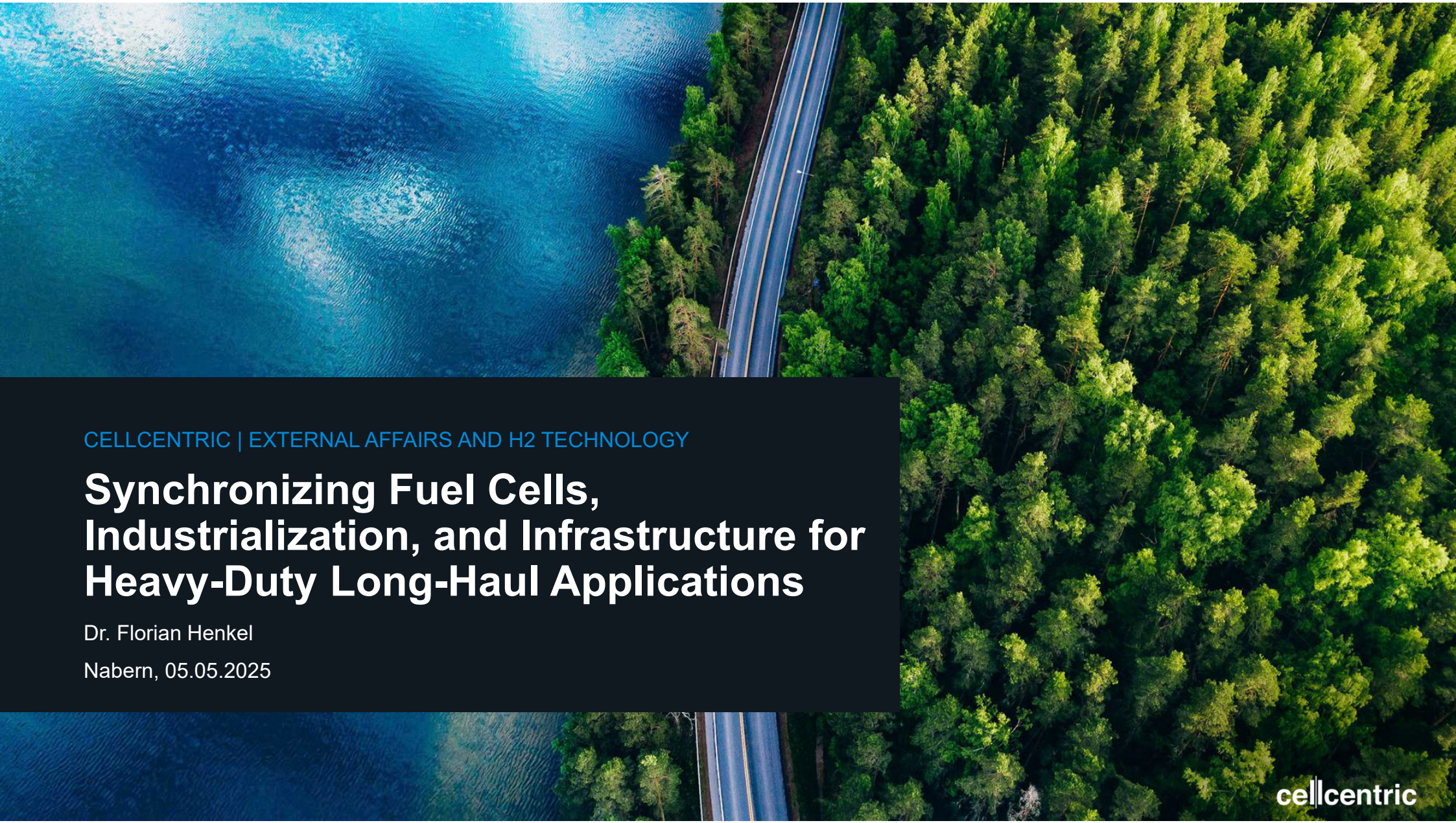

CELLCENTRIC | EXTERNAL AFFAIRS AND H2 TECHNOLOGY

Synchronizing Fuel Cells, Industrialization, and Infrastructure for Heavy-Duty Long-Haul Applications

Dr. Florian Henkel

Nabern, 05.05.2025

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At a glance

cellcentric
A Daimler Truck & Volvo Group Company

cellcentric's ambition is to become a leading global manufacturer of fuel-cells and thus help the world take a major step towards climate-neutral and sustainable transportation.

MISSION & VISION

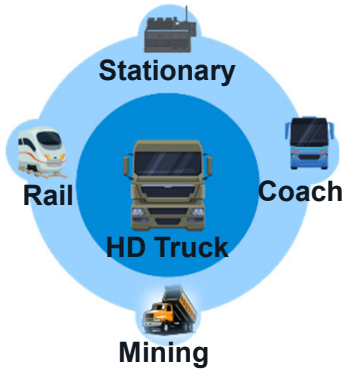
Our Purpose - Why do we exist?
We power sustainable life
Our Vision - What are our goals?
Be the first choice for superior fuel cell solutions

EMPLOYEES

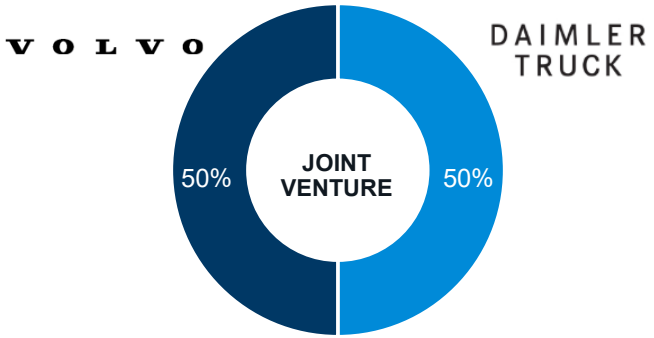
560+

Daimler Truck and Volvo as the two main customers in heavy duty vehicle application

MARKET PENETRATION STRATEGY

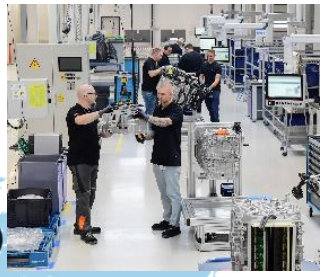


PARTNERSHIP OF COMPETITORS

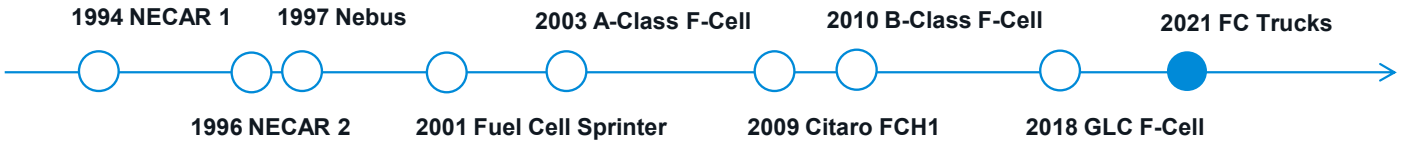


LOCATIONS

4



OVER 30 YEARS OF FUEL CELL EXPERTISE



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Significant improvements in power density and cost reduction

