Brasil 2045

The Petrobras we need

Brazil 2045: Building an Environmental Powerhouse
Volume 5 – 2025

Future of Energy Series

OBSERVATÓRIO DO CLIMA
CLIMA e ENERGIA

Brasil 2045

The Petrobras We Need

Proposal by the Brazilian Climate Observatory network for Petrobras to transition from an oil company to a clean energy company without losing value and importance in shaping the country's future.

OBSERVATÓRIO DO CLIMA

CLIMA e ENERGIA

Dados Internacionais de Catalogação na Publicação (CIP)
(Câmara Brasileira do Livro, SP, Brasil)

A Petrobras de que precisamos : proposta da rede do observatório do clima para que a Petrobras faça sua transição de petroleira para empresa de energia limpa sem perder valor e importância nos rumos do país / Suely Araújo ... [et al.]. -- 1. ed. -- Rio de Janeiro : Laboratório do Observatório do Clima (LABOC), 2025.-- (Série futuro da energia ; volume 5)

Bibliografia
Outros autores: Shigueo Watanabe Junior, Mirela Coelho Pita, Fábio Ishisaki, Felipe Betim
ISBN 978-65-987655-1-4

1. Brasil - Política e governo 2. Clima - Mudanças 3. Energia - Armazenamento 4. Energia - Indústria 5. Petrobras 6. Petroquímica I. Araújo, Suely. II. Junior, Shigueo Watanabe. III. Pita, Mirela Coelho. IV. Ishisaki, Fábio. V. Betim, Felipe. VI. Série.

25-297910.0 CDD-338.27282

Índices para catálogo sistemático:

1. PETROBRAS : História 338.27282

Maria Alice Ferreira - Bibliotecária - CRB-8/7964

AUTHORS

Suely Araújo
Shigueo Watanabe Jr.
Mirela Coelho
Fábio Ishisaki
Felipe Betim

Authoring Organizations

1. **350.org**
2. **Minas Gerais Association for Environmental Defence (*Associação Mineira de Defesa do Ambiente*)**
3. **Rare Brazil Association (*Associação Rare Brasil*)**
4. **Brazil Center on Climate (CBC) (*Centro Brasil no Clima*)**
5. **Engajamundo**
6. **São Francisco Permanent Forum (*Fórum Permanente São Francisco*)**
7. **Environmentalist Group of Bahia (Gambá – *Grupo Ambientalista da Bahia*)**
8. **Black Women's Institute (Geledés – *Instituto da Mulher Negra*)**
9. **Greenpeace Brazil**
10. **Brazilian Institute for Consumer Protection (IDEC)**
11. **Democracy and Sustainability Institute (IDS – *Instituto Democracia e Sustentabilidade*)**
12. **International Energy Initiative (IEI)**
13. **Institute for Energy and Environment (IEMA – *Instituto de Energia e Meio Ambiente*)**
14. **Institute for Socioeconomic Studies (INESC – *Instituto de Estudos Socioeconômicos*)**
15. **Alziras Institute (*Instituto Alziras*)**
16. **Comida do Amanhã Institute (*Instituto Comida do Amanhã*)**

17. **ClimaInfo Institute (*Instituto ClimaInfo*)**
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21. **Institute for Transportation and Development Policy (ITDP – *Instituto de Políticas de Transporte e Desenvolvimento*)**
22. **Oceana Brazil**
23. **CIPÓ Platform (*Plataforma CIPÓ*)**
24. **Pólis – Institute for Social Policy Studies, Training and Advisory (*Instituto de Estudos, Formação e Assessoria em Políticas Sociais*)**
25. **Health and Happiness Project (*Projeto Saúde e Alegria*) Purpose Brazil**
26. **Revolusolar**
27. **The Climate Reality Project Brazil**
28. **WRI Brasil – World Resources Institute Brasil**
29. **WWF Brazil**

Organization: Suely Araújo, Shigueo Watanabe Jr., Délcio Rodrigues

Writing and Editing: Felipe Betim

Review: Suely Araújo, Shigueo Watanabe Jr., Mirela Coelho e Rodrigo Vargas

Design: Bia Gomes (Revuo Design)

English Version: Edoardo Lobl

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INTRODUCTION

The trajectory of Petróleo Brasileiro S.A. (Petrobras) is intertwined with Brazil's own political and economic history. Since it was founded by President Getúlio Vargas in 1953, the company has assumed the responsibility of leading Brazilian economic development through investment in energy sovereignty—self-sufficiency in the production, refining, and distribution of oil and gas derivatives—industrialization, and technology.

From its creation, born out of the "The Oil is Ours" campaign, to the discovery of the pre-salt reserves (2006), and during the military dictatorship (1964–1985) as the driving force behind the establishment of a national petrochemical sector, the company has been omnipresent in national debate and a fundamental part of the strategy of different governments, even after the monopoly was broken and the company went public in 1997. Even with the federal government sharing its ownership with domestic and international investors, Petrobras has forged itself as a company of the nation, historically aligned with the country's objectives and serving as a national symbol for Brazilian society.

Now it should be no different. Climate change has placed Brazil—and the rest of the world—in a race against time to mitigate its effects by containing global warming and the climate crisis, which is already a reality. Petrobras must lead these efforts to progressively abandon fossil fuels, regardless of the Brazilian government's efforts to be taken seriously as a climate leader.

But how?

There is a vast scientific literature and an international consensus linking the current climate emergency to the growing burning of fossil fuels since the Industrial Revolution in the 19th century, which has resulted in the emission of billions of tons of carbon dioxide (CO_2), methane (CH_4), among other greenhouse gases (GHG) every year.

It bears repeating: the high concentration of these gases in the atmosphere, responsible for intensifying the greenhouse effect and consequently global warming, is the direct result of human activity.

Although historical responsibility for global warming rests with developed countries, it is also true that Brazil today is not only one of the world's largest emitters of greenhouse gases—particularly due to emissions from deforestation[1] —but also one of the main players, through Petrobras, in the global fossil fuel supply chain.

[1] SEEG. (2024). *Analysis of Greenhouse Gas Emissions and Their Implications for Brazil's Climate Targets (Análise das emissões de gases de efeito estufa e suas implicações para as metas climáticas do Brasil)*. Available at: https://seeg.eco.br/wp-content/uploads/2024/11/SEEG-RELATORIO-ANALITICO-12.pdf. Accessed on August 20, 2025.

Crude oil has become one of Brazil's three leading export products, reaching 1.8 million barrels per day in 2024, according to the Brazilian Institute of Oil and Gas (IBP)[2], including Petrobras production and that of foreign oil companies. With a total output of 3.4 million barrels per day, Brazil closed 2024 as the eighth-largest global producer, responsible for about 4% of total world oil production[3].

Furthermore, Petrobras is among the world's ten largest oil companies and also among the most profitable. In its consolidated 2024 balance sheet, the company recorded revenues of more than US$91 billion and net profits of US$7.5 billion[4]. Although this result was lower than in the previous year, mainly due to "exchange rate variations on debts between Petrobras and its subsidiaries abroad,"[5], the company resumed accelerating its gains in the first half of 2025 and rose to 3rd place among the world's most profitable oil companies. Net profits reached US$10.7 billion in just the first six months of the year, a 140% increase compared to the same semester in 2024, behind only Saudi Aramco and ExxonMobil[6].

Even if part of the oil extracted by Petrobras in Brazil is exported, and a large portion of the emissions from its main product are generated in other countries, the effects of global warming are shared by all. Planet Earth and its atmosphere are one. Therefore, however ambitious Brazil's national targets may be, it is no longer acceptable to keep Petrobras outside these objectives under the justification that a significant portion of emissions occurs beyond Brazilian territory.

It is not a matter of requiring Petrobras to actively seek to reduce national and global demand for fossil fuels. This depends, as we will see below, on national and international laws, regulations, and public policies that express the still insufficient political will to carry out an effective energy transition.

Nor is it a matter of expecting the company to abandon oil production in the very short term, redirecting its investment portfolio to renewables overnight.

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[2] Brazilian Institute of Oil and Gas (IBP). (2025). *Evolution of Oil Production, Export, and Import in Brazil (Evolução da produção, exportação e importação de petróleo no Brasil)*. Available at: https://www.ibp.org.br/observatorio-do-setor/producao-importacao-e-exportacao-de-petroleo/. Accessed on July 6, 2025.

[3] Brazilian Institute of Oil and Gas (IBP). (2025). *World's Largest Oil Producers in 2024 (Maiores produtores mundiais de petróleo em 2024)*. Available at: https://www.ibp.org.br/observatorio-do-setor/snapshots/maiores-produtores-mundiais-de-petroleo/. Accessed on August 24, 2025.

[4] Petrobras. (2025). *Annual Report and Form 20-F 2024 (Relatório Anual e Formulário 20-F 2024)*. Available at: https://www.investidorpetrobras.com.br/apresentacoes-relatorios-e-eventos/relatorios-anuais/. Accessed on August 24, 2025.

[5] Petrobras. (2025). *Petrobras Reports Net Profit of R$36.6 Billion in 2024 (Petrobras lucra R$36,6 bilhões em 2024)*. Available at: https://agencia.petrobras.com.br/w/negocio/petrobras-lucra-r-36-6-bilhoes-em-2024. Accessed on August 24, 2025.

[6] Poder360. (2025). *Petrobras Rises to 3rd Place Among the Most Profitable Oil Companies* (Petrobras sobe para 3ª posição entre petroleiras mais lucrativas). Available at: https://www.poder360.com.br/poder-energia/petrobras-sobe-para-3a-posicao-entre-petroleiras-mais-lucrativas/. Accessed on August 24, 2025.

The problem is that Petrobras's future strategy has been increasingly detached from the global commitments already undertaken, from Brazil's own objectives in reducing its emissions, and from the International Energy Agency (IEA)'s forecast of a global peak in oil demand by 2030, followed by decline[7].

With this projection on the horizon, it makes no economic sense for Petrobras, for example, to continue investing in new refineries to meet domestic demand for derivatives or to plan the opening of new exploration frontiers for crude oil exports, such as in three basins of the Equatorial Margin, including the Foz do Amazonas, which has become a contested arena between technical arguments and intense pressure from political interests; or in the Pelotas Basin (Rio Grande do Sul), among other areas sensitive from a socio-environmental perspective. An operation of this kind takes at least 10 years to become viable, and even longer to prove profitable—if commercially exploitable oil exists at all.

It is expected that, starting in the next decade, global oil demand will be in decline. Consequently, these investments will not yield the expected returns and face a real risk of becoming stranded assets, contrary to the assessment of Petrobras and other oil companies operating in Brazil. It is worth questioning which studies underpin this understanding, while also recalling that other major players—such as the United States, Russia, or Saudi Arabia—will also seek to remain the leading suppliers for the residual global demand, in some cases selling oil that is more competitive than Brazil's, as is the case of Saudi Arabia.

These factors must not be disregarded. While major oil companies are scaling back investments in new reserves and production fields due to the drop and current stagnation in oil prices, Petrobras is implementing a "belt-tightening" strategy that prioritizes productivity gains where risks are lower, while at the same time, paradoxically, redirecting funds to unexplored regions with uncertainties about their economic viability, such as the Pelotas Basin and the Equatorial Margin basins—along the coast from Amapá to Rio Grande do Norte[8].

