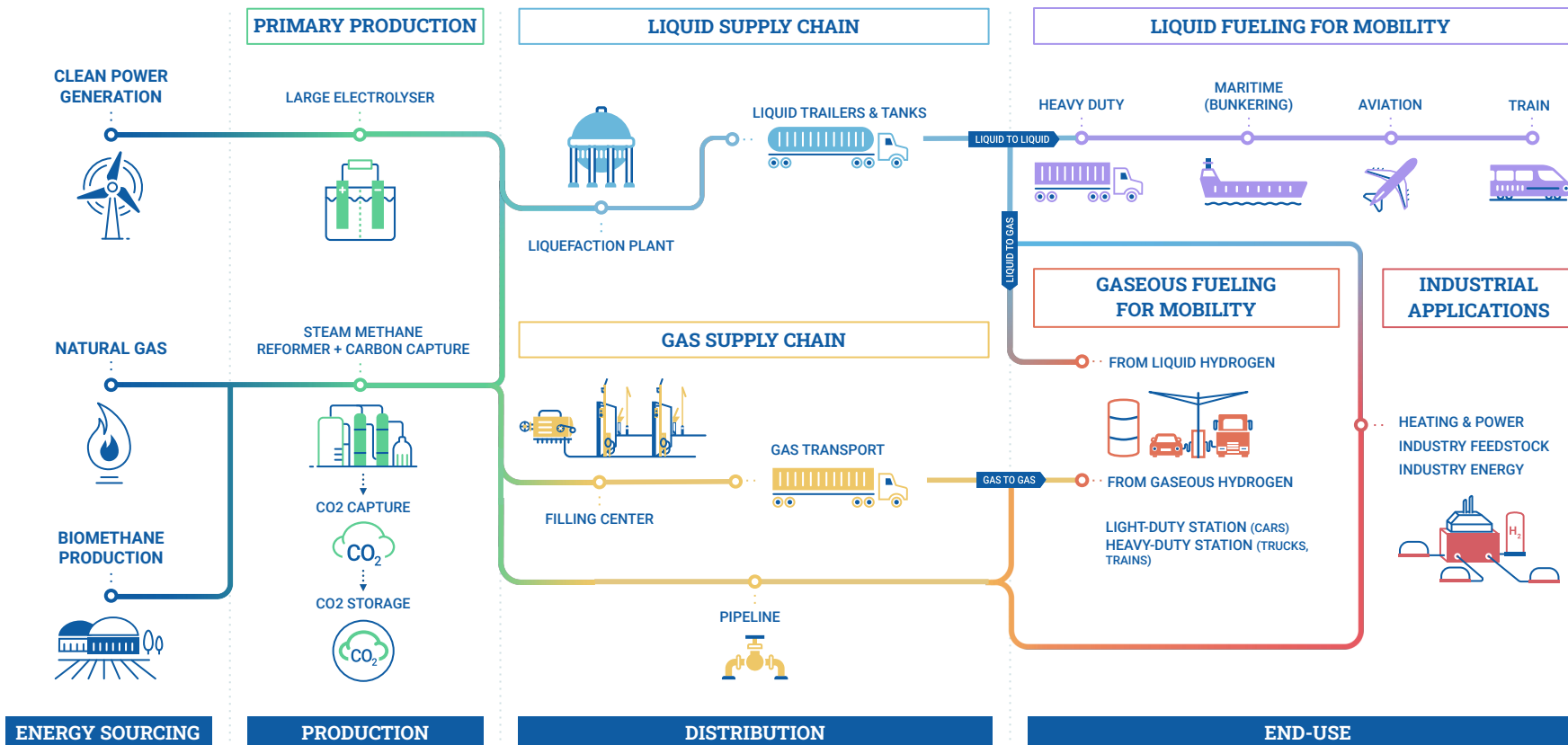


An aerial photograph of a multi-lane highway bridge supported by concrete pillars, crossing a lush green forest. A white semi-truck is driving on the bridge. A white circle and a white square are overlaid on the image, framing the truck.

