

DAIMLER

Daimler Truck

The Future of Zero Emission Long-Haul Trucking

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19 February, 2020

Brussels



Introduction

Commitment to Paris Agreement

Climate action already established as a global mission of cities, companies, countries and governments worldwide

Worldwide commitments with action plans

| | | |
|--------------------------|----------------|----------------------------|
| 2,508 CITIES | 209 REGIONS | 2,138 COMPANIES |
| 479 INVESTORS | 238 CSOs | COOPERATIVE INITIATIVES |
| 12,549 TOTAL COMMITMENTS | | |



...going to distance itself from fossil fuels

Rockefeller Family Fund hits Exxon, dives from fossil fuels



Rockefeller fund eliminates holdings of Exxon Mobil

...and accelerates CO₂ regulations

VW To Unleash 20 EVs By 2020 As Dieselgate Turns Into Tesla's Tarbaby

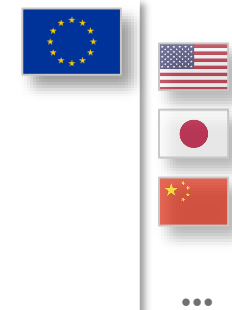
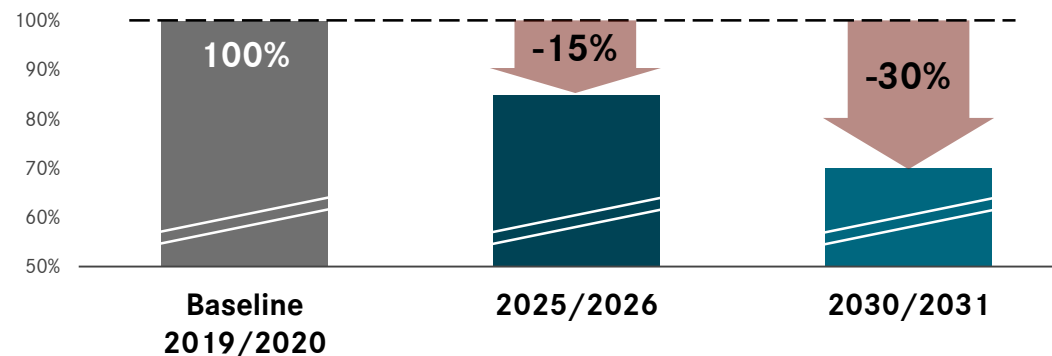


Which states follow California's emission and zero-emission vehicle rules?

*Unprecedented support of „Paris“ → >1,000 mayors, governors and CEOs

Regulatory requirements

European Union



Trucks in category 5.2 count the most:

very costly to build CO₂ compliance strategy on several categories. OEM specific target value 2025 for each sub-group

| Vehicle sub-group | Annual mileage [km] | Average payload [t] | MPW factor |
|-------------------|---------------------|---------------------|--------------------------------------|
| 4.2-RD | 78.000 | 3,2 | 15% seven trucks in 4.2 equal |
| 5.2-LH | 116.000 | 13,8 | 100% one truck in 5.2 |
| 10.1-RD | 68.000 | 10,3 | 43% two trucks in 10.1 equal |

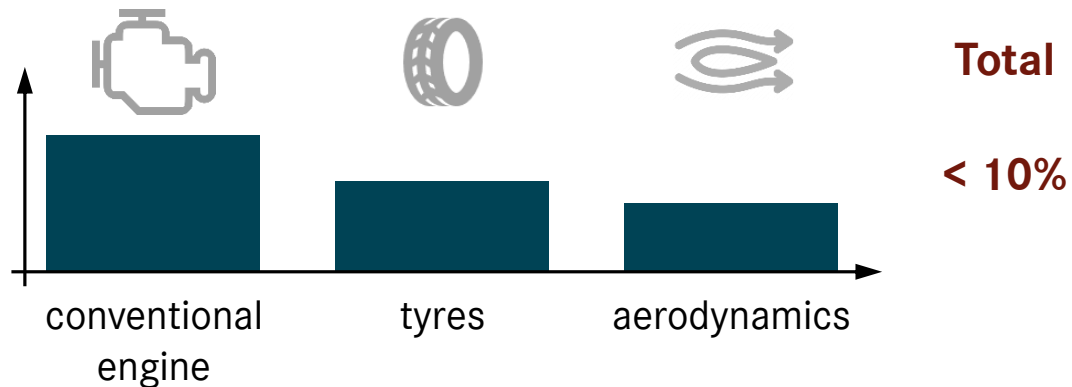
Available technologies to comply with regulation and customer needs

