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FEIRA E CONGRESSO
10–11 DE ABRIL DE 2024
FORTALEZA, BRASIL
WEBINAR
Brazilian Green Hydrogen – what to expect in 2024?

ABOUT THE ORGANIZER OF THE WEBINAR

The smarter E South America

LATAM’s innovation hub for the new energy world

By uniting four parallel exhibitions, The smarter E South America is LATAM’s largest platform for the new energy and mobility world. Following the vision of a renewable, decentralized and digital energy world and a sustainable mobility future, The smarter E South America takes a comprehensive approach by presenting cross-sector solutions and technologies. It creates opportunities to address all key areas across sectors and industries. Focusing on the interplay of power generation, storage, energy management and e-mobility, The smarter E South America brings together international stakeholders of the energy and mobility future from across the world’s most influential markets.

CONTENT

Brazilian Green Hydrogen – what to expect in 2024?

Content of Webinar

Green hydrogen is poised to transform many sectors of the global economy in the coming years, including industry, logistics and energy. Brazil is uniquely positioned to become a leading global supplier of green hydrogen, due to its highly competitive solar and wind resources, among other decisive factors.

This webinar will give an overview of the current development of the Brazilian green hydrogen sector, highlighting the most promising applications, ongoing project development activities, supplier landscape, as well as the evolution of public policies.

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SPEAKER / MODERATOR

Webinar Speaker and Moderator

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Sérgio Augusto Costa

Founder and Executive President

Brazilian Association of Hydrogen and Sustainable Fuel

Markus Vlasits

Managing Director

NewCharge Energy

Time For Questions

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Intersolar Summit Brasil Nordeste – Brazil's most successful event boosting Northeast's PV Bussiness

Fortaleza (CE), Brazil | April 10–11, 2024

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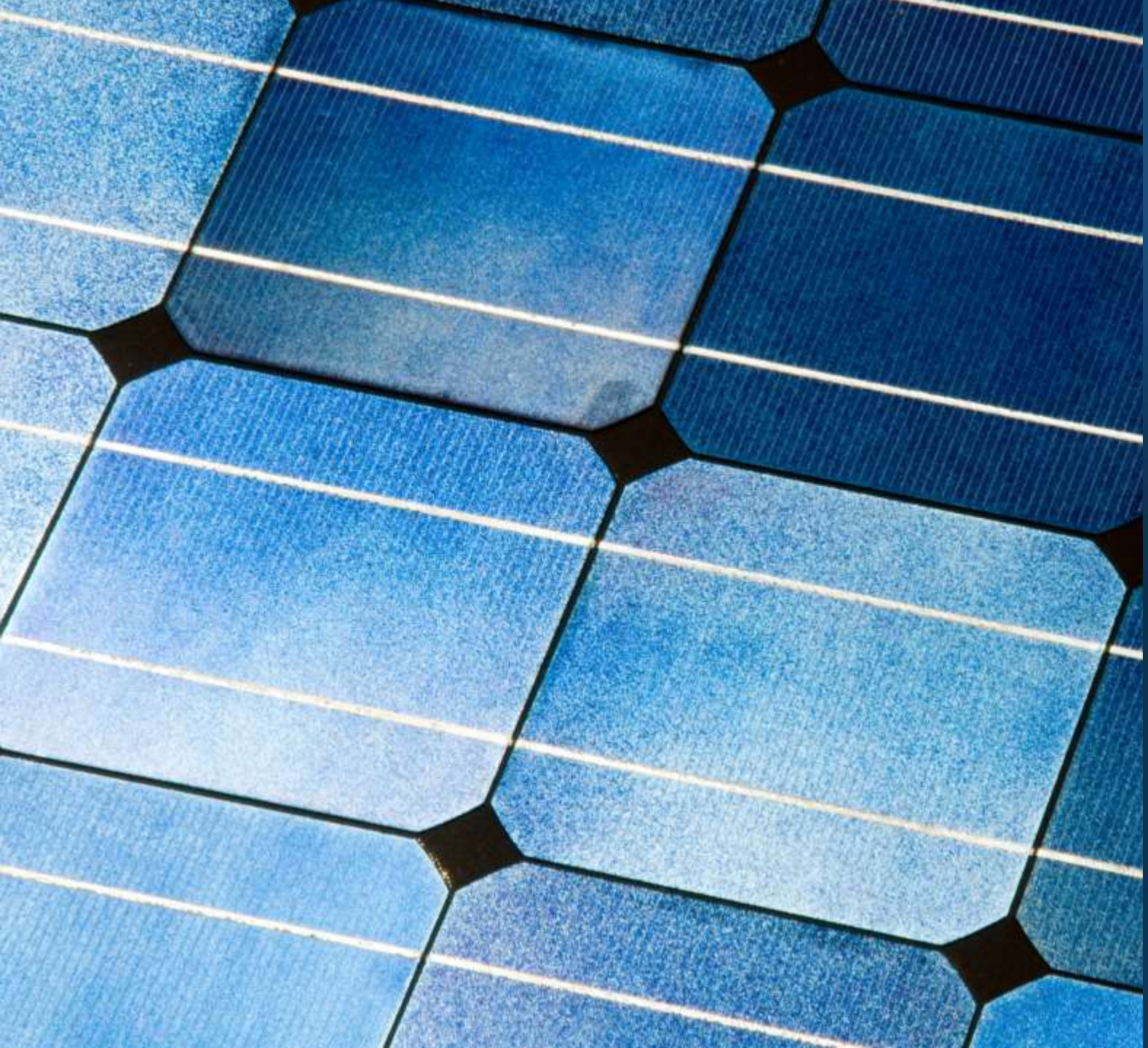