The recent statement by the current Executive Director of Corporate Affairs, Clarice Coppetti, that "we need to invest in new exploration frontiers" because, according to her, global energy demand is

[7] International Energy Agency (IEA). (2025). *Oil 2025 – Analysis and Forecast to 2030*. Available at: https://www.iea.org/reports/oil-2025. Accessed on July 20, 2025.

[8] O Globo. (2025). *Hitting the Brakes: Oil Companies Reduce Investments Amid Stagnating Barrel Prices (Pé no freio: petroleiras reduzem investimentos com estagnação do preço do barril)*. Available at: https://oglobo.globo.com/economia/negocios/noticia/2025/07/06/pe-no-freio-petroleiras-reduzem-investimentos-com-estagnacao-do-preco-do-barril.ghtml. Accessed on July 20, 2025.

growing, is noteworthy[9]. Indeed, economic growth translates into increased energy demand, but this demand will increasingly be met by renewable sources. Also concerning is her view that the energy transition should "in no way compromise Brazil's economic development."

Energy transition and economic development are not contradictory ideals. On the contrary, transition and development must move forward together.

In a recent interview with the newspaper *Valor Econômico*[10], the company's president, Magda Chambriard, stated that "there is no future for an oil company without exploration." But is there a future for Petrobras if the company continues to bet on oil?

For the Brazilian Climate Observatory (OC), Petrobras must, in general terms, present a timeline to align its energy policy and strategic planning with the Paris Agreement, with the goal of limiting the increase in average global temperature to 1.5°C above pre-industrial levels and achieving carbon neutrality by 2050.

In addition to the International Energy Agency (IEA)'s forecast of a decline in global oil demand from 2030 onward—different from overall energy demand, it is worth stressing—the OC also considers that the oil company must incorporate the guidelines for a just transition proposed in the study *Future of Energy: the Brazilian Climate Observatory's Vision for a Just Transition in Brazil* (*Futuro da Energia: visão do Observatório do Clima para uma transição justa no Brasil*)[11].

These guidelines assume an average annual growth of Brazil's GDP of 2.1% until 2050, which will put pressure on energy and consumer goods demand. Even so, the study presents technically feasible pathways for the energy sector to reduce its emissions to 102 million tCO_2e—a reduction of about 80% compared to the 2022 level of 490 million reported by the System for Estimating Greenhouse Gas Emissions and Removals (SEEG)[12].

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[9] *Valor Econômico. (2025). "We Need to Invest in New Exploration Frontiers," Says Petrobras Executive Director ("Precisamos investir em novas fronteiras exploratórias", diz diretora da Petrobras)*. Available at: https://valor.globo.com/empresas/noticia/2025/06/17/precisamos-investir-em-novas-fronteiras-exploratrias-diz-diretora-da-petrobras.ghtml. Accessed on July 20, 2025.

[10] Valor Econômico. (2025). *"There Is No Future for an Oil Company Without Exploration," Says Chambriard ("Não existe futuro para uma empresa de petróleo sem exploração", diz Chambriard)*. Available at: https://valor.globo.com/empresas/noticia/2025/05/23/nao-existe-futuro-para-uma-empresa-de-petroleo-sem-exploracao-diz-chambriard.ghtml. Accessed on July 20, 2025.

[11] Brazilian Climate Observatory. (2024). *Future of Energy: the Brazilian Climate Observatory's Vision for a Just Transition in Brazil (Futuro da Energia: visão do Observatório do Clima para uma transição justa no Brasil)*. Available at: https://www.oc.eco.br/wp-content/uploads/2024/10/OC_Futuro-da-Energia_DIGITAL.pdf. Accessed on July 20, 2025.

[12] SEEG – System for Estimating Greenhouse Gas Emissions and Removals. (n.d.). *Platform data*. Available at: https://plataforma.seeg.eco.br/. Accessed on July 20, 2025.

Another study that provides important guidelines for decarbonization in the country is the *Proposal by the Brazilian Climate Observatory for Brazil's Second Nationally Determined Contribution (NDC) under the Paris Agreement (2030–2035)* (*Proposta do Observatório do Clima para a Segunda Contribuição Nacionalmente Determinada (NDC) do Brasil no âmbito do Acordo de Paris (2030–2035)*)[13], which sets out an aggregated target and feasible, scalable, sectoral goals based on existing technologies that represent Brazil's fair contribution to limiting global warming to 1.5°C.

Taking these parameters as premises, we present below our vision for the Petrobras we need—and want—for the future. A Petrobras that transforms itself into an energy company, engaged in diverse activities, with investments in biofuels, low-carbon hydrogen, and consumer distribution, among others. One that maintains its character as a public company, aligned with the commitment to reindustrialize the country through these drivers, rather than simply expanding the range of products for export.

This understanding was debated and developed in workshops with representatives of the member organizations of the Energy and Climate Working Group and members of the Brazilian Climate Observatory's secretariat. In addition, it was informed by the report *Key Issues and Strategic Alternatives for Decarbonizing Petrobras's Investment Portfolio* (*Questões-Chave e Alternativas Estratégicas para Descarbonização do Portfólio de Investimentos da Petrobras*), authored by professors Carlos Eduardo F. Young and Helder Queiroz Pinto Jr. of the Institute of Economics at the Federal University of Rio de Janeiro (IE/UFRJ), at the request of the Brazilian Climate Observatory.

It should be noted that the two publications—the report produced by the two professors and this document—although largely convergent, are independent of each other and may present different conclusions and understandings on certain points.

[13] Brazilian Climate Observatory. (2024). *Brazil 2045: Building an Environmental Power – Foundations for a Proposal for Brazil's 2nd NDC (2030–2035) (Brasil 2045: construindo uma potência ambiental – bases para proposta de 2ª NDC para o Brasil (2030–2035))*. Available at: https://monitor2045.oc.eco.br/wp-content/uploads/2024/12/Brasil2045_Bases_NDC.pdf. Accessed on August 7, 2025.

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THE PETROBRAS WE NEED

The global energy transition is a reality, though not always advancing at the necessary pace to limit warming to 1.5°C. However, with the arrival of new renewable energy technologies and engine electrification, and the consequent decline in global oil demand projected to begin in 2030, Petrobras must align its strategies and investments with the targets established under the Paris Agreement, ratified by 194 countries, including Brazil, as well as the European Union (EU)[14]. The treaty embodies the global commitment to keep the increase in average global temperature well below 2°C above pre-industrial levels and to pursue efforts to limit the increase to 1.5°C.

The company must also align itself with Brazil's latest Nationally Determined Contribution (NDC), submitted at the end of 2024 to the United Nations Framework Convention on Climate Change (UNFCCC) under the Paris Agreement, which commits to reducing net GHG emissions by 59% to 67% by 2035 compared to 2005 levels—equivalent to limiting emissions to between 850 million and 1.05 billion tCO_2e. On this point, it is important to emphasize that Petrobras must, at the very least, commit to the upper range of the reduction target (67%), though ideally it should adopt an even more ambitious goal. In fact, the guiding premise should be the proposal of the Brazilian Climate Observatory for Brazil's NDC[15]: a 92% reduction in net emissions by 2035 compared to 2005 levels.

In response to these targets, Brazil has been developing its National Mitigation Strategy (ENM)[16] — which, together with the National Adaptation Strategy, makes up the Climate Plan (Plano Clima). The federal government released the draft ENM document and its seven sectoral plans, including those for energy and transport, in July and submitted them for public consultation.

The proposed ENM includes, among its national objectives, to "expand sustainable biofuel production, promote technological innovation, and develop value chains related to bioenergy"; as well as to "encourage the replacement of fossil fuels by promoting the development and efficient use of sustainable biofuels, electrification solutions, and low-carbon hydrogen."

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[14] Brazilian Climate Observatory; Paris Agreement Observatory (*Observatório do Acordo de Paris*); LACLIMA Network (*Rede LACLIMA*). (2024). *Paris Agreement: A Guide for the Perplexed (Acordo de Paris: um guia para os perplexos)*. Available at: https://www.oc.eco.br/wp-content/uploads/2024/09/Financiando-o-Futuro-Acordo-de-Paris-Um-guia-para-os-perplexos-2024.pdf. Accessed on August 22, 2025.

[15] Brazilian Climate Observatory. (2024). *Brazil 2045: Building an Environmental Power – Foundations for a Proposal for Brazil's 2nd NDC (2030–2035) (Brasil 2045: construindo uma potência ambiental – bases para proposta de 2ª NDC para o Brasil (2030–2035))*. Available at: https://monitor2045.oc.eco.br/wp-content/uploads/2024/12/Brasil2045_Bases_NDC.pdf. Accessed on August 7, 2025.

[16] Ministry of the Environment and Climate Change (MMA). (2025). *Climate Plan: National Mitigation Strategy (Plano Clima: Estratégia Nacional de Mitigação)*. Available at: https://www.gov.br/mma/pt-br/composicao/smc/plano-clima/enm_consolidada-vsubex-final-10-07-25-limpa-1-1.pdf/. Accessed on July 24, 2025.

The document released for public consultation also states that:

> *In the medium term, Brazil will encourage the gradual replacement of fossil fuel use through different technological pathways, especially biofuels and other low-carbon intensity fuels, such as synthetic fuels, but also through hybridization—particularly in transportation—and greater electrification of productive sectors. The replacement of fossil fuels with biofuels enables the development and expansion of bioenergy production associated with carbon capture and storage (BECCS), which represents an important approach to meeting national demand for negative greenhouse gas (GHG) emissions.*
>
> *Brazil will also make efforts to develop markets for low-carbon hydrogen as an alternative to fossil inputs, as well as to consider a range of solutions in low-carbon fuels and electrification, depending on the technical and economic feasibility of the solutions, especially to make emission reductions viable in hard-to-abate sectors. In addition to biofuels and electrification, the use of low-carbon hydrogen—particularly through synthetic fuels—is foreseen by 2035 as a viable alternative in the transport sector, requiring investment in dedicated infrastructure.*

The draft Sectoral Energy Plan[17] states that "the impactful actions involve direct interventions in the energy matrix and in production processes, seeking the replacement of fossil fuels, thereby enabling greater use of biofuels, the electrification of hard-to-abate activities, the promotion of renewable energy, and gains in energy efficiency."

To advance the national objectives mentioned above, the document highlights a set of key actions to be developed in the transport sector, including:

- decarbonizing the urban, semi-urban, and metropolitan public transport system;
- decarbonizing urban and long-distance freight transport, the public fleet, and essential service vehicles;
- encouraging the decarbonization of individual motorized transport;
- promoting the use of clean vehicles (electric, hybrid with biofuels) in corporate fleets;
- expanding the use of renewable fuels to replace fossil fuels;

[17] Ministry of the Environment and Climate Change (MMA). (2025). *Climate Plan: Sectoral Energy Plan (Plano Clima: Plano Setorial Energia)*. Available at: https://www.gov.br/mma/pt-br/composicao/smc/plano-clima/psm-energia-documento-na-integra.pdf/. Accessed on July 24, 2025.