| | Conventional Diesel | Electric | | | Gas | | Electric (H ₂) Fuel Cell/ICE |
|---|--|---|--|---|--|--|---|
| | | BEV | Plug-in hybrid | Catenary | HPDI | SI | |
| Entire Portfolio | | | | | | | |
| Technology Assessment (fleet, customer) | ✓ | ✓ | ? <small>(not covered in reg.)</small> | No! | No! | No! | ✓ |
| | <ul style="list-style-type: none"> • Base Technology • Limited fleet potential | <ul style="list-style-type: none"> • Customer acceptance • Infrastructure | <ul style="list-style-type: none"> • Limited fleet potential • 'VECTO' unclear | <ul style="list-style-type: none"> • Limited fleet-potential • Infrastructure • Finance, timeframe, technology limitations | <ul style="list-style-type: none"> • Limited flee - potential • Infrastructure | <ul style="list-style-type: none"> • Limited flee - potential • Infrastructure | <ul style="list-style-type: none"> • Customer acceptance • Infrastructure |
| Zero Emission | No | Yes | Yes (limited) | Yes (depends) | No | No | Yes |

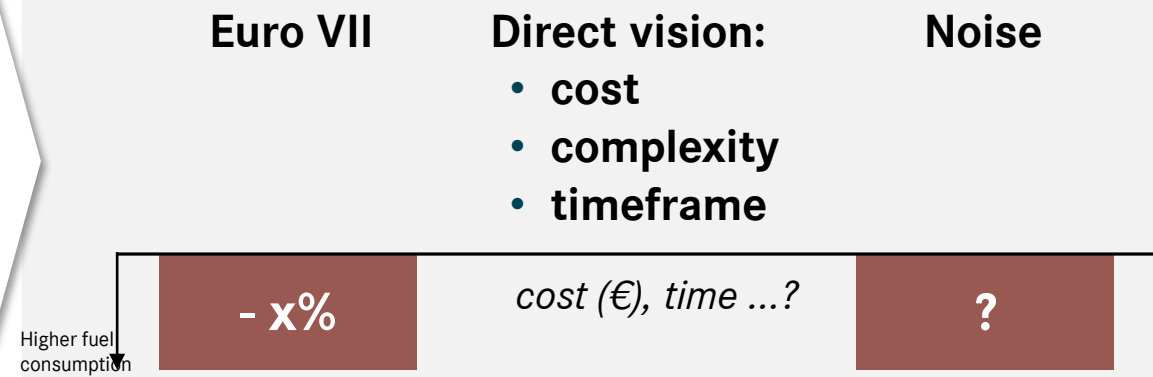
* Tank-to-Wheel SI = Stoichiometric injection ($\lambda=1$) ICE = Internal Combustion Engine

Conventional potential very limited – Former NGO FC reduction projections more than questionable, but new challenges at the horizon

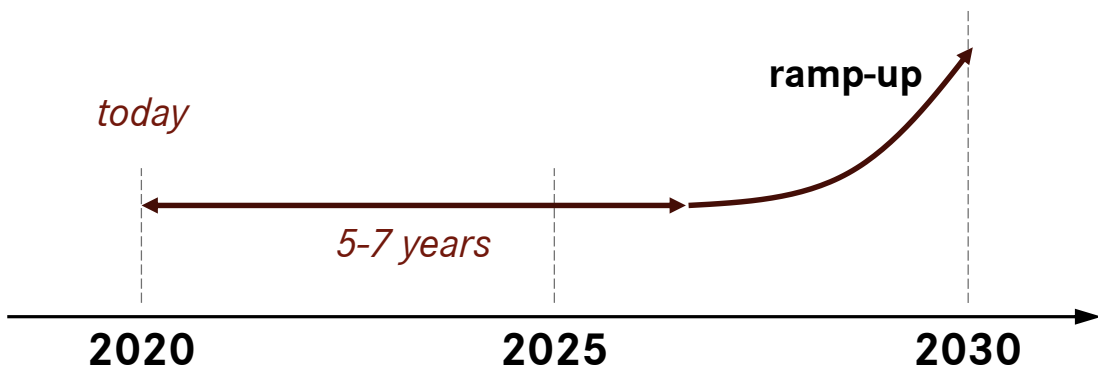
Fuel consumption savings



But:



Development timeframe (in context of e-mobility)

