



Linde Hydrogen FuelTech
Tomorrow's fuel today



Linde Hydrogen FuelTech

Competences, technologies & products

Brussels, May 17th 2019

Making our world more productive



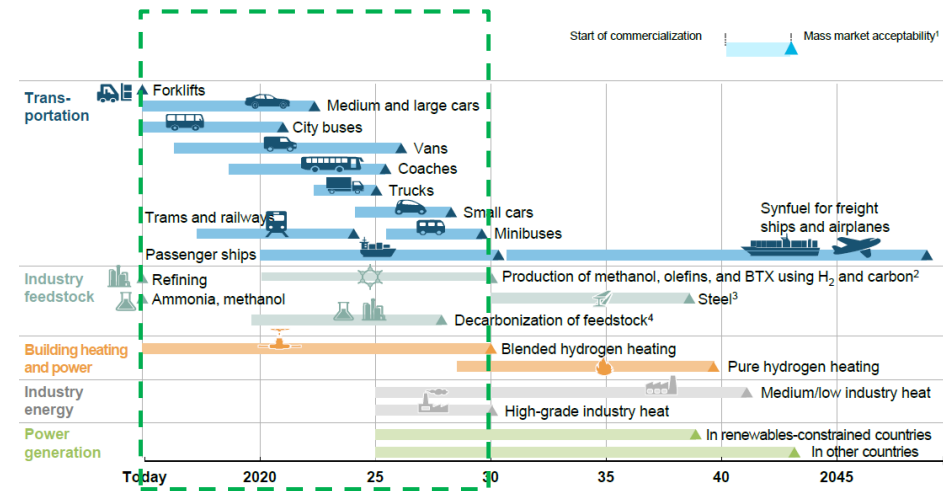
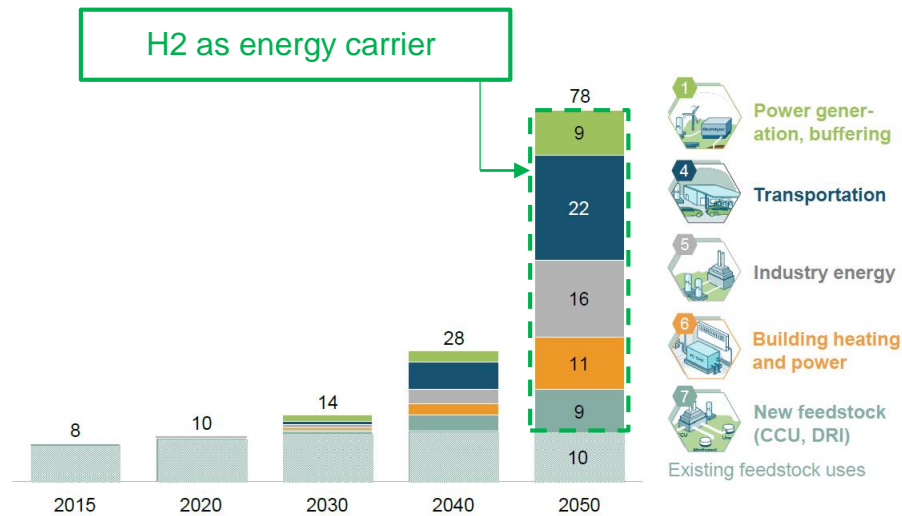
Hydrogen: a game changer in industry

H2 plays a central role as energy carrier



H2 emerging as energy carrier*...

...with mobility applications as first commercial users**



- **De-carbonization** transforms the energy industry; **H2** expected to play an important role as energy carrier
- Applications going to transform to H2 at different paces; with **H2 mobility / transportation** being the frontrunner

* Source of graph: H2 Council, units: Exa Joule, 1 EJ = 7m tons H2 = 80Bn Nm³ H2 ** Source of graph: H2 Council

Hydrogen: a game changer in mobility

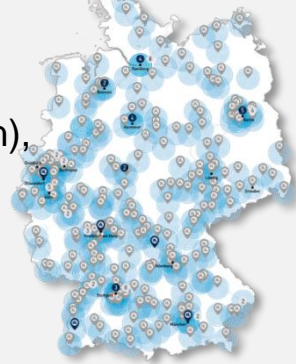
Linde Gas – operational models



Network

Network of H2 refueling stations for seamless mobility for Fuel Cell Electric Vehicle (FCEV) passenger cars