2010 CITARO F-CELL

- Citaro Bus reached lifetime of >19.000 h

2018 GLC F-CELL

- Power density +100 %
- Platinum content -90 %

2022 BZA100+

- Power output from 70 to 100+ kW
- New stack technology
- Production process for medium volumes

2025 BZA150

- Power output from 100+ to ~143 kW
- Production process for high volumes
- Expected lifetime target 25.000 hours[1)] / up to 10 years (long haul truck)

202X NextGen

- Up to 375 kW continuous net power
- 20% less fuel*
- 40% waste heat reduction*
- 40% more power density & 40% less complexity*

*Comparison over BZA150

1) for heavy-duty application only

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MORE THAN 30 YEARS

Extensive company and product history

Commercial vehicles

1994
NECAR 1

1997
Nebus

2001
Fuel Cell Sprinter

2009
Citaro FuelCELL-Hybrid

2021
Fuel Cell Trucks

2003-2009
Fuel Cell Citaro | Fuel Cell Sprinter

2009-2010
Fuel Cell Sprinter

1996-2001
Necar 3 | 4 | 5

2003-09
F600 | A-Class F-Cell Advanced

1996
Necar 2

2003
A-Class F-Cell

2010
B-Class F-Cell

2018
GLC F-Cell

Passenger cars

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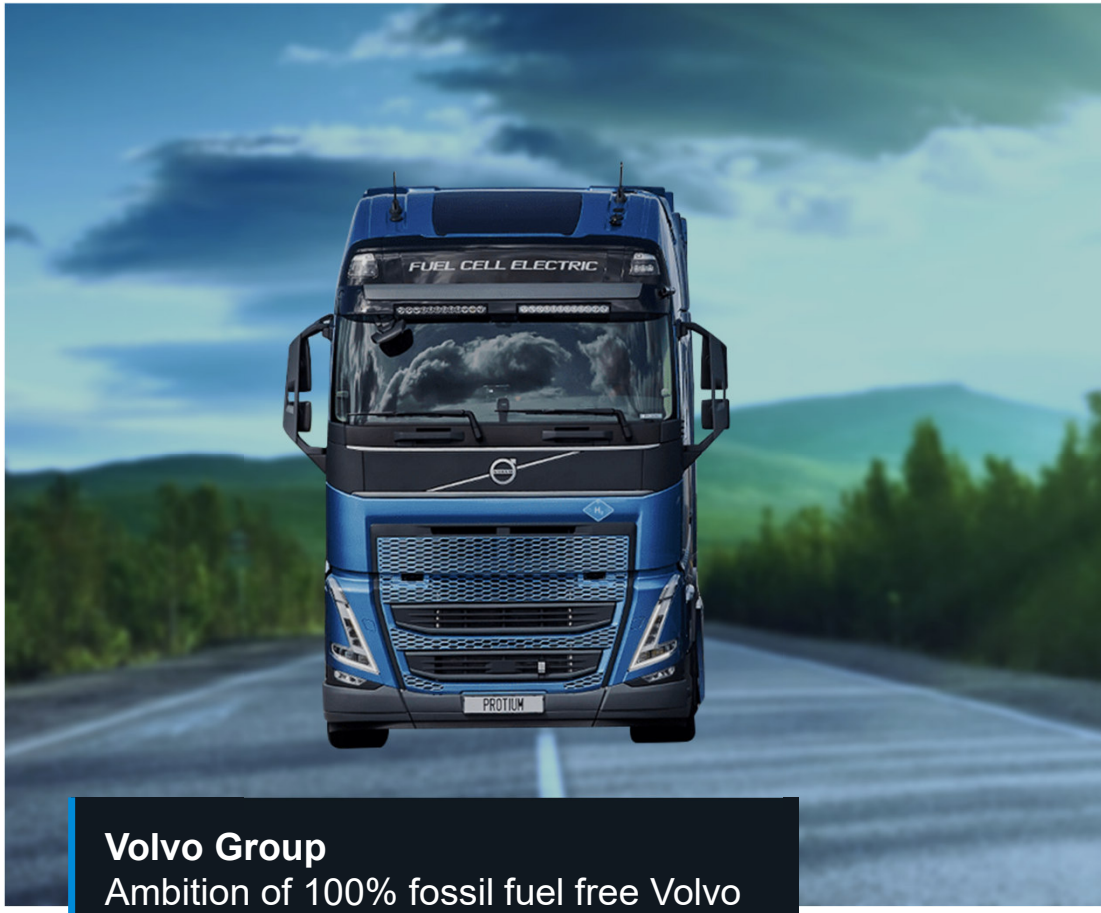
DAIMLER TRUCK AG AND VOLVO GROUP AMBITIONS

CO_2-neutral and sustainable transport by 2050

Daimler Truck
All new vehicles in the Triad* to be CO_2-neutral by 2039



Volvo Group
Ambition of 100% fossil fuel free Volvo Group vehicles from 2040

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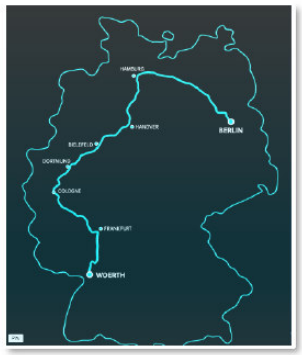
Daimler Truck #HydrogenRecordRun: Truck exceeds 1.000-kilometer (2023)

Next step: real-world testing with customer fleet in 2024, #100 starting in 2026+

2023 Record Run



1.047 km with one fill

Fully loaded: 40 tons*

2024 Customer Trial

AIR PRODUCTS — Transport von Flaschengasen / Transport of cylinder gases

amazon — Paketlogistik / Parcel logistics

HOLCIM — Baustofflogistik / Building materials logistics

INEOS — PVC- und Vinyltransport / PVC and vinyl transportation

WIEDMANN & WINZ — Seecontainer / Sea containers

Source: „Wasserstoff im Schwerlastverkehr – wo stehen wir?, Megatrend Wasserstoff, 17. Okt. 2024 , Daimler Truck

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Beyond Fuel Cells: What it takes to succeed - H2 ecosystem

Heavy-duty technology: fuel cells are tailor made for long-haul trucking

- Distribution trucks (low payload and range needs) tend towards BEV due to high energy efficiency
- Vocational trucks (cost sensitive, low range needs) tend towards H2 ICE if BEV does not fulfill mission
- **Long-haul trucks are the ideal case to benefit from the strengths of fuel cell technology**
  - ✓ Benchmark fuel consumption due to very high **efficiency** in hydrogen usage
  - ✓ Long driving **range** due to high efficiency (>1.000 km with today's level of technology)
  - ✓ **Flexibility** in use profile due to long range, short refueling times and relative ease of H2 infrastructure build-up

