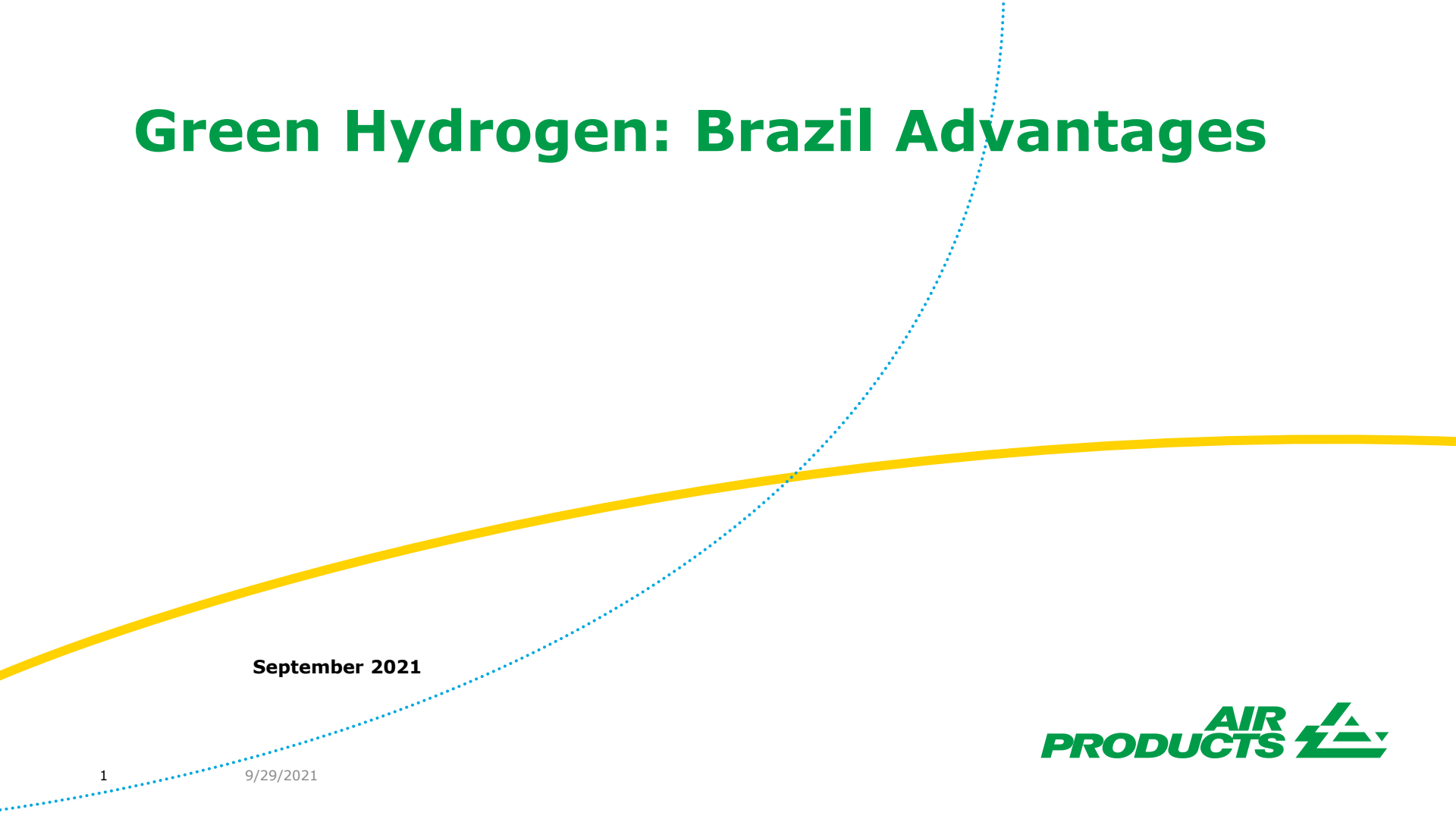


Green Hydrogen: Brazil Advantages



September 2021

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9/29/2021



Air Products Today

FY2020 sales of
~US\$8.9 billion

~17,000
employees

operations in
50+ countries

~US\$60 billion
market capitalization

80+
years business

~170,000
customers

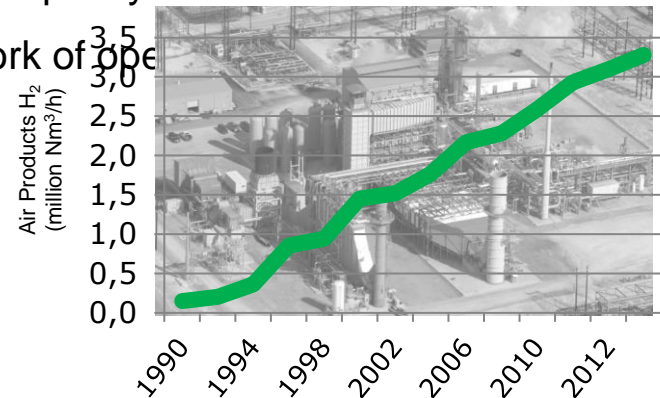
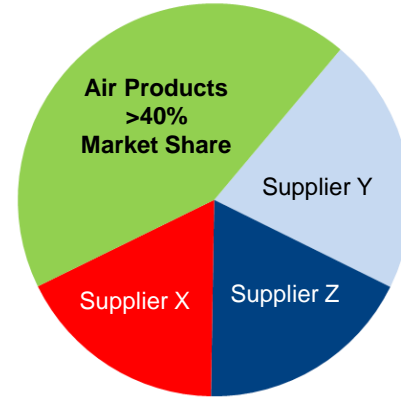
1,800
miles of industrial gas
pipeline

750+
production
facilities

30+
industries
served

Air Products' H₂ Experience

- Over 35 years designing, building, and operating H₂ / CO plants (steam methane reformers)
- Operate >80 H₂, CO and syngas plants worldwide
- Large-scale CCUS project in operation since 2012
- Over 1,400 years of operating experience
- 1500+ km of H₂ pipelines, > 90 contract customers
- >3.7 million Nm³/h (>2.9 million TPA) production capacity
- Dedicated support organization, worldwide network of open plants, continuously improving our product
- Knowledge transfer and retention program in place

