CARBON CAPTURE, UTILIZATION AND STORAGE IN BRAZIL

CONTRIBUTIONS TO AREA SELECTION: 2025 CYCLE

EXECUTIVE OVERVIEW

Oil and Natural Gas Superintendency
2026

epe 20+

MINISTÉRIO DE MINAS E ENERGIA

GOVERNO DO BRASIL
DO LADO DO POVO BRASILEIRO

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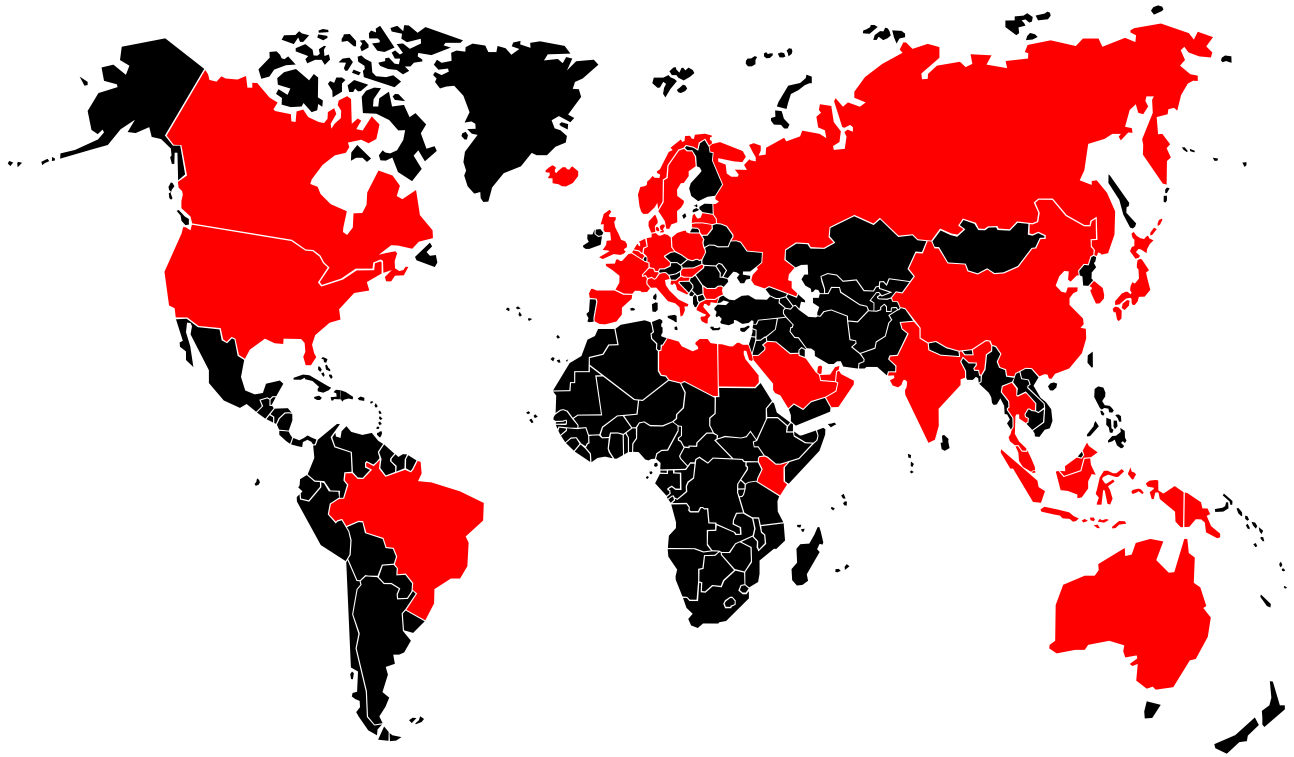
PUBLIC VALUE

EPE conducts studies and research to support the formulation, implementation, and evaluation of Brazil's energy policy and planning.

Within the decarbonization agenda, EPE contributes to improving the quality of the debate and supporting decision-making on carbon capture, transport, utilization, and geological storage pathways in Brazil, through the organization and systematization of relevant technical information.

The second edition of this publication expands and updates the database, incorporating methodological enhancements designed to more accurately reflect the geological, productive, and logistical diversity of the country's different regions. Acknowledging the limitations inherent to this exercise, the document is presented as a technical reference to support planning and the prioritization of opportunities across carbon capture and storage pathways, while also helping to reduce information asymmetries among institutions, sector stakeholders, and society at large.

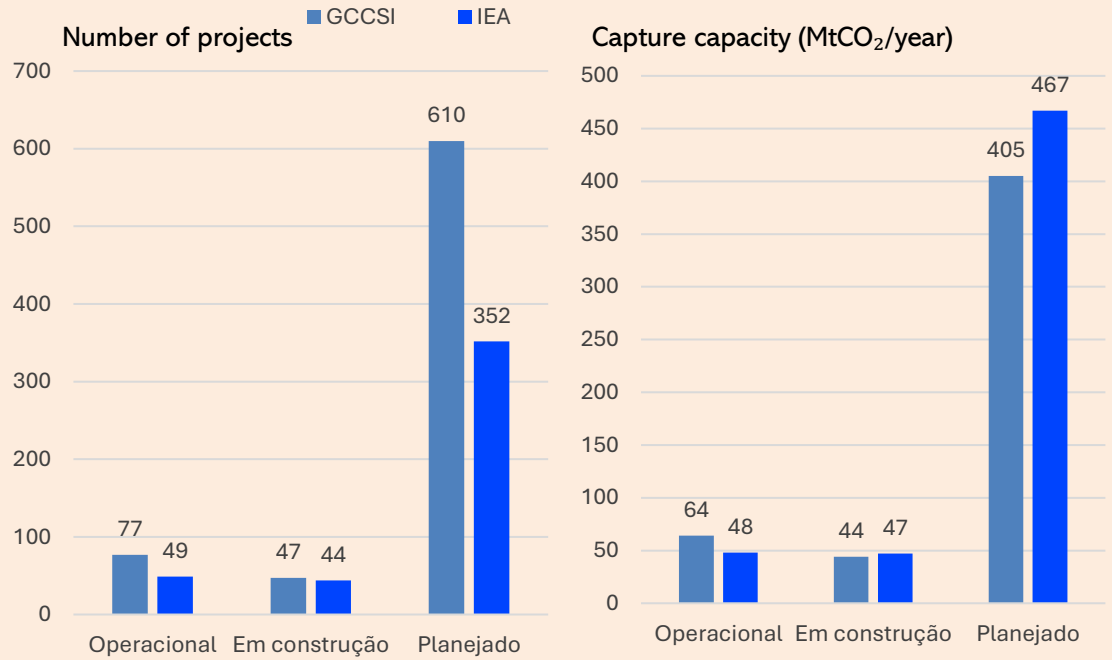
Accelerated expansion phase, driven by more robust policies, increased private-sector engagement, and the expansion of global infrastructure.

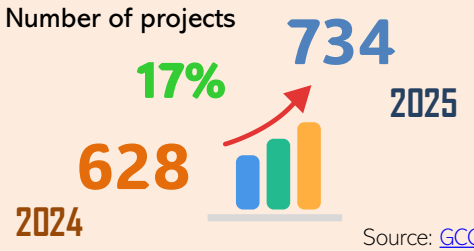


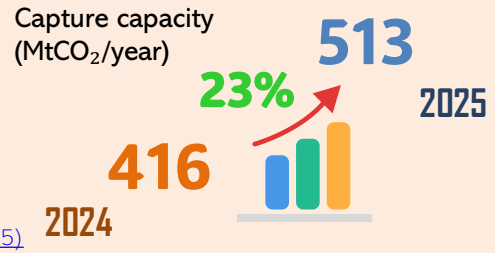
2025 marked a milestone with the **start of operations of Northern Lights**, the **world's first cross-border CO_2 transport and storage hub.**

CCS PROJECTS AND CAPTURE CAPACITY WORLDWIDE, IN 2025

Sources: GCCSI (2025) and IEA (abr/2025)







