Empresa de Pesquisa Energética

NATIONAL ZONING OF OIL & GAS RESOURCES

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Department of Oil and Gas Studies

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MINISTÉRIO DE MINAS E ENERGIA

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UNIÃO E RECONSTRUÇÃO

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General Information

www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/zoneamento-nacional-de-recursos-de-oleo-e-gas

- Analyses of the Brazilian sedimentary basins accompanied by a georeferenced database.
- Geographic representation of the relative importance of various areas in Brazil for the economic development of the Oil & Gas sector (IPA Maps).
- Totally produced by the EPE team.
- Published every 2 years.
- Free for download.
- Available at **www.epe.gov.br**

IPA is the Portuguese acronym for “Mapa de Importância de Área” or "Map of Areal Importance“, in English

Methodology: Perspectives adopted

Basin selection

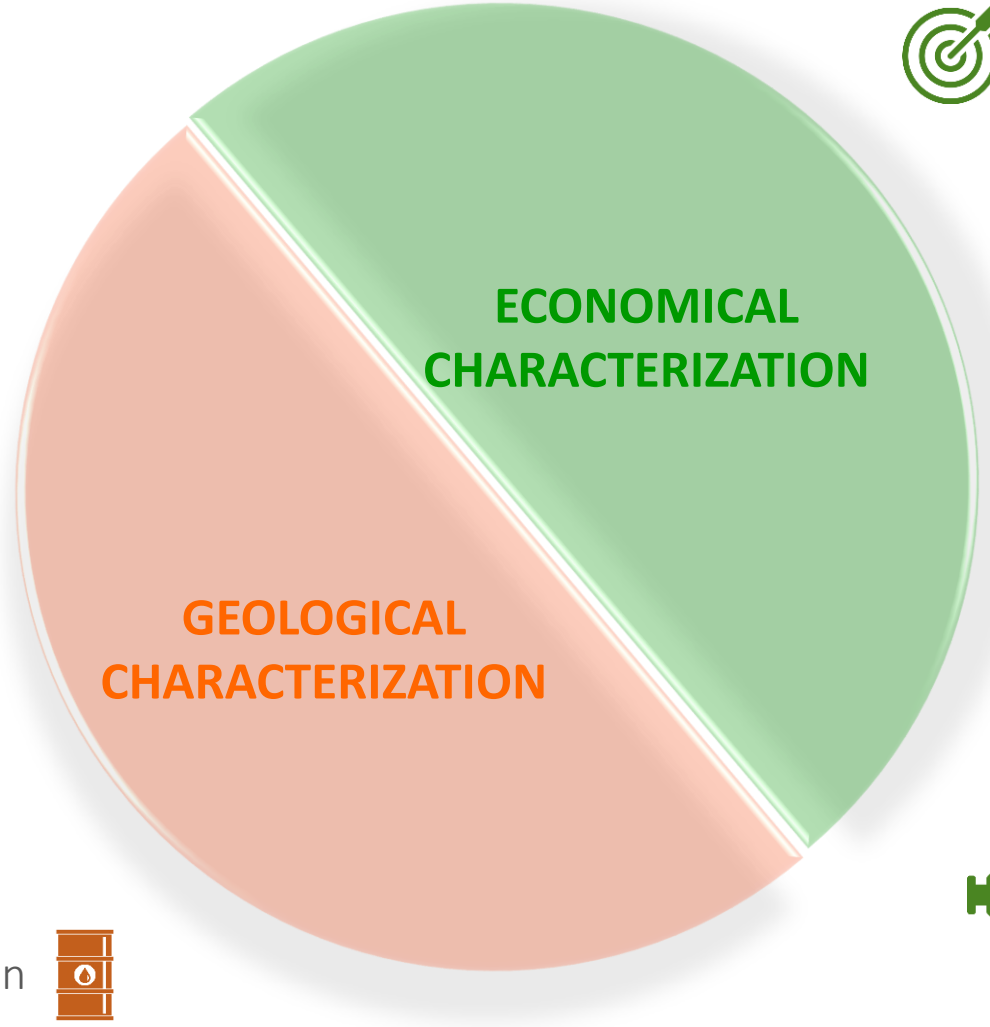
Exploratory Plays

Effective Basins

Discovery Chances

Fluid Type Expectancy

Volumetric Estimation



Exploratory Activity

Explotatory Intensity

Prospectivity

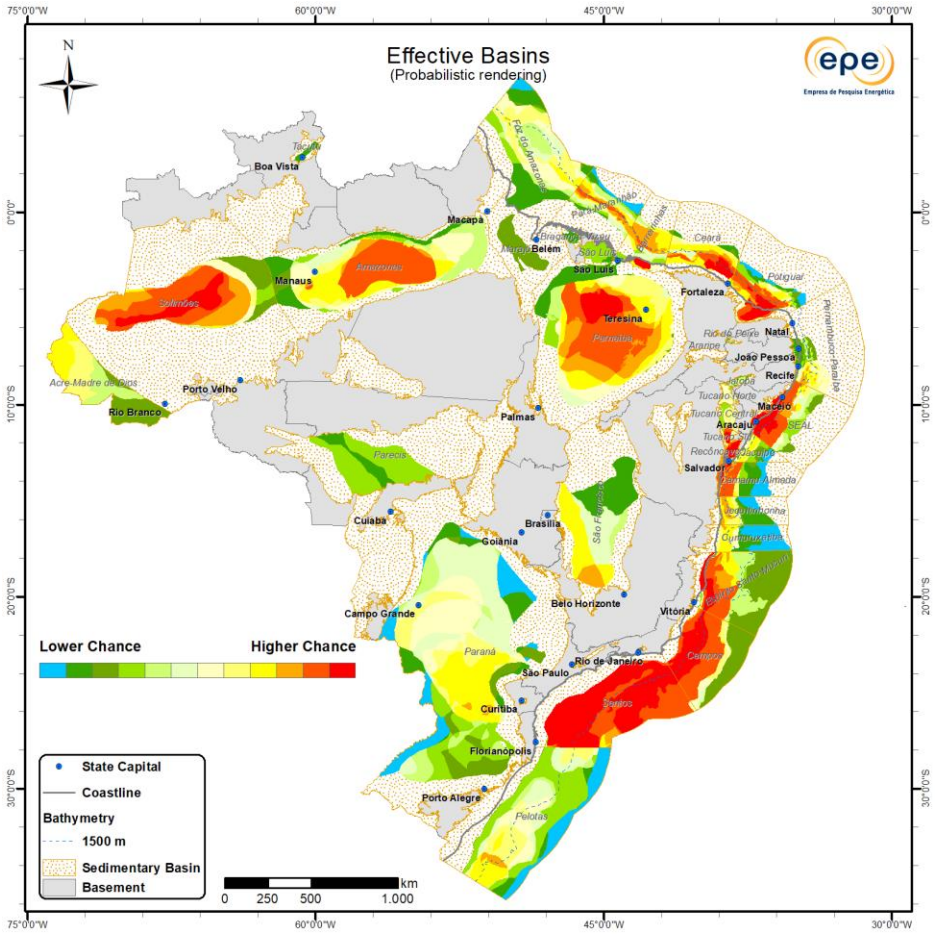
Evidence of Hydrocarbons