# Hydrogen Energy

Building a sustainable,  
low-carbon society

# HYDROGEN VALUE CHAIN



# Hydrogen: a CO<sub>2</sub> neutralizer



Industry

**23%**

of CO<sub>2</sub> EMISSIONS



Transport

**23%**

of CO<sub>2</sub> EMISSIONS

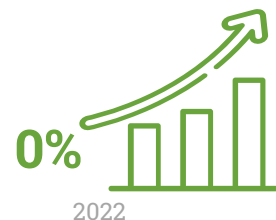
**46%**

of CO<sub>2</sub> global emissions  
could be concerned  
by the hydrogen  
revolution

Source: IEA, 2021



















## Zoom on hydrogen

**Hydrogen in  
our energy mix**



**\$2,500 bn**  
potential market  
for hydrogen in 2050

# We need a combination of solutions to decarbonize different needs

		Use case				
		 <b>Ground</b> (light, low intensity)	 <b>Ground</b> (heavy, high intensity)	 <b>Rail</b>	 <b>Waterborne</b>	 <b>Aviation</b>
Best solutions	Battery electric					
	Hydrogen	 Long distances Isolated areas Large vehicles		 Isolated areas		
	Overhead wire					
	Ammonia				 Toxicity issues	
	E-fuels				 CO <sub>2</sub> emissions Cost	 CO <sub>2</sub> emissions Cost