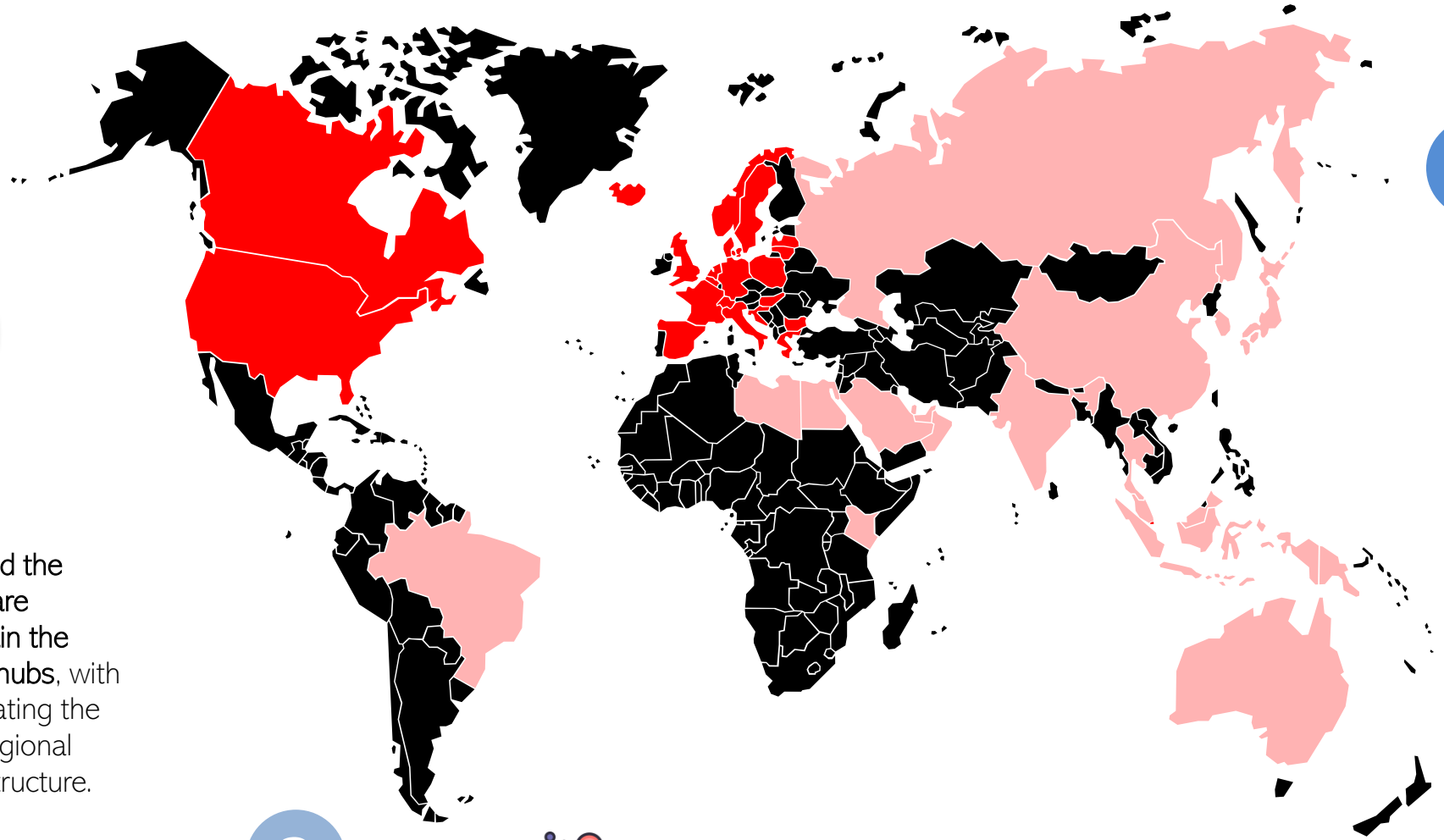
Source: GCCSI (2025)

[1] *The acronym CCS (carbon capture and storage) is used as an umbrella term to encompass the different pathways involving CO_2 capture—whether from point sources or directly from the atmosphere—its transport, and its storage, whether permanent or not (thus including utilization pathways).*

By the end of the decade…

1

North America and the European Union are expected to remain the **main global CCS hubs**, with the latter accelerating the deployment of regional hub-based infrastructure.



Employment growth associated with projects in:

2

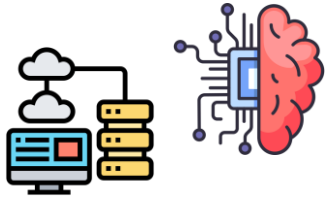
HYDROGEN

LOW-CARBON AMMONIA

POWER GENERATION

INDUSTRIAL HEAT

3



The integration of **CCS with natural gas-fired power plants** enables the provision of firm, competitive, and low-carbon electricity, a relevant attribute to **support the projected expansion of artificial intelligence data centers**.

2024

oct — Law No. 14,993/2024 Fuel of the Future

COMBUSTÍVEL DO FUTURO

dec — Law No. 15,042/2024 Brazilian Emissions Trading System (SBCE)

SBCE Implementation Roadmap
Ministry of Finance

2025

jul — Establishment of the CCUS Subcommittee Oil and Natural Gas E&P Policy Department (DEPG/SNPGB/MME)

oct — Decree No. 12,677 Establishment of the Extraordinary Secretariat for the Carbon Market (Semc)

nov — Public consultation on the draft decree regulating CCS/CCUS/BECCS

dec — Decree No. 12,768 Establishment of the Permanent Technical Advisory Committee of the SBCE

CLIMATE PLAN AND THE ROLE OF CCS PATHWAYS IN BRAZIL

In the Climate Plan (2024–2035), BECCS and CCS/CCUS are addressed as relevant pathways to support the achievement of climate targets, by enabling both emissions mitigation in hard-to-abate sectors and the compensation of residual emissions over the long term **(MMA, 2025)**.

Four related structural actions are identified:

CCS/CCUS[1]

ENR.E.08 - Develop Carbon Capture, Transport, Use, and Storage

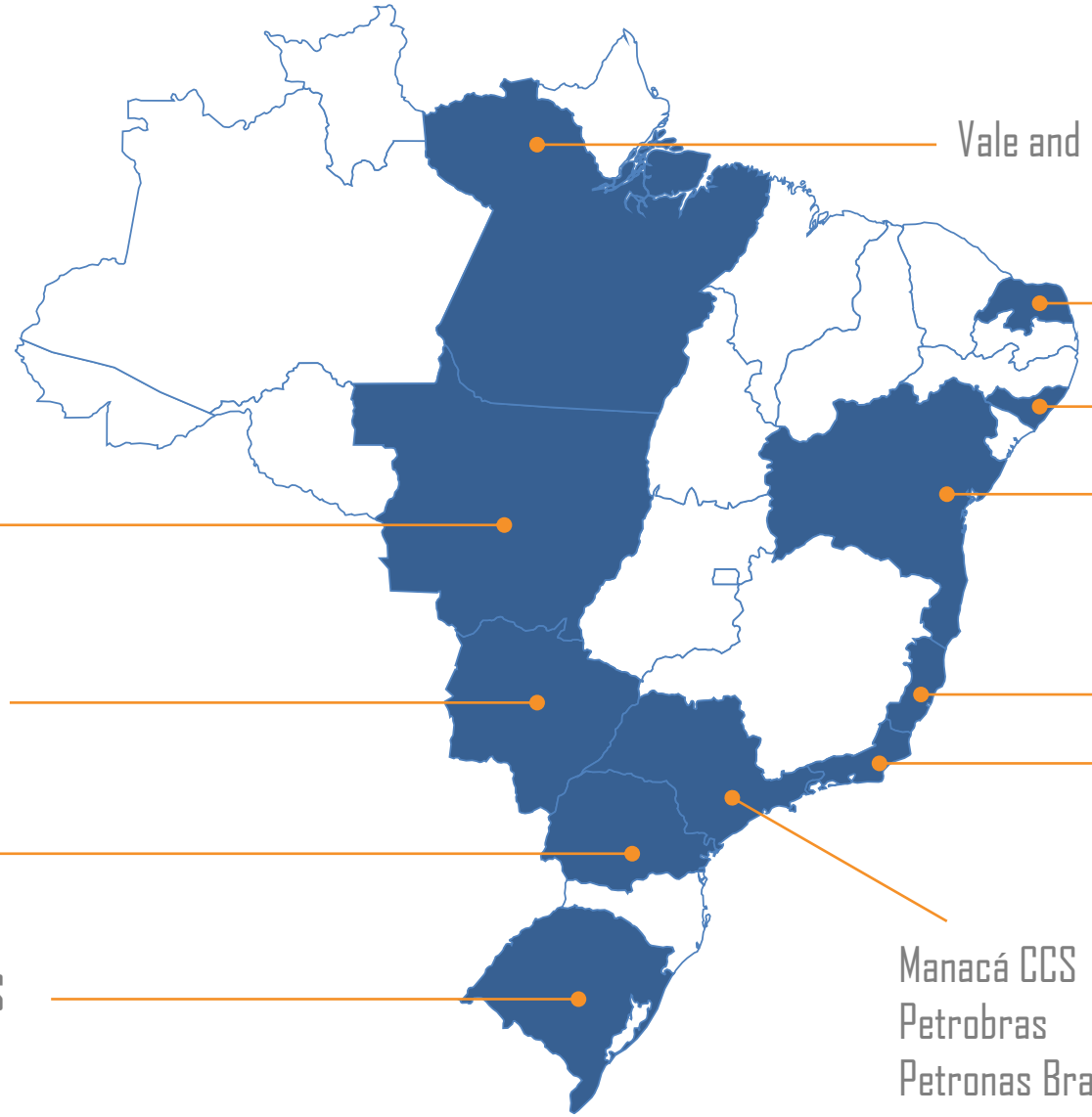
BECCS

ENR.E.09 – Develop bioenergy production with carbon capture and storage (Bio-CCS)

ENR.E.10 – Strengthen biomass production for energy use

ENR.E.13 – Promote infrastructure for carbon dioxide transport and storage

[1] CCS and CCUS solutions are linked to a specific long-term structural action (ENR.E.08), which is directly influenced by other actions, such as ENR.E.13