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Green Hydrogen in Ceará

March 21, 2024

Jurandir Picanço
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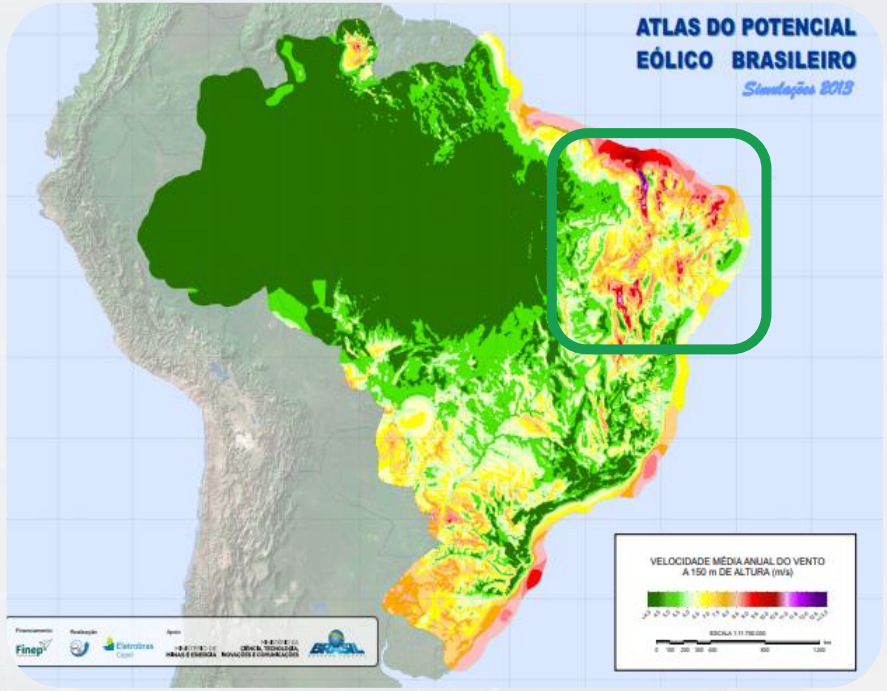
Brazil's Wind and Solar Potential