Need for Knowledge

O&G Supply Infrastructure

Geological Characterization: Main Results

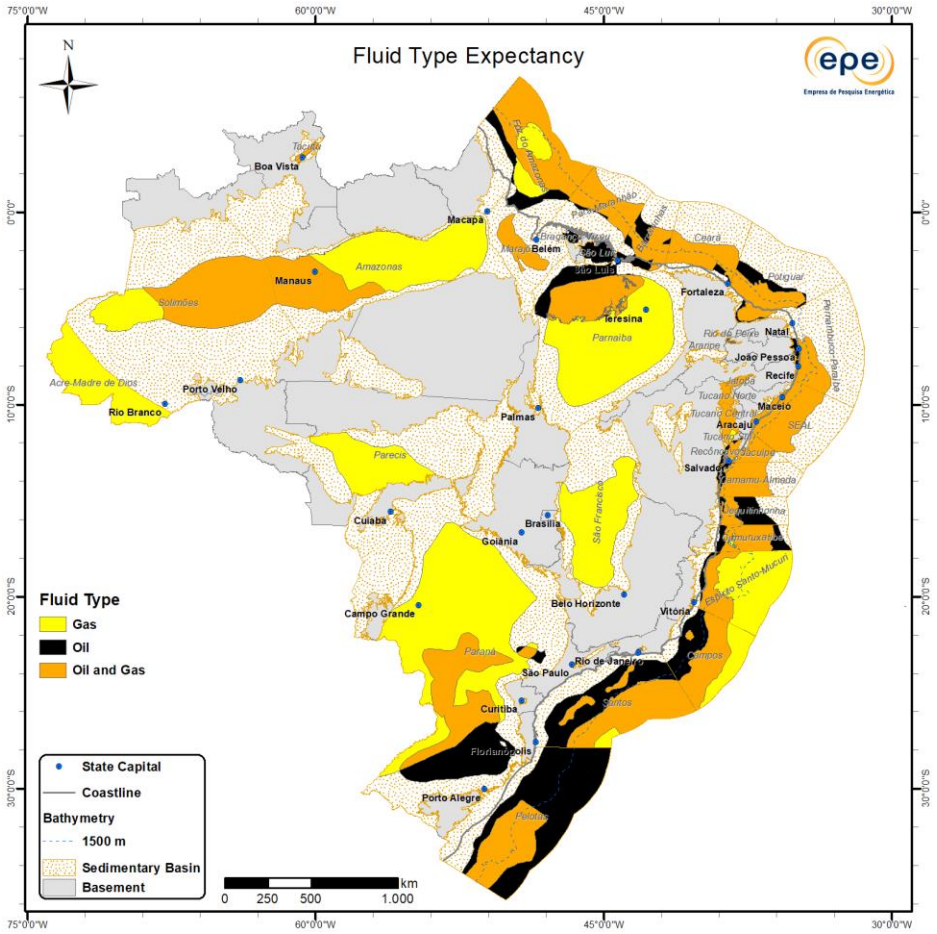
Probabilistic Effective Basins



- Onshore basins: generation potential maps resulting from studies by REATE Subcommittee 3 were decisive for changes in the charge factor of the Amazonas, Paraná and Parnaíba basins;
- Equatorial Margin: changes in Pará-Maranhão (increased chances in the Travosas Upper Cretaceous play); Barreirinhas (review of the Travosas Upper Cretaceous play); Ceará and Potiguar (inclusion of areas under study and on offer with expected opportunities in Cretaceous and Paleogene turbidites).
- Northeast Margin: in SEAL basin, increased chancez on the geological external high where 7 fields were declared commercial at the end of 2021.
- Southeast Margin: increased chances on the southern distal portion of Santos Basin due to the similarity of reservoirs (Paleogene turbidites) around blocks adjacent to Baúna field.
- In the southern portion of Pelotas Basin (Torres High), seismic data show an Aptian source rock and favorable migration. Turbidite reservoirs similar to those discovered in Namibia. In the northern portion, increased chances related to the continuity of the Cretaceous carbonate play in Santos Basin.

