

Progressing the Hydrogen Economy Through Transformative Projects

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GENERATING A CLEANER FUTURE



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Air Products Today



12.6

Billion dollars in sales



~23,000+

Employees worldwide



~50

Countries where we operate



~60

Billion dollars in market cap



>8

Decades in business



>250,000+

Customers



1,800

Miles of industrial gas pipeline



750+

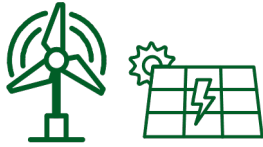
Production facilities



30+

Industries served

Hydrogen is One Component of the Energy Transition



Multiple Solutions required

Clean hydrogen can replace fossil fuels in hard-to-abate sectors where electrification isn't feasible



Hydrogen is one answer

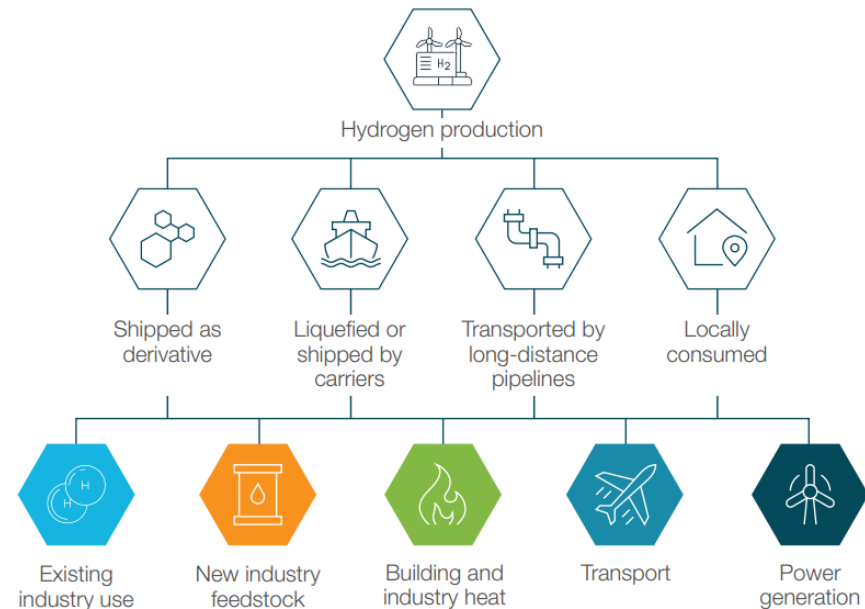
Versatile energy carrier, could contribute to 20% of global emissions reduction*



International Energy Trade

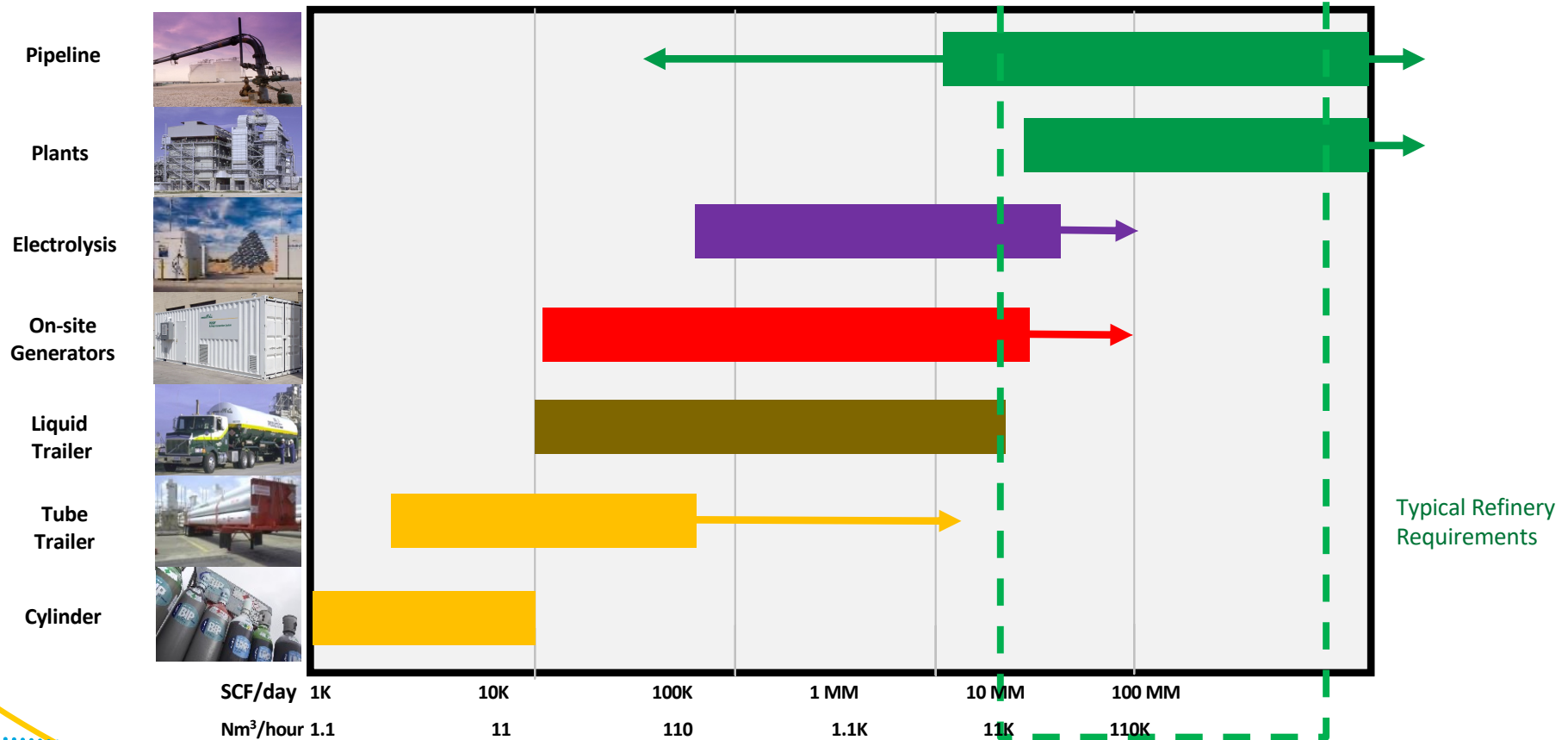
can reduce the cost of the energy transition by \$6 trillion USD*

