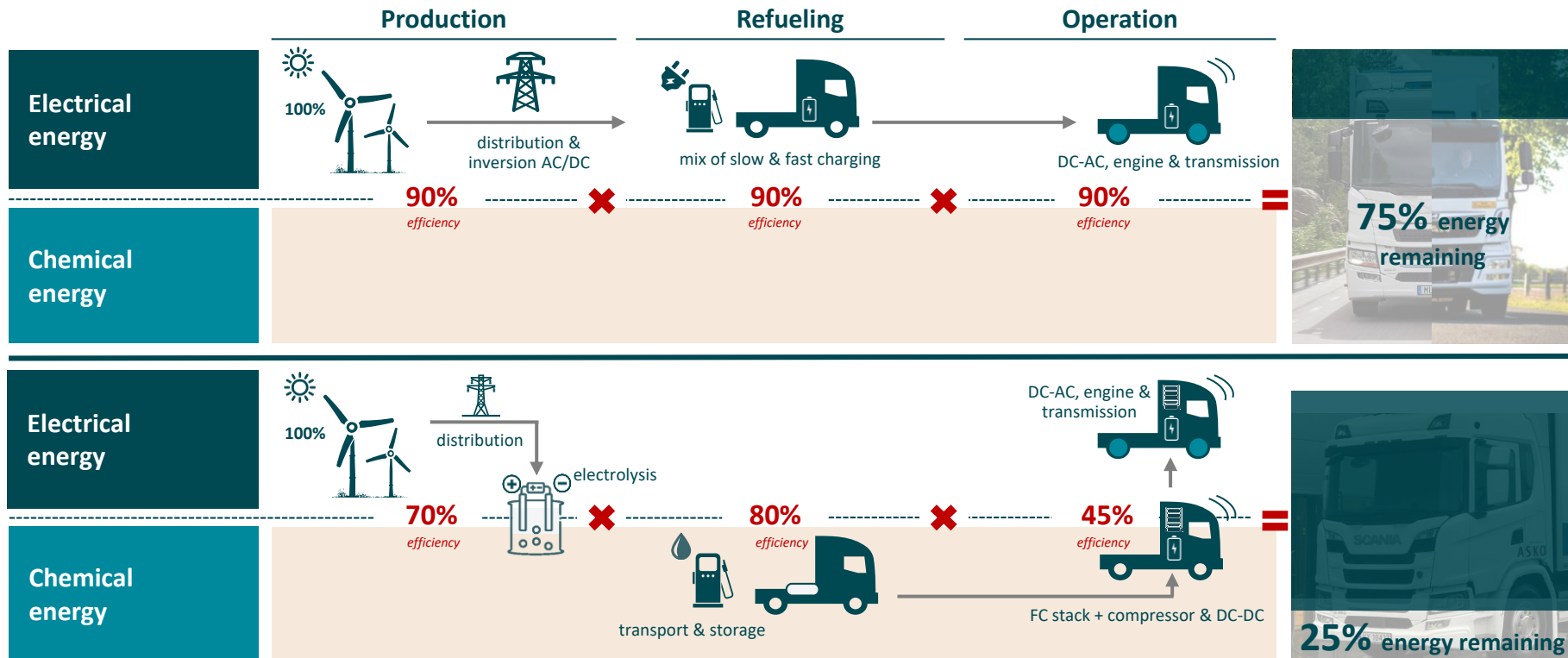


5 years ago, few expected **BEV concepts to apply in long-haulage**



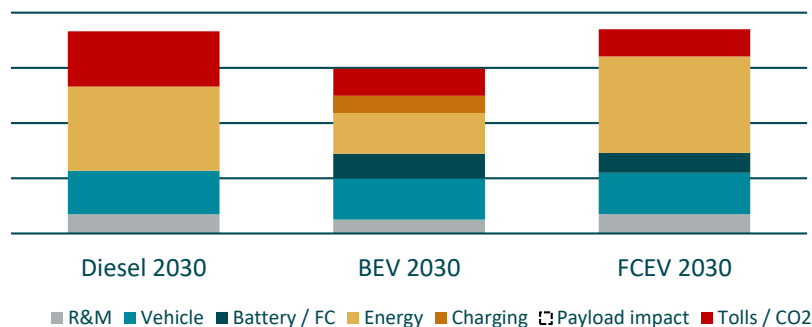
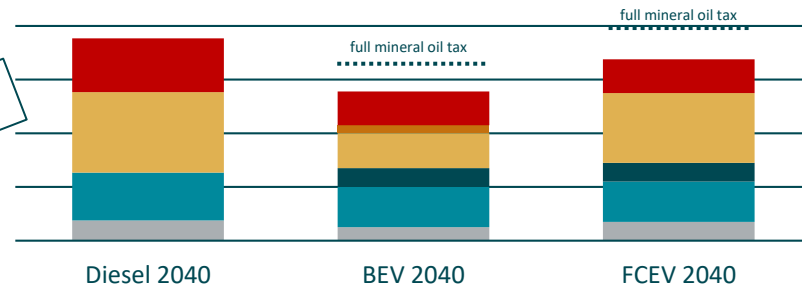
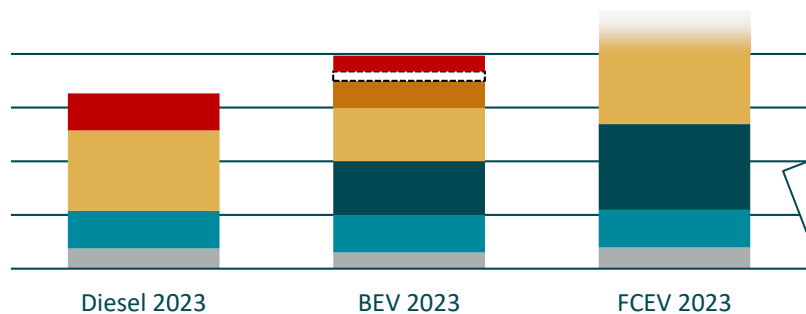
Historically, battery cost has fallen **~2.5x faster than predicted**