→ **Heavy-duty fuel cells best-fit decarb solution for long-haul trucks**

Main TCO drivers by truck application

Distribution

- Purchase price
- Depreciation & resale
- Maintenance & repair

Vocational

- Purchase price
- Maintenance & repair
- Downtime

Long-haul

- **Fuel consumption!**
- Downtime
- Maintenance & repair

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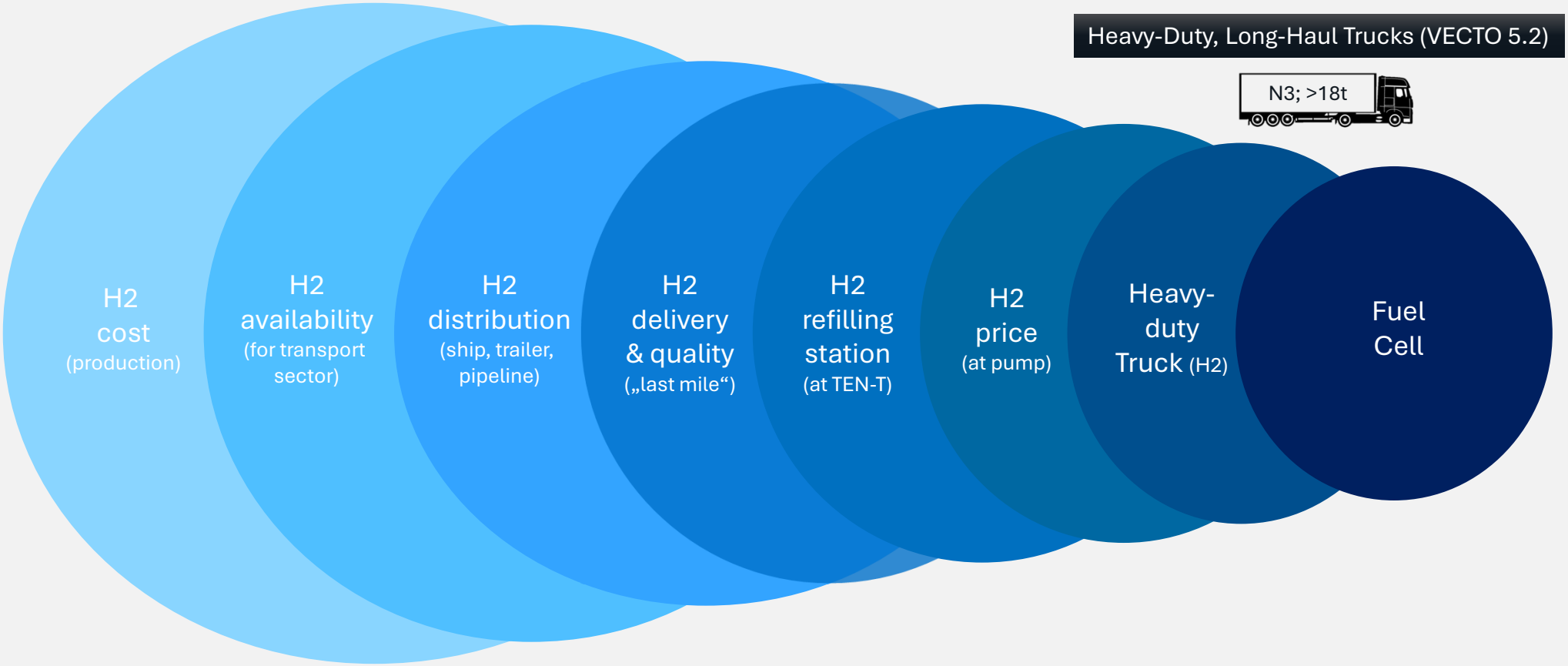
H2 ecosystem dependencies for heavy-duty trucking (Zero-Emission Vehicle)



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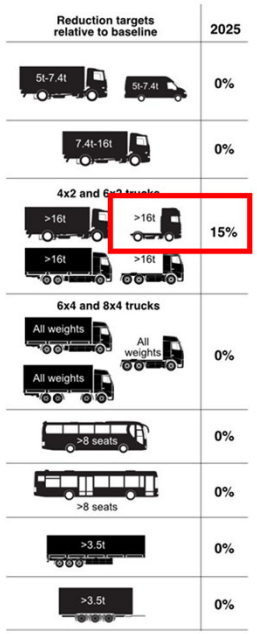
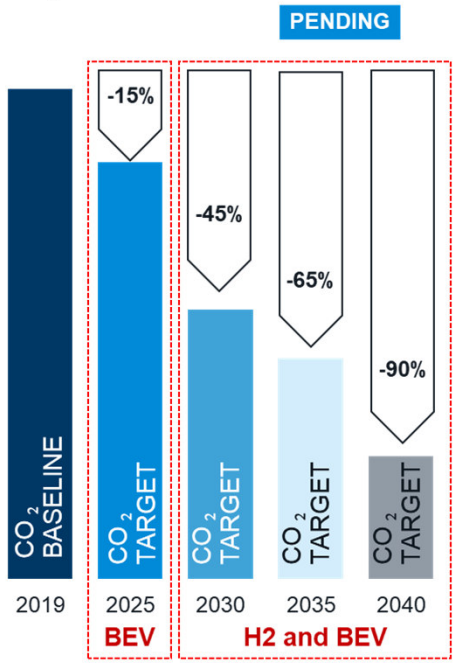
European Green Deal set some of the **most challenging CO_2 regulations for HDVs worldwide:** -45% by 2030 & -90% by 2040