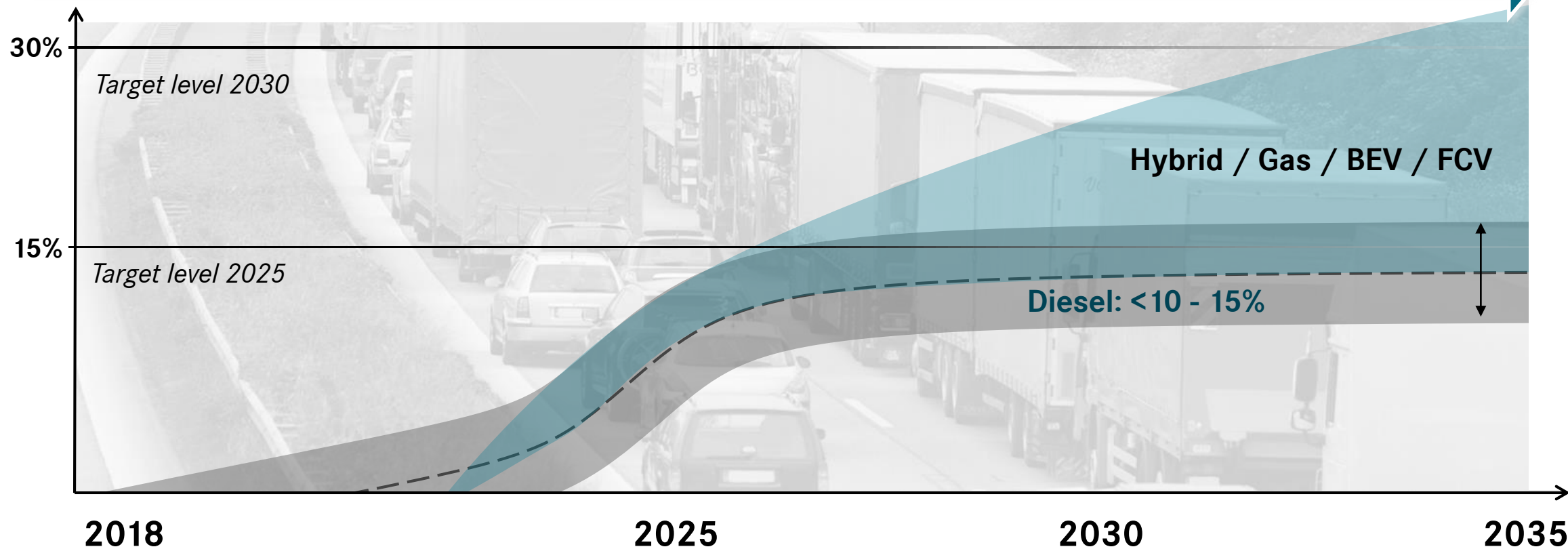


- ! Decisions need to be made today to achieve 2030 reduction target
- ! Long lead times to be reflected in today's regulatory activities
- ! Industry, infrastructure companies (oil/gas & utilities) and government need to work together

Conventional measures are not sufficient to achieve 2030 target

Zero/low emission technologies are required to reach challenging targets

Regulatory outlook



The road to CO₂-neutral transportation – Daimler Trucks and Buses CO₂-neutral commercial vehicle fleet by 2039



Climate protection – our vision:
We shape the future of CO₂-neutral road transportation