Vale and Circlua

Repsol and UFRN

Origem Energia

Petrobras e Braskem

FS
UISA

ISI Biomassa, Petrogal Brasil and
LIPACT/UFRJ

Petrobras

Petrobras

Repsol and SENAI CIMATEC
ExxonMobil and Lagesed (UFRJ)

Repsol Sinopec Brasil and PUC/RS
Eneva

Manacá CCS
Petrobras
Petronas Brasil and Unicamp

Objective

MAPPING

Update the relevance map for carbon capture, transport, and geological storage, integrating the technical and economic evidence currently available in Brazil

Axis 1

METHODOLOGY

Enhance the methodology developed since the first cycle (published in 2024), expanding the capacity for data extraction, qualification, and interpretation

Axis 2

HOTSPOTS AND ROUTES

Identify and differentiate hotspots suitable for different pathways (CCS, BECCS, DACCS, and CCUS), considering geological and logistical conditions

Axis 3

INDUSTRIAL SECTORS

Map sector-specific opportunities and challenges, supporting the assessment of carbon capture and storage pathways as an industrial decarbonization strategy

Axis 4

PLANNING

Strengthen EPE's contribution to CCS/BECCS/DACCS/CCUS planning, enhancing coherence between public policy guidelines and regional realities

Axis 5

INTEGRATION

Consolidate EPE as a national reference by connecting CCUS to other decarbonization alternatives in the energy and industrial sectors

POTENTIAL CCS/CCUS DEMANDERS

Identifies industrial facilities facing greater decarbonization challenges and, therefore, with a higher likelihood of considering CCS/CCUS as a mitigation pathway. It highlights the spatial distribution of major emission sources, enabling the identification of industrial clusters with potential to support hubs, shared infrastructure, and systemic cost reductions—while also indicating where higher demand for carbon credits may emerge.

Seven sectors are considered: steel, cement, oil and gas (O&G) production, refining, chemical industry, mining, and fossil-fuel-fired thermal power plants (TPPs). For steel, cement, chemicals, and mining, emissions estimated for 2024 are used; for O&G production and refining, 2023 data are adopted. In the case of fossil TPPs, only plants operating between 2021 and 2025 are included, using the period average to reduce the influence of hydrological variability on thermal dispatch.

BECCS - POTENTIAL AVAILABILITY OF BIOGENIC CO_2

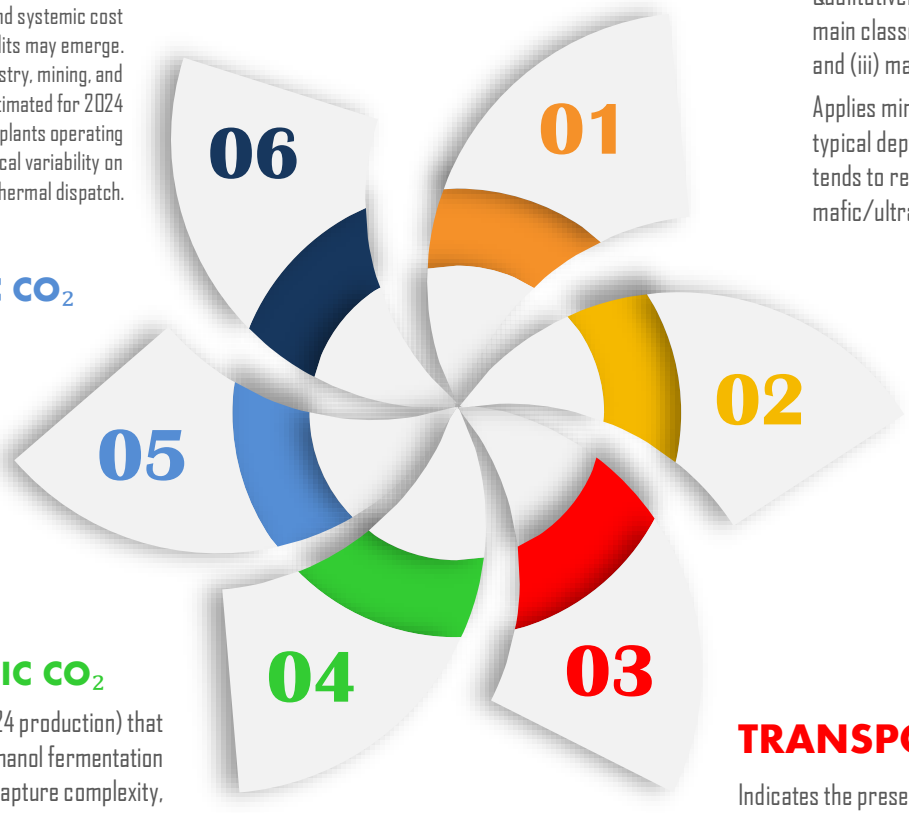
Broadens the analysis to less immediate opportunities associated with future expansion - such as new ethanol plants and increased biomethane production - as well as sources requiring additional capture infrastructure (e.g., cogeneration exhaust gases or processes with more diluted CO_2 streams, such as pulp and paper industries).

Supports medium-term planning by indicating where BECCS may expand through more robust investments and industrial integration, helping anticipate infrastructure needs (transport and storage) and policy measures required to enable scale-up.

BECCS - IMMEDIATE AVAILABILITY OF BIOGENIC CO_2

Represents currently available biogenic CO_2 sources (based on actual 2024 production) that generate relatively pure and concentrated streams - particularly from ethanol fermentation (sugarcane and corn) and biomethane-related pathways. Given their lower capture complexity, these sources tend to require more limited investments (e.g., compression, logistics, and storage).

Functions as a short-term prioritization indicator for BECCS, identifying where projects are more likely to be deployed rapidly, accelerating learning effects, market development, and the potential large-scale generation of negative emissions.



STORAGE SITES

Qualitatively identifies geological formations with potential for subsurface CO_2 storage. Three main classes are considered: (i) depleted or depleting oil and gas fields, (ii) saline reservoirs, and (iii) mafic/ultramafic rocks with mineralization potential (storage via chemical reaction).

Applies minimum viability criteria: the presence of a geological seal (to reduce leakage risk); a typical depth of ≥ 800 m for depleted fields and saline reservoirs (conditions under which CO_2 tends to remain in a supercritical state); and a differentiated criterion of ≥ 400 m for mafic/ultramafic rocks, reflecting the nature of mineral trapping mechanisms.

KNOWLEDGE FRAMEWORK

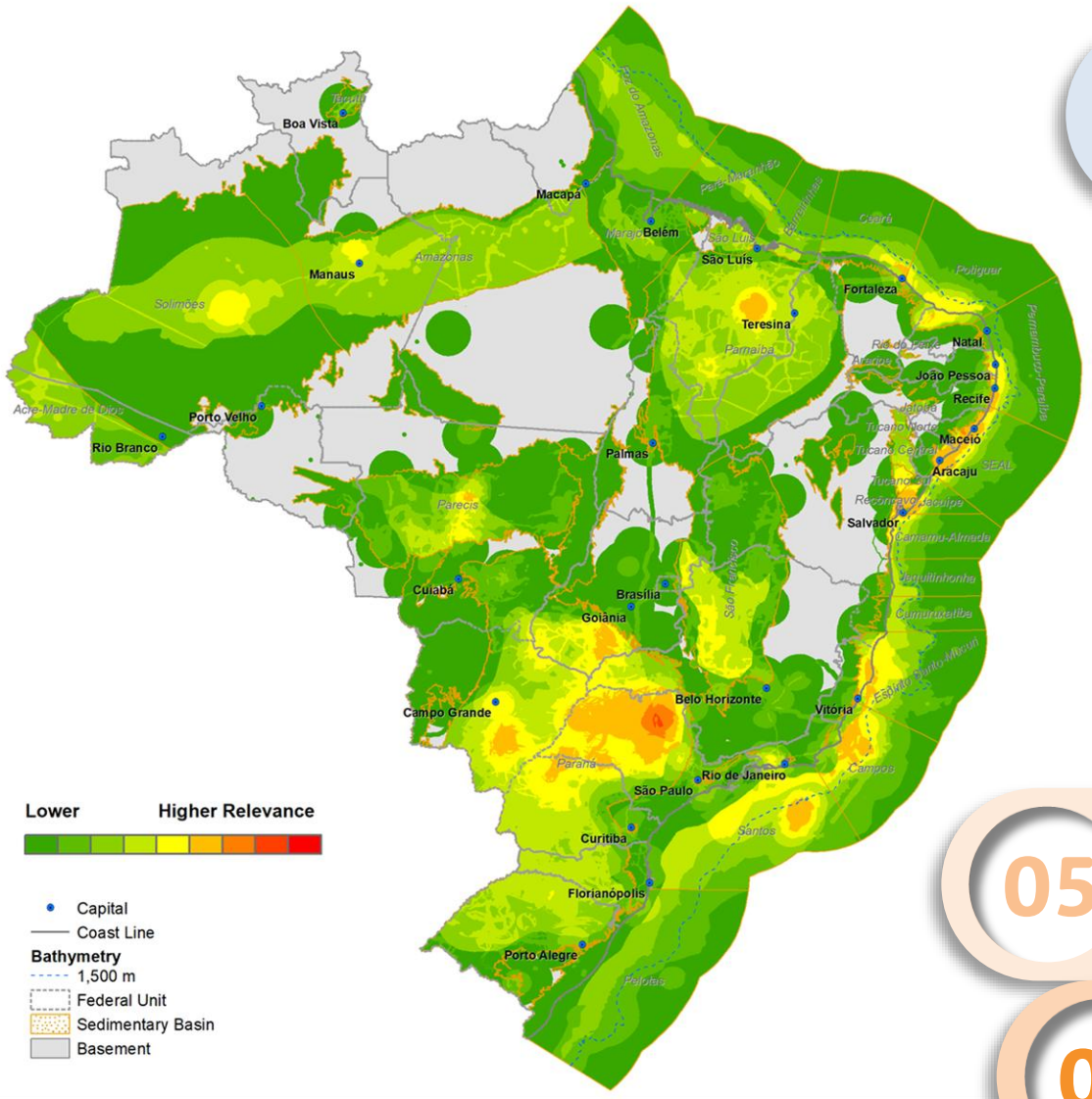
Shows where geological and geophysical data are available to support more reliable technical decisions regarding geological CO_2 storage. It serves as an indicator of subsurface knowledge maturity, combining the presence of exploratory wells and 2D/3D seismic surveys.