REDUCTION TARGETS BY VECTO CLASS*

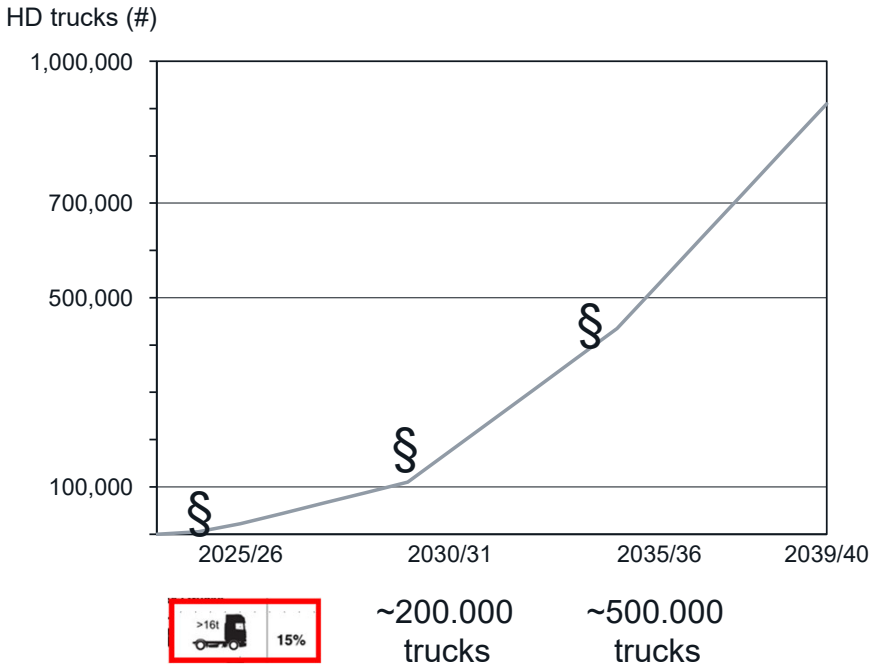


CO_2 TARGETS FOR TRUCKS



Legislative triggered ZEV 4x2 long-haul trucks* in EU

Vecto class 5.2 (LH) only, others not considered



Vecto class 5-LH ZE trucks only in EU: from 2025 ~ 22k p.a., **from 2030 65k p.a**, from 2035 ~95k p.a.

*) Based only on approx. 145,000 long 4x2 tractor haul trucks (year 2021; VECTO class 5-LH); Source ID-243-–-EU-CO2-trucks_final2.pdf

TANK-TO-WHEEL EFFICIENCY OF EXISTING LONG-HAUL TECHNOLOGY

Upcoming years 2025+: First BEV in addition to Diesel

Range: ~500 km

Battery electric

Volvo FH Electric

eActros600

Energy consumption (40t) =
~110 kWh/100 km

Ideal minimum theoretical propulsion* = 100 – 110 kWh/100 km

Range: >2.000 km

Diesel

Fuel Consumption (40t) =
31,9 l/100 km

Energy consumption (40t) =
313 kWh/100 km

Heizwert Diesel = 9,8 kWh/l

*) ideal minimum propulsion energy @80 km/h on Motorway, no inclination = 0°, European Truck frontfacet A, c_w and average tire friction coefficient c_{roll}

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TANK-TO-WHEEL EFFICIENCY OF EXISTING LONG-HAUL TECHNOLOGY

Next step: Hydrogen and Fuel Cell = efficiency, range, flexibility → long-haul

Fuel Cell

H2 Fuel consumption (40 t): 80 kg/1047 km = 7,6 kg/100 km

Heizwert H2 = 33,3 kWh/kg

Fuel Consumption (40t) = **7,6 kg**/100 km

Energy consumption (40t) = **254 kWh**/100 km

H2-ICE

Range: 600 km

https://press.mantruckandbus.com/corporate/de/man-erweitert-zero-emission-portfolio/

MAN H2-ICE Truck
56 kg of H2
600 km
(proposed driving range)

Heizwert H2 = 33,3 kWh/kg

Fuel Consumption = **9,3 kg**/100 km

Energy consumption = **311 kWh**/100 km

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CURRENT SITUATION OF MOTORWAY SERVICE STATIONS

Denkendorf service station @ A8 motorway near Stuttgart, Germany

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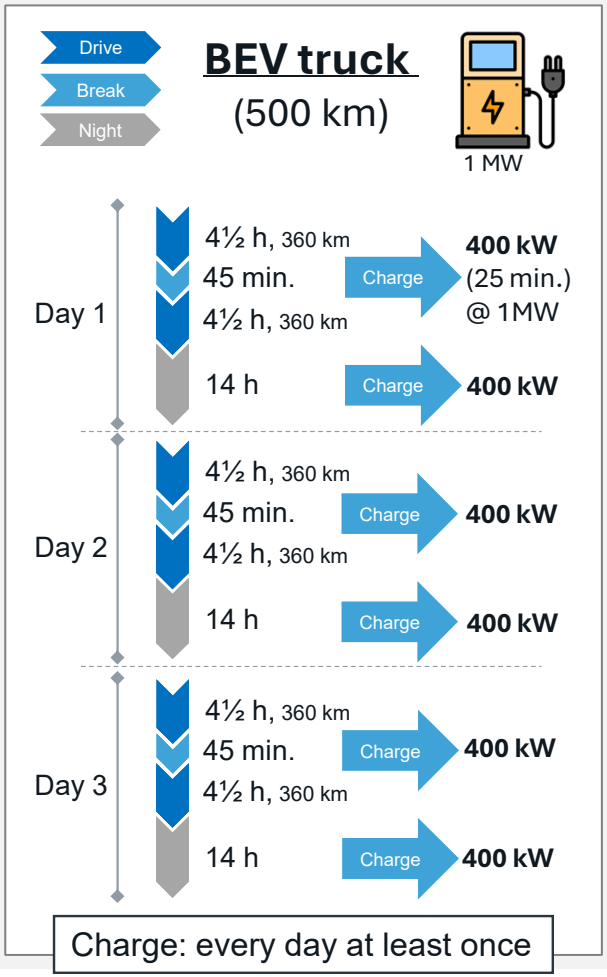
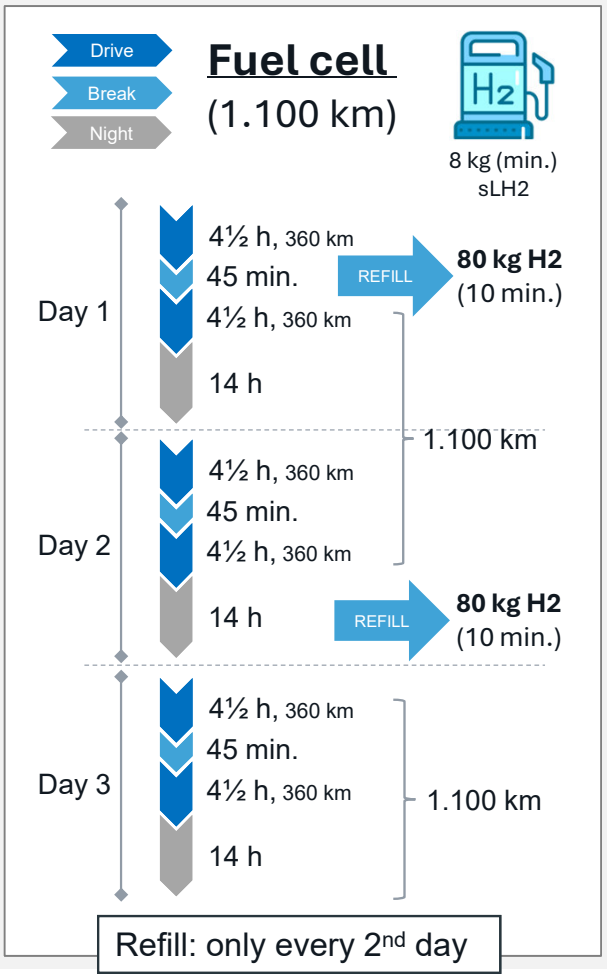
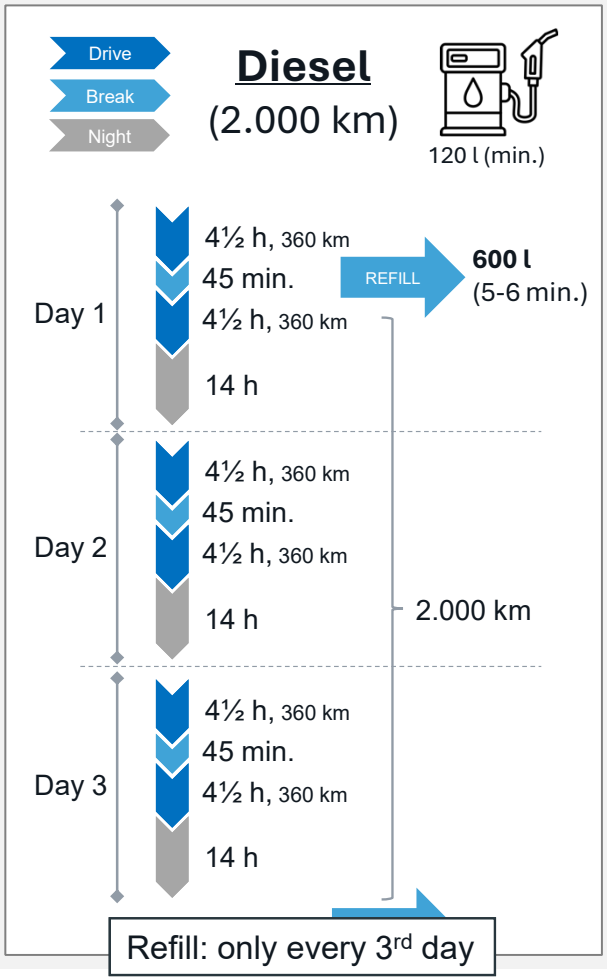
OPERATION OF HEAVY DUTY TRUCKS (HDT) BASED ON TODAYS AVAILABLE TECHNOLOGY

