

Case study: industrial decarbonisation infrastructure in Brazil

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The energy transition demands accelerating renewables deployment and a structural surge in electricity demand from electrification.

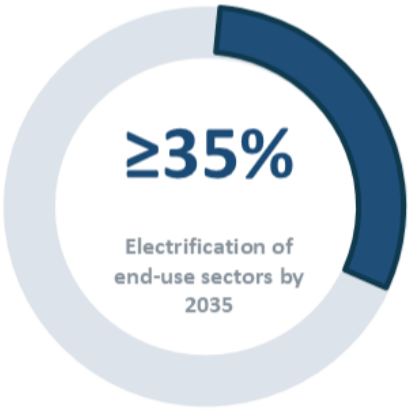
- Renewables beat coal globally in H1 2025 for the first time on record.
- 90% of industrial energy demand is electrifiable with technology that exists today.
- Fossil fuel crisis triggered factory closures across Europe and APAC, from Pakistan to South Korea - a structural vulnerability exposed.
- Energy security and climate action now demand the same response: a grid revolution.

ELECTRIFICATION

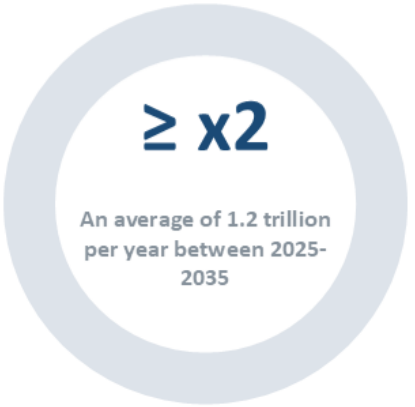
Transport

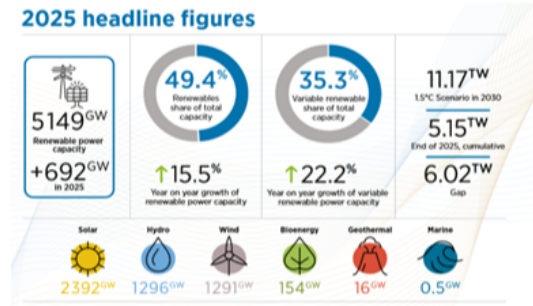
Buildings

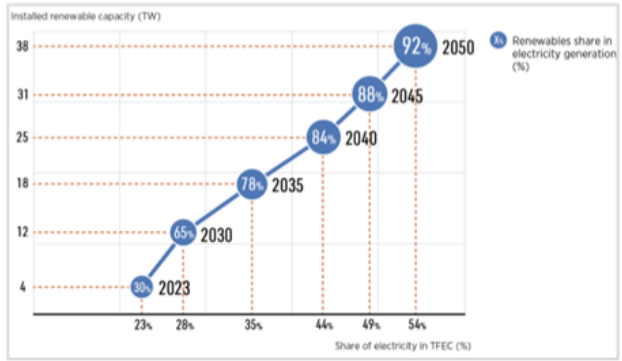
Industry

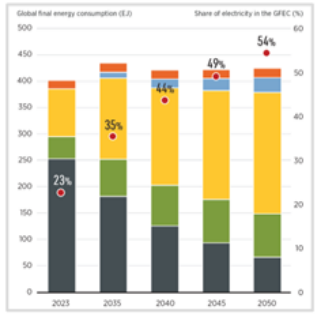


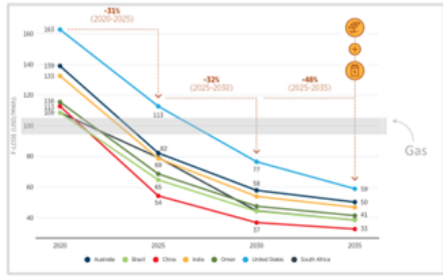
GRIDS











Source: IRENA (2026)

A low-carbon electricity system as the basis for industrial development in Brazil

