BIOS

Department of Oil Products and Biofuels

BIOGENIC CARBON IN BIOENERGY

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MINISTÉRIO DE MINAS E ENERGIA
GOVERNO DO BRASIL
DO LADO DO POVO BRASILEIRO

TECHNICAL SHEET BIOGENIC CARBON IN BIOENERGY

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Disclaimers

This publication contains information about the availability of biogenic CO_2 in different bioenergy-related processes, according to studies by the Energy Research Company (EPE). Also, perspectives on its use in productive systems or as an asset in carbon capture and storage operations are also presented.

This document has informational purposes only, aiming to support the planning of the national energy sector. Therefore, any decisions regarding next steps (such as the formulation of public policies, definition of strategic guidelines, investment decisions, or business strategies) are the responsibility of other public and private institutions.

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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.

With this study, EPE promotes transparency and reduces information asymmetry by publishing data and insights that can enhance the development of initiatives aimed at a fair and inclusive energy transition that leverages Brazil's competitive advantages.

In this report, EPE analyzes opportunities, challenges, and the international landscape of biogenic carbon capture, utilization, and storage activities, in addition to providing georeferenced data on the immediate and potential availability of this resource across the national territory. Disseminating such data can support the implementation of public policies and private ventures that drive the development of low-carbon businesses in the country, aligning decarbonization strategies with national development.

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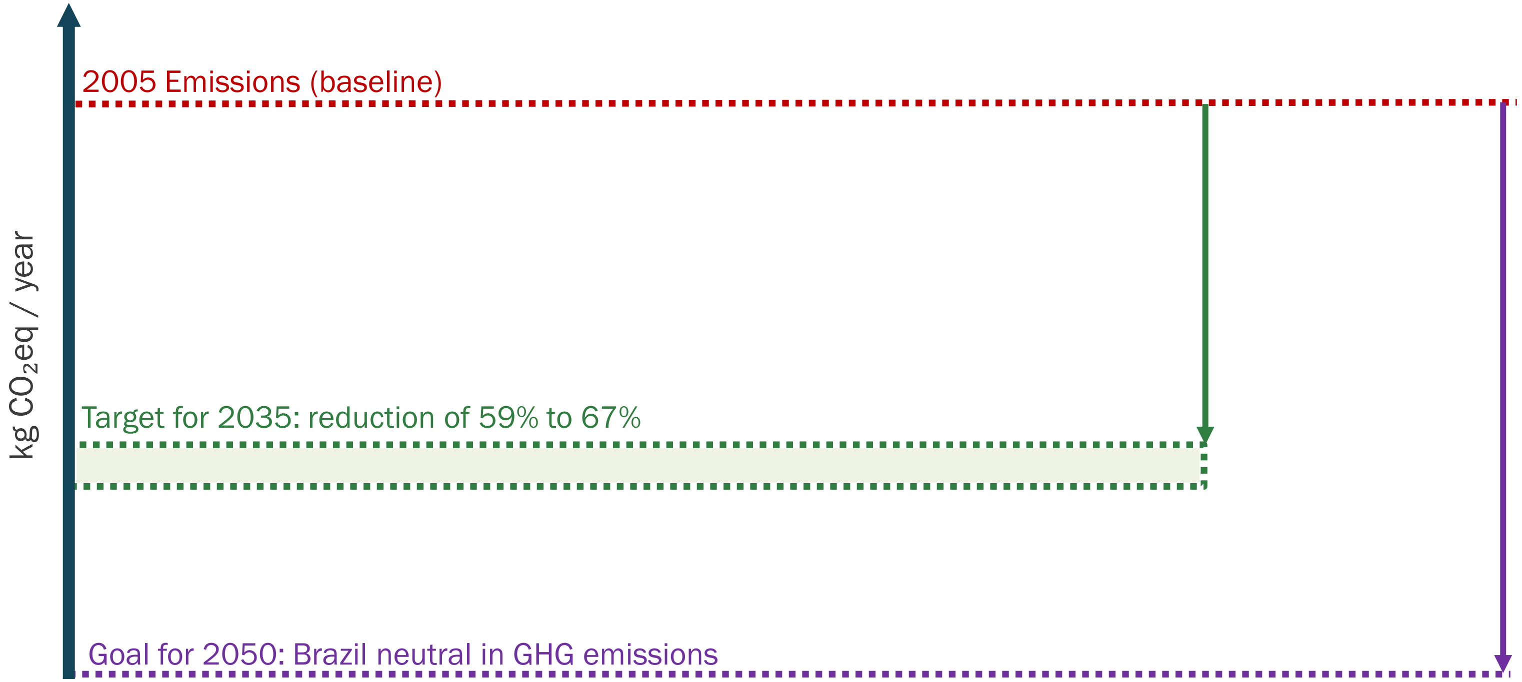
Context

Nationally Determined Contributions

Reducing anthropogenic greenhouse gas (GHG) emissions* is a central theme in international efforts aimed at global climate change mitigation. In this context, several countries have committed, in the last decade, to Nationally Determined Contributions (NDCs), establishing emission reduction targets.

Brazil's NDC, updated in 2024, sets a target of reducing emissions by 59% to 67% by 2035, based on the country's 2005 emissions, and achieving a GHG-neutral economy by 2050. **This goal encompasses all sectors of the economy.**

Brazilian targets for reducing GHG emissions



* The increased concentration of greenhouse gases in the atmosphere is the main cause of phenomena associated with global climate change. The main greenhouse gases that accumulate in the atmosphere as a consequence of human activities are CO_2, CH_4, and N_2O. According to the IPCC, the decade of 2011-2020 recorded an increase of 1.1°C in global average temperature compared to the period from 1850 to 1900, unequivocally due mainly to human activities.

Energy sector for emissions reduction

Although the energy sector is only the third largest emitter of GHGs in the Brazilian economy, it offers several opportunities and technologies for decarbonization with a high degree of maturity, which can represent significant emission reductions in the short and medium term and contribute considerably to achieving Brazil's NDC goals. The development of solutions for energy decarbonization is amplified by international efforts, since the sector is the largest global emitter.

The use and/or storage of biogenic CO_2 is a highly effective strategic possibility for reducing GHG emissions in energy, even potentially leading to negative emission levels in the sector (net carbon removal). This potential can be decisive to achieving neutrality by 2050, as other segments may have greater difficulty in reducing emissions.

Sectoral share of net emissions in Brazil, in CO_2 equivalent.

Source: EPE based in MCTI 2024

Opportunities for the use and/or storage of Biogenic CO_2

What is biogenic carbon?

Carbon is the basis of many products used today across various sectors of the economy:

Solid, liquid and gaseous fuels

Plastics and polymers

Chemical industry

Pulp and paper

Pharmaceuticals and cosmetics

Advanced materials

etc...

Regardless of the application, carbon can only be obtained from three major sources:

Biological raw material
(e.g., plant or animal biomass)

Fossil and mineral resources
(e.g., coal, oil, and natural gas)

Directly from the atmosphere
(eg., CO_2 or CH_4)

Biogenic carbon is defined as carbon that originates **from biological raw materials.**

Biogenic carbon is **renewable** and can be used in a wide variety of applications, including energy and materials.

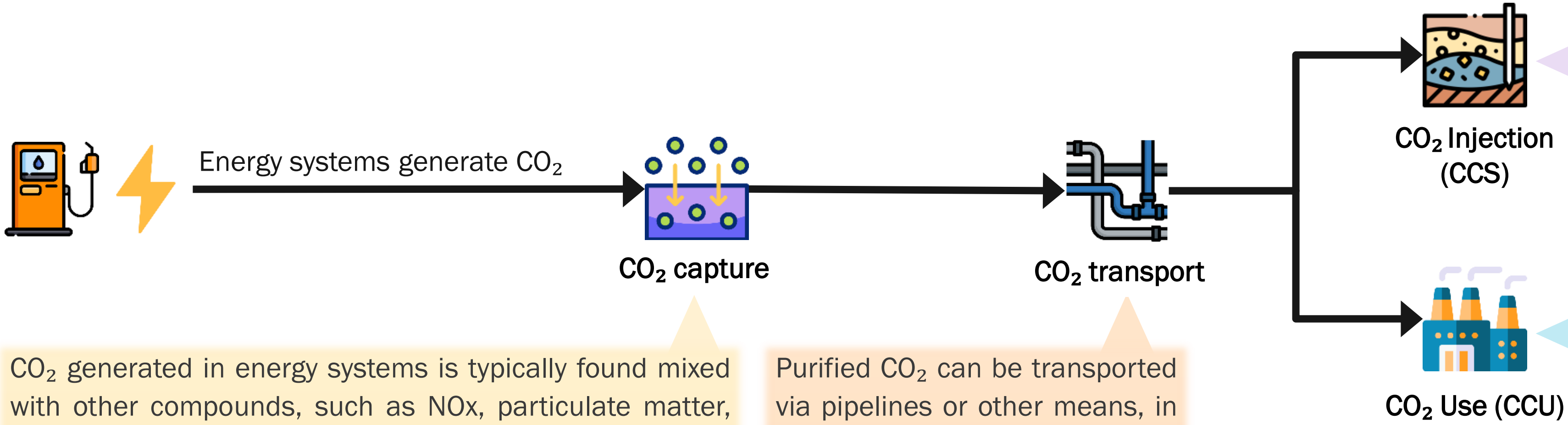
In the context of **energy**, biogenic carbon is present in liquid and gaseous biofuels and in solid biomass used for **bioenergy**.

