



H₂ Energy

At the heart of the energy transition

Dave Edwards

Director and Advocate for Hydrogen Energy

Air Liquide



The world leader in gases, technologies and services for Industry and Health.



Present in 80 countries.



Approximately 65,000 employees.



More than 3.5 million customers and patients.



292 millions euros of innovation expenses, almost 60% of these expenses are related to the improving of the environmental footprint, air quality and healthcare.

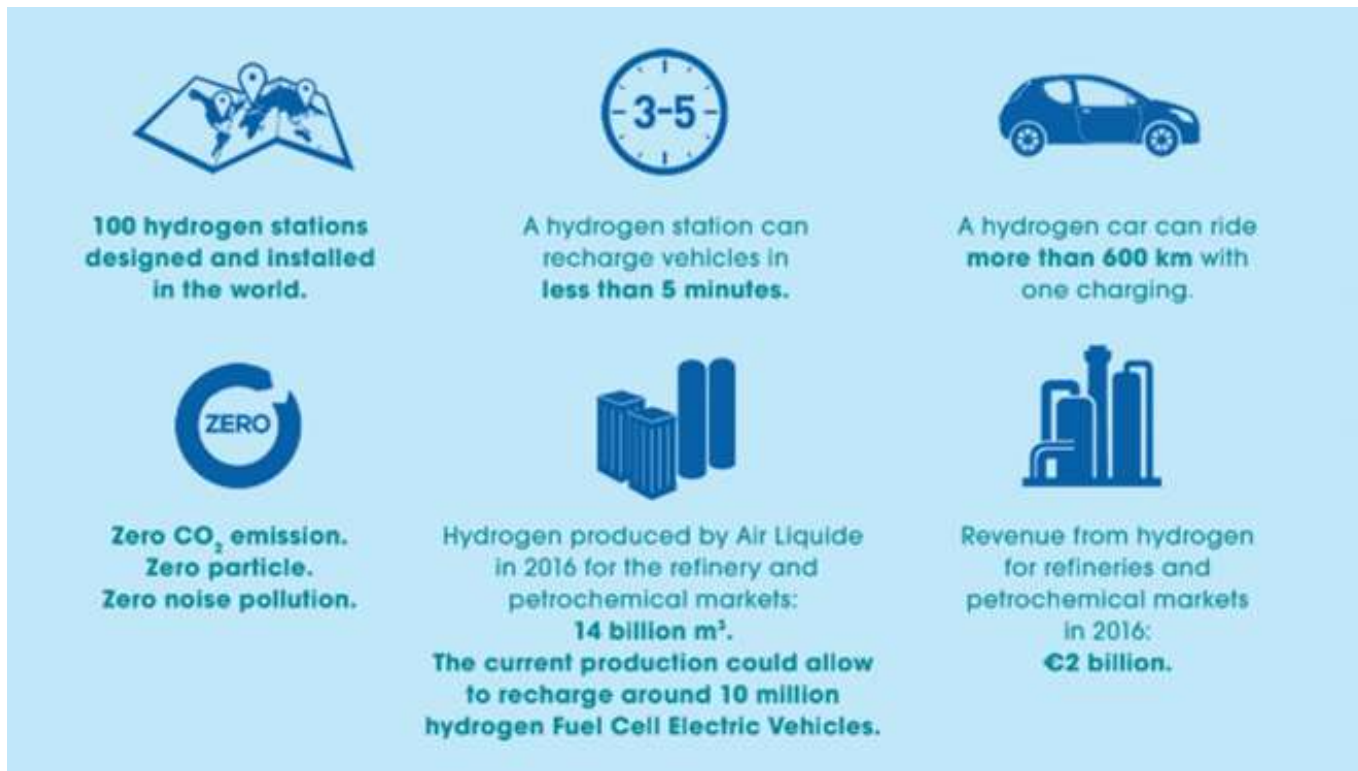


Around 300 patents per year.