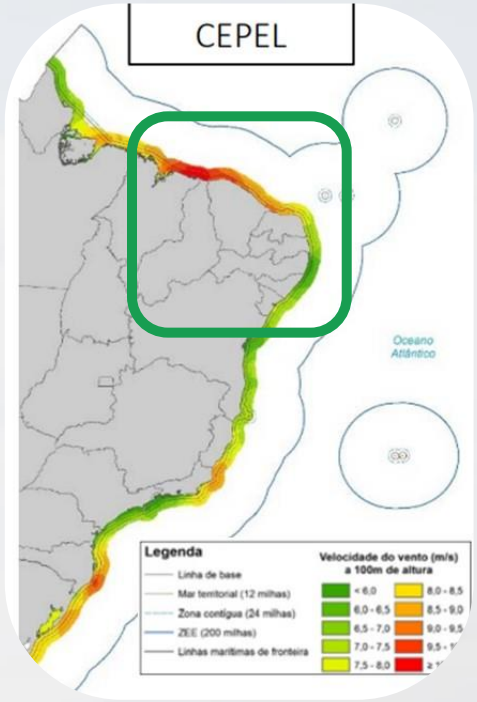
Wind Onshore Potential

Brazil: 880 GW (100m)
Northeast: 35%



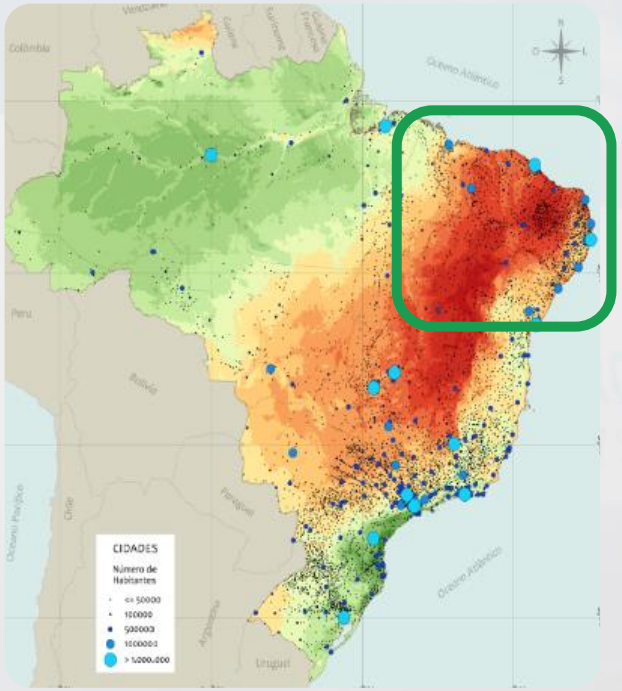
Wind Offshore Potential

Brazil: 1,335 GW (100m)
Northeast : 51%



Solar Potential

Brazil: 28,500 GW
Northeast : 24%

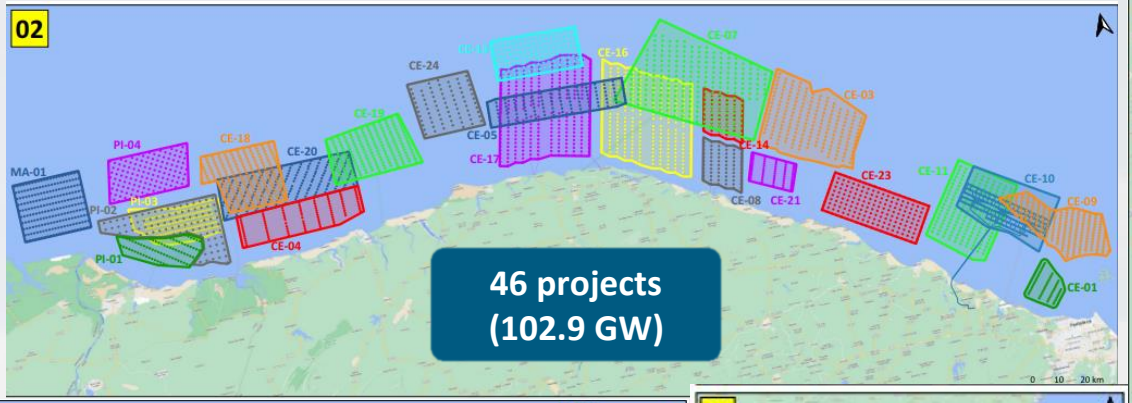


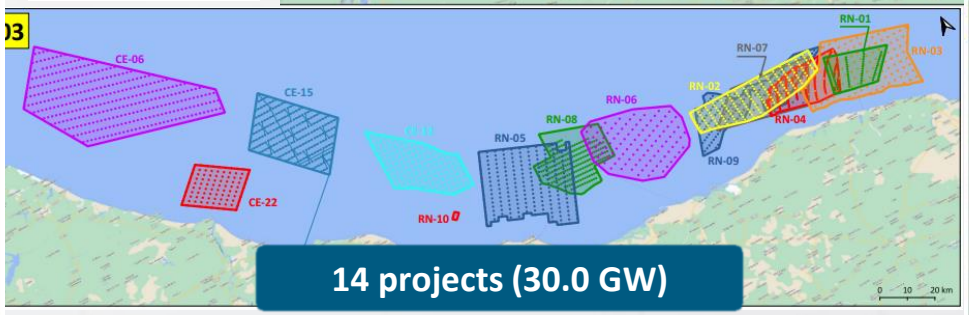
The potential is greater than 140 times the current installed capacity

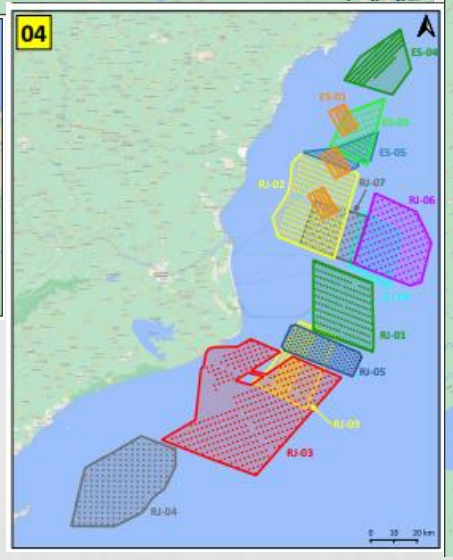
The greatest potential for wind onshore, offshore and solar energy is in the Northeast region.

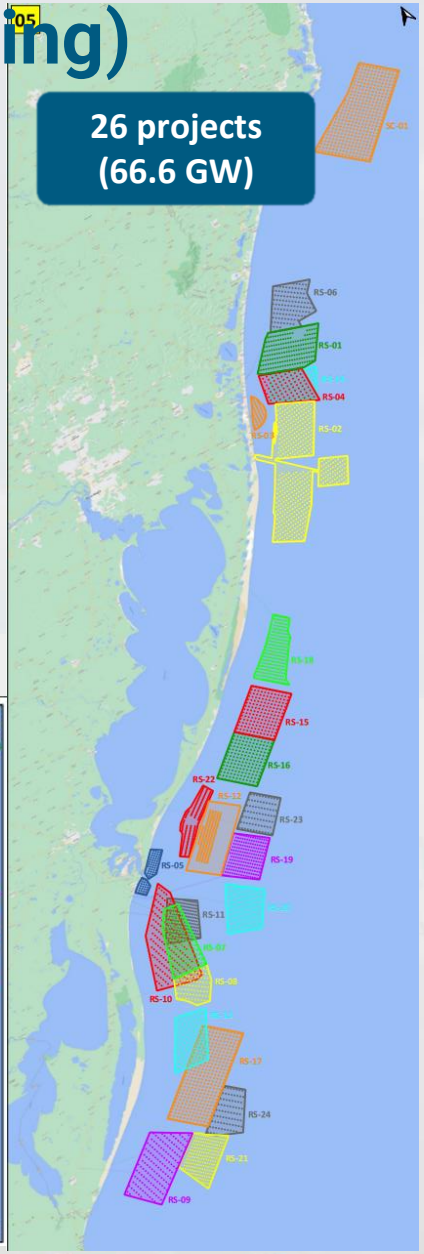
Brazil's Offshore Wind Projects (under environmental licensing)

Brazil, 91 projects, 219,22 GW









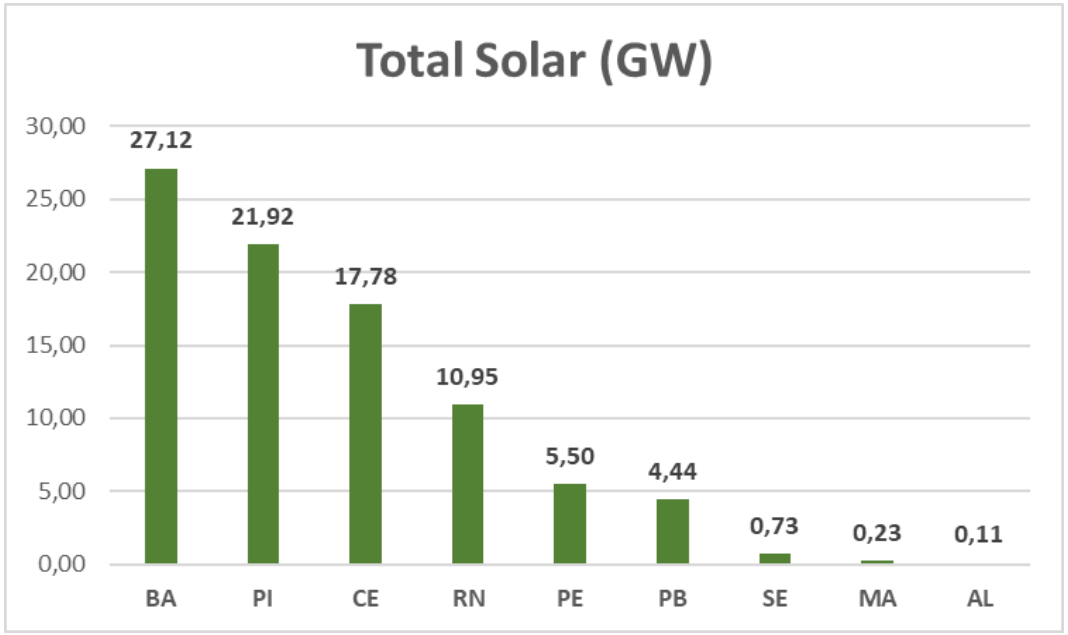
- **Rio Grande do Sul**, 26 projects (66.6 GW)
- **Ceará**, 25 projects (64.8 GW)
- **Rio de Janeiro**, 13 projects (35.6 GW)
- **Rio Grande do Norte**, 13 projects (22.5 GW)
- **Northeast**, 46 projects (102.9 GW)