Geological Characterization: Main Results

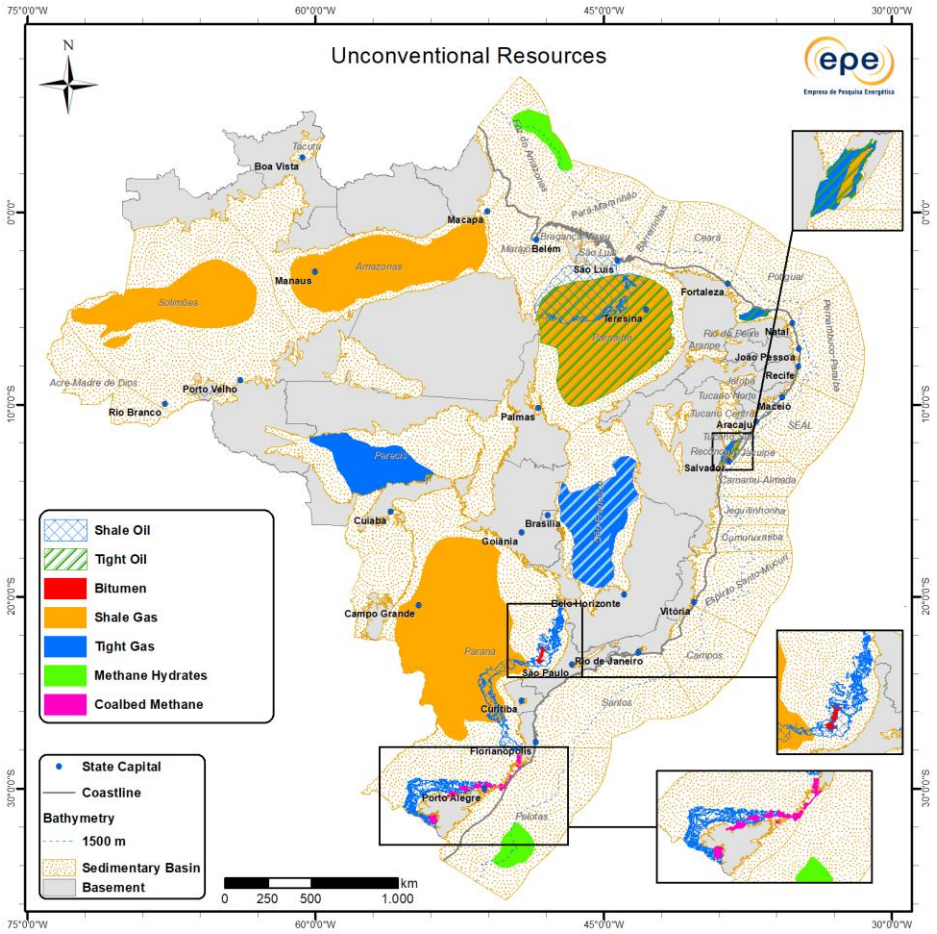
Fluid Type Expectancy



- Availability of information on fluid type expectations at play level and predominant fluid type expectations by basin, the latter obtained from the combination of the former.
- Greater propensity for accumulations of non-associated gas in onshore basins (Acre-Madre de Dios, Solimões, Amazonas, Parecis, Parnaíba, São Francisco and Paraná). On the east margin, expectations in the offshore region of the Espírito Santo-Mucuri and Campos basins; in Santos, outside the reach of the salt wall. In the Foz do Amazonas Basin, greater expectations for gas in its central portion.
- Predominant oil expectations in the proximal portions between Pelotas and Camamu-Almada basins.
- Oil and gas are expected in the Jacuípe, SEAL and Pernambuco-Paraíba basins. They also stand out in the central-southern portion of Pelotas basin and in most of the region above the pre-salt polygon, as well as in the largest portion of the basins on the equatorial margin.

Geological Characterization: Main Results

Unconventional Resources

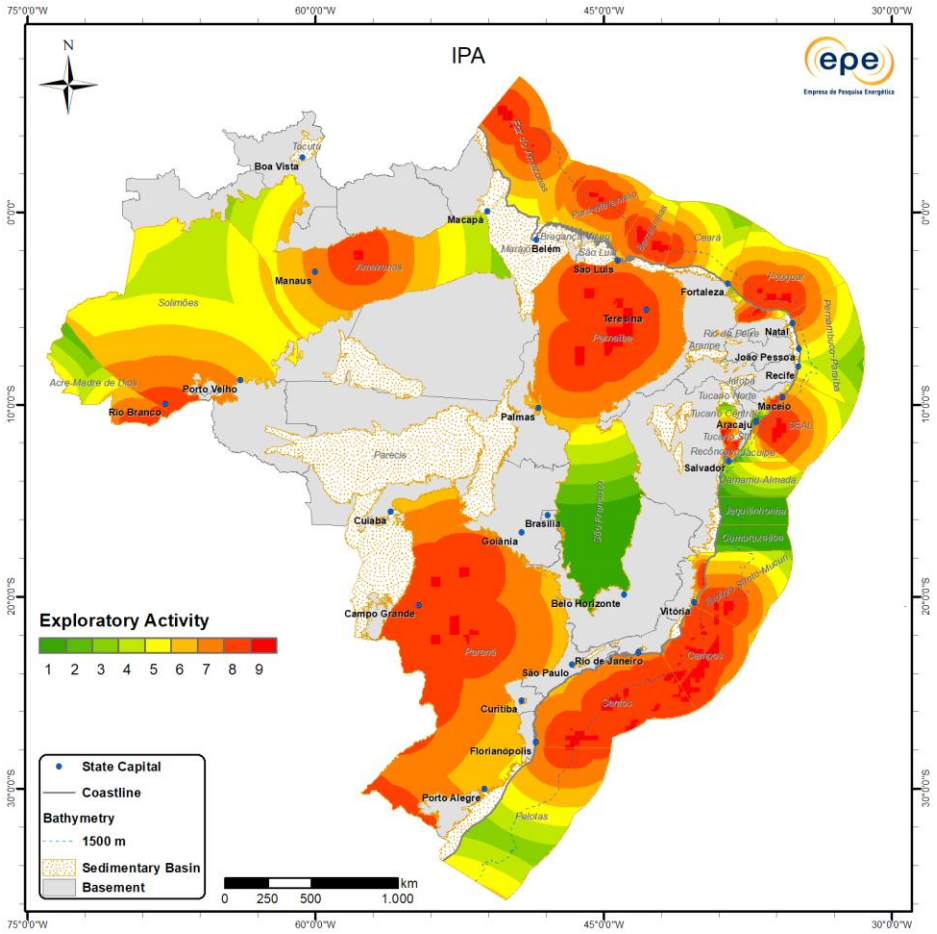


- As in previous publications, the indication of the possibility of occurrence of 7 types of unconventional resources distributed in 14 Brazilian basins was maintained:
  1. Bituminous/Oil/Tar Sands
  2. Shale Oil
  3. Tight Oil
  4. Shale Gas
  5. Tight Gas
  6. Methane Hydrate
  7. Coalbed Methane

- Prevalence of possibilities in the terrestrial environment.
- Exploratory risk analysis is not performed for the unconventional resources.

Economical Characterization: Main Results

Exploratory Activity



Description

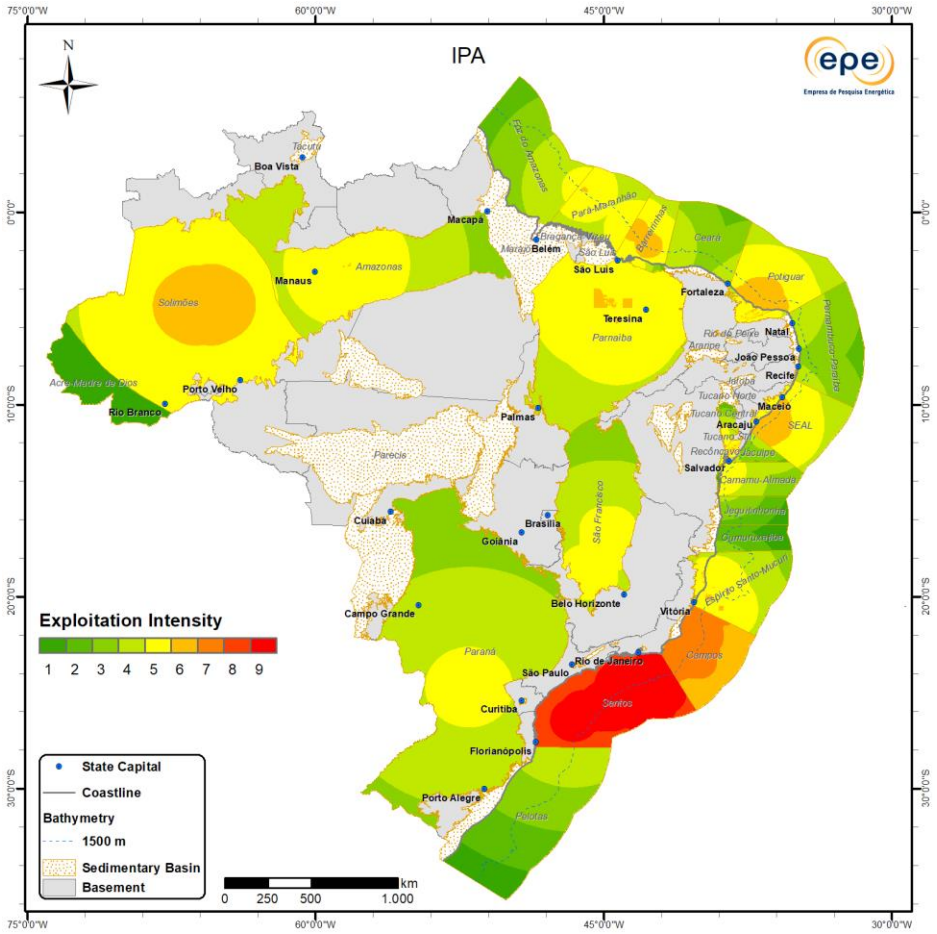
This map represents the importance of areas contracted for E&P activities that are still in the exploratory phase. Importance is inversely proportional to the distance from exploration blocks to other points in a basin. It also considers information from neighboring basins in South America.

