Fueling the future: Brazil's strategy on SAF and aviation energy transition

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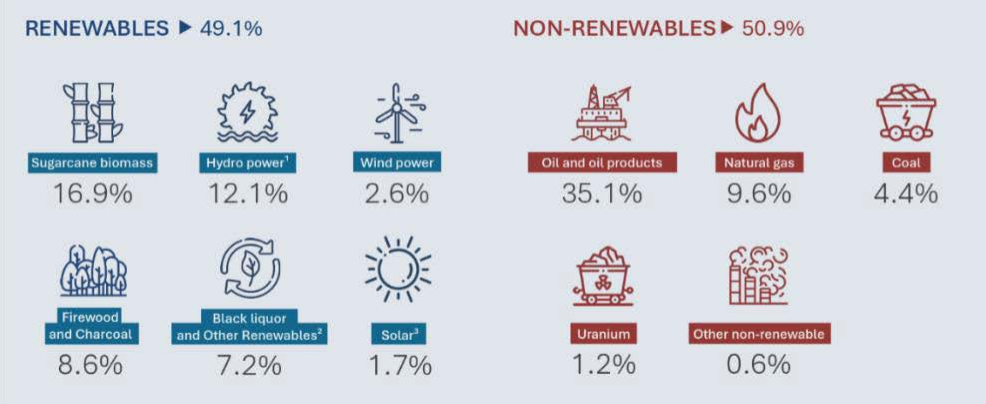
Brazil has a well-recognized potential to be one of the most important SAF producers in the world, and this comes from a longstanding tradition. Since the 1970's, the country has made substantial investments in the decarbonization of its energy matrix, starting from the building up of hydropower plants and the establishment of a robust biofuels – ethanol as a first - industry.

As time moved on since then, several and different programs and policies have been implemented in Brazil to foster the deployment of renewable and sustainable energy sources. The result of these policies is that the energy mix in Brazil is currently (2023) about 49% renewable, in which sugarcane biomass by itself comprises 16,9% of the whole energy consumed in the country.[1] Wind power (+17,4% YoY[2]) and solar power (+51,1% YoY) have been growing at an accelerated pace, while non-renewable sources are declining over time.

As examples of these policies, we can note that Brazil has mandatory blending mandates established for ground transportation, which can reach up to 35% of ethanol blended in gasoline – currently moving up to 30% - and provisions for increasing t up to 25% of biodiesel blended into diesel – currently at 14% of biodiesel, apart provisions for up to 3% of additional green diesel. The RenovaBio Policy e put in place procedures to ensure that biofuels produced in Brazil meet high levels of sustainability criteria while ensuring the continuous reduction in the carbon intensity of fuels over time.

Given this renewable energy friendly environment, which includes consolidated infrastructure to produce and distribute renewable fuels, the availability and continuing increase in renewable electricity production, and the potential to produce biomass meeting all sustainability criteria, Brazil had to take the next step: the Fuels of the Future law and the SAF National Program.



1 National Energy Report 2024. Available at: https://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-819/topico-715/BEB_Summary_Report_2024.pdf

2 Year over year (YoY).

The SAF National Program in Brazil

On 8 October 2024, Brazil enacted the law called *Fuels of the Future* (Combustível do Futuro, in Portuguese), which, among other provisions, established the Sustainable Aviation Fuel's National Program, aiming at fostering the research, production, commercialization and use of SAF in the Brazilian energy matrix.

The SAF National Program was developed via a thorough regulatory process, which included collaborative discussions among regulatory agencies – both civil aviation and biofuels authorities, the aviation industry, fuel producers and distributors, academia and civil society. From this process, several pillars founded the establishment of the SAF National Program, including the establishment of a mandate, financing, taxation, fuel qualification, research, among others.

