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Air Liquide Hydrogen Energy

More than 50 years of expertise on Liquid Hydrogen



ARIANE 5: Launcher
700+ Ariane tanks

From the conquest
of space,

through mobility,

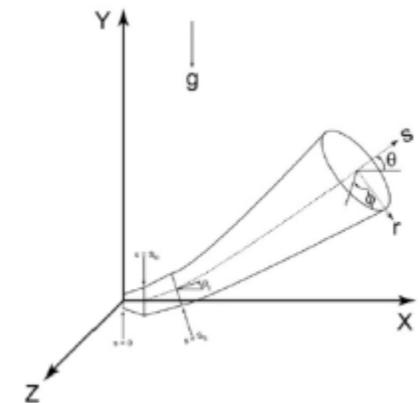
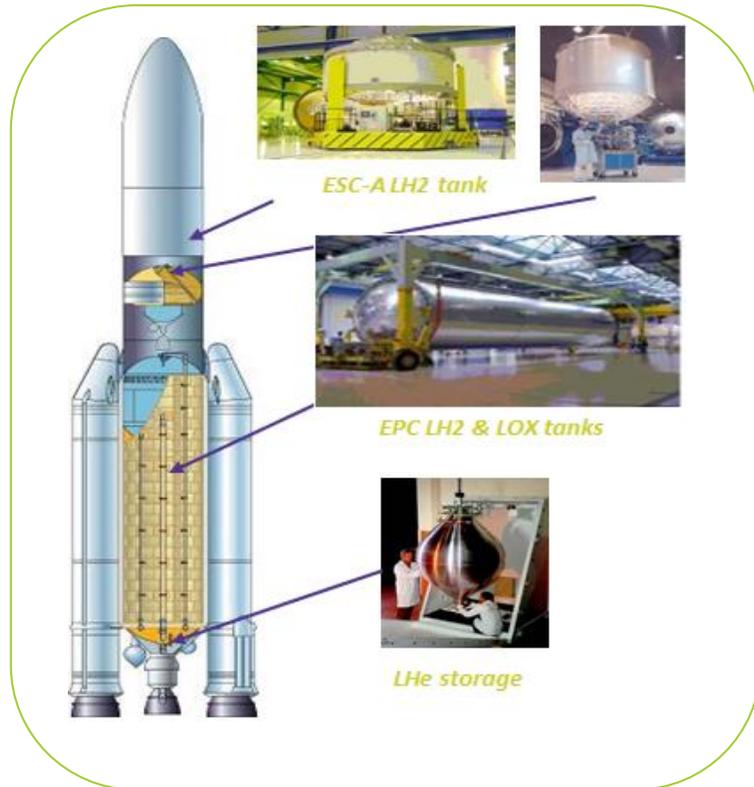
to aerospace



Safety

- 256 space launches (Ariane 1 to Ariane 5) without any safety incident linked to hydrogen

- Safety tools are ready and deployed by R&D

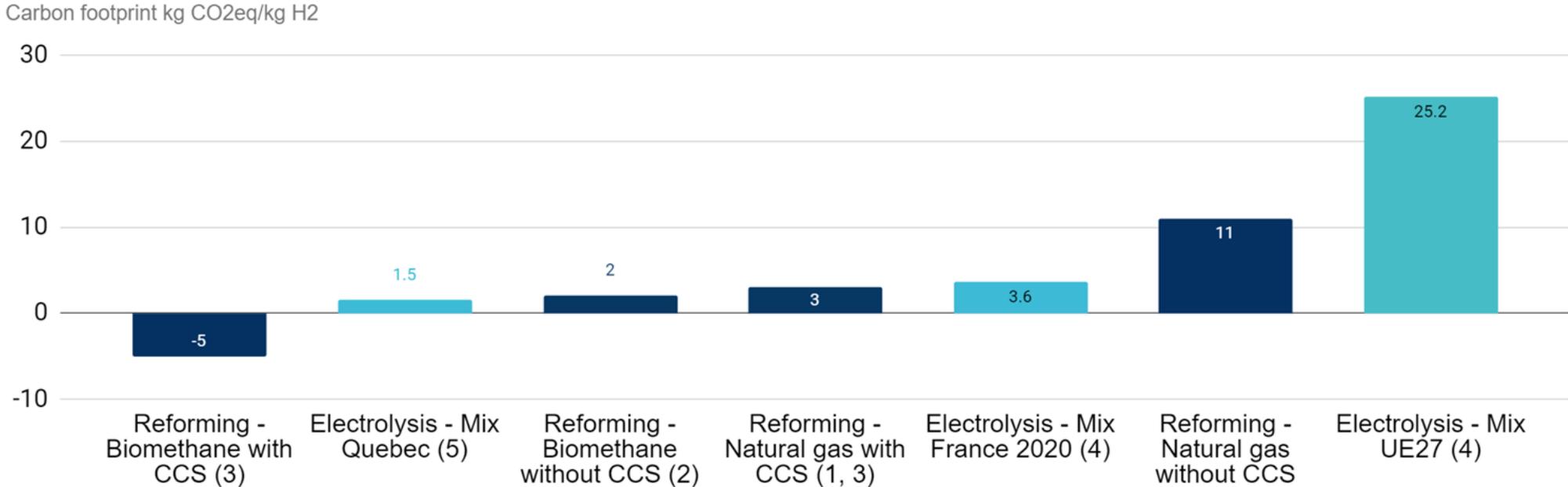


Carbon footprint of produced hydrogen (kg CO2/kg H2)

