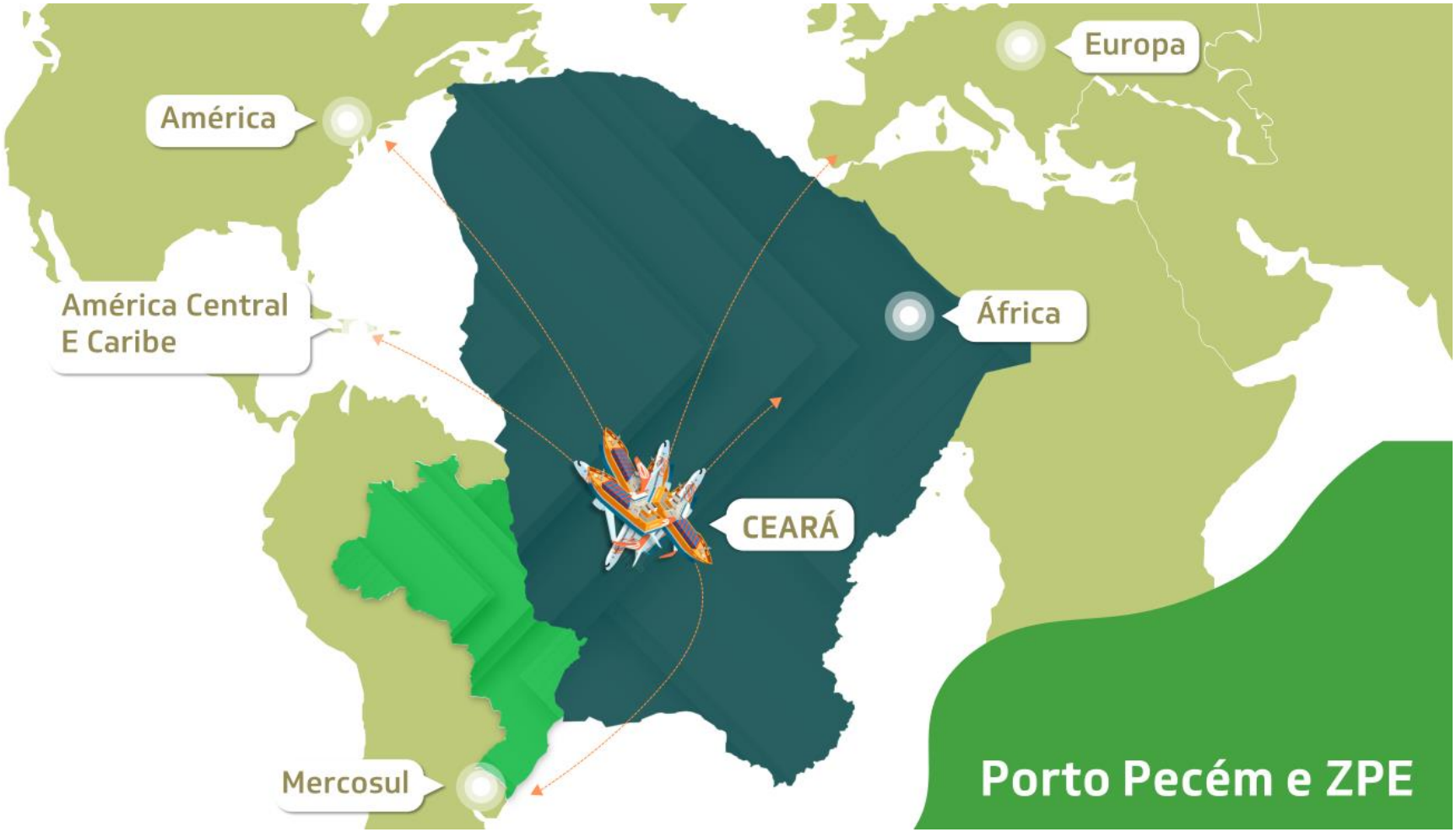
Green Hydrogen Ceara Strategy - from Policy to Practice
International high-level dialogue with public and private stakeholders

Ceará has a privileged geographical location for serving global markets through the Pecém Industrial and Port Complex