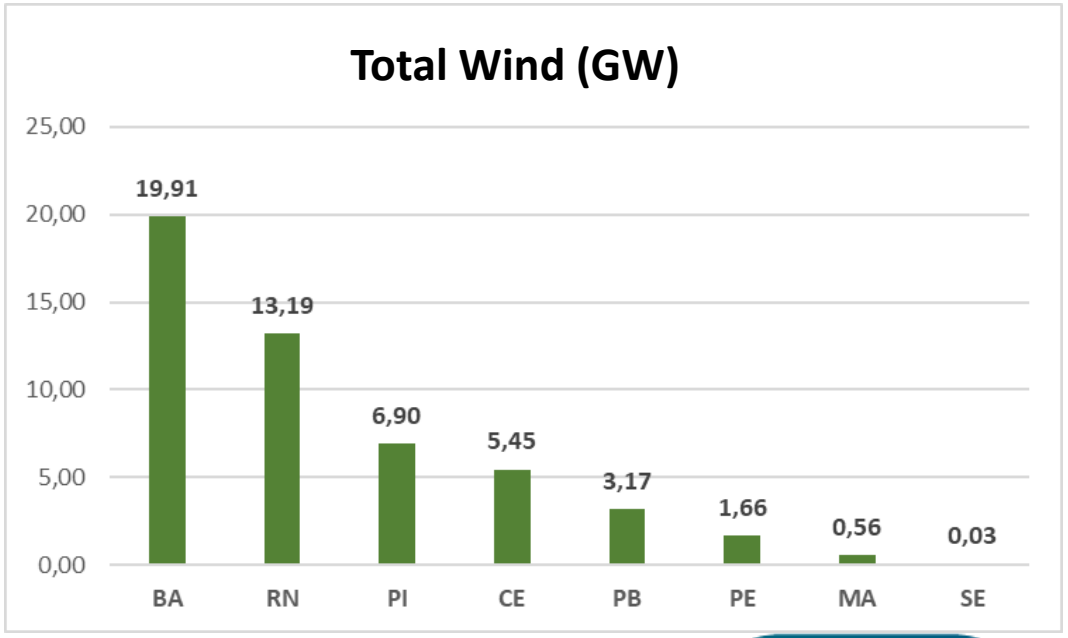
Source: IBAMA (20/09/2023)

Wind/Solar Energy Projects in the Northeast Region

Projects granted by ANEEL (Regulatory Agency of the Brazilian Electricity Sector)

139,6 GW
88,8 GW Solar
50,9 GW Eólica

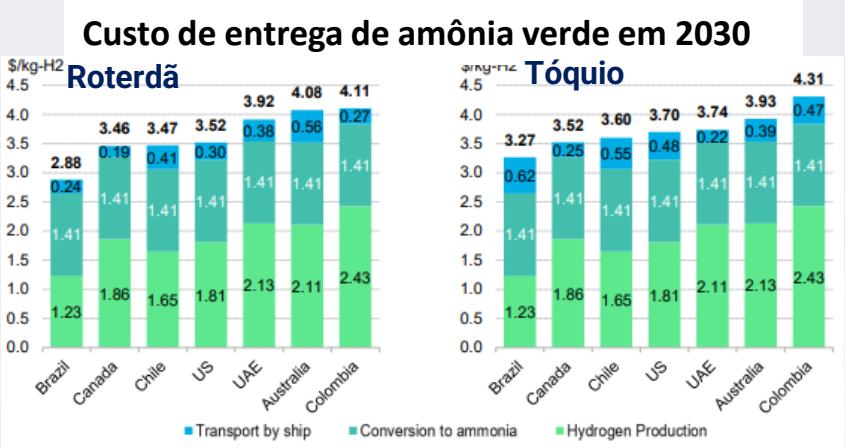




Source: ANEEL (26/02/2024) https://shorturl.at/dmvY8

Opportunity for Brazil – International Studies

BlombergNEF
(Bloomberg New Energy Finance)



"Brazil has the resources to deliver lower-cost ammonia to Europe and Japan"

IRENA
(International Renewable Energy Association)

"Brazil should have green H2 cheaper than blue H2 as early as 2024"

McKinsey

"Brazil has a unique opportunity to accelerate inclusive and sustainable growth and to take a leading role in decarbonizing the global economy."

WHL - World Hydrogen Leaders

"Brazil is poised to be a major player in the global hydrogen market and become one of the leading exporters of green fuel."

Roland Berger

"Brazil could capture significant potential from international markets and surpass domestic demand as early as 2030"

Fraunhofer

"In the overall comparison of all the countries analysed and the costs of the Power-to-X 2030 offer, Brazil and Australia stand out in particular."
"Brazil with the lowest cost of Liquefied Hydrogen (LH2) and the same cost of Ammonia (NH3) as Australia."

