



Linde Group – Sustainable Technology Solutions

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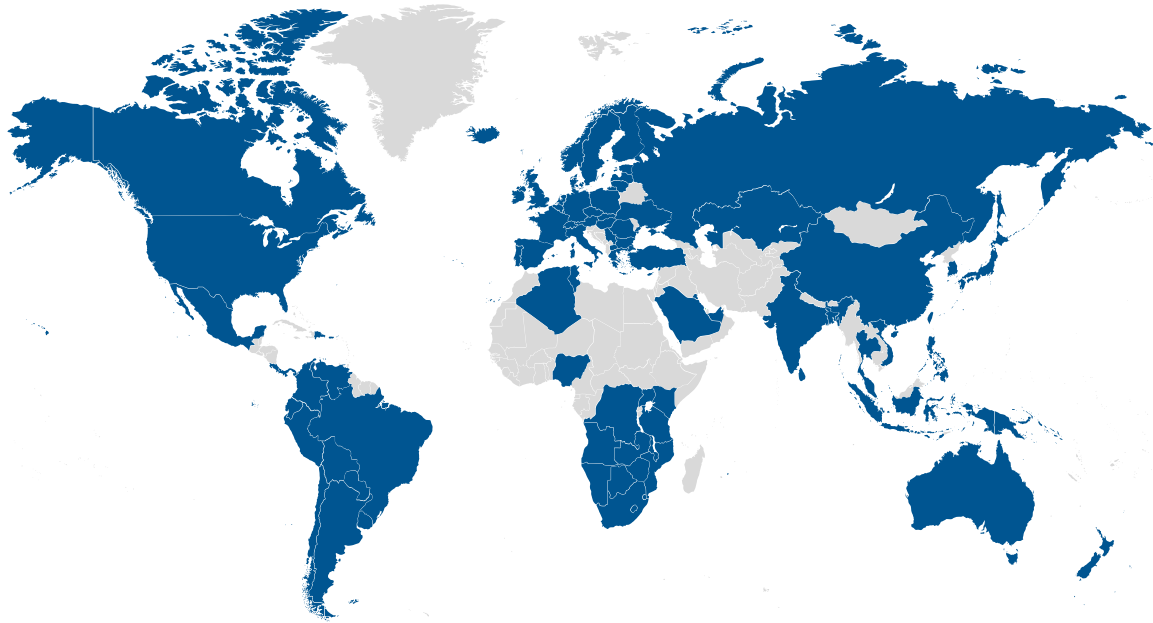
Sustainable Technology Solutions & Opportunities Development

Making our world more productive



Over 140 years of technological progress

Introduction to Linde



100+

countries

Enabling strong, complementary positions in all key geographies and end markets

~65,000

employees

Achieving our full potential, individually and collectively

\$33 billion

2022 sales

Established presence where customers are and where their operations are growing

6,500+

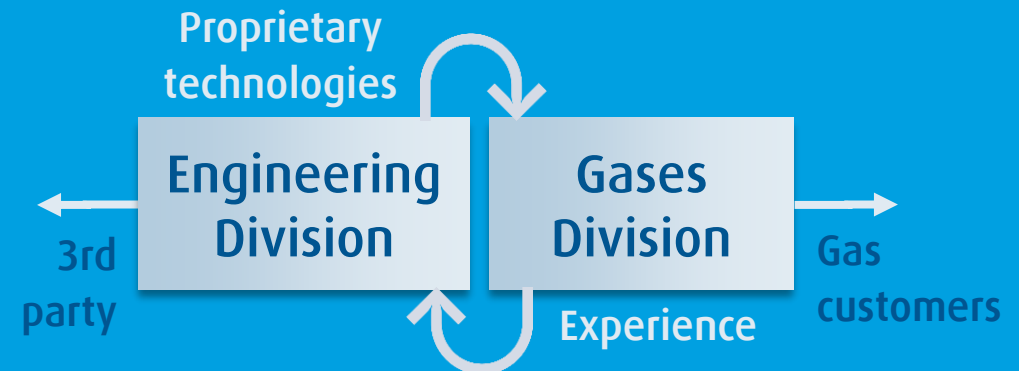
active patent assets worldwide

Leading with innovative products, solutions and technologies

Our Mission

We live our mission of *making our world more productive every day*. Through our high-quality solutions, technologies and services we are making our customers more successful and helping to sustain and protect our planet.