2021-2023 Highlights

- Increases in importance in relation to the 2019-2021 publication: on land, in the Alagoas, Espírito Santo-Mucuri, Potiguar, Recôncavo and Tucano Sul basins. Direct connection with the auction of areas available in the 3rd Open Acreage Cycle. In Santos Basin, in addition to the effect of the auctioned areas, the blocks bought in the 17th Bidding Round also make an impact.
- Increments observed in the Acre-Madre de Dios, Pelotas and Paraná basins related to the update of the database on blocks in neighboring basins in South America.
- Reductions in importance in Amazonas, Ceará, Pernambuco-Paraíba, Sergipe, Camamu-Almada, Jequitinhonha: return of areas to the Union.

Economical Characterization: Main Results

Exploitation Intensity



Description

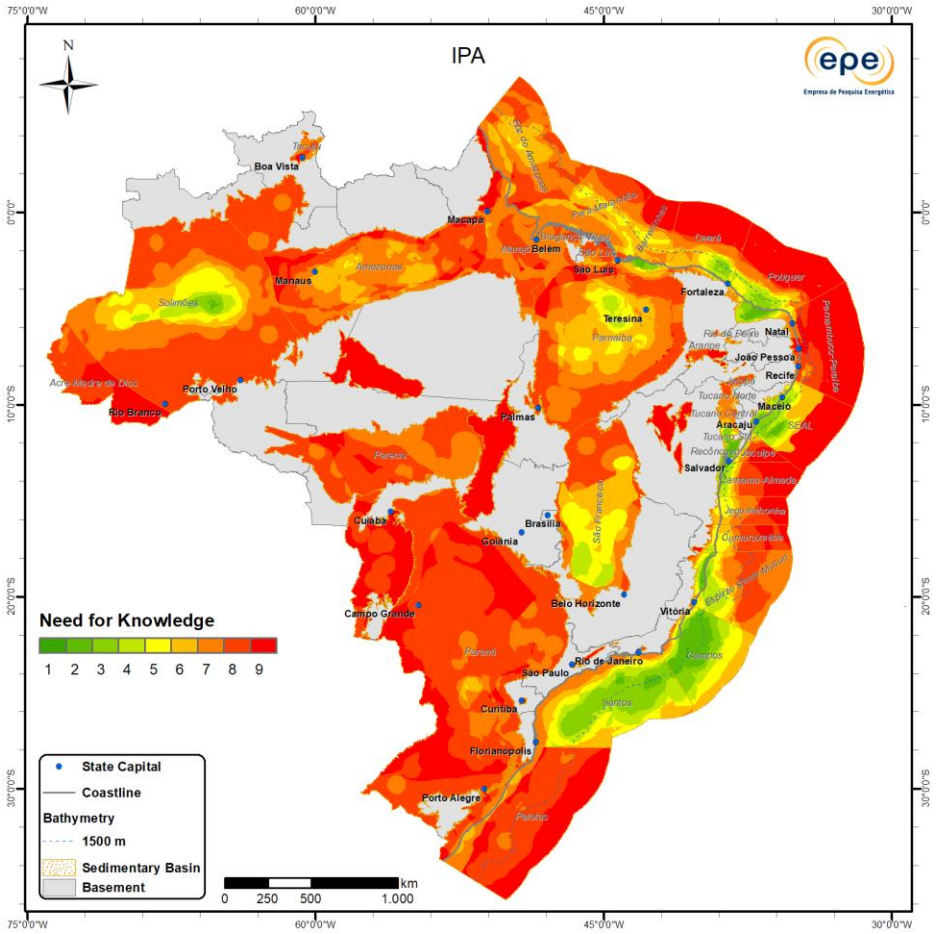
This map represents the importance of the distance from a given point in the sedimentary basin to an oil or natural gas discovery, under evaluation or in production. It takes into account the volumetric dimension of discovered resources (oil and/or gas) in each basin.

2021-2023 Highlights

- Highest importance: Santos and Campos basins (the main producers of oil and natural gas in the country).
- Increases in importance in relation to the 2019-2021 publication: Campos Basin, Amazonas Basin and onshore portions of the Alagoas and Espírito Santo-Mucuri basins. Noticeable increase in discovered volumes of natural gas.
- Reductions in importance: related to the return of areas to the Union in the Recôncavo, Solimões and Tucano Sul basins. At sea, in the Camamu-Almada, Ceará, Potiguar and SEAL basins.

Economical Characterization: Main Results

Need for Knowledge



Description

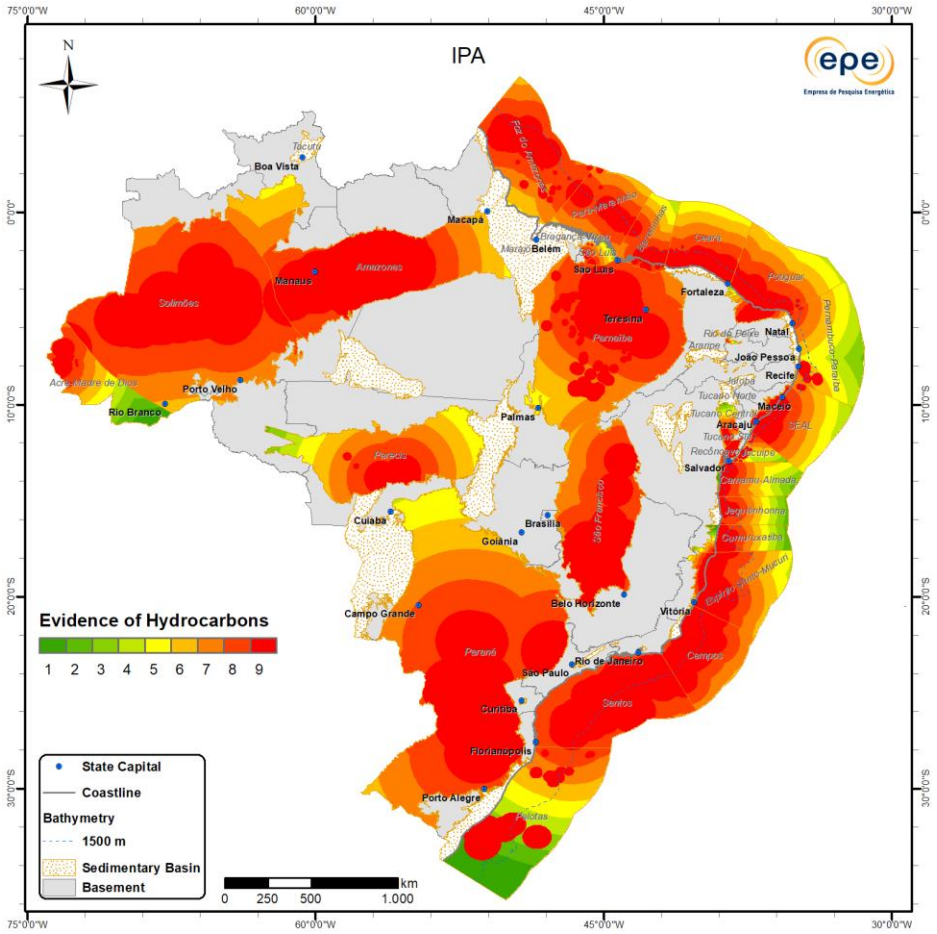
This map represents the degree of uncertainty in the assessment of regional geological factors that control the formation of oil or natural gas resources in a sedimentary basin. It indicates the need for additional data acquisition, processing and/or interpretation.

