BJIR Brazilian Journal of International Relations
unesp UNIVERSIDADE ESTADUAL PAULISTA "JÚLIO DE MESQUITA FILHO"
Igepri Instituto de Gestão Pública e Relações Internacionais

The implications of the European Green Deal stemming from the REPowerEU plan for Brazil–European Union relations in the sustainable fuels sector (2019–2024).[1]

As implicações do Pacto Ecológico Europeu a partir do *RepowerEU* para as relações entre Brasil e União Europeia no Setor de combustíveis sustentáveis (2019–2024).

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Abstract: This article examines the implications of the European Green Deal and the REPowerEU program on Brazil-European Union bilateral relations in the sustainable fuels sector from 2019 to 2024. The research is based on the global relevance of the environmental agenda, Brazil's strategic role as a bioenergy supplier, and the EU's position as a leader in the pursuit of energy transition and greenhouse gas emission reduction targets. The adopted methodology combines a literature review and documentary analysis, thus enabling the mapping of European and Brazilian policies, as well as an assessment of their impacts on Brazilian exports. Among the findings, the strengthening of Brazil-EU relations stands out, particularly in the development of Sustainable Aviation Fuels and green hydrogen, driven by regulations and incentives on both sides. However, first-generation biofuels face regulatory challenges, which limit their access to the European market. This study aims to contribute to a deeper understanding of energy transition dynamics and their effects on international relations.
Keywords: Brazil; European Union; sustainable fuels; climate policies; energy transition.

Resumo: Este artigo examina as implicações do Pacto Ecológico Europeu e do programa *REPowerEU* nas relações bilaterais entre Brasil e União Europeia no setor de combustíveis sustentáveis, entre 2019 e 2024. A pesquisa parte da relevância da agenda ambiental global, do papel estratégico do Brasil como fornecedor de bioenergia e da posição da UE como líder na busca por transição energética e metas de redução de emissões de gases do efeito estufa. A metodologia combina pesquisa bibliográfica e análise documental, permitindo mapear as políticas europeias e brasileiras e avaliar seus impactos nas exportações brasileiras. Entre os principais resultados, destaca-se o fortalecimento das relações Brasil-UE, especialmente no desenvolvimento de Combustíveis Sustentáveis de Aviação e hidrogênio verde, impulsionado por regulamentações e incentivos de ambos os blocos. No entanto, os biocombustíveis de primeira geração enfrentam desafios

[1]The research was developed within the scope of the Jean Monnet Chair at the Federal University of Goiás and is based on the Final Course Work (TCC) in International Relations at the same University. The chair is funded by the European Union. Views and opinions expressed are, however, solely those of the author(s) and do not necessarily reflect those of the EU. Neither the EU nor the granting authority can be held responsible for the views and opinions presented here. We also acknowledge the support of CEHTES/UFG (FAPEG-PD&I no. 04/2023).

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DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

regulatórios, limitando sua inserção no mercado europeu. O estudo contribui para a compreensão das dinâmicas da transição energética e seus reflexos nas relações internacionais.
Palavras-chave: Brasil; União Europeia; Combustíveis Sustentáveis; Políticas Climáticas; Transição Energética

1. Introduction

Climate change has emerged as one of the greatest global challenges of the 21st century, requiring urgent and coordinated responses at the international level. In this context, the transition to sustainable energy sources has become a pillar of greenhouse gas (GHG) mitigation strategies, with renewable fuels playing a crucial role in the decarbonization of strategic sectors like transport and industry. The European Green Deal (EGD), launched by the European Union (EU) in 2019, represents an ambitious milestone in this direction. This strategy was later reinforced by the RepowerEU plan in 2022, after Russia's invasion of Ukraine (2022-present) exposed Europe's energy dependence on Russian sources (Hasan, 2022).

Brazil has the potential to play a key role in this scenario, being one of the world's leading producers and exporters of biofuels like ethanol and biodiesel. Its vast experience in the sector, combined with the availability of natural resources and a renewable energy matrix, place the Brazil in a strategic position. Furthermore, the country's ability to expand the production of advanced biofuels and green hydrogen (H2V) reinforces its relevance in the context of demands driven by initiatives such as the European Green Deal and RepowerEU (Machado, 2023).

This article seeks to answer the following question: how did the ECP and REPowerEU impact relations between Brazil and the EU in the sustainable fuels sector between 2019 and 2024? To this end, the research has adopted a methodology that combines a detailed literature review and an in-depth documentary analysis. A variety of sources were used including scientific articles, reports from international bodies like the International Energy Agency (IEA), statistical data on international trade in biofuels and EU regulatory documents. This approach allows for a comprehensive understanding of EU policies and their effects on Brazilian exports. Furthermore, regulatory mechanisms that directly or indirectly shape the dynamics of bilateral trade in sustainable fuels were identified, with an analysis of future projects such as green hydrogen and Sustainable Aviation Fuel (SAF).

The central hypothesis proposes that the implementation of REPowerEU, when aligned with the objectives of the EEP, has strengthened Brazil-EU relations by fostering investment in

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

decarbonization technologies, while also encouraging an increase in Brazilian exports of renewable fuels. REPowerEU, as an essential component of the EU's energy strategy, aims to accelerate the transition to clean energy and reduce fossil fuel dependence. In this context, Brazil has emerged as a key player, with a significant progress in energy transition policies like the Fuel of the Future Law (CF), the National Hydrogen Policy (PHN2) and the Pact for Ecological Transformation, all of which are important to the development of the national energy matrix. Moreover, Brazil's potential to supply raw materials and biofuels has resulted in stronger cooperation with the EU. However, the analysis also considers that EU regulatory constraints, such as trade barriers imposed on first-generation biofuels and stringent sustainability requirements, may slow down growth in this sector.

The present work is divided into three main sections: 1) an analysis of the general panorama of Brazil-EU trade relations in the field of sustainable fuels; 2) a comparison of the decarbonization strategies adopted by both, including an assessment of the policies and emission reduction targets with an emphasis on the political dimension of the energy transition; and 3) a detailed examination of the impacts of EU policies on trade in sustainable fuels, particularly with regard to Brazilian exports, highlighting the effects of the PEE and REPowerEU regulations on trade practices and bilateral cooperation between Brazil and the EU.

2. Brazil-European Union Relations: A Historical Overview and Sectoral Dialogue on Sustainable Fuels (1960–2024)

According to Cervo and Bueno (2011), relations between Brazil and the EU can be divided into three spheres: relations between European countries and Brazil, between the EU and the Southern Common Market (Mercosur), and bilaterally between the EU and Brazil. The focus of this study is on the latter. In this sense, it can be said that the Brazil-EU relationship began with the establishment of diplomatic relations in 1960, when the bloc was known as the European Economic Community (EEC), starting the long process of developing closer ties (Brazil, 2025a). Even though Brazil maintained diplomatic ties with the European economic bloc dating back to the EEC's founding, this political-economic relationship remained "forgotten" until the creation of Mercosur in 1991 (Cervo, Bueno, 2011).

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When Mercosur was founded by Brazil, Argentina, Paraguay and Uruguay, in the Treaty of Asunción in 1991, the EEC saw an opportunity for institutional inter-bloc dialogue and an opportunity to export its political model of integration. The Brazil-EU association was officialized in the 2007 Strategic Partnership (SP), a country-bloc relationship of equal importance. In this sense, the SPs designed by the EU aimed to create deep ties of cooperation with global and regional powers, in order to propagate principles like democracy and multilateralism, as well as to ensure greater prominence in the international system. In relation to Brazil, it demonstrated the country's recognition as a strategic partner, due to its significant leadership in the biofuels sector and other renewable energies. Furthermore, according to economic data, Brazil accounted for around 80% of Mercosur's GDP, 22% of Brazilian exports were destined to the EU, while the EU was a major investor in Brazil (Cervo, Bueno, 2011).

During the Lula administration, the Brazil-EU relationship was marked by joint action plans (2008-2011 and 2012-2014), focused on energy security and climate change mitigation. However, the 2008 financial crisis negatively affected long-term relations, reducing enthusiasm on both sides after 2014 (Ferreira-Pereira, 2021). During the Dilma Rousseff administration, there was a significant distancing, with Brazilian foreign policy losing prominence and shifting to relations with BRICS and South-South cooperation. The Strategic Partnership thus entered a period of inactivity, while the EU faced a series of internal and external challenges, such as Russia's annexation of Crimea and Brexit (Ferreira-Pereira, 2021).

During the Bolsonaro government (2019–2022), Brazil received significant criticism from the EU due to its environmental management. There were significant setbacks in the country's regulations, resulting in increased deforestation in the Amazon. From this perspective, the administration adopted a political stance at odds with the global movement in favor of sustainability. However, these actions were in line with US President Donald Trump, who had withdrawn the USA from the Paris Agreement. As such, the environmental issue became one of the main factors in the delay in ratifying the Mercosur-EU agreement (Estevo, Ferreira, 2022).

The government of Luís Inácio Lula da Silva (2022 - Present) needs to consider the context of the war in Ukraine (2022-present), which raised important concerns about energy security. The conflict exposed the dependence of EU member states on Russian gas, oil and coal. This dependence resulted

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

in deep insecurity, with the EU seeking alternatives for Russian inputs and trying to increase its self-sufficiency in the sector through the 2022 the REPowerEU plan (Hasan, 2022).

Currently, the bilateral relation is based on the Framework Agreement for Cooperation between the Federative Republic of Brazil and the European Economic Community, ratified in 1995 (Table 1). This highly relevant agreement covers several areas of cooperation, from trade and economic aspects to the harmonization of standards. In addition, it specifically provides for cooperation in the energy sector, including provisions regarding the "rational use of energy" and "energy planning", advancing the conduct of joint research and the implementation of projects in this sector, albeit without mention of biofuels.