Level playing field is essential
Through technology-agnostic solutions and hydrogen supply chains focused on outcomes



*Mckinsey Oct 2022 - <https://hydrogencouncil.com/wp-content/uploads/2022/10/Global-Hydrogen-Flows.pdf>

Today's Hydrogen Supply Modes/Transport



Importance of Hydrogen Safety

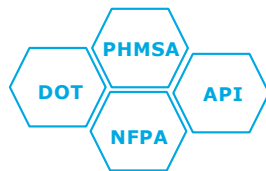
Now and in a Future of Growth

Air Products' 65 Years of Hydrogen Safety Experience

Production, transportation and dispensing at world scale requires expertise and knowledge.

Refinery Hydrogen production and pipeline operation

- Strong Oversight at Federal and State levels
- Mature, effective, well-established codes & regulations
- Strong safety record



Air Products continuing investment in hydrogen safety

- Fire and explosion testing
- New hydrogen specific fire & explosion models,
 - now adopted by commercially available risk & consequence software packages
- Active sharing of lessons learned and best practices
- External emergency responder training
- Engagement in critical codes, such as NFPA 2

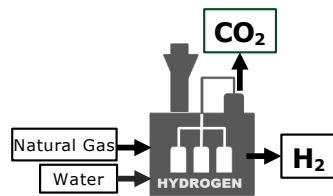
Emerging hydrogen for mobility

- High pressure gas / liquid hydrogen transportation and storage
- Established and new players, technologies < 20 years old,
- Codes & regulations still evolving
- Current investment in testing and advanced modeling

The World is Moving Towards Low-Carbon Future

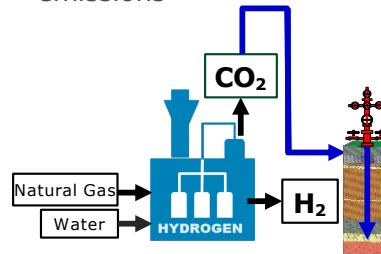
Grey Hydrogen

- Steam methane reforming (SMR): ~95%+ of world's H₂ production



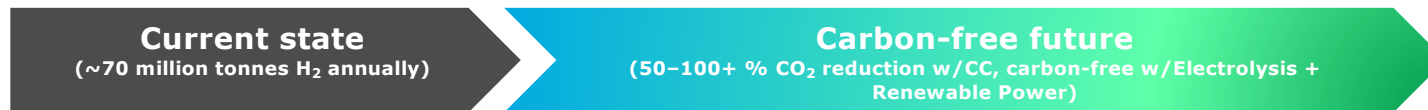
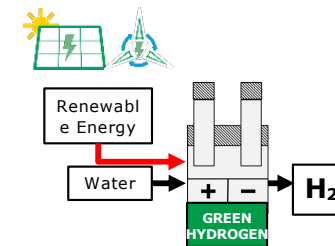
Blue Hydrogen

- SMR / ATR / POX with CO₂ capture and storage
- Can achieve negative carbon emissions