- reducing fossil fuel consumption in transport infrastructure and operations; and

- creating regulations to establish greenhouse gas (GHG) emission reduction targets for domestic navigation through increased blending of biofuel into marine fuel.

Therefore, even though the energy sector targets can be criticized—for example, the projected increase of 33% in GHG emissions by 2030 and between 1% and 44% by 2035[18], the National Mitigation Strategy (ENM) brings forward proposals aimed at achieving neutrality by 2050, several of which converge with the guidelines of the report Future of Energy: the Brazilian Climate Observatory's Vision for a Just Transition in Brazil (Futuro da Energia: visão do Observatório do Clima para uma transição justa no Brasil). We understand that Petrobras must align its medium- and long-term strategies and investments with these overarching objectives of the ENM, focusing on the guidelines that bring together the ENM and the OC's vision for the future of energy.

However, Petrobras's 2025–2029 Business Plan[19] projects US$111 billion in investments over the coming years, of which only US$9.1 billion will be allocated to low-carbon energy—an increase of US$2.9 billion compared to the previous business plan, but still far short of what is needed to meet Brazil's goals in this field. This amount includes investments in onshore wind power and solar photovoltaic (PV) power (US$4.3 billion), ethanol (US$2.2 billion), biorefining (US$1.5 billion), biodiesel and biomethane (US$600 million), and hydrogen (US$500 million).

In addition, Petrobras projects cross-cutting investments of around US$16.3 billion for the energy transition, a figure that covers low-carbon energy and activities such as mitigation of Scopes 1 and 2 emissions (US$5.3 billion), research, development and innovation (R&D&I) in low-carbon investments (US$1 billion), and a Decarbonization Fund (US$1.3 billion), among other initiatives.

On the other hand, the document projects investments of US$15.2 billion solely to expand the company's refining capacity, in addition to US$77 billion for oil and gas exploration and production, with the declared objective of replenishing reserves until 2050 through the opening of new exploration frontiers.

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[18] Talanoa Institute. (2025). *National Mitigation Strategy: The Plan Needs to Move Forward (Estratégia Nacional de Mitigação: o plano precisa andar pra frente)*. Available at: https://politicaporinteiro.org/2025/07/21/estrategia-nacional-de-mitigacao-o-plano-precisa-andar-pra-frente/. Accessed on July 24, 2025.

[19] Petrobras. (2025). *Petrobras 2025–2029 Business Plan (Plano de Negócios Petrobras 2025–2029)*. Available at: https://api.mziq.com/mzfilemanager/v2/d/25fdf098-34f5-4608-b7fa-17d60b2de47d/4c9eecc5-c298-081d-799f-217fff1a1c82?origin=2. Accessed on July 24, 2025.

Even though Petrobras acknowledges a decline in global demand for oil and gas by 2050, the company projects more persistent domestic demand for fossil fuels in Brazil, in contrast to the more ambitious long-term objectives of the Climate Plan (Plano Clima).

Therefore, it bears repeating: Petrobras's investments in low-carbon energy and the energy transition, as well as public policies to reduce domestic demand for oil derivatives, remain insufficiently ambitious when compared to Brazil's commitments and, especially, to the decarbonization objectives set forth in international agreements.

> "The investment programs in Low-Carbon Energy must be expanded and their implementation prioritized. They may not reach the same level of return on investment as upstream projects that are declared commercially viable, but they can be profitable and are fundamental to the goals of diversifying the core business and to the role the company can play in addressing the challenges posed by the climate emergency. The joint consideration of this binomial—business profitability and diversification—is important both at the level of the Union (the majority shareholder of Petrobras) and in relation to the company's other shareholders. To this end, it is essential to structure and expand the innovation chain in new fuels, drawing on the experience that Cenpes already has in terms of technological capacity and human resources." — *Key Issues and Strategic Alternatives for Decarbonizing Petrobras's Investment Portfolio (Questões-Chave e Alternativas Estratégicas para Descarbonização do Portfólio de Investimentos da Petrobras)*

Petrobras must accelerate its transformation into a renewable energy company, committed to investments in low-carbon sources and to diversifying its core business. In this context, oil and fossil gas exploration and production should become a decreasing—not leading—share of the investment portfolio, with the aim of meeting a global and domestic demand that is steadily declining for fossil fuels, alongside public policies that reinforce this downward trend.

According to the newspaper Valor Econômico, the company's president, Magda Chambriard, stated that the revitalization of the Campos Basin—one of the priorities outlined in the 2025–2029 Business Plan—"could allow oil extraction over the next 40 to 50 years in volumes similar to what the region has produced to date."[20].

[20] *Valor Econômico. (2024). Petrobras Seeks to Maintain Campos Basin Output for Another 50 Years (Petrobras quer manter nível da Bacia de Campos por mais 50 anos)*. Available at: https://valor.globo.com/empresas/noticia/2024/10/15/petrobras-quer-manter-nivel-da-bacia-de-campos-por-mais-50-anos.ghtml. Accessed on July 24, 2025.

Thus, we advocate that upstream investments be limited to developing production in already discovered reserves, in consolidated basins such as the Campos Basin. We consider it neither desirable nor economically viable to open new production frontiers in previously unexplored areas, particularly in the Equatorial Margin and the Pelotas Basin.

The oil company must also halt investment in new conventional refineries, which are highly capital-intensive and require long maturation periods—a measure that, it should be stressed, must be accompanied by a reduction in domestic demand for derivatives. New investments in this segment should be restricted to projects for decarbonization, modernization, and energy efficiency in operations.

The capital that would otherwise be used for the construction of new refineries and the opening of new exploration frontiers should instead be redirected to expand the share of new fuels in the energy matrix, in line with the National Mitigation Strategy (ENM) and the report *Future of Energy: the Brazilian Climate Observatory's Vision for a Just Transition in Brazil* (*Futuro da Energia: visão do Observatório do Clima para uma transição justa no Brasil*), fostering economies of scale for renewable energy projects.

This redirection of investments should also accelerate the decarbonization of operations and improvements in energy efficiency. The Business Plan foresees a 30% reduction in absolute operational emissions compared to 2015—a target that is insufficiently ambitious and lacks transparency. Moreover, the document reports operational emissions only for 2023—46 million tCO_2e—but does not provide the figure for 2015, the baseline year for the emissions cut, nor the exact number that is meant to be achieved by 2030, limiting itself to pointing to a 30% reduction.

To maintain its economic relevance and its role in shaping Brazil's development, Petrobras must accelerate the decarbonization of its operations while substantially increasing its investments in the energy transition. The energy transition cannot remain a rhetorical figure to justify the continuation of the status quo.

There is room for Petrobras to expand the development of green hydrogen technologies and biofuels—particularly second- and third-generation biofuels, renewable diesel (HVO), and sustainable aviation fuel (SAF)—as well as projects in biorefining, biogas, and biomethane. The company was a pioneer in technological development for offshore and deep-water exploration. It therefore has the capacity to structure an innovation system, as it has done in the past, involving a chain of local suppliers, scientific institutions, and its own research and innovation center (Cenpes).

The use of biofuels in Brazil is already significant—through ethanol and biodiesel—and is expected to increase with the introduction of electric or flex-fuel hybrid engines. Therefore, this system of innovation must also include greater investments to accelerate, together with government-led public policies, the decarbonization of freight logistics and passenger transport.

In addition, Petrobras can—and must—leverage its prior experience to distribute these new fuels directly to end consumers, an activity abandoned after the privatization of BR Distribuidora and which, fortunately, the company's current management is considering resuming, as reported by Bloomberg[21]. This resumption of distribution should also include electric vehicle charging stations, which would contribute to the transition in the transport sector and position the company in a new market.

While declining oil demand is expected to impact international oil prices and reduce the profitability of oil companies, among other challenges, increasing the allocation of investments in new technological activities could provide a more secure financial return for Petrobras in the future, creating the conditions for the company to remain influential in shaping the country's trajectory and at the forefront of global technological leadership.

[21] Bloomberg. (2025). *Petrobras Considers Returning to Fuel Distribution (Petrobras cogita retornar à distribuição de combustível)*. Available at: https://www.bloomberg.com/news/articles/2025-07-16/petrobras-cogita-retornar-a-distribuicao-de-combustivel-fonte. Accessed on July 24, 2025.

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RESPONSIBILITIES OF THE STATE

Petrobras's energy transition will only become a reality if it is driven by a State-led climate policy, which must, in turn, result in a State-led energy policy. It is therefore the responsibility of the competent authorities to define sectoral policy guidelines (for energy, environment, industry, and technology) that provide clear signals for reducing fossil fuel demand among both the population and companies.

Thus, it is the role of public policies promoted by the Brazilian State—particularly the federal government and the National Congress, but also state governments, municipalities, and their respective legislative bodies—to bring down domestic demand for oil and gas derivatives, with Petrobras being required to adapt its business model to this decline in demand.

> "It is essential, on the part of the Brazilian State, to have a clear and non-conflicting definition of sectoral policy guidelines (energy, environment, industry, and technology) that sets a horizon for reducing fossil fuel demand. Without a clearer policy compass to be followed by companies across the entire value chain of the oil and refined products industry, the effective implementation of the government actions announced in 2024—such as the National Energy Transition Policy, the Ecological Transformation Plan (ETP), and the Fuel of the Future Program (Combustível do Futuro)—is at serious risk of failing to translate into concrete results." — *Key Issues and Strategic Alternatives for Decarbonizing Petrobras's Investment Portfolio (Questões-Chave e Alternativas Estratégicas para Descarbonização do Portfólio de Investimentos da Petrobras)*

Among other considerations, it should be noted that the company's planned investments in new conventional refineries will only be discontinued if there is a forecast of a decline in domestic demand for oil derivatives, in line with what is projected globally. To date, the Energy Research Office (EPE), linked to the Ministry of Mines and Energy (MME), projects an increase in demand, which justifies Petrobras's current investments.

As mentioned above, the National Mitigation Strategy (ENM) sets out important objectives and initiatives to promote decarbonization in the transport and energy sectors; however, there are gaps that slow this process and, paradoxically, encourage the continued production of fossil fuels. It should be noted that among the problematic points are the projections in the Sectoral Energy Plan that forms part of the Climate Plan (Plano Clima): an increase of 33% in greenhouse gas (GHG) emissions in the energy sector by 2030 and between 1% and 44% by 2035.

Furthermore, fossil gas is still mistakenly treated in the Climate Plan proposal as a transitional or low-carbon fuel. In *Future of Energy*, the understanding is that fossil gas "should be ruled out as a transition source in both the power sector and industry, and its production should be limited to

meeting needs in cases where no technological substitution is possible, such as in the fertilizer sector or the chemical industry, in addition to ensuring electricity supply in the event of hydrological stress."

This means that fossil gas-fired thermal power plants—Petrobras owns 13 and plans to build two more at the Boaventura Energy Complex (RJ)[22] — should be restricted and dispatched only when necessary. Moreover, fossil gas consumption should be gradually reduced both in households and in the chemical, cement, and food industries, among others.

It is also worth highlighting, among the guidelines advocated in *Future of Energy: the Brazilian Climate Observatory's Vision for a Just Transition in Brazil*, the elimination of government subsidies for fossil fuel production, with the redirection of these resources to support a just energy transition.