Table 1 — Main bilateral agreements signed between Brazil and the European Union in force in the period 2019–2024 and their references to the energy and fuel sector

Agreements	Content	Períod (year)
1. Framework Agreement for Cooperation between the Federative Republic of Brazil and the European Economic Community	Trade, economic, financial and scientific-technological cooperation. Recognizes the importance of environmental protection, economic cooperation in the energy sector and joint research in the area; does not mention fuels.	**Signed:** 1992 **Ratification:** 1995 **In force:** 1995 **Situation:** in force
2. Supplementary Adjustment to the Framework Agreement for Cooperation between the Federative Republic of Brazil and the EU to Support the Restructuring of the Brazilian Electric Power Sector — EBRA 2000	Institutional cooperation with EU funding for the restructuring project of Brazil's energy sector. There are mentions of the use of European experience in the area of energy policy. However, the fuel sector is not mentioned.	**Signed:** 1998 **Ratification:** [no data] **In force:** 1998 **Situation:** in force
3. Scientific and Technological Cooperation Agreement between the Government of the Federative Republic of Brazil and the EU	Scientific and technological cooperation. There is no specific mention of the development of joint research in the energy niche and the fuels sub-niche.	**Signed:** 2004 **Ratification:** EU — 2005; Brasil — [no data] **In force:** 2006

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		Situation: in force
4. Agreement on Civil Aviation Safety between the Government of the Federative Republic of Brazil and the EU.	Aviation cooperation for flight safety and environmental quality. There is no specific mention of the energy and fuel sectors.	**Signed:** 2010 **Ratification:** EU — 2011; Brazil — 2013 **In force:** 2013 **Situation:** in force
5. Agreement between the Federative Republic of Brazil and the EU on certain aspects of air services	Cooperation in aviation. Article 4 provides for taxes on aviation fuels.	**Signed:** 2010 **Ratification:** EU — 2011; Brazil — 2018 **In force:** 2018 **Situation:** in force
4. Memorandum of Understanding between the Federative Republic of Brazil and the EU on International Cooperation	Coordination of international cooperation between parties in third countries. No mention of the energy and fuel sectors, although the objectives of the 2030 Agenda for Sustainable Development are highlighted.	**Signed:** 2021 **Ratification:** [no data] **In force:** 2021 **Situation:** in force

Source: Prepared by the author using data from Brazil (2025b).

From the information presented, it is clear that rapprochement between the actors frequently occurs through sectoral dialogues. In other words, the exchange of political and technical information, as well as know-how, constantly takes place with regard to particular issues of shared interest and with the participation of various administrative bodies. As for investments, the EU stands out, with an amount of EUR 263 billion, representing 49.5% of all foreign investments in Brazil in 2020 (ApexBrasil, 2023). In 2021 the EU launched a fundamental initiative called Global Gateway, which aims to operate Foreign Direct Investment (FDI) and promises to allocate a total of € 300 million by

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2027 to sustainable infrastructure projects and a climate diplomacy strategy, propagating the EU's new sustainable agenda (European Commission, 2023). During a visit by the President of the European Commission, Ursula von der Leyen, to the CELAC countries in June 2023, a future investment of € 2 billion was announced for the development of projects for the production of green hydrogen (H2V), through the Global Gateway scheme. In addition to this initiative, which focuses more on infrastructure projects, the EU developed the Horizon 2020 program that invested € 80 billion in Research and Innovation (R&I) from 2014 to 2020. A relevant joint research project was the Brazil-EU Cooperation for Development of Advanced Lignocellulosic Biofuels project, carried out from 2017 to 2022, involving the exchange of knowledge and technologies between the BECOOL (EU) and BioValue (Brazil) projects on advanced lignocellulosic biofuels (European Commission, 2023).

In view of the above, President Lula da Silva has aspired to strengthen ties with the EU by reformulating the country's foreign policy that had weakened in the years before. To do so, the government will need to face the difficulties of the European context, such as the fact that the EU is still dealing with the consequences of Brexit and the growing concern of European civil society about the environmental agenda. At the same time, the EU is showing more interest in Brazil, given that the present administration has shown a greater intention to strengthen its climate diplomacy. In addition, President Lula has given more importance to regional organizations and bloc negotiations, which resulted in the finalization of the Mercosur-EU Agreement in December 2024, to be ratified in 2025 (Folly, Closs, 2023; Brazil, 2024a). For Brazil, the EU currently represents a critical "third way" in a system dominated by China-US competition.

3. Comparative Analysis of Fuel Sector Decarbonization Strategies: European Union and Brazil

The European Union's Strategic Agenda 2019-2024, launched in June 2019, outlined the main guidelines for the bloc during this period, with an emphasis on several relevant areas established by the European Council and the Council of the European Union (2020). Among the general objectives, the ambition to build an environmentally neutral, sustainable and inclusive Europe stands out, a central principle of the creation of the European Green Deal, underpinned by the European Climate Pact (ECP). The ECP encompasses a series of cross-sectoral initiatives aimed at achieving climate neutrality by

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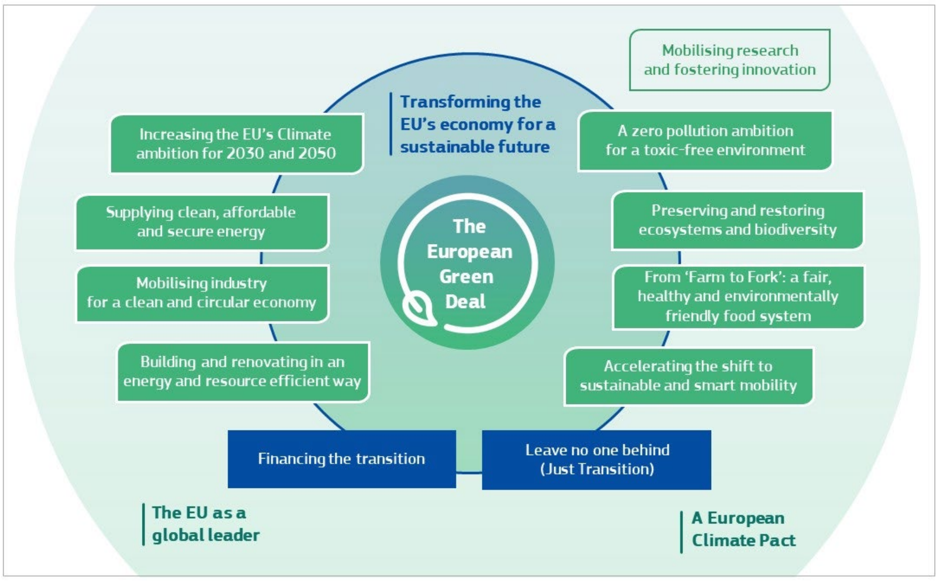
2050, an ambitious target that exceeds previous objectives, which had envisaged a reduction of only 60% (European Commission, 2019).

Figure 1 – European Green Deal – Schematic Overview

Source: European



Commission, 2019.

In 2020 and 2021, the bloc launched *Fit for 55* and the European Climate Law. The former is a package of legislative proposals that aims to align EU policies with its climate targets of reducing emissions by 55% until 2030, compared to 1990 levels. The latter states the ambition of achieving climate neutrality by 2050, while both are connected with the ECP (Council of the European Union, 2025a). In the energy sector, responsible for more than 75% of emissions, the ECP seeks to expand the use of low-emission sources, integrate systems across Member States and align legislation on efficiency and renewable fuels with climate targets, thus ensuring an efficient and inclusive energy transition (Council of the European Union, 2025b). The energy crisis caused by the conflict between Russia and Ukraine in 2022 has exposed the EU's dependence on Russian gas, oil and coal, supplies of which have been disrupted. This has resulted in high energy prices and energy insecurity for the region (Hasan, 2022). In response, the European Commission presented the REPowerEU plan, focused on three actions: improving energy efficiency, diversifying supply sources and accelerating the energy

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transition. Member States must submit detailed plans for reforms and investments in the sector to the European Commission in order to obtain funding (Council of the European Union, 2025b).

In July 2023, following a review, the Energy Efficiency Directive was adopted as part of Fit for 55, aiming to reduce primary energy consumption by 40.6%, cover production and supply, including the transport sector; in addition to a mandatory 38% reduction in final energy consumption (Council of the European Union, 2023). Furthermore, the Renewable Energy Directive (RED), which underwent an update (RED III) in October 2023, increased the target for the share of renewable energy in final consumption to 42.5%, with an additional 2.5% to reach the 45% target (European Commission, 2025a).

