Linde Clean Energy

Dii Desert Energy Partners' Meeting

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Making our world more productive

www.lindehydrogen.com

Introduction to Linde

- The leading industrial gases and engineering company, combining technology and operational excellence
- Formed in 2018 with the merger of Linde AG and Praxair, Inc – two world-class companies with nearly 140 years of shared history and successful achievements
- BOC, a Linde company, is the largest provider of industrial, medical and special gases in the UK and Ireland
- Best-in-Class Safety Performance

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.

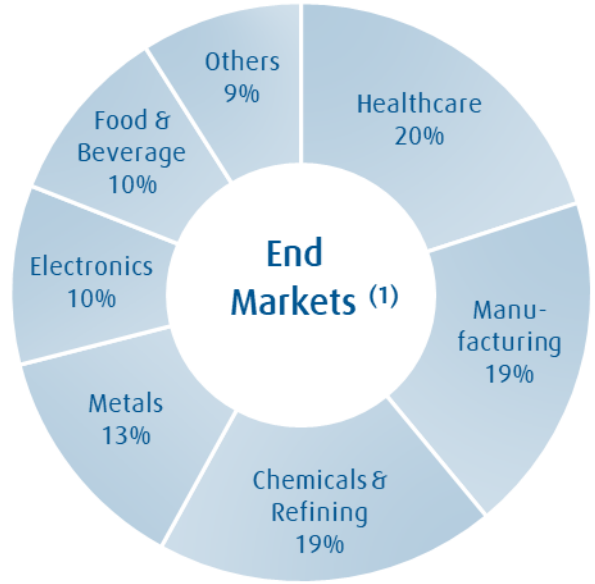
100+
countries
Enabling strong, complementary positions in all key geographies and end markets

~75,000
employees
Achieving our full potential, individually and collectively

$27 billion
2020 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

2020 SALES



(1) Total sales excluding Linde Engineering

Linde as a clean hydrogen advocate
Leading by example

Fostering clean hydrogen

Linde is a steward of sustainability and an industry leader in clean hydrogen. We are **founding members** of the **Hydrogen Council** and the **H2 Mobility** and actively **advocate** for clean hydrogen policies and initiatives through more than **20 industry and government** sponsored **organizations** around the world.

We lead by example and are taking steps towards decarbonizing our own operations. Our **SD 2028 Targets** include lowering our **greenhouse gas emissions** intensity **by 35%,** investing **at least $1 billion** in decarbonization initiatives and dedicating at least **1/3 of our R&D budget** to decarbonization.

Hydrogen Council
H2Accelerate
Hydrogen Europe
H2 MOBILITY WASSERSTOFF TANKEN
H2Global
UK HFCA
FCHEA Fuel Cell & Hydrogen Energy Association
European Clean Hydrogen Alliance
HYDROGEN FORWARD
FCH FUEL CELLS AND HYDROGEN JOINT UNDERTAKING
CALIFORNIA HYDROGEN BUSINESS COUNCIL
Hydrogen Means Business in California!
Dii

Cooperation with

Bundesministerium für Wirtschaft und Energie
U.S. DEPARTMENT OF ENERGY

Unique setup enables smooth transition to clean hydrogen

Leveraging our experience, technology and reach

Production and Processing

Sourcing from Natural Gas and Biogas

150+ SMR & 1,000+ PSA

Steam Reforming (SMR) With Carbon Capture and PSA

40+ Compressors

H_2 Processing

Sourcing from Renewable Energies

80+ plants

Electrolysis

170 TPD

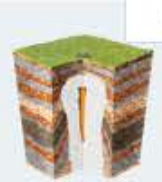
H_2 Liquefaction

Storage and Distribution

1000+ km

H_2 Pipeline

World's first



High-purity H_2 Cavern

1600 trucks

Liquid and Gaseous H_2 Distribution Trailers

Cryogenic Tanks and Cylinders

Applications

200+ stations

Mobility – From Cars to Trains

Pioneer projects

Industry Feedstock: Refineries, Steel, Chemicals, Ammonia

Largest P2X plant

Power Buffering

Building Heating

Hydrogen production with PEM electrolysis

GLOBAL GREEN GAS SOLUTIONS | ITM LINDE ELECTROLYSIS

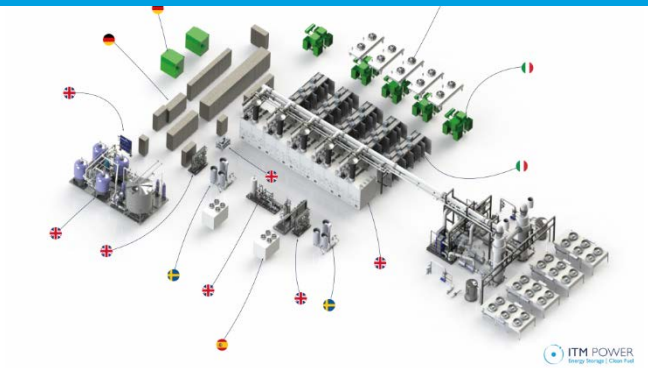
World class technology for energy storage and green industry feedstock