According to a study by the Institute for Socioeconomic Studies (INESC), federal subsidies for the production and consumption of oil, fossil gas, and coal reached R$ 81.74 billion in 2023. It should be noted that most incentives stem from special tax regimes which, when they take the form of tax expenditures, reduce the tax base and, consequently, the resources available for investments in public policies, including those for climate change mitigation and adaptation[23]. In turn, renewable energy received almost five times fewer incentives from the Brazilian government, according to the same study.

While it is essential to reduce subsidies for fossil fuel production, those related to consumption—especially diesel and liquefied petroleum gas (LPG)—must be handled carefully so as not to penalize the most vulnerable segments of the population.

Oil and fossil gas revenues—the non-fiscal portion from royalties, special participation payments, and signature bonuses—constitute another significant incentive for fossil fuel production, in addition to creating dependency among states and municipalities on income from extraction. However, in 2024, only 0.16% of these revenues were directed to environmental and climate actions[24].

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[22] Petrobras. (2025). *Petrobras 2025–2029 Business Plan (Plano de Negócios Petrobras 2025–2029)*. Available at: https://api.mziq.com/mzfilemanager/v2/d/25fdf098-34f5-4608-b7fa-17d60b2de47d/4c9eecc5-c298-081d-799f-217fff1a1c82?origin=2. Accessed on July 24, 2025.

[23] Institute for Socioeconomic Studies (INESC). (2023). *Monitoring of Subsidies for Fossil and Renewable Energy Sources: 2022–2023 (Monitoramento de Subsídios às Fontes Fósseis e Renováveis: 2022–2023)*. Available at: https://inesc.org.br/subsidios-fontes-energeticas-2023/. Accessed on August 19, 2025.

[24] Institute for Socioeconomic Studies (INESC). (2025). *Oil Revenues in Brazil: Challenges, Contradictions, and Pathways to Overcome the Fossil Era (Renda do petróleo no Brasil: desafios, contradições e caminhos para a superação da era fóssil)*. Available at: https://inesc.org.br/renda-do-petroleo-no-brasil-desafios-contradicoes-e-caminhos-para-a-superacao-da-era-fossil/. Accessed on August 16, 2025.

The cases of the state of Rio de Janeiro and the cities along its northern coast, beneficiaries of production in the Campos Basin, are emblematic: uncontrolled public spending and tax exemptions surged in the wake of increased royalty revenues in the mid-2000s. Originally intended as a financial compensation mechanism for states and municipalities for the negative externalities of hydrocarbon production, these royalties did little to serve as investments in education, technology, or the building of public savings[25].

However, in the debate over expanding the exploration frontier in the Equatorial Margin, what is observed is political pressure for drilling at any cost, overriding even the technical requirements of environmental licensing by the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA). This is not about job creation or bringing development to places such as the state of Amapá, one of the interested parties in the exploration, since the oil and gas sector is not labor-intensive and will rely primarily on qualified professionals from other states—not to mention that Petrobras plans to concentrate operations in Pará.

> "Petrobras—and the oil and natural gas sector as a whole—cannot be regarded as mere instruments to solve the macroeconomic problem that encompasses the country's fiscal issue. Notwithstanding the importance of the financial resources collected through royalties, taxes, and other government levies, it is important to recall the risk associated with the dependence of public administrations (federal, state, and municipal), given that oil activity is characterized by the extraction of exhaustible resources whose prices are extremely volatile. These aspects point to the need to improve the allocation of financial resources that will remain relevant for a long time." — *Key Issues and Strategic Alternatives for Decarbonizing Petrobras's Investment Portfolio (Questões-Chave e Alternativas Estratégicas para Descarbonização do Portfólio de Investimentos da Petrobras)*

The dividends of Petrobras—and of other state-owned enterprises—distributed to the Federal Government (União) are governed by Law No. 9,530/199726[26], which provides for allocating these resources to the amortization of the public debt. Therefore, the claim that the income from the oil

[25] Eixos. (2023). *Oil and the Dutch Disease in Rio de Janeiro (O petróleo e a doença holandesa no Rio de Janeiro)*. Available at: https://eixos.com.br/politica/o-petroleo-e-a-doenca-holandesa-no-rio-de-janeiro/. Accessed on July 24, 2025.

[26] Brazil. (1997). *Law No. 9,530, of December 10, 1997 (Lei nº 9.530, de 10 de dezembro de 1997)*. Available at: https://www.planalto.gov.br/ccivil_03/leis/l9530.htm. Accessed on July 24, 2025. Tesouro Transparente. (n.d.). *How the Government Pays the Public Debt – Part 2 (Como o governo paga a Dívida Pública – parte 2)*. Available at: https://www.tesourotransparente.gov.br/videos/a-divida-em-videos/6-como-o-governo-paga-a-divida-parte-2.pdf. Accessed on July 24, 2025.

company's activities will fund the energy transition or expand resources for public policies in health, education, and the environment is tenuous.

Changes in this regard should be on the authorities' radar if they wish to make good on the promise that oil revenues will finance the energy transition. Even so, it is worth emphasizing that the resources to be allocated to financing the energy transition must be tied to the reserves currently being exploited. It is not reasonable to use the need to decarbonize our energy matrix to justify expanding the exploration frontier for oil and gas. On this misguided path, the very problem that the energy transition needs to tackle is progressively exacerbated.

Lastly, given the relevance of biofuels to the energy transition—and the history of severe social and environmental impacts associated with their production—the Brazilian State must create, promote, and ensure the implementation and continuous application of socio-environmental safeguards for the expansion of bioenergy in Brazil, in partnership with organizations representing affected communities, academia, and civil society organizations active on the topic.

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CONCLUSIONS

The Brazilian Climate Observatory (OC) proceeds from the premise that Petrobras is an important national asset, given its role in Brazil's economic development, its technological excellence, and the expertise of its workforce. Accordingly, the country's energy transition must not take place on the margins of the company's activities. On the contrary, the OC and the organizations that make up its Energy and Climate Working Group recognize the company's importance, its market value, and its standing with Brazilian society—and they want a Petrobras that is engaged, aligned with national objectives, and acting as a cornerstone of the solutions to advance Brazil's energy transition.

To that end, change is required. The climate emergency demands planning and engagement over the coming decades. The policy of recent years—prioritizing the payment of high short-term dividends—must be replaced. Moreover, this short-term view may quickly become unsustainable, given the expected decline in global oil demand from 2030 onward, and this outlook should also be taken into account by the company's investors. We need energy to meet our growing demand, but we need a different kind of energy. Petrobras must review its future priorities, aligning its targets and business model with Brazil's and the world's objectives for decarbonizing the sector.

> "The increasing risk of a future contraction in demand for fossil fuels resulting from the implementation of international agreements already concluded by countries—which require rapid and significant reductions in greenhouse gas (GHG) emissions—must be incorporated into the company's planning and decision-making. Otherwise, it faces substantial future losses from stranded assets in activities that will conflict with the carbon budget constrained by climate policy, which will be all the more stringent the longer the energy transition is delayed." — *Key Issues and Strategic Alternatives for Decarbonizing Petrobras's Investment Portfolio (Questões-Chave e Alternativas Estratégicas para Descarbonização do Portfólio de Investimentos da Petrobras)*

The company must therefore expand its investment portfolio so that oil and gas account for an ever-smaller share of the business, rather than its sole focus. We need a Petrobras engaged in research, development, and innovation in biofuels and low-carbon hydrogen; that resumes investing in distribution and charging terminals for end consumers—whether by reacquiring BR Distribuidora or creating a new structure; and that maintains its public and national character.

Among the main points advocated, the following stand out:

- align Petrobras's business plan with the more ambitious objectives of the Paris Agreement, Brazil's Nationally Determined Contribution (NDC), and the National Mitigation Strategy (Climate Plan), as a minimum requirement—ideally going beyond these targets by implementing

government environmental policies that foster the low-carbon economy and promote a just energy transition;

- give priority to investments in low-carbon sources, in order to diversify the company's core business;
- reallocate investments planned for new refineries to expand the share of new fuels in the energy matrix, which should be linked to the reduction in domestic demand for oil and gas derivatives;
- pursue a real reduction in the company's greenhouse gas (GHG) emissions from operations, without relying on low-impact measures such as the purchase of carbon credits and carbon capture technologies;
- leverage experience to invest in biofuels—especially second- and third-generation fuels—renewable diesel (HVO) and sustainable aviation fuel (SAF); and
- support the decarbonization of freight logistics and passenger transport.

Technical details on these and other measures can be found in the annexes below.

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ANNEX 1 - PETROBRAS AND CLIMATE CHANGE

Petrobras must align its strategic plan for the coming years and its medium- and long-term business model with the following premises, already consolidated at the international and domestic levels:

- climate change worldwide is caused mainly by the combustion of fossil fuels (coal and oil and gas derivatives);
- the world must limit warming to 1.5°C above pre-industrial levels, as set forth in the Paris Agreement, ratified by 194 countries, including Brazil, as well as the European Union (EU);
- the ongoing global energy transition will lead to a decline in global oil demand starting in 2030, according to the International Energy Agency (IEA), which should impact its international price and render unviable investments that require long lead times to yield returns, such as new refineries and the opening of new exploration frontiers;
- Brazil's commitment to reduce its net greenhouse gas (GHG) emissions by 59% to 67% by 2035 compared to 2005 levels—equivalent to reaching between 850 million and 1.05 billion tCO_2e (with efforts toward the more ambitious end of the range);
- the Brazilian strategy, set out in the proposal for its National Mitigation Strategy (Climate Plan/ Plano Clima), to "expand sustainable biofuel production, promote technological innovation, and develop value chains related to bioenergy," in addition to "encouraging the replacement of fossil fuels by promoting the development and efficient use of sustainable biofuels, electrification solutions, and low-carbon hydrogen."

In addition to what is already consolidated above, the Brazilian Climate Observatory understands that it is possible to go beyond the commitments already undertaken by the Brazilian government, as recorded in the report *Future of Energy: the Brazilian Climate Observatory's Vision for a Just Transition in Brazil* (*Futuro da Energia: visão do Observatório do Clima para uma transição justa no Brasil*) and in the OC's proposal for a new Brazilian NDC.

This means that Petrobras can be even more ambitious than the Brazilian government itself and help the country become the first major economy in the world to sequester more greenhouse gases (GHG) than it emits, becoming carbon-negative by 2045.

Brazil has the capacity to become an environmental and energy powerhouse with strong contributions from Petrobras. To this end, we advocate as a guiding objective the commitment to reduce net emissions by 92% by 2035 relative to 2005 levels—from 2.44 billion tonnes of CO_2e to around 200 $MtCO_2e$.

In the long term, the report *Future of Energy: the Brazilian Climate Observatory's Vision for a Just Transition in Brazil* (*Futuro da Energia: visão do Observatório do Clima para uma transição justa no Brasil*) shows that it is possible—considering average GDP growth of 2.1% per year, which translates into increased energy demand—for Brazil's energy sector to reach 2050 emitting around 102 $MtCO_2e$, a figure that corresponds to roughly 80% less than the sector emitted in 2022.

