Brazil at a Crossroads

Rethinking Petrobras oil and gas expansion

IISD REPORT

IISD
International Institute for Sustainable Development

WWF

World Benchmarking Alliance

June 2025

International Institute for Sustainable Development

The International Institute for Sustainable Development (IISD) is an award-winning, independent think tank working to accelerate solutions for a stable climate, sustainable resource management, and fair economies. Our work inspires better decisions and sparks meaningful action to help people and the planet thrive. We shine a light on what can be achieved when governments, businesses, non-profits, and communities come together. IISD's staff of more than 200 people come from across the globe and from many disciplines. With offices in Winnipeg, Geneva, Ottawa, and Toronto, our work affects lives in more than 100 countries.

IISD is a registered charitable organization in Canada and has 501(c)(3) status in the United States. IISD receives core operating support from the Province of Manitoba and project funding from governments inside and outside Canada, United Nations agencies, foundations, the private sector, and individuals.

Head Office

111 Lombard Avenue, Suite 325
Winnipeg, Manitoba
Canada R3B 0T4

Tel: +1 (204) 958-7700
Website: iisd.org
𝕏: @IISD_news

Brazil at a Crossroads: Rethinking Petrobras oil and gas expansion

June 2025

Written by Olivier Bois von Kursk (IISD), Joachim Roth (WBA), Ricardo Junqueira Fujii (WWF-Brazil), Carolyne Schiavo (WWF-Brazil), Laura Hurtado Verazaín (WBA) and Emir Erhan (WBA)

Photo: iStock

Acknowledgements

This report was produced in collaboration between IISD, the World Benchmarking Alliance (WBA), and WWF-Brazil. The authors would like to thank the following for providing peer-review advice and suggestions:

- Luis Costa (WBA)
- Ivetta Gerasimchuk (IISD)
- Kjell Kühne (Leave it in the Ground Initiative)
- Tara Laan (IISD)
- Nicolas Lippolis (Columbia Climate School)
- Paasha Mahdavi (University of California Santa Barbara)
- Francois Mosnier (Carbon Tracker)
- Angela Picciariello (IISD)
- Guy Prince (Carbon Tracker)
- Vicky Sins (WBA)

The authors are grateful to Megan Darby for her exceptional contribution in developing and shaping this report.

Moreover, the authors also thank Elise Epp (IISD), Sydney Hildebrandt (IISD), and Tom Penner (Firefly Communications).

At a Glance

- Brazil is set to expand oil and gas production by more than 20% by 2030, at a time global demand is nearing its peak. Petrobras accounts for more than half of this expansion.
- Up to 85% of oil from Petrobras' new projects is not economically viable to extract in a 1.5°C world. Petrobras' riskiest ventures can only pay off in a world with 2.4°C warming or more.
- Petrobras plans to sink USD 97 billion into oil and gas from 2025 to 2029. That is six times its spending on decarbonizing and diversifying its business.
- Polling shows Brazilians want Petrobras to lead the transition to renewable energy, but the company is lagging the top climate performers in the oil and gas sector.
- The Brazilian government can chart a safer path by curbing oil and gas expansion, redefining Petrobras' mandate, and shifting financial flows from oil and gas to clean energy.