2021-2023 Highlights

- Greater need for knowledge in the interior basins and ultra-deep waters of the continental margin, corresponding mostly to the New Frontier basins.
- Less need for knowledge in Mature basins (Recôncavo and other terrestrial producing basins in an advanced stage of exploration, such as Potiguar, Sergipe and Alagoas) and High Potential basins (Santos, Campos and the maritime portion of Espírito Santo-Mucuri), indicating a greater availabity of studies and knowledge.

Economical Characterization: Main Results

Evidence of Hydrocarbons



Description

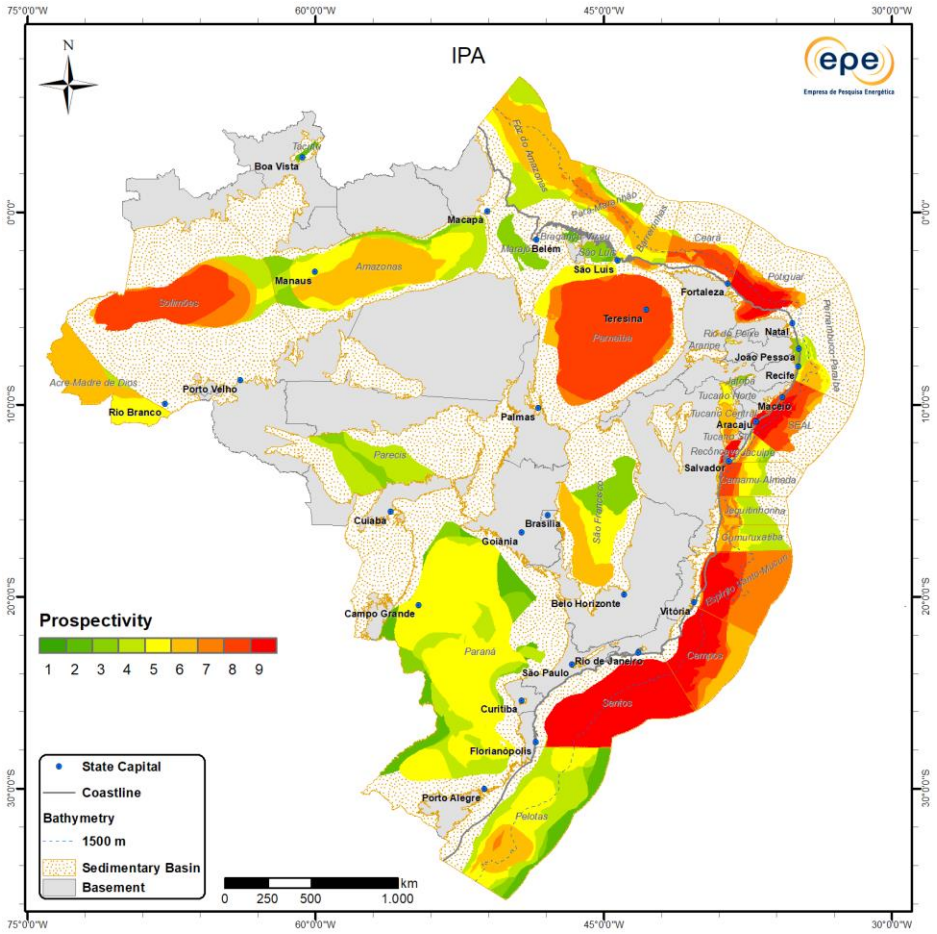
This map represents the idea that areas outside of oil or natural gas accumulations under exploratory assessment or already commercial (fields) that are close to the occurrence of signs or confirmations of the presence of hydrocarbons are more important, due to this proximity.

2021-2023 Highlights

- Although most of the Brazilian sedimentary area has evidence of hydrocarbon generation and migration, this does not necessarily guarantee the existence of commercial accumulations.
- Reduced importance in the extreme south of Pelotas basin and in the distal portions of the Cumuruxatiba, Jequitinhonha, Camamu-Almada, Jacuípe and Pernambuco-Paraíba basins. In addition to these, the eastern end of the Acre-Madre de Dios Basin, the Rio do Peixe Basin and the western and eastern extremes of the Parecis Basin.
- No importance, to date, in Bragança-Vizeu, Marajó, Tacutu, Tucano Norte, Jatobá, Alto Tapajós, Araripe, Bananal, Lençóis, Irecê, Pantanal and Taubaté basins.

