Policy Blueprint

Country Profile
Brazil
DISCLAIMER

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Considerations, opinions, conclusions and recommendations expressed in this publication do not necessarily represent a consensus among consulted experts on any given point, and do not necessarily reflect consensus views of Biofuture Initiative members.
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This profile is part of the analysis carried out for the Biofuture Platform Policy Blueprint project.

The report was produced by Dr. Adam Brown and Andrea Rossi, members of the Biofuture Platform IEA Facilitation Team under the guidance of Paolo Frankl (IEA) and members of the Biofuture Platform Core Management Group under the chairmanships of Renato Godinho and Jim Spaeth.

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SUMMARY

This report is part of the work carried out as part of the Biofuture Platform Policy Blueprint project. It should be read in conjunction with the other reports prepared under the project including similar project profiles for Netherlands and the USA, the methodology statement and the summary report, which will be available via the Biofuture Platform website.

Use of bioenergy, and biofuels in transport in Brazil

- Bioenergy contributed 32% to final energy consumption in Brazil in 2019 and 25.0% of transport energy.
- With over 30% of global annual production, Brazil is the world’s second largest producer of bioethanol and is also one of the leading producers of FAME biodiesel (principally from soy oil). Most of this production is used within the Brazil with only 1.3% of production of ethanol exported in 2019.
- Biofuels use in transport reached 0.90 PJ in 2019, 0.74 EJ of ethanol and 0.16 EJ of biodiesel
- Bioethanol use has grown by nearly 50% since 2010, and the use of biodiesel has grown by over 150% over the same period.

Benefits

- In 2019 use of biofuels is estimated to have reduced emissions from transport in Brazil by 70MTCO₂e. These savings are equivalent to 78 kTCO₂e for each PJ of energy.
Biofuels provide 3 million direct and indirect jobs in Brazil, equivalent to 3300 jobs/PJ of biofuels used.

**PRINCIPAL POLICY MEASURES**

Key policy measures include:

- A strategic priority given to biofuels production given the close links with the strategically important sugar and wider agriculture sector.
- A very long-standing commitment to biofuels production and use with drivers and economic development as well as to efforts to reduce GHG emissions.
- Priority given to enhanced biofuels production and use within Ten Year Energy Plan (PDE) as part of the drive to meet ambitious climate goals.
- Legally binding blending mandates for ethanol and biodiesel.
- Financial support for ethanol use provided primarily via differential tax and duty rates.
- The wide availability of flex-fuel vehicles which enable the use of unblended hydrous ethanol as well as gasoline blends.
- Support for investment in both crop production and biofuels production provided by BNDES and other financial bodies.
- Incentives for further investment in the sector and for improved GHG performance through the recently introduced RenovaBio Policy.
- Few concerns about the sustainability of biofuels production given the extensive land area available, existing regulatory measures and the perceived energy security, economic and environmental benefits.

Outstanding issues being addressed under Brazil’s Future Fuels Programme include:
• Need to optimise the coordination of the various policy elements such as the mandatory blending elements and RenovaBio.

• The development and commercialisation of cellulosic biofuels, drop in biofuels and biojet.

Policy Analysis

Strategic Priority

Biofuels features strongly in future energy plans and projections and is expected to be close to the levels envisaged in the IEA SDS by 2025 and 2030.

Policy clarity and certainty

The long-term use of biofuels blending mandates (since 1931 for ethanol and since 2008 for biodiesel) has provided policy certainty that has successfully stimulated investment in bioethanol and biodiesel production. The introduction of the RenovaBio Policy provides additional certainty going forward.

Market access

Blending regulations allow for higher blends of ethanol and biodiesel and the wide availability of flex-fuel vehicles provide for easy market access.

Financial support or incentives

The mandatory blending mandates and tax and duty incentives make the production and use of biofuels economic viable in Brazil. The introduction of the RenovaBio Policy will provide increased motivation for expanded production of ethanol and biodiesel. The current low value of CBios, averaging R$43 in 2020 and R$30.7 from January to May 2021 (c. 6 – 8 USD/TCO₂e) may not be sufficient to
stimulate production of some novel biofuels including cellulosic ethanol, bio-jet fuels etc.