In practice, it helps distinguish areas with higher uncertainty (limited data) from better-characterized regions (more extensive data), supporting the prioritization of investments in additional studies, exploratory campaigns, and risk reduction ahead of demonstration or commercial projects.

TRANSPORT INFRASTRUCTURE

Indicates the presence of infrastructure capable of enabling CO_2 transport from capture points to geological storage sites and/or utilization locations. The focus is on transport modes with established use or applicability in international projects: pipelines, port facilities, roads, and railways.

The underlying assumptions aim to reflect operational feasibility; for instance, port facilities with incompatible uses (e.g., tourism) and unpaved road networks that would hinder sustainable CO_2 transport by trucks are excluded. This layer is a key input for understanding costs, scale, and connectivity of potential hubs.



01 EXPLORATORY AND QUALITATIVE NATURE

The map is intended to indicate territorial trends that must be validated through project-specific analyses. It is reinforced that permanent storage is the priority, while CO_2 utilization is considered an additional benefit.

02 DIVERSITY OF STORAGE SITES

An increase in geological heterogeneity among basins is observed, with particular emphasis on proximal portions of offshore basins, regions with depleted oil and gas fields, and emerging prospects in basins such as the Paraná Basin.

03 DATA AND INFRASTRUCTURE BOTTLENECKS

Limited data availability in inland areas and the lack of dedicated CO_2 transport infrastructure remain key bottlenecks to the advancement of CCS pathways. Connecting emission sources to geologically secure and technically robust sinks is essential!

04 SHARED INFRASTRUCTURE AND HYBRID LOGISTICS

The development of hubs with shared compression and transport infrastructure is strategic to dilute costs and attract investors, while the combination of different transport modes helps overcome regional challenges and connect isolated emitters.

05 BIOENERGY AS A LEVER

The availability of high-purity CO_2 streams, combined with expansion potential, technological maturity, and integration with climate policies, positions the bioenergy sector as strategic for scaling up BECCS. Estimates from the PNE 2055 indicate a removal potential of over 140 $MtCO_2eq$ associated with the production of liquid biofuels and biomethane.

06 OPORTUNIDADES PARA AS EMISSÕES INDUSTRIAIS

The proximity between major emission hubs and areas with storage potential, combined with growing competitive pressures from policies such as the Carbon Border Adjustment Mechanism (CBAM), underscores the need to accelerate CO_2 hubs, with CCUS acting as a strategic solution to decarbonize hard-to-abate sectors.

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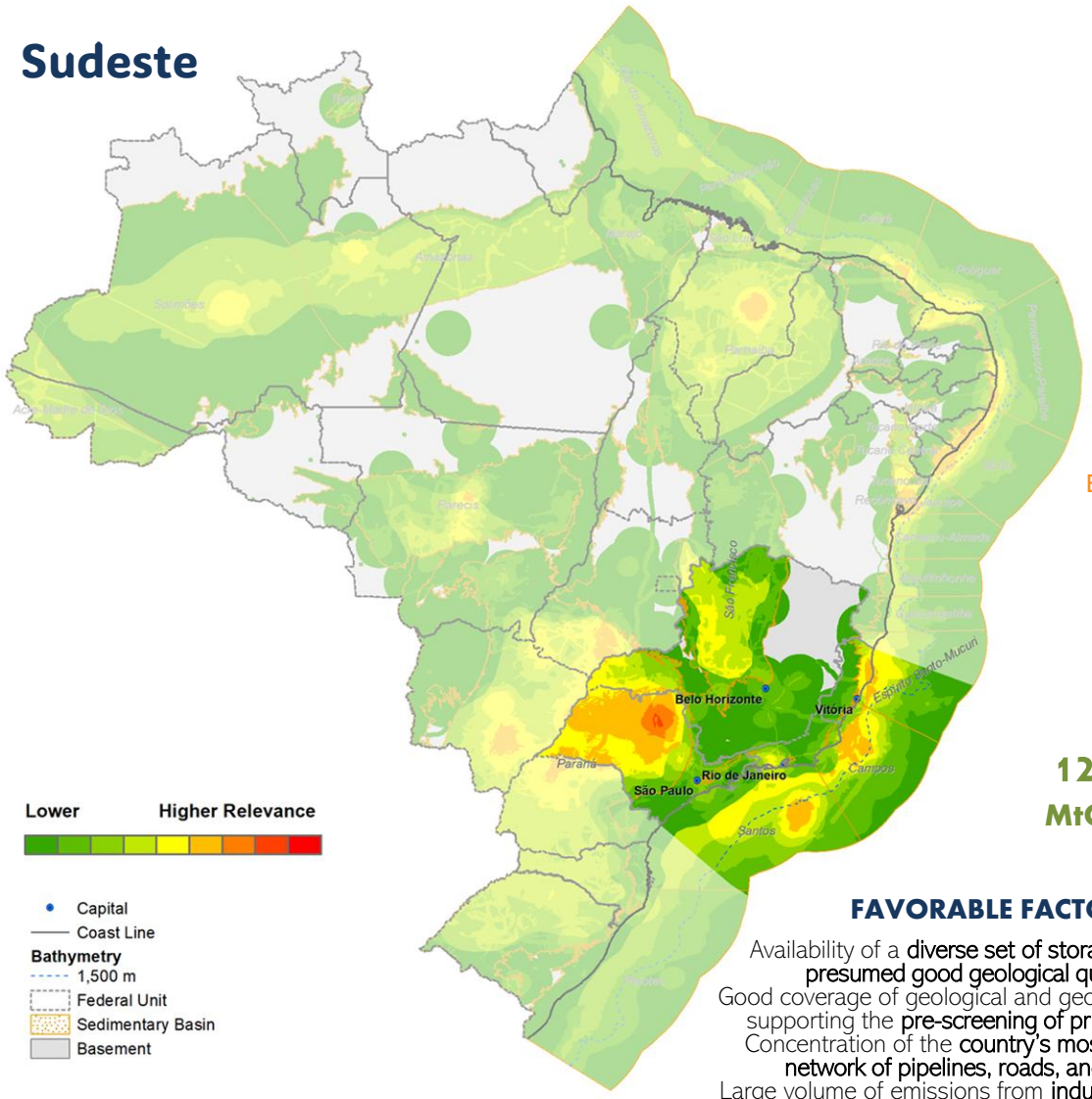
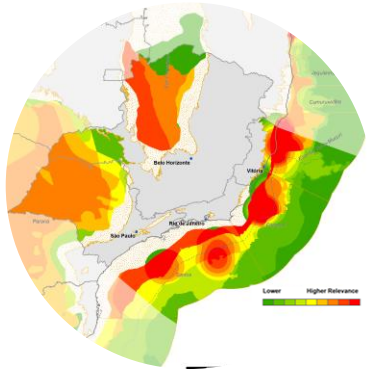
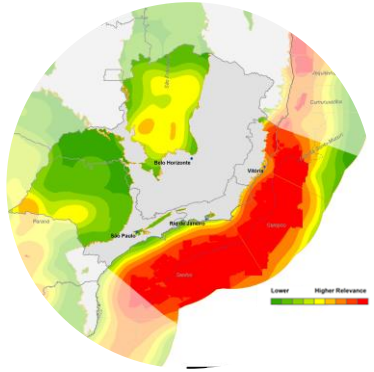
Sudeste