Economical Characterization: Main Results

Prospectivity



Description

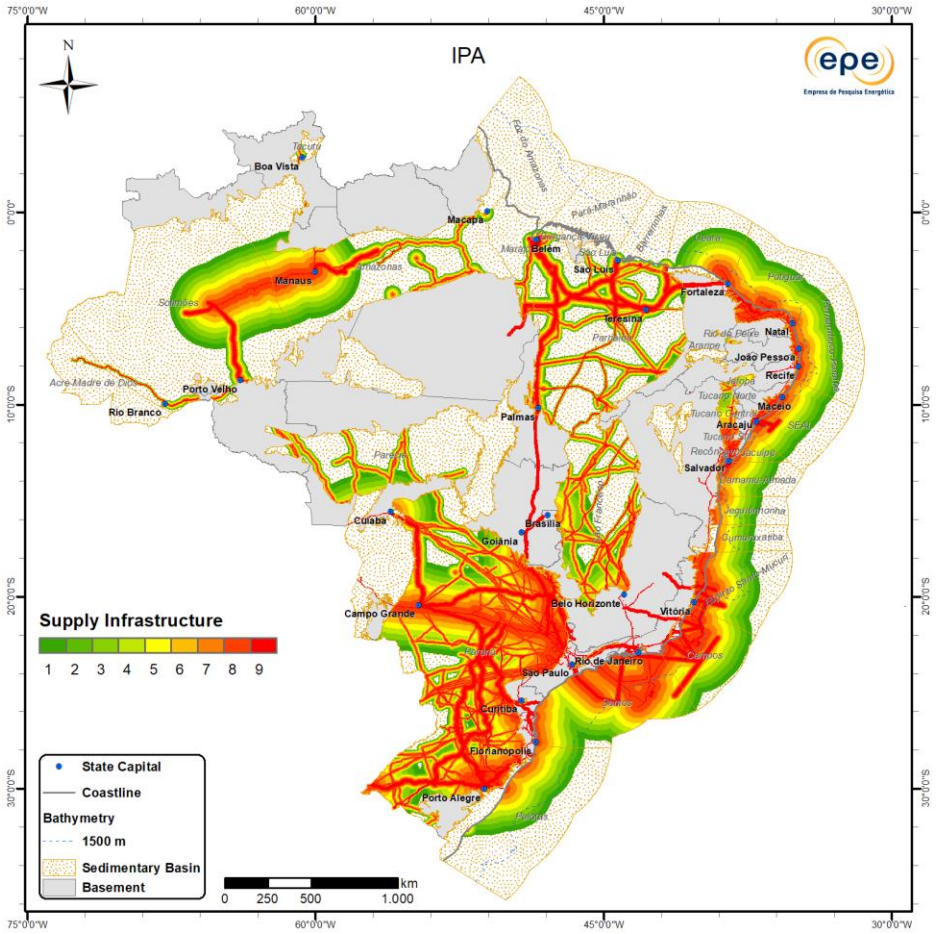
This map represents the composition of information about the chances of exploratory success in an area together with the volumetric estimation of undiscovered oil and gas resources in each sedimentary basin.

2021-2023 Highlights

- Greater prospects in the producing basins, with several oil & gas fields and discoveries, where geological risks are relatively lower. Highlights for the Santos, Campos, Espírito Santo-Mucuri, Camamu-Almada (proximal maritime and terrestrial portion), SEAL, Potiguar Ceará, Sergipe, Alagoas, Recôncavo, Parnaíba and Solimões basins.
- Intermediate importance at sea, in Pará-Maranhão, Foz do Amazonas, Barreirinhas, Jequitinhonha, Cumuruxatiba, Pernambuco-Paraíba and Pelotas basins (in the Rio Grande Cone region). On land, Amazonas, São Francisco (south/southwest part), Acre-Madre de Dios, Paraná, Tucano Sul and Tucano Central basins.

Economical Characterization: Main Results

Infrastructure



Description

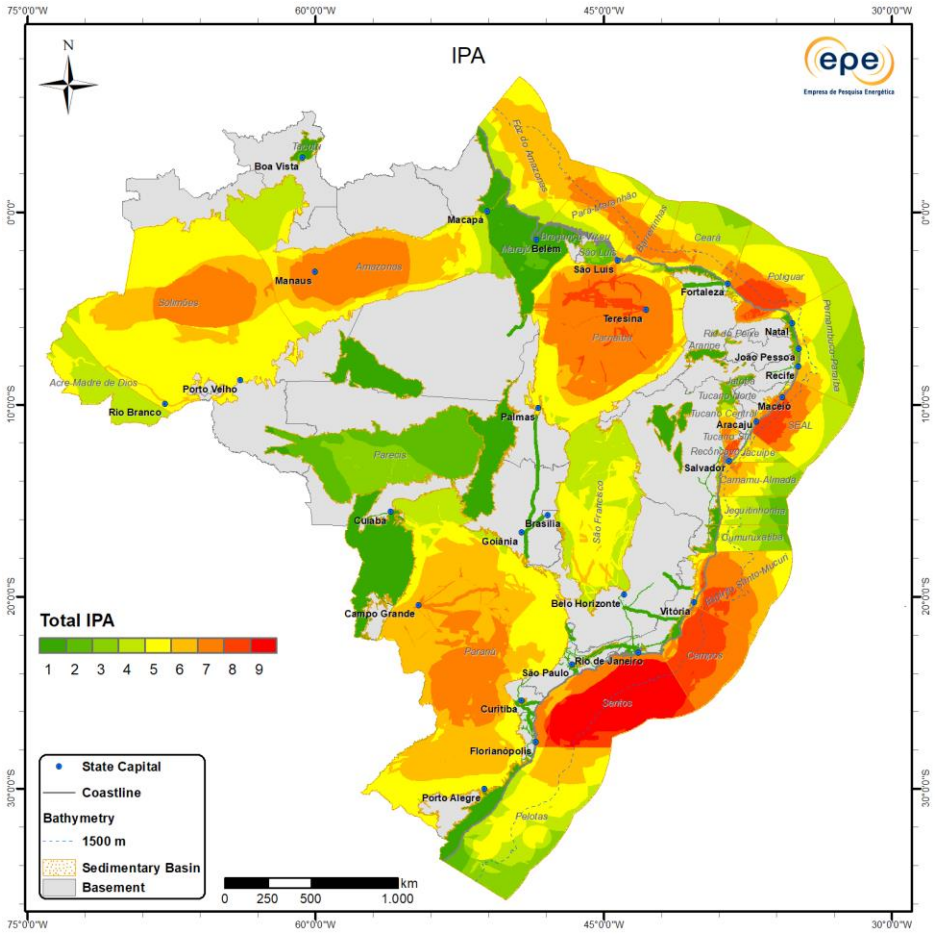
This map represents the operational and economic importance attributed to the areas closest to facilities that enable society to take advantage of oil and natural gas production, considering infrastructure under construction and planned in addition to existing ones.

2021-2023 Highlights

- Update of pipelines and terminals in study, especially those suggested in EPE's 2021 Indicative Natural Gas Processing and Outflow Plan (PIPE), and in EPE's Pipeline Indicative Plan (PIO) – 2021/2022 Cycle, contributed to changes in relation to the 2019-2021 publication.
- Center-West, North and Northeast regions: part of the importance linked to the influence of gas pipelines under study, which may or may not actually be installed.
- Proximity to electrical transmission lines: increased importance for basins that can take advantage of their natural gas reserves through the gas-to-wire model.

Economical Characterization: Main Results

Total IPA



Description

The Total Areal Petroleum Importance (Total IPA) is the result of the combination of the six arguments previously described, with the following distribution of weights: Exploitation Intensity = 0.35; Exploratory Activity = 0.20; Prospectivity = 0.20; Direct Evidence of Hydrocarbons = 0.15; Need for Knowledge = 0.05 and Supply Infrastructure = 0.05.

2021-2023 Highlights

- The 17th Bidding Round and the 3rd Permanent Offer Cycle contributed to the increase in importance in Santos and the onshore portions of the Alagoas, Espírito Santo-Mucuri and Potiguar basins, in addition to the Recôncavo and Tucano Sul basins.
- Greatest importance: Santos, Campos, Espírito Santo-Mucuri, Recôncavo, Tucano Sul, SEAL, Sergipe, Alagoas, Potiguar, Ceará, Barreirinhas, Pará-Maranhão, Solimões, Amazonas, Parnaíba and Paraná (central portion) basins.
- Moderate importance: close to the aforementioned portions, as well as in Acre-Madre de Dios (western sector), São Francisco (center-south), Pelotas (central-north portion), Cumuruxatiba, Jequitinhonha, Camamu-Almada, Jacuípe, Pernambuco-Paraíba and Foz do Amazonas basins.