Emission Reductions Advocated by the Brazilian Climate Observatory (OC) for Energy Sector Activities		
Activities	**2022 (SEEG)**	**2050**
Freight transport	116.1 $MtCO_2e$	38.3 $MtCO_2e$
Passenger transport	101.8 $MtCO_2e$	16.4 $MtCO_2e$
Fuel production	42.5 $MtCO_2e$	14.4 $MtCO_2e$
Metallurgical industry	55.4 $MtCO_2e$	5.4 $MtCO_2e$
Chemical, cement, food, and other industries	52 $MtCO_2e$	9.2 $MtCO_2e$
Electricity generation	44 $MtCO_2e$	2.7 $MtCO_2e$
Buildings	29.8 $MtCO_2e$	6.6 $MtCO_2e$
Agriculture (energy consumption)	21.3 $MtCO_2e$	9.1 $MtCO_2e$
Total	462.9 $MtCO_2e$	102.1 $MtCO_2e$

Table 1 - ***Emission reductions advocated by OC in energy sector activities, 2022–2050.*** *Source: Future of Energy/OC.*

Residual emissions can be offset through a strategy of biome preservation and the intensification of low-carbon agriculture, enabling the country to capture more carbon from the atmosphere than it emits.

It is possible to reach the figures above based on the commitments and guidelines proposed in the Brazilian Climate Observatory (OC) study—each extensively debated and deemed appropriate, technically feasible, and robust. To that end, the starting point—that is, the minimum expected—must be Petrobras's alignment with the National Objectives of the National Mitigation Strategy (ENM), as set out in the document submitted for public consultation.

The commitments advocated by the OC converge with 11 of the 12 National Objectives of the National Mitigation Strategy—the exception is item 7, which addresses the development of carbon capture, utilization, and storage (CCUS) technologies[27].

National Objectives of the proposed National Mitigation Strategy (ENM)
Ensure the integrity of national biomes through the conservation, restoration, and sustainable use of their ecosystems.
Promote the broad adoption of sustainable, low-greenhouse-gas (GHG) agricultural and livestock production models, ensuring food security for all.
Expand sustainable biofuel production, promote technological innovation, and develop value chains related to bioenergy.
Increase the share of clean, renewable technologies and sources in the national energy matrix, ensuring energy security and accessibility for all.
Encourage the replacement of fossil fuels by promoting the development and efficient use of sustainable biofuels, electrification solutions, and low-carbon hydrogen.
Promote circularity through the sustainable and efficient use of natural resources and energy efficiency along production chains.
Build capacity for and encourage subnational entities to adopt integrated, sustainable urban development and climate-action strategies aligned with national guidelines.
Generate jobs, income, and productive inclusion in economic activities related to decarbonizing the economy and sustainable development, promoting a just, inclusive, and sustainable socioeconomic transition.
Turn Brazil's comparative advantages into competitive advantages, making the country a provider of goods, services, and climate solutions for a world transitioning to low-carbon development models.
Undertake specific actions to mitigate high-impact non-CO□ pollutants that drive global warming.
Prioritize mitigation measures with the potential to generate co-benefits for climate-change adaptation and resilience and for sustainable development.

*Table 2 - **ENM proposal for the national objectives**. Available at: https://www.gov.br/mma/pt-br/composicao/smc/plano-clima/enm_consolidada-vsubex-final-10-07-25-limpa-1-1.pdf/. Source: MMA/ENM*

[27] The National Objective 7 of the National Mitigation Strategy (ENM) provides for "leveraging innovative, low-carbon solutions in domestic industrial production and developing carbon capture, utilization, and storage technologies (CCUS) in industrial and bioenergy production and in fossil fuel production sectors." The Brazilian Climate Observatory disagrees with the portion concerning the development of CCUS technologies—especially in fossil fuel production sectors—on the grounds that it is a palliative measure with limited structuring effect.

Petrobras must also take into account, as already mentioned, the more ambitious priorities and actions for transport, energy, industry, and urban mobility, among other activities, advocated by the National Mitigation Strategy (ENM) to achieve the objectives above.

It should be noted that the Climate Plan (Plano Clima) has not yet been finalized and that the version of the Sectoral Energy Plan (Plano Setorial de Energia) released presents gaps regarding important aspects of decarbonization, especially with respect to reducing oil exploration. Even so, the ENM sets out relevant priorities. By way of example, the priorities related to transport from the Sectoral Transport Plan (Plano Setorial de Transportes) are presented below.

ENM Proposal for Transport Priorities
Induce technological and industrial development applied to e-mobility and to the use of renewable, low-carbon alternative fuels, considering key issues such as the development of new biofuels, more efficient domestically developed batteries, solutions for battery reuse and disposal, and charging points.
Promote greater use of sustainable, low-carbon-intensity fuels, encouraging the development of domestic road, inland waterway, maritime, and aeronautical vehicle technology, and improving the energy efficiency of vehicles, vessels, and aircraft.
Improve, strengthen, and diversify low-carbon logistics infrastructure, promoting multimodality through efforts to expand and adapt transport networks across different modes, with a view to greater intermodal integration and higher efficiency in passenger and freight transport nationwide.
Establish and implement vehicular emission limits in accordance with national air quality standards, contributing to decarbonization and the reduction of local pollutants.
Encourage the transition to more efficient, sustainable, and lower-carbon modes of freight and passenger transport.
Improve the quality of transport infrastructure to increase energy-use efficiency and, consequently, reduce greenhouse gas (GHG) emissions.
Encourage the transition to more efficient, sustainable, and lower-carbon modes of freight and passenger transport.
Improve the quality of transport infrastructure to increase energy-use efficiency and, consequently, reduce greenhouse gas (GHG) emissions.

*Table 3 - **ENM proposal for transport**. Available at: https://www.gov.br/mma/pt-br/composicao/smc/plano-clima/psm-transportes-documento-na-integra.pdf/. Source: MMA/ENM*

We therefore contend that Petrobras should go beyond what is set out in the Climate Plan (Plano Clima) and align itself with the guidelines of *Future of Energy: the Brazilian Climate Observatory's Vision for a Just Transition in Brazil* (*Futuro da Energia: visão do Observatório do Clima para uma transição justa no Brasil*), notably:

- transforming Petrobras into an energy company—not merely an oil company—with a focus on developing new businesses, the progressive reduction of oil production, and material investment in low-carbon sources, through strategies that ensure the company's market value is preserved;

- designating exclusion zones in sensitive areas and, consequently, eliminating new oil ventures in the Equatorial Margin and the Pelotas Basin;

- increasing investment in biofuels, with proper environmental oversight and all necessary socio-environmental safeguards in place for projects;

- decommissioning oil fields that have already reached the end of their planned service life, without outsourcing this commitment to smaller companies with limited capacity;

- adopting the approach of meeting domestic oil demand by strategically using areas that have already been explored and calculating the minimum necessary oil production for the coming years, so as to gradually reduce extraction intensity across operating blocks and maintain residual production aimed at domestic activities that cannot fully substitute oil and derivatives.

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ANNEX 2 - COMPANY STRUCTURE AND GOVERNANCE

A public company

In its process of transforming into a company that prioritizes the energy transition and significantly diversifies its investment portfolio, Petrobras must remain a public company identified with the nation's interests. From this perspective, several relevant issues debated by the Unified Federation of Oil Workers (FUP – Federação Única dos Petroleiros) and other labor organizations in the sector merit attention.

During the years of backsliding under President Jair Bolsonaro (2019–2023), Petrobras became a company focused almost exclusively on oil, specializing in deep-water extraction. To that end, it sold important assets—such as BR Distribuidora—and intensified a market-driven logic of monthly dividend distribution, in addition to extraordinary dividends. In this period, dividend payouts rose from US$1.3 billion in 2020 to US$37.7 billion in 2022. And even today they remain at elevated levels: in 2024, more than US$18 billion were distributed despite a consolidated net profit of US$7.5 billion for the year[28].

At present, any questioning of this role generates market turbulence and causes the company's share price to plunge. And although the Federal Government (União) is the company's majority shareholder, interventions and challenges by the government to the company's internal policies—especially its pricing policy—are pointed to by market actors and opinion-makers as something necessarily inappropriate and undesirable, regardless of the content and results of government actions.

This is irrational. The debate on Petrobras's direction as a public company must be reopened. Reducing Petrobras to a mere dividend distributor does not do justice to its size, its history, its expertise, or its strategic importance for Brazil's development.

Research, Development & Innovation (R&D&I)

It is worth questioning whether the constant distribution of dividends in any way affects the funding allocated to research and investment. The amount earmarked for Research, Development & Innovation (R&D&I) in low-carbon sources through 2029 is only R$ 1 billion, according to the 2025–2029 Strategic Plan. This sum falls far short of what is needed for Petrobras's future challenges and for the role the company can—and should—play in Brazil's economic and energy development.

[28] Petrobras. (2025). *Presentations, Reports, and Events (Apresentação, relatórios e eventos)*. Available at: https://www.investidorpetrobras.com.br/apresentacoes-relatorios-e-eventos/relatorios-anuais/. Accessed on August 24, 2025.

The Petrobras we need must mobilize a technological value chain to achieve its objectives. To this end, it should redefine the R&D&I division so as to reclaim its vocation to be a multi-energy company, rather than remaining restricted to a single source.

The company has had its own center of excellence since 1963: the Leopoldo Américo Miguez de Mello Research, Development and Innovation Center (Cenpes), which the company describes as one of the largest applied-research complexes in the world. For this to be the case, this important arm of research and innovation must be strengthened with resources and refocused on low-carbon technologies, especially in the biofuels and low-carbon hydrogen sectors.

Petrobras should not become merely a renewable energy company, but rather a renewable energy company with innovation.

Transparency

Petrobras's transformation into a renewable energy company with an innovation focus must be carried out with the utmost transparency to society. It is understandable that the company wishes to protect its business from competitors and therefore keep some information confidential. On the other hand, Petrobras must step up its accountability to society—not only to its shareholders—regarding the nature of its investments and the detailed emissions from its operations, among other information. It is unacceptable for the company to lag behind privately owned oil companies in terms of transparency.

Tools and access channels must be created so that society can monitor and verify the emissions of each Petrobras operation, as well as hold the company to account for investments aimed at progressively decarbonizing its operations and products, together with the respective results.

In short, Petrobras's engagement with the energy transition must be based on clear targets and commitments within a timeline for decarbonizing its operations and business model; and the outcomes of this process must be public and transparent, so that society can assess the results of each initiative and venture undertaken by the company.

Greener Executive Board and Board of Directors

Petrobras currently has an executive department focused on energy transition and sustainability, but this theme should be cross-cutting across all areas of the company. To this end, top-level posts—especially the executive leadership and the Board of Directors—should have a greener composition. Priority should be given to appointing managers with expertise in the energy transition and the low-carbon economy, as well as in engagement with public policy. In addition to shareholder nominations, these positions can also be filled with greater participation from workers and civil society.

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ANNEX 3 - PETROBRAS'S INVESTMENT PLANS AND THE RESULTS OF THE 5TH PERMANENT CONCESSION OFFER CYCLE (OPC)

Petrobras, one of the world's largest oil and gas producers, keeps its operations heavily concentrated in the pre-salt layer, but to some extent has sought to expand investments in low-carbon projects in response to pressures from the energy transition.