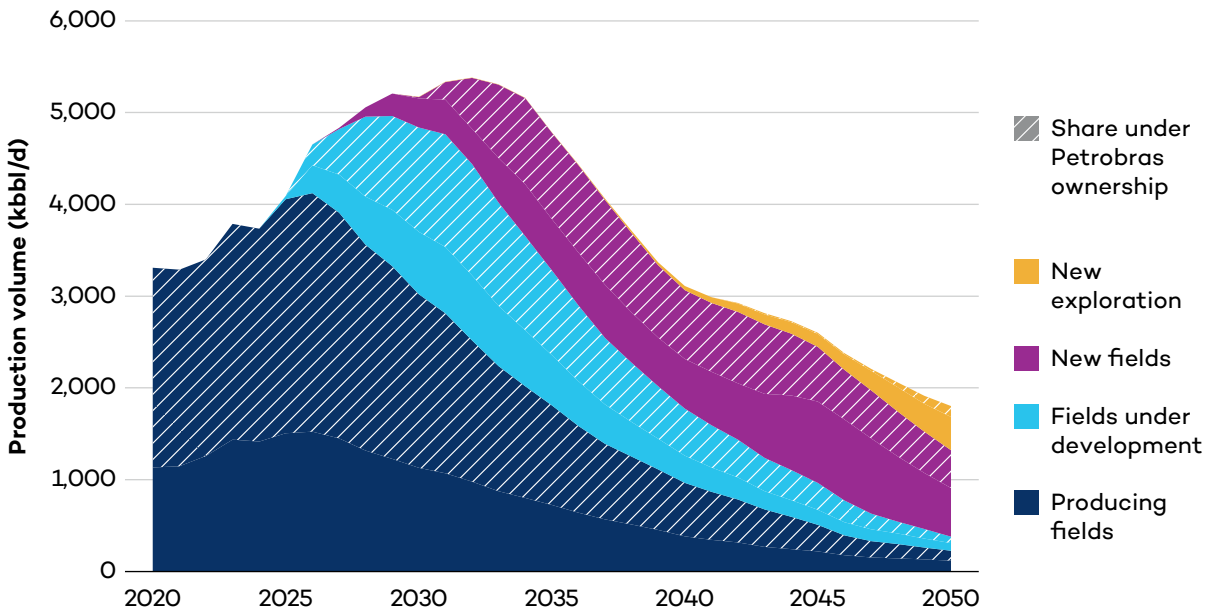
Executive Summary

Brazil is set to grow its oil and gas production by more than 20% by 2030, propelling the country from the seventh to the fourth-largest oil producer in the world. As the world nears peak oil and gas demand, increasing the country's dependence on export oil and gas revenues is a gamble. New production can only pay off in a dangerously overheated world. Conversely, effective climate action will make some fossil fuel assets obsolete.

Governments agreed at the 28th UN Climate Change Conference (COP 28) in Dubai to triple renewable energy capacity (and double energy efficiency) by 2030 and to transition away from fossil fuels in energy systems. Even under current policy settings, the International Energy Agency (IEA) forecasts global demand for all fossil fuels will peak by 2030, as clean technologies take off. China, the world's biggest oil importer, has already reached a plateau in demand for oil-based fuels.

In this context, competition between oil and gas suppliers is set to intensify—and developers of frontier projects are at a disadvantage against incumbents. Our analysis shows that a significant share of new Brazilian oil production is at risk of becoming stranded: 22% if governments meet their announced climate pledges or 56% if demand declines in line with a 1.5°C global warming limit.

Figure ES1. Brazil and Petrobras' oil and gas production forecast



Source: Rystad Energy UCube v.2.3.2, 2025.

As shown in Figure ES1, the national oil company Petrobras is responsible for more than half of Brazil's oil and gas expansion plans. It is also pursuing some of the riskiest and most expensive frontier development in Brazil. Accordingly, stranded asset risks are significantly higher for Petrobras than for the Brazilian oil and gas sector as a whole: up to 85% of

Petrobras' new oil production is economically unviable in a 1.5°C world. Globally, oil and gas demand in a 1.5°C scenario can be entirely met by fields already in production, meaning that any Brazilian expansion would have to be offset by closures elsewhere.

Petrobras's highest-cost projects can turn a profit only if governments worldwide do nothing to accelerate the transition to clean energy. This scenario is consistent with 2.4°C warming or more, breaching the Paris Agreement and bringing increased threats from extreme weather and rising seas. Table ES1 shows that breakdown of the share of stranded asset for Brazil and Petrobras under three IEA scenarios.

Table ES1. Proportion of projected oil production in Brazil and from Petrobras that is economically unviable under the IEA Stated Policies (STEPS), Announced Policy Pledges (APS), and Net Zero Emission (NZE) scenarios (2025–2040)

	Scenario	Producing	Under development	New fields	Total
Brazil	STEPS – 2.4°C	2%	0%	0%	1%
	APS – 1.7°C	13%	8%	20%	13%
	NZE – 1.5°C	26%	46%	56%	37%
Petrobras	STEPS – 2.4°C	0%	0%	0%	0%
	APS – 1.7°C	8%	7%	26%	11%
	NZE – 1.5°C	17%	55%	85%	40%

Source: Author's calculations based on Rystad Energy (2025) and IEA (2024).