HDT daily routing: H2 and Diesel enable short & decoupled refilling cycles







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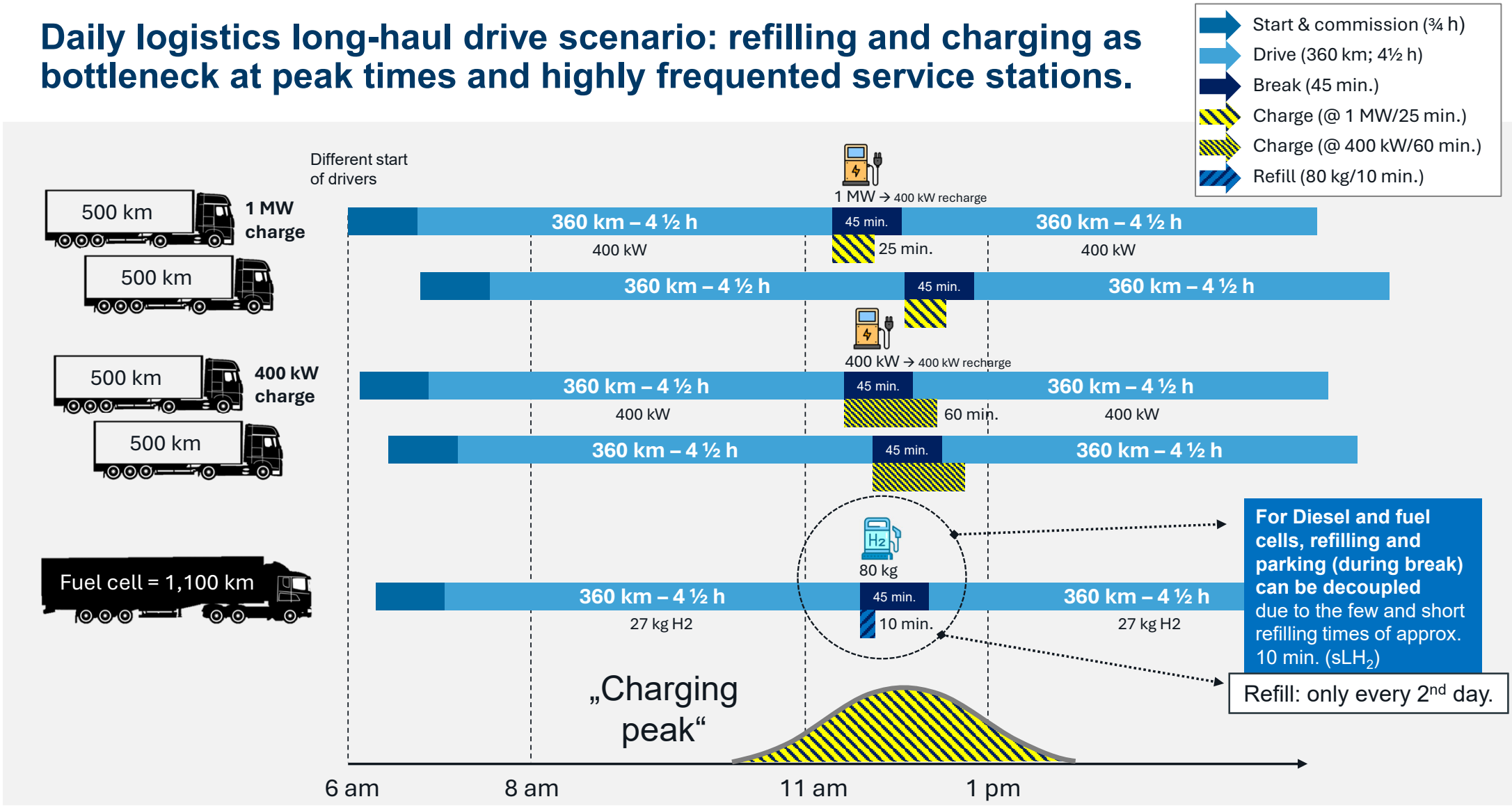
Daily logistics long-haul drive scenario: refilling and charging as bottleneck at peak times and highly frequented service stations.