The use of these energy sources results in the residual generation of **biogenic CO_2**, that is, CO_2 containing biogenic carbon.

In this report, the opportunities and challenges for the **economic use of biogenic CO_2** will be highlighted, as well as the **availability of the resource** in Brazil.

CO_2 utilization in energy systems

CO_2 from energy production, traditionally considered a residue of the process, can be better utilized economically:



CO_2 generated in energy systems is typically found mixed with other compounds, such as NOx, particulate matter, and inert gases.

Therefore, to enable better resource utilization, it is necessary to separate and purify it, generating streams that can be better employed downstream.

Typical CO_2 capture technologies include absorption, adsorption, membrane separation, and cryogenic separation.

The technological choice depends on aspects such as the scale of operation, required purity, initial CO_2 concentration, and type of impurity.

Purified CO_2 can be transported via pipelines or other means, in compressed form.

The ideal characteristics for CO_2 transport are highly specific to each capture project, as they depend heavily on the distance between the collection point and the point of use or injection, the volume of CO_2 captured, and the available infrastructure.

CCS* consists of the permanent injection of captured CO_2 into geological reservoirs.

CCS allows for a significant reduction in greenhouse gas emissions from energy systems, leading to potential economic gains for the involved agents through regulated or voluntary carbon markets.

CCU* consists of using CO_2 as a feedstock in production processes.

In the energy sector, catalytic reactions with hydrogen for the production of e-methanol or synthetic hydrocarbons stand out. These products are evaluated as promising advanced fuels for the energy transition.

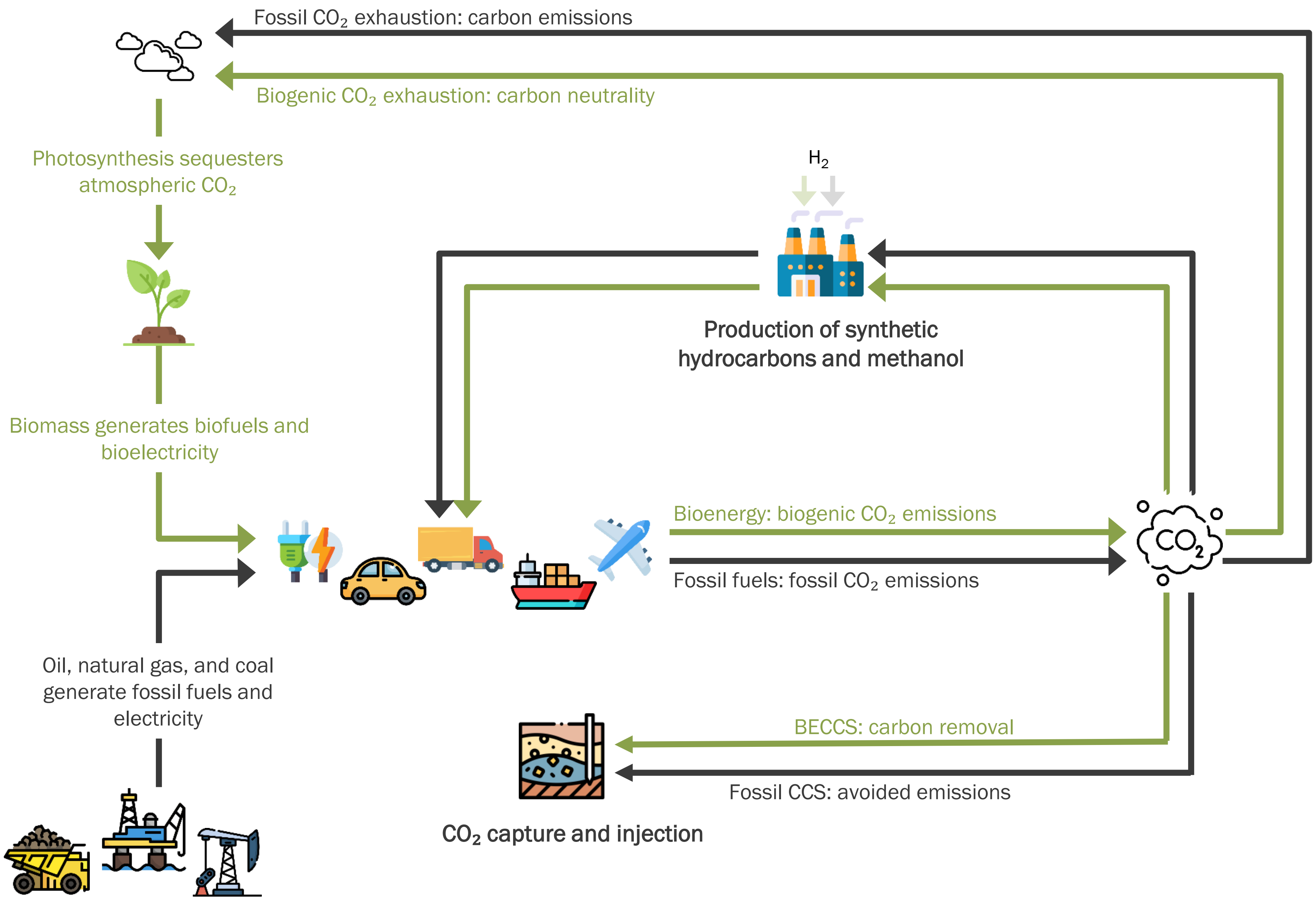
Non-energy applications of CO_2 can also be mentioned, such as beverages carbonation, urea production, among others.

When capture involves biogenic CO_2, the operations are named BECCU and BECCS*.

Also noteworthy is the possibility of mixed strategies, called BECCUS, in which CO_2 storage occurs concurrently with its use.

* Acronyms for *Carbon Capture and Utilization* - CCU, *Carbon Capture ans Storage* – CCS, and for the respective operations associated with bioenergy (*Bioenergy with CCU* – BECCU and *Bioenergy with CCS* – BECCS).

Carbon cycles in energy systems



Biogenic CO_2 constitutes a **renewable carbon source**, sequestered from the atmosphere by photosynthesis. Thus, it enables environmentally advantageous cycles and processes when compared to fossil CO_2:

- **Zero net carbon emissions,** in cases where the exhausted CO_2 returns to the atmosphere;
- Production of **100% renewable fuels** in CO_2 capture and utilization operations (BECCU), provided that CO_2 is associated with renewable H2;
- **Carbon removal flows with negative net emissions** in operations that capture and store CO_2 (BECCS).

Origins of biogenic CO_2 in bioenergy

Biogenic CO_2 is generated during the combustion of biomass or biofuels. Furthermore, it is also present in other streams deriving from the bioenergy chain, in purer conditions:

Biogenic CO_2 source	Application	Availability characteristic	Typical CO_2 concentration
Combustion of biomass or biofuels	Biomass cogeneration (thermal power plants)	Stationary	Below 15% (vol/vol)
	Internal combustion engines using biofuels	Mobile	
Biogas purification*	Key step for biomethane production	Stationary	Above 85% (vol/vol)
Alcoholic fermentation	Key step in ethanol production, both from sugarcane and corn	Stationary	Above 95% (vol/vol)

Capturing CO_2 from mobile sources is more challenging than from stationary sources, whether due to technical challenges or the need for developing more sophisticated business models involving additional stakeholders, such as gas stations, for example.

More concentrated CO_2 streams constitute more cost-effective raw materials for BECCU or BECCS because they **considerably reduce the costs associated with capturing step. Bioenergy** stands out for providing **streams with very high purity.**

The levelized cost of capturing one ton of CO_2 can be estimated as[1]:

- US$ 25 – 35 for alcoholic fermentation (concentrated stream);
- US$ 50 – 100 for thermal power plants (diluted stream);
- US$ 134 – 342 for direct capture from the atmosphere (highly diluted stream, ~400 ppm of CO_2).