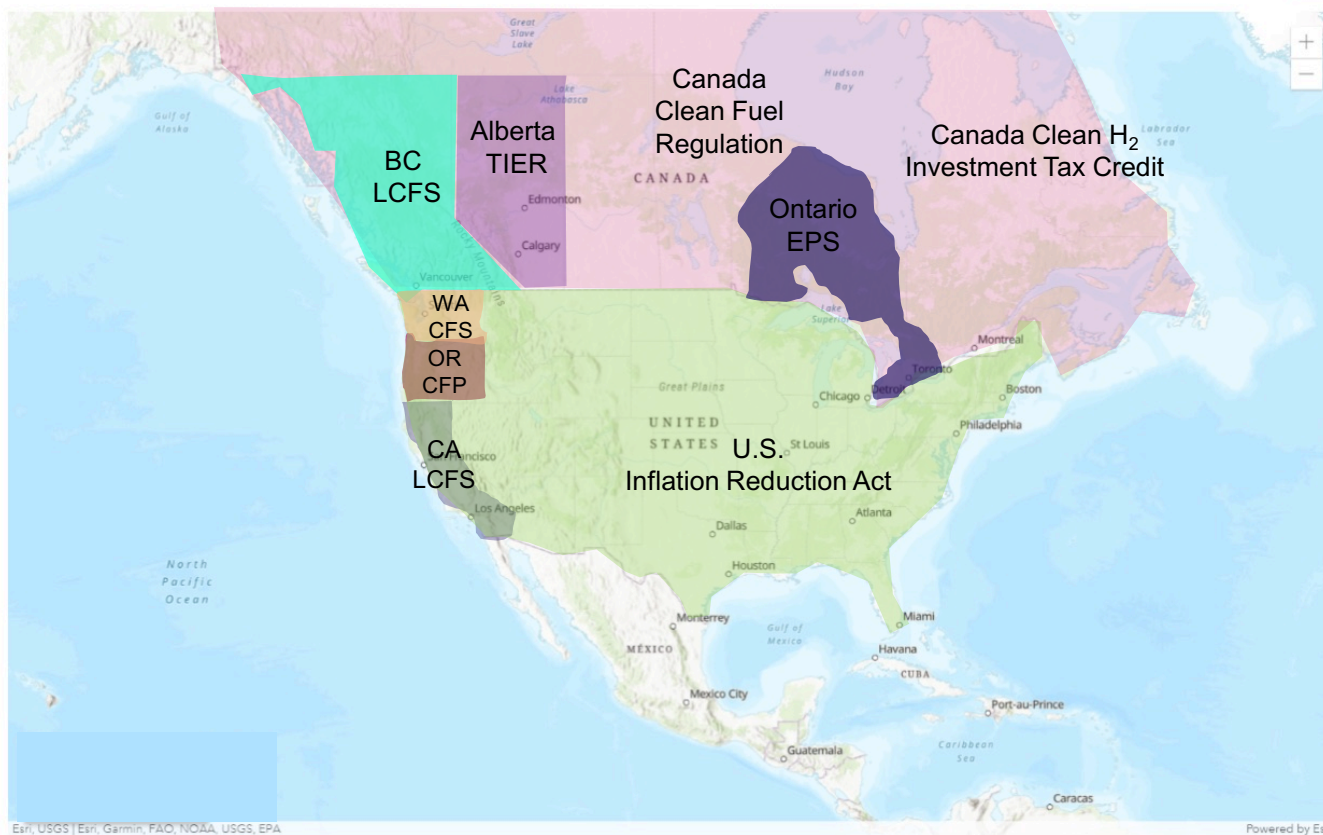


Green Hydrogen

- Electrolysis of water with renewable energy
- CO₂-free, requires new construction and low-cost renewable energy



North American Incentives for the Production and Consumption of Low-Carbon Hydrogen



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Major European Incentives for the Production and Consumption of Low-Carbon Hydrogen

EU RED II

RFNBO:

Mandates use of specified % of Renewable Fuel of Non-Biological Origin (e.g., renewable hydrogen) in transport and industry

EU ETS:

Emission Trading Scheme implements cap-and-trade program for carbon emissions

EU CBAM:

Carbon Border Adjustment Mechanism imposes tax on carbon emissions associated with imports to the EU

UK RTFO:

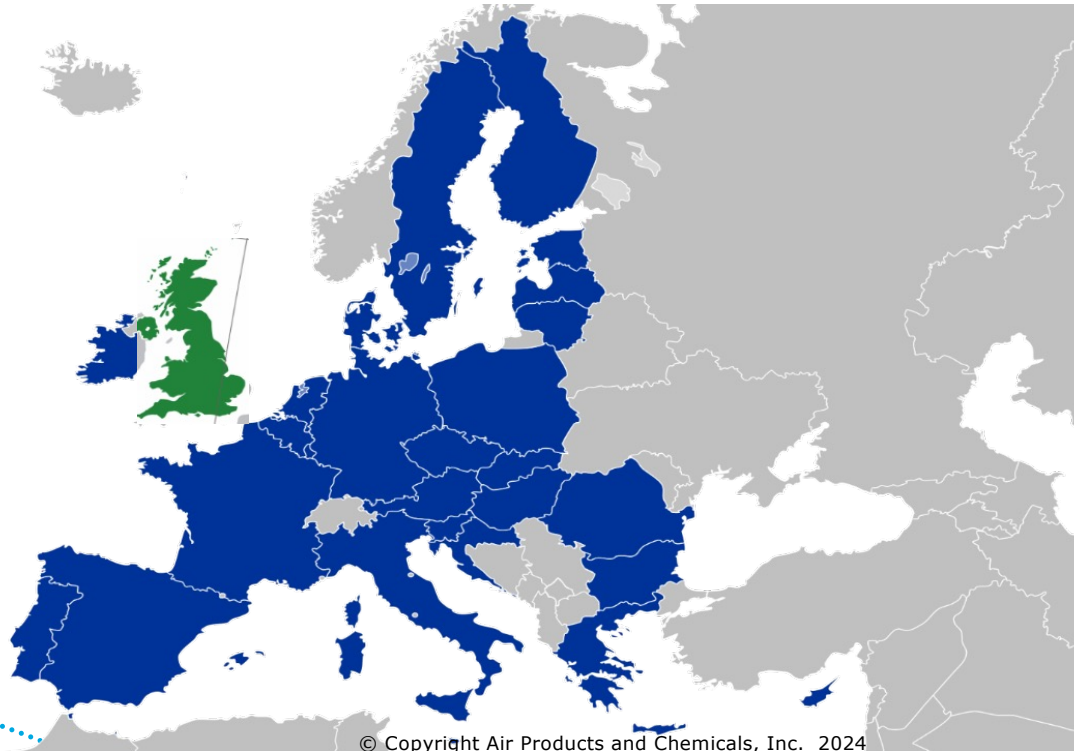
Renewable Transport Fuel Obligation mandates use of specified % of renewable fuels in transportation

UK LCFS and HPBM:

Provide standards and incentives for production of low-carbon hydrogen

UK ETS:

Emission Trading Scheme implements cap-and-trade program for carbon emissions



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Air Products' Existing Operations and Announced Blue Hydrogen Projects: Leading the transition

65+ years

110+ production facilities globally

>9,000 MTD Capacity

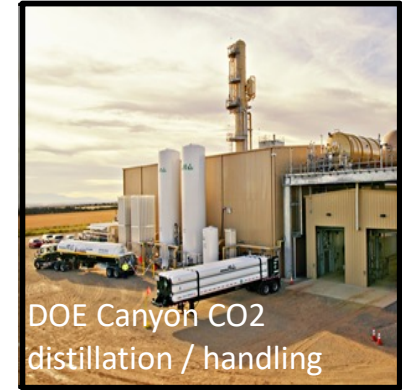
>\$15B world-leading investment in low-carbon H₂ projects



Air Products CO₂ Technology Enables Low-Carbon Hydrogen

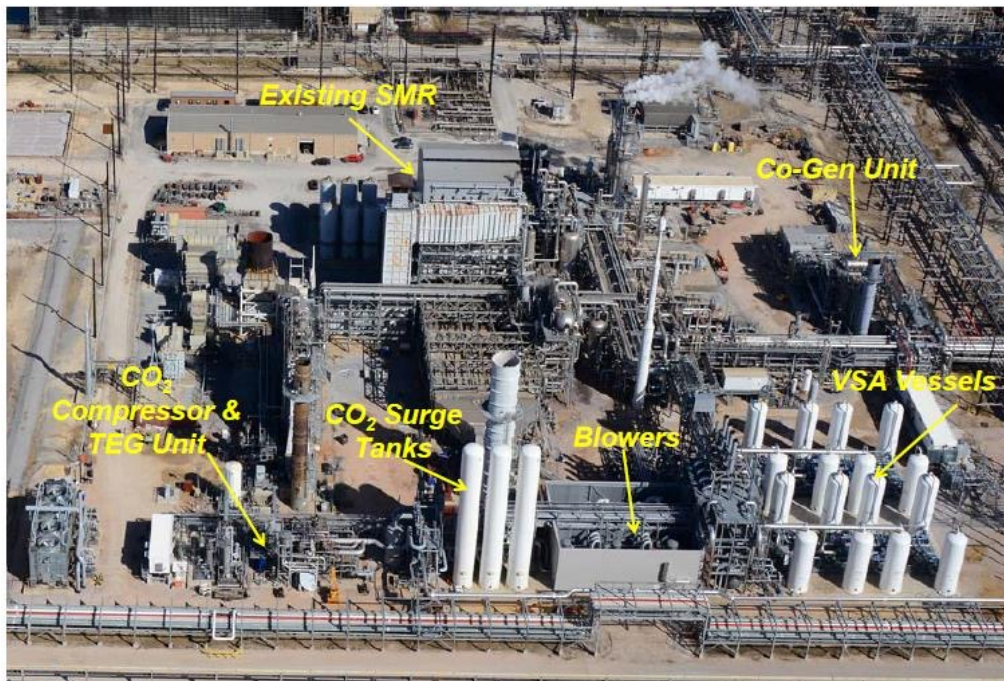
Wide CO₂ technology portfolio

- CO₂ Distillation
- Adsorption processes, CO₂ VSA
- Membranes
- Hybrid cycles
- Storage (cryogenic liquid, gaseous)
- Transportation (road, rail, ship, sub/super critical pipeline)
- CO₂ capture retrofit