**Hydrogen can address all mobility segments**

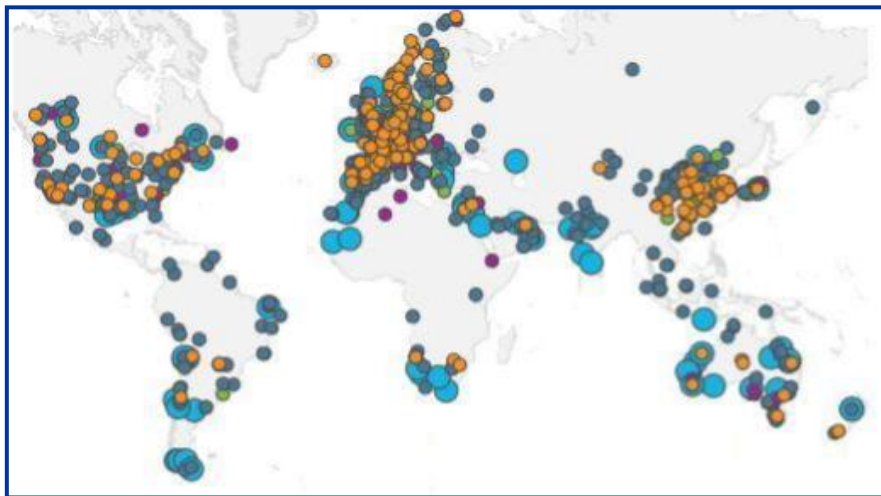


Best suited solution



In certain situations

# Significant international momentum



**110+** Giga-scale production  
*(renewable and low-carbon projects)*

**550+** Large-scale Industrial usage  
*(refinery, ammonia, methanol, steel and industry feedstock)*

**190+** Transport  
*(trains, ships, trucks, cars and other mobility applications)*

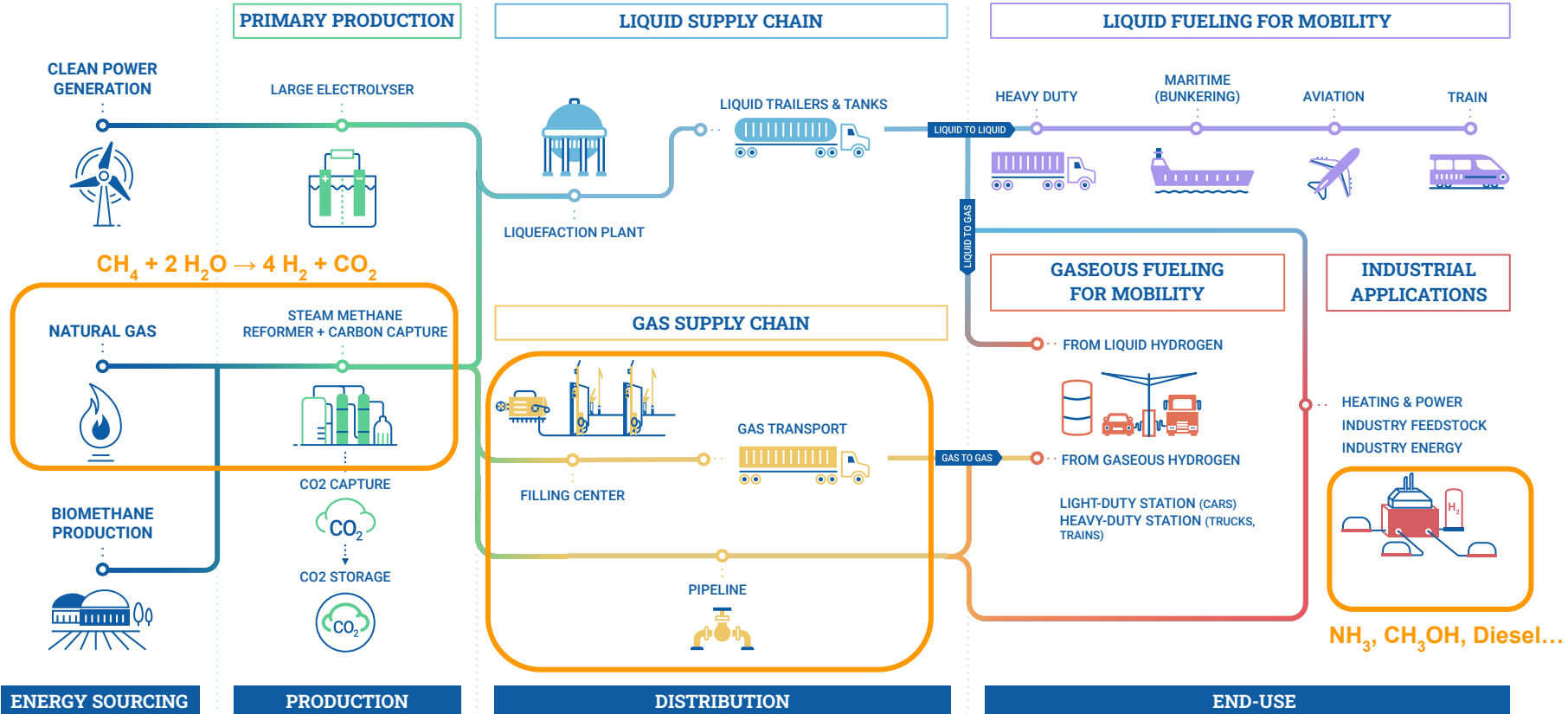
**90+** Integrated hydrogen economy  
*(cross-industry, projects with different types of end-uses)*

**90+** Infrastructure  
*(hydrogen distribution, transportation, conversion and storage)*

**~1.000** projects announced  
with **investments** of  
**\$320 bn** (and a target of  
\$610 bn by 2030)

**53%** industry  
**18%** transport  
**+ large infrastructure projects emerging**  
(exports, pipelines)

# HYDROGEN VALUE CHAIN

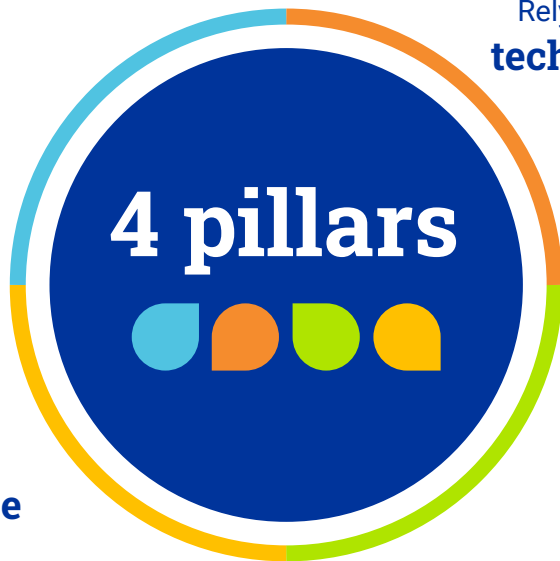


# Building upon our strengths to move fast

An approach  
**focused  
on basins**



Leveraging Air Liquide's  
long-standing  
**operational excellence**



Relying on our **best-in-class  
technologies** and our capacity  
**to innovate**