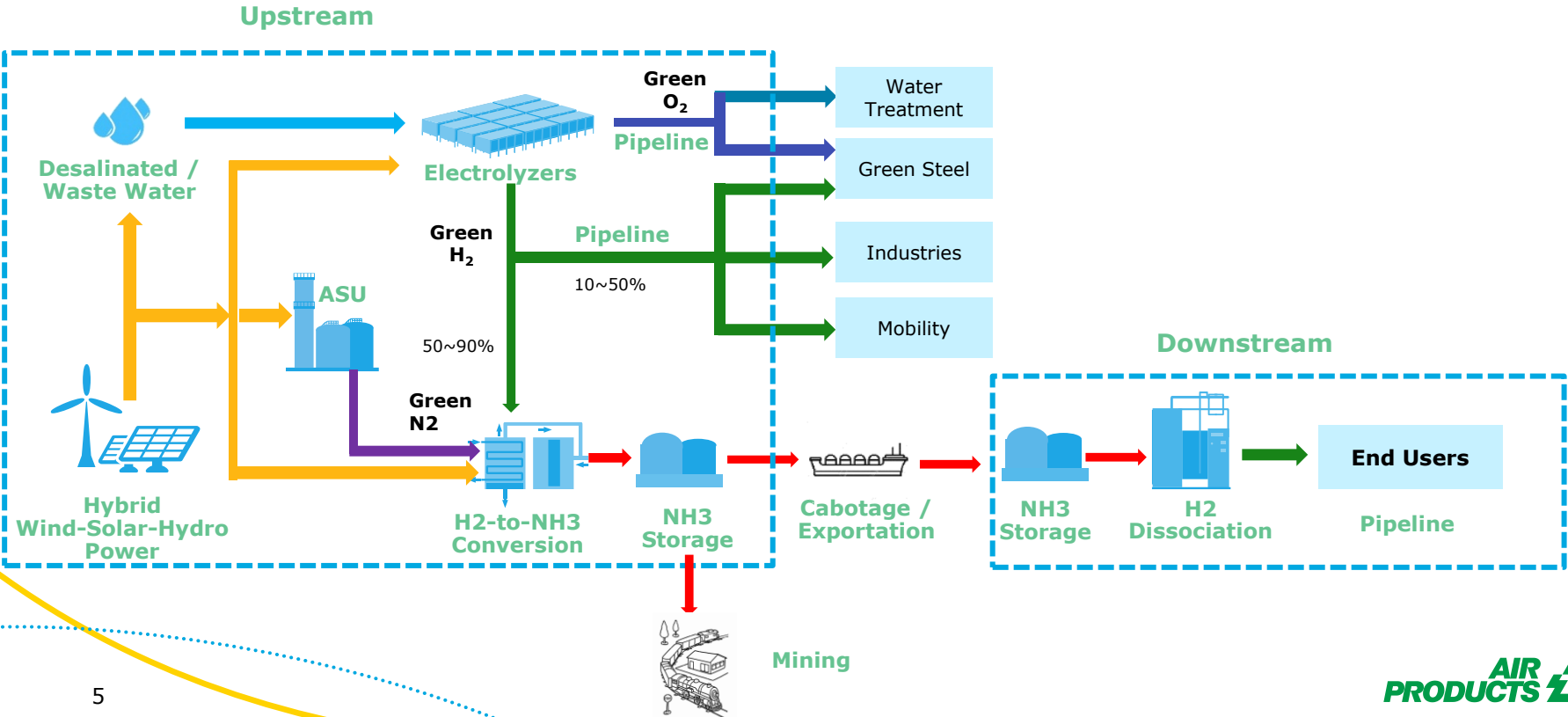


Paving the Road to Green Hydrogen

- **Air Products** signed strategic cooperation agreements for world-scale electrolysis, ammonia synthesis and cracking plants to generate green hydrogen, convert it into a carrier and crack it back.
- **Air Products, ACWA Power and NEOM** signed agreement for US\$5 billion production facility powered by renewable energy for production of up to 650MTD and export of green hydrogen (thru conversion into ammonia) to global markets.



Air Products Green H2 Projects' Concept



Green H2 to EU and Southeast States

USD 15~20bn internal market + USD 3~5bn in exports before 2040

Sea routes from NE Brazil to Europe and SE



Highlights

Sea routes to Rotterdam

- Fortaleza (CE): 4018.50 NM (8.3 days)
- Natal (RN): 4055.03 NM (8.4 days)
- Itaqui (MA): 4117.53 NM (8.5 days)

Cabotage to Vitória port (ES)

- Fortaleza (CE): 1201.57 NM (2.5 days)
- Natal (RN): 958.71 NM (2 days)
- Itaqui (MA): 1583.56 NM (3.3 days)

Cabotage to Rio de Janeiro port (RJ)

- Fortaleza (CE): 1461.68 NM (3 days)
- Natal (RN): 1218.83 NM (2.5 days)
- Itaqui (MA): 1843.67 NM (3.8 days)

Northeastern Brazil Advantages

- Frequent and intense night winds allow hybrid solar-wind-hydro almost flat power generation to optimize large scale electrolysis
- Taxes incentives in States of Ceará (CE), Rio Grande do Norte (RN) and Maranhão (MA)
- Industrial complexes such as Pecém, CE, where green H₂ and O₂ out of the electrolysis have a market
- Major railway integrated to iron ore and grains exporting port in Itaqui, MA, which allows ammonia to be transported by rail to the countryside and major mines
- Natural hydrogen seeps found in Ceará
- Europe is eight days away by ship