Applications: Areal Importance for the Natural Gas Sector

Analyses that can contribute to the **adoption of appropriate strategies for the economic and environmentally sustainable use of natural gas** potential in the Brazilian territory.

Brazilian Natural Gas: contributes to the **Low Carbon Energy Transition. Lighter** natural gas than that produced in other countries; promotes **stability and security** concomitant with the expansion of renewable sources; **generates income** and contributes to the **development of technologies.**

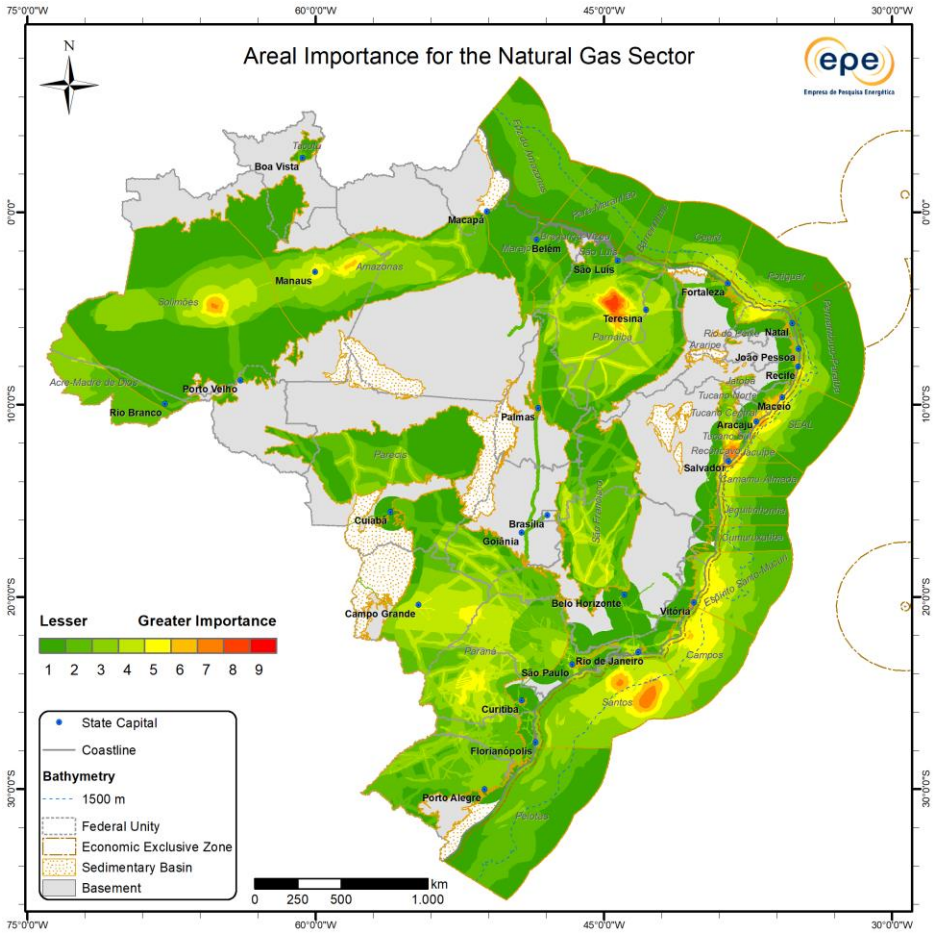
Map with the **importance of areas** for the natural gas sector: **planning tool**.

Shared methodology with **Areal Petroleum Importance (IPA)** maps.

- ✓Availability of Natural Gas
- ✓Natural Gas Favorability
- ✓Existing Demand for Natural Gas
- ✓Infrastructures of Interest for the Natural Gas Sector
- ✓Areas of interest for Underground Natural Gas Storage

Applications: Areal Importance for the Natural Gas Sector

Final Map



- As in the 2019-2021 publication, greater importance in the northeast, north and southeast regions.
- Northeast region with the greatest importance: Parnaíba Basin has the fourth largest production of natural gas and the fourth largest reserves in the country. High favorability for new discoveries, strong demand and established and growing infrastructure focused on the reservoir-to-wire model. Recôncavo, Sergipe, Alagoas and SEAL basins also stand out.
- North Region: Solimões Basin, close to the Arara Azul, Araracanga, Cupiúba, Leste do Urucu, Rio Urucu and Sudoeste Urucu fields (among the largest gas reserves in the country). Despite the high chance of new discoveries, infrastructure development is also necessary for better use.
- Southeast Region: Santos (near the Mexilhão field and in the central portion of the pre-salt polygon) and Campos (Alto de Badejo and Baixo de Corvina-Parati). They reflect the current supply (two largest producers in the country), strong demand and robust existing infrastructure.
- South and Center-West regions: lack of infrastructure. Importance is still low to intermediate despite the potential market linked to the residential and industrial segments, especially agriculture.

Applications: Carbon Storage

Systemic view of **how the O&G sector can contribute** to the **modernization and expansion** of the **national energy sector** in the era of **energy transition**, avoiding or reducing, on economic growth and social well-being, the impact of actions necessary to fulfill international commitments to reduce GHG content in the atmosphere.

Adaptation of the O&G sector: natural gas, hydrogen and CCUS attract **resources**, foster **research** and promote **technological innovations**.

CCUS: supports the **removal** (in large quantities) of **carbon** from the atmosphere. Takes advantage of **labor**, **knowledge** and **expands** the **lifespan of installations**.

Objective: to provide a **regional guide** related to the **importance** of each area for the **development of possible projects.**