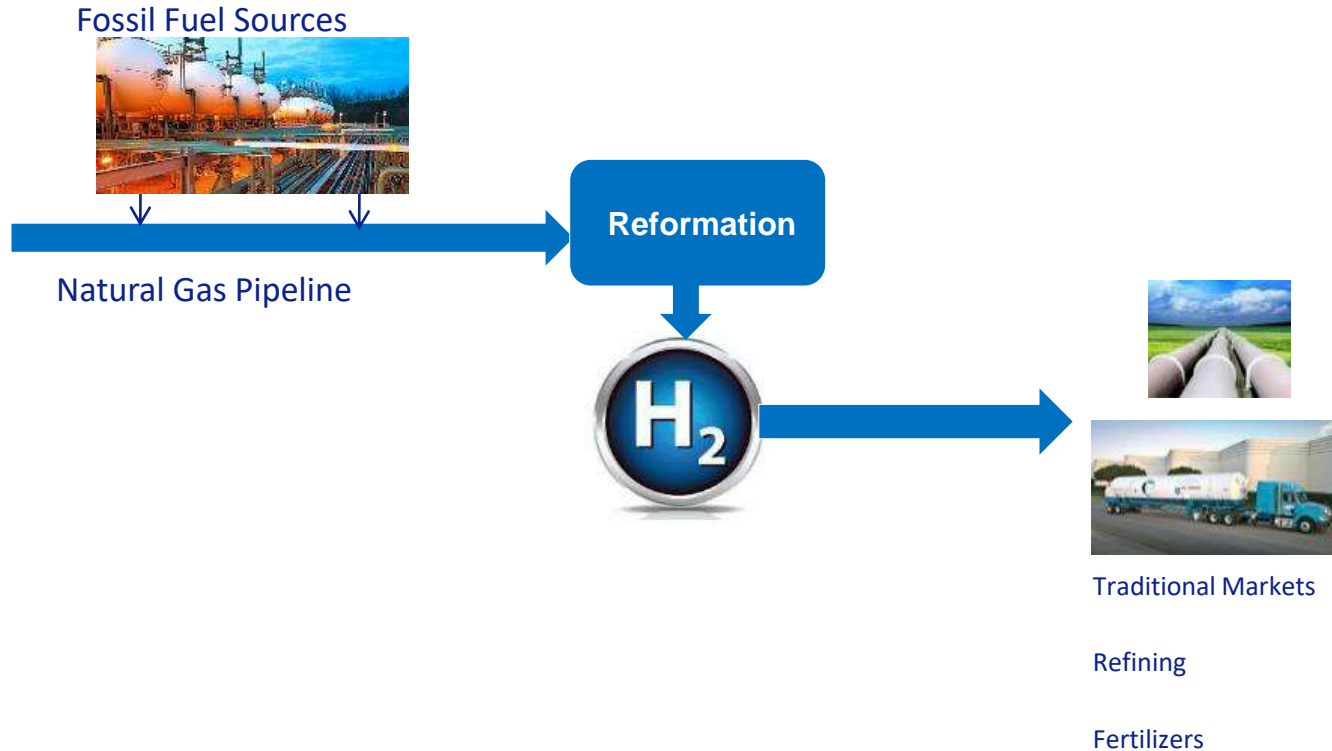


2017 Revenue: €20.3 billion.
2017 Net profit: €2.2 billion.

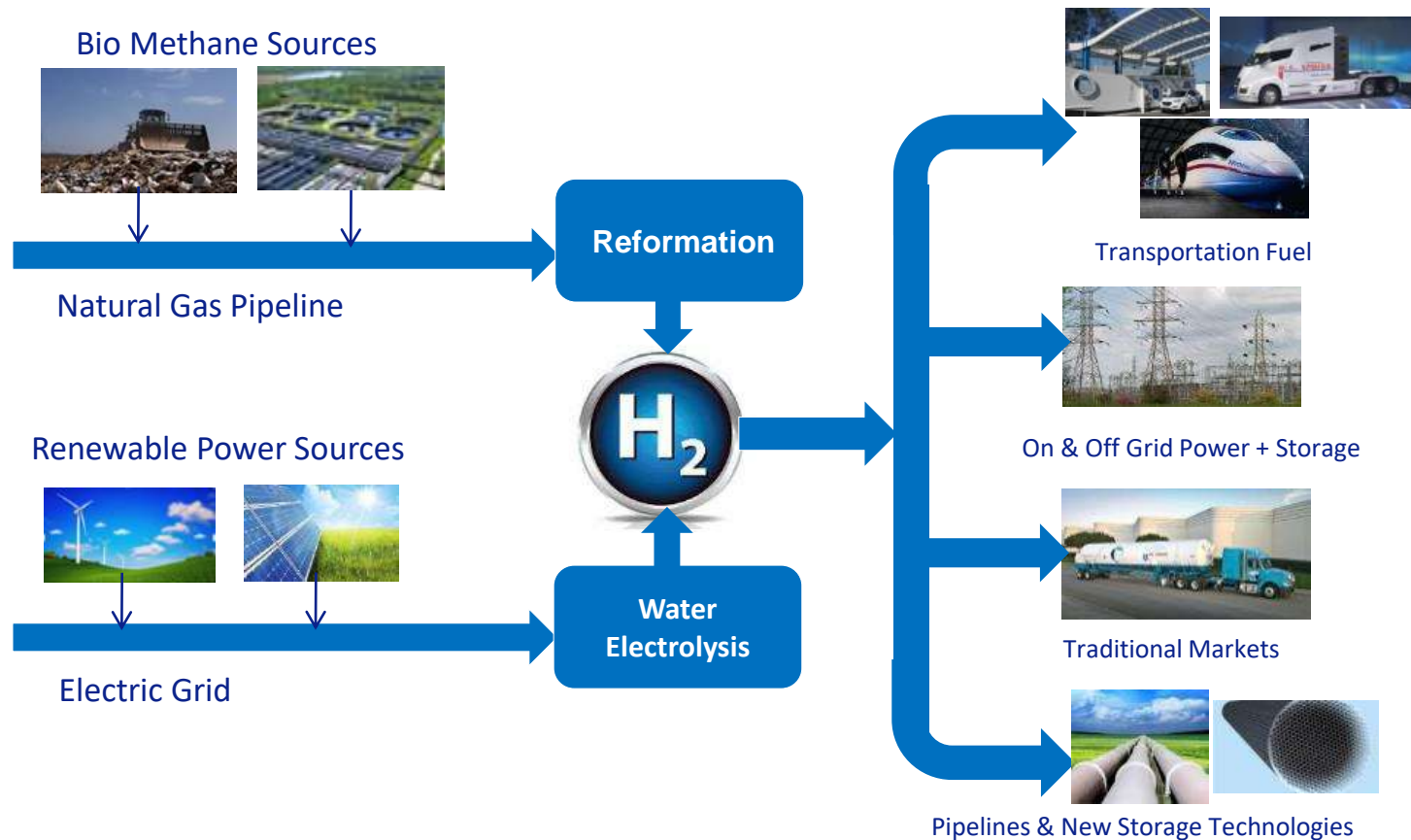
Air Liquide - Hydrogen Energy



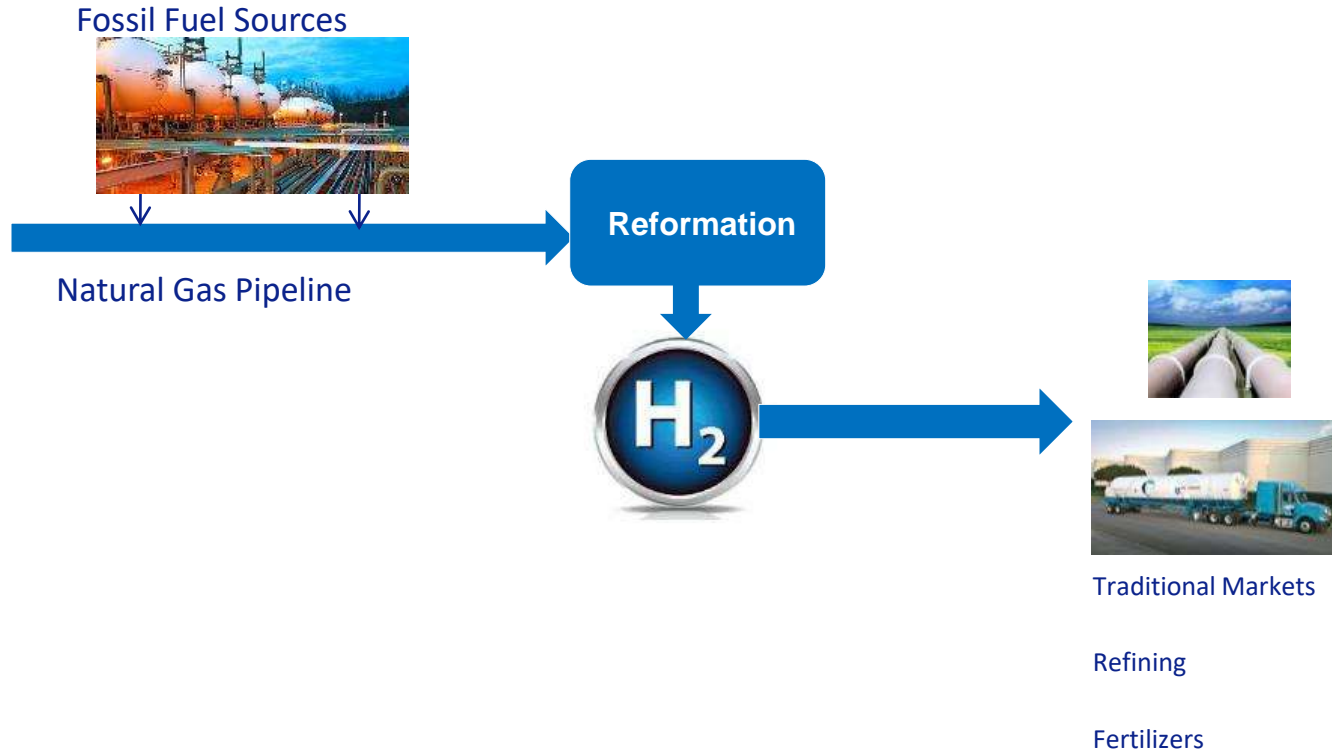
Hydrogen – today's industrial pathway



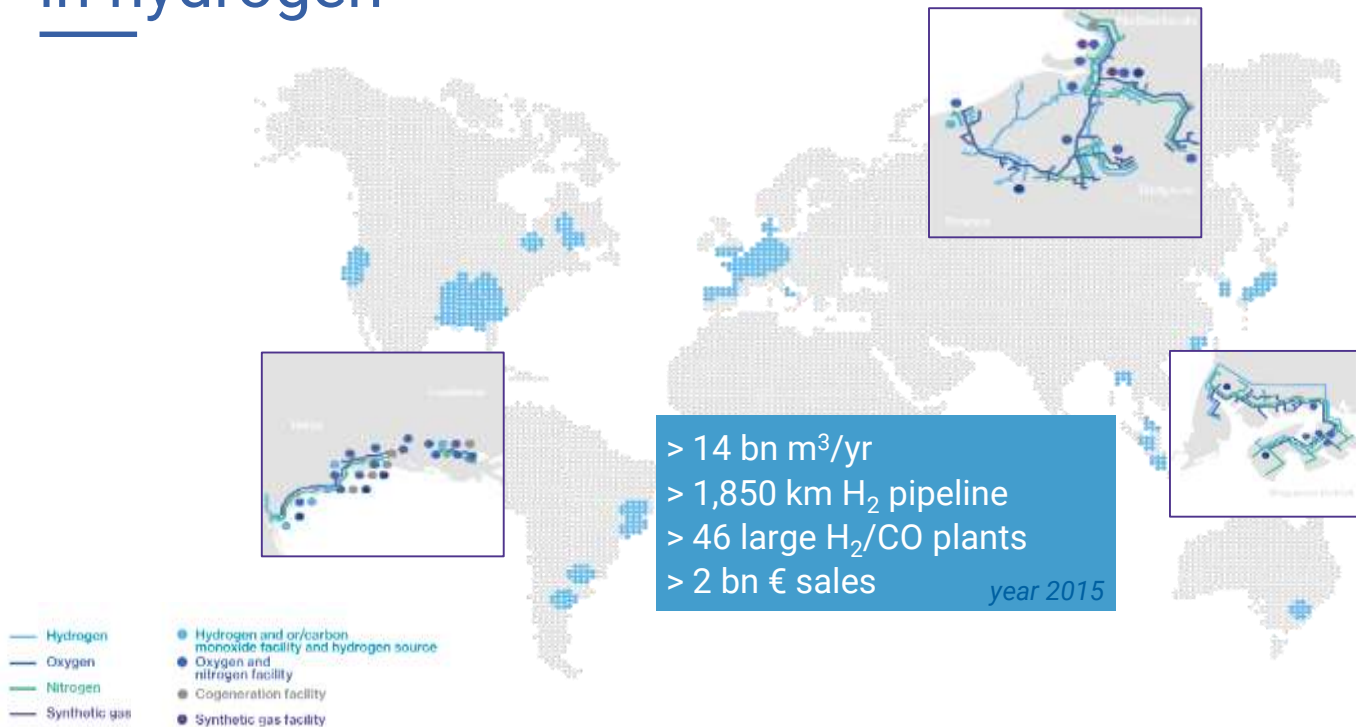
Hydrogen – the pathway with renewables



Hydrogen – today's industrial pathway



40 years of global investment in hydrogen



Production



Distribution



Applications



Air Liquide to build first world scale liquid hydrogen production plant dedicated to the supply of Hydrogen energy markets

Air Liquide will build the first world scale liquid hydrogen production unit dedicated to the hydrogen energy markets, located in