The Importance of an “Ecosystem”

The conversion into a green economy is such a huge endeavor that a single government or company will not succeed if it tries to carry it out alone. The reasons for it are:

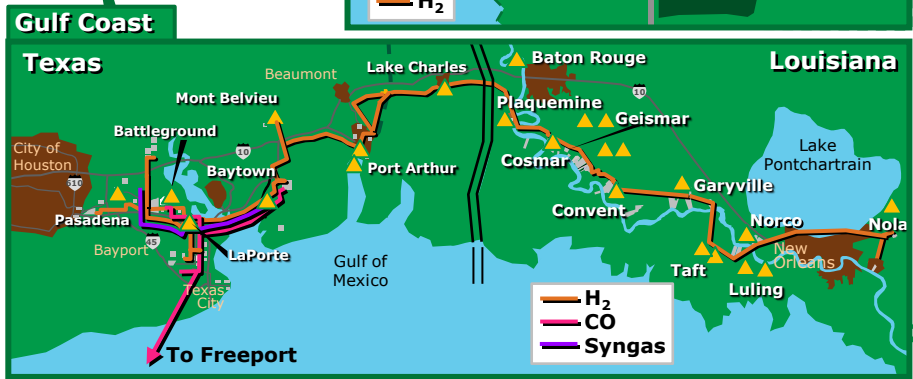
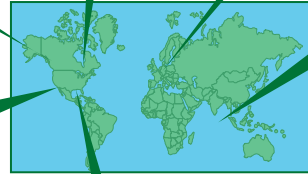
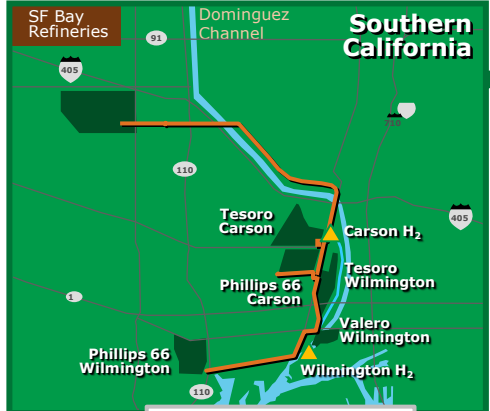
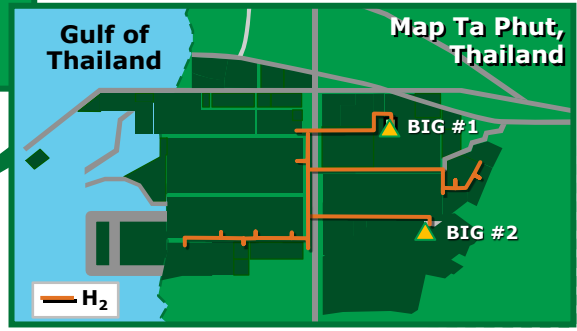
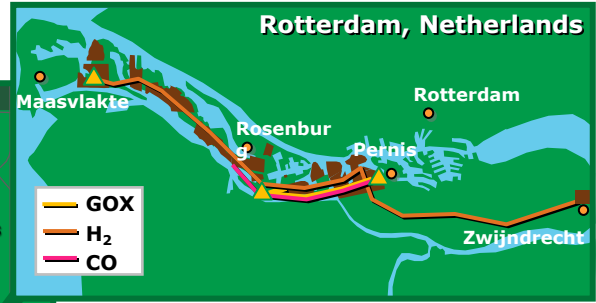
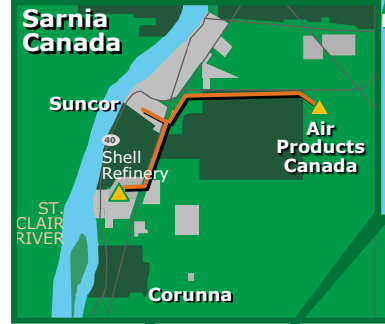
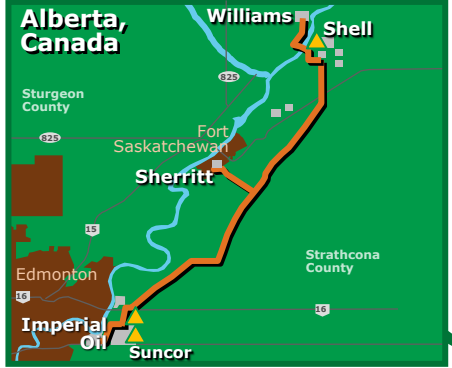
- Large sums of capital investments will be required.
- No single company retains all the knowledge to close the technology gaps: partnerships are key.
- Governments at all levels (municipal, States, Federal) need to promote the conversion with regulation and incentives until the technologies achieve maturity.