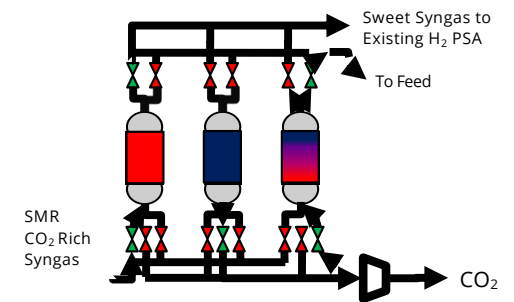


SMR Retrofit: Port Arthur, TX

In operation for more than 10 years



VSA CO₂ Capture Technology



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Air Products Rotterdam

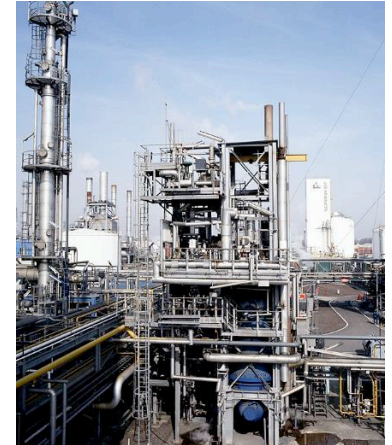
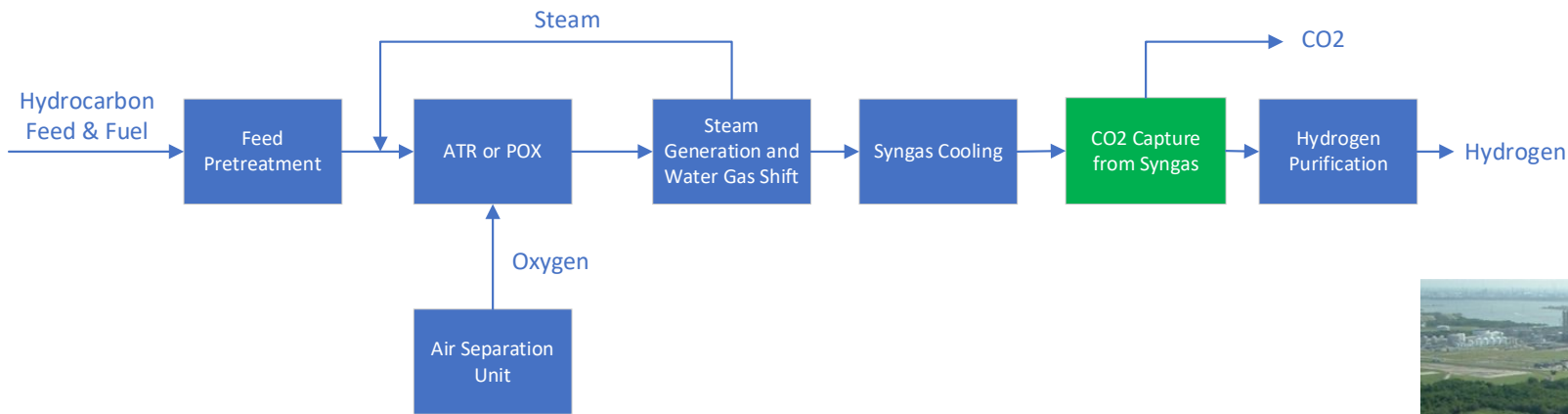
CO₂ Capture Retrofit of Steam Methane Reformer

- Build, own and operate state-of-the-art carbon capture and CO₂ treatment facility at Air Products' existing hydrogen production plant
- Transport and storage of CO₂ performed by Porthos
 - Sequester in depleted gas fields in the North Sea
- Strong Netherlands government support and subsidies

