

# Green hydrogen production: Landscape, projects and costs

Executive summary and report brochure



# Why hydrogen?

Hydrogen is having its day in the sun. As the Energy Transition gathers pace, it is increasingly being discussed as a key solution to many of the problems faced by decarbonizing the energy ecosystem. Hydrogen can be a fuel to supplement or displace others in transportation, heavy industry and many other applications; ones that are notoriously difficult to decarbonize. However, 99% of current hydrogen production is made from hydrocarbons. Green hydrogen is an alternative.

## **What is Green Hydrogen?**

Green Hydrogen is the production of Hydrogen via Wind and Solar using electrolysis. It is starting to gain traction as Wind and Solar become cheaper and installations break record highs year after year.

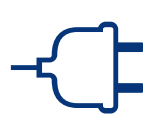
## **About the report**

The 84-page report details the electrolyzer vendor landscape, policy and investment environment, different user cases and case studies, and project pipeline. It also details production costs across different scenarios, for five different regions, and forecast out to 2030. The report is accompanied by a dataset detailing different costs at different assumptions. The costs are backed by a one-of-a-kind proprietary model.

## **Executive summary**



# Hydrogen is back on the agenda for policymakers, industry and investors



## Brown, Grey or Blue Hydrogen

- A versatile clean energy carrier with potential to decarbonise economy-wide;
- Current production is fossil-based. Brown hydrogen comes from gasification (coal or lignite) while Grey is produced from steam methane reformation (SMR).
- Blue hydrogen is obtained when pairing SMR with CCS

## Green Hydrogen

- Green hydrogen is produced from water electrolysis powered by renewable electricity
- Immense opportunity to produce low carbon hydrogen using solar and wind electricity
- In 2018, only 1% of total hydrogen came from water electrolysis

## Electrolyser Vendor Landscape

- Two main electrolysis technologies; Alkaline and Proton Exchange Membrane (PEM) electrolyzers
- Cumulative installed cap to reach ~ 250 MW electrolyzers by end 2019. Above 3.2 GW projects announced for 2020-25 operation
- We expect US\$365 million has been invested in the green hydrogen electrolyzer market to date

## Hydrogen Projects and Investments

- We analyzed several projects aiming to serve Gas infrastructure, Heavy-duty trucking, Ammonia and Methanol, Grid flexibility and storage in the study
- The Hydrogen Council is a CEO-led initiative of 60 leading energy, transport and industry companies with a long term vision to develop the hydrogen economy

## Levelized Cost of Hydrogen (LCOH)

- A proprietary Cost Model using electrolyzer capex (stacks and balance of plant) and soft costs.
- LCOH modelled for Australia, China, Germany, Japan and US using different electricity prices and load hours
- With US\$30/MWh electricity at 50% load hours, LCOH is at parity with grey hydrogen by 2030 in most markets

# Green hydrogen is produced exclusively from renewables

## Hydrogen comes in several “colors”

Hydrogen produced from various sources is commonly referred to by different colors:

**Brown** – produced from coal (brown or lignite)

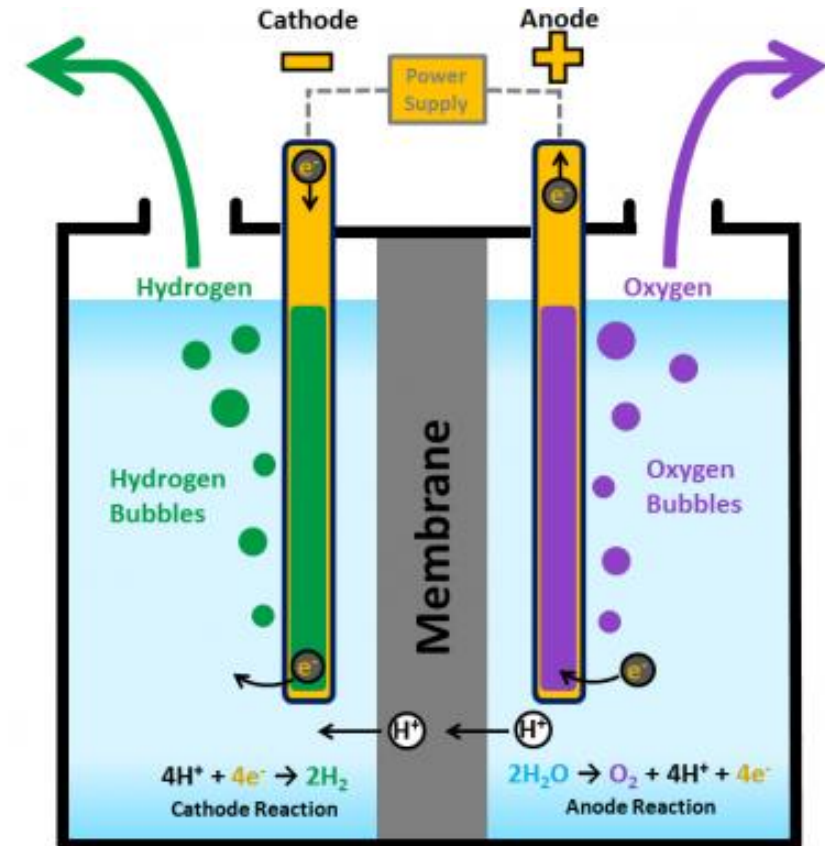
**Grey** – produced from steam methane reforming

**Blue** – produced from steam methane reforming paired with carbon capture and storage

Unlike more than 99% of hydrogen produced from hydrocarbons, this report examines **green hydrogen**, which is hydrogen produced from renewable electricity via electrolysis.