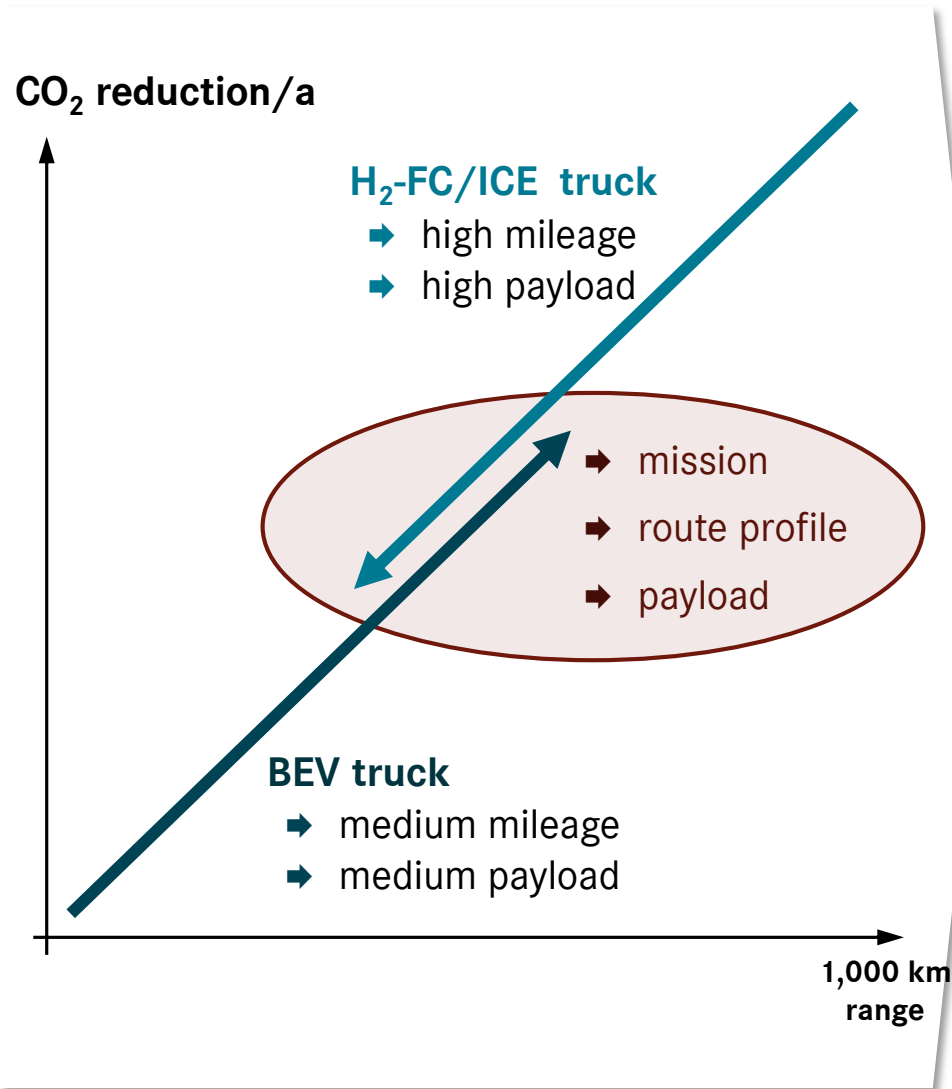
For our **new commercial vehicles**, it is our ambition to become **tank-to-wheel CO₂-neutral in 2039 in the triad**



By 2022, the **product portfolio in the core regions will also include battery electric series production vehicles**



BEV and H₂-FC/ICE powertrains can perfectly complement one another: customers can choose most cost-efficient solution for mission requirements



But ... infrastructure key:

- ! We need a powerful charging infrastructure
- ! Electric power and eTrucks must become much cheaper
- ! Long term investment stability required
- ! Euro-Vignette with a clear benefit for Zero Emission Trucks

Charging stations (industry) (on top of 200.000 charging stations with <100kW)

| | 2025 | 2030 |
|-------------|---------------|---------------|
| DC 350 kW | 11,000 public | 20,000 public |
| DC > 500 kW | 2,000 public | 20,000 public |

H² (Daimler)

| | | |
|-----------------|------|-------|
| LH ₂ | > 50 | > 500 |
|-----------------|------|-------|

Today: our Gen 1 projects

Strong investment in emission free trucks & busses world-wide



Technical data



| | |
|-----------------------------|--|
| <i>Perm gross weight:</i> | 18 t/25 t |
| <i>Vehicle application:</i> | heavy distribution traffic |
| <i>Drivetrain:</i> | electric |
| <i>Output:</i> | 252kW (2x126kW) |
| <i>Chassis:</i> | 4x2, 6x2 (current version) |
| <i>Operation range:</i> | Up to 200 km |
| <i>Torque:</i> | torque per drive motor 485 Nm (2 pieces) |
| <i>Batteries</i> | 270 kWh installed battery capacity, thereof 240 kWh usable battery voltage 750 V |

- presently 12 vehicles running -

In series



**Mercedes-Benz
eCitaro**



**FUSO
eCanter**

Prototypes running



**Thomas Built Buses
Jouley**



**Freightliner eCascadia
& eM2**

Daimler Trucks runs several trials in the world to achieve steep learning curve in technology, suppliers, charging & customers: Example USA