**Sustainability Governance**

The RenovaBio Policy incentivises good GHG performance, and places requirements on the areas from which feedstocks are sourced.

**Support for innovation**

There is a national R&D effort aimed principally at improving and optimising current production systems, as well as looking at new processes and fuels.

**Summary**

This analysis is summarised in Table S1 and Figure S1.

<table>
<thead>
<tr>
<th>Table S1: Key Indicators</th>
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<tbody>
<tr>
<td>Bioenergy in energy supply %</td>
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<tr>
<td>Biofuels in transport %</td>
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<tr>
<td>PII 2030 %</td>
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<td>Jobs/PJ</td>
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<td>GHG Savings kTCO2e/PJ</td>
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Figure 1 • Summary of Policy Analysis – Brazil
1. INTRODUCTION

This report is part of the work carried out as part of the Biofuture Platform Policy Blueprint project. It should be read in conjunction with the other reports prepared under the project including similar project profiles for the Netherlands and the USA, the methodology statement and the summary report, which will be made available via the Biofuture Platform website.

The profile discusses the national energy context in Brazil and then discusses the trends in biofuels use in the transport sector along with the main relevant policies. It then reviews this data by calculating a number of quantitative indicators and reviews the policy portfolio against a number if qualitative benchmarks, as described in the Policy Blueprint methodology document.
2. NATIONAL CONTEXT

OVERALL ENERGY TRENDS

Overall energy demand in Brazil has been rising with increasing economic development and population, with total primary energy supply rising by 40% between 2000 and 2010, and by 10% between 2010 and 2019. (Figure 2).

Figure 2 • Brazil– Trends in Primary Energy Supply

Note: Includes electricity imports originated from hydropower.
Source: Brazilian Energy Balance (EPE, 2020), Table 1.3.a.

Petroleum products are the main sources in final energy consumption (39%). The natural gas share is stable in 7% since 2005. Despite having consolidated itself as
a net oil exporter, in 2019 Brazil imported nearly 13% of consumed oil products, due to the characteristics of its refining park, and imports 27% of its gas supply.

Brazil is one the world’s leading countries as far as renewable energy developments are concerned, with some 46% of its energy needs being met by renewable sources (2019). This proportion has remained above 40% despite the growth in total energy supply.

Renewables play a major role in power generation, providing 82% of all generation – especially from hydropower and bioenergy but with an increasing share from wind (9%) and solar PV (1%) in 2019. Renewables – notably bioenergy – also play an important role in supplying nearly 40% of the energy used for industrial heating, and 25% in transport.

**ENERGY DRIVERS AND POLICY**

Brazilian energy policy is closely linked to its commitment to the objectives of the UN Framework Convention on Climate Change and to its Nationally Determined Contribution.

This is embodied in the main energy planning document, the Ten-Year Energy Plan (PDE), developed by the Energy Research Agency (EPE) and published annually by the Ministry of Mines and Energy (MME).

As a result of COP 21, Brazil committed to reduce its domestic GHG emissions to 37% by 2025 and the intention to reach 43% by 2030, both based on 2005 levels.

A range of further measures will be adopted to reduce emissions from energy production and use in the Electricity, Industry, Transport and Agriculture sectors, as well as those associated with land use change and forestry (See Figure 4).
The expansion of the role of sustainable bioenergy is an important element in this plan.

Figure 3 • Brazil – emission reduction priorities

• Bioenergy currently provided 32% of Brazil’s total primary energy supply in 2019, including:
  • 8.3% of electricity generation (52.1 TWh)
  • 40% of industrial heat requirements (1,323 PJ), principally through the production heat in CHP systems in sugar plants, the use of firewood

ROLE OF BIOENERGY IN BRAZIL

The production and use of bioenergy in Brazil are very strongly integrated with the strategically important agriculture sector and the production of sugar, soy and other agricultural products.

Source: Brazil Ten Year Energy Plan (PDE).
and black liquor energy recovery. Brazil is the world’s largest producer of industrial heat from bioenergy.