- Electrolysis is an electrochemical reaction that uses electricity to split molecules into their constituent atoms.
- In hydrogen production, electrolysis occurs in a device called an electrolyzer, which splits water into hydrogen and oxygen.
- Hydrogen produced from electrolysis is high purity, around 99.999%.
  - » Hydrogen produced from fossil fuels has high levels of impurities and requires treatment before use.

## The process of electrolysis



Source: U.S. Department Of Energy

# Despite comparatively high costs, green hydrogen will see significant near-term growth

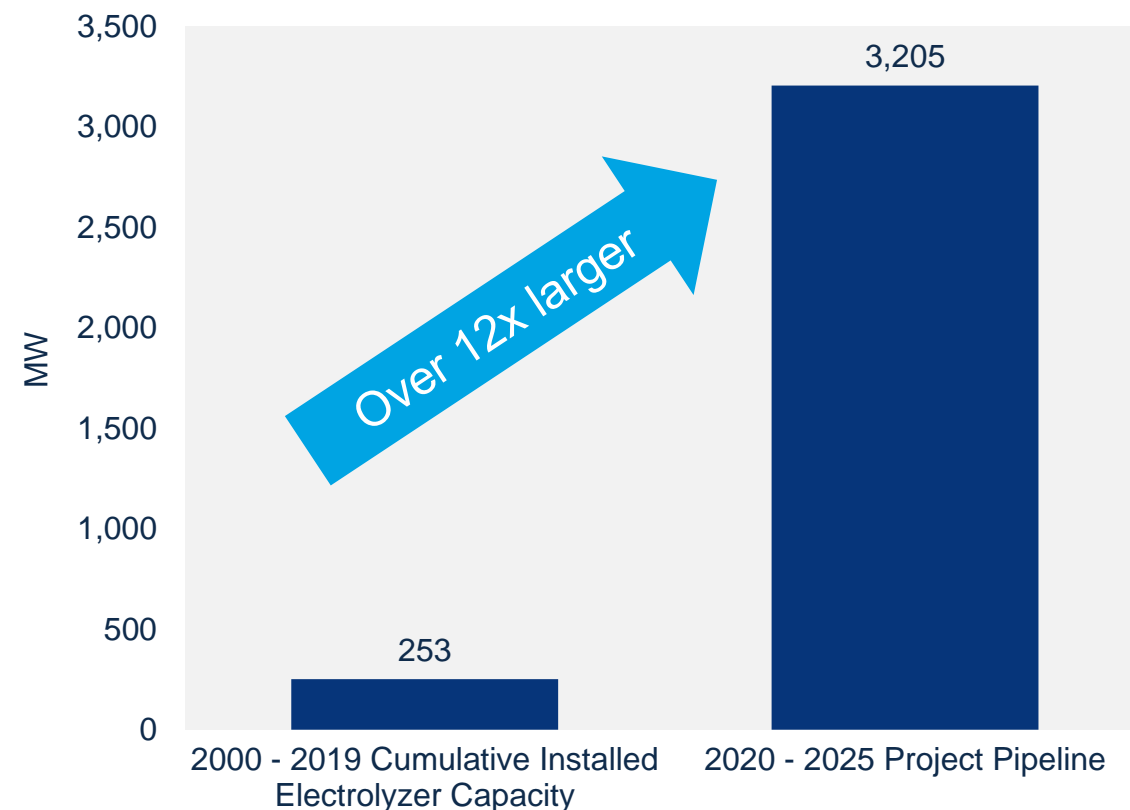
## The project pipeline for green hydrogen is massive

From 2000 to the end of 2019, a total of 253 MW of green hydrogen projects will have been deployed. **By 2025, an additional 3,205 MW of electrolyzers dedicated to green hydrogen production will be deployed globally – a 1,272% increase.**

Until the past few years, the green hydrogen market was diminutive. As such, the large increase in the 2019-2025 period is partially due to the nascency of the market. But aggressive targets in East Asia and increased interest from major international stakeholders will drive deployment in the near term.

While cost-competitiveness might be out of reach in most scenarios by 2025, national targets and pilot projects will produce enough volume to realize substantial capex declines beyond 2025.

Cumulative installed capacity vs. 2020-2025 project pipeline (MW)



**Full report brochure**



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# Report availability

This report is only available to subscribers of Wood Mackenzie's [Energy Transition Service](#).

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