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Location bottleneck

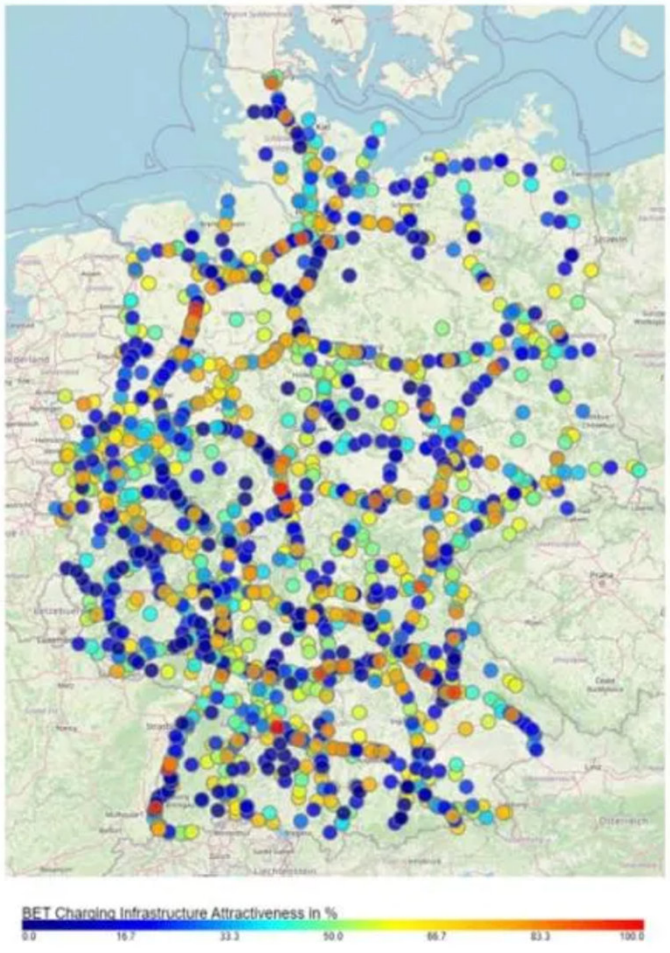
Long-haul heavy duty trucks will drive along the TEN-T corridors, using key infrastructure along these routes.

This leads to more „popular“ service station locations („attractiveness“).

Core Network Corridors	km
Baltic-Adriatic	2,410
North Sea-Baltic	3,800
Mediterranean	5,390
Orient-East Mediterranean	4,360
Scandinavia-Mediterranean	5,610
Rhine-Alpine	1,690
Atlantic	4,240
North Sea-Mediterranean	2,260
Rhine-Danube	4,540

Figure 5: Attractiveness evaluation of potential truck parking areas in Germany

The attractiveness of p = 1648 potential truck parking areas for future BET charging infrastructure in Germany in%.



Interaktive Karte klassifiziert potenzielle Lkw-Ladestandorte - electrive.net

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Two Infrastructures are better than one…
(Electric AND Hydrogen)
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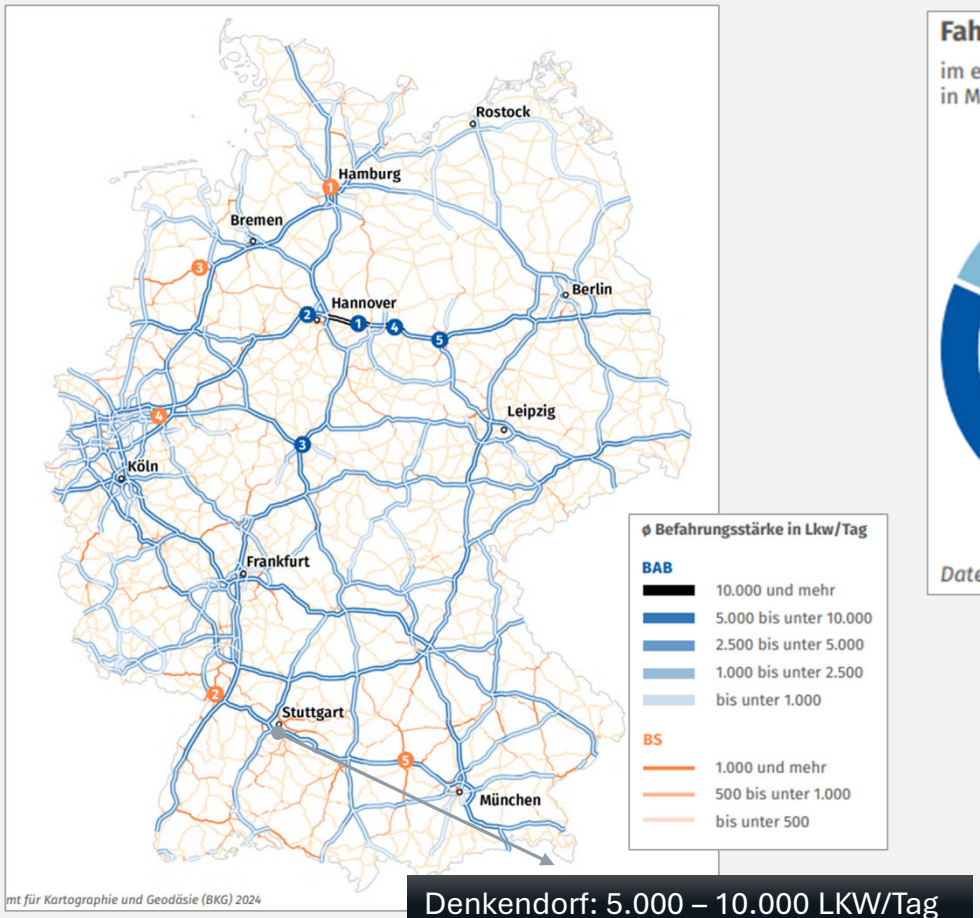
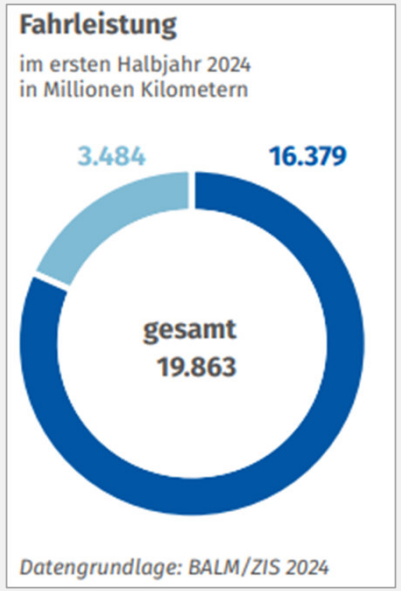
BEISPIEL: HALBJAHRESBERICHT DER TOLL COLLECT DEUTSCHLAND – MAUTFPLICHTIGER SCHWERVERKEHR

Befahrungsstärke durch mautpflichtigen Schwerverkehr (DEU; 2024)



Denkendorf: 5.000 – 10.000 LKW/Tag



Fast 20 Milliarden Kilometer Fahrleistung

Im ersten Halbjahr 2024 betrug die Gesamtfahrleistung auf mautpflichtigen Bundesfernstraßen circa 19,9 Milliarden Kilometer. Sie wurde von rund 1,377 Millionen unterschiedlicher mautpflichtiger Lkw erbracht. Durchschnittlich sind das mehr als 14.427 Kilometer pro Fahrzeug im Halbjahr, also mehr als 79 Kilometer je Mautfahrzeug pro Kalendertag.

