INTERNATIONAL PARTNERSHIP FOR
HYDROGEN AND FUEL CELLS IN THE ECONOMY

IPHE Country Update June 2021: Brazil

Name	Dante Hollanda
Contact Information	dante.hollanda@mctic.gov.br
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1. New Initiatives, Programs, and Policies on Hydrogen and Fuel Cells

The Brazilian Energy Plan 2050, launched in the second half of December 2020, presents Brazil's objectives to develop regulatory improvements related to the quality, safety, transportation infrastructure, storage, supply, incentive and use of the hydrogen energy's new technologies. The country will work with other international institutions that have initiatives in these areas. In this document, green hydrogen is considered to be the most relevant internationally, and Brazil is recognized worldwide as a potential important player regarding this energy source, although Brazil is going to produce and utilize Blue Hydrogen in large-scale during the energy transition period.

In February 2021, the Energy Research Office (EPE) published a document entitled "Bases for Consolidation of the Brazilian Hydrogen Strategy" (only in Portuguese) considering the hydrogen market; technological routes and hydrogen production processes; hydrogen competitive costs; challenges for the development of the Brazilian market for hydrogen energy technologies adoption; and the hydrogen's role in the energy transition.

On 20 April 2021, the Ministry of Mines and Energy (MME) officially published the Resolution no. 6, to propose guidelines for the Brazilian Hydrogen Plan. The Ministry of Science, Technology and Innovations (MCTI), with the Ministry of Regional Development (MDR), being supported by EPE, will make these guidelines available to the Brazilian Energy Policy Council (CNPE) by July 2021.

2. Hydrogen and Fuel Cell R&D Update

Nothing to report for this period.

3. Demonstration, Deployments, and Workforce Developments Update

Green Hydrogen HUB Ceará

The Northeast of Brazil holds the country's greatest potential for wind and solar energy. About 88% of the installed wind and solar power plants are located in this region. Ceará's renewable wind and solar energy generation potential is estimated to be around 900GW, including onshore, offshore and hybrid installations. The state is among the top 5 Brazilian states in wind and solar power generation, with around 10GW projects in operation, under installation, and in planning. There is great renewable energy potential - solar photovoltaic: 643GW; onshore wind: 94GW; offshore wind: 117GW; and hybrid wind: 137GW. These resources are enough to supply more than twice the total Brazilian power demand. Other renewable sources, such as waste biomass and solid waste are available for the development of the Power-to-X industry.

The Pecém Port and Industrial Complex (CIPP) has the necessary infrastructure for the implementation of a Green Hydrogen HUB such as port facilities, free trade zone (ZPE

Ceará) and an industrial area of more than 13,000 hectares. CIPP is located in the Metropolitan Region of Fortaleza, a capital with 2.8 million inhabitants and a complex system of public and private transportation. With its strategic location close to future importers and consumers from the Northern Hemisphere and its 30% ownership by the Port of Rotterdam, the Pecém Complex represents a potential green hydrogen producer and consumer market and is very attractive for the installation of companies in the hydrogen sector.

Memoranda of Understandings have been signed with Enegix, Linde/White Martins/Praxair Group, Qair Energy while others are being negotiated. One of the project's ambitions is 5GW for hydrogen production by electrolysis, meaning 900,000 tons/year in a 200 ha area. Ceará's objective is to become a global player in the production, export and distribution of Green Hydrogen for use in various sectors of the economy, such as industry and transport. The Green Hydrogen HUB Institutional Project Partners are the Ceará State Government, the Pecém Port and Industrial Complex (CIPP), the Industry Federation of Ceará (FIEC) and the Federal University of Ceará (UFC).

Green Hydrogen HUB - Porto do Açu

Porto do Açu is the largest deep-water industrial port complex in Latin America. In operation since 2014, it is managed by Porto do Açu Operations, a partnership between Prumo Logística and Port of Antwerp International, a subsidiary of Antwerp Port Authority. Plans for the next five years include the industrialization of the port based, among others, on sustainable projects and generation of clean energy: chemical products, fuels, pelletizing, steel. Companies will be able to use green hydrogen as an input to increase their sustainable energy mix. A Memorandum of Understanding (MoU) between Fortescue Future Industries Pty Ltd (FFI) and Porto do Açu Operações SA indicates that they will install a green hydrogen plant with a capacity of 300MW to produce 250,000tons of green ammonia per year using offshore solar and wind power on the coasts of Rio de Janeiro and Espírito Santo States.

In April 2021, Itaipu Technological Park started building a demo green hydrogen production facility using renewable energy sources (photovoltaic panels) integrated with battery energy storage systems as the energy supply to develop technological solutions for local operations. The main goal is to set up a facility to give technical support to companies including start-ups in the development and testing of the entire fuel cell (or electrolyser) stack assembly process (more details on https://www.pti.org.br/pt-br/hidrogenio).