**Partnerships**  
as a key driver



To serve  
our markets



**Industry**



**Mobility**



# Operational excellence

## Recognized operational excellence



Optimized **energy procurement**



Extensive expertise with **large industries**

*300+ hydrogen plants*



**Best-in-class safety, technical know-how and reliability,**  
based on long-standing experience and existing operations

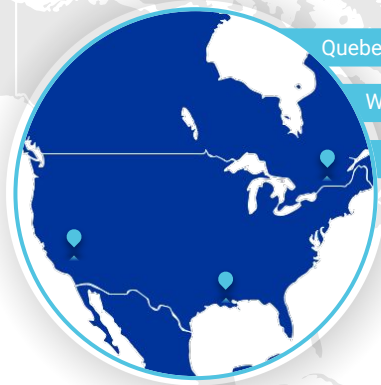


**Strong supply chain know-how** and organization to develop  
**efficient bulk logistics**

*1,500+ hydrogen trailers*



# Focus on 15 key targeted basins



Quebec/Ontario/US North East

West Coast

Texas/Gulf Coast



Norway

Benelux

Rhine/Ruhr



Seoul

Yeosu



Normandy

Fos-sur-Mer



Nagoya/Tokyo



KSA



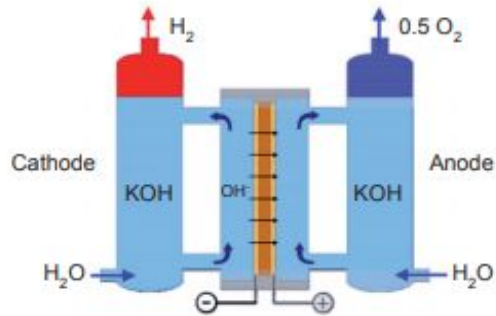
Beijing

Shanghai

Guangdong

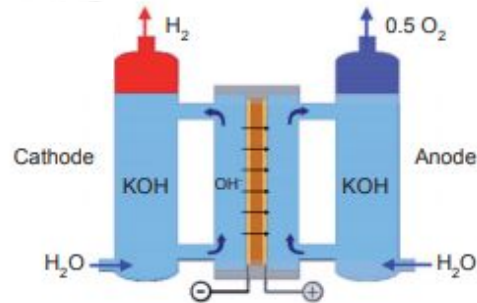
# Electrolysis available technologies

## Alkaline (atmospheric pressure)



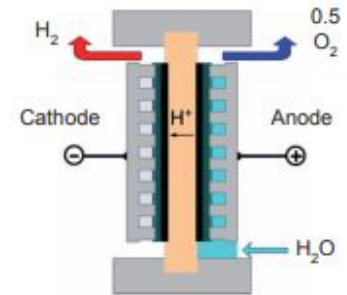
- Mature
- Scalable
- Cost effective
- Lifetime