In this entire process, the guiding principle was that SAF is the principal means for the decarbonization of the aviation sector. This principle was considered in every step of the process and led to a major regulatory innovation not only for Brazil, but a first-of-its-kind in the world: a SAF use mandate directly based on CO_2 emissions reductions, applied to the final users of SAF, the airlines. In order words, Brazil was a pioneer in moving away from a blending mandate, but rather established a decarbonization mandate in which SAF plays a pivotal role. The Brazilian mandate means that the airlines that operate domestic flights shall reduce a percentage of their CO_2 emissions each year by replacing fossil fuels by SAF, starting at 1% CO_2 reduction in 2027 and continuously increasing this percentage to 10% from 2037 onwards. One important aspect of the Brazilian mandate is that it fosters the energy efficiency of SAF production and deployment. Comparing it with a traditional fuel blending mandate, in which the environmental benefits are a secondary aspect, a CO_2-emissions reductions mandate by the use of SAF brings the environmental attribute of SAF to the core of the legislation, taken on an agnostic approach, and has some significant advantages:

- It incentivizes CO_2 efficient pathways, as the CO_2 emissions abatement cost will be the major player in the choice of SAF options by the airlines;
- It empowers the airlines – the final consumers of the product – to push for feedstocks and conversion processes that have lower CO_2 emissions per unit of fuel energy content (gCO_2/MJ);
- It is agnostic on feedstock and conversion processes: what matters is emissions reductions and the compliance with sustainability criteria.
- It avoids logistical difficulties associated with SAF distribution, as the fuel uplift can be concentrated on airports nearby production facilities and feedstock sources, avoiding the CO_2 emissions and costs associated with transportation of the SAF to all airports, which could be a major constrain in a country such as Brazil;
- It does not penalize the growth of the sector, as the emissions reductions are proportional to the market share of the aeroplane operators.

In order to ensure the effective implementation of the mandate, the national policy encompasses provisions to promote market-based mechanisms, such as the so-called book-and-claim system. Allowing this kind of system is a way to promote a more efficient deployment of SAF – the availability can be concentrated in major hubs closer to production while, at same time, ensuring that all airlines – even those that do to have operations in those airports, can have access to the environmental benefit coming from SAF. For sure, the implementation of such a system entails the definition of sustainability criteria to ensure the traceability of the custody chain and that no double claiming happens.

Another important element of the Brazilian SAF National Program is that it aims for alignment with the CORSIA framework. Once again, Brazil has taken the lead in recognizing the need for avoiding a patchwork of different regulations when it comes to assessing the sustainability and eligibility of SAF in its own national regulation. Also, this approach, if implemented by ICAO Members States in their own legislation, allows for the constitution of a global market in which SAF produced in any part of the world meets a set of sustainability requirements that can be accepted for all countries and, therefore, deployed by all airlines in their decarbonization measures.

Mechanisms to promote the development of the SAF industry in Brazil

The establishment of a mandate for the deployment of SAF by the airlines was just a first step in the pathway for incentivizing SAF production in Brazil. It has provided the regulatory framework that has secured a relatively stable domestic demand for SAF, which was seen as an important measure to incentivize investments. Nevertheless, the National SAF policy has also envisaged other complementary steps needed to create a business-friendly environment for this nascent industry to flourish. In that regard, several actions have been deployed in Brazil in order to identify additional actions to put in place the right incentives for SAF production.

a) SAF Connection

The development of SAF industry in Brazil relies mainly on private investment and initiatives. The Brazilian government has very limited resources in its national budget to provide subsidies or direct incentives for this industry to flourish. Therefore, a close collaboration between the public and the private sector is needed to provide the right incentives and policies to incentivize, in the most effective way, the private sector to ramp up their investment in the production of SAF.

In addition, the air transport sector in Brazil is already constrained by a very high costs structure in which fuels account for up to 40% of their overall operational costs. Given that, in this moment, SAF is more expensive than conventional fuel, the costs for the aviation sector, which may impact on the development of air transportation in Brazil, constitutes a major concern.