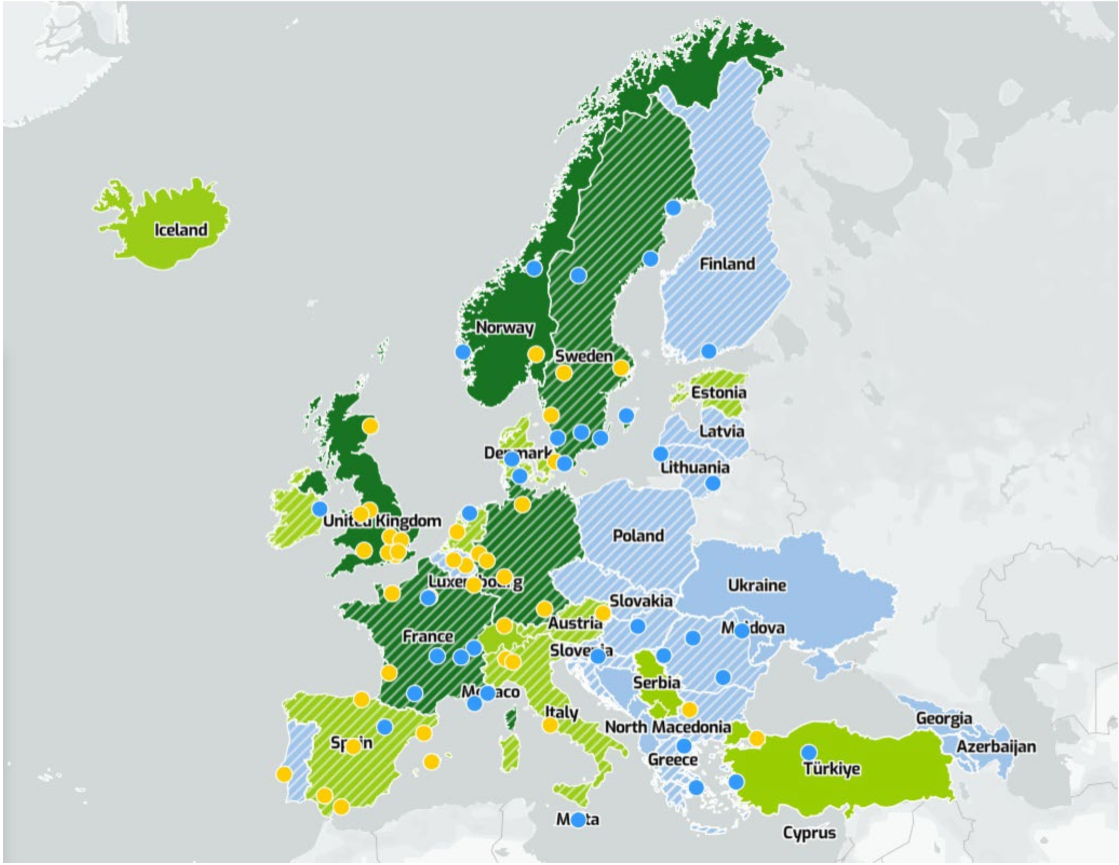
In the transport sector, RED III elevated the target for the share of renewable energy in transportation from 14% to 29% by 2030 and introduced an alternative target of a 14.5% reduction in the carbon intensity of fuels. To achieve these objectives, Member States can opt for one of these targets and should prioritize the use of advanced biofuels, such as renewable diesel (Hydrotreated Vegetable Oil (HVO) and sustainable aviation fuel (SAF), as well as renewable fuels of non-biological origin (RFNBO), which must account for at least 5.5% of total energy consumption in the sector, with a minimum of 1% by 2030 (European Commission, 2025a).

In aviation, the ReFuelEU Aviation Initiative, adopted in October 2023, established progressive targets for the use of SAF, starting with 2% in 2025 and reaching 70% by 2050, the year set to reach emissions neutrality in the sector. This regulation requires airlines, suppliers and airports to gradually adapt to the new rules in order to reduce emissions in the sector (European Commission, 2025b). In February 2025, the European Commission established a financial support system under the European Union Emissions Trading System (EU ETS) to incentivize the use of SAF. The system aims to cover the price difference between SAF and fossil kerosene through the allocation of emission allowances. Airlines must report their use of SAF by March 2025, and the Commission will define the allocation of allowances by August 2025. Its aim is to accelerate the transition to sustainable fuels, even though economic and logistical challenges remain (Directorate-General for Climate Action, 2025). As shown in Figure 2, European airports have been making SAF available to comply with national and EU mandates, despite this fuel's scarcity on a global scale.

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

Figure 2 - European Countries with SAF Mandates and Distribution at Airports

Legend:



Airports: 🟡 Airports offering SAF / 🔵 Base of operations of airlines using SAF / ⚫ Airport with SAF mandate in force. National Policies: National SAF policies under development - Light Green / National SAF policies enacted - Dark Green / No information - Blue / Hatched - SAF mandates. **Source: ECAC, 2025.**

In maritime transport, the FuelEU Maritime Transport Initiative, adopted in July 2023, requires a progressive reduction in the GHG intensity of marine fuels, starting at 2% in 2025 and reaching 80% by 2050. From 2030 onwards, passenger and cargo ships will also be required to use shore-based power when docking at major EU ports, contributing to the reduction of local pollution (European Commission, 2025b). The 2024 Gas and Hydrogen Markets Package sets out guidelines for the transition from fossil gas to renewable and low-carbon gases in the EU, including green hydrogen, promoting investment in its production and distribution (Council of the European Union, 2024). In 2023, hydrogen production in Europe reached 10.8 million tonnes per year, with 95.5% of this production coming from conventional methods such as natural gas reforming, partial oxidation, gasification and refining by-products. Natural gas reforming is the main process, which converts

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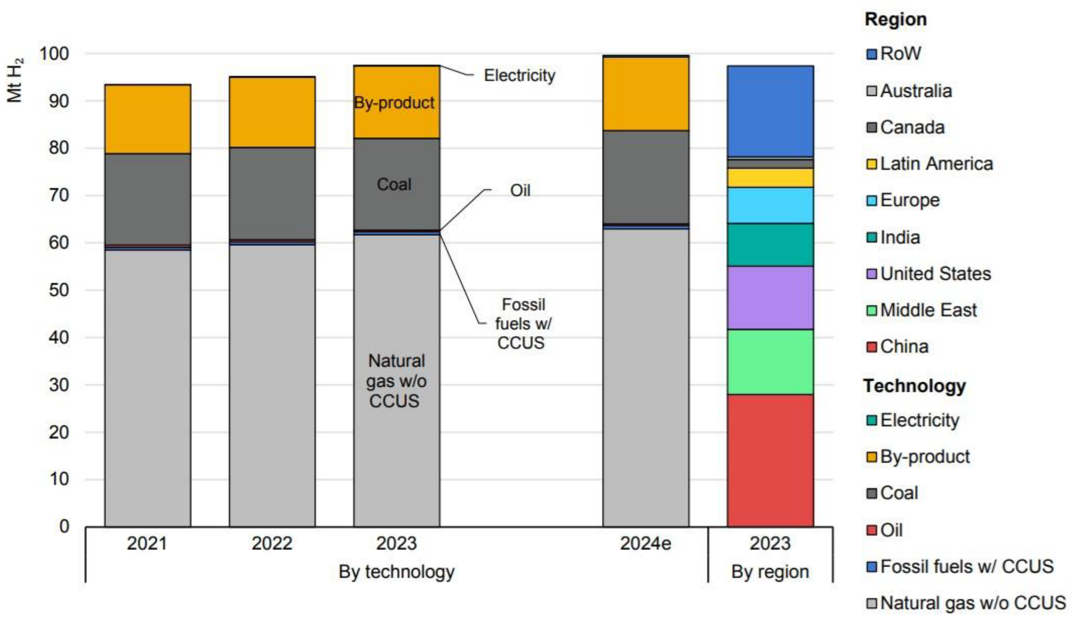
methane into hydrogen, but generates CO_2 emissions. Clean hydrogen, obtained by water electrolysis, represents only 0.9% of total capacity, although this method is growing. These facts reflect Europe's ongoing dependence on fossil fuels, while more sustainable technologies are expanding (Espitalier-Noël, et al, 2024). As shown in Figure 3, globally, hydrogen production still originates mostly from non-renewable sources, mainly natural gas, with a focus on China, the Middle East, the United States, India and Europe.

Figure 3 — Hydrogen production by technology and region, 2021-2024



Source: IEA, 2024

According to Espitalier-Noël et al (2024), in 2023 Europe produced hydrogen mainly through natural gas reforming (68.4%), a process that uses hydrocarbons and emits CO_2, and is therefore classified as grey hydrogen. The reforming of refinery waste gases accounted for 22.2%, while 4.9% came as a byproduct of the petrochemical industry, both considered grey. Processes with carbon capture, known as blue hydrogen, accounted for 0.5%, but these are also dependent on fossil fuels. Another 3.6% was obtained through electrolysis as an industrial byproduct, while only 0.4% came from water electrolysis with renewable energy, the only fully sustainable source of green hydrogen.

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In contrast to the EU, the energy sector in Brazil is not the main emitter of GHG. In 2023, renewable sources represented 49.1% of Brazil's energy matrix, while in electricity generation this percentage was even higher, reaching 89.2%. In the same year, GHG emissions related to the country's energy sector totaled 428 million tons of CO_2 equivalent, with transportation being the largest contributor, emitting 217 Mt CO_2-eq. Per capita, a Brazilian emits on average only 14.5% of what a citizen of the United States emits, 36% of the emissions of a European from the OECD and 26.2% of the emissions of a Chinese citizen, in terms of energy consumption and production (EPE, 2024a).

Under Brazil's presidency, the G-20 placed the energy transition at the center of global debates, reinforcing the country's commitment to a sustainable development model and decarbonization of the economy. With the theme "Building a fair world and a sustainable planet", Brazil promoted the theme of a fair and inclusive ecological transition, expanding access to clean energy sources, especially for developing countries with less financial capacity. European countries acknowledge the importance of the climate agenda and a more egalitarian world, according to the President of the European Council, Charles Mitchel: "The EU will always be on the side of those who fight for the United Nations and those who fight against poverty and climate change. We believe strongly in collective intelligence. Together, if we want to, we can change the course of history" (Michel, 2024a, n.p). In a previously published article, he highlighted the relevance of the meeting of countries.

> The G20 is in a privileged position to face the challenges of our time. When the largest economies speak with one voice, we have the power to do great things — protect our planet, make the digital lives of our citizens safer, and combat poverty and inequality. The G20 can help build a reinvigorated multilateralism that serves everyone with more equity, more inclusiveness, more trust, and more mutual respect (Michel, 2024b, n.p).