Back-up

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Strong Hydrogen Pipeline Positions

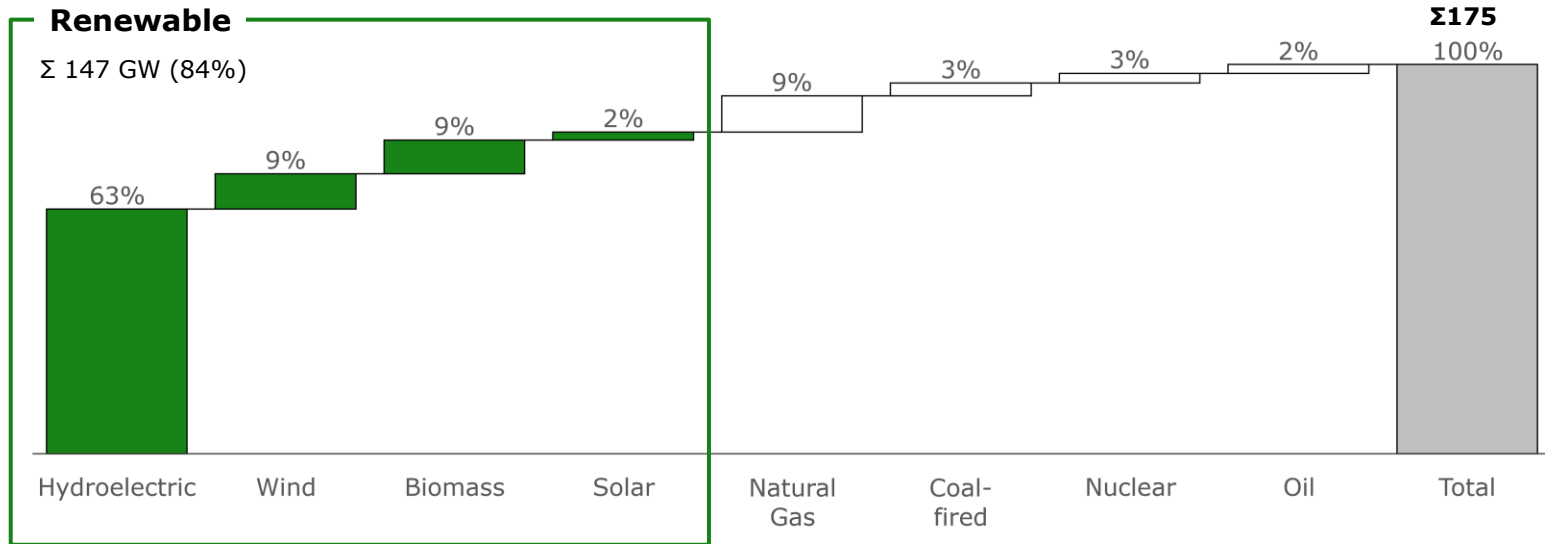


-  Air Products HyCO facilities
-  H₂ pipeline
-  CO pipeline
-  Syngas pipeline

Brazilian electricity matrix

Power installed capacity by source

GW, May'20



Thanks!

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Air Products Internal Use Only