Petrobras plans to invest USD 97 billion in exploration, production, transportation, and refining of oil and gas from 2025 to 2029. While the company has made some moves to decarbonize operations and diversify into low-carbon energies, these account for only 15% of its spending. A much larger share of its budget could be redirected to accelerate Brazil's energy transition.

Comparing Petrobras with other oil and gas companies shows significant room for improvement. Petrobras lags the top performers in the sector on target setting, carbon intensity of its products, and diversifying into low-carbon business activities. Meeting and exceeding industry standards would be prudent and achievable–and popular. In a 2024 poll of Brazilians by Pollfish for Climainfo, 81% of respondents said Petrobras should shift into renewable energy immediately, against 19% who said it should remain a fossil fuel company.

The Brazilian government holds a controlling stake in Petrobras, which presents both a threat and an opportunity. On the one hand, the Brazilian people pay a price when public money is invested unwisely. On the other hand, the government has influence over Petrobras and can support its clean energy transition to a higher share of clean energy, which would also help the company diversify away from the roller coaster of volatile export markets.

For a stable, secure, and sustainable future, the Brazilian government should

- **make a roadmap to curb domestic oil and gas expansion:** Stop issuing fossil fuel exploration licences and phase out development licences, starting with assets most likely to become stranded under low-carbon pathways. Link national transition planning with credible sectoral and regional pathways and implementation at company level.
- **redefine Petrobras's mandate:** Work with Petrobras on a credible, ambitious transition plan in line with climate and sustainable development goals. Adopt a "harvest mode" strategy to maximize cash flows and shareholder returns by avoiding capital expenditure on oil development. Address policy contradictions that hold back Petrobras's transition through whole-of-government coordination.
- **shift financial flows from oil and gas to clean energy:** Encourage Petrobras to redirect investment into clean energy. Preventing the development of new fields that are still in the exploration phase could help Petrobras avoid between USD 13 and 36 billion in stranded asset losses, depending on the speed of the energy transition. Create a level playing field for different energy technologies and companies through fossil fuel subsidy reform and sustainability regulations on financial institutions.

Investors also have a role to play. The Brazilian Development Bank, through its investment arm, is the second largest investor in Petrobras and can influence its transition plan. It could condition its financing on ending oil and gas expansion and work with other financial actors in the region, such as the Inter-American Development Bank, to normalize this standard.

Table of Contents

List of Figures

List of Tables

List of Boxes

1.0 Introduction

Brazil has shown leadership as one of the first countries to publish its updated nationally determined contribution (NDC). While gaps remain, its NDC stands out for emphasizing the United Framework Convention on Climate Change global stocktake and its work to define and implement the decision to transition away from fossil fuels in energy systems in a just, orderly, and equitable manner. This report shows that there are multiple policy levers and actions Brazil can take to turn these pledges into reality.

Over the past decade, Brazil has emerged as a net oil exporter, driven by significant production increases that see the country selling over a third of its domestic output on global markets. Brazilian oil and gas production is projected to reach approximately 4.1 million barrels of oil equivalent per day (boe/day) in 2025 and is forecast to reach nearly 5.2 million boe/day by 2030 (Rystad Energy, 2025). These expansion plans are spearheaded by the national oil company (NOC) Petrobras, which is currently responsible for more than half of domestic production, with plans that includes expanding its activities in the Amazon River mouth in new offshore blocks.

To deliver on the global stocktake decision to transition away from fossil fuels agreed by all parties at the 28th United Nations Climate Change Conference (COP 28), NOCs such as Petrobras must be held accountable to present a credible transition plan aligned with these principles. Authoritative and credible energy and climate scenarios show that there is no room for new fossil fuel projects to meet the target of keeping global warming within the 1.5°C target (Green et al., 2024). Oil and gas expansion plans too often rely on scenarios with questionable assumptions to weaken climate action. A detailed assessment of the Brazilian government's oil production landscape and Petrobras's strategic plans can inform constructive proposals for alternative energy policies.