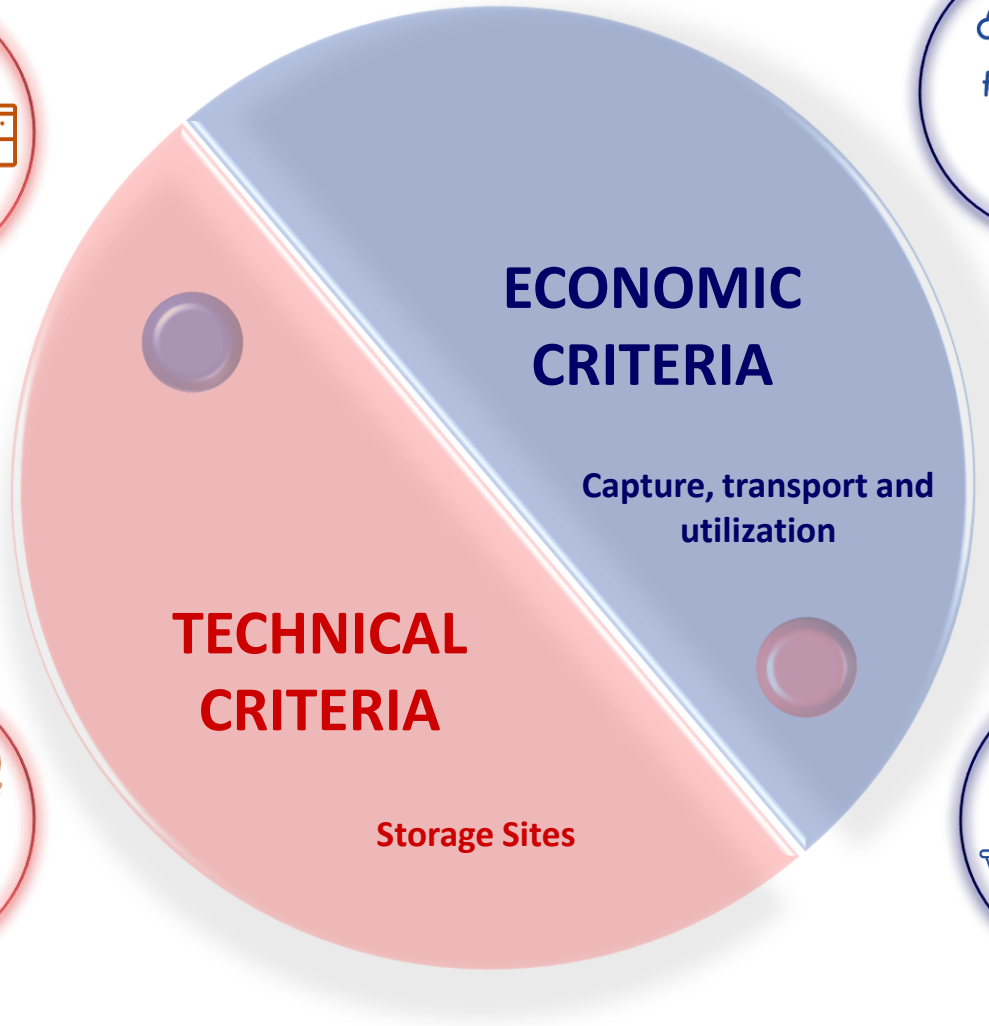
Based on the methodology of the **Areal Petroleum Importance (IPA)** maps.

Applications: Carbon Storage

Reservoirs of interest (O&G)

Highly saline reservoirs

Knowledge Framework



CO_2 Emissions**

Energy and Industrial Processes

**(On land and by state)

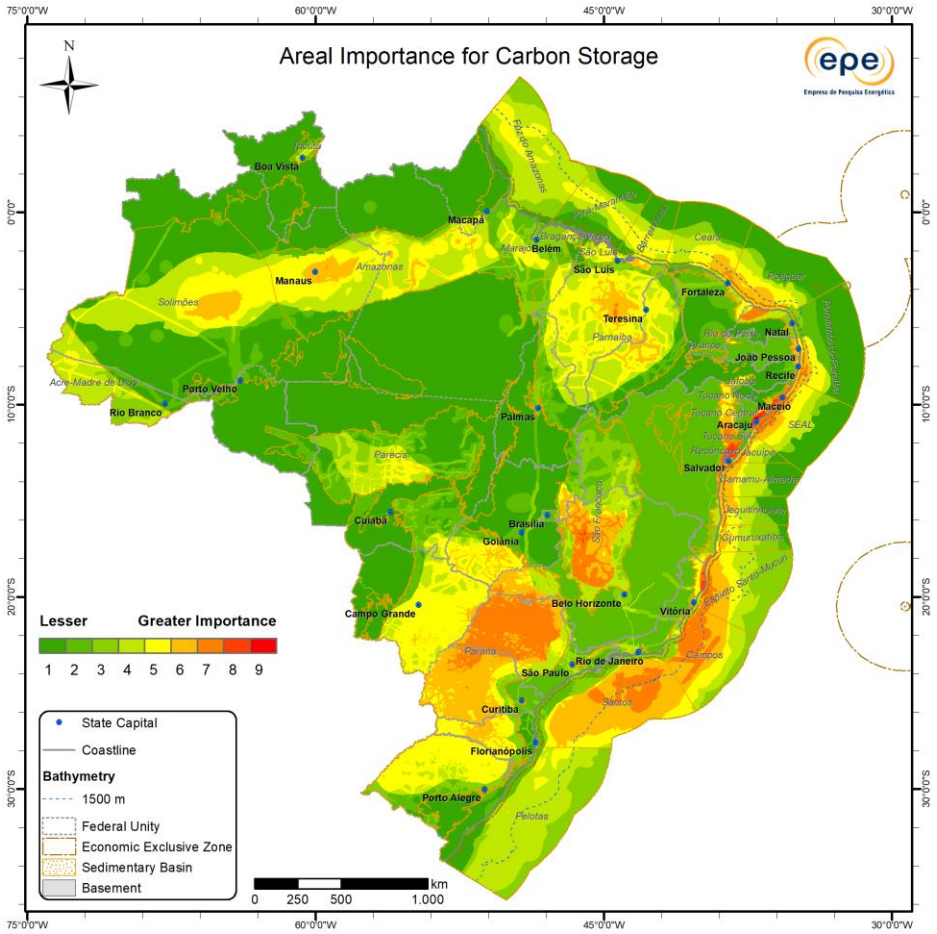
Infrastructure

Industries for Carbon Credits

Future updates

Carbon Storage: Recognizing Options

Final Map



- Areas of greatest relevance: Alagoas, Campos, Espírito Santo-Mucuri, Santos, São Francisco, SEAL, Sergipe, Paraná, Recôncavo and Tucano Sul basins have sandstone reservoirs with discoveries and high expectations for the accumulation of fluids. With the exception of the last 3, all of them have carbonate reservoirs. Reservoirs in igneous rocks also occur in the Alagoas, Campos, Recôncavo, Santos, Sergipe and SEAL basins.
- Proximity to large emission sources (especially in the capitals) and to the market interested in carbon credits - where the steel, petrochemical and paper & cellulose sectors, thermoelectric and ethanol plants stand out - are relevant factors.
- South, mid-west and northeast regions: agricultural and sugar-energy sectors can take advantage of the carbon capture and storage process associated with CO2 from biomass (BECCS) and promote negative emission levels. However, it is necessary to better understand the storage capacity of the basins in these regions and expand the transport infrastructure, mainly through gas pipelines.

Final Remarks

Mission: dissemination of free, quality information, contributing to reduce knowledge asymmetry.

- Georeferenced database on an easy-to-access platform.

Acquisition, processing and interpretation of data (Geology, Geophysics and Geochemistry): these are essential sources for future cycles.

Stimulation and renewal of the study: what is the **role** of the **O&G sector** in the **Energy Transition**?

- **Classic**: New Frontiers of E&P; attractiveness of neighboring basins.
- **Adaptation**: Integration with other sources; Hydrogen; CCUS and others.

Dialogue with multiple agents and **partnerships** are **essential**!

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