- + In case of technology break-through (successful customer value proposition), high growth potential
- High upfront investment in infrastructure necessary, with low utilization rates initially (business case challenge)
- Strong & continuous buy-in from multiple players required (OEMs, infrastructure & utility providers, authorities)



Back-to-base

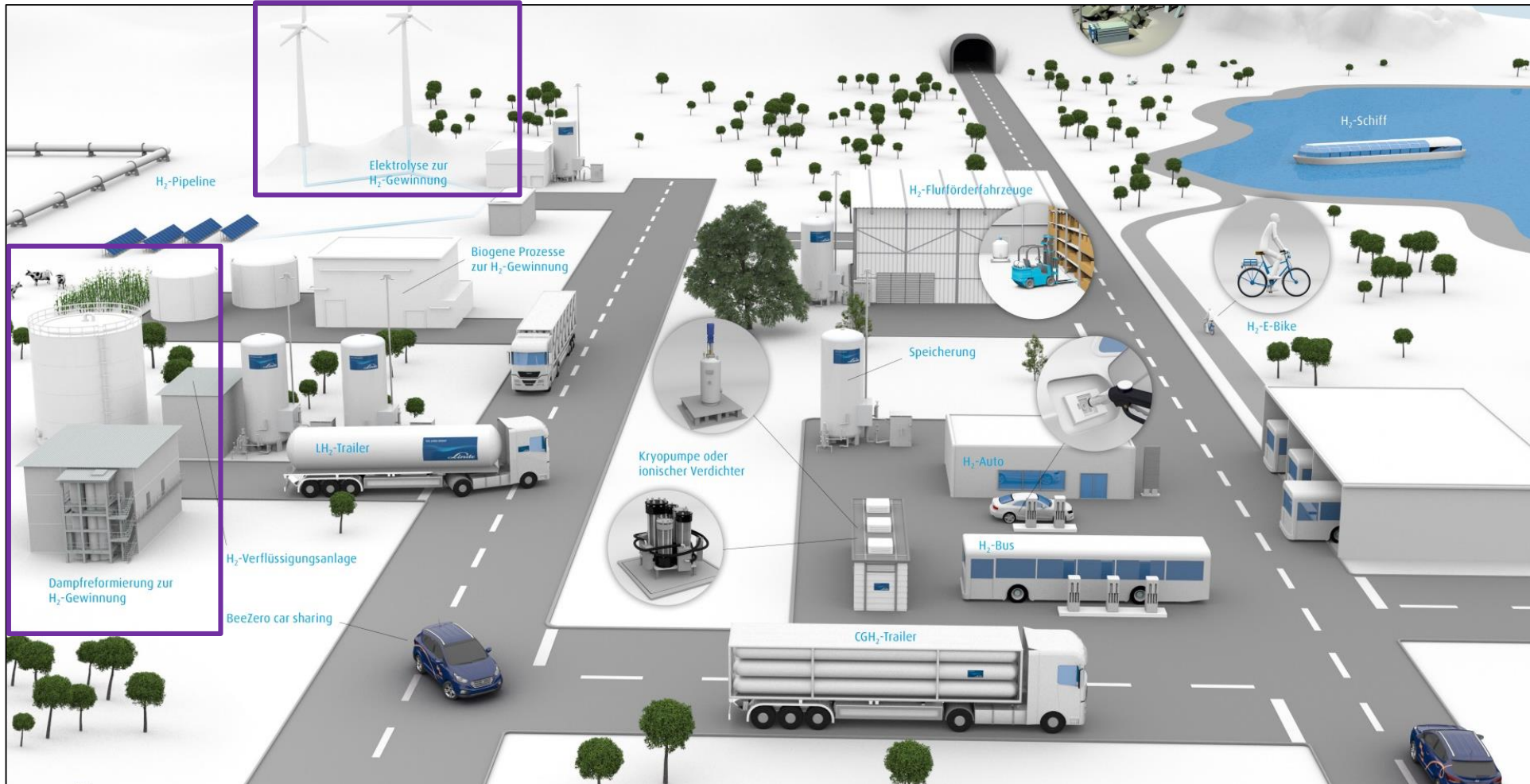
Buses, urban delivery trucks, intralogistics vehicles, taxis, car fleets with regular routes & **H2 refueling at a fix depot (base)**

- + Upfront investment in infrastructure limited to one (few) H2 station(s) at central depot
- + High utilization and predictable H2 demand allowing for economically attractive business cases
- + Strongly positive impact on urban environment (local emission free, noise reduction) already with first project
- Vehicle availability and costs



Linde technology along the hydrogen value chain.

