

Green hydrogen

What is that technology?

Hydrogen is the simplest and most common element in universe

3x It can be isolated and used as fuel and as raw material in several industrial processes. It has a potential energy 3 times higher than gasoline and diesel oil

Absence of CO² or carbon monoxide production when burning

A completely clean process, which results in producing only water

Green hydrogen is a fuel produced from renewable energies, such as wind and solar power

Zero carbon emission during its production, which is why experts see this type of fuel as a key to a carbon-neutral world

The production of green hydrogen in Brazil is not for the future, it is the present!

First Molecules!

- 2022
 - Ceará (CE) and Itumbiara (MG) produce the first molecules of H₂
 - over 150 ton - Pernambuco supplies local market in medium scale
- 2023
 - 390 ton/year - University of São Paulo (USP) and private initiative begin a P&D (Research and Development Project) in H₂
 - Cooperation between Brazil and Germany for Sustainable Development open hydrogen plant in Santa Catarina

Brazilian potential in the production of green hydrogen

The abundance of quality wind in Brazil potentialize the onshore and offshore production, increasing the opportunity of producing green hydrogen in the country

Brazil will be an important global player

Considering that the energy costs correspond to approximately 70% of the total costs of producing green hydrogen, Brazil will have the lowest green hydrogen cost produced from wind sources in 2030 when compared to other countries, due to the abundance and low costs related to that source in the country

Over R\$ 200 billion dollars in investment currently mapped in announced projects, Joint Ventures or memoranda (MoUs) signed between the private initiative and public authorities (the Government of the State of Ceará, Rio Grande do Norte and Rio de Janeiro)

We already have a pilot plant in Complexo do Pecém (CE), where the first molecule was produced in December 2022

In the Oil Refinery of Camaçari (BA), we have the first industrial-scale project of Brazil, with investments estimated in **US\$ 1,5 billion.**

The first phase of the project came into commercial operation in late 2022, and counts on a wind farm capable of producing:

10,000
tons of green hydrogen

& 60,000
tons of green ammonia per year

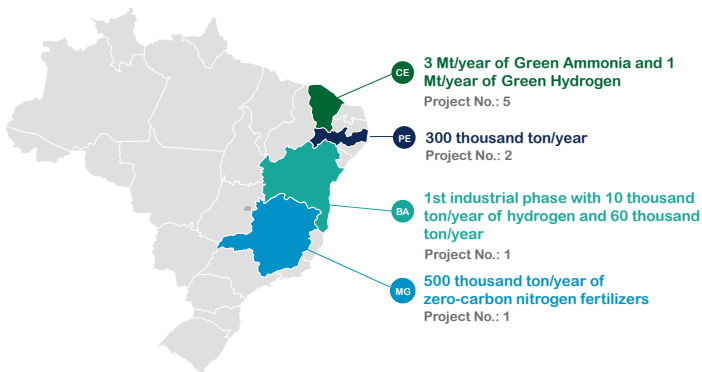
That volume corresponds to approximately 0.5% of the Brazilian demand for fertilizers imported in 2019.

With the Brazilian renewable potential and industries investing in the green hydrogen chain,

by 2030, Brazil will produce **the most competitive** green hydrogen in the world from onshore wind farms.

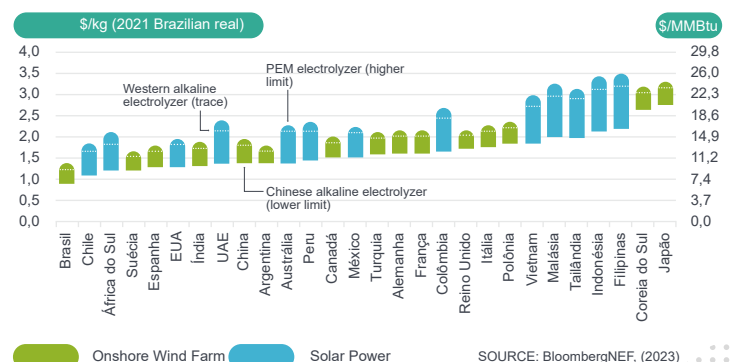
As estimated by BloombergNEF.

Great Industrial-Scale Projects Operation expected between 2025 and 2027



Levelized Cost of Hydrogen (LCOH)

Projection by cheapest renewable energy and country.



Hydrogen as an Energy Transition vector

- It is the raw material for industrial applications in the sector of fertilizers, petrochemicals, chemicals etc
- Produced by electrolysis from onshore wind and solar photovoltaic power
- **It does not emit carbon or pollutant gases** when produced or burned
- Proper to surpass electrification limits in sectors with high CO2 emission

Geopolitics and Energy Crisis

Russo-Ukrainian War: lack of Natural Gas (NG) and general increase in prices of derivatives of fuel (fertilizers, steel, chemicals in general etc)

Movement in more developed economies: creation of policies to eliminate dependence on Russian NG and speed energy transition and safety

Political and Market Momentum Brazil:

US\$ 30 billion in projects announced

Over 40 contracts between the public and private sectors (partnership agreements and joint ventures)

Presentation of the first environmental studies to the authorities in charge of Ceará (CE)

ABEEólica and institutions from the sector have signed a Pact for Renewable Hydrogen to promote the industry and the market

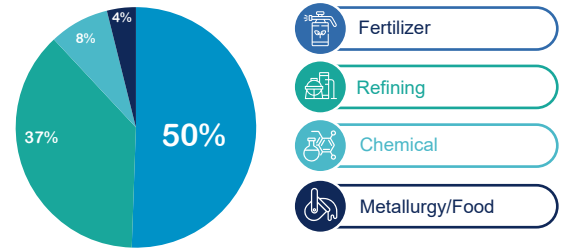
International Scenario

United States: Incentives through the Inflation Reduction Act (IRA);

European Union: European Green Deal, H2Global Auction to purchase products outside of Europe, REPowerEU (partnership agreements and joint ventures).

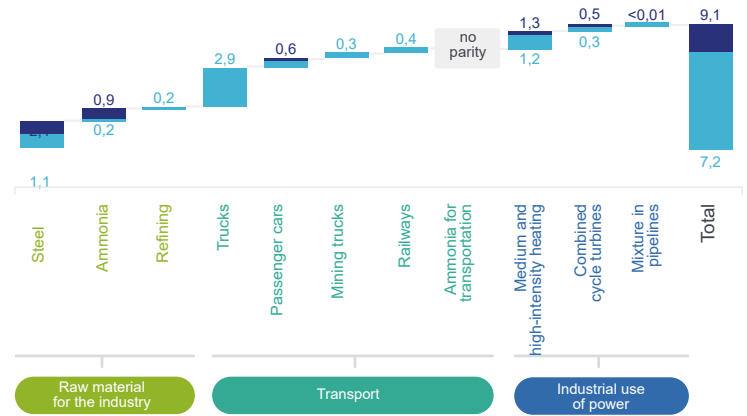
Market Routes for Hydrogen Opportunities for the Brazilian Demand

Estimations of demand in the Brazilian internal market by benefited sector



Creating a regulated carbon market in Brazil, the demand for green hydrogen will be potentialized

Millions of tons 2040 Forecast



Brazil will need **US\$ 200 billion in investment and an additional capacity of renewable energy in the order of 180 GW by 2040**, which is almost twice our current total capacity of electric power generation.

How to speed that development up?

Need for a Green Industrial Policy, with a regulatory framework and clear and well-defined tax mechanisms. Thus, bringing legal safety and motivating investors from several industry to produce Green Ammonia and Steel

As a result, an increase in energy demand, incentive to new energy projects and broadening competitiveness of Brazilian products to export to the international market