GEOGRAPHIC LOCATION



Source: CIPP and SDE

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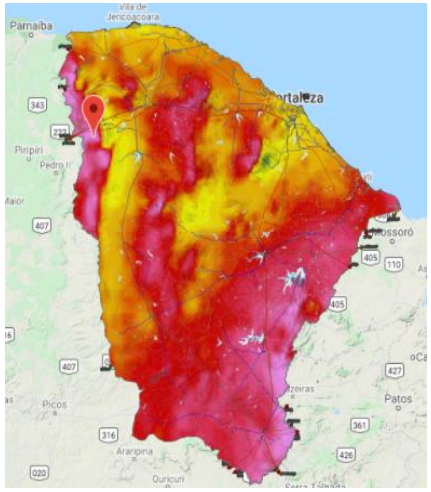
The cost of Green Hydrogen production in Ceará should be one of the lowest in the world due to the abundant availability of energy and due the high capacity factors

POTENTIAL FOR RENEWABLE ENERGY GENERATION IN CEARÁ

Solar Energy Potential

643 GW

Mapa Energia Solar

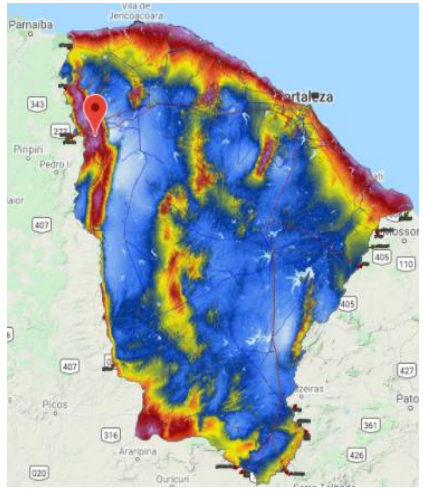


- 0.7 GW in operation
- 6,3 GW in development
- 20,4 GW in DRO

Onshore Wind Potential

94 GW

Mapa Eólico *Onshore*

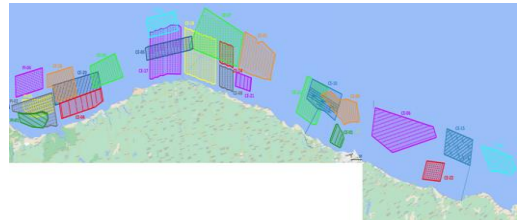


- 2,6 GW in operatiion
- 1,5 GW in development
- 6,1 GW in DRO

Offshore Wind Potential

117 GW

Projetos *offshore* em desenvolvimento



- Regulation Framework in progress
- 56,6 GW under licensing process (22 projects)

Hybrid Potential

137 GW

Mapa Híbrido Solar/Eólico

- Development on the right track

Source: Ceara State Government and FIEC

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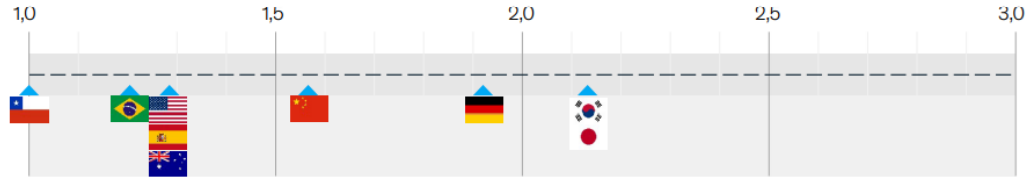
EXPECTED COSTS

EXPECTED GREEN HYDROGEN COSTS

Cost 2030

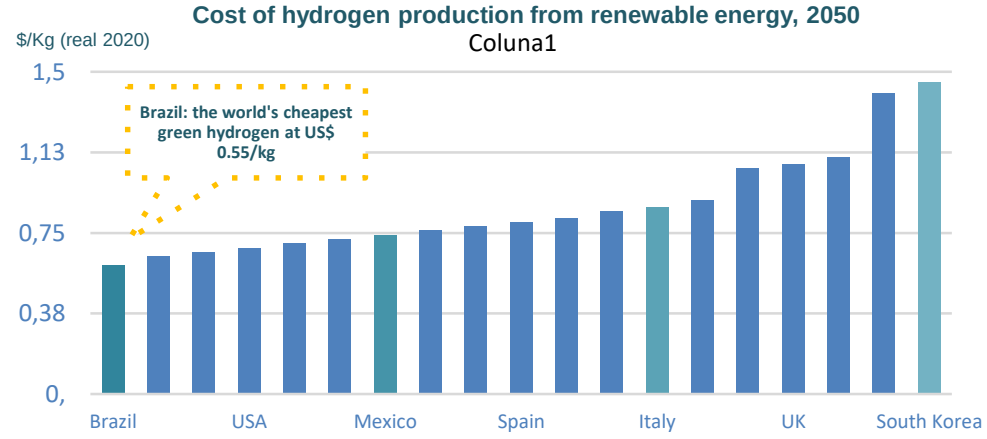
The levelised cost of Brazilian green hydrogen would be about ~1.50 USD/kg of H2 in 2030 and ~1.25 USD/kg of H2 in 2040.