Linde Profile

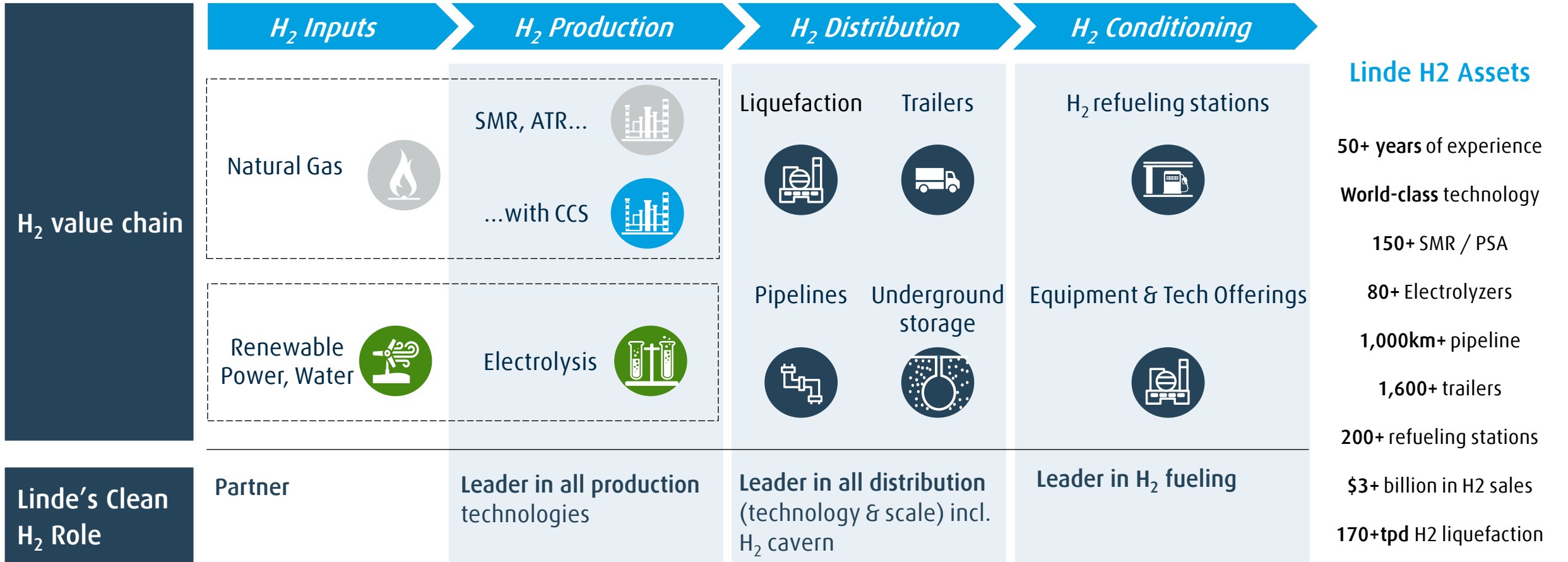


Hydrogen Value Chain

Linde acts as an integrator across the entire value chain



● Grey H₂
 ● Blue H₂
 ● Green H₂
 ● H₂ Distribution, Conditioning & Application



Linde is a leader across the hydrogen value chain, agnostic to the hydrogen color

GREEN HYDROGEN & PtX PROJECT OPPORTUNITIES

Linde Technology: Integrated Green H2 & PtX for Chemical Cluster, Mobility and Aviation.