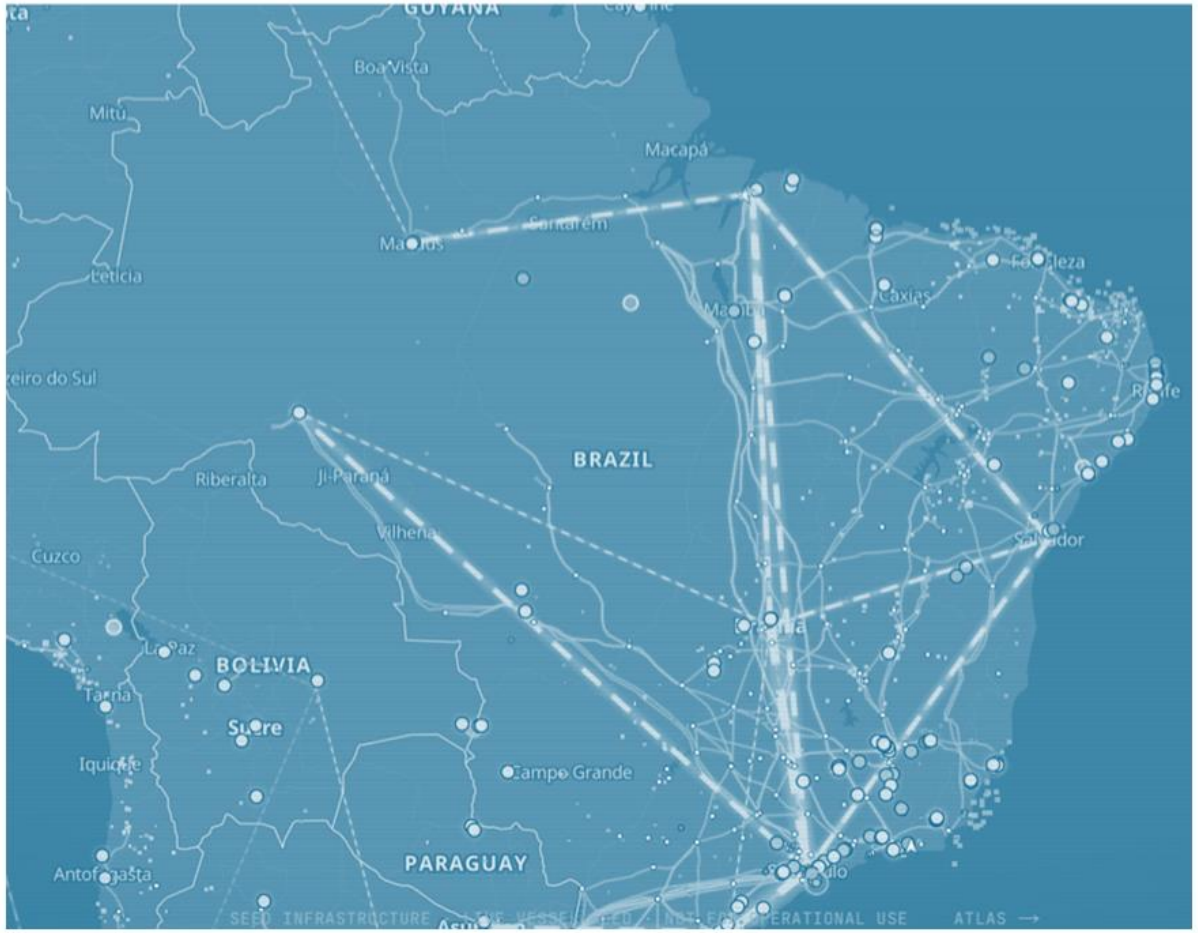
- Brazil's electricity supply is among the **least carbon-intensive** of the large industrial economies
- Three industrial value chains are being developed on that basis: low-carbon **hydrogen** and **ammonia** at Pecém, hot-briquetted **iron** for steel, and low-carbon **fuels**.
- BNDES is being strengthened to **accelerate the transition**, channelling a billion-dollar programme to decarbonise energy-intensive industries, mobilise private capital and reduce industrial greenhouse gas intensity.
- IRENA's joint analysis with BNDES detailed how **strategic energy planning** and **development finance** can successfully collaborate to attract private investment.