Green Hydrogen HUB of Ceará

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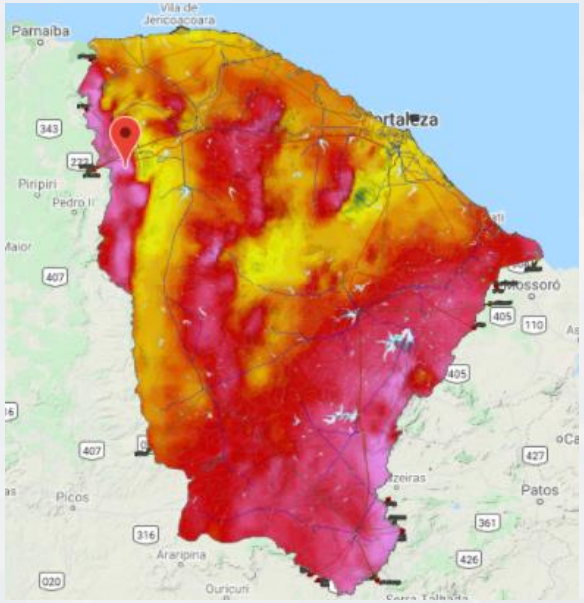
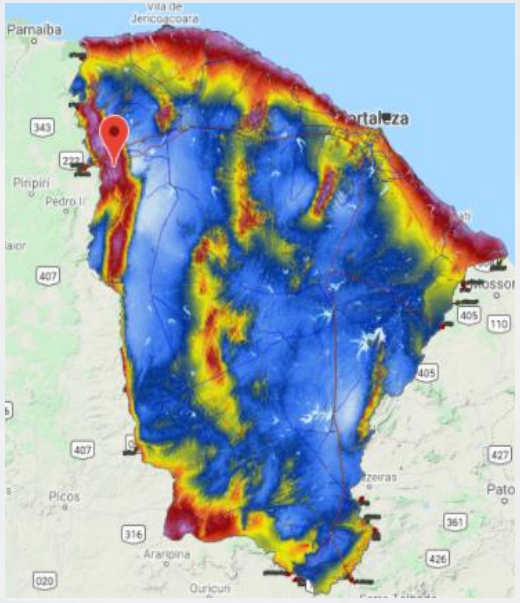
Ceará – Excellent Wind and Solar PV

Solar PV Potential	Onshore Wind Potential	Offshore Wind Potential	Hybrid Potential
643 GW	94 GW	117 GW	137 GW

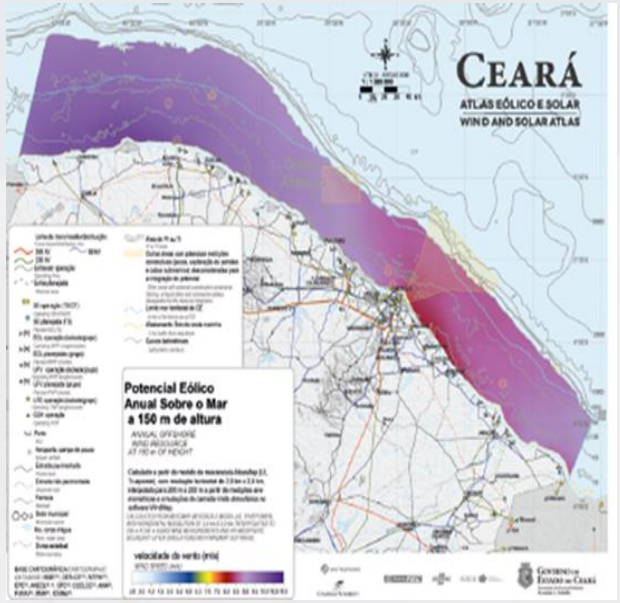
Solar PV Map



Onshore Wind Map



Offshore Wind Map



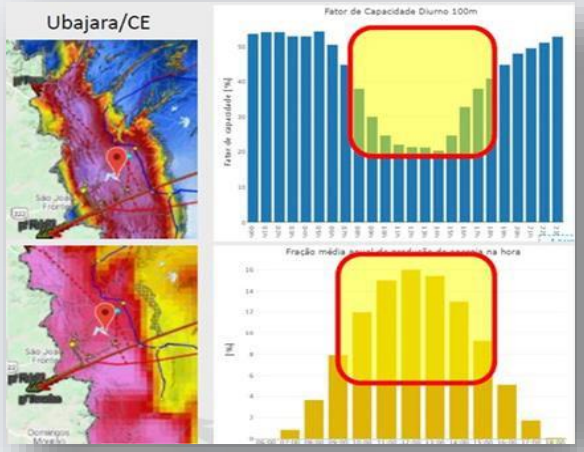
Hybrid Solar/Wind Map

1.5 GW in Operation	2.6 GW in Operation	Regulation on track	429.4 MW in Operation
16 GW in Under Construction or Construction Not Started	2.9 GW Under Construction or Construction not started	64.8 GW in environmental licensing	

Sources: ANEEL (set/2023); http://atlas.adece.ce.gov.br/; IBAMA

Ceará – Competitive Advantages

Great Renewable Energy Potential



Solar + Wind Daily Complementarity

Low Logistic Cost

Pecém Complex: Free Trade Zone + Industrial Area + Port + Partnership with the Port of Rotterdam

Green Hydrogen Projects in Ceará

Companies that signed MoUs

Announced Electrolysis Capacity and Investments by Company

Company	Country	Electrolyzer Power (GW)	Investment profile	Investments announced: US$ (billion)
Fortescue	**Australia**	2.1	Electrolysis + Renewable	**6.0**
Casa dos Ventos	**Brazil**	2.4	Electrolysis + Renewable	**7.0**
Qair	**France**	2.4	Electrolysis + Renewable	**6.95**
Transhydrogen *	**Netherlands**	3.0	Electrolysis	**2.0**
AES Brasil *	**United States**	1.0	Electrolysis	**2.0**

* AES and Transhydrogenium's renewable energy investments have not been declared

Total investment in excess of US$ 20 billion

Projects under development

Company	Country
Energix	Australia
GoVerde/Apollo Asset	Brazil
Cactus Energia	Brazil
Alupar	Brazil
Diferencial	Brazil
Eneva	Brazil
H2 Green	Brazil
H2 Helium	Brazil
Nexway	Brazil
Gansu Science and Technology	China
Goldwind	China
Mingyang	China
Powerchina	China
ENGIE	France
EDF Renewables do Brasil	France
HDF Energy	France
Total Eren	France
Voltália	France
Hytron	Germany
Linde/W. Martins	Germany
Green Hydrogen Corridor	Netherlands
Platform Zero	Netherlands
Enel Green Power	Italy
Hitachl	Japan
Mitsui/Caetano Bus	Japan
EDP	Portugal
Jepri	Spain
NEOENERGIA	Spain
ABB Automation	Switzerland
BP Energy	UK
LightsourceBP	UK

More advanced H2 projects in Ceará

Most Promising Projects

🔴 **Reserved area in the Free Trade Zone**

🟢 **Environmental licensing approved**

Projections until 2030 in Ceará

- 1 million tons of Green Hydrogen
- 10 GW electrolysis
- 20 GW of renewable energy generation
- 80,000 jobs

Pilot Plant 1,25 MW

Project in operation – EDP Energias de Portugal

3 MW dedicated solar PV generation
OBJECTIVE: To test the decarbonization of EDP's 720 MW coal-fired thermal power plant and simulate the green hydrogen production chain.