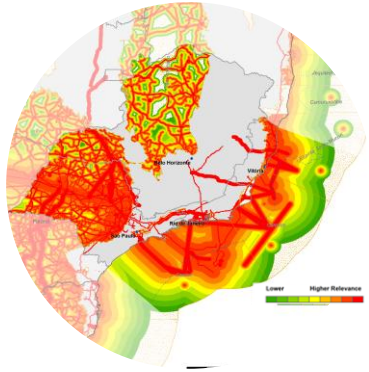
STORAGE SITES



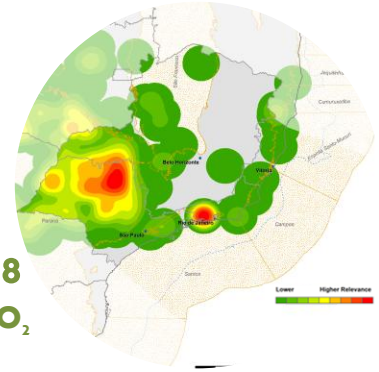
KNOWLEDGE FRAMEWORK



TRANSPORT INFRASTRUCTURE

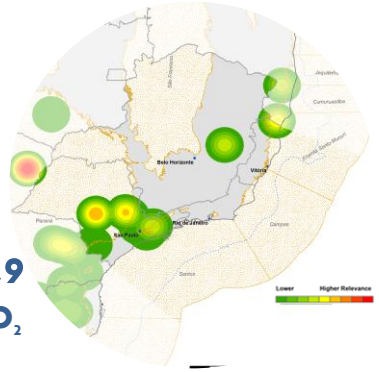


BECCS - IMMEDIATE AVAILABILITY



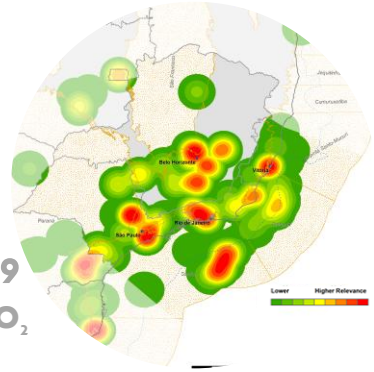
12,8 $MtCO_2$

BECCS - POTENTIAL AVAILABILITY



117,9 $MtCO_2$

POTENTIAL CCS/CCUS DEMANDERS



92,9 $MtCO_2$

FAVORABLE FACTORS

Availability of a **diverse set of storage sites of presumed good geological quality**.
Good coverage of geological and geophysical data, supporting the **pre-screening of priority areas**.
Concentration of the **country's most extensive network of pipelines, roads, and ports**.
Large volume of emissions from **industrial activities and the sugar-energy sector**.
Long-standing experience with continuous CO_2 **injection for EOR**.

KEY CHALLENGES

Storage sites located in **ultra-deep waters pose logistical and cost challenges** for **offshore storage**.

MARKET SIGNALS

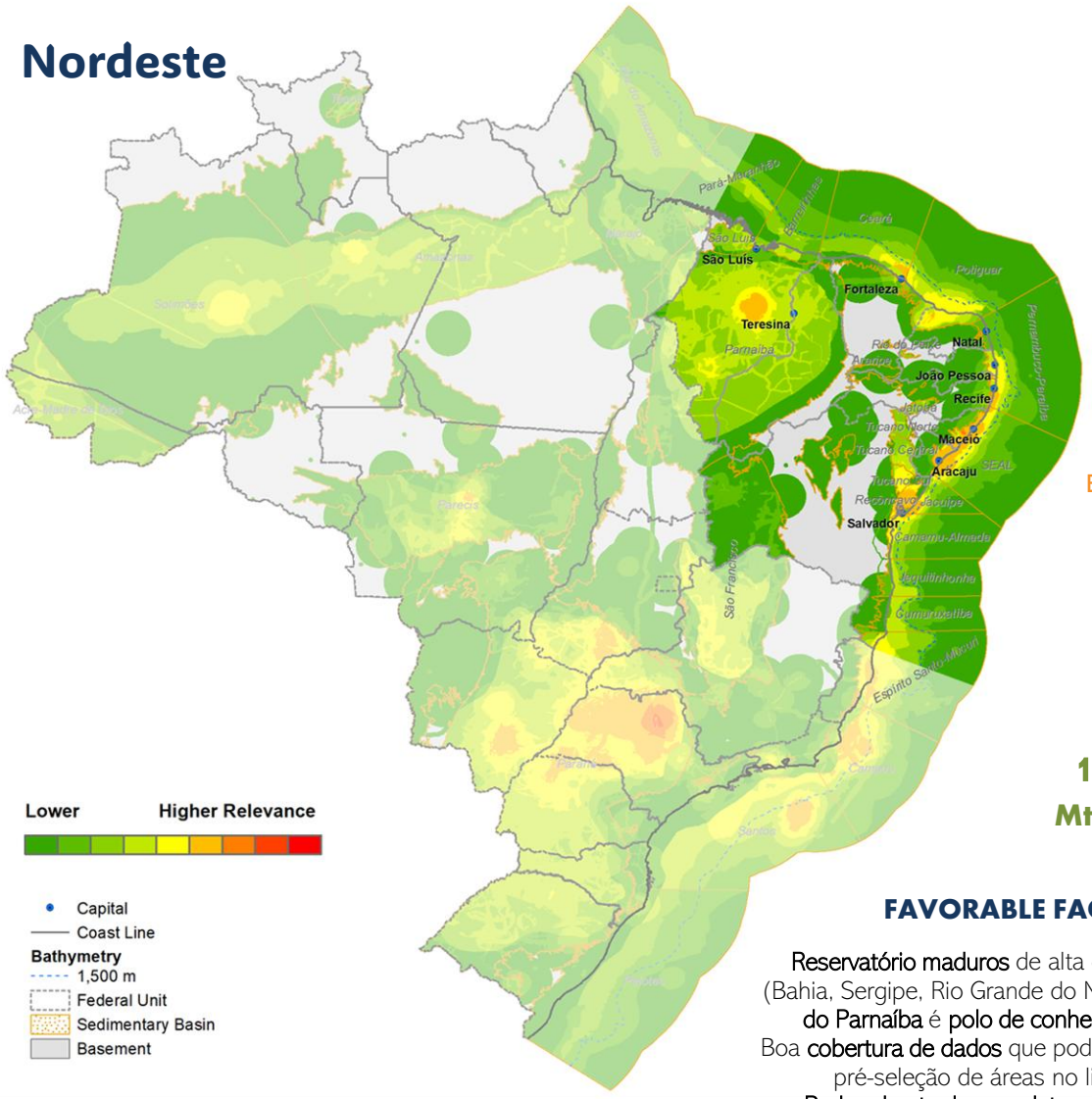
Growth in **multi-sector memoranda of understanding and letters of intent**, covering both onshore and offshore basins.

TARGET INDUSTRIES

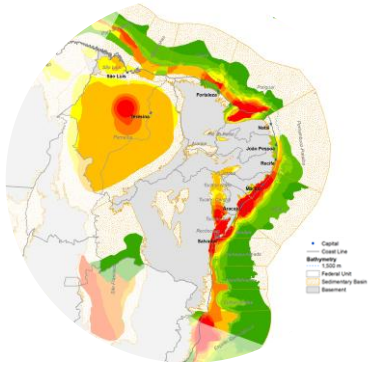
Steel | **Biomethane** | **Sugarcane** | **Cement**

Mining | **O&G** | **Refining** | **Thermal Power Plants (TPPs)**

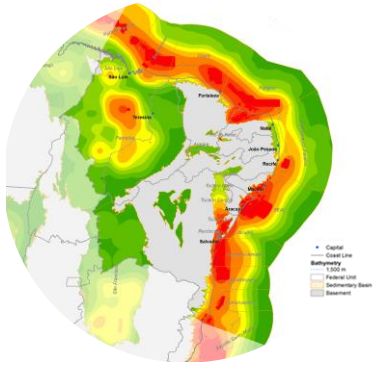
Nordeste



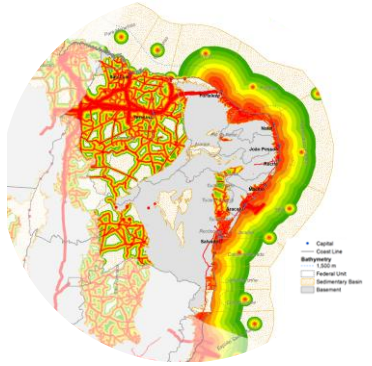
STORAGE SITES



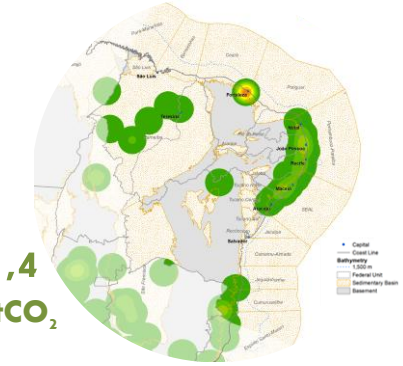
KNOWLEDGE FRAMEWORK



TRANSPORT INFRASTRUCTURE

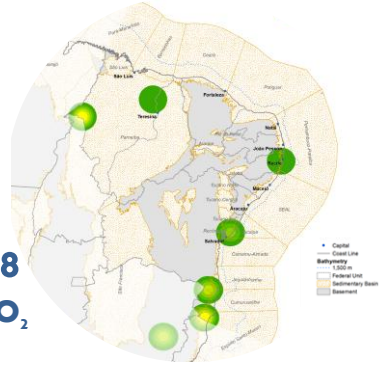


BECCS - IMMEDIATE AVAILABILITY



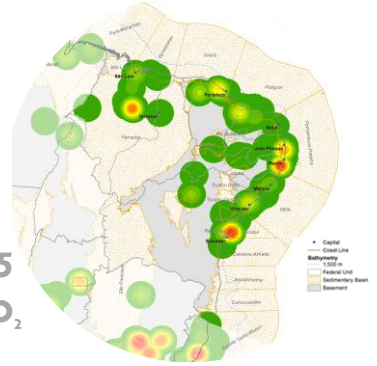
1,4 $MtCO_2$

BECCS - POTENTIAL AVAILABILITY



20,8 $MtCO_2$

POTENTIAL CCS/CCUS DEMANDERS



24,5 $MtCO_2$

FAVORABLE FACTORS

Reservatório maduros de alta qualidade (Bahia, Sergipe, Rio Grande do Norte). **Bacia do Parnaíba** é **polo de conhecimento**. Boa **cobertura de dados** que podem auxiliar a pré-seleção de áreas no litoral. **Rede robusta de gasodutos e portos**. **Cana** e **biometano** se destacam para BECCS. **Emissões industriais** significativas.