This report has been produced by the International Institute for Sustainable Development (IISD), the World Benchmarking Alliance, and WWF-Brazil to support science-based energy policies. The insights provided in this report set clear benchmarks for climate leadership within these forums and explore how Brazil and Petrobras could diversify energy investments to develop a Paris-aligned transition strategy.

The report has six sections followed by recommendations. The first reviews the oil and gas production landscape in Brazil, including historical trends. The second delves into the implications of various energy transition scenarios for oil and gas production pathways, while the third analyzes stranded asset risks under selected scenarios. The fourth examines the evolution of Petrobras's transition plan, including a comparison with other oil and gas companies. Finally, the last two sections go into greater depth regarding the policy and financial levers that can enhance Petrobras' transition plan and accelerate the transition away from oil and gas.

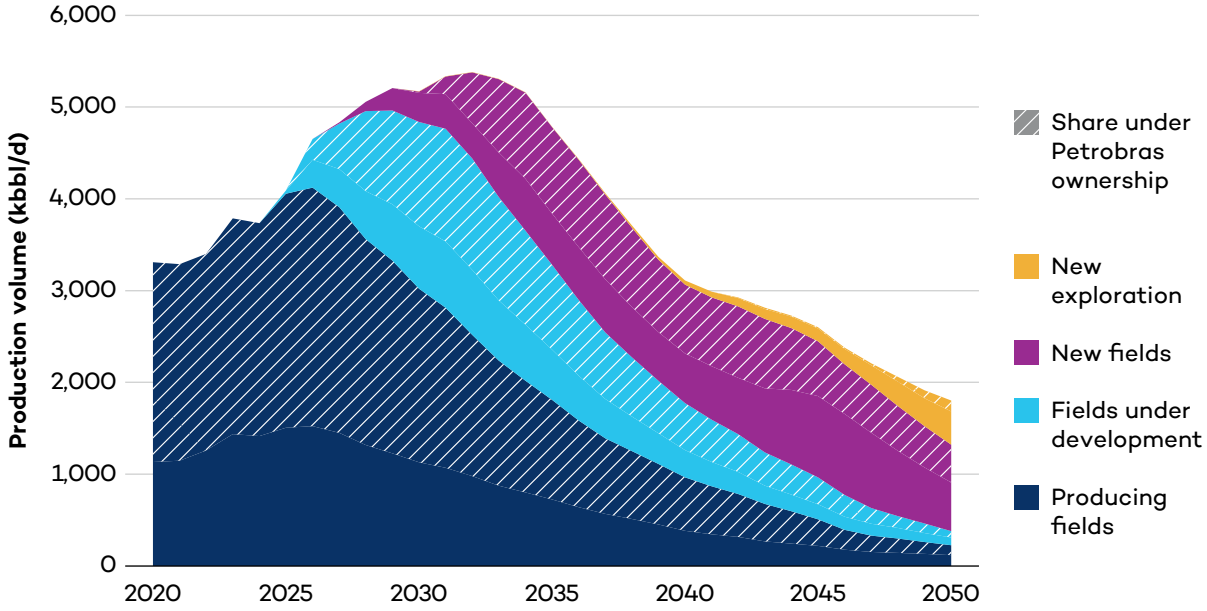
2.0 The Oil and Gas Production Landscape in Brazil

Brazil's Oil and Gas Production Trends

Brazil has a large pipeline of oil and gas projects currently under development and a large stock of licensed reserves that could increase daily domestic production up to 5 million boe/d in the 2030s. Figure 1 shows a breakdown of forecast production in Brazil and by Petrobras, disaggregated by their different life-cycle categories. As seen in Figure 1, the Brazilian government has also awarded vast acreages of exploration licences to the industry that could hold more than 50 billion boe in economically recoverable volumes, based on Rystad's business-as-usual oil price scenario (Rystad Energy, 2025).

Government-controlled Petrobras operates nearly half of these fields under development and has a similar stake in the ones already in operation. While Petrobras is technically a publicly traded company on the stock exchange, the federal government retains control of the company.[1] Successive administrations in Brazil have used Petrobras as a strategic vehicle for government-driven investments, not only for oil and gas production but also for refining, petrochemicals, biofuels (bioethanol and biodiesel), fuel transportation and distribution, and electricity generation, especially through natural gas.