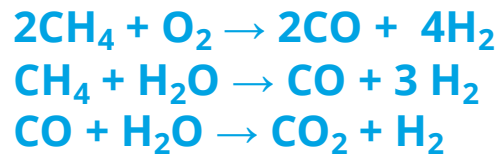


Hydrogen Production from POx & ATR

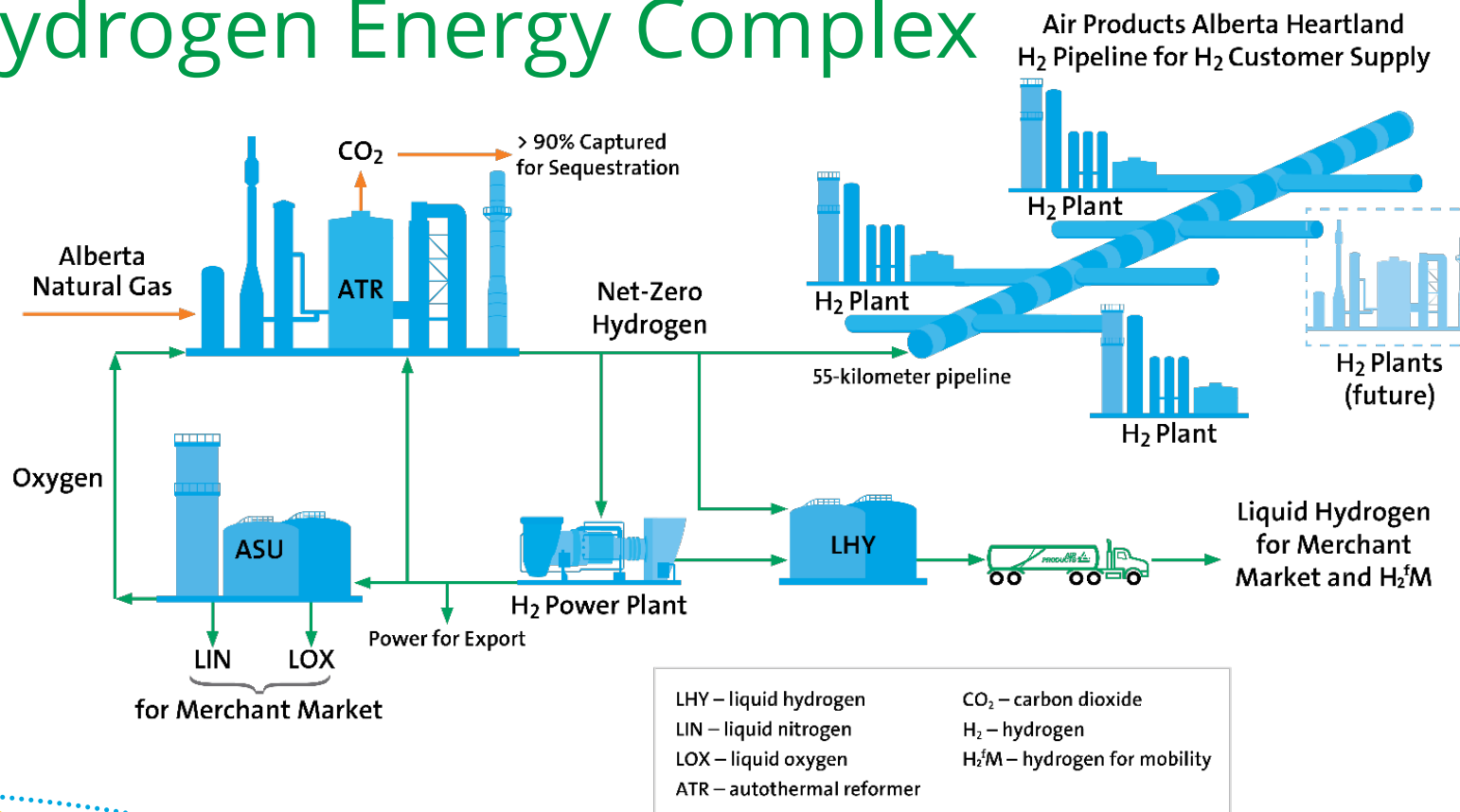
CO₂ capture potential >95%



POx:
Reforming:
Shift:



Alberta, Canada World-Scale Net-Zero Hydrogen Energy Complex



Integrated Facility Drives Synergy

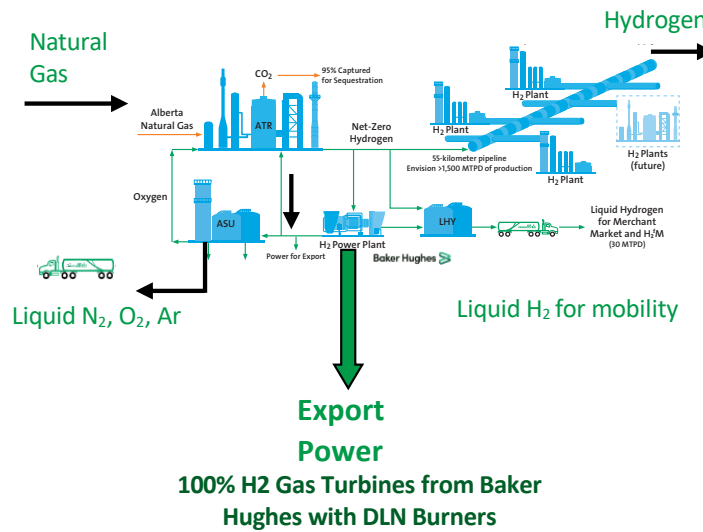
Conventional –
 H₂ + byproduct steam
 Grid power is *imported*