 Bundesministerium für Wirtschaft und Energie

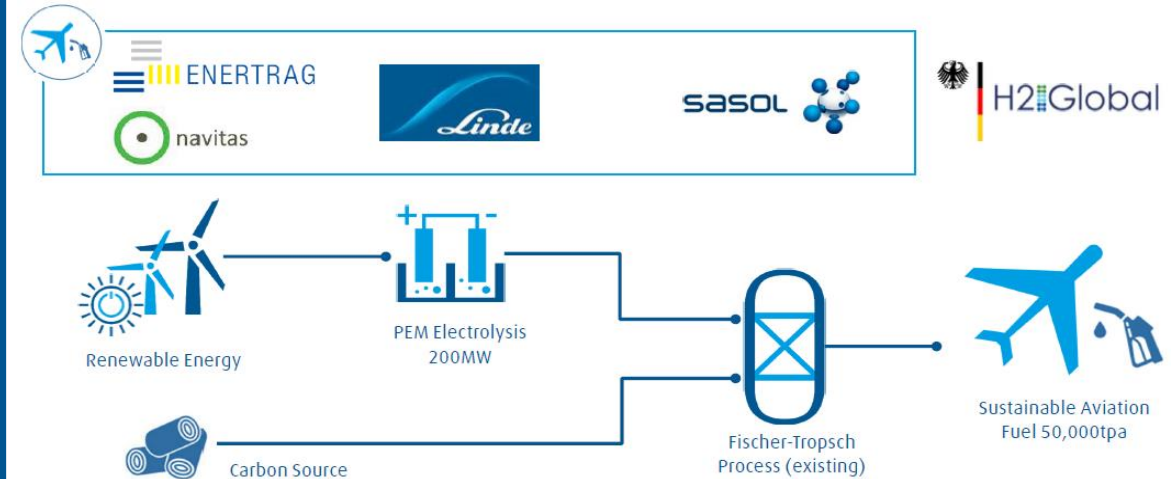


Linde Green Hydrogen Project in Germany

- Leuna is a large refinery/petrochemical cluster in Germany
- Linde has large gaseous and liquid H2 production facilities (~300 TPD H2), mainly from NG-based feedstock
- Linde is investing 24 MW Green H2 production facility (PEM) to feed Mobility (liquid H2) and existing industries
- Project is supported by **government as part of BMWi funds** (100 mEUR p.a.) to facilitate decarbonization



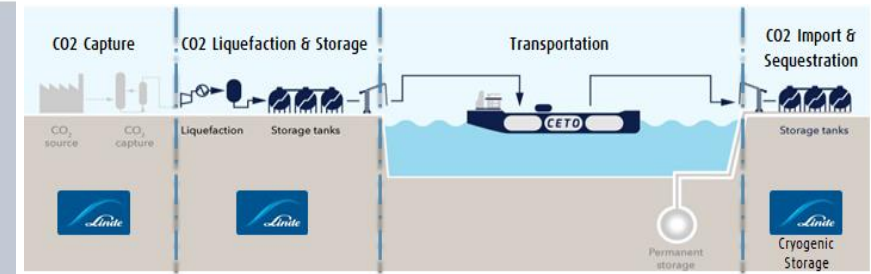
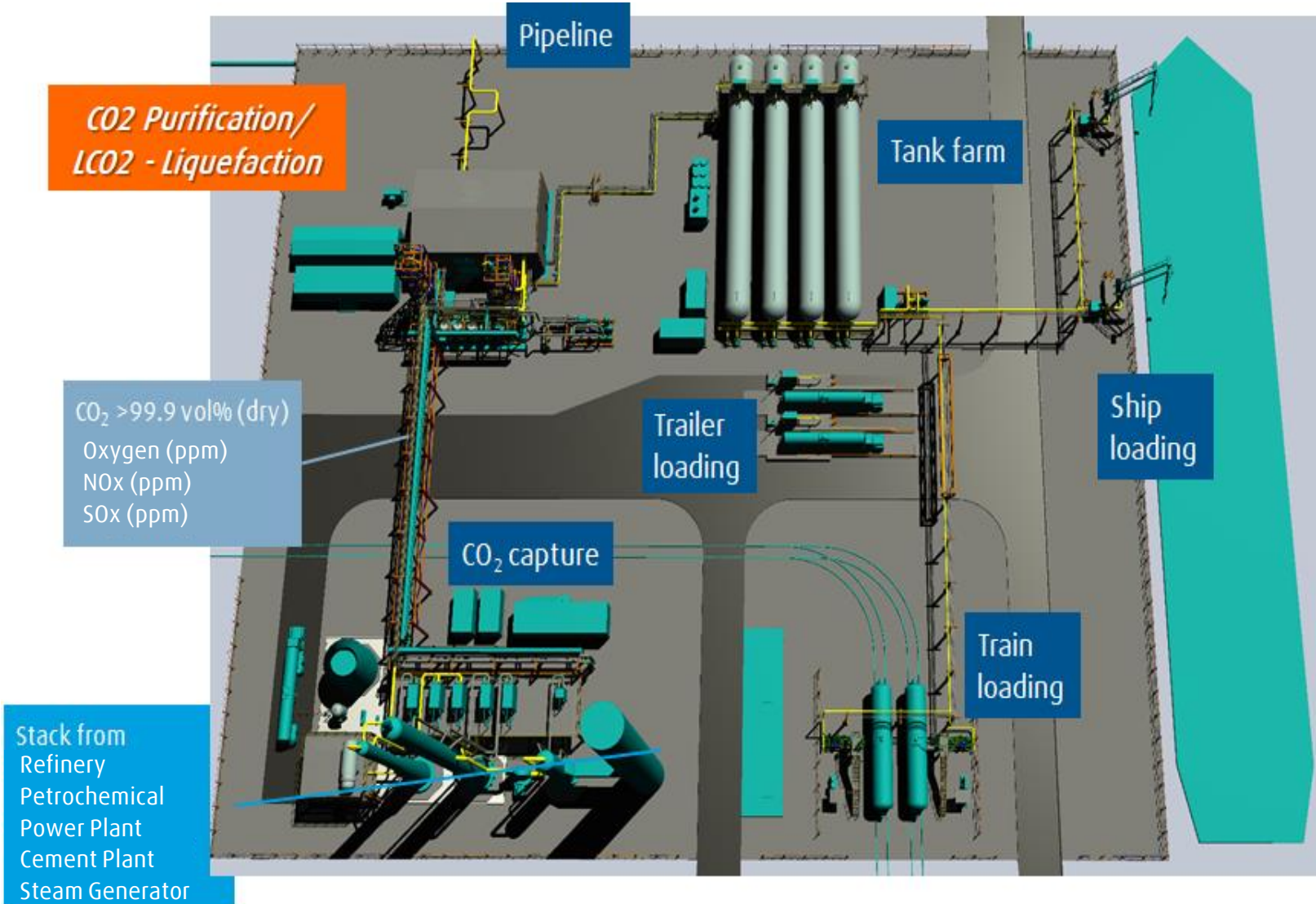
Linde Green Hydrogen with PtX Project in South Africa