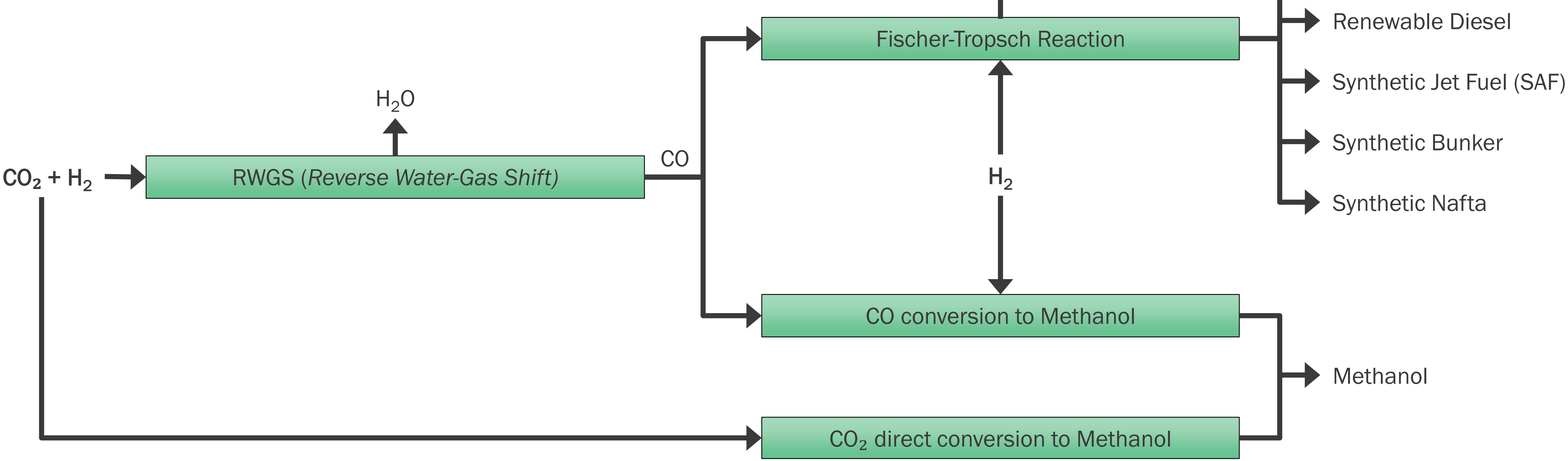
[1] IEA 2021

* Biogas is a gaseous mixture typically containing methane (35% - 70%), CO_2 (15% - 50%), and other impurities (Gupta et al. 2023). After the purification process, biogas gives rise to a specified biomethane stream, interchangeable with natural gas, and a residual stream rich in CO_2.

Energy uses of CO_2

Some of the most promising BECCU operations involve synthetic fuels production. These processes occur through catalytic chemical reactions with hydrogen*. The obtained product depends on the catalyst used and the temperature and pressure conditions of the reactor:

- When hydrogen is obtained from water electrolysis, the resulting products are called electrofuels. In these cases, they receive the prefix "e" (e.g., e-Methanol, e-SAF, e-Gasoline, etc.).



CO_2 can also be injected into oil reservoirs to increase well productivity, a process called Enhanced Oil Recovery (EOR). This is an example of BECCUS.

Non-energy uses of CO_2

CO_2 also has uses in non-energy sectors, among which the following stand out:

Urea production

Urea is obtained from the chemical reaction between CO_2 and NH_3. This process is currently the largest CO_2 industrial consumer.

Beverages Carbonation

CO_2 is dissolved in the production of carbonated beverages, a well-established and common practice in food industry.

Production of concrete with carbonates

CO_2 can be used to produce new concretes containing carbonates, a technology that is still in its early-stages, but which has high potential.

Uses in the chemical industry

Several processes that use CO_2 as an input in the chemical industry are currently under development, including polymer production.

Public Policies

Several recent public policies have fostered the development of BECCU and BECCS in Brazil:

RenovaBio

National Biofuels Policy (Renovabio) – Law N° 13,575/2017

The national biofuels policy provides a **bonus of up to 20% on the energy-environmental efficiency rating (NEEA) of biofuel producers or importers who demonstrate negative greenhouse gas emissions,** encouraging the adoption of BECCS systems.

COMBUSTÍVEL DO FUTURO

Future Fuel Law – Law N° 14,993/2024

The Future Fuel Law officially **introduced the capture, utilization, and geological storage of carbon dioxide into the Brazilian legal framework**. Currently, the Ministry of Mines and Energy is conducting Public Consultation n° 205, which proposes an additional decree introducing further details for CCS-related provisions. So far, the main advances introduced by the law include:

- Legal definition of the activities of "carbon dioxide capture," "geological storage of carbon dioxide," and "synthetic fuels";
- Inclusion of synthetic fuels and recognition of carbon dioxide capture and storage as a strategy for mitigating greenhouse gas emissions in the National Energy Policy;
- **Indication of the National Agency of Petroleum, Natural Gas and Biofuels (ANP) as the authorizing and regulatory agent for carbon dioxide capture, utilization, and storage activities**;
  - The ANP Resolution N° 859/2024 authorizes, on a transitional basis, the analysis of projects related to carbon capture and storage activities to be carried out through an experimental regulation mechanism by pilot project, according to the rules established in a 2024 report. This mechanism provides legal certainty to ventures currently being established or that will be established while definitive regulatory definitions are under development. Furthermore, it allows for the active participation of entrepreneurs in the regulatory design.

BNDES

Energy Transition Acceleration Program (Paten) – Law N° 15.103/2025

PATEN included low-carbon synthetic fuels and carbon capture and storage activities as priority adhering sectors in the program, allowing projects to access **financing from the Green Fund (BNDES) and tax transaction mechanisms conditioned on investment in sustainable development**.

PLANO CLIMA Mitigação

Climate Mitigation Plan – Energy Sector Plan

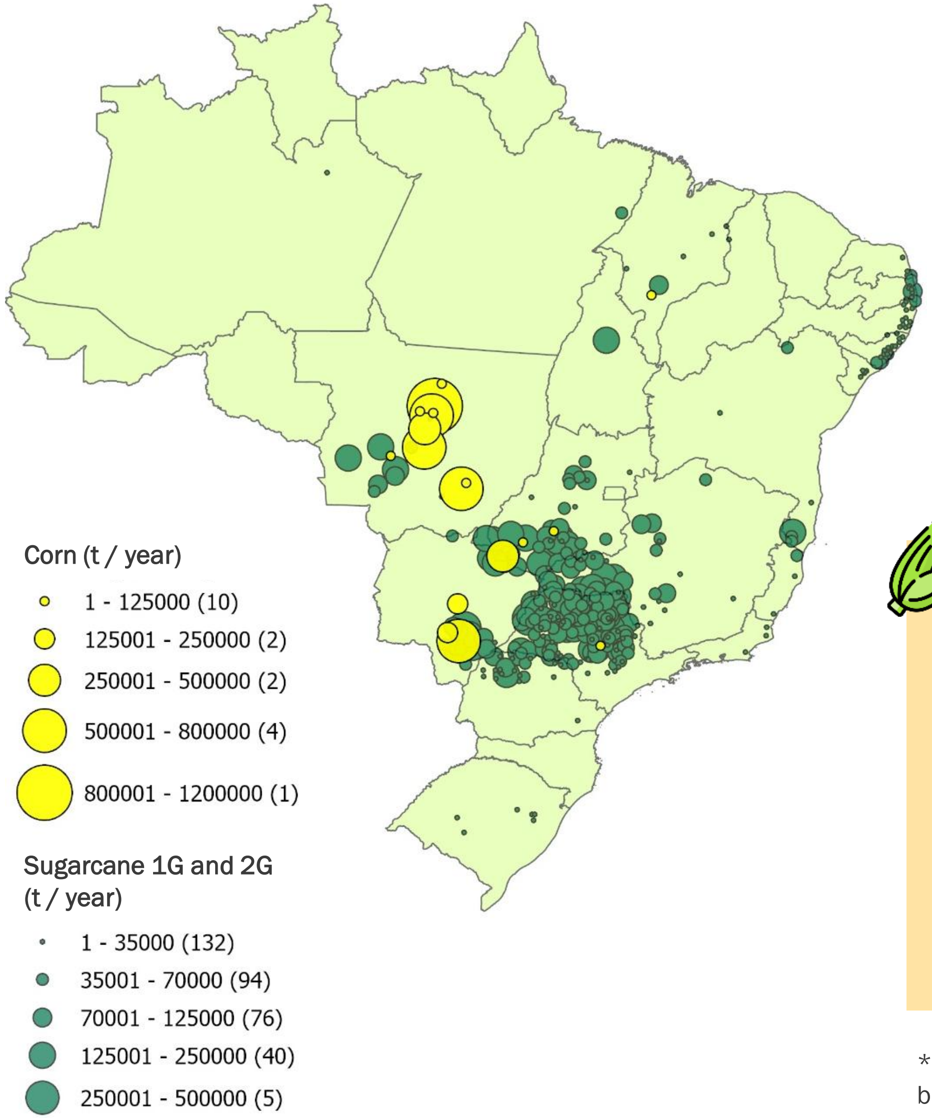
BECCS are envisaged as highly relevant operations to achieving the goals of the Brazilian Climate Mitigation Plan for energy.