Autobahnen tragen 82 Prozent der Gesamtfahrleistung. Im Berichtszeitraum von Januar bis Juni 2024 sind das rund 16,4 Milliarden Autobahnkilometer (Abbildung 3).

Erstes Halbjahr 2024:
- 19,9 Milliarden km
- 1,38 Millionen LKW (>7,5t)
- 82% Anteil Autobahn

Veröffentlichungen - Bundesamt für Logistik und Mobilität

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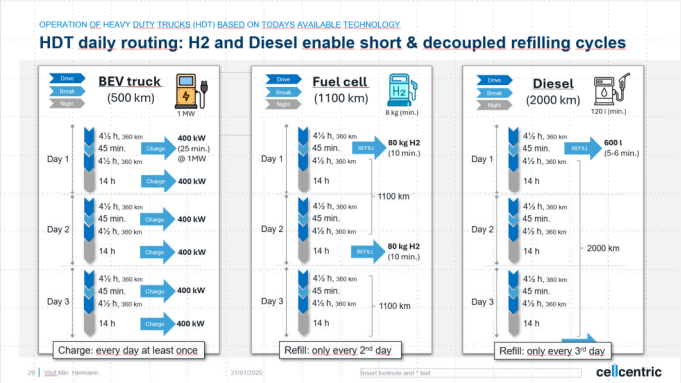
AT THE EXAMPLE OF DENKENDORF

Three Infrastructure bottlenecks for long-haul transport – Electric only?

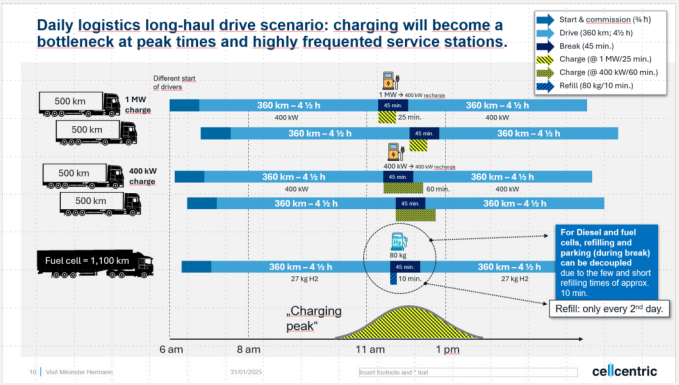
Frequency

(„every single break“)
at lunchtime every day and at night



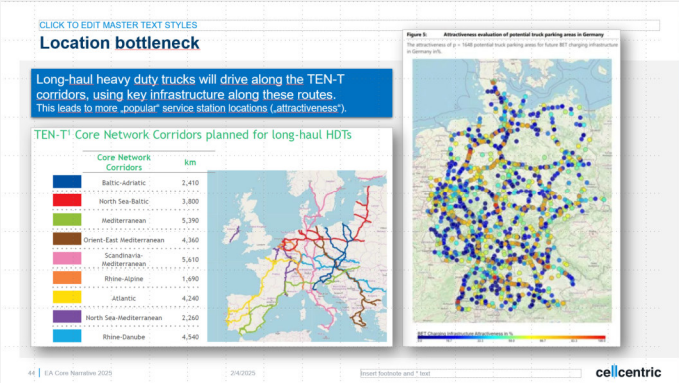
Peak

(„all at a time“)
at lunchtime



Location

(„all at the same place“)
along TEN-T corridors



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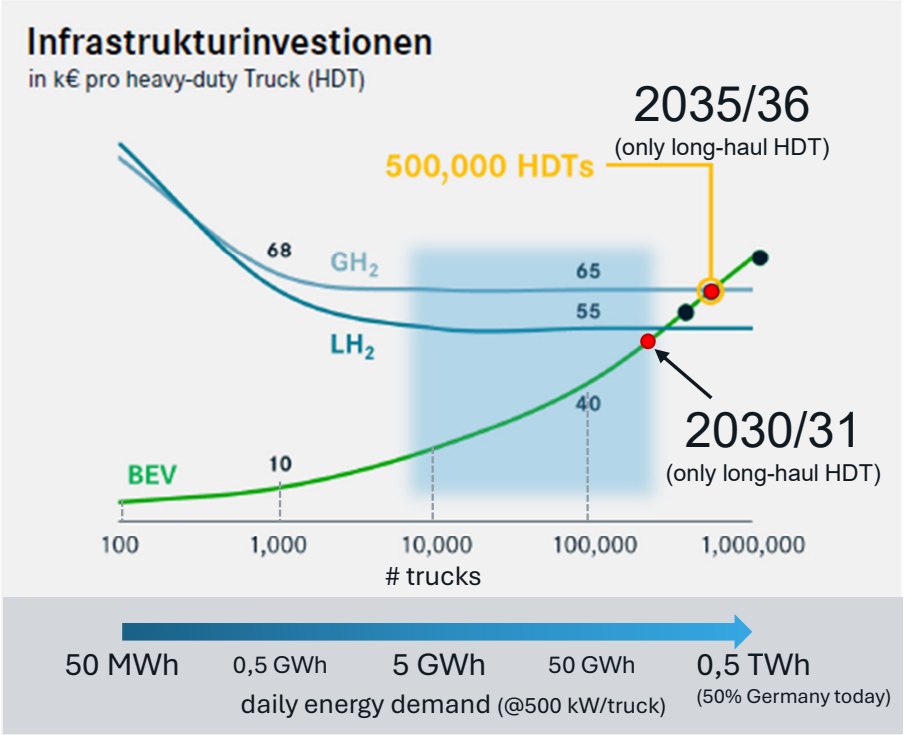
Counter-intuitive: Establishing two infrastructures for Zero emission trucks is faster and less capital intensive at scale, needed for 2030+



Batterie-Ladeinfrastruktur

- Geringe Initialkosten, vor allem für die Installation zusätzlicher Ladepunkte
- Aber: Erforderlicher Netzausbau erfordert Zeit und erhebliche Investitionen

Wasserstofftankstellen

- Hohe Initialkosten
- Aber: Bei steigender Auslastung hohe Skaleneffekte und geringer Flächenbedarf

Source: Daimler Truck AG

Fact sheet: CO2 standards for heavy-duty vehicles - ACEA - European Automobile Manufacturers' Association

H2 for CVs reduces limitations by infrastructure in decarbonization

- En-route charging for BEV trucks will reach limitations in volume scale-up
  - Locally and time-wise condensed charging at hubs with a high energy need for big batteries
  - Large number of chargers required for relatively long parallel charging of several vehicles
  - Potential grid uprating for energy provision