- **PtX production** of Sustainable Aviation Fuel (SAF): **Linde PLC**, **ENERTRAG AG** and **Navitas Holdings (Pty) Ltd** – the **LEN Consortium**
- The **LEN Consortium** will enable **Sasol** to work with Liquid fuels and chemicals **with Fischer-Tropsch (FT) technology**.
- **Linde is a leader in the design and operations** of next generation **PEM electrolyzers** produce Green Hydrogen.
- Concept to produce Sustainable Aviation Fuel (SAF) under the auspices of the **German Federal Government's H2Global auction platform**.

Integrated Solutions for Blue Hydrogen

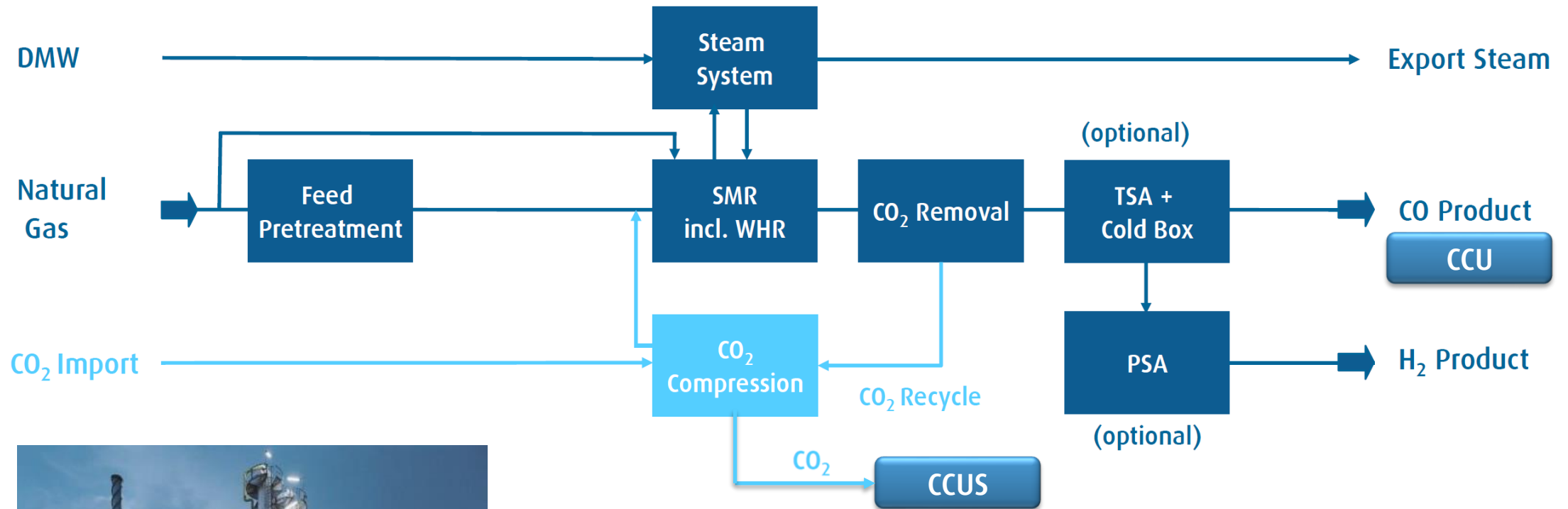
Decarbonization and CO₂ & LCO₂ Terminal with CCUS Technology