- provides 25% of transport energy needs (891 PJ) mostly from bioethanol and biodiesel.
- 28.1% of residential energy needs.
- Increasing the share of sustainable bioenergy in the Brazilian energy matrix is a key component of the future energy plan. The objective is to expand biofuel consumption, increasing ethanol supply and including a greater proportion of advanced biofuels including cellulosic ethanol in the gasoline fuel mix, and more biodiesel in the diesel mix.

**Figure 4 • Bioenergy in Brazil**

![Pie chart showing primary energy supply from bioenergy in Brazil](source)

*Source: Brazilian Energy Balance (EPE, 2020).*
3. BIOFUELS FOR TRANSPORT IN BRAZIL

PRODUCTION OF BIOFUELS

Brazil is the world’s second largest producer of bioethanol. Bioethanol production has increased by some 40% since 2010 and grew by 11% from 2018 to 2019, when Brazil produced a record of over 35 billion litres (0.75 EJ) (some 33% of total global production).\(^1\) Production is mostly based on sugar cane products, but there is a growing level of production of ethanol from corn (1.3 billion litres in 2019). There are some relatively small volumes of ethanol both imported and exported from Brazil depending on international market conditions. In 2019 there was a net export equivalent to 1.3% of domestic production (1.9 billion litres).

Brazil is also one of the world’s largest producers of biodiesel, principally from soy (70% average). Biodiesel production has also been rising strongly (by a factor of nearly 2.5 from a low level in 2010) and also grew by 11% in 2019 to reach a record level of 5.9 billion litres (0.2 EJ), all consumed within the country. In March 2021 the mandatory biofuels blend in diesel was increased to 13%.

Other biofuels for transport are so far produced only in small quantities. Biogas and biomethane produced from agricultural and industrial wastes are so far used for heat and electricity production, and production of HVO, biokerosene etc. are still at pilot scale.
USE OF TRANSPORT BIOFUELS

Overall transport energy demand in Brazil has grown by some 22% between 2010 and 2019. Diesel is the most used fuel (42% of total in 2019) along with gasoline (25%). Other fossil energy sources (including natural gas) and electricity make up only a small proportion.

Biofuels contributed 25% to transport energy demand (in energy terms) in 2019, with the % varying as shown in Figure 5.

Bioethanol is used as a gasoline replacement, either by blending with gasoline (anhydrous ethanol) or alone (hydrous ethanol). In 2019 ethanol (hydrous and anhydrous) provided some 20.6% of transport energy requirements and 49.1% of fuel needs in the Otto cycle fleet. Both hydrous and anhydrous ethanol use
increased significantly since 2010, providing 0.5 and 0.24 EJ in 2019, respectively. Since 2010, the use of anhydrous ethanol has grown 49%, as the mandatory blending level has been increased, and hydrous ethanol has grown by 44%, with the gain in competitiveness against gasoline.

Biodiesel use has grown strongly, by 154% since 2010 and now provides 0.16 EJ, some 4.5% of transport energy needs in 2019, and 9.6% in diesel cycle demand.

No other biofuels are so far used in significant quantities in transport.

Figure 6 • Trends in transport energy use – 2010–2017

Source: Based on data in Brazilian Energy Balance, 2020, Table 3.6a (EPE, 2020).
BENEFITS

GHG reductions

The GHG emissions avoided through the use of biofuels for transport were estimated at nearly 70 MtCO$_2$e in 2019 (with a further 2.8 MtCO$_2$e coming from the use of bioenergy in power generation).$^2$

![Avoided emissions from biofuels use in Brazil –2019](image)


Jobs

The production of biofuels is estimated to support over 3 million direct and indirect jobs in Brazil in 2019. 75% of these relate to agricultural production, and the rest to biofuel production.$^3$
Import substitution

According to EPE, Brazilian Energy Balance total use of biofuels in Brazil reached 22 MTOE in 2019. Assuming an average oil price for 2019 of USD 57/barrel or USD 376/TOE, this has a value of some USD 8.3 Billion.

Figure 8 • Avoided fuel imports in Brazil 1970-2019

Source: Based on data in Brazilian Energy Balance, 2020 (EPE, 2020).