Linde Hydrogen FuelTech is the leader in hydrogen fueling infrastructure.



Production



Steam reformer

(e.g. steam
biomethane
reformer)

or

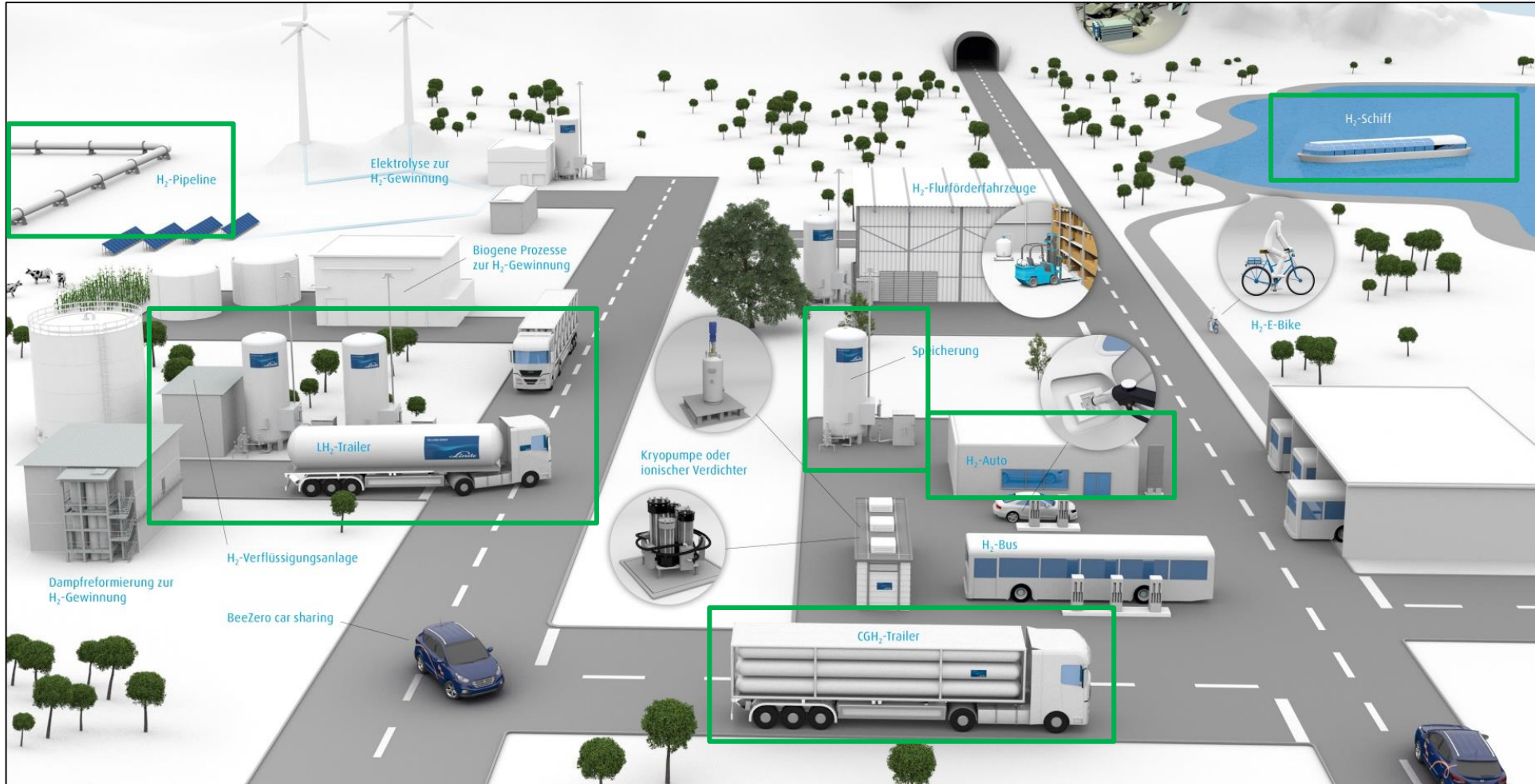


Electrolyser

(e.g. PEM or alkaline)

Linde technology along the hydrogen value chain.