Source: McKinsey

Note: The LCOH (Levelized Cost of Hydrogen) represents the costs of producing electricity, water, electrolysing cable and opex; does not include installation costs such as transmission lines, pipelines and storage, nor distribution and shipping costs.

2050

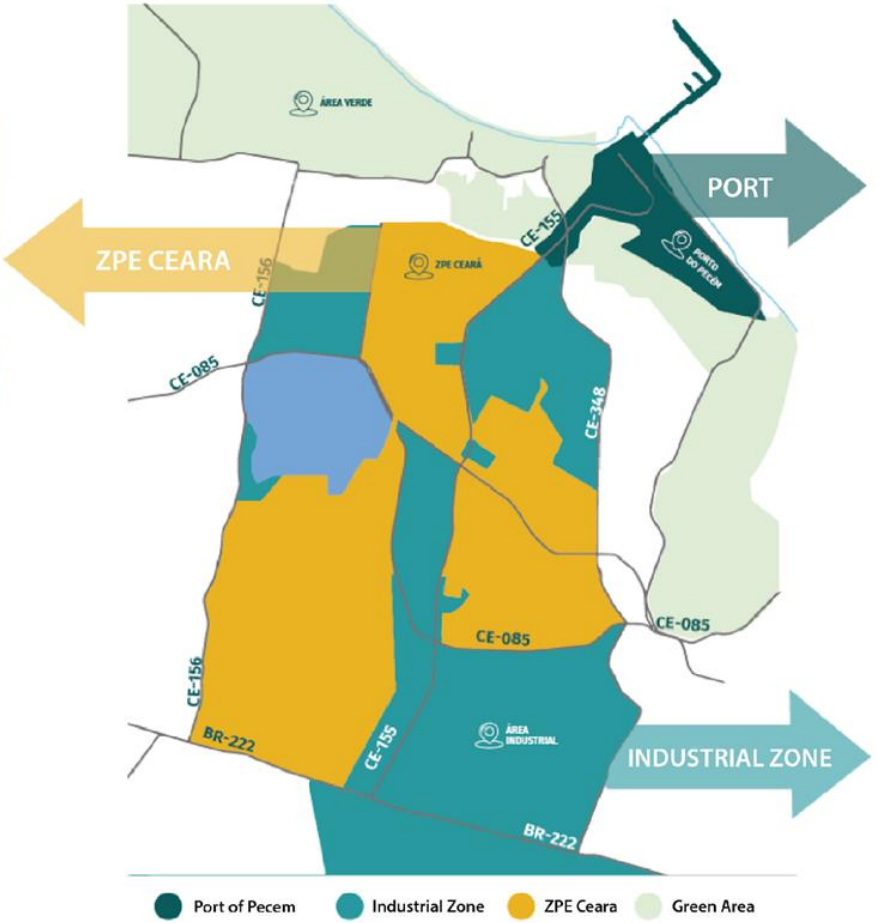


Source: BloombergNEF - assumes an optimistic scenario of alkaline electrolysing costs and the use of solar photovoltaic or wind energy on the ground, which leads to a cheaper hydrogen production cost.