PRINCIPAL BIOFUELS POLICY MEASURES

Targets and Projections

Existing policies in Brazil, including the RenovaBio, are likely to lead to continuing growth in bioenergy use. The Brazilian Ten-Year Energy Expansion plan (PDE 2029) foresees a 39% increase in the use of bioethanol by 2029 and a 64% expansion in biodiesel use using 2019 as reference year.
**Blending Mandates**

Brazil has a long history of bioethanol blending mandates, dating back to 1931 when a blend of 5% was instituted. The blending mandate was reinstated as part of the ProAlcohol Program in 1975, and the blend level has progressively been increased and since 2015 has been set at 27% (volume/volume) (c. 18% by energy). All standard gasoline contains this level of ethanol.

In addition, the wide availability of flex-fuel vehicles mean that consumers can also choose to buy neat (hydrous) ethanol when this is more economic.

A blending mandate for biodiesel was instituted under the National Biodiesel Production Programme in 2005, and the level has been progressively increased from the initial 2% and stands at 13% (vol/vol) (c. 12% by energy), with the intention that this will rise to 15% by 2023. Diesel vehicles, such as fleets of buses and trucks can go beyond this mandated level (15%) if they wish.

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**Figure 9 • Blending mandates in Brazil 2010–2020**

![Blending mandates graph](image_url)
Financial support and incentives

Tax and duty differentials

The Federal government provides preferential treatment for ethanol compared to gasoline under its Contribution for Intervention in Economic Domain (CIDE) and its contribution to Social Integration/Contribution for Financing Social Security (PIS/COFINS) programmes. The Federal Government also sets tax exemptions and incentives for biodiesel according to the nature of the raw material, size of producer and region of production to encourage production and promote social inclusion.

In addition, there are differential rates of duty on ethanol and gasoline levied by State Governments via the ICMS (Tax on circulation of Goods and Services), with the rate depending on the State.

The prices of gasoline and ethanol are influenced by several factors, such as oil and sugar price in international market and climate conditions on crops.

The related impact of these measures and factors on the relative prices of ethanol and gasoline are shown in Figure 11, with ethanol being on average 66% (vol/vol) of the cost (per litre) of gasoline in 2019.

Estimates of the support provided by these Federal and State tax differentials indicate that the support amounts to USD 1.8/GJ for FAME biodiesel, and to USD 12.3/GJ and USD 8.9/GJ for hydrous and anhydrous ethanol respectively (based on analysis of state fuel taxes level of São Paulo and Minas Gerais, the two largest users of ethanol)\(^5\). This analysis may not fully represent all the support provided.
to ethanol and biodiesel, which varies depending on the relative prices of the biofuels and fossil fuels, and some further analysis will be required to elucidate the full picture.

There are also lower rates of purchase tax which encourage the purchase of flex-fuel vehicles and other low carbon alternatives including those fuelled by natural gas or biomethane.

Figure 10 • Relative price of standard gasoline and hydrous alcohol, and State levels of ICMS on hydrous alcohol


Other financial and fiscal support

The direct support for biofuels provided through differential ICMS levels for ethanol and by RenovaBio is complemented by a range of other measures which provide financial and fiscal support. These include:

- The regional producer subsidy, which provides support to sugar cane producers
The BNDES \(^i\) provides credit lines for sugar, ethanol, cogeneration, logistics, and transport investments, and for feedstock development, planting and harvesting systems. In 2019 financing for the sector amounted to some 1.9 billion R$ (c. 463 MUSD – 1USD = 4.1R$, 2019 exchange rate\(^ii\)).

Support is available in the form of loans for the renewal and expansion of sugar cane production and encourage planting of new more productive varieties via the ProRenova programme (217 R$ Million (USD 67.6 million) – representing 12% of the total amount).

**RenovaBio**

Late in 2019, Brazil introduced a new policy mechanism – RenovaBio – designed to incentivise a reduction on transport emissions. The main features of RenovaBio are

- A long-term target to reduce carbon emissions from transport (by 10% over a ten-year periods) and annual targets which are assigned pro-rata to individual fuel distributors, based on % of fossil fuel sales.
- The award of GHG emission reduction certificates (CBIO) to low carbon fuel producers, awarded on the basis of Life Cycle Analysis with 1 CBIO for each tonne of CO\(_2\)e reduced compared to fossil fuels.
- The value of the CBIO is established by trading in the stock market.