Source: IRENA, OECD, World Bank;

Industry is 11 per cent of Brazil's emissions and a larger share of its export exposure

Carbon is a condition of access to export markets, which gives industrial emissions a commercial price



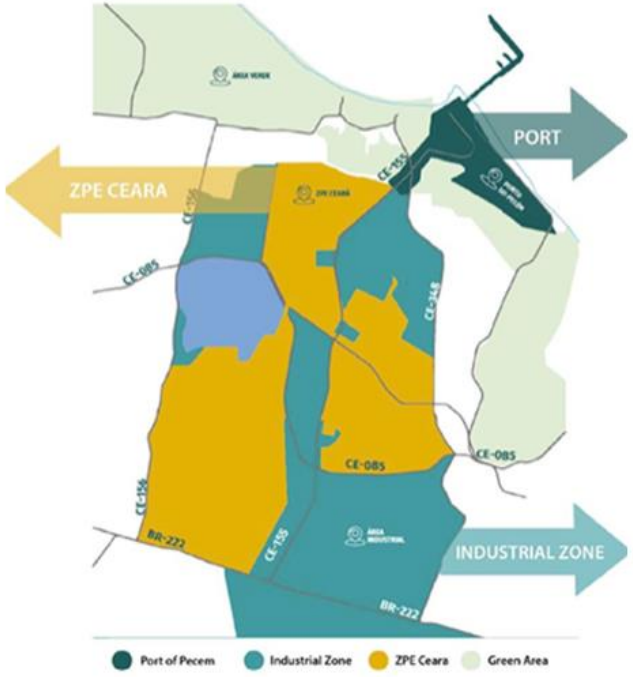
- Brazil's net emissions were 1,489 MtCO2e in 2024, of which **industry** accounted for approximately 163 MtCO2e, or 11 per cent
- Iron and steel, cement, and chemicals and fertilisers represent **65 per cent of industrial emissions**.
- Crude **steel** output was 33.34 Mt in 2025 and exports to Europe doubled to 1.38 Mt
- The national target is a **30 per cent reduction** in the emissions intensity of industrial GDP by 2033.

Source: CIF, Aço Brasil, Ministry of Finance

Pecém concentrates port, grid and industrial demand in one location

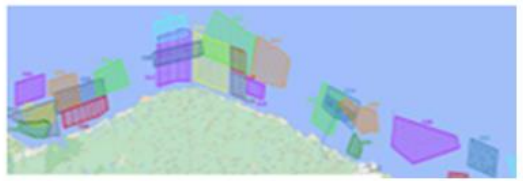
Co-location answers the transport and offtake questions that stall comparable projects

- The complex lies approximately fifty kilometres from Fortaleza, held jointly by the state of Ceará and the Port of Rotterdam, with a free trade zone and **steel**, **power** and **cement** plants on site.
- Design parameters for the hydrogen hub are 6 GW of **renewables** and 2 GW of **electrolysers**, with headroom to 3 GW; phase one pairs 500 MW with 400,000 tonnes of **ammonia** a year.

