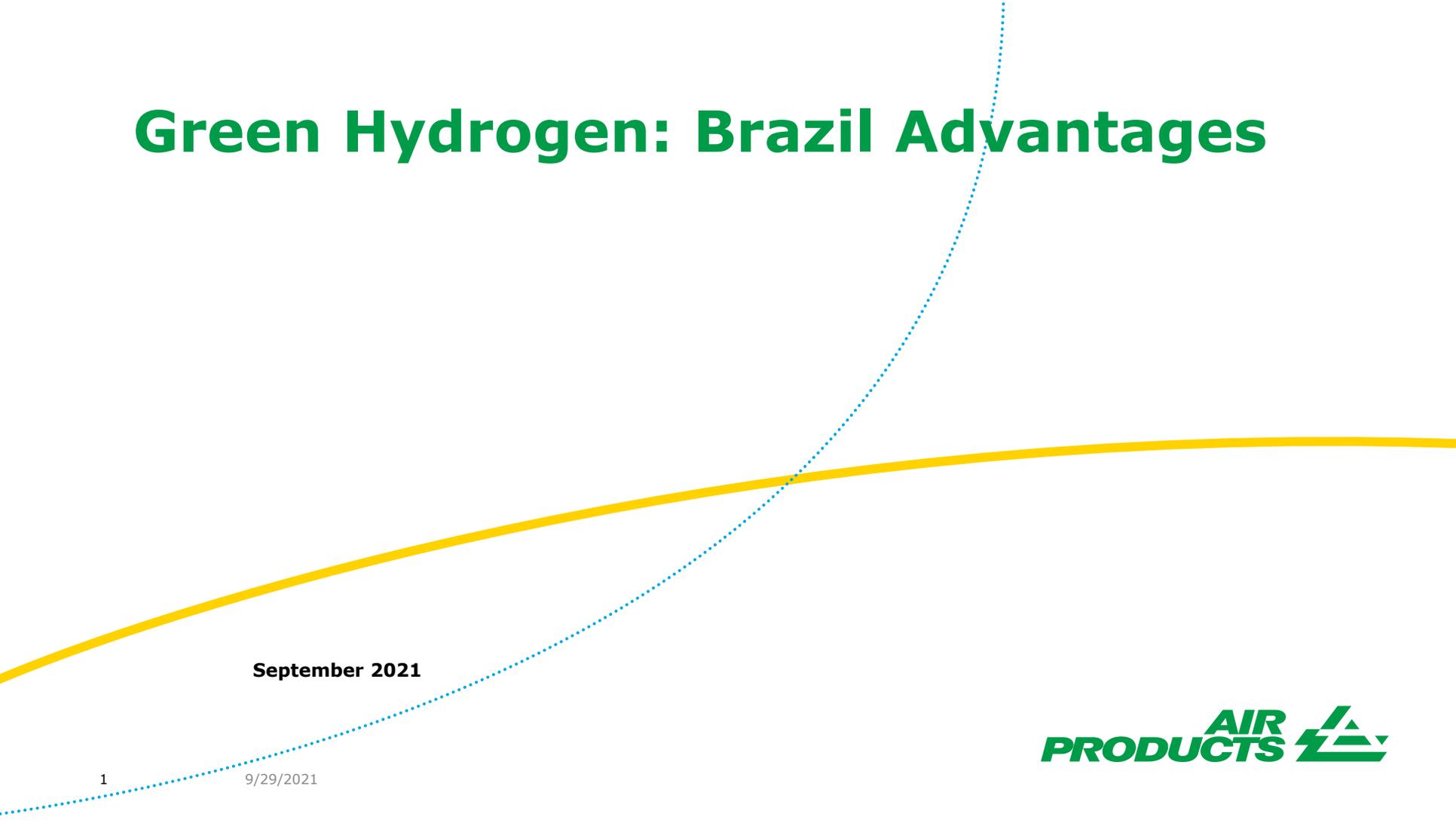


# Green Hydrogen: Brazil Advantages



# 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

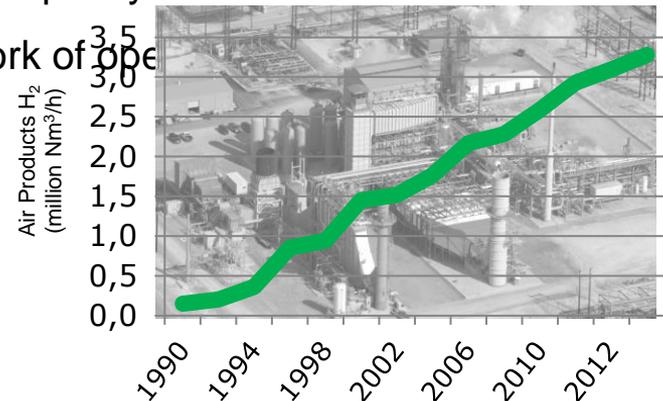
**1,800**  
miles of industrial gas  
pipeline

**750+**  
production  
facilities

**30+**  
industries  
served

# Air Products' H<sub>2</sub> Experience

- Over 35 years designing, building, and operating H<sub>2</sub> / CO plants (steam methane reformers)
- Operate >80 H<sub>2</sub>, CO and syngas plants worldwide
- Large-scale CCUS project in operation since 2012
- Over 1,400 years of operating experience
- 1500+ km of H<sub>2</sub> pipelines, > 90 contract customers
- >3.7 million Nm<sup>3</sup>/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