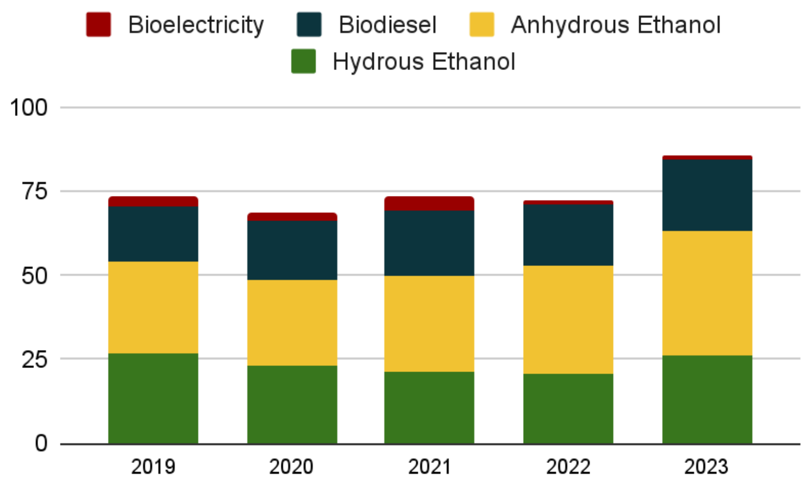
President Lula da Silva's government has emphasized the urgency of concrete actions against climate change, aligning itself with international commitments and strengthening its position as a powerhouse in renewable energy. This leading role is even more relevant given its hosting of COP-30 2025 in Belém, as well as Brazil's BRICS presidency in the same year, thus reinforcing its role as an articulator of environmental and energy policies on the international stage (Estevo, et al, 2024).

In addition, Brazil's presidency of the G-20 occurs at a crucial moment of global transition, where reducing fossil fuel dependence and the strengthening of sustainable production chains has become an urgent need. Brazil also participates in the Global Alliance for Biofuels (GBA), launched

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

at the G-20 under the India's leadership, seeking not only to expand its leading role in the sector, but also to encourage a more equitable energy model aligned with climate challenges. Among the European countries participating are Italy, Hungary, Finland and Iceland. The Ministry of Mines and Energy has reinforced that Brazil has the technical knowledge and production capacity to transform biofuels into one of the central vectors of the global energy transition, promoting innovation, investments and exports in this strategic sector (Estevo, et al, 2024).

Graph 1 — Emissions Avoided in Brazil with Bioenergy (2019-2024) (MtCO2)



Source: EPE, 2024

Brazil's main strategy to decarbonize the sector is RenovaBio, or the National Biofuels Policy, Law No. 13,576/2017. It has the objective to reduce emissions in accordance with the national goals of the Paris Agreement, and to encourage production. The policy has established annual decarbonization targets for fossil fuel distributors, encouraging the replacement with more sustainable alternatives like ethanol, biodiesel and, more recently, SAF and green hydrogen. To ensure implementation, RenovaBio has adopted a biofuel certification model based on carbon intensity (gCO_2/MJ), allowing qualified producers to issue Decarbonization Credits (CBIOs), tradable assets on the Brazilian stock exchange (B3) that reflect the achieved emission reductions (Lázaro, Thomaz, 2021; EPE, 2024b).

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As the country advances in the energy transition of the transport sector, RenovaBio is consolidating itself as a central element in the mitigation of carbon emissions. Within five years of operation starting in 2024, its effectiveness will be assessed by looking at the performance of the CBIO market and its contribution to reducing the sector's carbon footprint. In addition to boosting the use of biofuels, RenovaBio has the potential to serve as a regulatory basis for new policies aimed at emerging fuels, thus expanding its impact on the decarbonization of aviation and industry. However, its implementation involves multiple actors and regulatory challenges and therefore requires continuous improvements. Major players, such as Petrobras, UNICA and UBRABIO have played a crucial role in formulating the policy, ensuring that it reflected the interests of the sector. The growing presence of Brazilian companies in the international biofuel market strengthens the country's position as a global leader in renewable energy and innovative climate policies, aligned with the Paris Agreement (Lazáro, Thomaz, 2021; EPE, 2024b).

At the end of 2024 President Lula da Silva signed the CF Law, which establishes guidelines for sustainable mobility and the decarbonization of the transportation sector. The new legislation defines six main target areas. The first concerns the blending of anhydrous ethanol in gasoline, at percentages varying from 22% to 27%, with the possibility of up to 35%, depending on technical feasibility. The law promotes the alignment of public policies by integrating RenovaBio, the Brazilian Vehicle Labeling Program and Mover, a replacement for the Rota 2030 Program. This should foster a more structured energy transition in the energy sector and in the automotive industry, guaranteeing incentives for reducing emissions and modernization. Another relevant point is the creation of the National Green Diesel Program, which provides for its progressive introduction, including percentages of mixing it with fossil diesel (Brazil, 2024b).

The legislation also regulates the production and use of synthetic fuels in Brazil, and established the National Decarbonization Program, which encourages the use of biomethane and biogas in Brazil. Starting in 2026, natural gas producers and importers will have annual emission reduction targets, which they can meet with biomethane or Guarantee of Origin certificates. Moreover, the law establishes a regulatory framework for activities involving the capture and geological storage of carbon dioxide, aimed at mitigating industrial emissions. Finally, the law has created the National Sustainable Aviation Fuel Program (ProBioQAV), aimed at encouraging the use of sustainable aviation

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fuel. It has set emission reduction targets for air operators, starting with 1% in 2027 and reaching 10% in 2037 (Brazil, 2024b).

Brazil has made progress in the energy transition with the creation of two important programs: the Energy Transition Acceleration Program (PATEN) and the National Energy Transition Policy (PONTE). Sanctioned in January 2025, PATEN (Law 15.103/25) seeks to foster sustainable projects by facilitating access to credit for companies using federal funding, such as court orders and tax credits, allowing these resources to finance low-carbon initiatives. The program relies on the Green Fund, managed by the National Bank for Economic and Social Development (BNDES), "(...) instead of traditional subsidies and tax incentives, we have designed an instrument that will help with access to credit. According to the Federal Revenue Service, the credits total approximately R$ 800 billion (Jardim, 2024, n.p). PONTE, approved by the National Energy Policy Council (CNPE) in 2024, establishes a strategic plan for the Brazilian energy transition, foreseeing R$ 2 trillion in investments over ten years. The resources will be allocated to essential sectors like renewable electricity, sustainable low-carbon fuels and sustainable mining (Brasil, 2024c; Brasil, 2025b).

In August 2024, the Pact for Ecological Transformation (PTE) was launched, uniting the executive, legislative and judiciary branches of government around energy transition, sustainable land use and development with climate justice. Its main guidelines include reducing emissions, protecting biomes, combating illegal deforestation and encouraging technological innovation. In addition, it establishes green financing mechanisms and regulatory incentives to boost strategic sectors of the low-carbon economy. All three branches of government will adopt management measures to minimize environmental impacts, including sustainable bidding, efficient use of resources and energy, and proper disposal of waste (Brazil, 2024d). Under the current administration of Lula da Silva, the country has made progress in the energy transition, in national policies for the sector, and in efforts towards an even cleaner energy matrix. This involves adopting new technologies, resuming Brazil's international leadership in the area, and integrating climate policies (Estevo, et al, 2024).

With reference to hydrogen, Brazil has followed the international debate on the subject since the 1990s. In 2021 the National Hydrogen Program was launched to structure the market, encourage investments and foster international cooperation. With the Three-Year Plan 2023–2025, goals were created, including the implementation of pilot projects throughout the national territory by 2025, as

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

well as the country's consolidation as a global leader in the low-emission hydrogen market by 2030 (Brazil, 2023). In 2024, significant progress was made with the approval of the PNH$_2$ - Law 14.948 of 2024, which established guidelines for production, storage, marketing and tax incentives (Brazil, 2024e). In order to advance production, Law No. 14.990/2024 was passed, which instituted the Low-Carbon Hydrogen Development Program (PHBC) (Brazil, 2024f). In the same year, the MME organized a public call for low-emission hydrogen HUBs for the industry, completed in December with 12 approved projects, some of which are listed in Table 2 (Brazil, 2024g).

Table 2 — HUB Projects Decarbonization of Industry and H2 Brazil

HUB Industrial Decarbonization	State	H_2 Brazil	State
Project H2Orizonte Verde / CSN	RJ	CH2V - Unifei	MG
DRHy/EDP Renewables	CE	LABH2-UFRJ	RJ
HUB de H2V Neoenergia	BA	CEHTES - UFG	GO
Uberaba Green Fertilizer/Atlas Agro	MG	H2CEA -SENAI/UFRN	RN
Hydrogen Hub /Petrobras	SP	NAPI-HCR- Itaipú/UFPR	PR

Source: Prepared by the authors based on Brasil, 2024f and Dyniewicz, 2024

In order to encourage projects in Brazil, partnerships have been formed between the government of Brazil, MME, Germany through the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), and the H2Brasil Project, aimed at developing the green hydrogen market in Brazil. Between 2021 and 2024, approximately € 34 million were allocated to various projects, as per the table below. H^2 Brasil came to life after the completion of the Promoting Alternative Fuels without Climate Impacts ProQR, which ran from 2017 to 2022 and helped develop pilot plants in Brazil (Dyniewicz, 2024).

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

4. The Impact of the European Union's Sustainable Liquid Fuel Policies in Brazil (2019–2024)

Biofuels, which can be liquid, solid or gaseous, are produced from renewable biomass and have the capacity to partially replace, through blending, or completely replace conventional fossil fuels. However, the EU separates biomass fuels from biofuels in its RED. The former are solid and gaseous, and can be produced from urban waste, whereas the latter are liquid fuels intended for the transport sector (Eurostat, 2025). The bloc prefers second-generation or advanced fuels, whose raw materials do not directly compete with food crops. In 2022, the consumption rate of the advanced type reached 40% compared to traditional fuels (Pelkmans, 2024). In Brazil, biofuels are limited to ethanol (bioethanol) from sugarcane and corn, aviation biodiesel (e.g. BioQAV) and, for gaseous fuels, biomethane (ANP, 2020).

Furthermore, the EU recognizes as advanced biofuels those obtained from waste and non-food biomass, such as algae, straw and bagasse, assigning them a double counting factor in their energy content to meet renewable energy targets. In this way, the EU defines fuels based on the raw material used rather than production technology, as is the case in Brazil and other countries (European Union, 2022).