Energy storage

Example: Energie Park Mainz

- Largest P2G plant, converting wind power into green hydrogen through electrolysis
- On-site production and storage of GH2
- 800 kg storage (25 MWh)
- Running since 2015

Refinery



Example: Shell REFHYNE project

- 10 MW Electrolysis system for H2 generation (modular approach 5 x 2MW)
- Solid water treatment management system to expand life-time of electrolyzers
- H2 purification to 5.0 purity, suitable for load and grid balancing

Chemical & Transport

Example: Leuna Chemical Complex

- World's largest PEM electrolyzer plant to be build at the Leuna cluster in Germany
- 24 MW electrolysis system for green H2 generation (modular approach 12 x 2MW)
- On-stream in 2022

Hydrogen refueling stations (HRS)

Fueling tomorrow

Leading expertise and know-how

- More than **200 HRS** installed **worldwide**
- More than 1.5 million successful fueling of cars, buses and forklifts
- Only provider of **LH2 90 MPa stations**
- Supplier of the world's **first** hydrogen station for **passengers' trains**
- Supplier of the **world's biggest hydrogen bus depot** in California

Global projects

Berlin

Tokyo

Emeryville, CA

Cutting-edge technologies

CP – Cryopump (LH2)

IC – Ionic Compressor (GH2)

Carbon capture, utilization and storage (CCUS)

Lowering GHG emissions

CO_2 capture in IG production
from SMR, ammonia, ethylene, steel & ethanol plants

Various **pre-combustion capture** as well as **post combustion capture technology options** available

CO_2 production for the **merchant market** & **large industrial consumers** (e.g. urea production)

CO_2 capture & utilization
for customer applications

CO_2 mineralization in concrete
Ready-mix & precast concrete application

CO_2 utilization in Greenhouses
Linde OCAP pipeline in The Netherlands

CO_2 utilization for water pH control & remineralization
Linde SOLVOCARB technology for wastewater & drinking water

CO_2 capture & utilization technology
for IG production & customer applications

Linde DRYREF™
dry methane reforming for chemicals production with external CO_2 import

Linde post-combustion capture & purification
for hard to decarbonize industries (e.g. cement, steel)

Linde oxyfuel combustion capture & purification
for industry decarbonization (e.g. power, cement, glass)

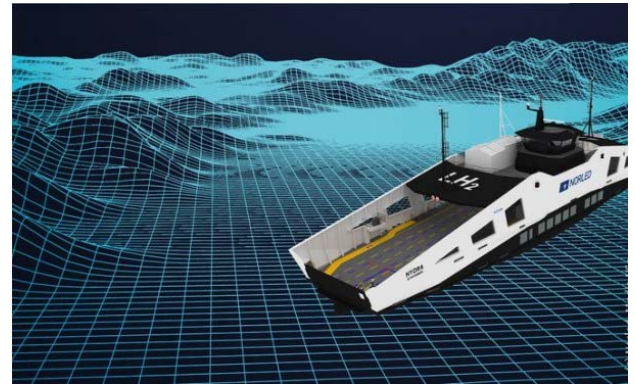
Success stories

World's 1st stationary HRS for fuel cell trains, Bremervoerde

- Operation of 14 H2 trains (Alstom Coradia iLint model)
- Up to 1600 kg H2 per day
- On-site storage of up to 1800 kg GH2
- Hydrogen supply through Linde GH2 trailers
- On-site production: expansion ELY with wind power supply
- Commissioning in 2021

Joint Venture with Hysong Corporation to invest in liquid hydrogen infrastructure

- JV to build, own and operate a nationwide network of hydrogen refueling stations
- Linde to build and operate Asia's largest liquid hydrogen facility
- Capacity > 30 tons per day of liquid H2
- Sufficient to fuel 100,000 cars & save up to 130,000 tons of CO2 emissions per year
- First phase to start operations in 2023



Linde to supply liquid hydrogen to world's first hydrogen-powered ferry

- Full-service solution to the MF Hydra ferry in Norway
- Supply of liquid green hydrogen
- Build & install onshore & onboard H2 storage, distribution & safety equipment
- Reduction of annual carbon emissions by up to 95%.
- Due to start operation in 2022.

Making our world more productive

Enabling the energy transition