For example, the plan mentions some expected results such as the implementation of BECCS pilot plants by 2030 and the expansion of CO_2 pipelines associated with the identification of storage sites for CCS by 2035. Increased production of synthetic fuels is also mentioned as an objective of the plan.

Availability of Biogenic CO_2 in Brazil

Immediate availability of CO_2 – Alcoholic Fermentation

Immediate availability of CO_2 (Fermentation)



Brazil is the second largest ethanol producer in the world, with a **large and widespread network of mills. The alcoholic fermentation process produces approximately 0.7 to 0.75 kg of CO_2 / l of ethanol.**

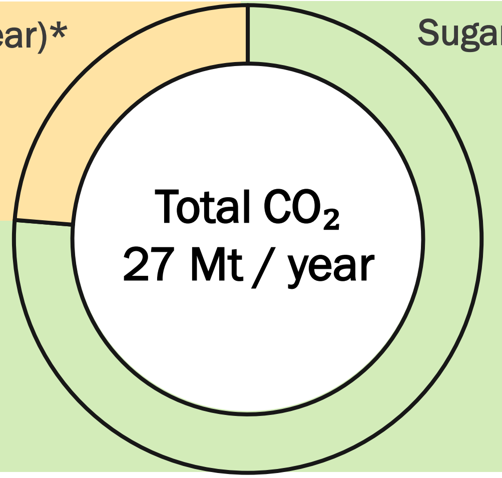
As it consists of high-purity streams, fermentation-derived CO_2 can be considered an immediately usable source of biogenic carbon, eliminating the need for large investments in capture equipment.

Based on 2024 ethanol production, the availability of biogenic CO_2 from fermentation is the following:

Corn (6.4 Mt / year)*

Corn processing plants operate continuously throughout the year, ensuring the supply of CO_2 and facilitating its utilization.

Many corn processing plants have large operating scales, which can facilitate the implementation of proprietary projects.



Sugarcane (20.6 Mt / year)

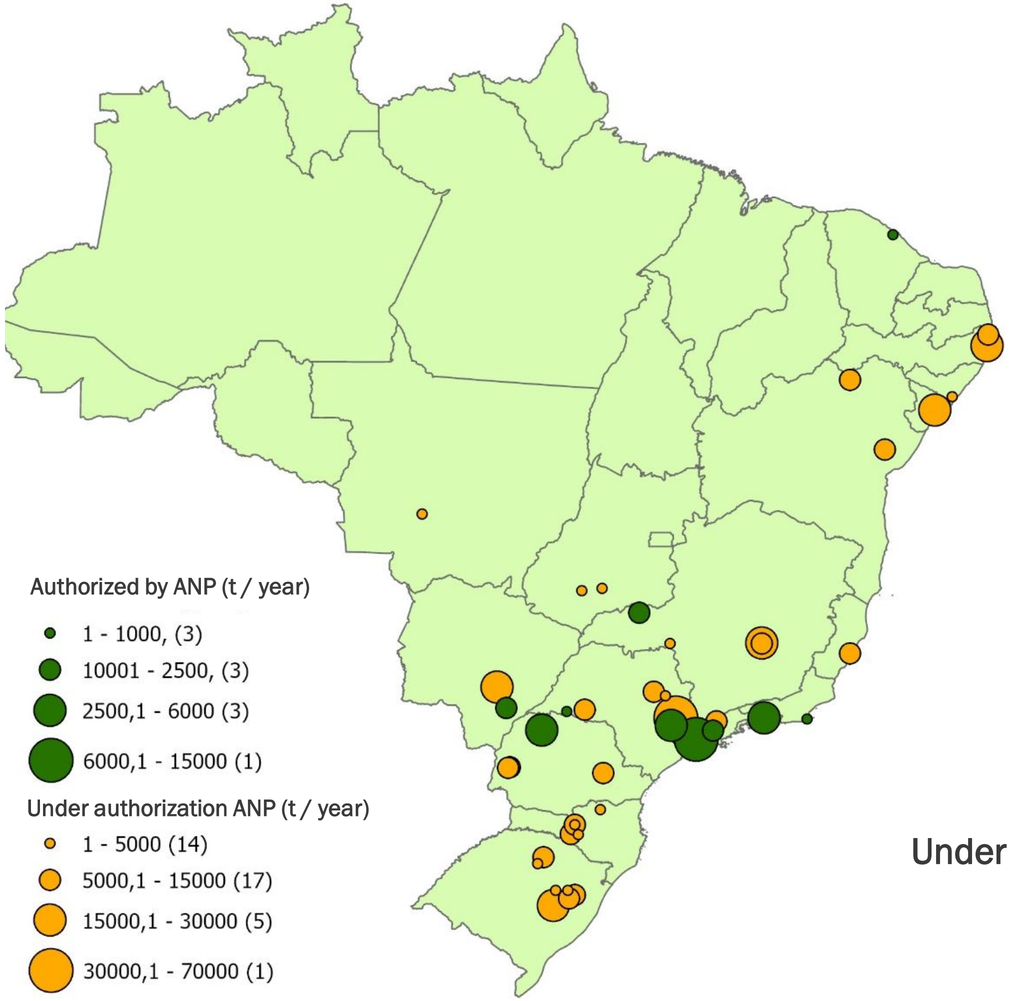
The large geographical concentration of sugarcane mills among the states of São Paulo, Minas Gerais, Paraná, and Goiás may facilitate carbon capture hubs implementation.

However, the seasonality of CO_2 availability, linked to the sugarcane harvest, may present challenges to its utilization.

* Ethanol mills that process both sugarcane and corn (flexible) were included in the "corn" category because they also present the advantage of not being restricted to seasonality for CO_2 availability.

Immediate availability of CO_2 – Biogas purification

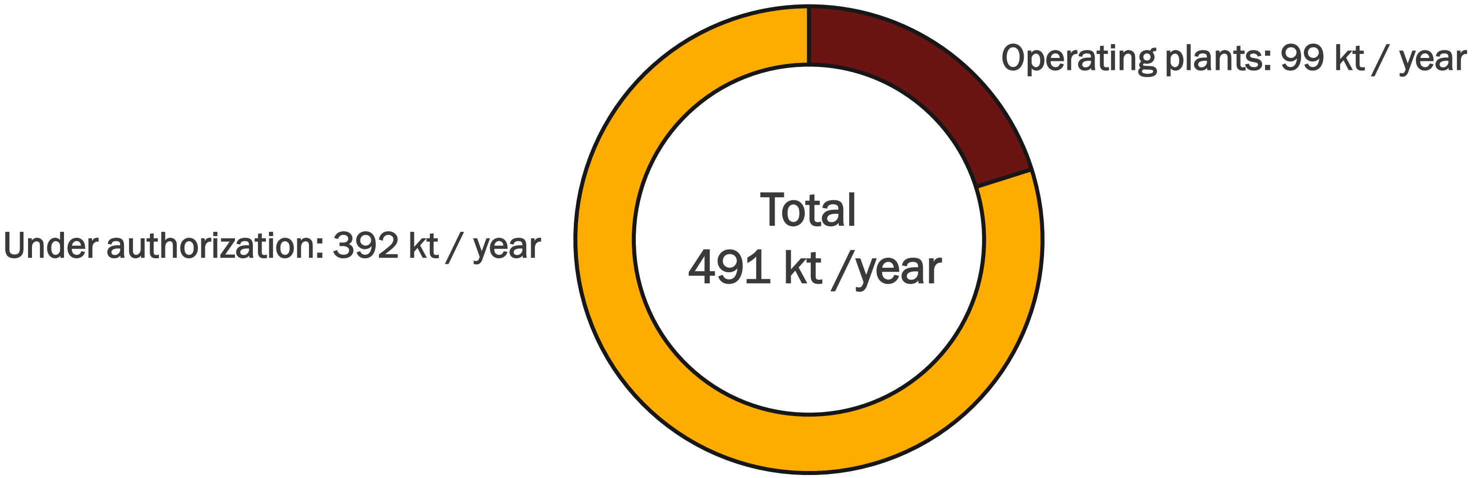
Immediate availability of CO_2 (Biomethane)



Biomethane has increasingly scaled as a promising emerging bioenergy source for Brazil's energy transition. Biomethane is directly interchangeable with natural gas and can be used in the same applications, making it a highly versatile energy source.