The EU legal framework for the sector is predominantly governed by RED III, the ILUC Directive and the FQD. The 2009 RED set a binding target of 10% renewable energy in transport by 2020, highlighting the importance of conventional biofuels. However, concerns about indirect changes to land use led to the 2015 ILUC Directive, restricting the participation of this traditional type. RED II, revised in 2018, further expanded these measures, setting national limits for conventional fuels, promoting advanced biofuels and addressing indirect land use risks associated with food crops. Despite the current dominance of conventional fuels produced from food crops that face sustainability challenges, the EU is seeking to gradually phase these out in favor of advanced biofuels based on lignocellulosic biomass residues which, although promising, are not yet in commercial production (Millinger et al., 2022).

Biodiesel is the most produced and consumed biofuel in the EU in terms of tons/year, with Germany and Spain standing out as the main producers. This is due to the historical predominance of diesel powered vehicles in Europe (Cames; Helmers, 2013), which is why this fuel remains the most purchased, followed by gasoline. Therefore, the introduction of biodiesel by blending it with regular diesel is more viable (Mellios, Gouliarou, 2023). The FQD determines that there should be a maximum

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

of 7% of fatty acid methyl ester (FAME), a type of biodiesel, in diesel and 10% ethanol in gasoline, although minimum percentages are not required (European Parliament; Council, 2009).

Another alternative to conventional diesel is renewable paraffinic diesel, also known as HVO or hydroprocessed esters and fatty acids (HEFA), classified as an advanced biofuel with chemical properties similar to fossil fuels, despite its lower energy content (European Technology and Innovation Platform, 2020). Unlike traditional biodiesel (FAME), whose incorporation into diesel is limited to 10%, HVO has no demarcation for its blending in the EU and is less polluting. Due to its remarkable capacity to reduce GHG emissions, several countries around the world have intensified their investments in its production. Furthermore, the manufacturing of HVO correlates with the production of SAF, as it can be used as a renewable aviation fuel, blended up to 50% with traditional options or altered to generate renewable kerosene (ETIP, 2023).

Regarding Brazilian ethanol (SH6 22.07.1013), the Netherlands, the EU's main gateway for foreign products, applies a rate of 19.2 EUR/100 L on the imported volume, equivalent to 20.62% of the value, according to Most Favored Nation duties (MFN). This rate is applied in the absence of preferential agreements between the parties involved. In comparison, South Korea, one of the main importers of Brazilian ethanol, charges only 10% of the MFN tariff (ITC, 2025).

According to the ITC (2025), no trade measures are applied to ethanol, but it must comply with five import requirements. Due to its perceived threat to the European industry, in 2023 the EC announced the implementation of a three-year retroactive monitoring of ethanol. The first measure consists of collecting detailed information on the flow of these imports, with the aim to make more assertive decisions. European authorities noted an increase of almost 45% in ethanol imports from 2021 to 2022, with 37% originating from Brazil, whose ethanol is 15% cheaper than domestic EU production. Moreover, the EU fears this increase because Brazil and the USA have a production capacity that exceeds domestic demand, which is not the case in the EU (Table 1). According to the European Commission (2023), imported ethanol has negatively impacted European production, with a 10% reduction, a 44% drop in domestic investment and a 57% decrease in profitability in 2022.

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

Table 3 – Production and consumption of ethanol in 2023

	USA (t)	Brazil (t)	EU (t)
Production	46.645.000	27.966.000	4.187.000
Consumption	42.370.425	23.004.800	5.190.000
Excess capacity	4 274 575	4.961.200	-1.003.000

Source: Prepared by the authors with data from EPE (2024a), RFA (2025), ANP (2024) and Statista (2024).

Among the imported biofuels, biodiesel stands out as the most relevant. Analyzing the data presented in the ITC (2025) by the Netherlands on Brazilian biodiesel (SH6 38.26.00), a tariff of 6.5% (MFN) is in effect, while 16 regulatory requirements are subject to application. It is important to highlight that most of the commercial transactions for the export and import of biofuels take place within the EU. That said, the main supplier of biodiesel to the Netherlands is Belgium, with almost 828 million kg more imported in 2022, compared to imports from Argentina, the main non-EU supplier (European Commission, 2025c).

With regard to renewable diesel, due to its innovative technological routes and diverse raw materials, there are no standardized and specific codes for controlling its exports and imports, as is the case with regular biodiesel. This means that its classification and categorization for international trade purposes may vary between different producers and countries. The same is true for green hydrogen. It is currently produced and distributed internationally and is considered a chemical raw material mainly consumed by the industrial sector. As an energy source, however, its market is still in the early stages of development. Although countries around the world are publishing investment plans for this source, with the EU committing to import 10 million tons of this energy commodity by 2030, for example, as of yet there are insufficient regulations and infrastructure to consolidate a large-scale global green hydrogen market (Patonia, Poudineh, 2022).

Green hydrogen can be stored and transported in a variety of ways, including ammonia, methanol, liquid organic hydrogen carriers (LOHC), compressed or liquefied, through dedicated pipelines, mixed pipelines or on ships (Patonia, Poudineh, 2022). However, two main options have emerged from EU strategies: pressurized pipelines for short and medium distances, and ammonia transport by ship for longer distances. Considering the long-time frame and the various elements that need to be addressed prior to the commissioning of transnational pipelines, there is speculation that

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

the use of hydrogen pipelines in the EU is unlikely to commence before 2030. Thus, according to AlSulaiman (2023), ammonia transport is expected to be the main initial option for hydrogen delivery in the region, until a pipeline infrastructure is consolidated. In Brazil, ethanol produced from sugarcane was assessed, according to RED III calculations, as capable of reducing GHGs by 71%. Similarly, biodiesel from soybeans was assessed as capable of minimizing emissions by 31%, according to the same calculations. National production is frequently affected by water shortages, frosts and high sugar prices on the global market. These factors, combined with lockdowns during the Covid-19 pandemic, made 2021 the worst year of the period for production (Table 2) (EPE, 2022). However, in 2022 there was a 2.5% recovery compared to the previous year, followed by a new record the following year.

Table 4 — Biofuel Production in Brazil between 2019–2024 in liters

	2019	2020	2021	2022	2023	2024
Ethanol	36 billion (Δ 11%)	32,6 bn (Δ - 9,5%)	29,9 bn (Δ - 8,4%)	30,6 bn (Δ 2,5%)	35,4 bn (Δ 15,5%)	36,83 bn (Δ 4,4%)
Biodiesel	5,9 bn (Δ 10,3%)	6,4 bn (Δ 8,6%)	6,7 bn (Δ 4,9%)	6,2 bn (Δ - 7,5%)	7,52 bn (Δ 20,4%)	9,07 bn (Δ 20,4%)

Source: Prepared by the authors using data from EPE (2020; 2021; 2022; 2023; 2024b) and UNICA (2025).

As for biodiesel, in 2019 production corresponded to 63% of the installed capacity (EPE, 2020). However, in the first year of the pandemic, 62% of installed capacity was produced, a percentage that subsequently fell to 54% in 2021 and 51.6% in 2023. Although there is still potential for growth, in 2022 there was a 7.5% drop in production due to a change in the biodiesel mandate to diesel oil (B10). At the end of the previous year, the CNPE reduced it from 12% to 10%, given the increase in the price of soybean oil, its main raw material (ANP, 2022; EPE, 2023). In 2023, production was boosted by the return of B12 (diesel containing 12% biodiesel) in April, which also impacted the year 2024 (Brazil, 2023b).

Regarding H2V, production started early 2023 at the Pecém Thermoelectric Complex, located in the Green Hydrogen Hub, Ceará. This plant is the first in Latin America and has an electrolyzer with a production capacity of 250 nm³/h fuel. In fact, the Green Hydrogen Hub has attracted several companies interested in establishing plants in the Ceará Export Processing Zone (ZPE) area, where the Pecém Complex is located (Ascom Cipp, 2023). Furthermore, the EU announced in November 2023

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

that it will build a plant for the production of H2V and ammonia in the Piauí EPZ destined for Europe, representing part of the € 2 billion reserved for Brazil by the Global Gateway platform. Construction work began in 2024 and hydrogen production is scheduled to initiate in 2026 (Brazil, 2023c).

In this context, although the 2021 PNH2 already exists, the definition of a legal framework for hydrogen is essential to consolidate the commitment in law. The PNH2 establishes the Brazilian Hydrogen Certification System and the Special Incentive Regime for the Production of Low-Carbon Hydrogen (Rehidro) and created the Low-Carbon Hydrogen Development Program (PHBC) (Brazil, 2024e). Certification, which is crucial to guarantee the sustainability of H2V, needs to be aligned with Europe's CertifHy in order to facilitate Brazilian exports to the region. To avoid market fragmentation, it is imperative that common standards, criteria, certification methodologies and maximum carbon limits are formulated (Castro, et al, 2023).

Regarding ethanol exports (Table 3), a positive trend can be observed in export volumes, even though these were affected by the pandemic, the effects of which began to be felt in 2021. In the case of biodiesel, Brazil's exports were not of great importance to the international market, that is, "(...) world trade remained concentrated between Europe, Argentina and the USA, with no significant participation of Brazil in the volumes transacted" (EPE, 2023, p.45).

Table 5 — Brazil's Biofuel Exports 2019–2023 in liters

	2019	2020	2021	2022	2023	2024
Ethanol	2 bn (Δ 17,6%)	2,7 bn (Δ 35%)	1,9 bn (Δ -29,6%)	2,5 bn (Δ 28,9%)	2,49 bn (Δ 3,7%)	1,87 bn (Δ -25,5%)

Source: Prepared by the author with data from EPE (2020; 2021; 2022; 2023; 2024b) and ComexStat (2025).

On the other hand, ethanol imports were taxed at 16% from the beginning of 2023, which will increase to 18% from 2024 onwards. Under the previous government, biofuel was exempt from taxation to control inflation. This new measure mainly harms the US ethanol industry, given that the US accounts for the most of Brazil's imports (Teixeira, Samora, 2023). As for biodiesel, its import, previously prohibited, is now regulated by the ANP, which determined that each distributor has a limit of 20% of the total volume for importing biodiesel intended for mandatory blending. This is due to ANP Resolution No. 857/2021, which stipulates that distributors must provide monthly proof of obtaining biodiesel from producers that have the Social Biofuel Seal, representing at least 80% of the total (ANP, 2023).