ArcelorMittal

Offtaker

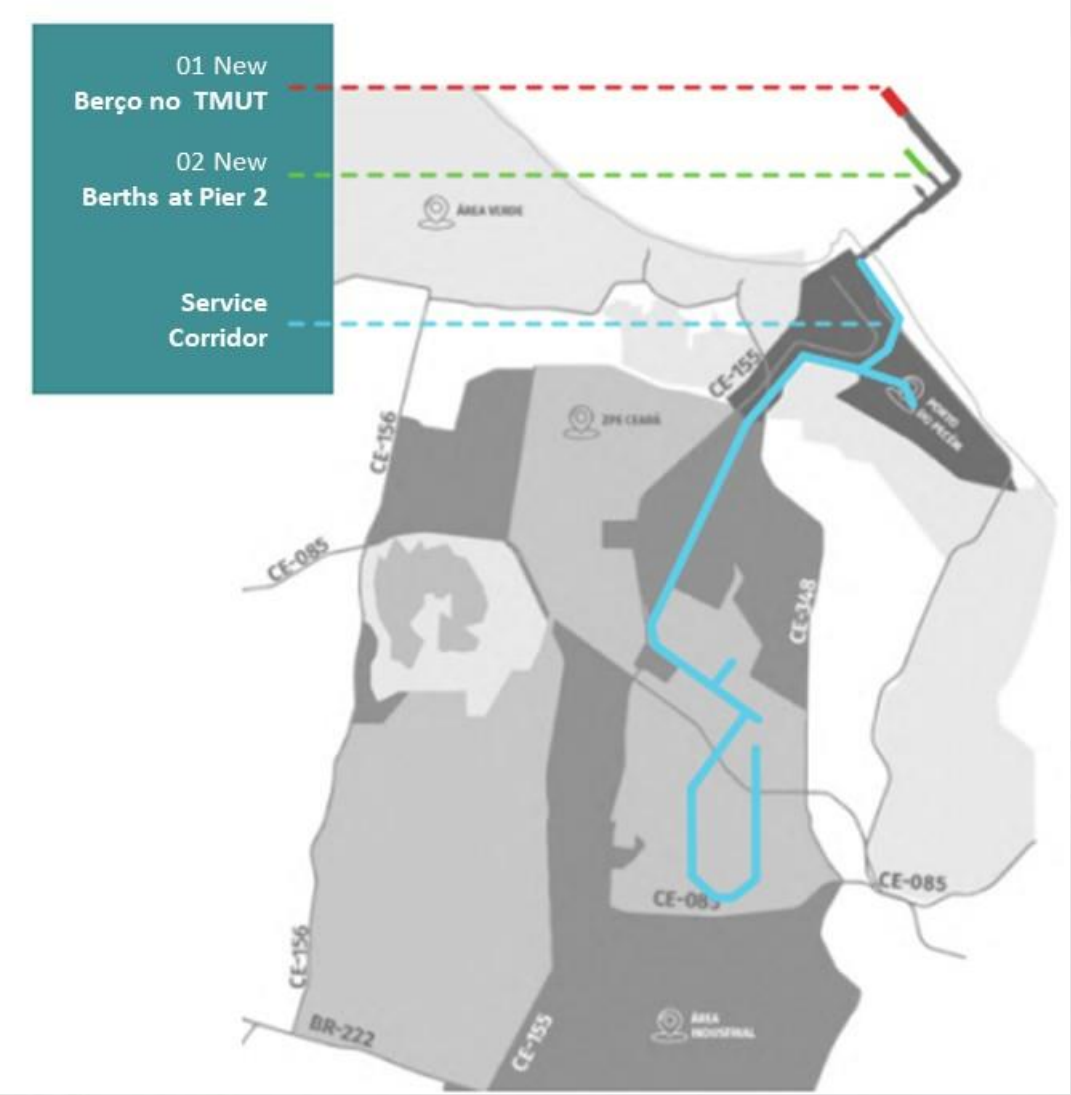
Infrastructure of the Pecém Green H2 Hub – Secured investments

Ceará secures investments of US$135 million in the Pecém Complex

- Investments in infrastructure;

- More inclusivity and sustainability;

- US$ 35 million from the CIF (Climate Investment Funds) for innovation and technical assistance



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Fonte: CIPP

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Green Hydrogen Corridor between Pecém and Rotterdam

On **May 10, 2023,** two agreements were signed for the creation of the **Green Hydrogen Corridor** between the Port of Pecém and the Port of Rotterdam and the **Green Ports Partnership**, between Ceará and the Basses.

The Prime Minister of the Kingdom of the Netherlands, **Mark Rutte** and the Governor of Ceará, **Elmano de Freitas** signed the agreements.

"The Rotterdam operations are already a major gateway for Brazilian commodities. This partnership can help increase Brazilian exports by up to 10%, reaching double digits", said Prime Minister Mark Hutte.

pecém COMPLEXO INDUSTRIAL E PORTUÁRIO

Joint ambition to supply 25% of the GH2 imported by PoR by 2030. Around 1 million tons.