## Alkaline (pressurized)



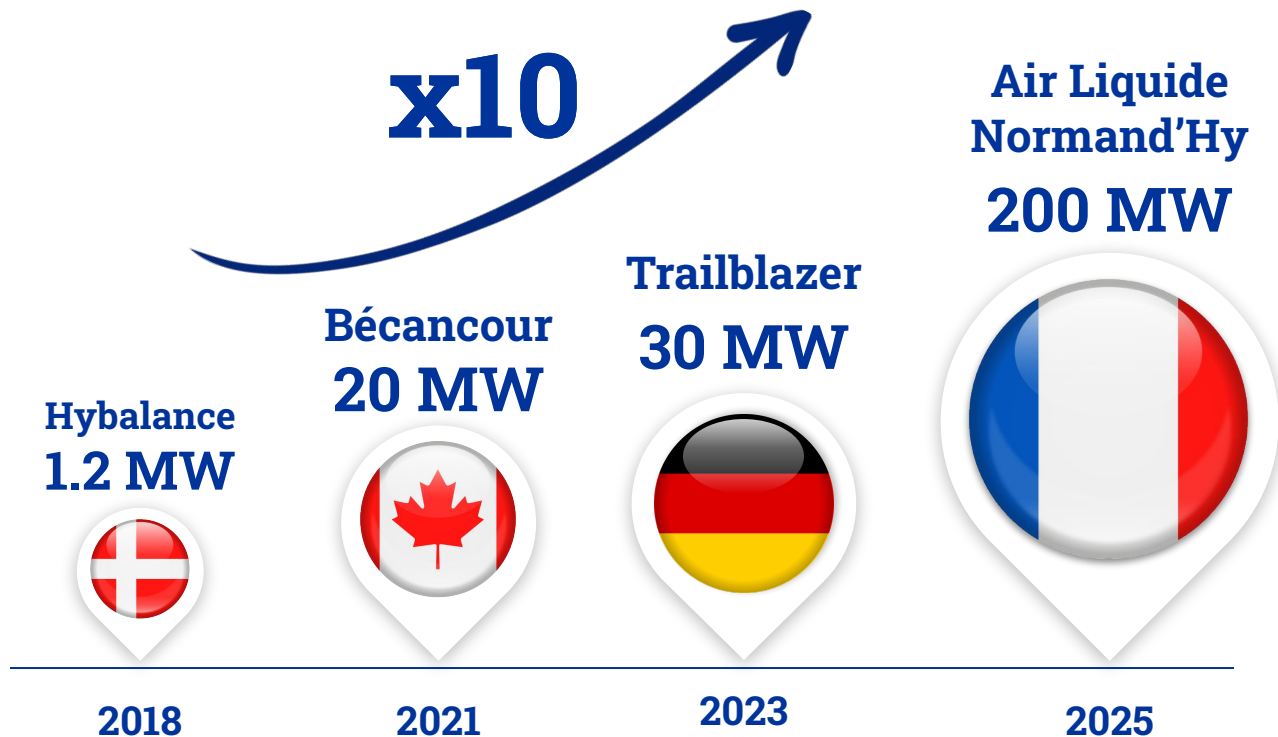
- Mature
- Scalable
- Cost effective
- High pressure
- (< 30bar)

## PEM (Proton Exchange Membrane)



- Compact
- No KOH
- Fast Reactivity
- High pressure

# Scaling up our electrolysis capacity



Leading position  
in large scale  
electrolysis  
to reach 3 GW  
capacity by 2030