the Western U.S., and has signed a long-term agreement with FirstElement Fuel Inc (FEF), a leader in retail hydrogen infrastructure in the U.S., to supply hydrogen to FEF's retail liquid hydrogen fueling stations in California. These new commitments will serve the growing needs of the hydrogen mobility market in California and help enable and complement the deployment of hydrogen fuel cell electric vehicles and support the hydrogen merchant market across the state.

Liquid Hydrogen - Production



The graphic features the 'CLEAN MOBILITY' logo with 'try Air Liquide' below it. The main title is 'Air Liquide's Western U.S. RLH₂ Investment'. Below this is a map of the Western United States with '1ST' in large blue letters. To the right of the map, it says '@scale renewable liquid hydrogen dedicated to the H₂E markets'. At the bottom left, '\$150' is written in large blue letters, followed by 'MM anticipated investment'.

CLEAN MOBILITY
try **Air Liquide**

Air Liquide's Western U.S. RLH₂ Investment

1ST @scale renewable liquid hydrogen dedicated to the H₂E markets

\$150 MM anticipated investment

- **Capacity** : 30 tons per day
- **Production** : Steam methane reforming
- **Key Figures**
 - Location: Western U.S.
 - Construction to begin early 2019
 - Operations & delivery by 2021
 - \$150 million USD investment

Liquid Hydrogen - Production

Air Liquide selects Hydrogenics for 20MW electrolyzer for hydrogen production; largest PEM electrolyzer in world

26 February 2019

Air Liquide will build in Canada the largest PEM (Proton-Exchange Membrane) electrolyzer in the world with a 20 megawatts (MW) capacity for the production of low-carbon hydrogen (the facility will use hydropower).

Air Liquide will install a 20 MW electrolyzer that increases by 50% the current capacity of its hydrogen facility located in Bécancour, Québec. The facility is expected to be in commercial operation by the end of 2020, with an output of just under 3,000 tons of hydrogen annually.

Station Characteristics



● Vehicles & User

- 4-5 kg/fill
- 3-5 minutes per fill
- H70

● Station Usage

- 100+ vehicles/day/position
- 1-4 fueling positions/station
- 1 nozzle/fueling position