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

NORDICS & WESTERN EUROPE LIKELY TO SEE EARLIEST BEV TOE PARITY

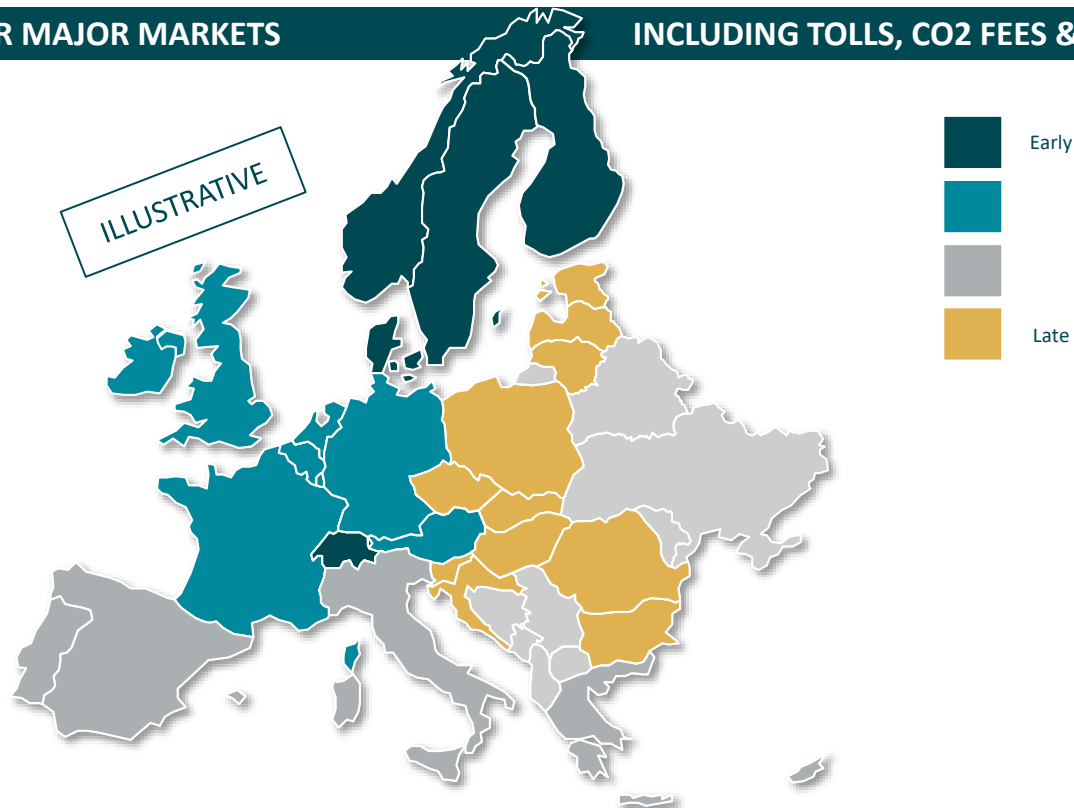
DRIVEN BY FAVORABLE ENERGY COST & REGULATORY ENVIRONMENT | TOLL EFFECTS SIGNIFICANT