Source: Ceara State Government, McKinsey and BloombergNEF

The Pecém Complex, a partnership between Ceara State (70%) and Port of Rotterdam (30%) is composed of port facilities, an industrial area of 19,115 ha, including a Free Trade Zone with 6,182 ha

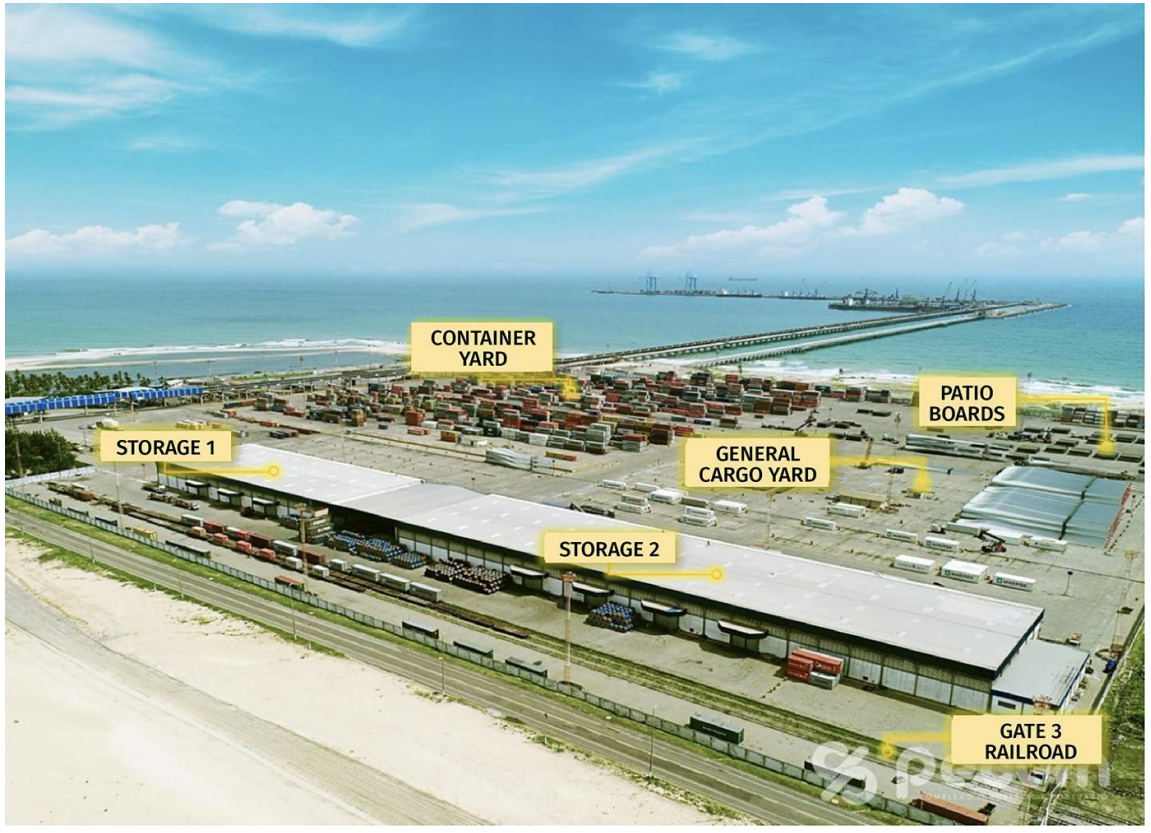
COMPOSITION OF THE PECÉM COMPLEX



Source: CIPP

The on-shore port facilities encompass an area of 45 ha for storage of any type of cargo

ON-SHORE PECÉM PORT FACILITIES



Source: CIPP

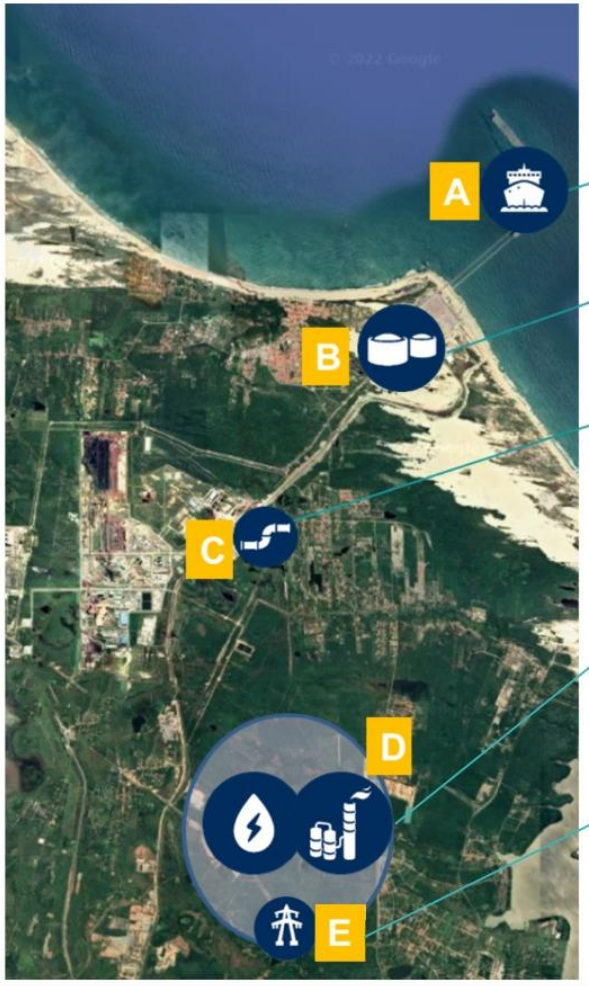
The off-shore port facilities include 2 piers and 1 multi-purpose terminal (TMUT) connected by 2 bridges