Biomethane is obtained from the purification of biogas, a mixture of methane and CO_2. Thus, the residual gas from purification is highly concentrated in carbon dioxide, also representing an immediately usable availability of biogenic carbon.

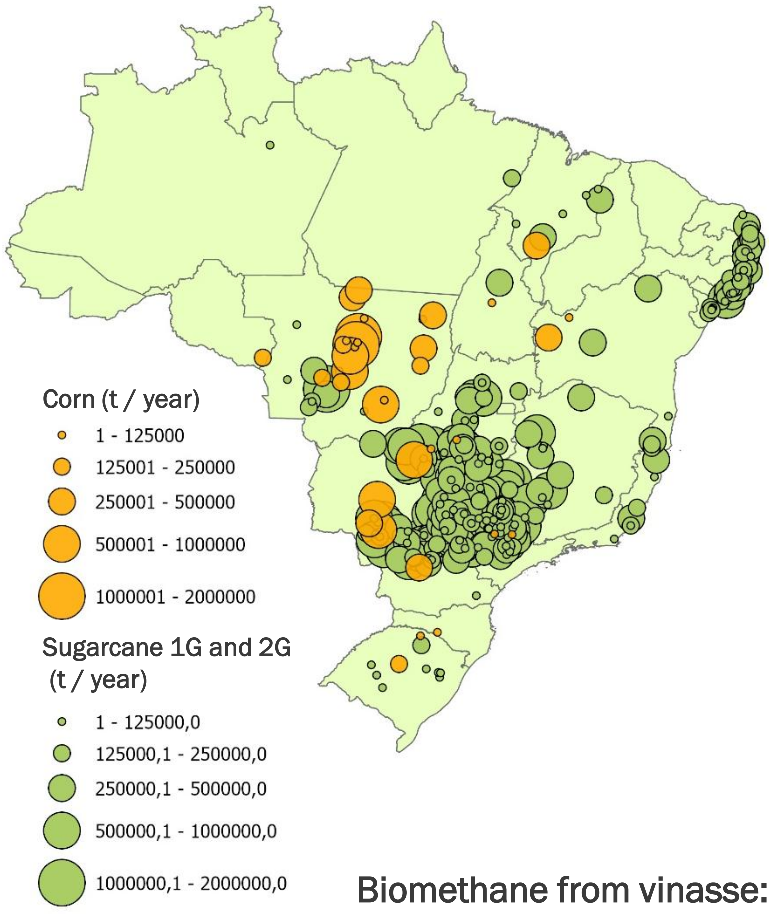
According to 2024 production, the immediate availability of biogenic CO_2 from existing biomethane plants and the future availability from plants undergoing authorization by the ANP is*:



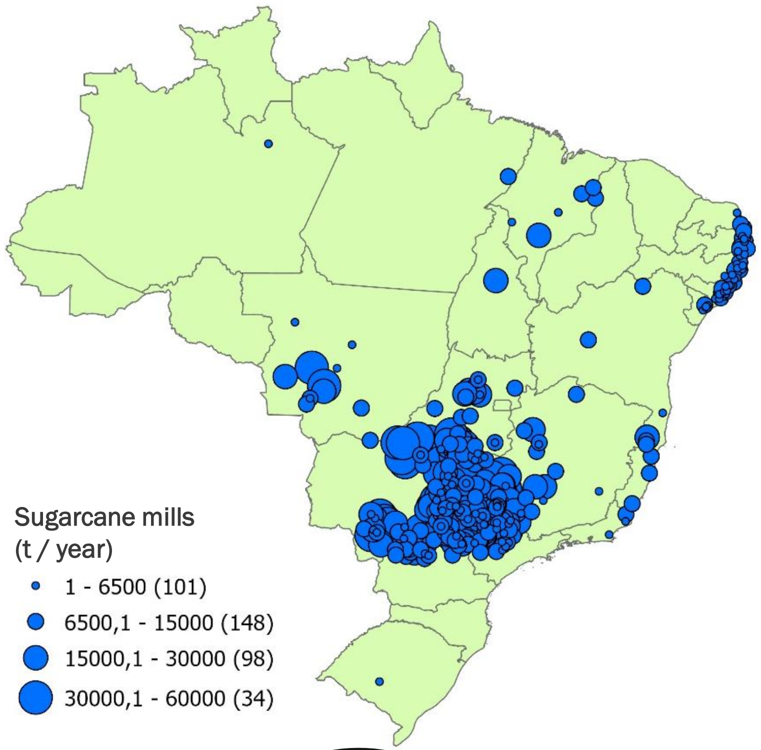
* The figures are based on productivity data provided by the ANP (National Agency of Petroleum, Natural Gas and Biofuels) that excludes internal consumption. Therefore, they may be underestimated.

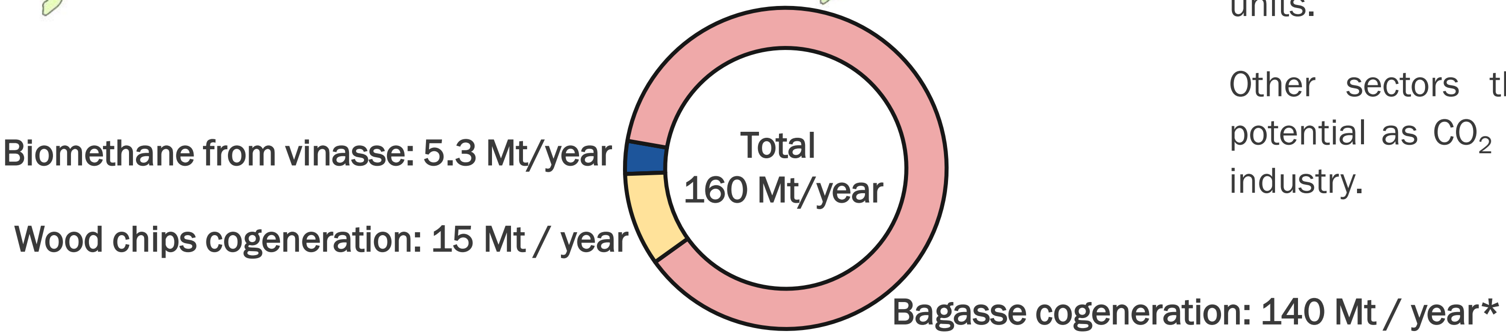
Potential additional availability of CO_2 in the ethanol sector

Additional CO_2 availability: cogeneration in ethanol plants



Additional CO_2 availability: biomethane from vinasse and filter cake





Beyond immediate availability, ethanol plants have the potential to supply significantly larger quantities of biogenic CO_2 from:

- Capture from biomass cogeneration exhaust streams, resulting from the use of biomass in boilers to generate electrical and thermal energy. Sugarcane mills use bagasse as biomass, while corn mills typically employ wood chips;
- Biomethane production from vinasse- and filter cake-derived biogas in sugarcane mills.

Making these CO_2 streams available requires a more significant investment by the plants, either through the implementation of more robust post-combustion capture systems or the installation of biomethane production units.

Other sectors that produce bioelectricity also hold potential as CO_2 suppliers, such as the paper and pulp industry.