In the first year of RenovaBio, fuel distributors met 97.6% of the mandatory goal of reducing greenhouse gas emissions, set by the National Energy Policy Council (CNPE), when 14,535,334 Decarbonization Credits (CBIOs) were retired by the obligated party by the end of 2020.

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\(^i\) Brazil National Bank for Social and Economic Development  
\(^ii\) There has been considerable volatility in Brazilian currency. For a view of USD/BRL Exchange rate movement in the last years, please see [https://www.bcb.gov.br/en](https://www.bcb.gov.br/en).
Figures 12 shows the initial pattern of trading of CBIOs up to July 2020. In 2020, biofuel producers received a total value of 650 million R$ (USD 125 million – 1USD = 5.16 R$, average 2020 exchange rate), with a mean value of some 43.5 R$/tonne/CO₂e (c. 8.4 USD/tonne/CO₂e). The value of the CBIOs once trading is more established will be important in determining how effective RenovaBio is, and especially if it can provide sufficient incentive to stimulate investments in new technologies and fuels.

It is anticipated that the new policy will expand current bioethanol production to 48 billion litres and biodiesel to 11 billion litres by 2030 as well as incentivising improved GHG performance and new fuels (MME, 2020)

**Sustainability governance**

Under the RenovaBio Policy, biofuels are certified according to the carbon intensity of their production through LCA analysis of their production chain and given a Note on Energy–Environmental Efficiency (NEEE) which reflects the mitigation of GHG compared to the fossil fuel equivalent. Figure 13 shows the range and mean scores for each of the main types of biofuel in Brazil.
RenovaBio will incentivise improved GHG performance – for example the improving mill performance through producing biomethane from vinasse, the production of ethanol from cellulosic materials and from corn.

The certification process also takes into account the origin of the biomass material used as feedstock. Only feedstock from registered sites is eligible, avoiding sites which involve removal of native vegetation.

The production sites for oil palm culture (for biodiesel production) are also controlled to ensure that sites associated with native forests or legal reserves are not used for cultivation.
SUPPORT FOR INNOVATION

Biofuels research and development is supported by a number of government-backed mechanisms providing support for R&D and demonstration plants. Public and publicly oriented support totalled over 200 MR$ (USD 38 million) in 2018.

This included support in the form of loans, equity participation and grants and is also available via the PAISS programme for ethanol and other biofuel production including cellulosic ethanol, and drop-in biofuels including aviation fuels.

Figure 13 • Public investments in renewable energy R, D&D

Source: CGEE A big push for sustainability in Brazil’s energy sector Figure II.11

RenovaBio is expected to catalyse the development and commercialisation of low carbon transport options with improved GHG performance. However, the value of CBios up until the end of May in 2021 have averaged around USD 5.7/TCO\textsubscript{2e}, until

\textsuperscript{iii} Based on the average exchange rate between January and May 2021 – USD1 = R\$5.4.
end of May, (c. USD 5.7). This is unlikely to be sufficient to incentivise the production of new fuels such as cellulosic ethanol and bio-jet fuels.

Specific innovations being given priority include:

- Commercialisation of production of ethanol from bagasse and sugar cane residues. Two full scale plants are in operation, but performance has still not reached design levels.
- Use of anaerobic digestion to process vinasses to produce biomethane in sugar mills to improve GHG performance of the plants.
- Use of ethanol fuels cells for light vehicle transport.

**Policy development and review**

Policy development in Brazil involves significant stakeholder engagement. For example, the RenovaBio Policy was developed with input from a wide range of stakeholders and a public consultation process.

Legislative development in Brazil includes an assessment of the economic, social, environmental and technological impacts of new policies and regulation.

EPE and ANP monitor the development of the various biofuel markets and make policy analysis and recommendations to MME to help optimise policy implementation.