● Capacity

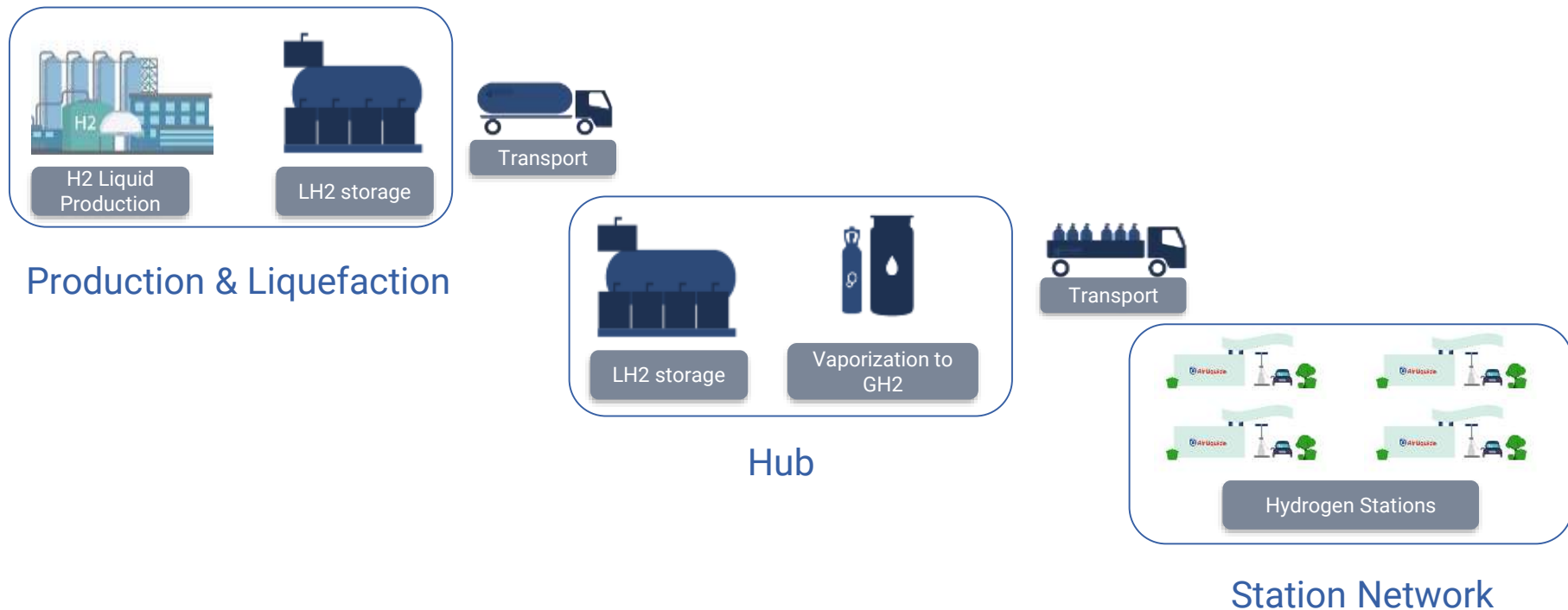
- Today: 300 kg per day
- Future: may exceed 1000 kg per day

