

Hydrogen and Ammonia

Source: The Royal Society Policy Briefings

World's Largest Green Hydrogen Project Unveiled in Neom, Saudi Arabia (July 2020)

- Air Products & Chemicals, the U.S. industrial gas giant, announced plans on Tuesday to build a green hydrogen plant in Saudi Arabia powered by 4 gigawatts of wind and solar power, the world's largest such project announced so far.
- The \$5 billion plant will be jointly owned by Air Products, Saudi Arabia's ACWA Power and Neom, a new mega-city planned near Saudi Arabia's borders with Egypt and Jordan.
- The completed facility will produce 650 tons of green hydrogen daily, enough to run around 20,000 hydrogen-fueled buses, Air Products said. The fuel will be shipped as ammonia to end markets globally then converted back to hydrogen or urea (fertilizer) or used directly as fuel. Ammonia production is expected to start in 2025.

Why Hydrogen?

- Most abundant element in the universe (but rarely in its gas form on earth)
- Using it as fuel produces nothing but energy and water
- Friendliest to the environment
- Greatly complements solar and wind as energy store

Challenges

- Huge capital investment in plant, bulk storage, distribution, safety and security
- Intensive energy required for producing hydrogen
- Loss of efficiency when converting through stages for purposes of storage or transport

95% of the global production of
Hydrogen is generated from
fossil fuels

Contributes 2% of CO₂
emissions

Types of Industrial Hydrogen

- Grey Hydrogen

Grey Hydrogen is hydrogen produced using fossil fuels such as natural gas. Unfortunately, this accounts for roughly 95% of the hydrogen produced in the world today. It also contributes 2% of unwanted gas emission.

- Blue Hydrogen

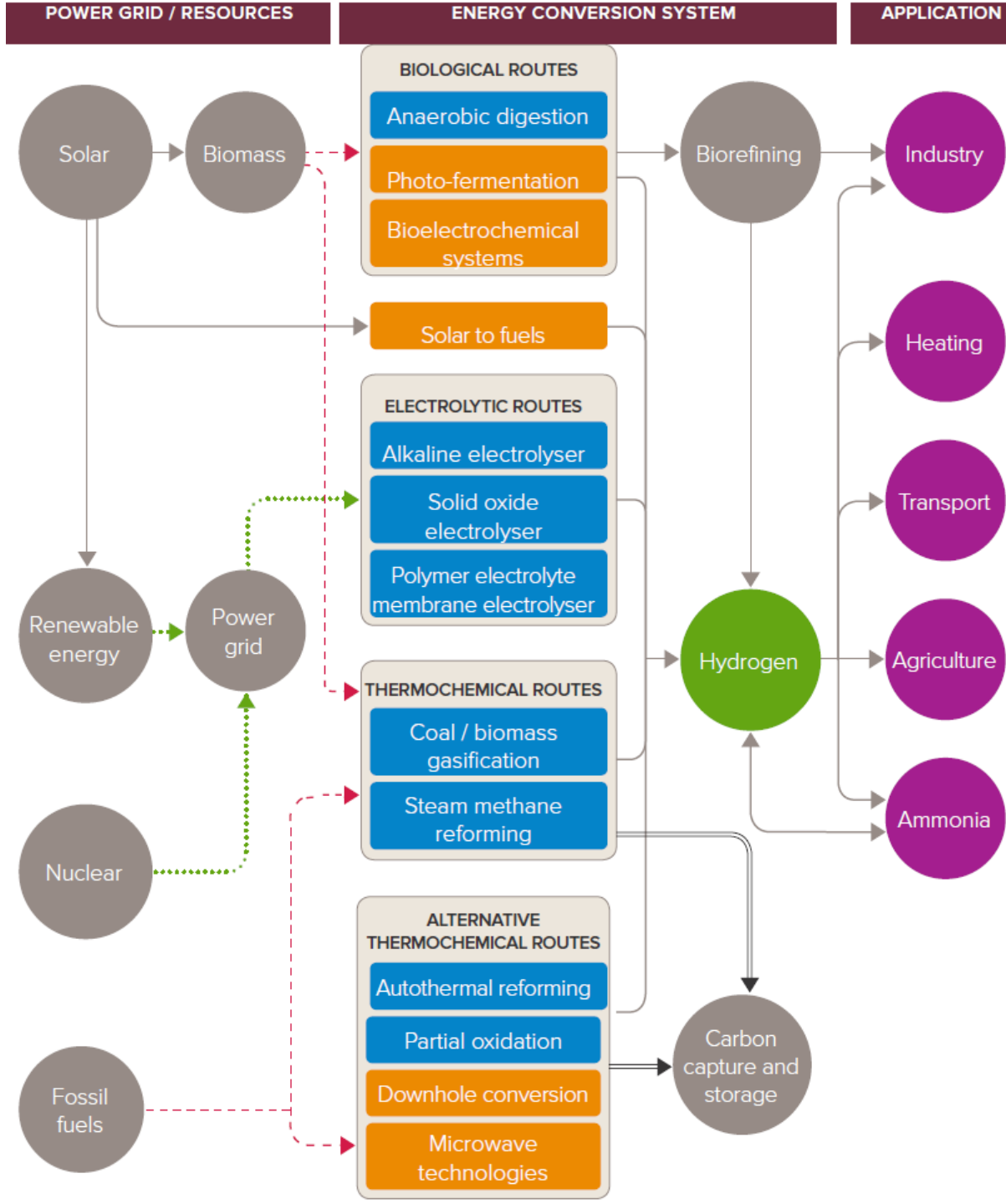
- Produced in the same way as grey hydrogen but CO₂ is captured and stored.
- Hydrogen that meets the low-carbon threshold but is generated using non-renewable energy sources (e.g. nuclear)