## Bécancour (Canada): 20 MW - 8.2 tonnes of H<sub>2</sub> per day

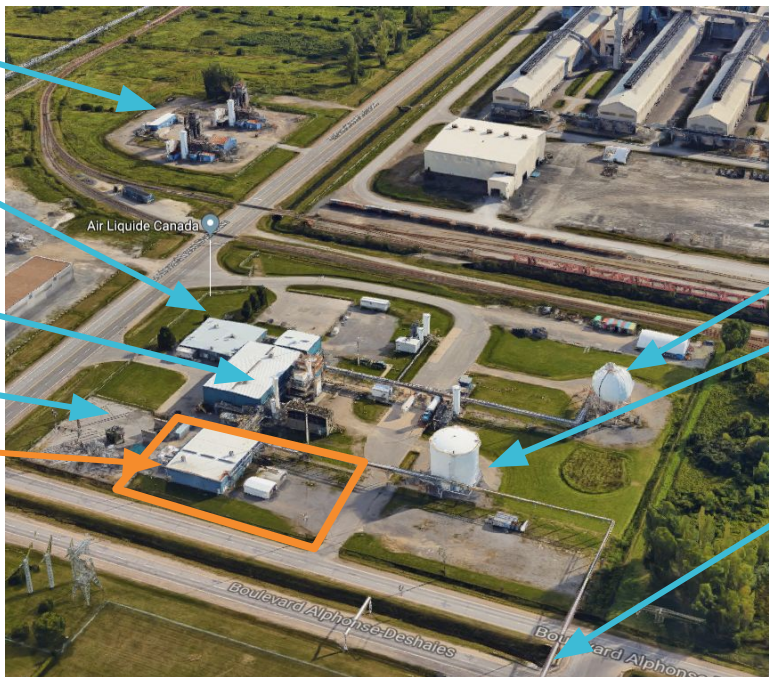
2 X SMR

Control Room

Liquefier

Sub-Station

Electrolyzer Building



LH<sub>2</sub> Storage

Gas Holder

H<sub>2</sub> Pipeline

Using local hydropower capacity

Emission reduction :  
27,000 tonnes of CO<sub>2</sub> per year

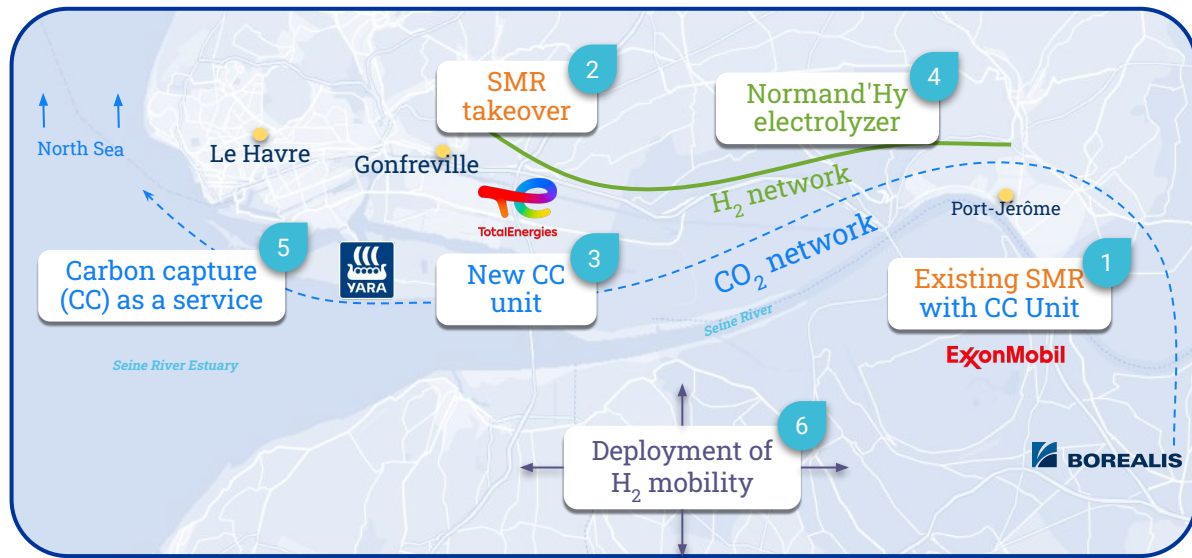
Integrated in an existing  
H<sub>2</sub> production site  
since 2021



# Building synergies at scale in key basins

## Normandy Basin (FR)

The world's first low-carbon hydrogen network  
and carbon capture as a service



- Innovative technologies
- Renewable energy sourcing
- Refineries' needs for renewable and low-carbon products
- CO<sub>2</sub> capture on customers assets
- Large scale carbon management with shipping and storage in Europe

# Air Liquide and Siemens Energy Gigawatt electrolyzer factory November 08, 2023



## Joint-venture with Siemens Energy

The state-of-the-art gigawatt factory will ramp-up to an annual production capacity of **three gigawatts by 2025**. Located in Berlin, the new manufacturing site spans over 2,000 square meters. It leverages **automation and robotics** for the series production of Proton Exchange Membrane (PEM) electrolyzer modules.