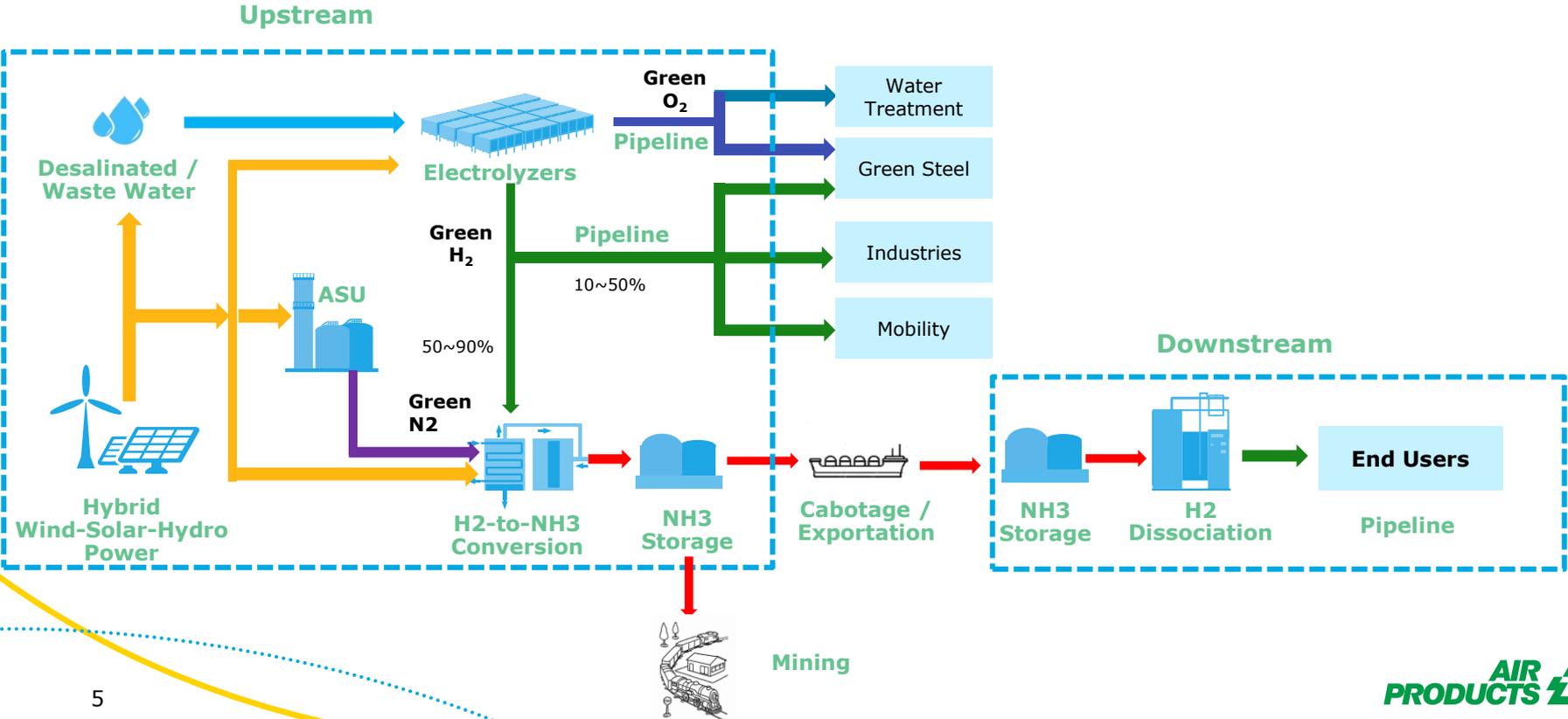


# Paving the Road to Green Hydrogen

- **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.



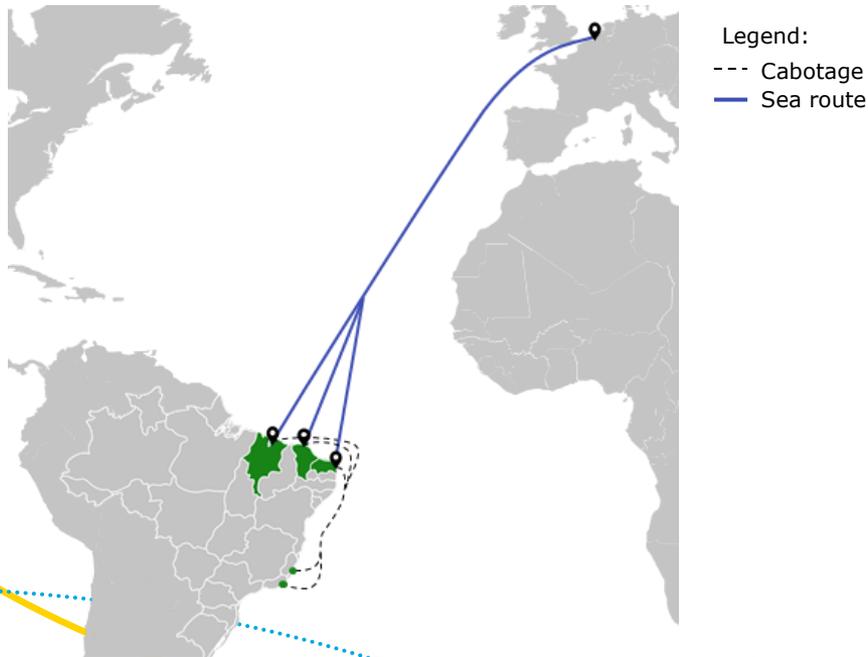
# Air Products Green H2 Projects' Concept



# 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 H<sub>2</sub> and O<sub>2</sub> 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:

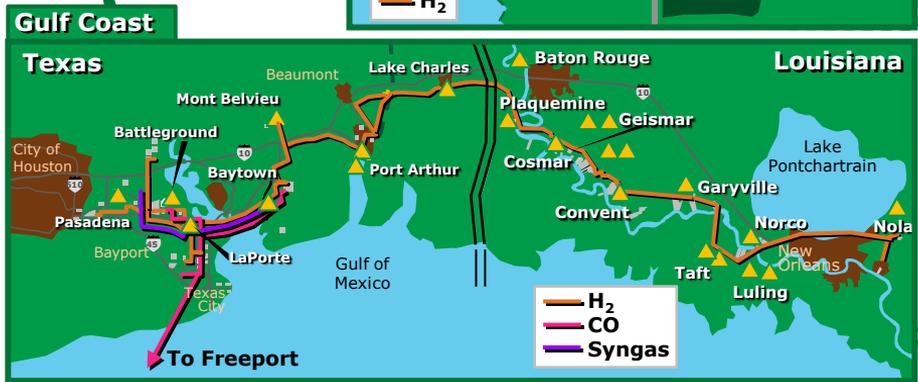
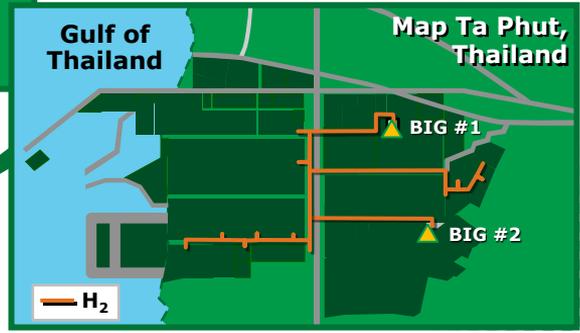
- Large sums of capital investments will be required.
- No single company retains all the knowledge to close the technology gaps: partnerships are key.
- Governments at all levels (municipal, States, Federal) need to promote the conversion with regulation and incentives until the technologies achieve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