In particular, EPE publish a comprehensive annual report of the development of bioenergy markets in Brazil the *Analise de Conjuntura dos Biocombustiveis* (Biofuels Current Outlook). This report analyses market trends and policy impacts in detail.
Outstanding policy issues being addressed through discussions under Brazil’s Future Fuels Programme (Combustivel do Futuro) include:\(^7\)

- Need to optimise the coordination of the various policy elements such as the mandatory blending elements and RenovaBio.
- The development and commercialisation of cellulosic biofuels, drop in biofuels and biojet.
4. BRAZIL POLICY REVIEW AND ANALYSIS

BRAZIL – DEPLOYMENT INDICATORS

The Table below shows the Brazil situation in terms of the indicators identified above.

Table 1 • Deployment Indicators – Brazil

<table>
<thead>
<tr>
<th>Current deployment</th>
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<tbody>
<tr>
<td>% bioenergy in final energy consumption</td>
<td>32%</td>
</tr>
<tr>
<td>% bioenergy in transport:</td>
<td>25.0%</td>
</tr>
<tr>
<td><strong>Growth of bioenergy in transport vs SDS projections for 2030:</strong></td>
<td></td>
</tr>
<tr>
<td>Biofuels in transport 2019</td>
<td>900 PJ</td>
</tr>
<tr>
<td>Rate of growth 2015/2019</td>
<td>0.035 EJ/y</td>
</tr>
<tr>
<td>SDS Biofuels in transport 2030:</td>
<td>4.0 EJ</td>
</tr>
<tr>
<td>Rate of growth needed to 2030</td>
<td>0.41 EJ/y</td>
</tr>
<tr>
<td>PII 2030iv</td>
<td>87%</td>
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<tr>
<td><strong>Jobs</strong></td>
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<td>Jobs/PJ</td>
<td>3300</td>
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<td><strong>GHG Savings kTCO2e/PJ</strong></td>
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<tr>
<td>GHG Savings 2019 MTCO2e</td>
<td>70</td>
</tr>
<tr>
<td>GHG Savings kTCO2e/PJ</td>
<td>78</td>
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</tbody>
</table>

iv PII – Policy Impact Indicator. Compares the rate of increase of deployment between 2015 and 2019 with that needed to meet the level of bioenergy in transport in IEA’s Sustainable Development Scenario (SDS).
Current policies have promoted sustained and rapid growth of biofuels up to 25% of transport needs. Even if current rates of growth were sustained the contribution of biofuels in transport would be close to those foreseen in the IEA SDS as shown in Figure 17. The RenovaBio project is likely to accelerate use of biofuels further.

**Figure 15 • Trends in bioenergy deployment and SDS projections**

![Graph showing bioenergy in transport (EJ) from 2015 to 2030 with different markers for deployment, SDS, and projection]

**POLICY ANALYSIS**

**Strategic Priority**

Biofuels features strongly in future energy plans and projections and is expected to be close to the levels envisaged in the IEA SDS by 2025 and 2030.

**Policy clarity and certainty**

The long–term use of biofuels blending mandates has provided long term policy certainty that has successfully stimulated investment in bioethanol and biodiesel production. The introduction of the RenovaBio Policy provides additional certainty going forward.
**Market access**

Blending regulations allow for higher blends of bioethanol and biodiesel and the wide availability of flex-fuel vehicles provide for easy market access.

**Financial support or incentives**

The mandatory blending mandates and tax and duty incentives make the production and use of biofuels economic in Brazil, and the introduction of the RenovaBio Policy will provide increased motivation for expanded production. The current low value of CBios, averaging R$43 in 2020 and R$30.7 from January to May 2021 (c. 6 – 8 USD/TCO$_2$e)\(^\dagger\) are unlikely be sufficient to stimulate production of novel biofuels including cellulosic ethanol, bio-jet fuels etc.

**Sustainability Governance**

The RenovaBio Policy incentivises good GHG performance, and places requirements on the areas from which feedstocks are sourced.

**Support for innovation**

There is a national R&D effort aimed principally at improving and optimising current production systems, as well as looking at new processes and fuels. The level of support available under the RenovaBio Policy may not be sufficient to incentivise investment in new technologies such as cellulosic ethanol or bio-jet fuel production.

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\(^\dagger\) Taking 1USD = 5.4 R$, the average exchange rate, Jan - May 2021
SUMMARY

This analysis is summarised in Figure 18.

Figure 16 • Summary of Policy Analysis – Brazil
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