SMR

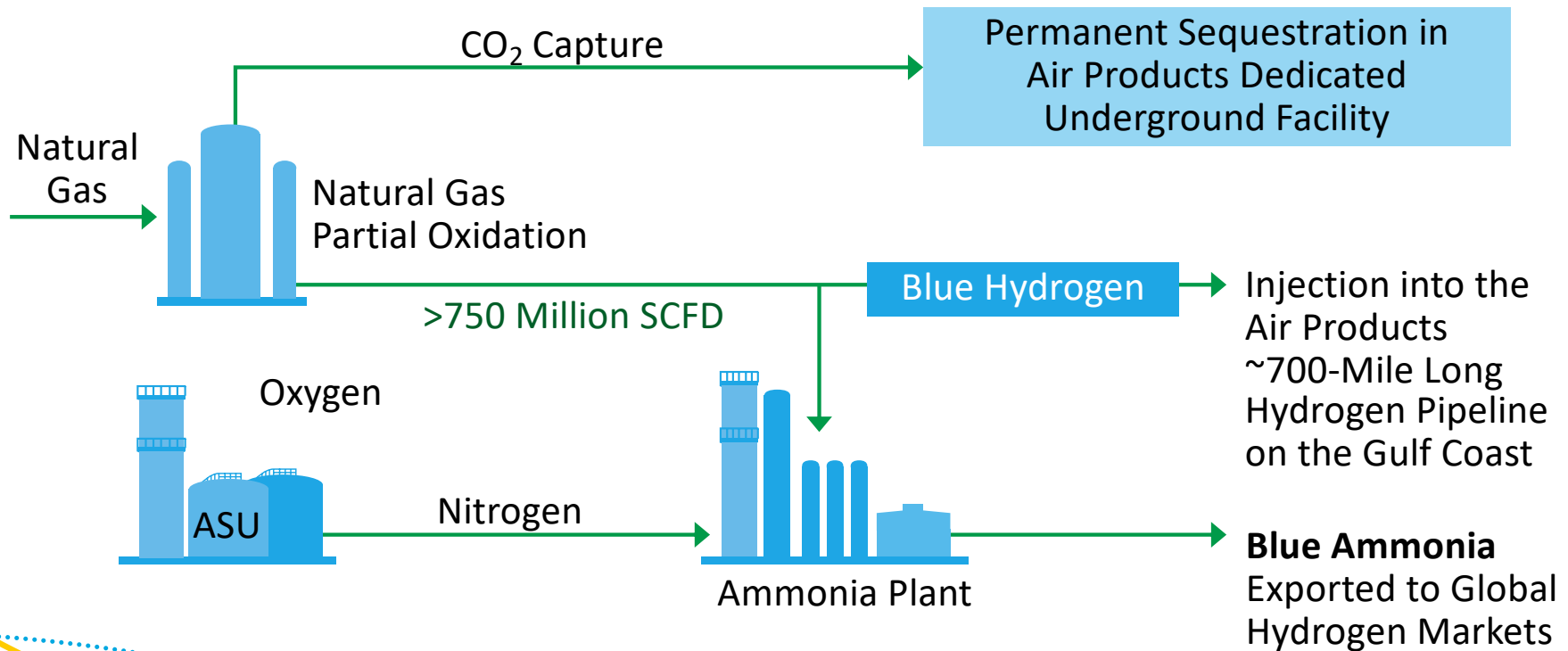
Air Products Blue H₂ Complex:
 Multiple Products
 Power is *exported*

Much lower CO₂ footprint



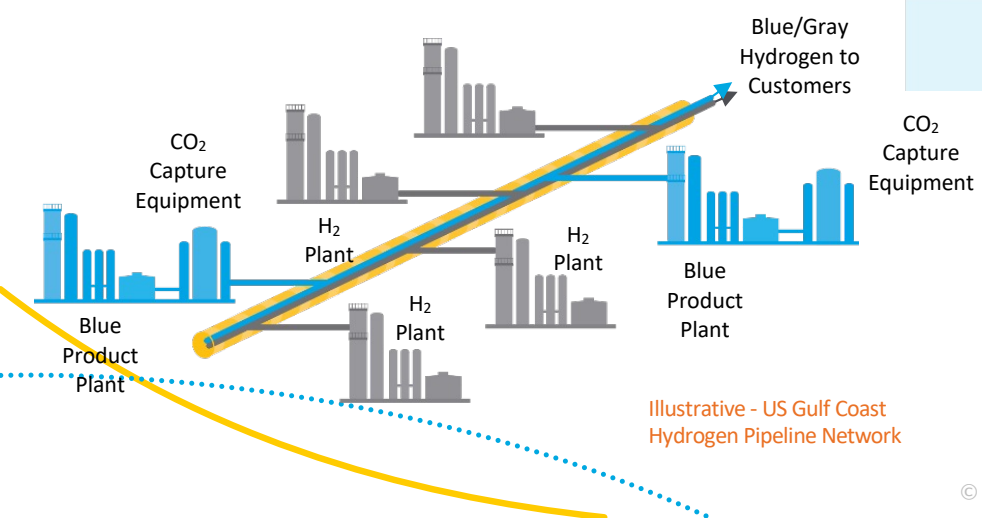
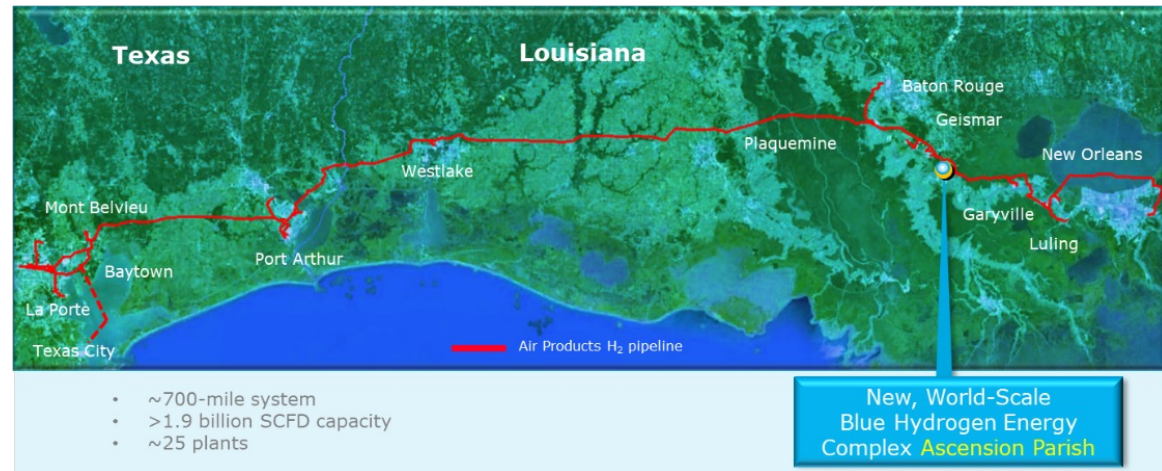
Blue Hydrogen: The Louisiana Project