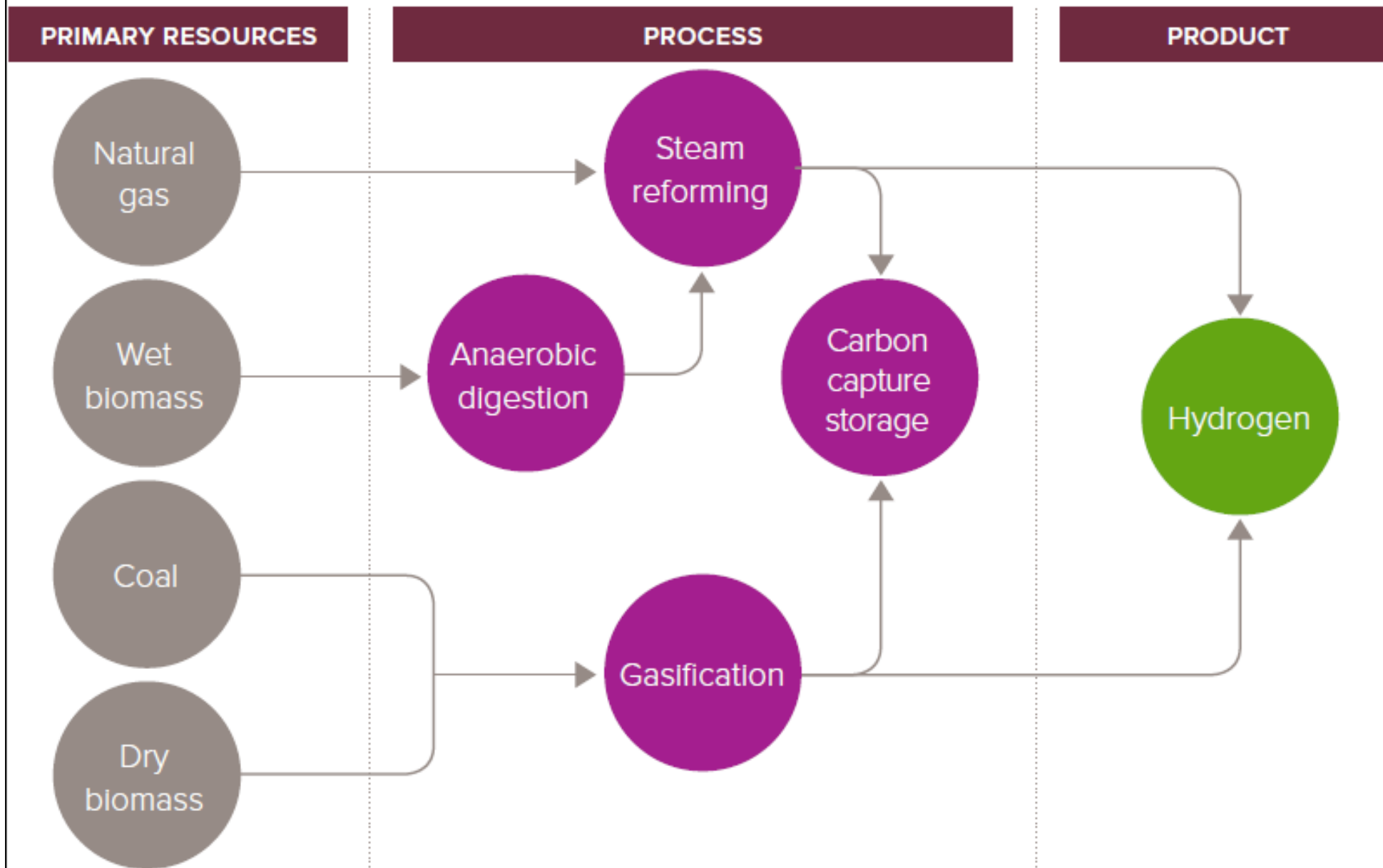
- Green Hydrogen

Green Hydrogen is hydrogen that not only meets the low-carbon threshold but is generated using renewable energy sources such as solar or wind.