OFF-SHORE PECÉM PORT FACILITIES

Source: CIPP

CIPP is already planning and preparing its port and industrial areas to receive the Green Hydrogen HUB

INFRASTRUCTURE SOLUTIONS FOR THE GREEN HYDROGEN HUB IN PECÉM



A. Port Infrastructure
Operation at Pier 2 (existing infrastructure)

B. Shared Tanking
Ammonia storage for centralizer tanking

C. Utilities
- Pipeline connecting the port and the industrial area
- Shared water solution: (1) Reuse of waste water, (2) Desalination and (3) Raw water

D. 1.100ha of industrial area for electrolysis plants in the CE ZPE
Wide area available in ZPE with possibility for expansion of H2 plants. Proximity to installed industries: Steel; Fertilizers, Cement and Thermoelectric.

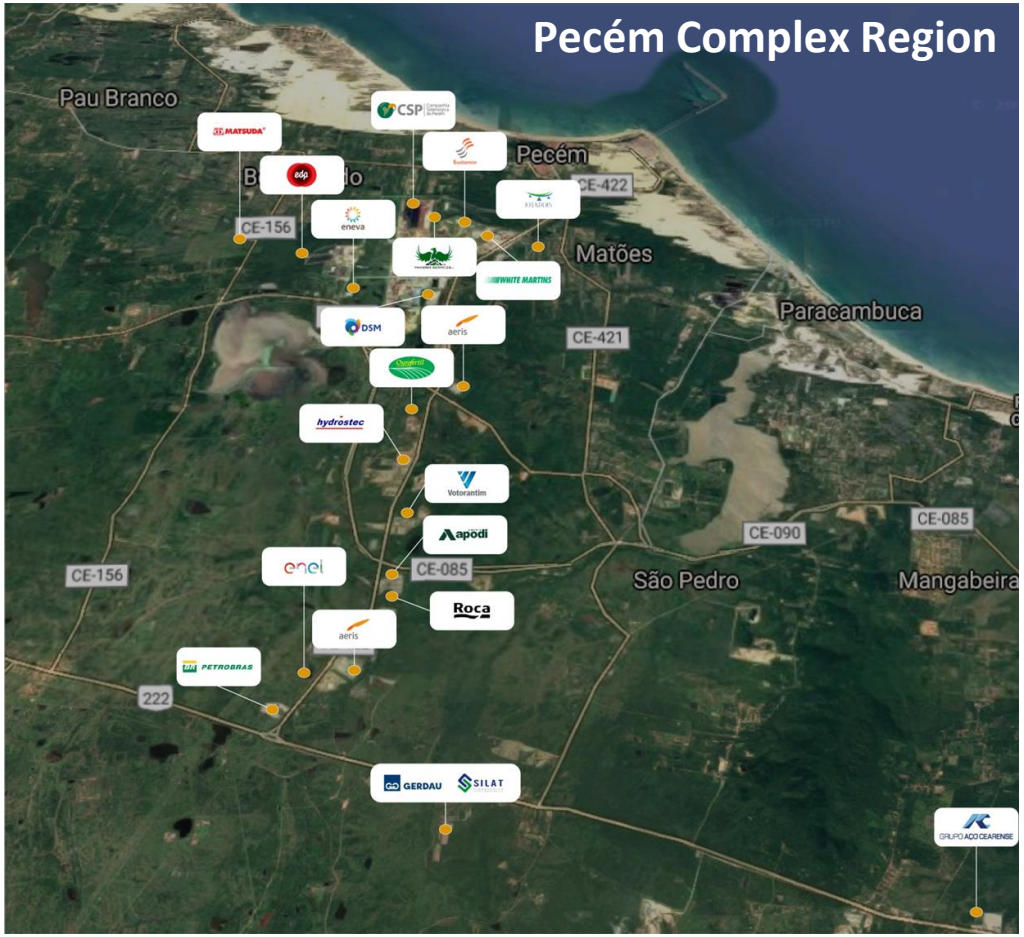
E. Electricity available to hub
Gives access to the SIN at the 500 kv voltage level, currently supports a 1,5-3GW power generation connection