Partial Oxidation of Natural Gas with CCS

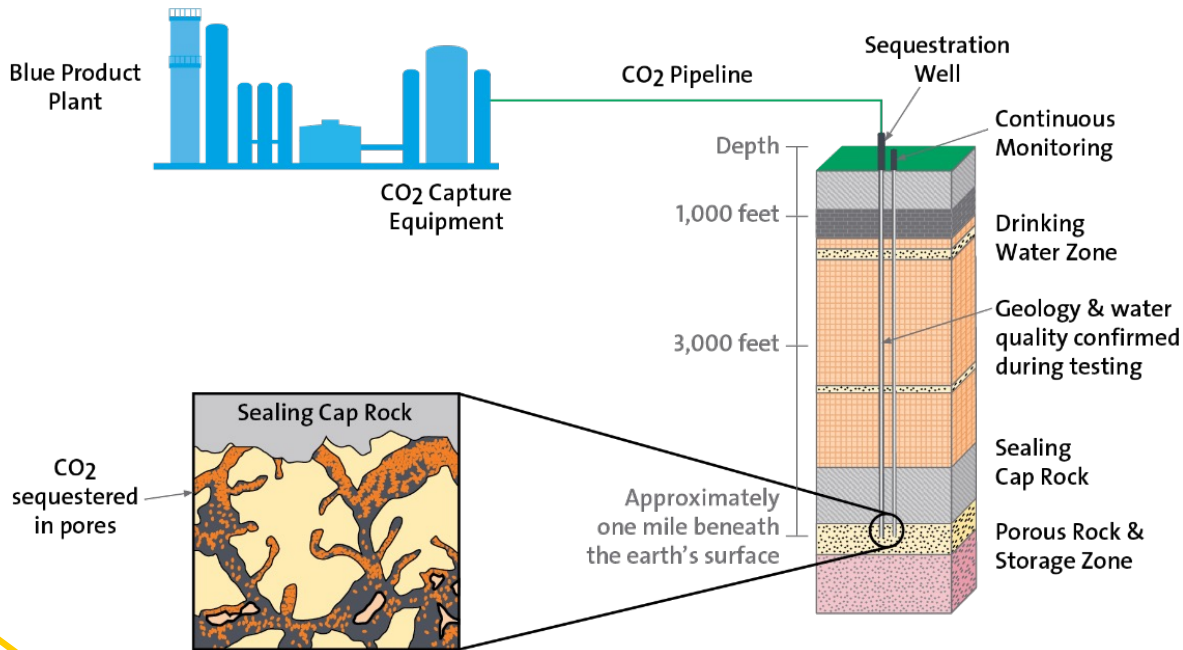


Air Products' US Gulf Coast System Can Provide Both Gray and Blue Hydrogen

Two modes of transport



Carbon Sequestration to Enable Blue Hydrogen



Conclusions

- Air Products develops the **optimal hydrogen solution** that best aligns with customer and market application needs and sustainability targets
- Air Products has a **proven track record** of operating a large fleet of hydrogen plants and is a leader in developing clean hydrogen projects for the transition to low-carbon energy in the heavy-duty transportation and industrial sectors
- Air Products operates **multiple supply modes** for hydrogen today and recognizes ammonia's emerging role as an energy carrier to support hydrogen's role in the energy transition



Thank you

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