KEY CHALLENGES

Need to **expand investments** to **reduce geological data asymmetries** and **accelerate the development** potential of coastal **hub-based solutions**

SOCIOECONOMIC IMPACT

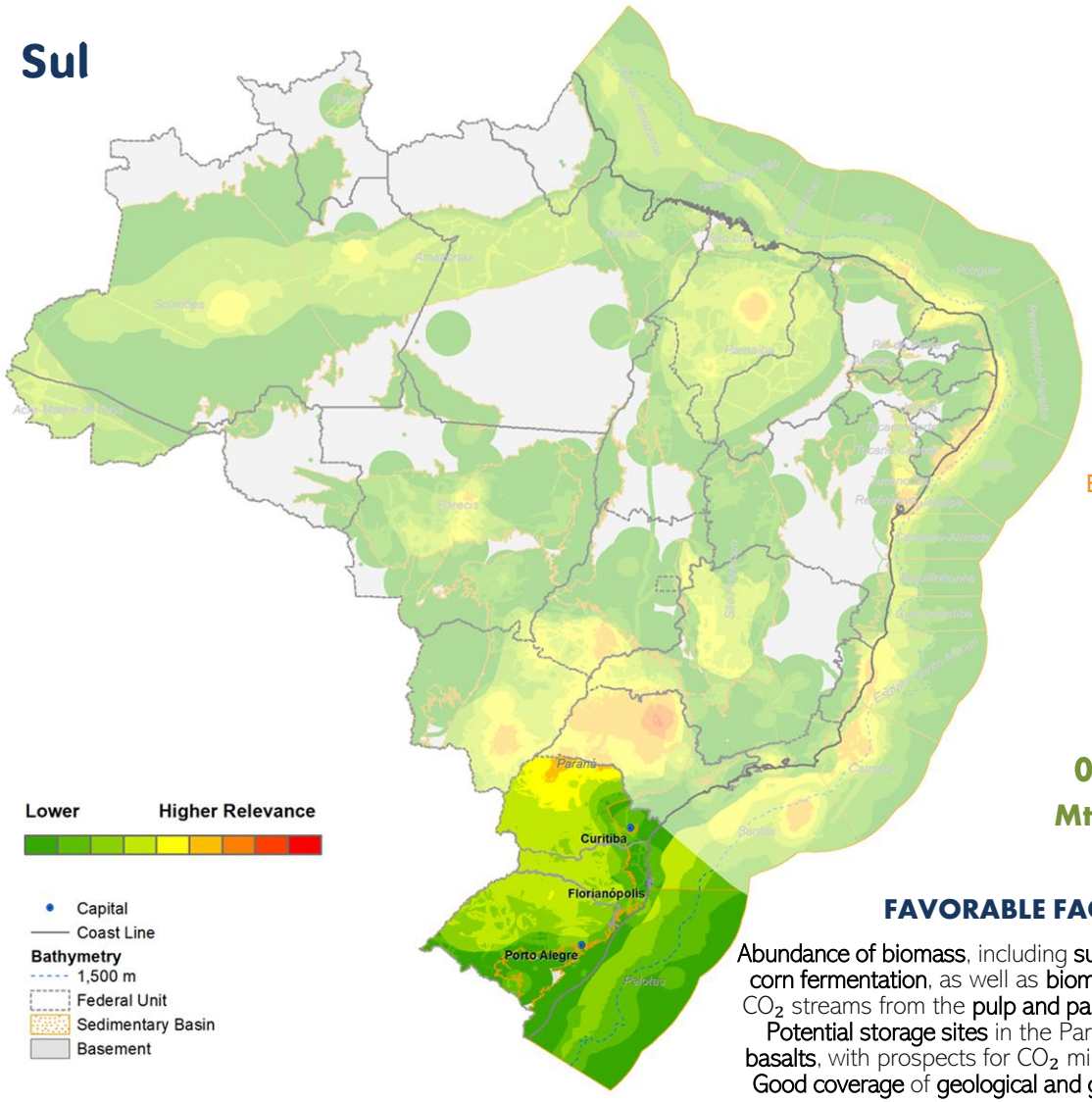
Strategic opportunity for the creation of **skilled jobs and the retention of regional** technical **capacity**.

TARGET INDUSTRIES

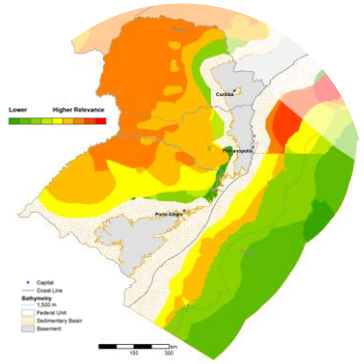
Steel **Biomethane** **Sugarcane** **Cement**

Mining **Chemical Industry** **Refining** **Thermal Power Plants (TPPs)**

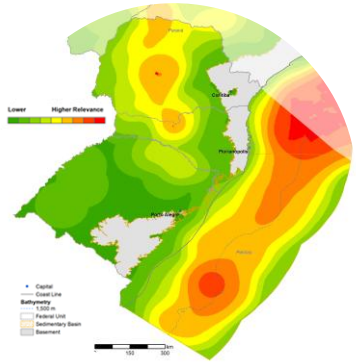
Sul



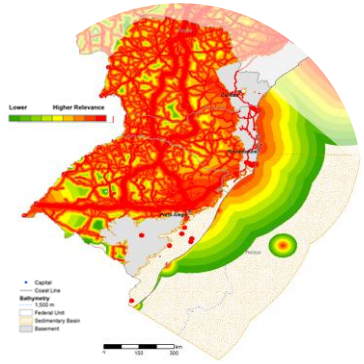
STORAGE SITES



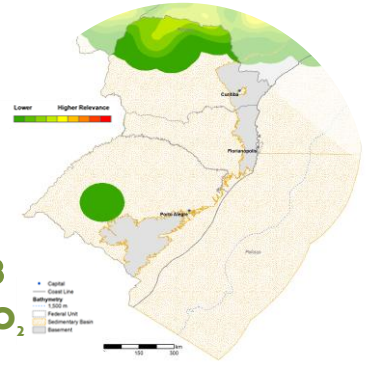
KNOWLEDGE FRAMEWORK



TRANSPORT INFRASTRUCTURE

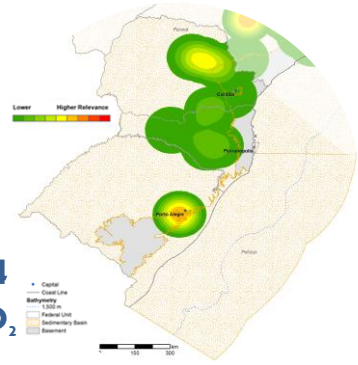


BECCS - IMMEDIATE AVAILABILITY



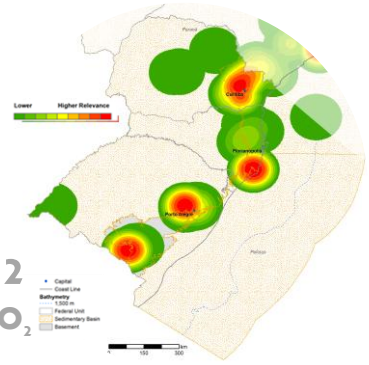
0,8 $MtCO_2$

BECCS - POTENTIAL AVAILABILITY



19,4 $MtCO_2$

POTENTIAL CCS/CCUS DEMANDERS



20,2 $MtCO_2$

FAVORABLE FACTORS

Abundance of biomass, including sugarcane and corn fermentation, as well as biomethane and CO_2 streams from the pulp and paper industry.
Potential storage sites in the Paraná Basin basalts, with prospects for CO_2 mineralization.
Good coverage of geological and geophysical surveys.
Extensive transport network, supported by roads and pipelines

KEY CHALLENGES

Need to demonstrate the viability of different storage site options and to expand data coverage toward inland areas.