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

The EU, through the CBAM, part of the ECP, plays a key role in the direction of Brazilian sustainable fuel exports. This tool, an essential component of the bloc's foreign policy, creates a dynamic that directly affects trade transactions, which can promote an environment conducive to Brazil standing out in the global hydrogen market. By encouraging the import of H2V from regions with low atmospheric pollution, the CBAM offers Brazil a competitive advantage. Positioning itself as one of the main competitors, Brazil stands out as a strong source of H2V, behind only the USA and Australia (Machado, 2023). This dynamic poses a challenge and, at the same time, an opportunity for Brazilian producers, who need to adjust their practices and processes to meet the strict European emissions criteria.

With the effective implementation of the CBAM from 2026, Brazilian producers will face the requirement to annually track and declare the GHG releases incorporated in their exports. Thus, this mechanism exerts pressure on Brazil to monitor and reduce its pollution, adjust to European standards and ensure its competitiveness in the market. Non-compliance may result in additional costs for European importers, who will then have to purchase carbon credits to offset higher emissions, thus making Brazilian hydrogen less attractive in the market (Smith, et al, 2023).

On the other hand, these European policies, notably the CBAM, have opened up greater possibilities for trade tensions (Smith, et al, 2023). The mechanism has been criticized by Brazil for its unilateral nature and for defying WTO standards, including principles of non-discrimination and national treatment. The lack of consideration for decarbonization initiatives not linked to carbon pricing, such as regulatory approaches, has also been highlighted as a worrying discrepancy (Moreira, 2023). In addition to the CBAM, Brazilian concerns include EU legislation for deforestation-free products (European Union Deforestation-Free Regulation — EUDR) that came into force at the end of 2024 (Brazil, 2023c).

Conceived within the PEE, this regulation covers several commodities, including palm oil and soybeans, which are the main raw materials for Brazilian biodiesel. Therefore, before placing their goods on European soil, exporters must prove, through a due diligence declaration, that these goods were not grown on deforested land, regardless of whether the local government has legalized it, as of December 31, 2020. If the requirements are not met, penalties like confiscation of the goods are foreseen. Regarding this issue, Brazil, together with other developing nations, presented a joint letter

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

at the 106th meeting of the WTO Committee on Agriculture in September 2023 and co-sponsored a Cairns Group declaration, reinforcing the need to respect multilateral trade rules (Brazil, 2023c).

Another opportunity for the South American country lies in H2Global, an instrument led by Hydrogen Intermediary Company GmbH (HINT.CO) with support of the German government, which offers a promising outlook for Brazilian producers. By establishing long-term purchase contracts on the supply side and short-term sales contracts on the demand side, H2Global acts as a financing mechanism that covers the difference between the price desired by the buyer and the amount needed to sustain the supplier's project. This could pave the way for Brazil to expand its participation in the global hydrogen market. Through auctions, green ammonia from non-EU or European Free Trade Association (EFTA) countries will be purchased simultaneously and sold to interested consumers. However, given that Brazilian H2V production is still in the early stages of project development, it is possible that there will be a considerable time gap before the country is ready to participate in these auctions (Fucuchima, 2022).

The EU’s hydrogen imports targets challenge Brazil to increase its H2V production, positioning it as a competitor against countries like Saudi Arabia, Australia and Chile, which have been analyzed by the EU as potential suppliers. The EU's preference for sustainable trading partners and its strategy to diversify present both challenges and opportunities for Brazil in a global context (Alsulaiman, 2023). However, the same cannot be said of the fuel sector. This sector is considered strategic and, therefore, exporting to the bloc becomes more difficult, as evidenced by the protectionist measure of three-year retroactive surveillance applied to foreign ethanol, leading to warrants for the Sugarcane and Bioenergy Industry (Unica) (Almeida, 2023).

Even though during the study period from 2019 to 2024, Brazilian biofuel production and exports were not immediately impacted by the growing European interest in sustainable liquids, an increase in investments was observed, in line with expectations of a future expansion in demand. Projects such as the inauguration of the Nardini Agroindustrial Ethanol Plant (GO); the expansion of the Grupo Potencial biodiesel plant in Lapa (PR); the completion of the expansion works of the Logum Logística pipeline system, responsible for transporting anhydrous and hydrated ethanol over a 128-kilometer stretch in São Paulo; the laying of the foundations of an ethanol production plant by the company Be8 in Passo Fundo (RS); and the Inpasa Brasil industrial complex, designed to produce 460

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

million liters of ethanol per year in the city of Balsas (MA); all indicate the sector's response to growth prospects (Brasil, 2023e).

The EU, in turn, has shown a preference for the electrification of transportation modes, with exception of the heavier segments, which shall rely on sustainable fuel (Cazzola et al, 2023). First-generation biofuels play a crucial role in the short- and medium term in the EU's energy transition, with RFNBO being the biggest beneficiaries in the long term. From a European perspective, against the background of a growing demand for biofuels whose production can lead to increased deforestation and emissions, stricter control of imports and the establishment of more comprehensive regulations in international trade are justified. These actions are not without criticism from developing countries like Brazil, which accused the EU of practicing "green neo-colonialism" and of using anti-deforestation legislation in a discriminatory manner (Mello, 2023).

Final Considerations

Brazil is positioned as a key strategic partner for the EU in the energy transition, given its vast supply of renewable sources and its capacity to produce sustainable fuels at competitive costs. The country can play a central role in meeting the goals of the European Green Deal and REPowerEU, mainly through the supply of green hydrogen, ethanol and advanced biofuels. The EU's commitment to import 10 million tons of H_2V by 2030 and the investments planned by the Global Gateway reinforce this partnership.

However, Brazil should analyze and defend its position regarding some of the provisions of these new European regulations, such as the CBAM and environmental requirements for biofuels. Although these standards may represent non-tariff trade barriers, the country has a competitive advantage in sustainable production that can boost its exports to Europe. Additionally, the EU's need to decarbonize key sectors like transport and aviation widens opportunities for fuels such as renewable diesel (HVO) and SAF, further consolidating Brazil as a key supplier.

Brazil-EU cooperation may translate not only into trade, but also in technological advances and strategic investments in energy infrastructure. Thus, the synergy between Brazilian and European interests can generate mutual benefits, promote the energy transition and boost sustainable development on both sides. It can be concluded that the EU has shown a significant interest in Brazil, which is directly associated with the former's objective of meeting the set goals. The EU's interest is

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

driven by Brazil's remarkable potential, due to the vast availability of natural resources, which positions it as a strategic partner in the global energy transition. Such a convergence of interests offers relevant opportunities for cooperation in the development and application of sustainable fuel solutions, thus contributing to the decarbonization of sectors such as transport and aviation, and the transition to a cleaner and more environmentally responsible energy future as envisioned in the European Green Deal.

References

ALMEIDA, H. Unica se diz preocupada com medida europeia de vigilância retroativa sobre importação de etanol. **Canal Rural**, 27 set. 2023. Available at: https://www.canalrural.com.br/economia/unica-se-diz-preocupada-com-medida-europeia-de-vigilancia-retroativa-sobre-importacao-de-etanol/. Accessed on: 10 mar. 2025.

ALSULAIMAN, A. Renewable Hydrogen Import Routes into the EU. **The Oxford Institute for Energy Studies**, 2023. Available at: https://www.oxfordenergy.org/wpcms/wp-content/uploads/2023/05/Renewable-Hydrogen-Import-Routes-into-the-EU-ET24.pdf. Accessed on: 23 mar. 2025.

ANP - Agência Nacional do Petróleo, Gás Natural e Biocombustíveis. Biocombustíveis. **ANP.** 11 dez. 2020. Available at:https://www.gov.br/anp/pt-br/assuntos/qualidade-de-produtos/biocombustiveis#. Accessed on: 23 jan. 2025.

ANP - Agência Nacional do Petróleo, Gás Natural e Biocombustíveis. **ANP regulamenta a importação de biodiesel**. ANP. 2023. Available at: https://www.gov.br/anp/pt-br/canais_atendimento/imprensa/noticias-comunicados/anp-regulamenta-a-importacao-de-biodiesel. Accessed on: 24 mar. 2025.

ANP - Agência Nacional do Petróleo, Gás Natural e Biocombustíveis. **Anuário Estatístico Brasileiro do Petróleo, Gás Natural e Biocombustíveis 2024**. ANP. 2024. Available at: https://www.gov.br/anp/pt-br/centrais-de-conteudo/publicacoes/anuario-estatistico/anuario-estatistico-brasileiro-do-petroleo-gas-natural-e-biocombustiveis-2024. Accessed on: 23 fev. 2025.

ANP - Agência Nacional do Petróleo, Gás Natural e Biocombustíveis. **Boletim de Biocombustíveis e Qualidade de Produtos**. ANP 2022. Available at:https://www.gov.br/anp/pt-br/centrais-de-conteudo/publicacoes/boletins-anp/arquivos-boletim-de-biocombustiveis-e-qualidade-de-produtos/boletimsbq2022.pdf. Accessed on 23 mar. 2025.

APEX BRASIL. **Mapa bilateral de Investimentos Brasil-União Europeia**. Brasília, 2023. Available at: https://apexbrasil.com.br/content/apexbrasil/br/pt/conteudo/estudos/mapa-bilateral-de-investi me tos-brasil---uniao-europeia.html. Accessed on 01 mar. 2025.

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

ASCOM CIPP. Complexo do Pecém e Cactus assinam pré-contrato para produção de hidrogênio verde. **Governo do Ceará**, 25 out. 2023. Available at:https://www.ceara.gov.br/2023/10/25/complexo-do-pecem-e-cactus-assinam-pre-contrato-para-producao-de-hidrogenio-verde/. Accessed on: 03 fev. 2025.