4. Events and Solicitations

The Brazilian Hydrogen Association's 2nd Brazilian Hydrogen Congress, November 2021.

Italy-Brazil Research-to-Business, a Side event in 12th International Conference on Hydrogen Production, 19-23 September 2021.

Energy Compact: Hydrogen, UN High-Level Dialogue on Energy, Side Event, 24 June 2021.

5. Investments: Government and Collaborative Hydrogen and Fuel Cell Funding

Nothing to report in this period.

6. Regulations, Codes & Standards, and Safety Update

The first meeting of the Green Hydrogen group, hosted by the Brazilian Association of Technical Standards (ABNT), was held on 20 May 2021, with the objective to elaborate and to propose standardizations to ISO.

Summary Country Update June 2021: Brazil

Transportation	Target Number	Current Status	Partnerships, Strategic Approach	Support Mechanism
Fuel Cell Vehicles[1]				
FC Bus		1 operational hybrid HFC bus		
Fuel Cell Trucks[2]				
Forklifts				
H_2 Refueling Stations	**Target Number**	**Current Status**	**Partnerships, Strategic Approach**	**Support Mechanism**
70 MPa On-Site Production				
70 MPa Delivered				
35 MPa On-Site Production		1 hydrogen production and refuelling station.		
35 MPa Delivered				

[1] Includes Fuel Cell Electric Vehicles with Range Extenders

[2] As above

Stationary	Target Number[3]	Current Status	Partnerships, Strategic Approach	Support Mechanism
Small[4]				
Medium[5]				
Large[6]				
District Grid[7]				
Regional Grid[8]				
Telecom backup				
H_2 Production	**Target[9]**	**Current Status**	**Partnerships, Strategic Approach**	**Support Mechanism**
Fossil Fuels[10]				
Water Electrolysis[11] (PEM, Alkaline, SOEC)	Production of approximately 40 kg of hydrogen with a purity of 99,995% by 2020	Experimental production to study the electrolysis system.	Hydrogen Technology demonstration plant, aiming to attract new investments from productive sectors.	Financing of Research and Development activities by Itaipu Binacional
By-product H_2	Oxygen	In Technical and Economic analyses for storage	Medicinal use	Financing of Research and Development activities by Itaipu Binacional

[3] Targets can be units installed and/or total installed capacity in the size range indicated
[4] <5 kW (e.g., Residential Use)
[5] 5kW – 400 kW (e.g., Distributed Residential Use)
[6] 0.3MW – 10 MW (e.g., Industrial Use)
[7] 1MW – 30 MW (e.g., Grid Stability, Ancillary Services)
[8] 30MW plus (e.g., Grid Storage and Systems Management)
[9] Target can be by quantity (Nm^3, kg, t) and by percentage of total production; also, reference to efficiency capabilities can be a target
[10] Hydrogen produced by reforming processes
[11] Please indicate if targets relate to a specific technology (PEM, Alkaline, SOEC)

Energy Storage from Renewables	Target[12]	Current Status	Partnership, Strategic Approach	Support Mechanism
Installed Electrolyser Capacity	48 kW	Operational	Hydrogen Technology demonstration plant, aiming to attract new investments from productive sectors.	Financing of Research and Development activities by Itaipu Binacional
Power to Power[13] Capacity	1. Pilot Hydrogen-based energy storage plant built to store 200 MWh/year. 2. Pilot Hydrogen-based energy storage plant built to store 730 MWh/year. 3. 0.014 MWh to 0.048 MWh	1. Pilot plant built, ongoing campaign of measures. 2. Pilot plant under construction. 3. Hydrogen Technology demonstration plant, aiming to attract new investments from productive sectors.	1. ANEEL, CESP, BASE Sustainable Energy (BASE), USP, UNICAMP, UNESP, PV Solar, MFAP Consultoria. 2. ANEEL, FURNAS, BASE Sustainable Energy, Brandenburg Technology University, Technology and Innovation Institute of Goiás (SENAI), UNICAMP, UNESP. 3. Hydrogen Technology demonstration plant, aiming to attract new investments from productive sectors.	1. Brazilian R&D Fund. Total investment 8 million Euros. 2. Brazilian R&D Fund. Total investment 11.9 million Euros. 3. Financing of Research and Development activities by Itaipu Binacional.
Power to Gas[14] Capacity	Production of approximately 0,6 kg H_2/h	Not available yet for the productive sectors.	Hydrogen Technology demonstration plant, aiming to attract new investments from productive sectors.	Financing of Research and Development activities by Itaipu Binacional

[12] Can be expressed in MW of Installed Capacity to use the electricity from renewable energy generation, and Annual MWh of stored energy capacity

[13] Operator has an obligation to return the electricity stored through the use of hydrogen back to electricity

[14] Operator has the opportunity to provide the stored energy in the form of hydrogen back to the energy system through multiple channels (e.g., merchant product, enriched natural gas, synthetic methane for transportation, heating, electricity)