Since 2020, the company has created internal structures specifically to address climate change and has gradually increased the share of investments in sustainable initiatives, rising from US$2.8 billion in the 2022–2026 Strategic Plan to US$16.3 billion in the 2025–2029 plan, which represents 15% of total planned outlays.

These resources include actions to decarbonize operations (US$5.3 billion); investments in low-carbon energy (US$9.1 billion), with funding for onshore wind power and solar photovoltaic (PV) power (US$4.3 billion), hydrogen (US$500 million), ethanol (US$2.2 billion), biorefining (US$1.5 billion), biodiesel and biomethane (US$600 million); as well as carbon capture and storage (CCUS) and R&D&I projects[29].

Despite the significant increase in the amounts announced, execution remains very limited: in 2023, only US$483.3 million were actually invested in initiatives for operational decarbonization, biorefining, and low-carbon R&D&[30]; in 2024, the figure rose to an insufficient US$600 million[31]. The strategy is presented as "profitable diversification," seeking to balance maintaining leadership in oil and gas with a gradual entry into new segments, although the "last to remain" logic in fossil exploration is still expressed in the centrality of the pre-salt in the investment portfolio. This scenario shows that, although Petrobras has taken steps toward the energy transition, its pace and scale of execution remain below the urgency indicated by scientists and by the global commitment to carbon neutrality by 2050.

In the 5th Permanent Concession Offer Cycle (OPC) of the Brazilian National Agency for Petroleum, Natural Gas and Biofuels (ANP), Petrobras played a significant role, especially in strategic consortia. However, part of these blocks are located in areas of high socio-environmental sensitivity, including fishing grounds and carbonate reefs, which may create legal and environmental risks and heighten challenges for licensing and the future viability of the projects.

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[29] Petrobras. (2024). *Sustainability Report 2024 (Relatório de Sustentabilidade 2024), p. 62*. Available at: https://sustentabilidade.petrobras.com.br/documents/1449993/35174516/PETROBRAS_RA_SUST24_FINAL_red.pdf/6b8a7806-923e-a372-81e9-08ce6f969521. Accessed on August 22, 2025.

[30] Petrobras. (2024). *Climate Notebook – 2024 (Caderno de Clima – 2024), p. 68*. Available at: https://issuu.com/estantepetrobras/docs/petrobras_caderno_clima_2024. Accessed on August 22, 2025.

[31] Petrobras. (2025). *Climate Change Notebook – 2025 (Caderno de Mudança do Clima – 2025), p. 98*. Available at: https://issuu.com/estantepetrobras/docs/caderno_de_mudan_a_do_clima_-_2025. Accessed on August 22, 2025.

In the Foz do Amazonas Basin, in partnership with ExxonMobil, the company secured blocks with expectations of high exploratory potential, investing R$ 141.49 million as the operator. In other cases, with ExxonMobil leading the consortium, it invested another R$ 120.59 million, totaling around R$ 262 million in signature bonuses in the region.

In the Pelotas Basin, the consortium formed by Petrobras and Petrogal Brasil was the only bidder, resulting in the acquisition of three blocks in sector SP-AUP3, with an outlay of R$ 11.46 million.

As shown below, in Figure 1, Petrobras ranks first in participation among the winners of the awarded blocks, trailing only the Chevron/CNPC consortium in terms of bonuses paid.

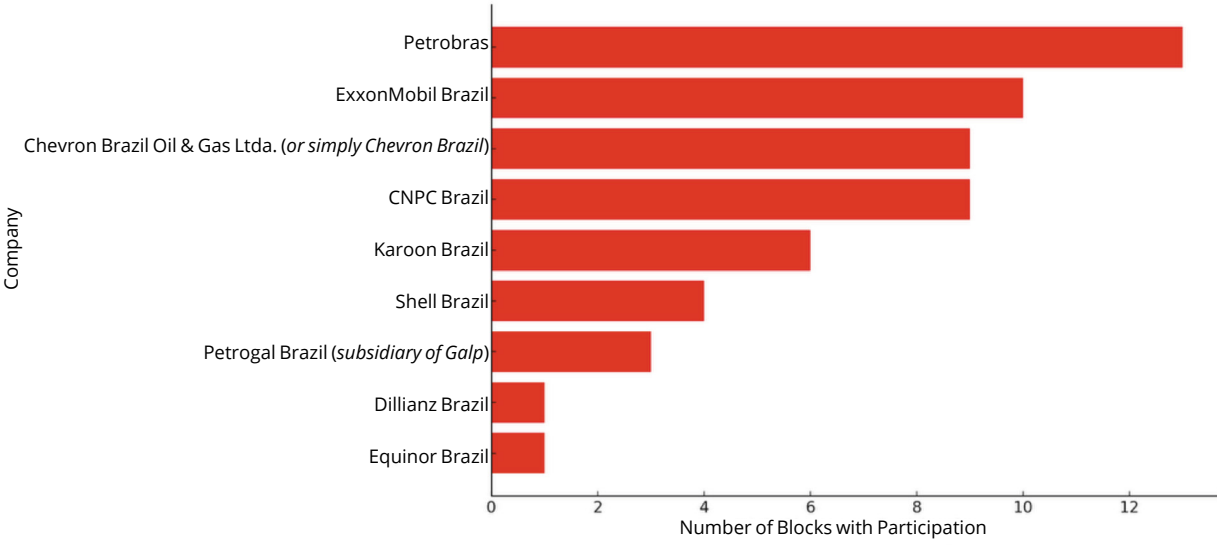

Figure 1- ***Companies' participation in awarded blocks****. Source: ARAYARA International Institute.*

From the results of the 5th OPC Cycle, it is observed that, notwithstanding Petrobras's plans showing a growing emphasis in discourse and planning around the low-carbon economy, structural contradictions still limit the effectiveness of this transition.

If the state-owned company truly intends to lead a consistent transition, several strategic paths are imperative. First, it must adopt robust portfolio-substitution targets, with clear deadlines for increasing the share of renewables, biofuels, and low-carbon hydrogen in operating revenue. This effort should include technological and industrial partnerships that enhance competitiveness.

Second, the budget execution rate must be increased, ensuring that the announced resources are effectively allocated to low-carbon projects with measurable impact.

In addition, Petrobras needs to internalize climate performance indicators (KPIs) to inform investment decisions, aligning with 1.5°C-consistent scenarios, as recommended by the International Energy Agency (IEA). This entails assessing not only economic returns but also the carbon cost and the medium-term risk of stranded assets.

Finally, it is essential to integrate the low-carbon strategy with national public policies, contributing to a sectoral energy transition plan that fosters green jobs and economic resilience, rather than reproducing dependence on fossil commodities.

Therefore, Petrobras's challenge is not merely to increase investments, but to do so differently: to direct its business toward clean sectors, ensuring that its technical, financial, and logistical capacity serves as a lever for real transformation—rather than merely prolonging the oil cycle under the label of a "transition."

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ANNEX 4 - JUST TRANSITION WITH SOCIO-ENVIRONMENTAL SAFEGUARDS

The energy transition must not reproduce—under the pretext of mitigating climate change—predatory models of exploitation that generate socio-environmental impacts, such as deforestation and the forced displacement of communities, among others. In addition, it must be committed to combating energy poverty and energy injustice, which still persist in Brazil. Petrobras needs to be aligned with these aims.

The study *Future of Energy: the Brazilian Climate Observatory's Vision for a Just Transition in Brazil* (*Futuro da Energia: visão do Observatório do Clima para uma transição justa no Brasil*) lists some of these risks and proposes safeguards to prevent such undesirable impacts. To this end, it adopts the premise that the energy transition must be just and feature broad participation by affected communities, as well as be guided by a more robust regulatory framework capable of addressing current challenges.

Recognizing the importance of biofuels, the document notes that "the mass production of ethanol, biodiesel, and other forms of bioenergy may exert environmental pressure," as well as "cause further deforestation and excessive water use, in addition to bringing impacts on soils due to extensive monoculture."

The risk is that the positive effects of adopting biofuels will be nullified by increased deforestation and other problems. Thus, the OC advocates the following minimum socio-environmental safeguards for biofuel production:

- control over the areas and resources to be employed in producing biofuels;
- the definition and regulation of exclusion zones, such as the Amazon Rainforest;
- prioritization of already degraded areas—without water stress—for planting sugarcane, soybeans, corn, and other feedstocks; and
- assurance of controls over environmental impacts and negative impacts on local communities.

Although it is not involved in the first stage of biofuel production—that is, the cultivation of feedstocks—Petrobras must assume responsibility and ensure that its production and supply chains are not involved in deforestation, illegal land grabs, or labor in conditions analogous to slavery, among other unlawful activities.

To this end, the company's guidelines must be continually reviewed and strengthened to avoid oversight and implementation failures in its business model that could result in perverse effects.

The same care must be taken in the development of low-carbon hydrogen, produced exclusively from renewables, considering a maximum carbon intensity of 2 $kgCO_2/kgH_2$. The question is whether these renewable sources—such as wind farms and solar plants, for example—are causing undesirable socio-environmental impacts. These problems must be addressed vigorously. In addition, the Brazilian Climate Observatory advocates that hydrogen should be produced without the use of freshwater, opting instead for reused water or even desalinated water.

Taking these safeguards seriously can also yield a positive economic outcome for Petrobras: greater competitiveness of its products in international trade. It is worth recalling that deforestation is one of the reasons raised by the European Union (EU) for blocking the import of biofuels.

Accordingly, Petrobras should allocate a larger share of its revenues to combating deforestation and promoting low-carbon agriculture. The company already has a small contribution to the Amazon Fund, but its involvement in combating deforestation should be greater. This can occur, for example, through economic solutions such as Payment for Environmental Services (PES) initiatives in which the company participates.

Petrobras must also align itself with other general measures to mitigate the socio-environmental impacts of renewables proposed in the *Future of Energy study*, including:

- environmental licensing processes must be more structured and careful, prioritizing conservation and reducing the impacts caused by new projects;
- socio-environmental and territorial safeguards must be established not only within licensing, with mechanisms for risk monitoring and control and for ensuring the fulfillment of rights;
- public authorities must map socially and environmentally sensitive areas for the deployment of renewable energy projects, establishing exclusion zones and buffer zones around protected or inhabited areas; and
- land regularization must be accelerated in territories that are in a legal limbo, so as to guarantee the rights of local populations.

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ANNEX 5 - TECHNOLOGICAL PATHWAYS FOR BIOFUELS

Bioenergy is increasingly embedded in Brazil's economy—the world's second-largest producer of biofuels, behind only the United States. The *National Energy Balance 2025* (*Balanço Energético Nacional 2025*)[32], produced by the Energy Research Office (EPE), linked to the Ministry of Mines and Energy (MME), presents figures that demonstrate this growing importance:

- bioenergy accounts for 33.3% of the total energy supplied in the national energy matrix;
- ethanol and biodiesel together account for more than 25% of the energy used in transport;
- industry (40%), transport (24%), fuel production (13%), and electricity generation (11%) are the activities with the highest demand for biofuels;
- industry has reached 64.4% renewability in its energy matrix thanks mainly to sugarcane bagasse—associated with the food and beverages sector—black liquor (pulp and paper industry), and charcoal.