➢ Increasing marginal cost for infrastructure

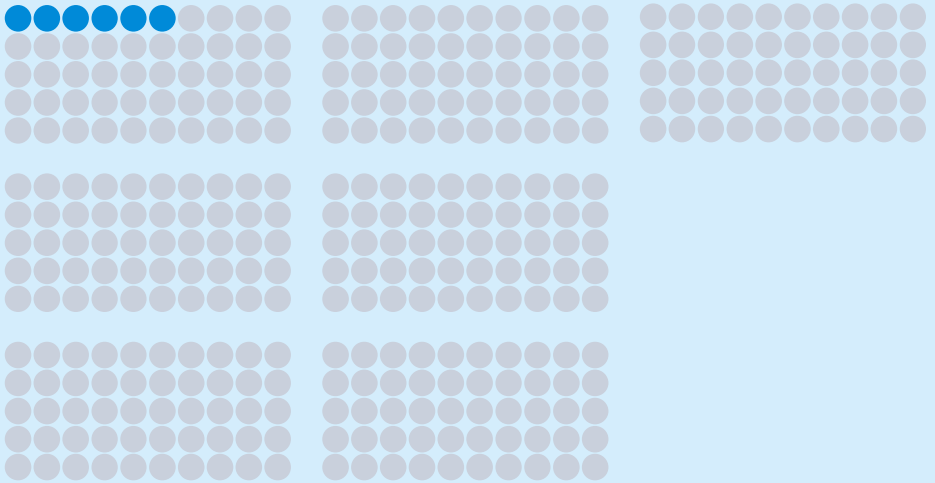
- En-route refueling for H2 trucks will compensate
  - Energy logistics comparable to existing solutions
  - A single refueling station can cater for large number of vehicles due to short refueling time
  - Scale effects due to demand and utilization

➢ Decreasing marginal cost for infrastructure

→ Two infrastructures are cheaper than one

Required infrastructure to match European truck CO2 targets for both technologies – heavy-duty truck BEV and H2

Megawatt charger (MCS) >800kW (as is vs need 2030 = ~35,000 units)*



H2 refuelling stations (as is vs need 2030 = ~2,000 units)*

*** Per dot = 100 units**

Source: ACEA, Fact-sheet-CO2_standards_for_heavy_duty_vehicles.pdf

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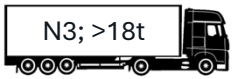
H2 ecosystem dependencies for heavy-duty trucking



H2 cost (production)

H2 availability (for transport sector)

H2 distribution (ship, trailer, pipeline)

H2 delivery & quality („last mile“)

H2 refilling station (at TEN-T)

H2 price (at pump)

Heavy-duty Truck (H2)

Fuel Cell

TEN-T corridors

Hydrogen refilling stations for HDT
(700bar/sLH; > 50 kg H2/single fill)

< 6€ / kg H_2

DAIMLER TRUCK

VOLVO

Pilot plant Pliensau-vorstadt (PSV)

Land acquisition Weilheim

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THANK YOU
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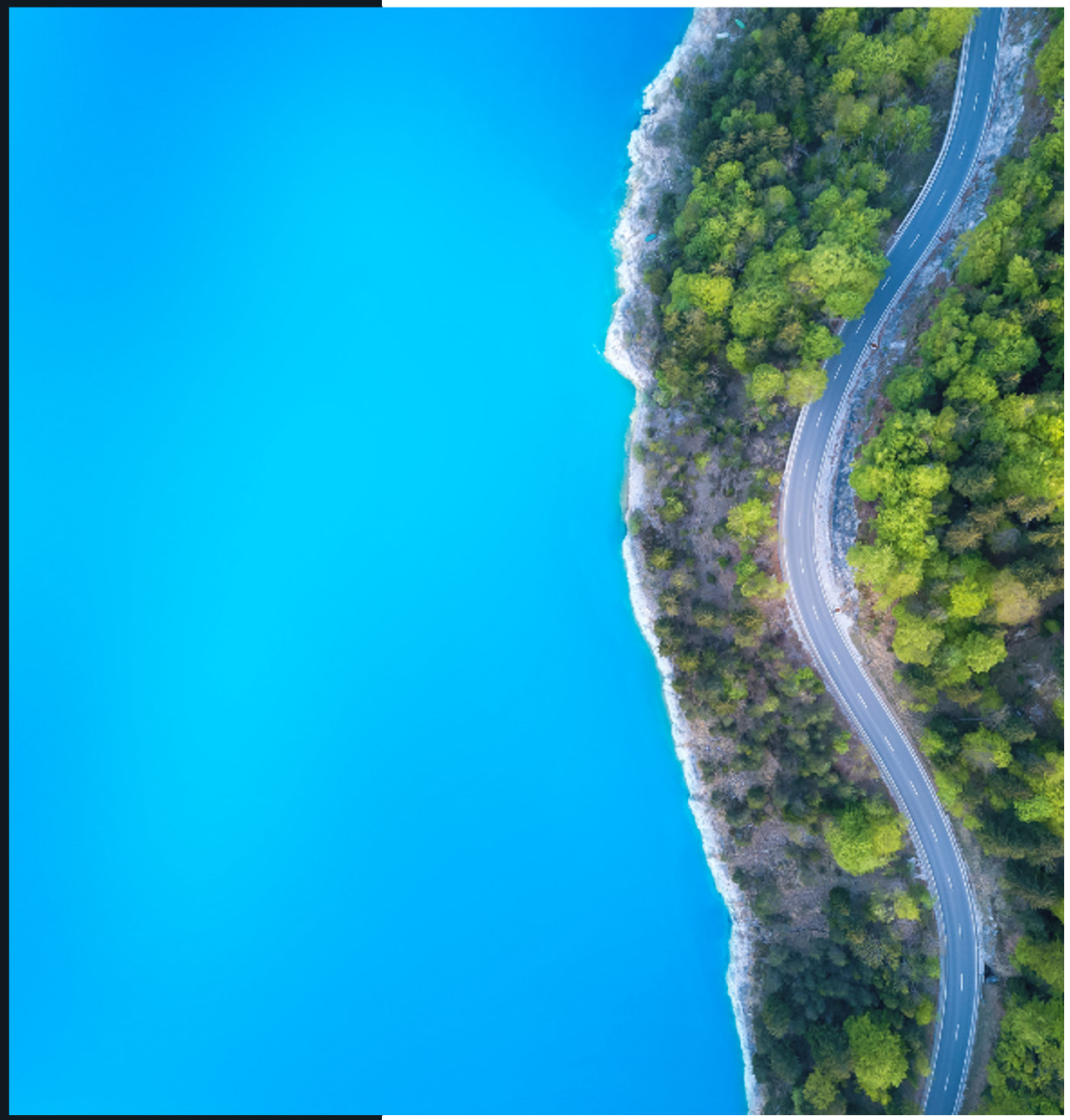
We power sustainable life

Dr. Florian Henkel

Lead External Affairs &
H_2 Technology Expert



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