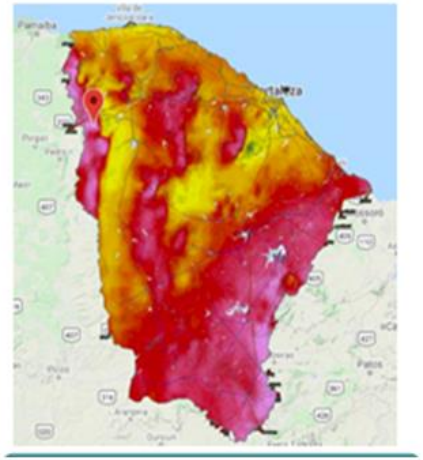




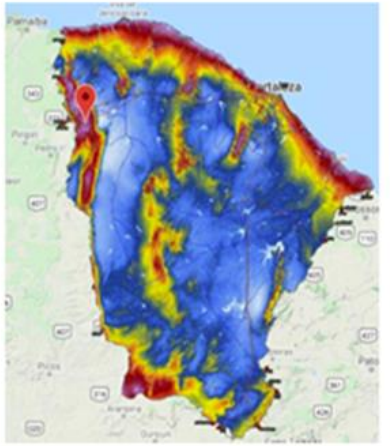
Projetos *offshore* em desenvolvimento



Mapa Energia Solar



Mapa Eólico *Onshore*



Source: GIZ, World Bank; CIPP

Transmission capacity, not the resource, delayed the first projects at Pecém

Grid connection queue, not the capital, sets the pace of industrial decarbonisation

- At the design stage, **transmission** availability at Pecém was approximately 300 MW against a requirement of at least 1.5 GW. In 2025 the system operator declined connection requests from north-east hydrogen projects, citing **overload and voltage collapse** risk, including a 0,9 Mt ammonia project at the port.
- Two measures followed: Decree 12,772 of December 2025 released 19 Ceará projects, seven of them hydrogen, from the connection queue, and the 2026 transmission auction contracted **synchronous condensers** for Ceará and Rio Grande do Norte.
- **Curtailment** remains material: cuts equal to 17.2 per cent of potential generation were recorded in the first four months of 2026, against 15.3 per cent a year earlier.



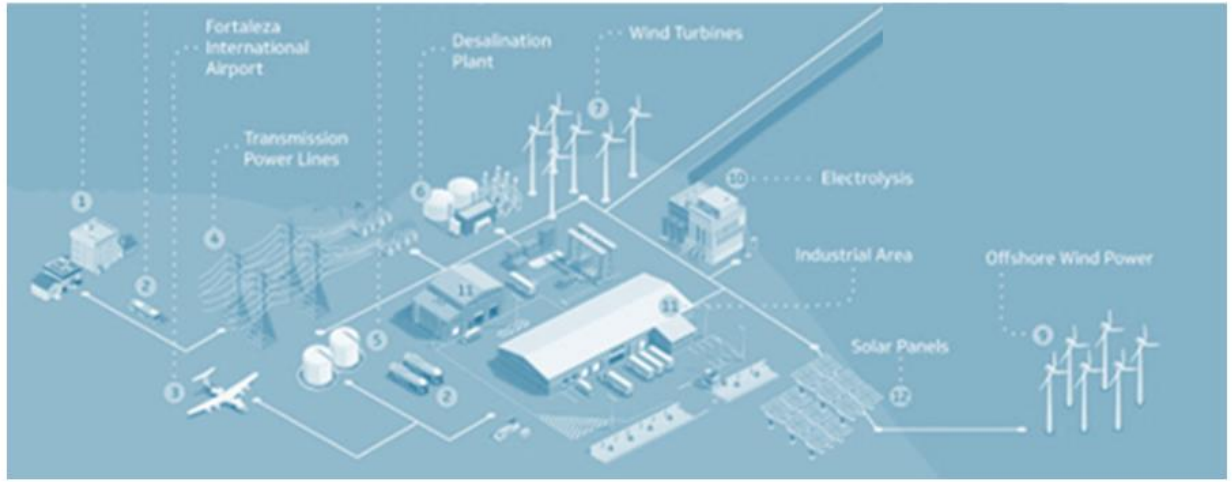
Source: Aneel, ONS, World Bank project document

Three value chains are being financed in parallel on one national platform

Different buyers and different technologies, which is what keeps the pipeline standing when one chain slips

- **Hydrogen and ammonia for export**

  The Fortescue project at Pecém is designed for 168,000 tonnes of hydrogen a year, equivalent to 946,000 tonnes of ammonia, on 2.1 GW of contracted renewables.



- **Green iron and steel**

  The pipeline lists hubs for hydrogen and hot-briquetted iron at USD 2 billion, and for steel decarbonisation at USD 3 billion, with Vale and the Port of Açu studying a direct reduction route.