BRASIL. Plano de Trabalho Trienal do PNH2. **Ministério de Minas e Energia.** 2023a. Available at: https://www.gov.br/mme/pt-br/assuntos/noticias/PlanodeTrabalhoTrienalPNH2.pdf. Accessed on: 20 fev. 2025.

BRASIL.Ministério de Minas e Energia destaca mudanças positivas com o B12. **Ministério de Minas e Energia.** 2023b. Available at: https://www.gov.br/mme/pt-br/assuntos/noticias/uniao-europeia-anuncia-construcao-usina-de hidrogenio-verde-no-brasil. Accessed on: 11 fev. 2025.

BRASIL. União Europeia anuncia construção usina de hidrogênio verde no Brasil. Ministério de Minas e Energia. 2023c. Available at:https://www.gov.br/mme/pt-br/assuntos/noticias/uniao-europeia-anuncia-construcao-usina-de-hidrogenio-verde-no-brasil. Accessed on: 12 mar. 2025

BRASIL. Medidas do Brasil junto ao Comitê da Agricultura da OMC a respeito da lei anti desmatamento da UE. **Ministério de Relações Exteriores,** 2023c. Available at: https://www.gov.br/mre/pt-br/canais_atendimento/imprensa/notas-a-imprensa/medidas-do-brasil-junto-ao-comite-da-agricultura-da-omc-a-respeito-da-lei-antidesmatamento-da-u. Accessed on: 11 fev. 2025.

BRASIL. Indústria de biocombustíveis avança e chega ao Maranhão. **MDCI**. 2023d. Available at: https://www.gov.br/mdic/pt-br/assuntos/nicias/2023/outubro/industria-de-b iocombustiveis-avanca-e-chega-ao-maranhao Accessed on: 11 fev. 2025.

BRASIL. Acordo de parceria Mercosul-União Europeia.**Ministério do Desenvolvimento, Indústria, Comércio e Serviços.** 2024a. Available at: https://www.gov.br/mdic/pt-br/assuntos/noticias/2024/dezembro/acordo-de-parceria-mercosul-uniao-europeia . Accessed on: 11 fev. 2025.

BRASIL. Lei nº 14.993, de 1º de junho de 2024. **Diário Oficial da União: seção 1**, Brasília, DF, 3 jun. 2024b. Available at: https://www.planalto.gov.br/ccivil_03/_ato2023-2026/2024/lei/l14993.htm. Accessed on: 23 fev. 2025.

BRASIL.Política Nacional de Transição Energética. **Ministério de Minas e Energia.** 2024c Available at: https://www.gov.br/mme/pt-br/assuntos/secretarias/sntep/dte/cgate/pnte. Accessed on: 10 fev. 2025.

BRASIL. **Pacto Pela Transformação Ecológica Entre Os Três Poderes do Estado Brasileiro.** Brasília, DF, 2024d. Available at:https://www.in.gov.br/en/web/dou/-/pacto-pela-transformacao-ecologica-entre-os-tres-poderesdo-estado-brasileiro-579829333 Accessed on: 10 fev. 2025.

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

BRASIL. **Lei nº 14.948**, de 2 de agosto de 2024. Brasília, DF, 2024e. Available at: https://www.planalto.gov.br/ccivil_03/_Ato2023-2026/2024/Lei/L14948.htm. Accessed on 10 fev. 2025.

BRASIL. **Lei nº 14.990,** de 29 de março de 2024. Brasília, DF, 2024f Available at: https://www.planalto.gov.br/ccivil_03/_ato2023-2026/2024/lei/L14990.htm. Accessed on: 10 fev. 2025.

BRASIL. MME divulga resultado da chamada pública de hubs de hidrogênio com foco na descarbonização da indústria. **Ministério de Minas e Energia**, 2024g. Available at:https://www.gov.br/mme/pt-br/assuntos/noticias/mme-divulga-resultado-da-chamada-publica-de-hubs-de-hidrogenio-com-foco-na-descarbonizacao-da-industria? Accessed on:10 fev 2025

BRASIL. União Europeia. **Ministério das Relações Exteriores**. 2025a. Available at:https://www.gov.br/mre/pt-br/assuntos/relacoes-bilaterais/todos-os-paises/uniao-europeia. Accessed on: 10 fev. 2025.

BRASIL. Concórdia. **Ministério das Relações Exteriores**. 2025b. Available at: https://concordia.itamaraty.gov.br/pesquisa-avancada. Accessed on: 01 fev. 2025.

CAMES, M.; HELMERS, E. Critical evaluation of the European diesel car boom – global comparison, environmental effects and various national strategies. Springer. **Environmental Sciences Europe**, v. 25. 2013. Available at:https://doi.org/10.1186/2190-4715-25-15 Accessed on: 02 dez. 2024.

CASTRO, N; LEAL, L; ELIZEU; B. Principais iniciativas e desafios para a certificação do hidrogênio. Hidrogênio Verde Aliança Brasil-Alemanha, **GESEL**. 2023. Available at https://gesel.ie.ufrj.br/wp-content/uploads/2023/02/Castro_2023_02_14.pdf. Accessed on: 01 dez. 2023.

CAZZOLA, P.; GERARD, F.; GORNER, M.; GIBBS, M.; YOUNG, K. Research for TRAN Committee– Assessment of the potential of sustainable fuels in transport. **European Parliament, Policy Department for Structural and Cohesion Policies**. Bruxelas, mar. 2023. Available at: https://www.europarl.europa.eu/RegData/etude Accessed on: 25 nov. 2023.

CERVO, A.; BUENO, C. **História da política exterior do Brasil**. 4. ed. rev. e aum. Brasília: Editora UnB, 2011.

COMEX STAT. **Dados gerais**. MDCI 2025. Available at: https://comexstat.mdic.gov.br/pt/geral. Accessed on: 05 fev. 2025.

COMISSÃO EUROPEIA. **Pacto Ecológico Europeu**. Comissão Europeia. 2019. Available at:https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0008.02/DOC_1&format=PDF Accessed on: 10 fev. 2025.

COMISSÃO EUROPEIA. **European Commission sets out a new agenda to strengthen the EU's partnership with Latin America and the Caribbean.** Comissão Europeia. 2023. Available at: https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3045. Accessed on: 12 fev. 2025.

CONSELHO DA UNIÃO EUROPEIA. Conselh Available at https://www.consilium.europa.eu/pt/press/press-re Accessed on Acesso em: 10 fev. 2025.

CONSELHO DA UNIÃO EUROPEIA. **Fit for 55: Conselho aprova pacote para o mercado de gás e hidrogênio**. 2024. Available at: https://www.consilium.europa.eu/pt/press/press-releases/2024/05/21/fit-for-55-council-signs-off-on-gas-and-hydrogen-market-package/. Accessed on: 10 fev. 2025.

CONSELHO DA UNIÃO EUROPEIA. Objetivo 55: Como é que a UE pretende impulsionar a utilização de energias renováveis?. **Conselho Europeu.** 2025a. Available at:https://www.consilium.europa.eu/pt/infographics/fit-for-55-how-the-eu-plans-to-boost-renewable-energy/ /. Accessed on: 09 fev. 2025.

CONSELHO DA UNIÃO EUROPEIA. O plano REPowerEU, em síntese.**Conselho Europeu.** 2025b. Available at: https://www.consilium.europa.eu/pt/infographics/repowereu/. Accessed on 10 fev. 2025.

DIRECTORATE-GENERAL FOR CLIMATE ACTION. Adoption of EU rules on the ETS support system to accelerate the use of sustainable aviation fuels. **Europe Commission**. 2025 Available at:https://climate.ec.europa.eu/news-your-voice/news/adoption-eu-rules-ets-support-system-accelerate-use-sustainable-aviation-fuels-2025-02-06_en. Acesso em: 25 fev. 2025.

DYNIEWICZ, L. Hidrogênio verde: Alemanha e Brasil aumentam investimentos. **O Estado de S. Paulo**, 6 jul. 2022. Available at: https://www.es Accessed on Acesso em: 15 fev. 2025.

ECAC - European Civil Aviation Conference. *Sustainable Aviation Fuel (SAF).* ECAC.2025 Available at: https://www.eurocontrol.int/shared/saf/ Accessed on 10 mar.2025.

ETIP - EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM BIOENERGY. **Strategic Research and Innovation Agenda 2023**. ETIP. 2023. Available at: https://new.etipbioenergy.eu/wp-content/uploads/2024/07/ETIP_SRIA_2023.pdf. Accessed on: 10 fev. 2025.

EUROPE UNION. Critérios de sustentabilidade e de redução das emissões de gases com efeito de estufa e critérios de baixo risco de alteração indireta do uso do solo. Europe Union, 2022. Available at:https://eur-lex.europa.eu/legal-content/PT/ALL/?uri=LEGISSUM%3A4608991. Accessed on 15 mar. 2025.

EUROPEAN COMMISSION. Commission Implementing Regulation (EU) 2023/1777 of 14 September 2023 introducing retrospective Union surveillance of imports of renewable ethanol for fuel. **European Commission**. 2023. Available at m:https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023R1777. Accessed on: 10 fev. 2025.

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

EUROPEAN COMMISSION. Renewable Energy Directive: targets and rules. **Europe Commission.** 2025a. Available at:https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-directive_en. Accessed on 10 fev. 2025.

EUROPEAN COMMISSION. ReFuelEU Aviation. **Europe Comission**. 2025b. Available at:https://transport.ec.europa.eu/transport-modes/air/environment/refueleu-aviation_en. Accessed on: 10 fev. 2025.

EUROPA COMMISSION. Access2 Markets – Statistics. **Europe Commission.** 2025c. Available at: https://trade.ec.europa.eu/access-to-markets/en/statistics. Accessed on: 23 fev. 2025.

