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Hydrogen and its role in the Energy Transition

Dave Edwards

Director and Advocate for Hydrogen Energy
Air Liquide

Air Liquide: Key Figures

~67,000
EMPLOYEES

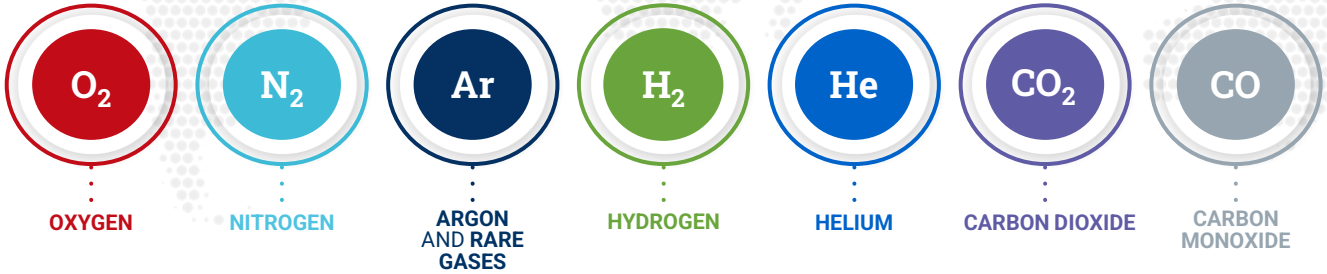
PRESENT IN
80 COUNTRIES

MORE THAN
3.7 MILLION
CUSTOMERS &
PATIENTS

REVENUE
€21.9bn

NET PROFIT
(GROUP SHARE)
€2.24bn

INVESTMENT
DECISIONS
€3.7bn



Air Liquide

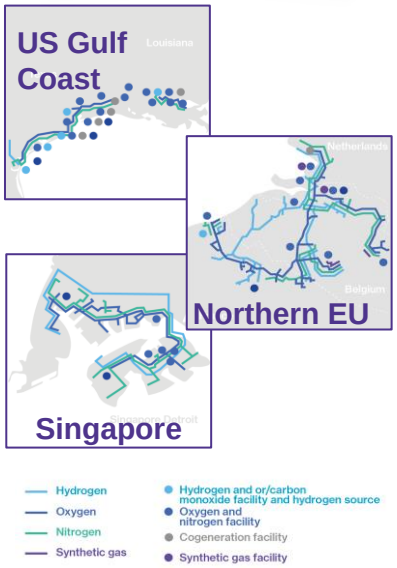
Air Liquide has nearly 50 years of hydrogen development

Production & Supply chain

Production

Supply chain

Distribution Networks



Markets Segments

Process industries

Oil & Gas

Steel, Glass

Electronics

Transportation

Space

Key Figures

14 Bm^3/yr

1,850 km H_2 pipeline

46 large H_2/CO plants

40 electrolyzers in operation

2 B€ sales

Air Liquide

Air Liquide investments in North America

Nevada

1st large scale **renewable liquid hydrogen** production plant dedicated to the Hydrogen energy markets

- Investment: **$250M**
- Capacity: **30 tons per day** (40,000 FCEVs in the West Coast)
- Location: **North Las Vegas, Nevada**
- Construction: **Began in 2020; operations & delivery in 2022**

World's Largest PEM Electrolyzer to supply **~100% low-carbon hydrogen** for Canada and the East Coast Markets

- Investment: **$40M** (additional investment to existing site with liquefier)
- Capacity: **>8 tons per day (20 MW PEM electrolyzer)**
- Location: **Bécancour, Québec**
- Construction: **Began in 2019; operations & delivery started 2021**

Bécancour

Air Liquide

North Las Vegas Reformer & Liquefier

Air Liquide

Becancour - Reformer, Electrolyzer, Purifier & Liquefier

Air Liquide

The Challenges of Biogas

Cost of Purchasing Environmental Attributes (EA)

There are no EPA RFS approved H2 pathways

- Pathway approvals in process - waiting more than 6 years
- Market price of EA established by LCFS & RFS for **CNG application**
    - Hydrogen at a disadvantage, we pay a premium
    - If pathways are approved, this reverses

Availability of EAs - supply limited

AL Nevada plant requires ~2 large landfills or ~20 dairy digesters supply

EA purchases in large quantities with expiration dates

- Use them or lose them
- Customers demand 0 CI to maximize HRI
    - Requires combination of LFG and digester gas EAs

Credit Value Sharing

The LCFS/RFS credit value is split amongst the entire feedstock supply chain

- Site, gas producer, pipeline operator, credit traders, H2 producer, station operator, customer

The Challenges of Biogas II

Limited impact of EAs

LCFS does not allow for application to “process energy” - only feedstocks

- EAs only for the fraction of RNG converted to H2
- No EAs for NG reactor heating (25%), compression, liquefaction

Another Challenge

CARB pathway process can be complex

A single site can require dozens of pathways

- Combinations of feedstocks and energy usage
- Multiple supply schemes

Pathways are determined by and require plant operating data

- Essentially no credits until performance is established
- 90 days operation required
- Plant startups can be very challenging and likely don’t have good operational data early on

CARB has been exceptionally accommodating as we go through this for the first major plant