- **Low-carbon fuels**

  Activated clay is listed at USD 700 million, and a USD 1.5 billion biorefinery for sustainable aviation fuel closed financing in May 2026.

Source: Fortescue, Ministry of Finance, Vale

Demand at the site, a cost edge, and rules that name the product: the three conditions behind investability

Each conditions need to be addressed to reach investment decision



- **Off-take** Industrial demand is present at the site: steel, cement and power plants operate at Pecém and an operator has been identified for the ammonia terminal, so a project does not need to create its own market.
- **Cost position** The Ministry of Mines and Energy estimates technical potential of 1.8 billion tonnes of low-carbon hydrogen a year, and ammonia can be directed towards the nearest large market, Europe.
- **Regulation** Law 14.948 of 2024 established the national policy, an authorisation route, a certification system and R$18.3 billion in tax benefits; Decree 13.096 of August 2026 brought the rules into force.

Source: Ministry of Mines and Energy, World Bank

Public finance sets the terms on which private capital enters the pipeline

The memorable part is the sequence: platform, bank anchor, concessional capital

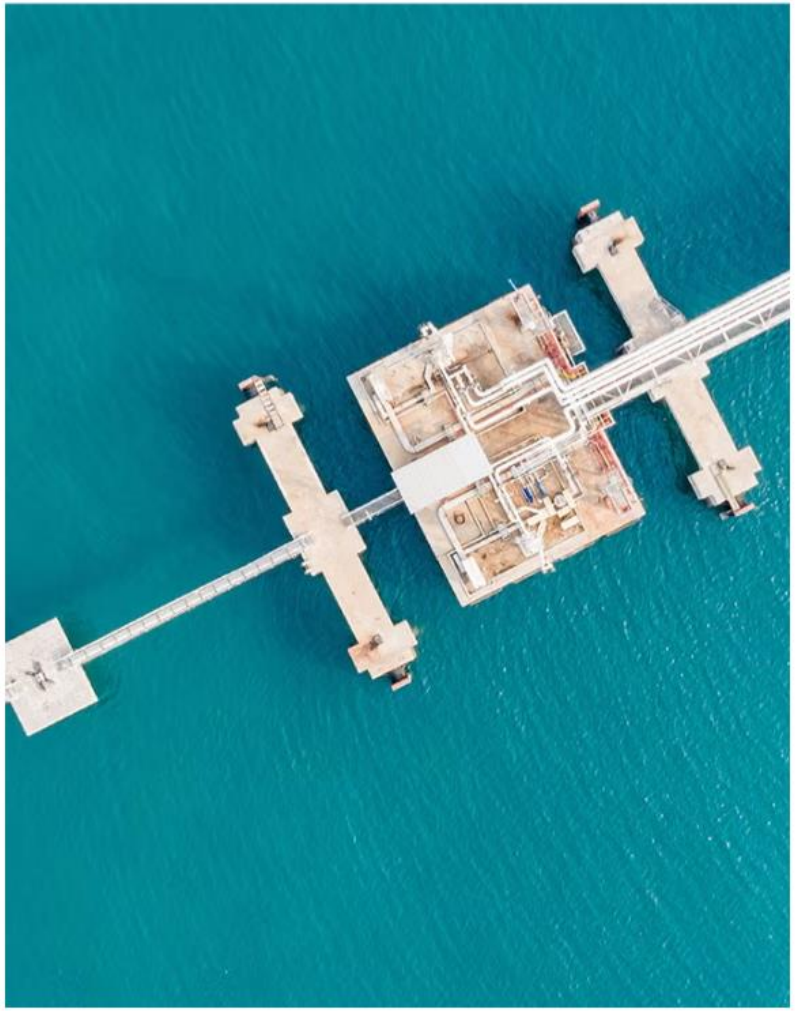
- In 2026, the World Bank Group approved a USD 1.06 billion operation, comprising a USD 1 billion IBRD loan and USD 60 million from the Clean Technology Fund, channelled through the **national development bank (BNDES)** and expected to mobilise a further USD 1.8 billion across *steel, cement, chemicals, aluminium and shared hydrogen and ammonia* **infrastructure**.
- The same year, the Climate Investment Funds endorsed a USD 250 million plan for Brazil, expected to catalyse over USD 3 billion, including USD 1.36 billion of **private capital**, in *iron and steel, cement, and chemicals and fertilisers*.
- Both are routed through the **national climate and ecological transformation platform (BIP)**, which lists 23 projects across 8 sub-sectors and USD 27.1 billion of potential investment.