Testing



**> 150 test
completed**

Truck



**> 10 vehicles
delivered**

Charging



**36 chargers
installed**

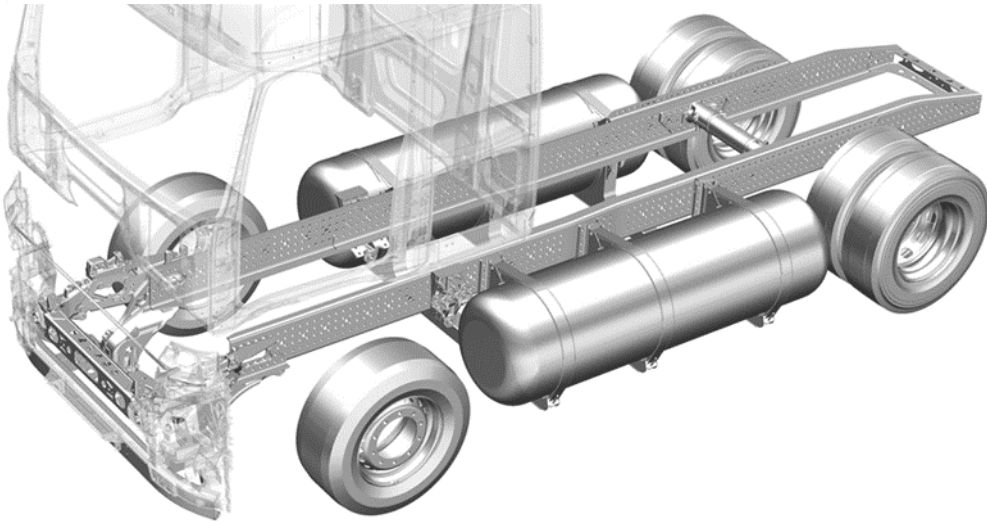
Training



**> 25 training
workshops done**

LH₂ enables high performance trucks with a range > 600 km/day at affordable costs

Use of H₂ in HDV



H₂ options

Challenges

CGH₂

- 35 MPa (buses)
- 70 MPa (passenger vehicles)

- Vehicle range
- **High cost for H₂ storage system**
- **Large scale distribution**

LH₂

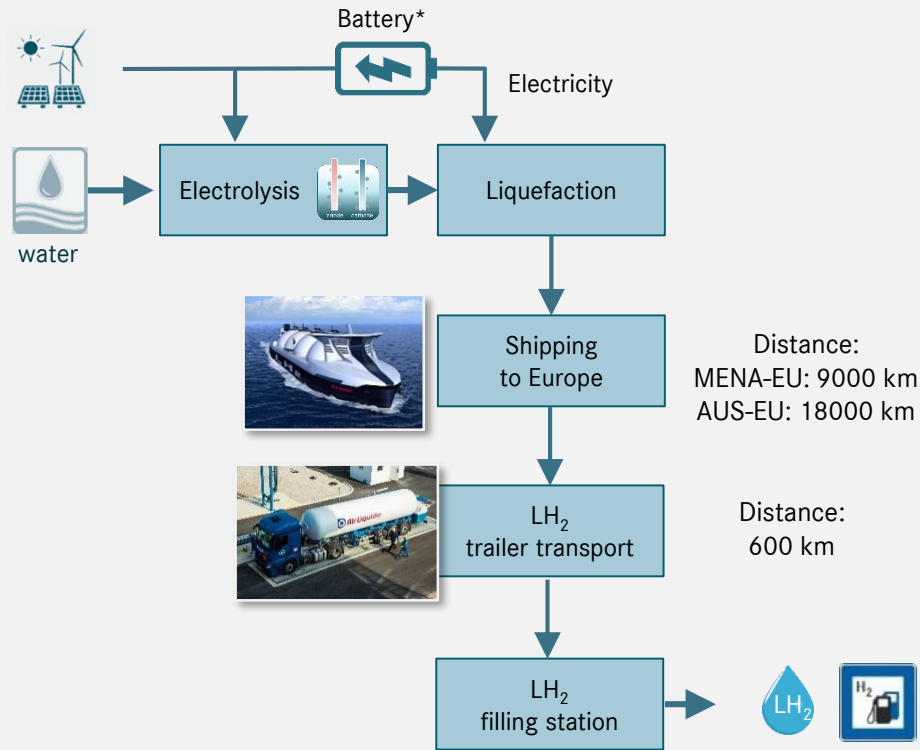
- Use of **cryogenic liquid hydrogen**

- **Build-up of a complete low-cost supply chain**
- **Challenging handling of LH₂**
- Storage design

- **Liquid Hydrogen in HD trucks would be ideal to satisfy customer long range requirements**
- **LH₂ supply chain to decouple local demand with regional supply deficits**