In order to put all stakeholders - from the supply and demand side - on the same page and look for proper alternatives that can be implemented either by the governmental agencies or by the private sector, SAF Connection (Conexão SAF, in Portuguese) was established by the National Civil Aviation Agency (ANAC) and the National Petroleum, Natural Gas and Biofuels Agency (ANP) in 2024. SAF Connection is a national informal forum, composed by more than 110 private and public stakeholders, for the discussion of the challenges and opportunities for the promotion of SAF production and deployment in Brazil.[3]

The initiative is organized into five different working groups, in which discussions all stakeholders can actively participate. The working groups are led by national coordinators, who represent government institutions, and focus on the following topics: (i) SAF certification and quality of product; (ii) infrastructure and deployment; (iii) regulation of the mandate for airlines; (iv) Financing and incentive policies; and (v) taxation. Since the law Fuels of the Future has been enacted, the discussions in SAF Connection are in full swing, especially those related to the implementation of the CO_2 reduction mandate for airlines and the incentives for SAF production, which are key for the development of this market in Brazil in the short term.

One important aspect of SAF Connection is that it provides the forum for social participation in an open and transparent manner. Governments alone may not have the whole expertise or tools to design effective policies, and allowing the private sector, the academia and civil society to make their contributions is a good practice that adds much value for the policy-making process.

b) Financing

One paramount aspect for the development of any nascent industry is providing access to financing mechanisms that can help reduce uncertainties and risks associated with a new market. To facilitate the implementation of SAF projects in Brazil, a joint public call for business plans has been put forward by the National Bank for Economic and Social Development(BNDES) and Finep (a public enterprise for financing studies and projects linked to the Ministry of Science and Technology), which will provide up 6 billion Brazilian reais (approximately USD 1.1 Billion) in funding

3 For more information on SAF Connection, please access https://hotsites.anac.gov.br/conexaosaf/

of SAF and maritime fuels projects. Surprisingly, the response from the market was much higher than expected: 76 proposals were received, summing up more than BRL 167 billion (approximately USD 29 billion) for SAF and maritime fuels. Currently (April 2025), BNDES and Finep are evaluating the proposals received and looking into additional financing opportunities aiming at increasing the budget available and assisting the development of this market in Brazil.

c) Research & Development and quality assessment

Research and development are fundamental pillars for exploring and evaluating the feasibility of new pathways and feedstocks for SAF production. Brazil has a potential to produce SAF from different feedstocks, some of them very unique to the Brazilian geographical position and climate conditions. In this regard, the Brazilian government has established a partnership with the most prominent national research centers, such as the Brazilian Agricultural Research Corporation (Embrapa), the University of Campinas (UNICAMP), the University of Rio Grande do Norte (UFRN) and Getulio Vargas Foundation (FGV) to finance up to USD 2 million in research related to SAF production in Brazil. The SAF Network aims at fostering studies on new SAF conversion processes and new feedstocks, ILUC modelling and risk-based analysis, sustainability criteria and certification schemes, cost-benefits analysis of public policies for SAF production.

In addition to this initiative, the Brazilian government has also carried out several studies on the availability of feedstock and feasibility of production to subsidize the decision-making process during the discussions on the Fuels of the Future. Those studies were carried out by the Energy Research Institute, which is linked to the Ministry of Mines and Energy. Those studies have drawn important conclusions for the policy-making process in Brazil, such as:[4]

1. SAF production in Brazil can have a lower carbon intensity compared to the same conversion processes in other countries due to integrated plants.
2. Brazil can stand out in SAF production due to its expertise in biofuels and the availability of land, biomass, and other renewable energy sources.
3. Existing initiatives for the construction of biorefineries can meet a portion of the emissions reduction required by CORSIA and National SAF Program. But, in the long term, it is necessary to diversify the feedstocks used in biofuels production, which could catalyze job creation and income distribution to rural areas in Brazil.

Finally, once SAF production is in place in Brazil, the National Petroleum, Natural Gas and Biofuels Agency (ANP) will need to carry out its own quality assessment procedures in order to ensure that the SAF deployed in Brazil meets all the quality and safety standard required from a drop-in fuel, In this regard, the Brazilian government has already made the investment to equip ANP with the proper tools and make its laboratory ready to test the SAF produced and deployed in Brazil according to ASTM and national safety and quality standards.

4 Available at: https://www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/combustiveis-sustentaveis-de-aviacao-no-brasil-perspectivas-futuras.