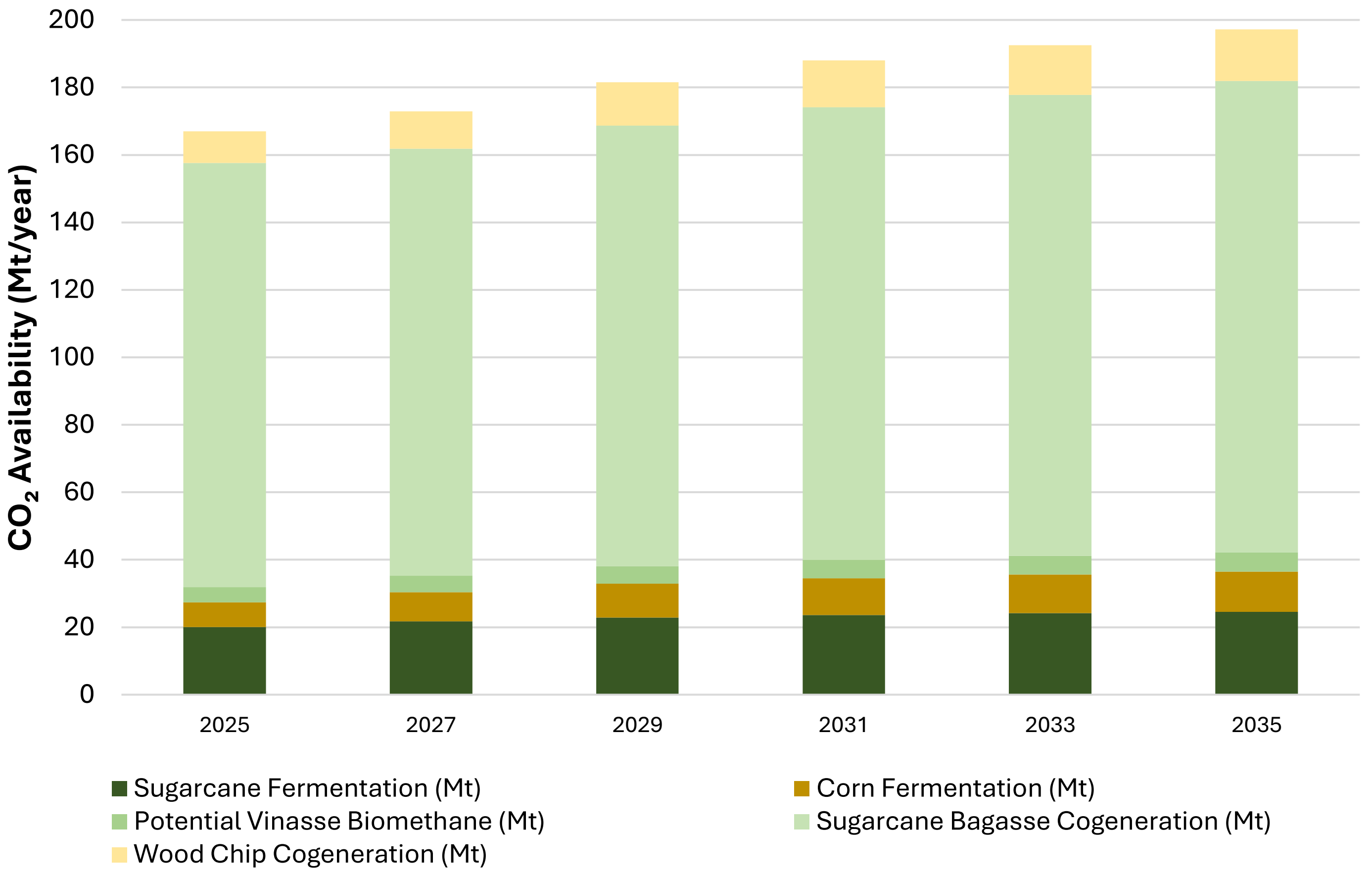
* Bagasse cogeneration also includes the sugarcane fraction destined for sugar production, which justifies its high volume

Current and future CO_2 potential in the ethanol sector

The annual availability of biogenic CO_2 from the ethanol sector could reach 197 Mt by 2035:

- 36 Mt of CO_2 from fermentation, being 67% from sugarcane ethanol plants and 33% from corn ethanol plants;
- 6 Mt of CO_2 from the purification of biomethane derived from vinasse and filter cake in sugarcane ethanol plants, considering the hypothesis of total conversion of these residues;
- 155 Mt of CO_2 from cogeneration, being 90% from the use of sugarcane bagasse and 10% from the use of wood chips in corn ethanol plants.

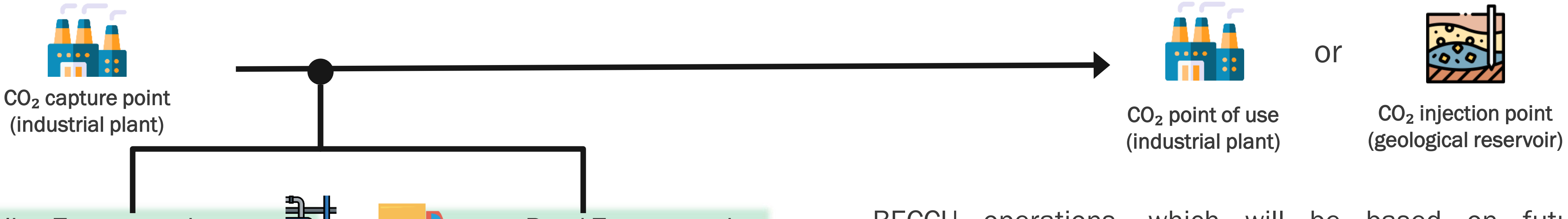
Projection of immediate and potential availability of biogenic CO_2 in sugarcane and corn ethanol plants until 2035



Challenges for the use and/or storage of Biogenic CO_2

Logistical challenges

Due to the Brazil's typically large geographical distances, the transport of CO_2 between its collection point and its use and/or injection site can represent a logistical bottleneck for the implementation of BECCU and BECCS operations.



Pipeline Transportation

The pipeline alternative **significantly reduces operating costs** and emissions associated with CO_2 transportation, especially over long distances. However, it depends on infrastructure that currently does not exist in the country, which results in **high investment costs** and a longer implementation time.

Road Transportation

The road transport alternative presents **high operating costs** and high emissions associated with CO_2 transport, especially over long distances. At the same time, it utilizes road infrastructure that is already widely available in the country, **significantly reducing investment costs** and implementation time.

BECCU operations, which will be based on future industrial plants, offer greater geographical flexibility for implementation. In this regard, the location of the CO_2 consuming unit can be defined prior to construction, in a way that minimizes logistical costs.

BECCS operations, in turn, depend on the physical location of the geological reservoirs; thus, they are less flexible in terms of injection location.

Informational Challenge

Geological knowledge of potential CO_2 injection sites in Brazil is limited, especially in the interior regions of country.

The development of continental geological prospecting activities adds costs and risks to the implementation of BECCS operations.

Learn more:

The National Zoning of Oil and Gas Resources, published every 2 years by EPE, provides a mapping of Brazil's potential for CO_2 injection.

Technological challenges

Technological improvements are essential for reducing costs at all stages of the BECCU and BECCS supply chains.

Notably, CO_2 capture usually represents the most expensive step, particularly in operations that use CO_2 from cogeneration, which is diluted in exhaust gases. Various technologies can be employed at this stage of the process, each presenting specific challenges for technological improvement and cost reduction:

Technology	Simplified description of the process	Main technological challenge for use in post-cogeneration streams
Chemical absorption	**Chemical absorption is the most commonly employed technology for capturing CO_2 from exhaust gases** at scales typical of thermal power plants. The CO_2 is chemically absorbed by a solvent, typically an amine-based liquid. Subsequently, the solvent is regenerated by increasing the temperature to recover the gas and recycle the solvent.	A significant amount of energy is required for solvent regeneration, which constitutes the primary cost driver of the process.
Physical absorption	Physical absorption is a technology with industrial significance, but which is primarily used in pre-combustion capture operations. It operates on a cycle similar to chemical absorption but under lower temperatures and higher pressures.	The process requires pressurizing and cooling of post-combustion streams, which results in high energy consumption and cost and hampers thermal optimization.
Adsorption	Adsorption is a technology used industrially, but typically on smaller operating scales than those required in post-combustion systems. CO_2 is captured by a solid adsorbent, which is then regenerated by increasing the temperature or reducing the pressure.	Scaling up the process to the capacities required by thermal power plants remains challenging.
Membrane separation	Membrane separation is a technology with lower maturity levels. Even so, there are examples of suppliers offering operational membranes for CO_2 capture. These materials selectively allow solely the passage of CO_2 molecule, which separates it from the exhaust gas.	Scaling up the process to the capacities required by thermal power plants remains challenging. Conventional membranes have lower operating temperatures than those required for post-combustion gases.

Source: EPE based in Hekmatmehr et al. (2024).

Regarding BECCU for energetic purposes, technological improvement is also still required for optimizing CO_2 and H_2 conversion processes. This is particularly true for Fischer-Tropsch synthesis (SAF, Green Diesel etc.) and for the direct conversion of these inputs into methanol.

Regulatory and market challenges

The widespread development of CO_2 capture, transport, use, and/or injection activities in Brazil still depends on the establishment a series of regulatory frameworks and the development of market incentives to create consolidated demand.

Although the Future Fuel Law represents an important step forward by designating ANP as the regulatory authority for the capture, use and injection of CO_2, technical specifications are still needed to **ensure regulatory safety for these activities.**

For example, details still need to be developed on the broad criteria for issuing operating permits, including aspects of capture, injection, monitoring and accountability (short- and long-term), environmental licensing, etc.

The formation of consolidated and scalable markets for biogenic CO_2 depends on the fair valuation of the environmental benefits provided by activities involving its use or storage. To achieve this, advances are still needed to ensure the creation of an effective demand for the product, justifying investments in these activities.