Delivery Options

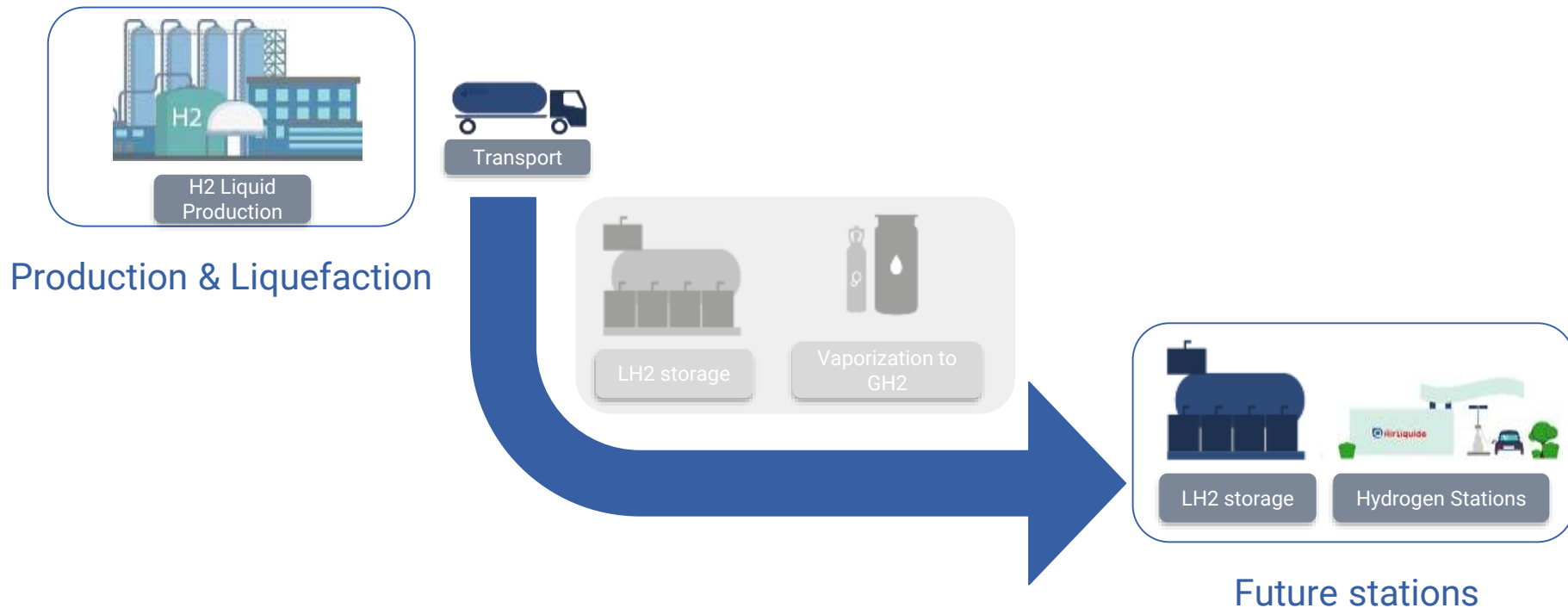


- Gaseous supply chain (300-450 bar)
- Onsite gaseous production
- Liquid supply chain

From Today's Distribution Model...



... To Tomorrow's Distribution Model



Gaseous Hydrogen - Transport & Storage



- Industry standard trailer: 300 kg of H₂, 2400 psi
- Air Liquide tube trailer: 440 kg of H₂, 6500 psi



- Underground Hydrogen Cavern
 - Beaumont, TX
 - Nearly one mile wide and 230 ft deep
 - Enough hydrogen to back-up a SMR for 30 days

Liquid Hydrogen - Transport & Storage



Onsite Liquid Storage

15,000 gallons is the typical storage
= 4 tons



Liquid Delivery Tanker

13,000 gallons in the typical tanker =
3.5 tons



NASA Sphere

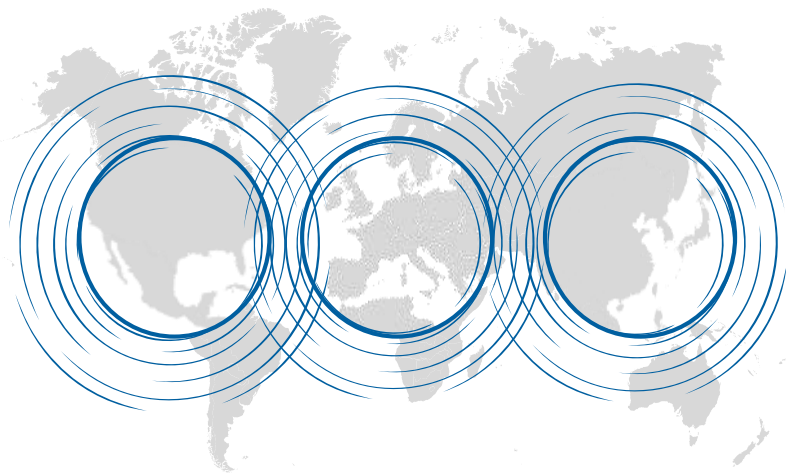
Built in the 1960's containing
850,000 gallons = 230 tons

Liquid Hydrogen - Liquefaction



- **Onsite Liquefaction**
 - 1 - 3 tons per day
- **Typical Industrial Liquefier**
 - 10 - 30 tons per day
- **Future Liquefier**
 - 100+ tons per day

Looking beyond...



PRESS RELEASE

Paris, February 25, 2019

Air Liquide invests in the world's largest membrane-based electrolyzer to develop its carbon-free hydrogen production



PRESS RELEASE

November 26, 2018

Air Liquide to build first world scale liquid hydrogen production plant dedicated to the supply of Hydrogen energy markets



PRESS RELEASE

January 24, 2019

Air Liquide makes a strategic investment in the production of decarbonated hydrogen by electrolysis



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Thank you