According to the 2023 *Biofuels Market Analysis* (*Análise de Conjuntura dos Biocombustíveis 2023*), also published by EPE[33], 84.5% of the fleet of 40 million light vehicles have flex-fuel technology—that is, they can run on either gasoline or ethanol—which boosts the production of this biofuel in Brazil.

The study also reports that Brazilian ethanol production reached 35.3 billion liters in 2023—29.5 billion from sugarcane and 5.8 billion from corn—an increase of 15.4% compared to the previous year. The arrival on the market of flex-fuel hybrid vehicles, which combine an electric motor with a combustion engine, should maintain ethanol's relevance in the light-vehicle segment.

In parallel, Brazil has been betting on biodiesel, blended into diesel, for heavy-duty vehicles. Produced primarily from soybeans—69% of the total—its output was 7.5 billion liters in 2023, a 19% increase over the previous year, according to the EPE report.

It should be noted that, according to the same document, the emissions avoided through the use of sugarcane and corn ethanol and biodiesel were 63.1 million tCO_2e and 21.1 million tCO_2e, respectively.

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[32] Energy Research Office (EPE). (2025). *National Energy Balance 2025 (Balanço Energético Nacional 2025)*. Available at: https://www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/balanco-energetico-nacional-2025. Accessed on August 4, 2025.

[33] Energy Research Office (EPE). (2024). *2023 Biofuels Market Analysis (Análise de Conjuntura dos Biocombustíveis 2023)*. 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 July 9, 2025.

Given this high degree of integration into Brazil's economy—together with the high productivity afforded by the country's edaphoclimatic conditions and its stock of available arable land—Brazil's energy transition strategy involves expanding the supply and consumption of biofuels.

The report *Future of Energy: the Brazilian Climate Observatory's Vision for a Just Transition in Brazil* (*Futuro da Energia: visão do Observatório do Clima para uma transição justa no Brasil*) argues that this expansion must take place without driving new deforestation of natural vegetation cover. According to MapBiomas data[34], there are roughly 105 million hectares of pastureland with medium and low vigor—that is, degraded—in Brazil.

Considering average annual growth of 2.1% and the guidelines advocated in the study for a just transition in Brazil, biofuel demand in the country would grow in the proportion shown below in Figure 2, according to calculations by the Institute for Energy and Environment (IEMA).

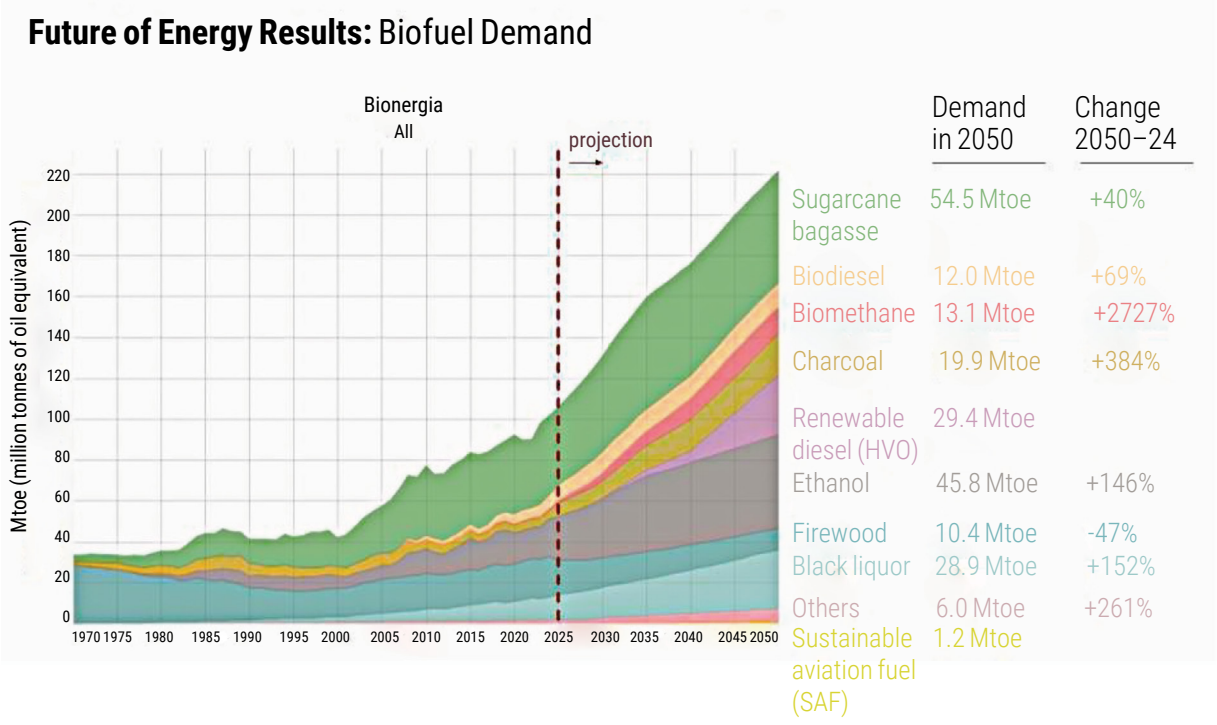

*Figure 2 - **Biofuel demand through 2050**. Source: Institute for Energy and Environment (IEMA).*

[34] MapBiomas. (2025). *Statistics – Pasture (Estatísticas – pastagem)*. Available at: https://brasil.mapbiomas.org/estatisticas/. Accessed on July 9, 2025.

In this context, Petrobras is not expected to participate in the first stage of the biofuel production chain—that is, feedstock cultivation. Its participation is more relevant in converting this plant biomass into fuel, in biorefining, and in storage and distribution. In addition, while the Brazilian Agricultural Research Corporation (Embrapa) seeks to increase the productivity of these crops, Petrobras should focus its R&D&I efforts on the technological development of new biofuels considered more promising than current ones.

In its 2025–2029 business plan, the company sets a goal to expand the "production of low-carbon fuels and products, including the ethanol, biodiesel, and biomethane chains, in order to meet market demand, developing actions to ensure adequate access to feedstock."

What follows presents technologies that could be the focus of a Petrobras more oriented toward renewable energy.

First-, second-, and third-generation ethanol

First-generation ethanol is produced from the fermentation of sugars present in sugarcane and corn, through an industrial process already well established in Brazil. Production involves milling, juice extraction, fermentation with yeast, and distillation.

Second-generation ethanol uses agricultural residues, such as sugarcane bagasse and straw, through more complex processes like chemical pretreatment of the biomass and enzymatic hydrolysis of cellulose. This technology increases the energy efficiency of production by making use of residues that would normally be discarded, but it is still at a less advanced commercial stage.

Finally, third-generation ethanol—still in experimental and pre-commercial stages—seeks to overcome the limitations of previous products by using genetically modified microalgae cultivated in aquatic systems, or other microorganisms, to produce ethanol (or other biofuels) directly.

Biodiesel and renewable diesel (HVO)

Biodiesel is produced by transesterification of vegetable oils or animal fats with an alcohol (usually methanol), resulting in a renewable fuel. Today it is blended into diesel at a proportion of 15%, with plans to reach up to 20% in the coming years. In Brazil, soybeans are the most commonly used feedstock.

Renewable diesel (HVO), produced from vegetable oils or oily residues treated with hydrogen at high temperatures and pressure, has chemical properties very similar to fossil diesel. It is more efficient, more stable, and can be used directly in engines without adaptation, and is considered more promising in the long term. Petrobras currently produces **Diesel R**, with 5% HVO[35].

The subsidiary Petrobras Biocombustível (PBio) operates primarily[36] in biodiesel production at plants in Montes Claros (MG) and Candeias (BA). In addition, Petrobras plans to produce HVO and sustainable aviation fuel (SAF) from soybean oil and tallow at the RPBC refinery in Cubatão (SP).

SAF (Sustainable Aviation Fuel)

Sustainable aviation fuel (SAF) is an alternative to traditional aviation kerosene and aims to drastically reduce greenhouse gas (GHG) emissions in the aviation sector. There are different production pathways, including the HEFA route, which uses hydrotreated vegetable oils and animal fats, and the AtJ (Alcohol-to-Jet) route, which converts ethanol into hydrocarbons compatible with aircraft turbines. SAF can be blended with aviation kerosene in proportions of up to 50% and has already been approved by international authorities.

Renewable marine fuels

Renewable marine fuels are sustainable alternatives to the heavy fuel oil traditionally used by ships. Options under development include marine renewable diesel (HVO), bio-oil (obtained by biomass pyrolysis), and green methanol. These fuels seek to meet the International Maritime Organization (IMO) requirements for emissions reductions in the shipping sector. Although Brazil does not yet have mature projects in this area, Petrobras could adapt HVO and biorefinery technologies to meet future marine demand.

[35] Petrobras. (2025). *Diesel R: A New Generation of Fuels (Diesel R: uma nova geração de combustíveis)*. Available at: https://petrobras.com.br/quem-somos/diesel-r5. Accessed on August 19, 2025.

[36] Petrobras Biocombustível (PBio). (2025). *Main Operations (Principais operações)*. Available at: https://pbio.com.br/#principais-operacoes. Accessed on August 22, 2025.

Biogas and quality control

Biogas is generated through the anaerobic digestion of organic residues—such as animal waste, agricultural residues, and sewage—forming a mixture rich in methane (CH_4) and carbon dioxide (CO_2). Production occurs in biodigesters, and biogas quality depends on removing impurities such as hydrogen sulfide, moisture, and siloxanes. When purified, biogas becomes biomethane, with quality equivalent to natural gas, and can be used as a vehicle or industrial fuel or for power generation.

Quality control—an area in which Petrobras must be rigorous—involves continuous analysis of methane content and the presence of corrosive or toxic compounds.

Biorefineries

Biorefineries are industrial complexes that process biomass to produce a variety of products, integrating multiple technological pathways at a single site and enabling the complete utilization of plant or organic feedstock. Production in biorefineries generally involves stages such as biomass pretreatment, chemical or biological conversion, and product purification. In Brazil, Petrobras has invested in creating and modernizing biorefineries coupled to its traditional refineries.

“The strategy envisages both adaptations in the refining park and new units capable of converting biomass into high-value-added products,” states the 2025–2029 Business Plan, which provides for a US$1.5 billion program to implement integrated SAF and renewable diesel (HVO) production units at the refineries.

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ANNEX 6 - LOW-CARBON HYDROGEN

Origin

Low-carbon, renewable hydrogen is presented as an alternative to fossil fuels because its combustion generates water vapor rather than greenhouse gases (GHG). But this depends on its origin and on the characteristics of the technological pathway used for its production.

Although the concepts behind these pathways are well known—electrolysis, reforming, extraction—there is still substantial basic research to be done to reduce each one's carbon footprint by combining efficiency gains and emissions reductions, both in materials and in the processes themselves. Petrobras, through Cenpes, its renowned research and development center, will play a fundamental and strategic role in identifying the cleanest routes adapted to the national context.