Air Liquide commitments:

2035 More than 50% of Air Liquide’s hydrogen sales will be low-carbon and renewable

2050 Targeting Carbon Neutrality



Source Air Liquide. Figures 2020. CCS = Carbon Capture & Storage. Well-to-outlet production gate emissions.
 (1) With CCS and drop of 50% in methane and CO2 leaks during extraction and transport of natural gas vs conventional steam methane reformer.
 (2) Assumption 46 kWh PCI/kg H2, emission factor "Biométhane - Injecté dans les réseaux - Mix moyen France Continentale" ADEME Base carbone v19.0
 (3) Assumption: 90% of the CO2 directly emitted is captured & stored
 (4) Assumption: 60 kWh/kgH2, electricity emission factor from ADEME Base carbone v19.0
 (5) Assumption 60 kWh/kg H2, emission factor base ecoinvent 3.4 & methodology IPCC GWP100 a

Walking the talk: We are scaling up!

Liquefiers:

~30 tonnes per day
→ towards 100+ tpd
(eq. to 30 planes)



West Coast liquefier
(under construction,
30 tonnes per day)

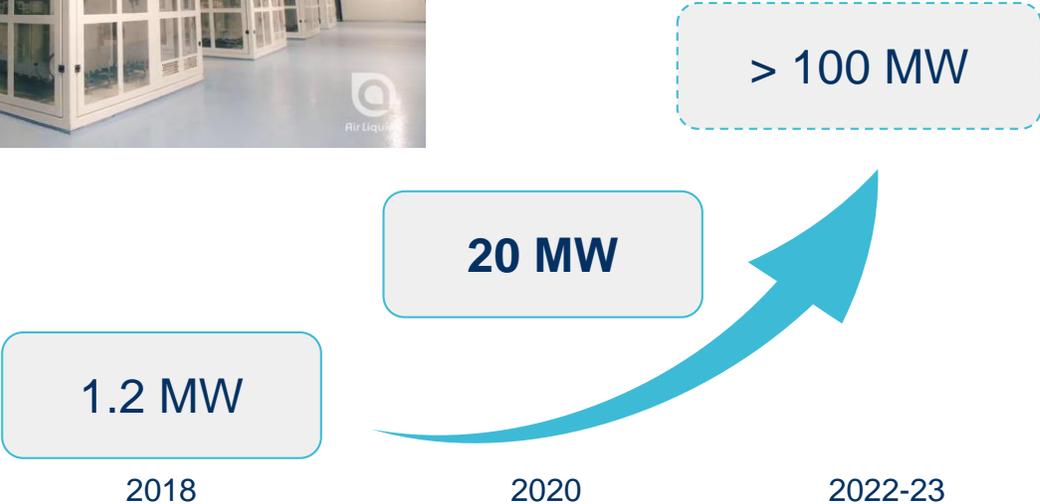
Electrolyzers:

Largest 20 MW PEM electrolyzer
running on hydropower
(started in Q4 2020)



Air Liquide commitment:

3 GW of electrolysis by 2030
(incl. 1 GW decided still under construction)

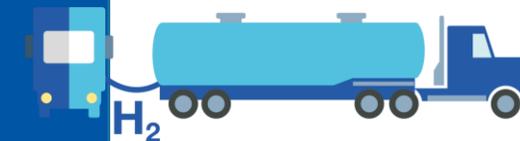


2050 forecast

100-300 airports
to be equipped

5 to 10 million tonnes of
liquid hydrogen per year

10,000 liquid hydrogen-
powered planes by 2050



Liquid infrastructure for one international airport*

**150 Hydrogen-aircraft take-off per
day**

150 tonnes of LH₂/day; 400 MW

10 to 20 mobile refuelers
using a specific LH₂ trailer

1 trailer for 10 aircrafts
15-20 minutes to refuel

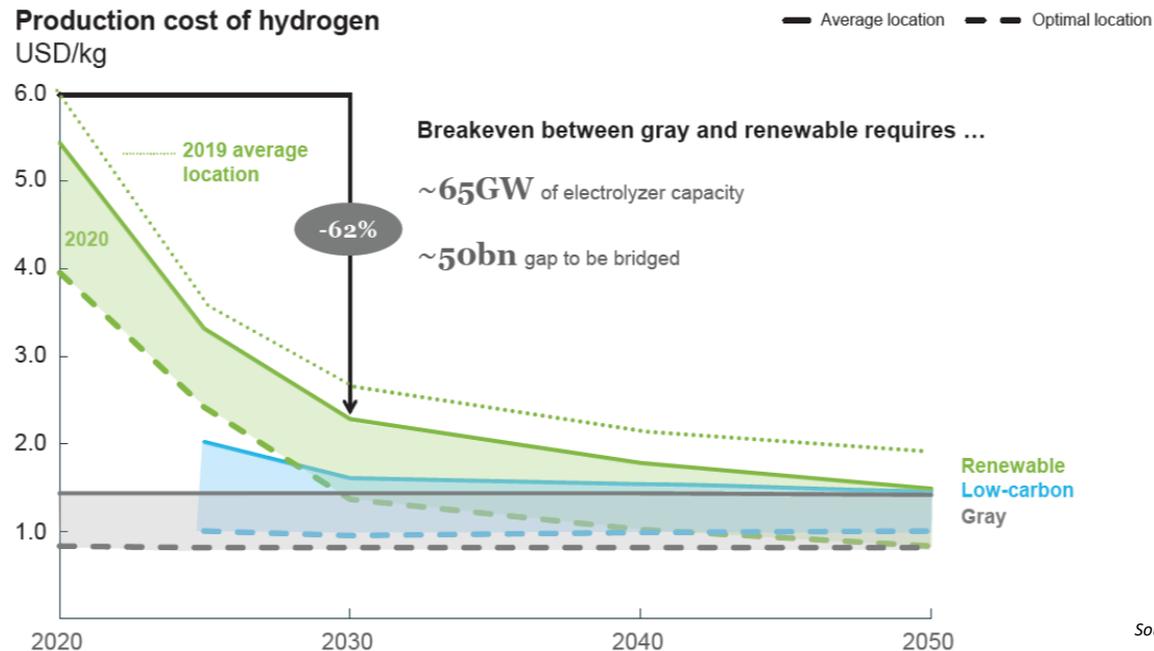
Hydrogen will be economical faster than previously anticipated



Aviation Fuels

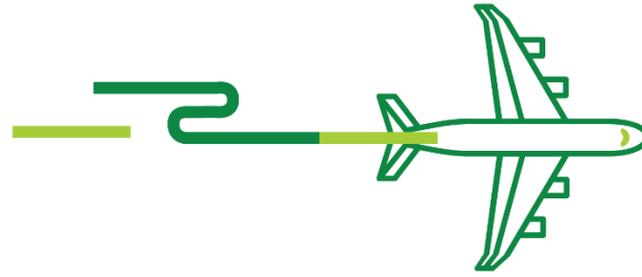
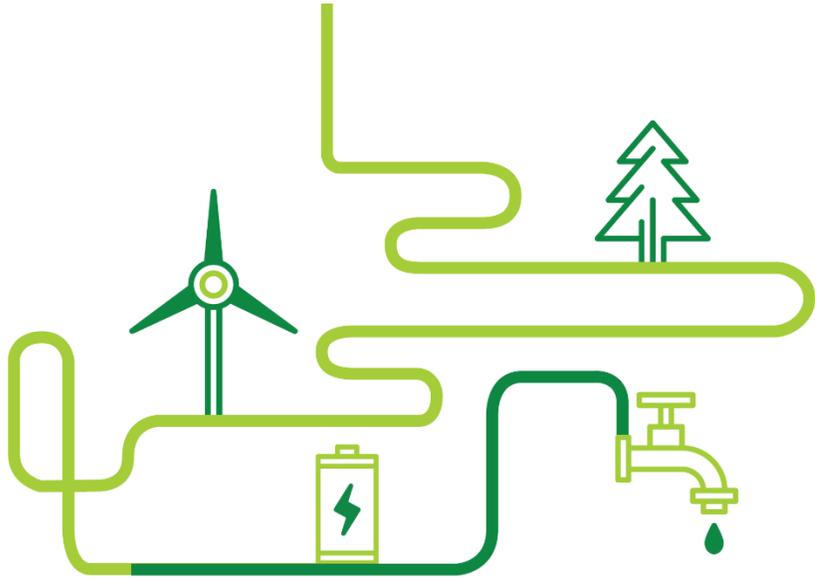
Hydrogen direct combustion	e-fuels
Fuel Cells	<i>Liquid hydrogen</i>

The cost of renewable hydrogen costs can be reduced by 60% by 2030:



Source: H2 Council 2021 Insights

- Up to -100% of direct CO₂ emissions avoided
- Volumes will bring costs down
- In 2030, liquid hydrogen for aviation will benefit from synergies with well established ground mobilities
- Regulations and political support



AVIATION CO₂ REDUCTIONS



PRE-STOCKTAKING WEBINARS

TECHNOLOGY · OPERATIONS · SUSTAINABLE AVIATION FUELS