Port of Rotterdam

Prioridade: Marco Nacional do Hidrogênio

Principais Projeto de Lei:

✓ Comissão do Senado (CEHV): Coordenador Senador Cid Gomes

✓ Comissão da Câmara dos Deputados: Coordenador Deputado Arnaldo Jardim

✓**PL 2308/2023 do Dep. Gilson Marques aprovado na Câmara dos Deputados**

- Remessa ao Senado Federal em 01/12/2023
- Na CEHV – Relator Senador Otto Alencar

✓PL 5751/2023 apresentado pela Comissão da Câmara em 28/11/2023

- Aguardando designação de Relator da Comissão de Meio Ambiente

✓PL 5816 2023 foi aprovado pelo Senado Federal

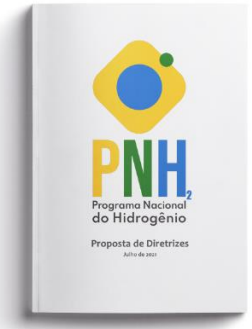
- Remessa a Câmara dos Deputados em 28/12/2023
- Apensado ao PL 5751/2023

O que falta nos PLs:

✓ Metas objetivas para induzir o mercado doméstico

✓ Incentivos que viabilizem a implantação dos projetos pioneiros

Plano Nacional do Hidrogênio



Proposta de Diretrizes
Julho de 2021

Plano de Trabalho Trienal
Agosto de 2023

FIEC Summit –Green Hydrogen- 2023

- ✓ **3,500** registered
- ✓ **1,426** in-person participants
- ✓ **17** participating countries
- ✓ **1,700** YouTube views

FIEC SUMMIT 2024
HIDROGÊNIO VERDE
GREEN HYDROGEN

August 12th and 13th, 2024

Access the full content of the 2023 edition of the FIEC Summit

1st day

2nd Day

Thank you!

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Brazilian Green Hydrogen
What to expect in 2024?

Sérgio Augusto Costa | Executive President

ABHIC - Brazilian Association of Hydrogen and Sustainable Fuels

21/03/2024

Presentation to:

THE smarter E | SOUTH AMERICA

abhic.org.br

ABHIC - A mark in the 🇧🇷 market

The **Brazilian Association of Hydrogen and Sustainable Fuels (ABHIC)** is a non-profit national entity whose mission is to **implement and optimize market, technological and regulatory conditions** necessary for the development of hydrogen and sustainable fuels in Brazil.

The ABHIC represents not only Green Hydrogen companies, but also organizations that work with Gray, Brown and Blue Hydrogen, that is, companies that use hydrogen produced from fossil fuels, but that are **committed to carrying out the energy transition to a sustainable economy through Green Hydrogen**.

We are partners of **German Association for Hydrogen and Fuel Cells (DWV)**.

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What to expect?

Market:

- **Investment potential for the coming years:**
  - Brazil has a gigantic potential in the green hydrogen sector. The country, **which electric grid is predominantly made up of renewable sources (over 86%)**, could become one of the world's largest hydrogen exporters, especially to Germany.
  - The Brazilian potential is **$200 billion invested over the next 20 years**, according to projections by McKinsey & Company consultancy.
  - Currently, **there are several commercial scale projects ongoing**, in addition to pilot projects.

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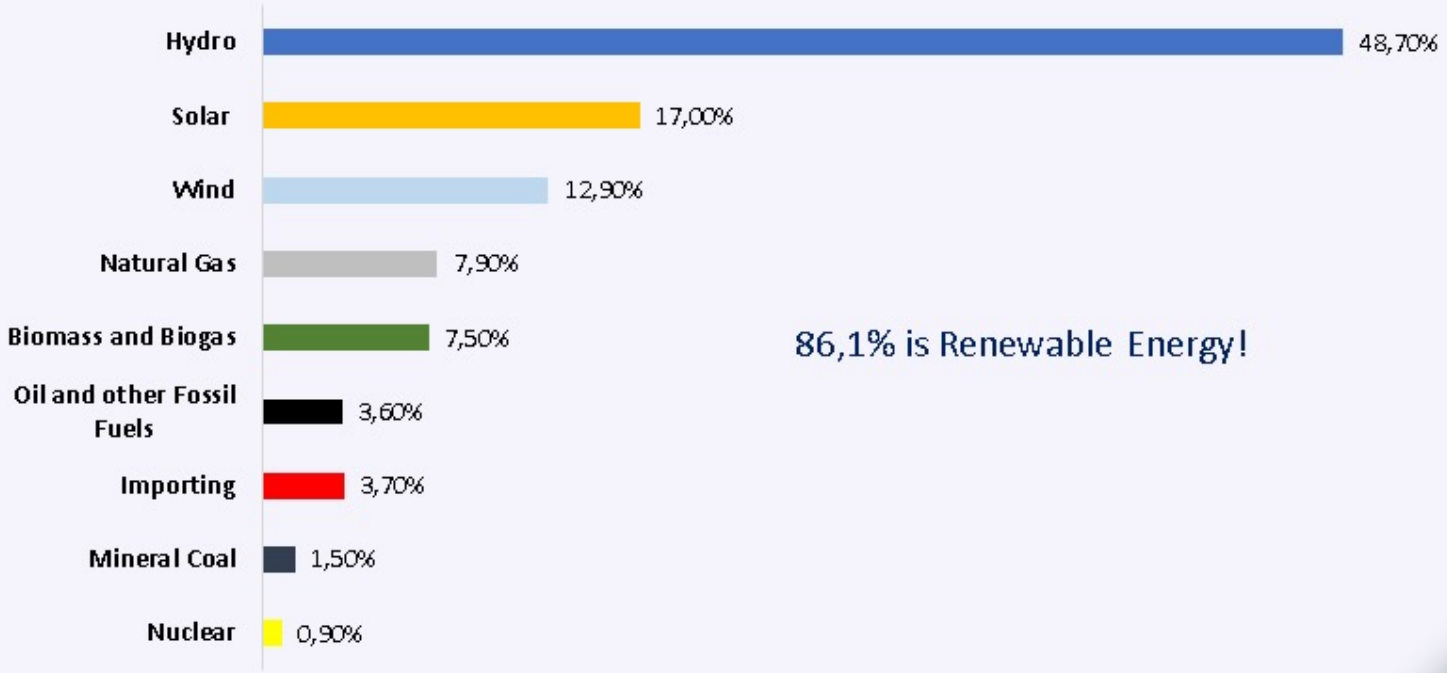
What to expect?

Brazilian electricity matrix - 225.827 MW:



86,1% is Renewable Energy!