# Back-up

9

29 September 2021

# Strong Hydrogen Pipeline Positions

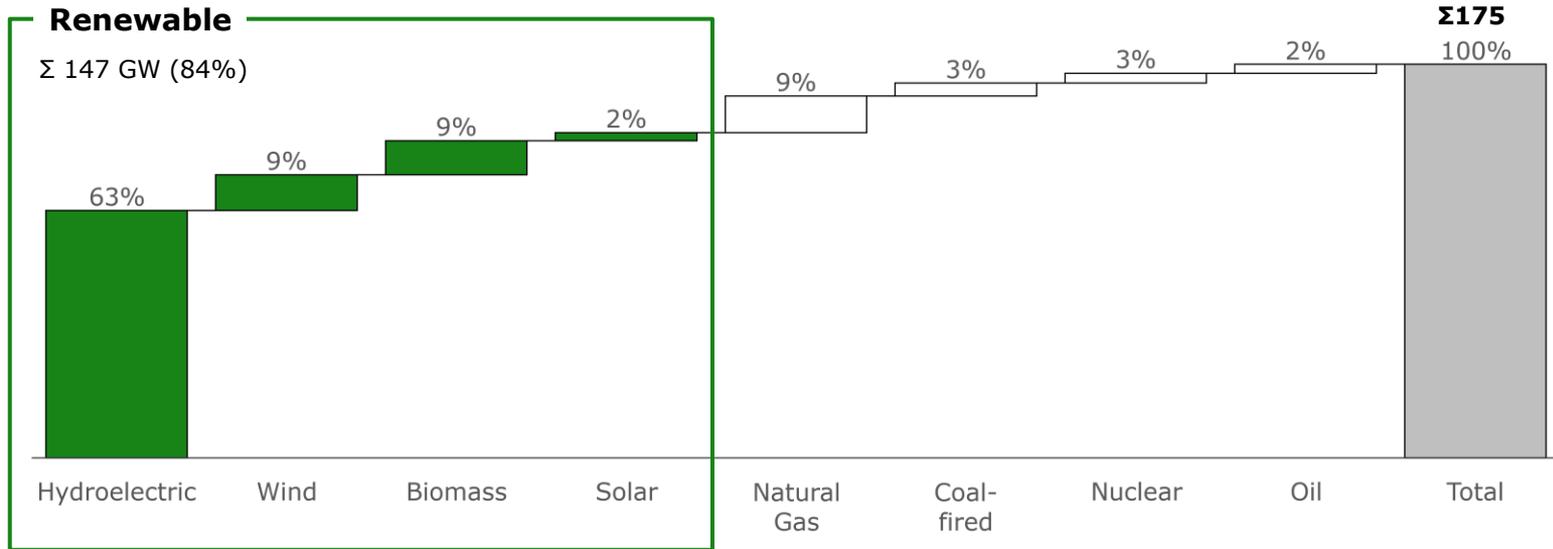


-  Air Products HyCO facilities
-  H<sub>2</sub> pipeline
-  CO pipeline
-  Syngas pipeline

# Brazilian electricity matrix

## Power installed capacity by source

GW, May'20



# Thanks!

12

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Air Products Internal Use Only