Source: CIPP

Part of the Green Hydrogen is expected to be exported and part to be commercialized locally

POTENTIAL OFFTAKERS

- The Port of Pecém and the Port of Rotterdam will be the closest H2 export/import route between South America and Europe.
- With an estimated production of 1.3 million tonnes H2/year in 2030, Complex of Pecém could potentially **meet 25% of Rotterdam's import demand.**
- The demand for Green Hydrogen in and though Rotterdam to Germany could reach 20 million tons/year by 2050, of which 18 million tonnes will come from imports.



- Cement;
- Fertilizers;
- Non-metallic minerals;
- Green synthetic fuels; and
- Steel industry

Source: Port of Rotterdam and CIPP

Currently in Pecém, there are several industrial and logistic activities

CLUSTERS IN THE PECÉM COMPLEX

Energy

- 2 coal-fired power plants:
- EDP (720 MW)
- Eneva (365 MW)

- 2 gas-fired power plants:
- Petrobrás (220 MW)
- Eneva (326,6 MW)

Wind

- 2 wind blade factories

- Offshore wind projects

Metal

- 1 integrated steel mill (steel slabs)
- 1 metal material recovery plant (slag)
- 1 industrial gas manufacturing plant

- 1 flat steel / long steel mill

- 2 seamed steel tube factories

Mineral

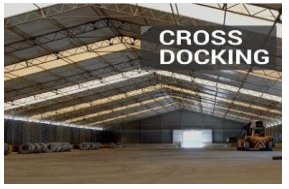
- 3 cement factories

- 1 precast concrete plant

Animal Nutrition

- 2 animal nutrition factory

Logistics Services



- 4 companies offering logistical services in a non-customs area
- Storage
- Cross-docking
- Pre-Trip Inspection

- Truck-center (under construction)

Source: CIPP

In line with those advantages, several companies have signed MoU´s with the State of Ceará

H2 INITIATIVES AND PRE-CONTRACTS SIGNED WITH CIPP

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edp

Primeira Molécula H2V Dezembro 2022

The goal of the 1.25 MW green hydrogen pilot plant, built with an $8 million investment and powered by 3 MW photovoltaic generation, is to test the solution to be adopted to decarbonize its 720 MW coal-fired power plant and simulate the green hydrogen production chain, from scalability to generation partnerships, storage, and mobility, among others.

MOUs SIGNED WITH THE STATE OF CEARÁ

Source: CIPP and Ceara State Government

The Ceara State´s Project aims to mitigate risks for private investors in the Green Hydrogen chain and thus accelerate the transition from pilot projects to industrial scale

GOALS

- Such risk mitigation will come from investments in the shared support infrastructure necessary for the effective implementation of the H2V chain in Pecém.
- This effort will support a national agenda for competitive H2V development in the country and its insertion in international markets.
- The lessons and learnings from this pilot experience may inform the development of similar initiatives in other parts of the country and there is potential replicability of the program.