COMPETITIVE ADVANTAGE

Decarbonization of the pork and animal protein export value chains supports competitiveness by helping overcome carbon-related barriers in global markets

TARGET INDUSTRIES

Biomethane | Sugarcane | Cement | Pulp and Paper | Chemical Industry | Refining | Livestock | Thermal Power Plants (TPPs)

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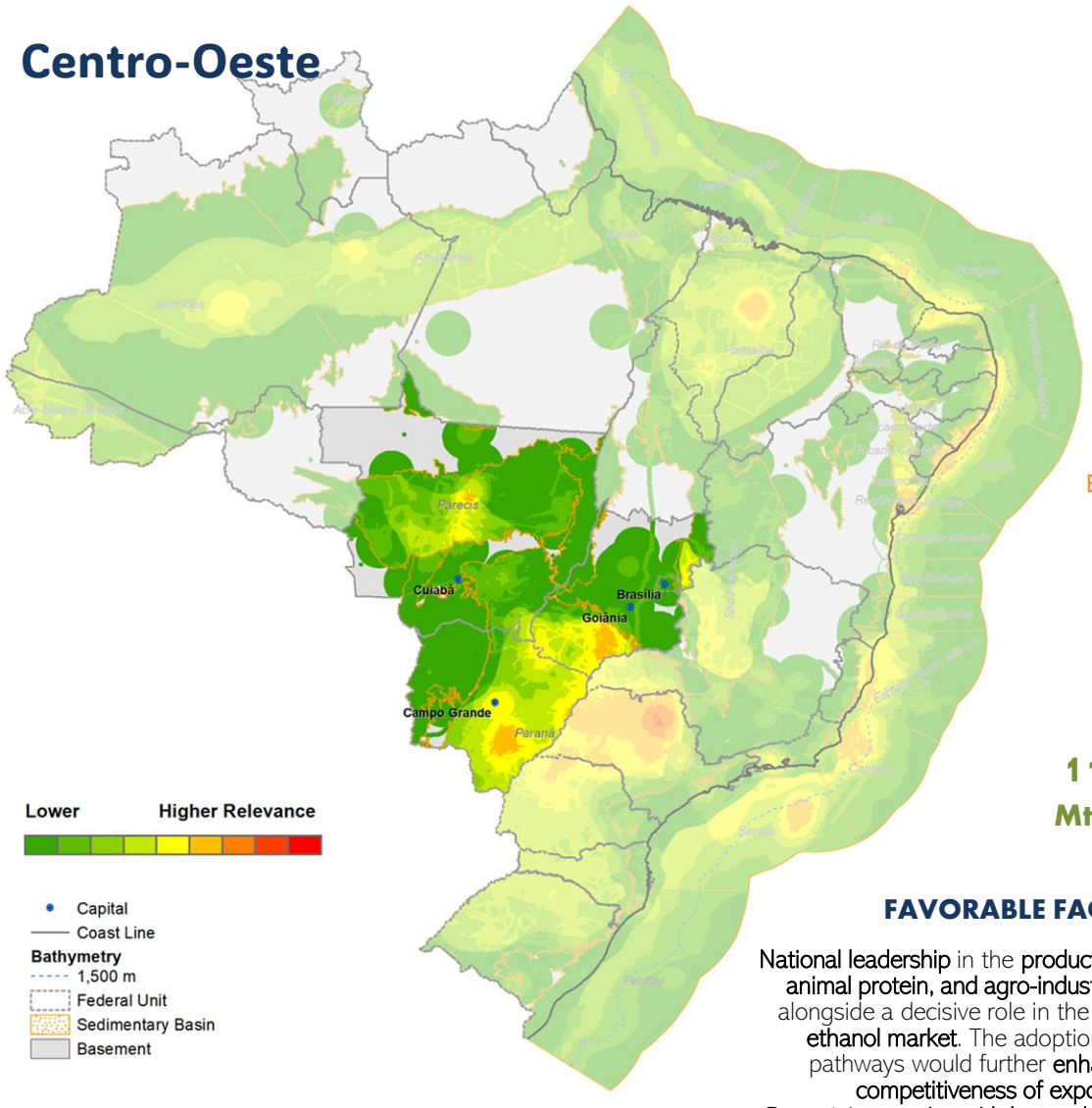
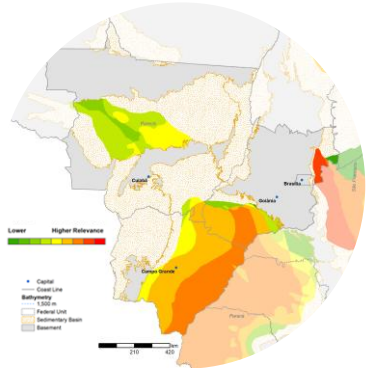
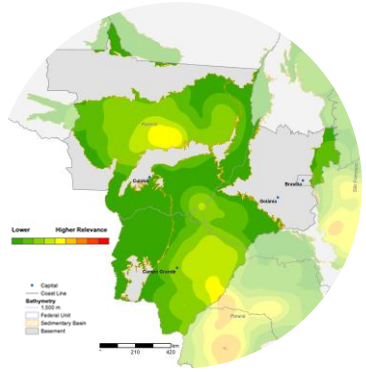
Centro-Oeste



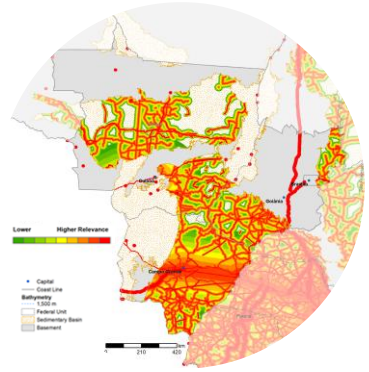
STORAGE SITES



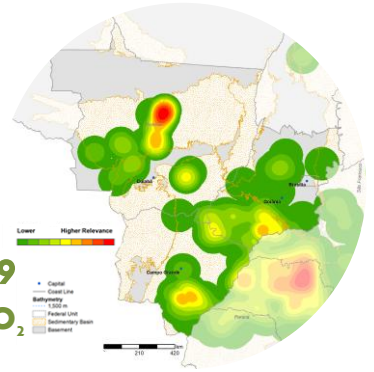
KNOWLEDGE FRAMEWORK



TRANSPORT INFRASTRUCTURE

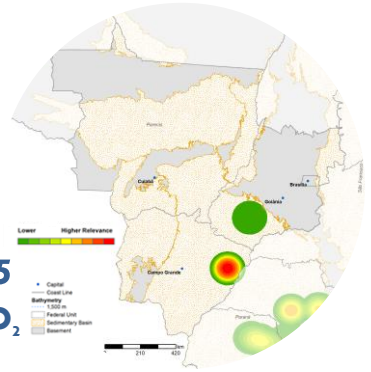


BECCS - IMMEDIATE AVAILABILITY



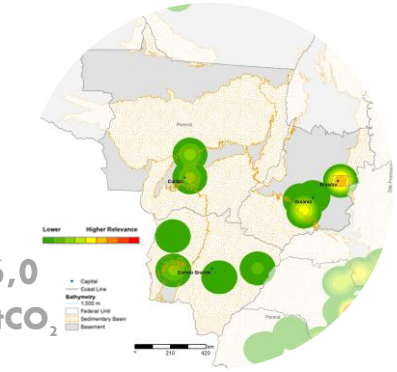
11,9 $MtCO_2$

BECCS - POTENTIAL AVAILABILITY



49,5 $MtCO_2$

POTENTIAL CCS/CCUS DEMANDERS



6,0 $MtCO_2$

FAVORABLE FACTORS

National leadership in the production of grains, animal protein, and agro-industrial inputs, alongside a decisive role in the global corn ethanol market. The adoption of CCS pathways would further enhance the competitiveness of exports. Potential synergies with low-carbon hydrogen production and nitrogen fertilizer plants.

KEY CHALLENGES

The expansion of transport infrastructure, deepening of the geological knowledge framework specific to local basins, and strengthening of regional research centers capable of conducting exploratory and monitoring activities are required.