It is worth recalling that Law No. 14,948/2024 points to low-carbon hydrogen by setting an emissions limit of at most 7 $kgCO_2e/kgH_2$ produced, according to life-cycle assessment (LCA) of the process. The European Union (EU) adopted a maximum limit of 3.2 $kgCO_2e/kgH_2$, also on a life-cycle basis. The higher national limit was defined under pressure from agribusiness to include hydrogen obtained from the reforming of biofuels.

Colors are used to identify hydrogen according to production routes and their carbon footprints[37]:

1) White hydrogen

The greenest "route" is, in fact, not a production route, but rather extraction from geological deposits. The emissions footprint stems mainly from how it is extracted: the fuel used for drilling and in extraction pumps. It is also necessary to account for the footprint of the materials used in the equipment, especially steel and cement. Petrobras has knowledge of the country's geology and prospecting and extraction technologies that can be adapted to the production of white (natural) hydrogen. In 2024, the company sponsored a symposium dedicated to natural hydrogen. There are strong indications of deposits in the Paraná and São Francisco river basins.

2) Green hydrogen

This is generated in electrolyzers powered exclusively by electricity from wind or photovoltaic plants. In this pathway, the carbon footprint derives from the materials used to build towers and panels and,

[37] Energy Research Office (EPE). (2021). *Foundations for Consolidating Brazil's Hydrogen Strategy (Bases para a Consolidação da Estratégia Brasileira do Hidrogênio)*. Available at: https://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-569/Hidroge%CC%82nio_23Fev2021NT%20%282%29.pdf. Accessed on August 22, 2025.

where necessary, from transmission systems. Some also include hydropower, although it is necessary to monitor methane formation in reservoirs and the gas that escapes after turbining.

Among the types of hydrogen, this should be the priority for the country, given the ample availability of renewable sources and water. There are plants operating in the North Sea that take advantage of the strong winds around decommissioned oil platforms, with the added benefit of reusing existing—now reinforced—pipelines to transport the gas to shore. This is a line of work Petrobras is already investigating.

3) Moss hydrogen

Produced from biomass through a variety of routes: catalytic reforming, gasification, pyrolysis, or anaerobic biodigestion. The emissions associated with these routes stem mainly from the biomass procurement stage, whether agricultural or organic waste.

4) Yellow hydrogen

Produced by electrolysis powered by electric grids with fossil thermal plants. In Brazil's case, current emissions in the interconnected system are related to the hydrological regime. In years with abundant rainfall in the basins where the large hydropower plants are concentrated, the System Operator has no need to dispatch fossil thermal plants, and the hydrogen will have a smaller carbon footprint. In drought years, the opposite occurs and yellow hydrogen acquires a higher emissions footprint.

5) Pink or red hydrogen

Refers to electrolysis powered by electricity generated in nuclear plants. Although the carbon footprint of nuclear generation is theoretically zero, the embedded emissions from plant construction, as well as from the production of enriched uranium, are significant. Added to this are the very high costs of generation by nuclear plants—resources that could be allocated to the energy transition—and the risks associated with such ventures. Petrobras would have no role in producing this type of hydrogen.

6) Turquoise hydrogen

Produced by pyrolysis of methane from fossil gas which, by breaking molecular bonds, releases gaseous hydrogen and carbon in solid form. In this sense, 100% efficient pyrolysis would not release CO_2. In practice, however, these emissions are not zero, and both carbon dioxide and some unreacted methane escape to the atmosphere. These must be added to the emissions that occur throughout the extraction, processing, and transport of fossil gas.

7) Gray hydrogen

Produced via steam reforming of fossil gas—or specifically, the methane contained in fossil gas. It is currently the main type of hydrogen produced worldwide. On average, the process emits around 6 $kgCO_2e/kgH_2$. This pathway cannot be part of transition plans.

8) Blue hydrogen

Chemically the same as gray hydrogen, but with carbon dioxide captured and stored in geological sites for an indefinite period (carbon capture and storage, CCS) or used in other industrial processes (carbon capture, utilization and storage, CCUS).

Although Petrobras conducts research related to CCS, the fact is that, to date, there are no commercially viable CCS or CCUS plants. The international oil and gas sector has an interest in this development. However, a serious energy transition aims to drastically reduce fossil consumption. In this sense, CCS and CCUS would be diversionary, palliative measures.

9) Black or brown hydrogen

Obtained from the gasification of coal. The carbon footprint is on the order of 18–20 $kgCO_2e/kgH_2$.

Uses[38]

1) Hydrogen as a fuel for power generation

A report by the International Energy Agency (IEA)[39] on power generation from low-carbon fuels gives special emphasis to hydrogen and ammonia, noting that they can serve as important flexible vectors to complement onshore wind power and solar photovoltaic (PV) power, provided they are 100% renewable in origin. The study outlines a transition pathway for systems heavily dependent on fossil-based generation, indicating that co-firing mixtures of these two renewables with fossil gas would be possible.

[38] International Energy Agency (IEA). (2019). *The Future of Hydrogen*. Available at: https://www.iea.org/reports/the-future-of-hydrogen. Accessed on August 22, 2025.

[39] Idem.

In the last two years, renewable sources—mainly hydropower—accounted for about 90% of electricity generation in Brazil[40]. This suggests that, considering the expansion of wind and PV and the likely increase in demand in a more electrified economy, this co-firing pathway could be important for the country's energy transition.

2) Hydrogen in fuel cells

Applications using hydrogen fuel cells are already found in both vehicles and stationary settings. Although more energy-efficient, existing fuel cells are, for now, more expensive when compared with uses such as in combined-cycle turbines, both in capacity and in energy. There are applications at different stages of development, ranging from automobiles to power stations.

3) Ammonia as a fuel

Ammonia is produced via the Haber–Bosch process, which combines hydrogen and nitrogen (extracted from air) in high-pressure, high-temperature reactors containing metallic catalysts. Although the chemical reaction is exothermic, the process requires more than 1 kWh/kg of ammonia, mainly to compress and heat the gases in the reactor.

Ammonia is perhaps a more interesting vector than pure hydrogen. In addition to fueling combined-cycle turbines to generate electricity, it has the potential to replace diesel in heavy-duty engines such as those used in generators, heavy trucks, and ships. In the latter, there are indications that ammonia would be the best source to reduce—or even eliminate—emissions from high-seas navigation.

4) Ammonia as feedstock

Ammonia is a feedstock for a range of industrial products, such as:

- fertilizers to supply nitrogen to crops in the form of urea, ammonium nitrate, and ammonium sulfate;
- explosives: ammonium nitrate;

[40] Energy Research Office (EPE). (2025). *National Energy Balance (BEN) 2025 – Synthesis Report (Balanço Energético Nacional (BEN) 2025 – Relatório Síntese)*. Available at: https://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-885/topico-767/BEN_S%C3%ADntese_2025_PT.pdf. Accessed on August 22, 2025.

- nitric acid production for the chemical industry;
- plastics, fibers, and resins: caprolactam production and a precursor to nylon;
- urea–formaldehyde–based resins for the production of adhesives, plywood, and MDF;
- cleaning products;
- refrigerant (R-717), especially in industrial systems, due to its high thermodynamic efficiency.

At present, virtually all ammonia is obtained from gray hydrogen produced via fossil gas reforming. Petrobras would have a broad field for development in which it was, until recently, an important player.

5) Hydrogen in steelmaking

Steel manufacturing is one of the two hard-to-abate processes, since metallurgical coke is both a feedstock and a heat source in blast furnaces. There is extensive research underway and some pilot plants in Europe. Thus far, the biggest obstacle to replacing coke with hydrogen is the scale of hydrogen production required to meet the high heat demand of the steelmaking process.

6) Hydrogen in other industrial applications

In principle, hydrogen can replace fossil gas in furnaces and boilers as it becomes more economically attractive. As in steelmaking, there are industrial processes that require high temperatures, such as cement and glass. It is likely that hydrogen use will begin with these applications, leaving lower-temperature processes to other alternatives such as biofuels and biomass-based solutions.

Safeguards

Just as it is imperative to incorporate socio-environmental safeguards into renewable energy projects, the same care must be taken in the hydrogen field. The safeguards work developed by communities affected by large wind and solar photovoltaic (PV) projects in Brazil's Northeast should serve as a basis to ensure that projects involving hydrogen as an energy vector do not cause impacts of similar magnitude.

Final considerations on hydrogen

At ambient temperature, hydrogen is a gas that requires great care. Its molecule (H_2) is small and therefore demands special precautions for transport.

It becomes a liquid only at extremely low temperatures, −253°C. Methane, the main component of fossil gas, liquefies at −161°C.

Depending on the distance, more energy may be spent liquefying, storing, and transporting the liquid than the energy generated by burning it. For this reason, it makes more sense to use hydrogen where it is produced or to convert it into another substance that is easier to transport and more energy efficient.

The prospect of producing hydrogen for export would only make sense for countries with few alternatives for power generation. In such cases, what would in effect be "exported" is the renewable electricity used in electrolysis—still with losses throughout the process.

The study *Future of Energy: the Brazilian Climate Observatory's Vision for a Just Transition in Brazil* (*Futuro da Energia: visão do Observatório do Clima para uma transição justa no Brasil*) sets out the following guidelines:

- low-carbon hydrogen produced solely from renewables, with broad international acceptance, although priority should be given to domestic use, adding value within the national economy;
- establishment of a maximum carbon intensity of 2 $kgCO_2e/kgH_2$, with priority use in transport activities and domestic industry, focusing on the chemical sector and steelmaking; and
- hydrogen should be produced without the use of freshwater, opting instead for reused water or, further, desalinated water.

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ANNEX 7 - BIOFUEL DISTRIBUTION AND CHARGING STATIONS

The dismantling of Petrobras during the Bolsonaro administration included the sale of the company's stakes in natural gas transportation and distribution; the privatization, in 2020, of Liquigás Distribuidora S.A., a subsidiary that bottled, distributed, and marketed liquefied petroleum gas (LPG); and, finally, the 2021 privatization of BR Distribuidora, now Vibra Energia S.A.

The Brazilian Climate Observatory (OC) understands that Petrobras should once again invest in distribution to end consumers, whether through the full or partial repurchase of the current Vibra Energia and other assets, or by creating a new distribution structure. The debate opened by the company's current management about including the resumption of distribution in the 2026–2030 strategic plan—positioning Petrobras "as a diversified and integrated energy company"—as reported by Bloomberg, should therefore be welcomed[41].

However, it should be emphasized that this distribution expertise must be strictly aligned with the corporate strategies of a Petrobras committed to the energy transition, prioritizing the decarbonization of its operations and products. The company can play an important role in the distribution of liquid biofuels (ethanol, biodiesel, and renewable diesel (HVO)) and gaseous biofuels (biomethane), as well as in the creation of electric vehicle charging points across the country.

[41] Bloomberg. (2025). *Petrobras Considers Returning to Fuel Distribution (Petrobras cogita retornar à distribuição de combustível)*. Available at: https://www.bloomberg.com/news/articles/2025-07-16/petrobras-cogita-retornar-a-distribuicao-de-combustivel-fonte. Accessed on July 24, 2025.

OBSERVATÓRIO DO **CLIMA**

Brasil 2045

CLIMA e ENERGIA

ISBN: 978-65-987655-1-4

CBL

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