Linde Hydrogen FuelTech is the leader in hydrogen fueling infrastructure.



Distribution & storage



Trailer & Tanks

(Trailer: 300 bar GH₂ or LH₂ or 500 bar GH₂, tanks for GH₂/LH₂, stationary & mobile)

or

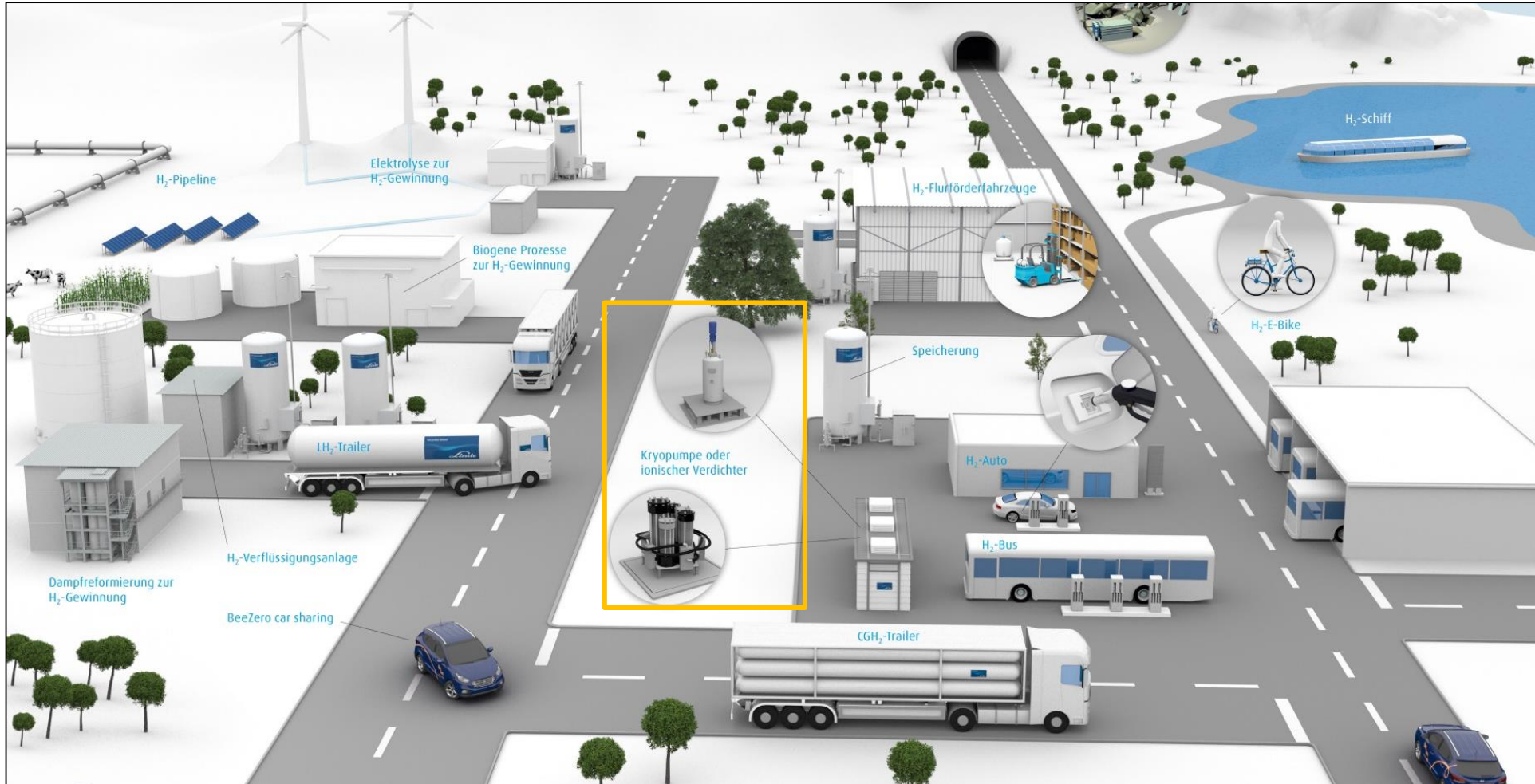


Pipeline

(e.g. from producer)

Linde technology along the hydrogen value chain.

Linde Hydrogen FuelTech is the leader in hydrogen fueling infrastructure.