STEPS

- Expansion of the current Multi-Utility Terminal to allow the implementation of a docking berth to handle large project cargoes and inputs for the H2 production chain
- Pier 2 expansion for H2V and derivatives (ammonia) operation to allow the H2V (ammonia) export movements
- Implementation of utility corridor infrastructure and Ammonia Storage Shared Area

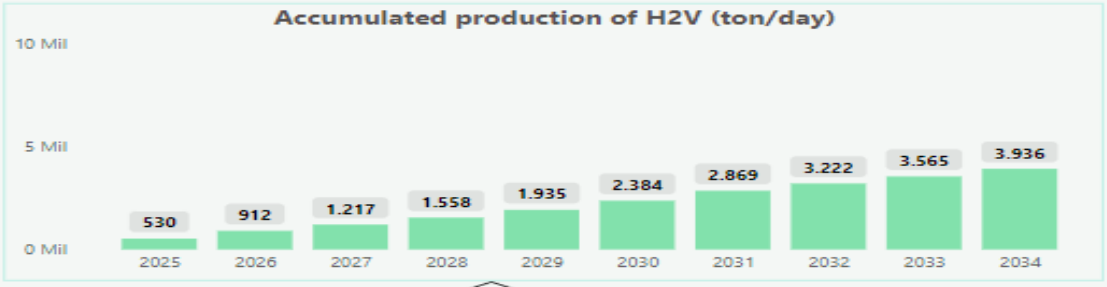
INVESTMENTS

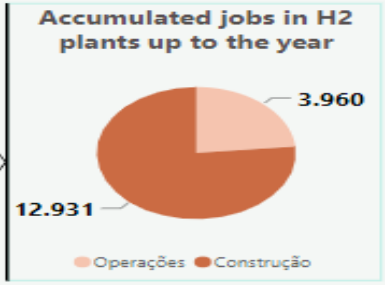
- The investments for the infrastructure are already included in CIPP's Business Plan, so the operation aims to finance the needs of the future operations
- Investments for Waste Water Treatment, Desalination and Demineralization projects are already being planned

This projection is based on a conservative scenario and in the growth of Green Hydrogen production based on investors that are already paying for the reservation of the area in the Free Trade Zone of the Pecem Port

GREEN HYDROGEN OVERVIEW IN CEARÁ UP TO 2034*

ESTIMATED HUB H2 PLANTS



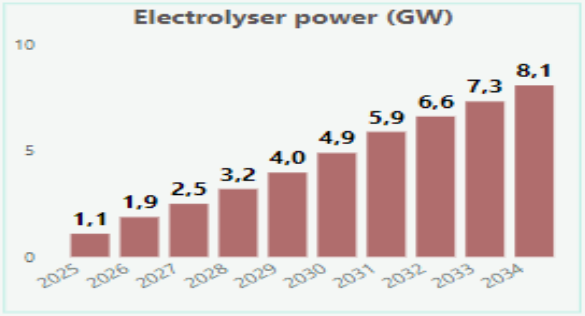


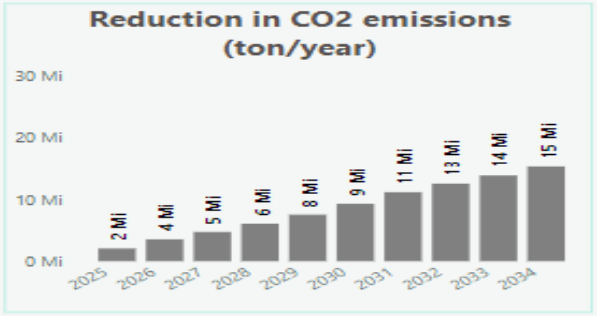
Accumulated investment up to the year (US$)

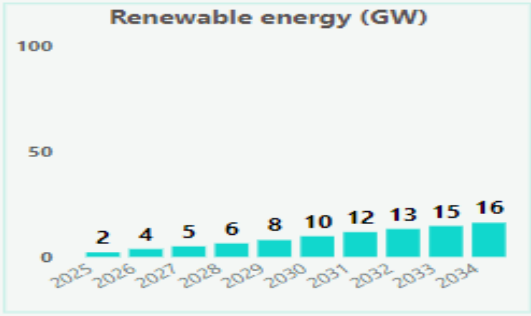
$26 Bi

- H2 Plants: 12,1 Bi
- Wind Farms: $10,5 Bi
- Solar Parks: $3,1 Bi

ESTIMATE OF ACCUMULATED DEMAND FOR RESOURCES FOR H2 PRODUCTION







Maximum water demand (m^3/s)

0,49

Conservative Scenario

* The values are estimates that were prepared based on market studies, consultation with investors in the sector and the number of MOUs signed with the States so far.

Source: Estimates prepared by the technical team of the SEDET Green Hydrogen HUB on 09/30/2022

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