There may arise a competition for biogenic CO_2 between use and injection pathways. The destination of the resource will depend on the market mechanisms developed for each option.

The regulation of biogenic CO_2 markets also still remains an open issue in many cases and plays a crucial role in the formation of competitive and firm demand for the product.

In Brazil, Law 15,042/2024 established the Brazilian Greenhouse Gas Emissions Trading System (SBCE), which can become a decisive mechanism for the development of regulated and consolidated carbon markets in the country. However, it is still necessary to define specific regulations for starting this market's operation.

Internationally, a series of programs are being developed to create markets for products that use biogenic CO_2 or store the gas during production. For energy applications, such as methanol or SAF production, fuel competitiveness in these programs depends heavily on the assumptions used to calculate carbon intensities (CI), which are still being defined for several pathways.

The definition of CI calculation assumptions and bonuses mechanism for BECCS operations are also still pending within the Renovabio framework.

International Overview of Biogenic CO_2 Capture, Utilization, and Storage

Global overview of BECCS/BECCUS

Currently, there are **6 operational BECCS/BECCUS plants** in the world, with a total capture capacity of **2.03 Mt CO_2 / year** (4.1% of the total operational capacity of CCS/CCUS)

Project	Country	Capacity (tCO_2/year)	CO_2 Source	CO_2 Destination
Illinois Industrial	USA	1,000,000	Fermentation (corn)	CCS
Arkalon Ethanol	USA	310,000	Fermentation (corn)	CCUS (EOR)
Blue Flint Ethanol	USA	200,000	Fermentation (corn)	CCS
GEVO	USA	180,000	Fermentation (corn)	CCS
Mikasa Power Plant	Japan	180,000	Cogeneration (palm residues)	CCS[1]
Bonanza Bioenergy	USA	160,000	Fermentation (corn)	CCUS (EOR)

[1] This project is in demonstration phase – the CO_2 is not yet being transported to its final injection site.

According to announced projects, the expected global BECCS/BECCUS capacity by 2032 is:

- **Under construction: 4.35 Mt CO_2 / year (4.4% of total capacity under construction for CCS/CCUS)**
- **Total planned: 80.72 Mt CO_2 / year (14.2% of total announced capacity for CCS/CCUS)**

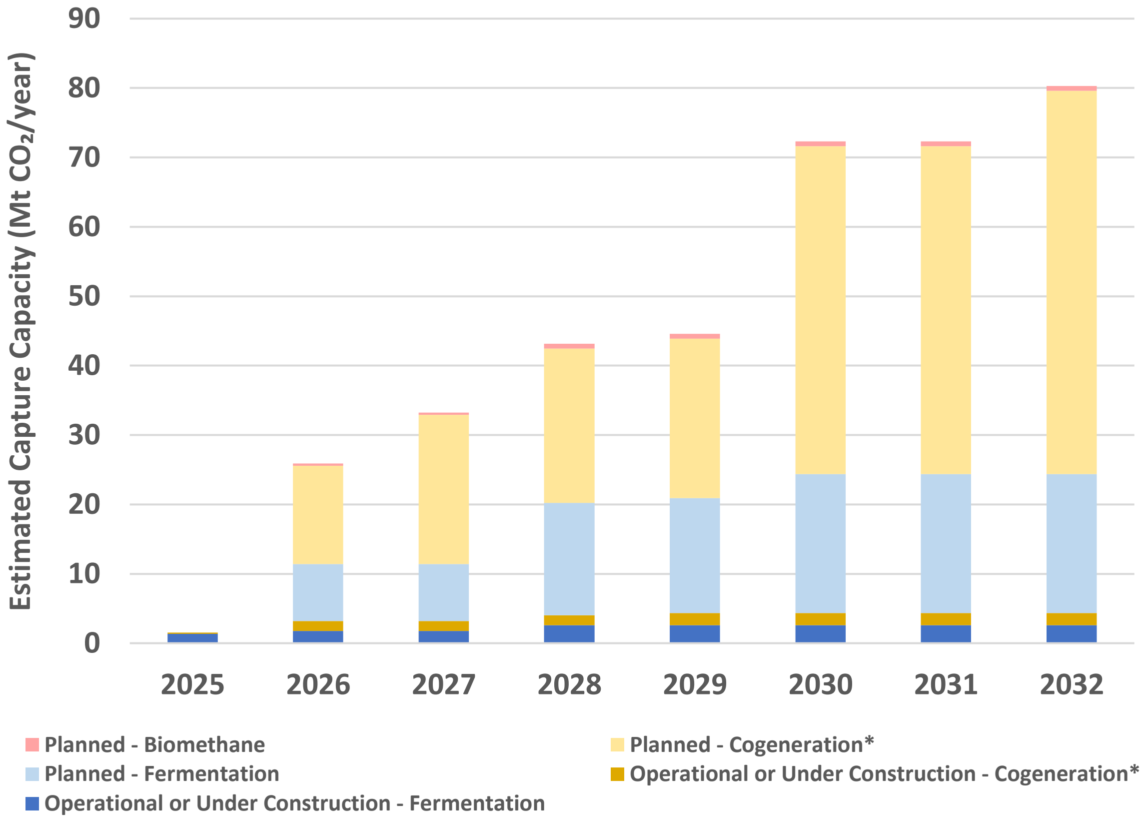
USA
40.7 Mt CO_2 / year
51% Cogeneration (8 projects)
49% Fermentation (46 projects)
No biomethane projects

Europe
36.6 Mt CO_2 / year
95% Cogeneration (32 projects)
3% Fermentation (2 projects)
2% Biomethane (3 projects)

Brazil
1.8 Mt CO_2 / year
100% fermentation (corn)

The average capacity of cogeneration projects is 1,335 tCO_2 / year, compared to 435 tCO_2 / year for fermentation. The larger scale, typical of bioelectricity projects, **can offset the higher capture cost associated with the lower concentration of exhaust streams.**

BECCS/BECCUS operational and announced capacity worldwide



* This includes waste-to-energy projects, which may, in some cases, mix non-biogenic carbon with biogenic CO_2.

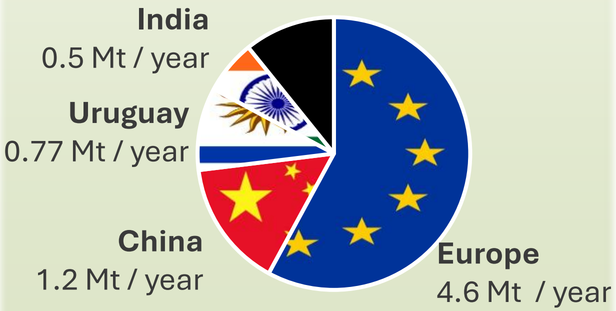
Source: EPE based on IEA and personal communications.

Global overview of BECCU in the energy sector

E-methanol and e-SAF production using biogenic CO_2 is still in its early stages worldwide, with only four operational projects reported, all at the **pilot scale.**

The expected global BECCU capacity for **e-methanol** by 2031 is:

- Under construction: 0.29 Mt Methanol / year (approximately 0.40 Mt CO_2 consumed / year)
- Total planned: 8.1 Mt Methanol / year (approximately 11.1 Mt CO_2 consumed / year)



The expected global BECCU capacity for **e-SAF** by 2031 is:

- Under construction: 0.014 Mt SAF / year (approximately 0.04 Mt CO_2 consumed / year)
- Total planned: 2.3 Mt SAF / year (approximately 7.3 Mt CO_2 consumed / year)