EUROSTAT. **Glossary**: **Biofuels.** Eurostat. 2023. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Biofuels. Accessed on: 08 fev. 2025.

EPE - EMPRESA DE PESQUISA ENERGÉTICA. **Análise de Conjuntura dos Biocombustíveis - Ano 2019**.. 2020. Available at: https://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao 489/Analise_de_Conjuntura_Ano_2019.pdf. Accessed on 08 fev. 2025.

EPE-EMPRESA DE PESQUISA ENERGÉTICA. **Análise de Conjuntura dos Biocombustíveis - Ano 2021**. EPE. 2022. Available at:https://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-688/NT-EPE-DPG-SDB-2022-02_Analise_de_Conjuntura_dos_Biocombustiveis_2021.pdf. Accessed on: 22 fev. 2025.

EPE-EMPRESA DE PESQUISA ENERGÉTICA (EPE). **Análise de Conjuntura dos Biocombustíveis - Ano 2022**. EPE. 2023. Available at:https://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-756/NT-EPE-DPG-SDB-2023-01_Analise_de_Conjuntura_dos_Biocombustiveis_Ano2022.pdf. Accessed on: 30 ago. 2023.

EPE-EMPRESA DE PESQUISA ENERGÉTICA. **BEN - Síntese.** 2024a. Available at:https://www.epe.gov.br/sitespt/publicacoedadosabertos/publicacoes/PublicacoesArquivos/publicacao-819/topico-715/BEN_S%C3%ADntese_2024_PT.pdf. Accessed on: 08 fev. 2025.

EPE-EMPRESA DE PESQUISA ENERGÉTICA EPE**. Análise de Conjuntura dos Biocombustíveis – Ano 2023. EPE** 2024b. Available at: https://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-834/NT-EPE-DPG-SDB-2024-03_ACBios_Ano2023.pdf Accessed on: 06 fev. 2025.

ESPITALIER-NOËL, M.; FONSECA, J.; FRAILE, D.; MURON, M.; PAWELEC, G.; SANTOS, S.; STAUDENMAYER, O. **Clean Hydrogen Monitor 2024.**. Available at:: https://hydrogeneurope.eu/wp-content/uploads/2023/10/Clean_Hydrogen_Monitor_11-2023_DIGITAL.pdf. Accessed on: 15 mar. 2025.

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

ESTEVO, J; FERREIRA, L. A política externa do governo Jair Bolsonaro para mudanças climáticas: ruptura negativa e os riscos. In.: GONÇALVES, F. N.; LOUREIRO, G do A.; MELLO, B. B. de. (orgs.). **Política Externa no Governo Bolsonaro: temas, resultados e retrocessos**. Ed. 1. Belo Horizonte: Lemos Mídia. 2022. Available at: https://lemosmidia.com.br/produto/politica-externa-no-governo-bolsonaro-temas-resultados-e-retrocessos/. Accessed on: 08 fev. 2025.

ESTEVO, J.; THOMAZ, L.; GONDIM, A. Mudanças climáticas e a transição energética: caminhos para reconstrução da política externa brasileira. **Revista Geopolítica**, v. 15, n. 5. 2024. Available at:http://www.revistage Accessed on : 05 fev. 2025.

FERREIRA-PEREIRA, L. European Union-Brazil Relations: A Strategic Partnership in Suspended Animation. In: FERREIRA-PEREIRA, L. C.; SMITH, M. (ed.). **The European Union's Strategic Partnerships: Global Diplomacy in a Contested World.** The European Union in International Affairs. Springer Nature Switzerland, Palgrave Macmillan, 2021. Available at:: https://doi.org/10.1007/978-3-030-66061-1. Accessed on: 06 jul. 2023.

FOLLY, M.; CLOSS, M. Novo Governo Lula: perspectivas para a política externa brasileira e as relações com a União Europeia. **Foundation for European Progressive Studies (FEPS); Plataforma Cipó, policy brief**. Bruxelas, jul. 2023. Available at: https://plataformacipo.org/en/publications/policy-briefbrazilian-foreign-policy-and-the-relations-with-the-eu/. Acesso em: 05 fev. 2025.

FUCUCHIMA, L. Brasil tem chance de desp Available at: Disponível em:https://economia.uol.com.br/noticias/reuters/2022/12/14/brasil-tem-chance-de-despontar-em-hidrogenio-verde-em-1-licitacao-da-europa.htm. Accessed on: 02 fev. 2025.

HASAN, Y. Russia-Ukraine Crisis and Energy Insecurity: Is energy transition a sustainable alternate?. **Journal of Peace & Diplomacy**, v. 3, p. 30–46, 30 dez. 2022. Available at:: https://doi.org/10.59111/JPD.003.01.016. Accessed on: 02 fev. 2025.

IEA-INTERNATIONAL ENERGY AGENCY. Global Hydrogen Review 2024**. IEA** Available at:: https://iea.blob.core.windows.net/assets/89c1e382-dc59-46ca-aa47-9f7d415 31ab5/GlobalHydrogenReview2024.pdf. Accessed on: 25 mar. 2025.

ITC-INTERNATIONAL TRADE CENTRE. **Market Access Map: Trade statistics for international business development. 2025.** Available at: https://www.macmap.org/en//query/results?reporter=528&partner=076&product=220710&level=6#jump-to-custom-duties-content. Acesso em: 02 fev. 2025.

JARDIM, A. PATEN acelera a transição energética. **JOTA.** 2024. Available at:https://www.jota.info/artigos/paten-acelera-a-transição-energetica Accessed on: 25 fev. 2025.

LAZARO, L; THOMAZ,L. A participação de stakeholders na formulação da política brasileira de biocombustíveis (RenovaBio). **Ambiente & Sociedade,** São Paulo, v. 24,, 2021. Available at: https://www.scielo.br/j/asoc/a/mpybYYvv8PMkybTMBZGdBvQ/?format=pd f&lang=pt Accessed on: 02 fev. 2025.

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

MACHADO,N.CBAM começa a valer e pode ajudar hidrogênio brasileiro. **EIXOS**, 10/OUT/. 2023. Available at: https://eixos.com.br/hidrogenio/cbam-comeca-a-valer-e-pode-ajudar-hidrogenio-brasileiro/ . Accessed on: 10 mar. 2025.

MELLO, P. C. G20: Brasil critica 'neocolonialismo ambiental' da União Europeia. **Estado de Minas.** , 09 set. 2023. Available at: https://www.em.com.br/app/noticia/politica/2023/09/09/interna_politica,1559120/g20-brasil-critica-neocolonialismo-ambiental-da-uniao-europeia.shtml. Accessed on: 02 fev. 2025.

MELLIOS, G; GOULIAROU, E. Fuel quality monitoring in the EU in 2021. **ETC CM Report 2023/01**. Available at:: https://www.eionet.europa.eu/etcs/etc-cm/products/etc-cm-report-2023-01. Accessed on: 03 jan. 2025.

MICHEL,C. G20: capacitar o multilateralismo para uma nova geração. O paradoxo do nosso tempo. Conselho Europeu. 2024. Available at: https://www.consilium.europa.eu/pt/european-council/former-euco-presidents/charles-michel/news/2024/11/14/20241114-pec-g20-article/ Accessed on 15 mar. 2025.

MILLINGER, M.; REICHENBERG, L.; HENDENUS, F.; BERNDES, G.; ZEYEN, E.; BROWN, T. Are biofuel mandates cost-effective? - An analysis of transport fuels and biomass usage to achieve emissions targets in the European energy system. Elsevier. **Applied Energy,** v. 326,2022. Available at: https://doi.org/10.1016/j.apenergy.2022.120016. Accessed on: 22 mar. 2025.

MOREIRA, A. Brasil critica na OMC medidas unilaterais da União Europeia. **Valor Econômico**. Genebra, 05 jun. 2023. Disponível em:https://valor.globo.com/opiniao/assis-moreira/coluna/brasil-critica-na-omc-medidas-unilaterais-da-uniao-europeia.ghtml. Accessed on: 13 mar. 2025.

PELKMANS, L. **Implementation of bioenergy in the European Union – 2024 update**. IEA, 2024. D Available at: https://www.ieabioenergy.com/wp-content/uploads/2025/01/CountryReport2024_EU27_final_v2.pdf. Accessed on: 18 de fev. 2025.

RFA-RENEWABLE FUELS ASSOCIATION (RFA)**.** Trade and Exports. REFA. 2025 Available at:: https://ethanolrfa.org/policy/trade-and-exports. Accessed on: 10 mar 2025

SMITH, I. D.; OVERLAND, I.; SZULECKI, K. The EU's CBAM and Its 'Significant Others': Three Perspectives on the Political Fallout from Europe's Unilateral Climate Policy Initiative. **Journal of Common Market Studies**, p. 1-16. Oslo, 2023. DOI: 10.1111/jcms.13512. Available at: https://onlinelibrary.wiley.com/doi/epdf/10.1111/jcms.13512. Accessed on: 13 fev. 2025

STATISTA. Production volume of fuel ethanol in the European Union from 2014 to 2023, with a forecast for 2024. **Statista.** 2024. Available at: https://www.statista.com/statistics/1295828/eu-fuel-ethanol-production/. Accessed on: 21 fev. 2025.

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008

TEIXEIRA, M.; SAMORA, R. Fim da isenção brasileira para importação de etanol decepciona indústria dos EUA. **Nova Cana**. 03 fev. 2023. Available at:https://www.novacana.com/noticias/fim-isencao-brasileira-importacao-etanol-decepciona-industria-eua-030223. Accessed on n: 13 mar. 2025.

UNICA - UNIÃO DA INDÚSTRIA DE CANA-DE-AÇÚCAR . **Etanol atinge maior oferta da história em 2024**. UNICA, 28 jan. de 2025. Available at: https://unica.com.br/noticias/etanol-atinge-maior-oferta-da-historia-em-2024/. Accessed on: 03 fev. 2025.

DOI: https://doi.org/10.36311/2237-7743.2025.v14.e025008