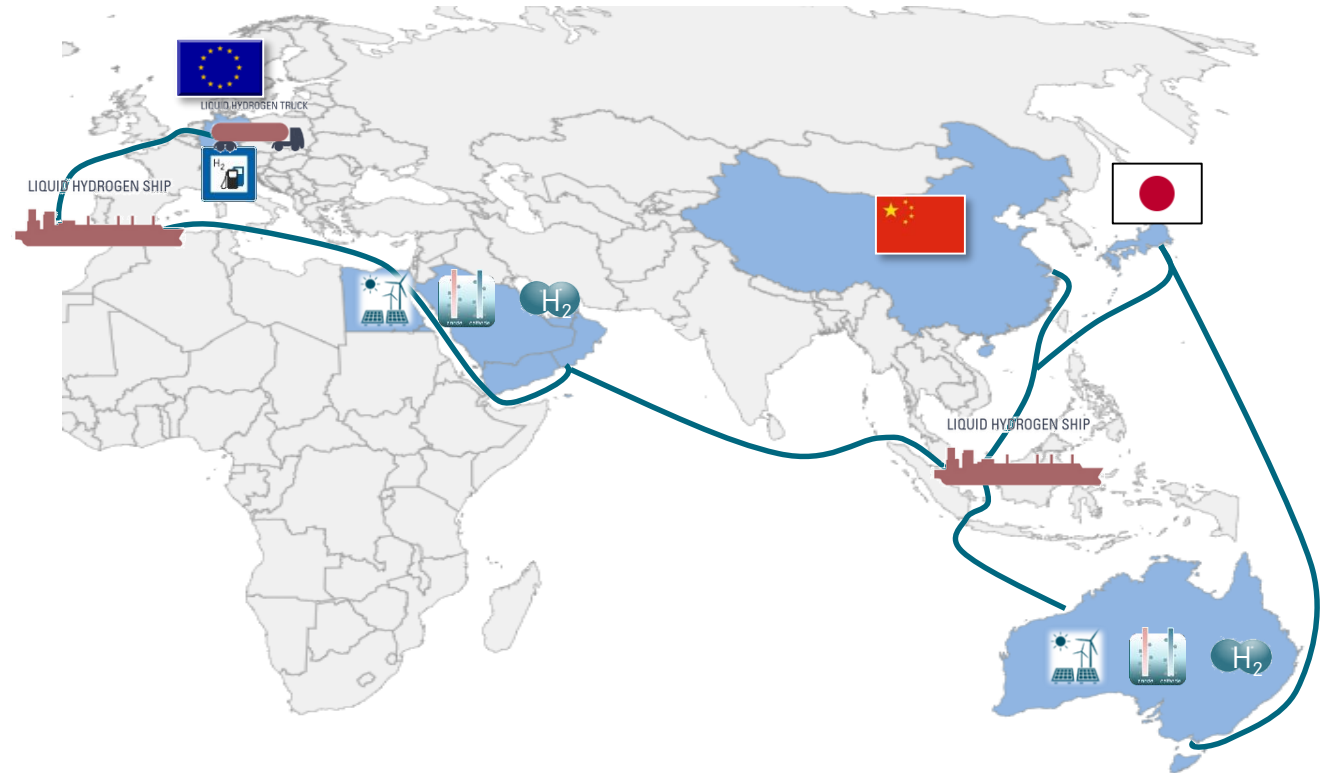
H₂ could become the energy carrier of the future especially in the HDV sector, but international liquefaction chain key to reach low cost

Supply chain



* battery needed for enabling 24/7 liquefaction of hydrogen

International H₂ production and shipping



- International sunbelt regions provide a fully renewable-based cost-efficient way to produce liquid hydrogen with abundant solar energy resources

Key take-aways: CO₂ regulation and business environment

Ambition Level

- Green wave in EU politics led to an ambition level of at least 30%, impact assessment completely mismatching regulatory and customer requirements

Energy Politics

- From an OEMs perspective medium and long-term future will be electrified using electric power and hydrogen
- Natural gas (NG) and Bio-LNG gaining political momentum in Brussels heavily supported by the respective industry, but outlook within the HDV sector remains very uncertain
- We expect a significant reduction of oil consumption in the EU transport sector around 2030, natural gas will not reach a significant level, significant use of elec. power in the HDV sector for BEVs, H2 consumption in EU-transport in the x00 kt p.a. around 2030

Robust Strategy

- High uncertainties in upcoming years require a robust technology strategy resistant to external shocks