**100+**  
stations

**5**  
countries

**50/50**  
JV

# Collaboration with TotalEnergies on retail network

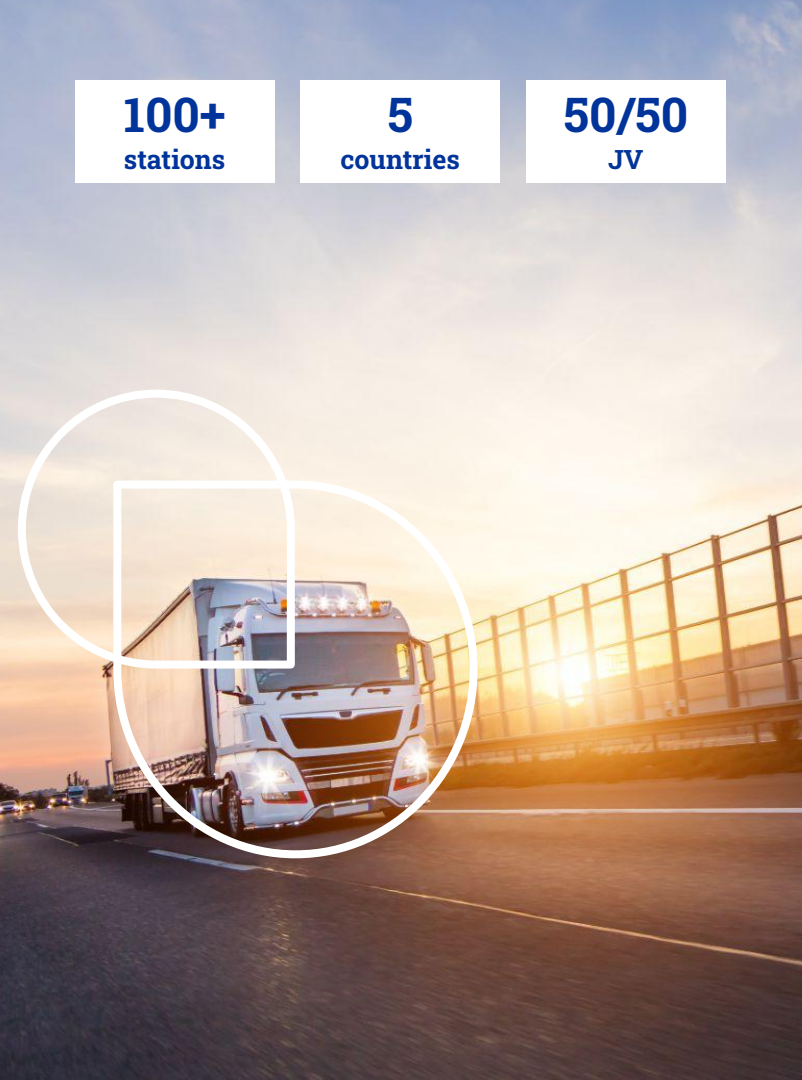


## Ambition

- A **50/50 joint venture** to accelerate the development of an **extended hydrogen station network**, primarily for trucks, in **5 countries in Europe** (France, Germany, Benelux), and take leading position in the H2 market.

## Approach

- Building a **consistent network of well positioned H2 stations in logistics hubs and along the main European traffic corridors**, thus becoming a reference player.
- An alliance that will provide **visibility to OEMs**, transport fleets to **accelerate vehicles deployment at scale**, and to public bodies to **accelerate financing supports**.
- An accelerator to **decarbonize heavy duty road transport** as it will **activate the H2 road mobility market** in Europe.
- The JV will **invest, build, own and operate the stations, source the hydrogen and the HRS technology** on the market and **distribute H2** to vehicles and transporters.



An aerial photograph of a multi-lane highway bridge supported by numerous concrete pillars, spanning over a lush green forest. A white semi-truck is driving on the bridge. A white circle and a white square are overlaid on the image, framing the truck.

**Thank you!**