TOE PARITY BEV LONG-HAUL FOR MAJOR MARKETS

INCLUDING TOLLS, CO2 FEES & SUBSIDIES

Key regulatory factors by market

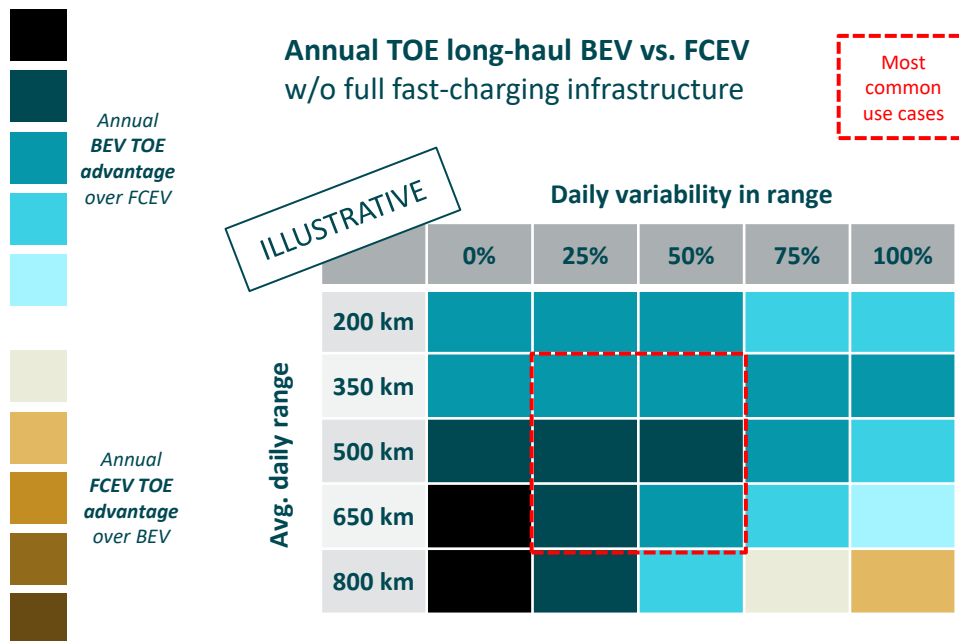
- € Tolls
- CO₂ CO2 fees
- 👤 Subsidies



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



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
 - a) reducing the **share of energy cost**
 - b) slowing **amortization of a large battery**
 - c) and, most importantly, **severely increasing payload losses**
 - Still, the BEV cost advantage only **breaks down when high daily range is combined with**
 - a) very **high variability in daily range**
 - b) 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

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



High hydrogen cost

Low hydrogen cost

MARKET SHARE INCL. BEV-FCEV SYNERGIES



High hydrogen cost

Low hydrogen cost

➔ 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

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