Fueling



Compression
(e.g. ionic compressor station)

or



Pumping
(e.g. cryopump station)

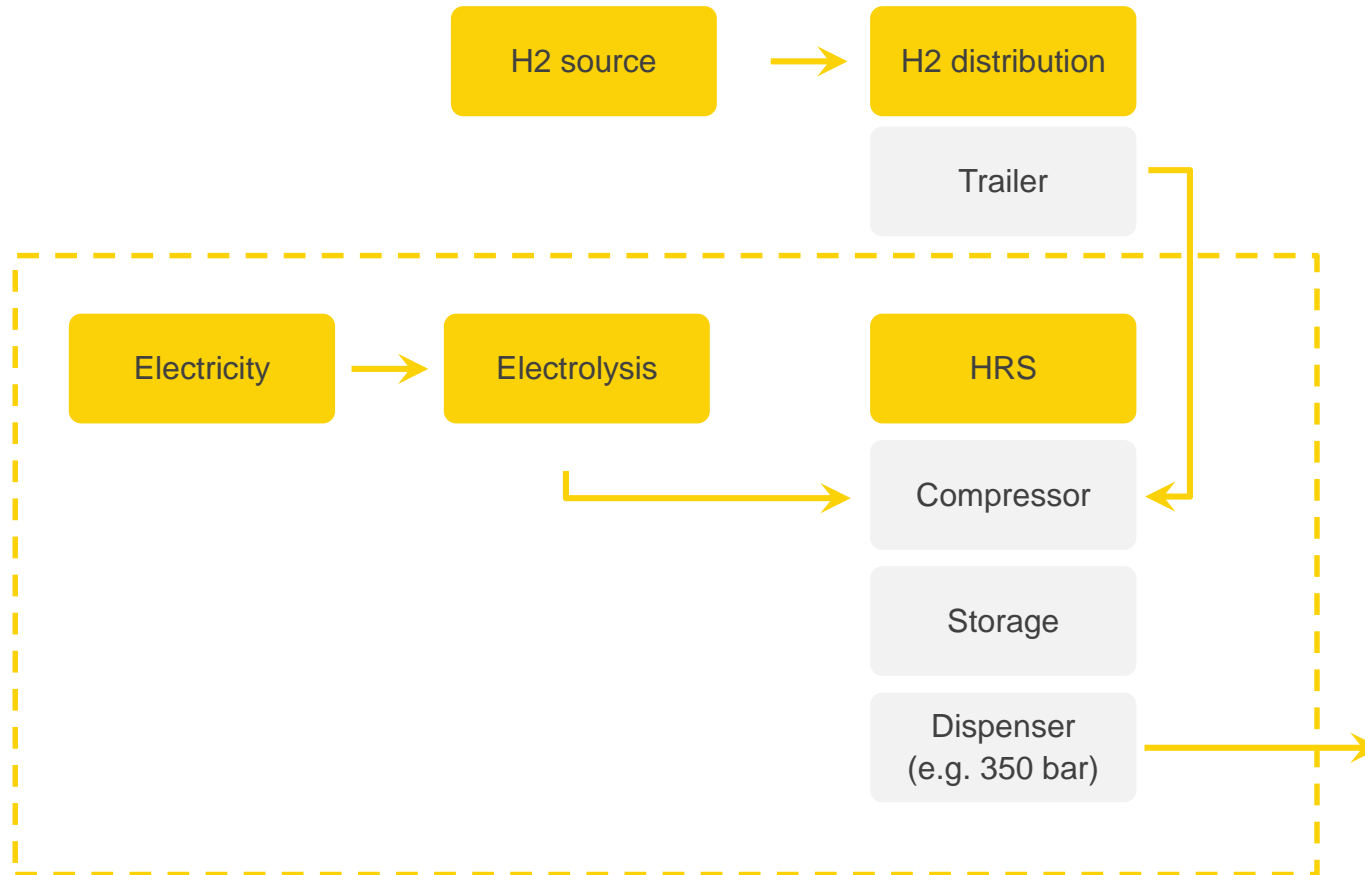
Core competence of
Linde Hydrogen FuelTech

First to world

Linde Hydrogen FuelTech is building the first station for hydrogen passenger trains



Alstom, Bremervörde/Lower Saxony, Germany



ALSTOM





Thank you for your attention.

Linde AG
Dr. Peter Haider
Peter.s.haider@linde.com
www.linde.com

Making our world more productive