CO₂
From Capture Process
99.99% Vol

LINDE'S LOW CARBON HYDROGEN TECHNOLOGY

Linde's Technology: HyCO (Syngas) Technology Solutions.



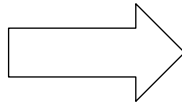
KEY ADVANTAGE POINTS:

- The solution for CCU technology with high quality Carbon monoxide
- The SMR technology with internal CO2 capturing technology
- Net import CO2 with Low Carbon Hydrogen product
- High Flexibility in operation with H2 / CO ratio.



Today

Tangible projects are few
Costs remain high
New technologies/scaleup are slow
Standards lacking on low carbon
More regulatory support is required



Enablers for Future

Policy &
Regulations

Government levers: carbon tax, grant, mandate, etc; industries need certainty

Technologies

New application technologies; partnerships; scaleup (Green H2, CCS and CCUS)

Costs

Scaleup; integration and optimization

Standards &
Certifications

Universal standards to trade low carbon molecules; essential to operationalize low carbon solution



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PRODUCTS PORTFOLIO OVERVIEW.

FCEV transportation and Green Logistic solutions - Hydrogen FuelTech GmbH for Hydrogen Mobility



Tomorrow's fuel today
Linde H₂ refueling technologies



production



distribution



fueling



zero emissions



First LH₂ station in California (USA)

With three times the capacity of all the existing GH₂ stations, we have built the largest public fueling station in Oakland (CA) based on our Cryo Pump technology.

- Linde H₂ station CP 90/40-L with a fueling capacity of 40 kg/hour¹
- Fully integrated into existing conventional fueling station (First Element)
- High storage capacity of 800 kg (LH₂) to keep up with growing demand
- Very small footprint of 10 m (length) × 3 m (width)
- Simultaneous refueling on a double: 700 bar (cars) and 350 bar (buses) dispenser

¹ inlet pressure of 2 bar



Refueling station in Oakland (California)



First hydrogen refueling station in South East Asia

H₂ fueling stations in Malaysia produce hydrogen by means of electrolysis. This flagship project includes 350 and 700 bar dispensing lines.

- Linde H₂ station Twin IC 90/60-L with a fueling capacity of 58 kg/hour
- Fully containerized, highly compact design
- Serves local bus fleet with fueling capacity of 1.200 kg/day (20 hours of operation)
- Max. outlet pressure 900 bar
- Low maintenance, low noise, high reliability



Refueling station in Sarawak (Malaysia)

Total H₂ Fueling Station 19% in Asia
from Linde Success stories



The World's First H₂ Fueling Station for Passenger Train - FCEV

Linde Hydrogen FuelTech is the supplier of the world's very first H₂ refueling station for passenger trains. The new depot is located in northern Germany and will fuel 12 Alstom Coradia iLint fuel cell trains, each with a 180 kg tank capacity.

- Fueling station based on three Twin IC 90/60 compressors (58 kg/hour each)
- Fueling capacity of 1.800 kg/day (12 fuelings in 24 hours)
- Total GH₂ storage at site is 4900 kg
- 2 × 250 bar dispenser line
- Application of innovative constant pressure tubes to minimize maintenance efforts



H₂ passenger train



Future-proof fueling depot for floor-borne vehicles

Fueling station at Daimler's production site in Düsseldorf, Germany, for fuel cell forklifts and tractors and possibly also light fuel cell vehicles like passenger cars.

- Fueling station based on IC 90/30 technology with a capacity of 28 kg/hour
- Fueling of up to 30 floor-borne vehicles per hour
- Extendable to passenger car fueling
- Specially designed dispenser for indoor production site
- High flexibility thanks to two dispensers that can be installed at two different locations



Fuel cell forklifts fueling station

Over 200 fueling stations
with Linde H₂ technologies

Over 1.5 million fuelings
with Linde H₂ technologies

The hydrogen
future is here now.
Linde can deliver it.