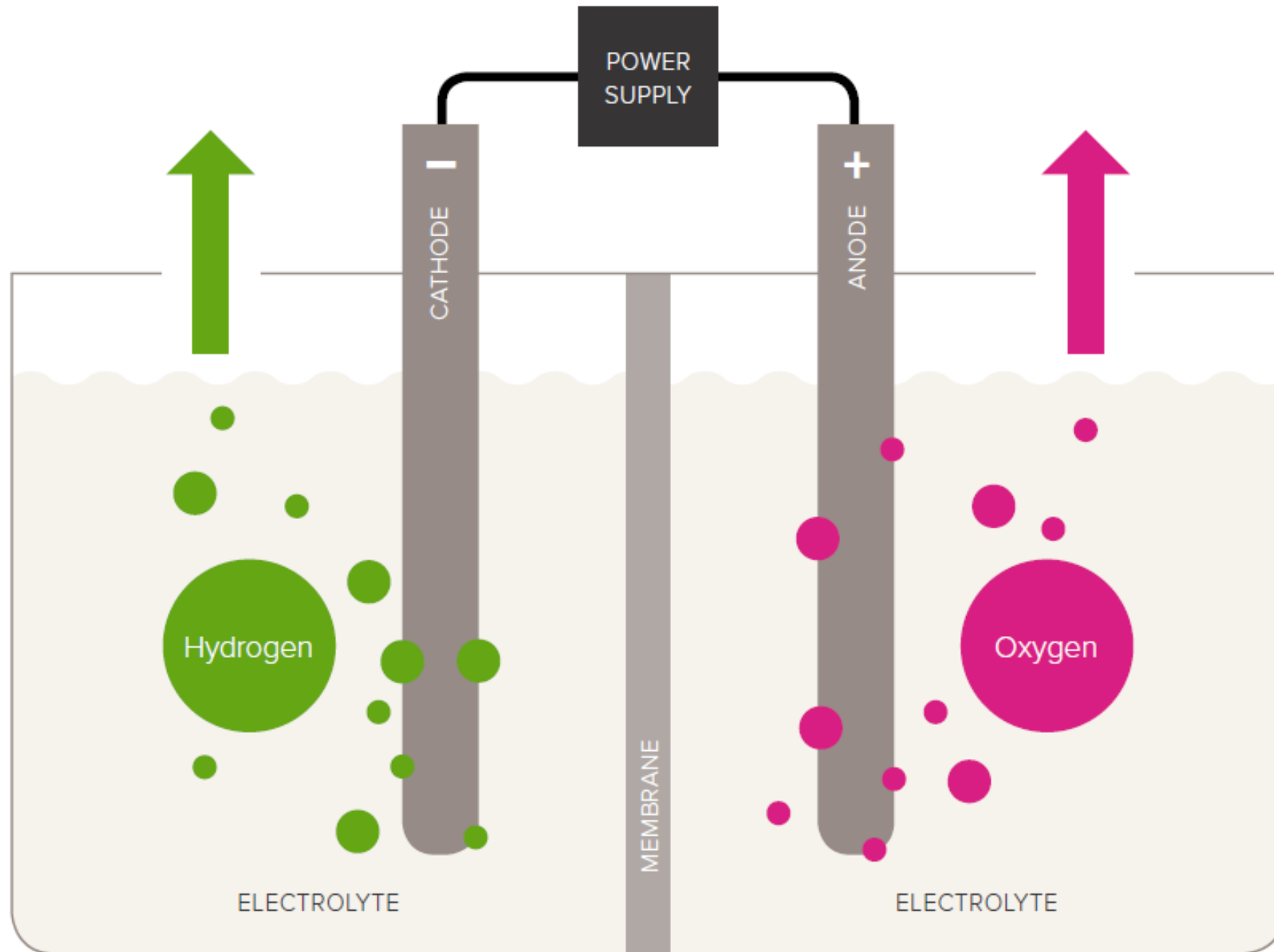
Routes to Producing Hydrogen

- Thermochemical
- Electrolytic
- Biological
- Solar to Fuel





The production of hydrogen and oxygen through electrolysis



Main Use of Hydrogen

- Mainly to produce Ammonia thru the Haber-Bosch process
- Current global production is 176 Million tons per year
- Contributing 1.8% to global CO₂ emissions

Ammonia as an energy carrier