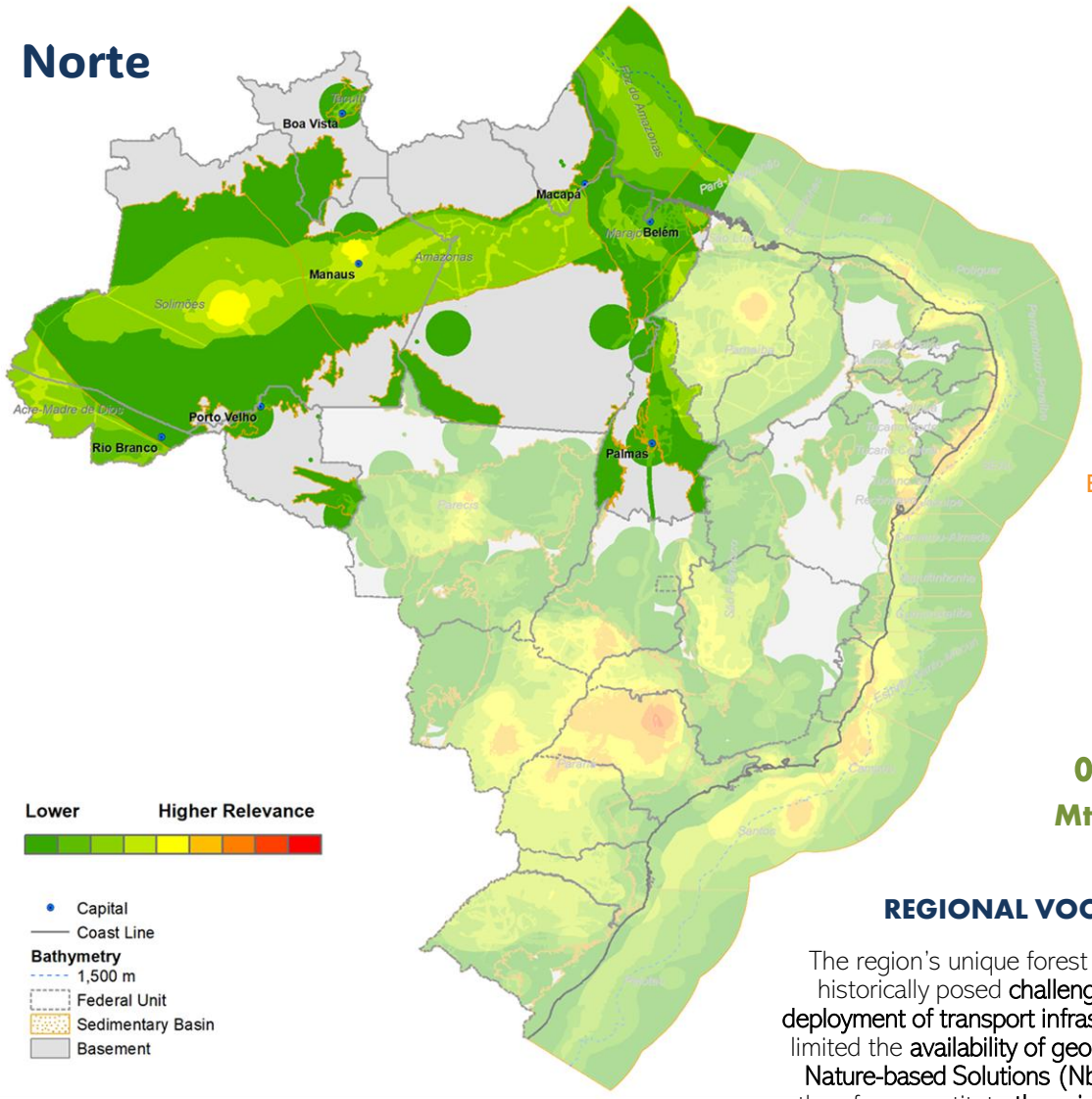
O MARCO ZERO

Brazil's first fully integrated BECCS project: FS Project (Lucas do Rio Verde, MT). Approved financing of BRL 384.3 million (BNDES).

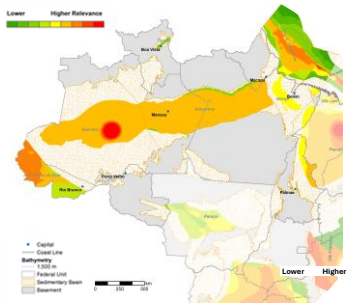
TARGET INDUSTRIES

- Biomethane
- Sugarcane
- Cement
- Corn
- Pulp and Paper
- Livestock

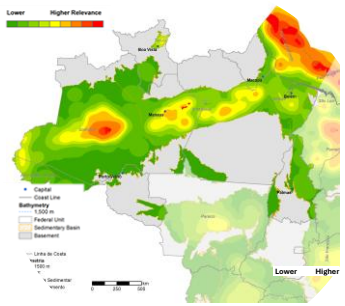
Norte



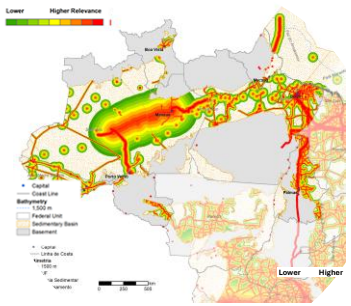
STORAGE SITES



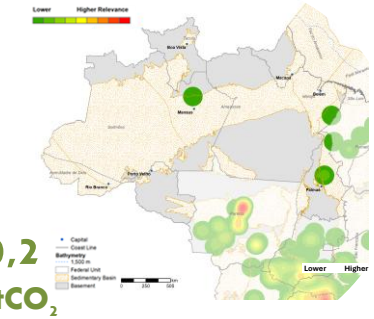
KNOWLEDGE FRAMEWORK



TRANSPORT INFRASTRUCTURE

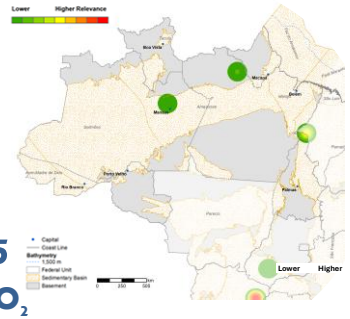


BECCS - IMMEDIATE AVAILABILITY



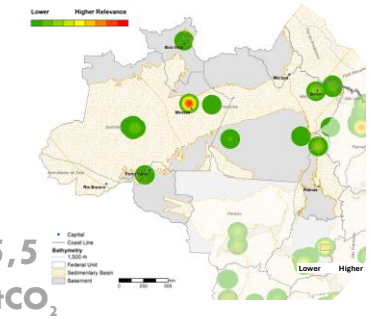
0,2 $MtCO_2$

BECCS - POTENTIAL AVAILABILITY



4,5 $MtCO_2$

POTENTIAL CCS/CCUS DEMANDERS



5,5 $MtCO_2$

REGIONAL VOCATION

The region's unique forest cover has historically posed **challenges to the deployment of transport infrastructure** and limited the **availability of geological data**. **Nature-based Solutions (NbS)** should therefore constitute **the primary axis of climate action** in the territory

OPPORTUNITIES

A **tendency toward site-specific projects** (notably in **Amazonas and Pará, near the Maranhão border**), with the **potential development of isolated hubs**.
Utilization of captured CO_2 as a value-added input, fostering local markets and reducing logistical dependencies

INNOVATION

Initiatives such as the Vale/Circlua project, which focuses on converting tailings from the Carajás Complex into low-emission cement, **enhance circularity and expand the range of opportunities associated with the carbon capture** and storage value chain

TARGET INDUSTRIES

- **Mining**
- **O&G**
- **Thermal Power Plants (TPPs)**

Favorable Ecosystem

Brazil brings together geography, technical capacity, public policy, and growing private-sector interest to scale up CCS and position itself as a leader in the supply of low-carbon commodities

Logistics

The lack of dedicated CO_2 transport infrastructure remains one of the country's main bottlenecks. While coastal concentration facilitates large-scale transport solutions, inland expansion requires robust technical solutions and clear regulatory frameworks. The acceleration of shared hub-based infrastructure is essential

Strength of BECCS

The bioenergy sector combines readily available high-purity CO_2 streams with strong expansion potential, supported by a sustainable biomass supply, technological maturity, and long-standing integration with climate and carbon-pricing policies. In this context, Brazil holds a privileged position to scale up the BECCS pathway globally

RegionaL Assessment

The Southeast and Northeast regions show high feasibility for industrial hubs, combining legacy O&G infrastructure, emission concentration, and proximity to high-quality storage sites. The Center-West and South regions stand out for BECCS-oriented agro-industrial applications, but depend on advances in basin-specific geological data and transport infrastructure, particularly pipelines

Utilization as a co-benefit

CO_2 utilization tends to follow emission hubs but should act as an additional benefit, rather than the primary driver of initial CCS investments

National Potential

The integration of available evidence confirms Brazil's capability to capture, transport, and store CO_2, while highlighting the need for expanded cooperation to advance metrics, governance, and project development

Favorable Opportunity

Brazil presents favorable conditions to advance multiple CCS pathways, with applications across the energy and industrial sectors. The realization of this potential requires the coordinated acceleration of policies and projects, supported by risk-mitigation instruments, first-of-a-kind project deployment, and market creation, in order to enable scale and effectively contribute to climate targets. Integration with other decarbonization strategies is possible and necessary

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exploracaoeproducao@epe.gov.br

Empresa de Pesquisa Energética

Diretoria de Estudos do Petróleo, Gás e Biocombustíveis

Superintendência de Petróleo e Gás Natural

Diretora
Heloisa Borges Bastos Esteves

Coordenação Técnica
Marcos Frederico Farias de Sousa
Marcelo Ferreira Alfradique
Regina Freitas Fernandes
Roberta de Albuquerque Cardoso

Equipe Técnica E&P
Bruna Silveira Guimarães
Isis Oliveira Fernandes
Natália da Veiga Bonavita Teixeira
Nathalia Oliveira de Castro
Pedro de Moura Bernardino
Péricles de Abreu Brumati
Rafael Freitas Funcia Lemme
Raul Fagundes Leggieri

Siga a EPE nas redes sociais:

EPE - Empresa de Pesquisa Energética
Praça Pio X, n. 54 - 2º andar - Centro
20091-040
Rio de Janeiro - Brasil

MINISTÉRIO DE MINAS E ENERGIA

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