Source: ANEEL|ABSOLAR – February 2024.

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What to expect?

Market:

- <u>Use of green hydrogen in different sectors :</u>
  - **Several sectors will benefit** from the use of green hydrogen in Brazil: **petrochemicals, fertilizers, steel, and mining**.
  - The definition of policies related to hydrogen **is among the priorities of the Brazilian industrial sector for 2024,** as reported by the National Confederation of Industry (CNI) this week.

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What to expect?

Market:

- <u>Use of green hydrogen in different sectors :</u>
  - **Large companies in the electric sector** demonstrated interest in this sector.
  - These companies see this segment as a **potential energy consumer for ammonia factories**, focusing on both domestic and international markets.
  - **Ammonia and Nitrogen for Fertilizers:** Brazil is currently responsible for around 8% of global fertilizer consumption, ranking 4th, behind only China, India and the United States. However, more than 80% of the fertilizers used in the country are imported (in the case of nitrogenous fertilizers, the importation is approximately 95%). Current demand is from 45 to 50 millions of tons of Fertilizers. Until 2040 can double this demand.
  - Furthermore, green hydrogen will be important for **the production of SAF and e-methanol**. <u>**In both cases, Brazil could be the leading country in production.**</u>

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What to expect?

REUTERS®

Boeing says Brazil could be top sustainable aviation fuel player

WORLD ECONOMIC FORUM

CLIMATE AND NATURE

When it comes to decarbonizing aviation, aluminium and steel, look to Brazil

OFFSHORE ENERGY

Petrobras and European Energy looking into e-methanol opportunities in Brazil

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What to expect?

Regulation:

- <u>Establishment of the Regulatory Framework for Hydrogen and Derivatives:</u>
  - One of the most urgent issues in the country is the **need to unify two Draft Law Projects addressing the same topic** (House of Representatives and Senate), thus creating the Legal Framework for Hydrogen and Derivatives.
  - The expectation is that the Regulatory Framework **be defined in the first semester of 2024, mainly because in the 2nd Semester have Elections for Municipalities (mayors, vice-mayors and councilors), with the 1st round of elections on October 6th, and the 2nd round scheduled for October 27th (if necessary).**

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What to expect?

Regulation:

- <u>Incentive policies:</u>
  - Due to the country's fiscal and economic situation, **it will be very difficult to establish subsidies**.
  - Therefore, it is important **to define tax benefits, considering tax exemptions and tax reductions**, so that the sector has the necessary viability to develop.
  - Furthermore**, access to low-interest financing** is essential to support research and development projects in the area.

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What to expect?

R&D:

- **National projects:**
  - There are **several ongoing projects related to R&D** in Brazil.
  - These initiatives aim to advance technologies related to the **production, transportation, storage and use of green hydrogen and sustainable fuels**.

- **FINEP PLUS INOVATION:**
  - ABHIC is working with its members to structure projects for submission to the public call for strategic topics of **FINEP PLUS INNOVATION,** related to green hydrogen technology and recently launched by the Brazilian government.
  - The project provides **R$ 250 million in non-repayable economic subsidy** for low-carbon hydrogen.

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What to expect?

Main ongoing projects in Brazil:

- **Unigel (Bahia) - Production of fertilizers:**
  - Investment: US$ 1.5 billion.
  - Hydrogen production: 100,000 tons/year.
  - Ammonia production: 600,000 tons/year.
  - Electrolysis capacity (first phase of the project): 60 MW.
  - Start: 2023.
  - Full operation: 2027.

- **Qair (Pernambuco), green hydrogen and blue hydrogen:**
  - Investment: US$ 3,9 million.
  - Green hydrogen production: 488,000 tons/year.
  - Blue hydrogen production: 198,000 tons/year.
  - Electrolysis capacity: 2.2 GW.
  - Projected start: 2025.
  - Full operation: 2032.

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What to expect?

Main ongoing projects in Brazil:

- **Qair (Ceará), green hydrogen:**
  - Investment : US$ 6,9 billion.
  - Green hydrogen production : 488,000 tons/year.
  - Electrolysis capacity: 2.2 GW.
  - Offshore wind energy capacity: 1.2 GW.

- **Casa dos Ventos e Comerc (Ceará), green hydrogen and green ammonia:**
  - Investment: US$ 4 billion.
  - Green hydrogen production : 365,000 tons/year.
  - Green ammonia production: 2.2 million tons/year.
  - Electrolysis capacity: 2.4 GW.
  - Projected start: 2026.
  - Full operation: 2030.

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What to expect?

Main ongoing projects in Brazil:

- **Fortescue (Ceará), green hydrogen:**
  - Investment : US$ 6 billion.
  - Green hydrogen production: 15 million tons/year (global target).
  - Projected start: 2025.
  - Full operation: 2027.

- **AES (Ceará), green hydrogen and green ammonia:**
  - Investment: US$ 2 billion.
  - Green ammonia production: 800,000 tons/year .
  - Electrolysis capacity: 2 GW.

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What to expect?

Main ongoing projects in Brazil:

- **White Martins (Pernambuco), green hydrogen:**
  - Investment: undisclosed.
  - Green hydrogen production: 156 tons/year.
  - Start: 2022.

- **Eletrobras Furnas (Goiás/Minas Gerais) – Pilot project of green hydrogen:**
  - Investment: R$ 45 million.
  - Production of green hydrogen so far: approximately 1.5 ton.
  - Power generation capacity: 1 MW.
  - Start: 2021.

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What to expect?

Main ongoing projects in Brazil:

- **EDP (Ceará) – Pilot project of green hydrogen:**
  - Investment : R$ 42 million.
  - Green hydrogen production: 250 Nm3/h.
  - Electrolysis capacity : 3MW.
  - Start: 2022.
  - Full operation: 2024.

- **Shell/Raízen/Hytron/Toyota (São Paulo) – Pilot project of green hydrogen from ethanol:**
  - Investment: R$ 50 million.
  - Green hydrogen production : 390 tons/year.
  - Start: 2023.

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For more information, partnerships and business opportunities, contact ABHIC.

Thank you very much!

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