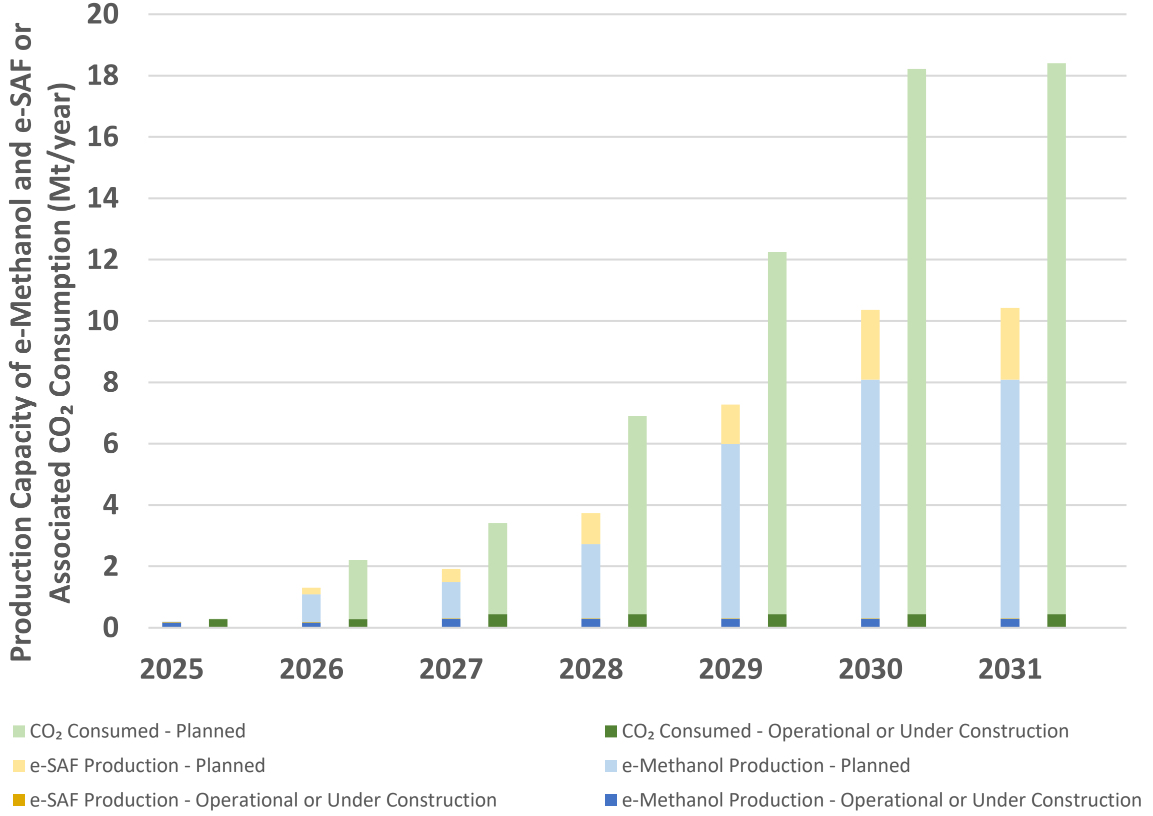
In Brazil, the 2024 public call for proposals by BNDES/FINEP named "Business Plans for investments in low-carbon aviation and shipping fuels" **received 11 project proposals involving BECCU for e-methanol, with a total capacity of approximately 0.79 Mt methanol/year.** This call reflects investment intentions for projects that have not yet been officially announced.

The CO_2 emissions targeted by these projects originate from the following operations:

- Fermentation: 0.53 Mt CO_2 consumed / year
- Biomethane: 0.48 Mt CO_2 consumed / year
- Cogeneration: 0.39 Mt CO_2 consumed / year

For SAF production, the main projects submitted to the call focus on other productive routes that do not directly involve the use of biogenic CO_2.

BECCU operational and announced capacity for e-methanol and e-SAF worldwide*



* Included only projects for which it was identified public announcements of the intention to use biogenic CO_2, at least partially. There are other renewable e-methanol and e-SAF projects announced for which the CO_2 source has not been specified, amounting to an additional potential annual capacity of BECCU of 13 Mt of e-methanol and 1.6 Mt of e-SAF.

Source: EPE based on Methanol Institute, ICAO, eFuel Alliance e T&E

Implementation example: *Summit Carbon Solutions*

A prominent implementation example of a biogenic CO_2 capture and storage hub is the project operated by a US company, Summit Carbon Solutions.

The construction of over 4,000 km of pipelines for the collection and transport of CO_2 is underway at 57 plants across five U.S. states, the vast majority of which involves biogenic CO_2 derived from corn ethanol production. The injection will take place into geological reservoirs in the state of North Dakota.

Completion is expected by 2027. The systems is designed to operate with a capacity of up to 18.5 Mt CO_2 / year.

The company is taking advantage of the significant recent advancements in the regulatory frameworks for CCS in the state of North Dakota, the geographical proximity of corn ethanol plants, and tax incentives for the activity in the United States (e.g., 45Q credits) to make the operation economically viable.

The business model based on capture hubs, with an operator responsible for collecting CO_2 at different availability sources, allows for considerable economies of scale and risk sharing.

Similar models could be implemented in Brazil, given the geographic concentration of plants supplying biogenic CO_2.

The viability of these operations, however, still depends on the structuring of more advanced regulatory frameworks and the creation of robust markets, as such projects require substatial investments.

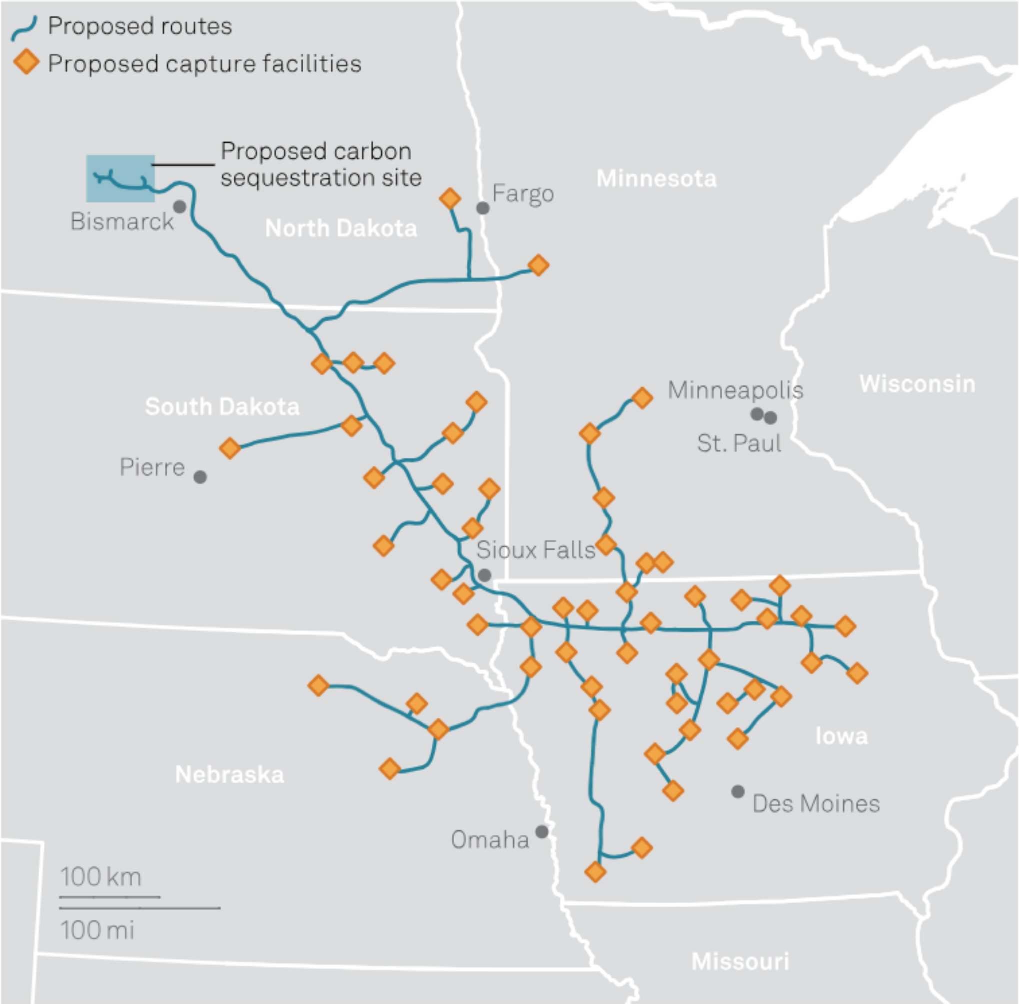


Image source: S&P Global (2024)

Final Remarks

The challenge of reducing anthropogenic GHG emissions is the driving force behind the search for new mitigation strategies by Climate Agreements' signatory countries, such as Brazil.

The economic exploitation of biogenic CO_2 can support Brazil in achieving this goal. This resource can be injected into geological reservoirs or used in production processes, for energy or non-energy uses.

Brazil has made progress in building a legal framework to support this strategy. Recent public policies, such as RenovaBio and the Fuel of the Future, as well as PATEN and the Climate Plan, address this issue.

There is great national potential for making biogenic CO_2 available. The main opportunities involve alcoholic fermentation and biogas purification (in terms of ease of capture) and biomass cogeneration (in terms of volume).

Several challenges still need to be overcome for the effective development of these opportunities in Brazil, such as logistical obstacles, technological improvements to reduce costs, regulatory definitions, and market consolidation.

The consumption of biogenic CO_2 for storage or use is expected to grow rapidly internationally. External experiences can be inspiring for the implementation of solutions adapted to the national context.

BIOS

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