Source: World Bank, CIF, Ministry of Finance

Replication holds where a hub, a customer and a policy signal already line up

Grid access and verified emissions data decide whether the next hub advances or waits, and both are still open



- **Other Brazilian hubs meet parts of the conditions**

  Suape, in Pernambuco, and Açu, in Rio de Janeiro, are developing hydrogen and iron capacity, and green shipping corridors connect Pecém, Piauí and Sergipe to Europe.

- **Grid connection remains the gate**

  Capacity is released project by project, and each new industrial load competes for the same transmission.

- **Verification requirements are tightening**

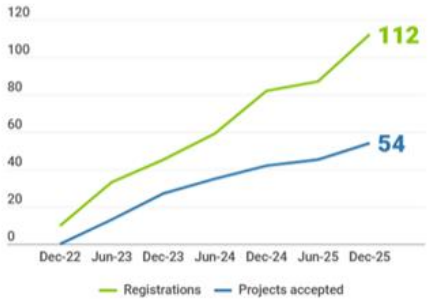
  Brazil now regulates hydrogen certification, and carbon border claims require verified facility-level data rather than national averages.

Source: IRENA, Aneel

IRENA Project facilitation platforms ETAF and CIP carry the work from project preparation to capital mobilisation

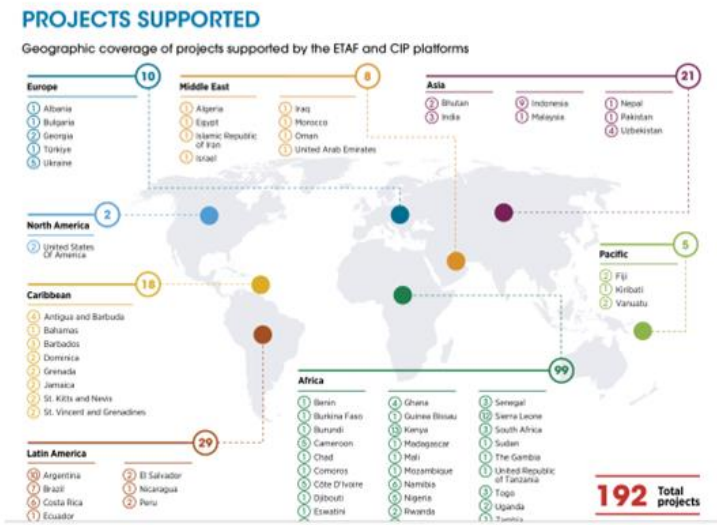
- ETAF is an inclusive, **multi-stakeholder** climate finance platform. ETAF pursues facilitating capital mobilisation to scale up the development of renewable energy projects to advance the energy transition across emerging markets.
- CIP is a **joint initiative** with a mandate to increase capital mobilisation and renewable energy investment in developing countries.
- Both platforms work together towards the **facilitation of mobilisation of investment** towards renewable energy projects.

ETAF | Energy Transition Accelerator Financing Platform





1GW under construction, powering **1 Million households** by 2026



CLIMATE INVESTMENT PLATFORM

IRENA's convening efforts make cross-border infrastructure cooperation easier

- IRENA ensure evidence reaches each of its members countries
- IRENA's convening power is the mechanism that gets it to them on equal terms.
- IRENA provides the, coordination platform, and implementation bridge that no single government or company can produce alone.



GOWA
Global Offshore Wind Alliance

UNEZA
UTILITIES FOR NET ZERO ALLIANCE

GLOBAL COALITION
FOR ENERGY PLANNING



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