Figure 1. Brazil and Petrobras' oil and gas production outlook by life-cycle category



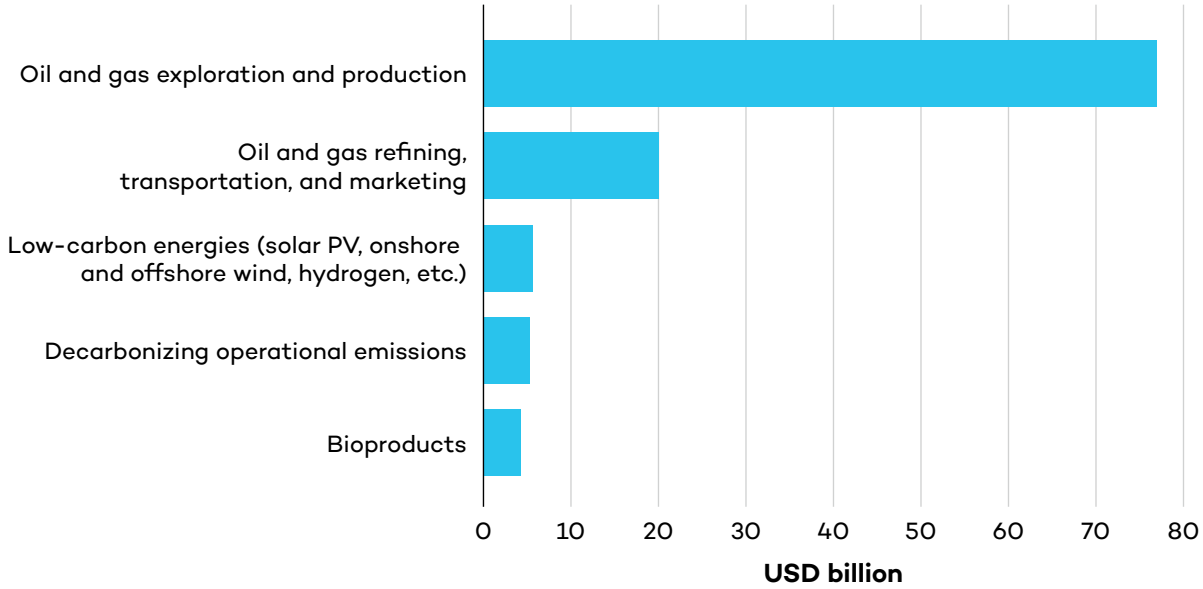
Source: Rystad Energy UCube v.2.3.2, 2025.

[1] As of January 2025, the Brazilian government possesses 36.61% of Petrobras's total capital but controls the majority of voting rights through common shares (Petrobras, 2025b).

More than 80% of Petrobras's daily average production of 2.4 million boe/day[2] in 2024 occurred in the so-called "pre-salt" (deep sea) offshore areas, which are estimated to contain 7.6 billion boe[3] of proven reserves (Rystad Energy, 2025). Petrobras holds the largest market capitalization[4] in Brazil and remains the market leader, accounting for more than 60% of national oil and gas production in 2024 (Rystad Energy, 2025).

It is the government's ambition to develop the discovered resources and conduct extensive exploration to identify new additional resources. In the past 12 months (04/2024 to 04/2025), Brazil has awarded 181 licences containing more than 200 million bbl of oil and 170 billion cubic feet of gas to the industry: another 332 blocks were set to be auctioned by the end of 2025 (Bois von Kursk & Posada, 2025; Rystad Energy, 2025). By themselves, these exploration licences contain about 100 $MtCO_2$ of emissions if they were extracted and consumed—equivalent to about 7.7% of Brazil's annual domestic emissions (United Nations Environment Programme [UNEP], 2024). This growth is expected to be spearheaded by Petrobras, which has been awarded most of these new exploration licences. In its 2025–2029 business plan, Petrobras announced USD 97 billion in investments for exploration, production, transportation, and refining, representing 87% of the total investment of the business plan[5] (Petrobras, 2024). Figure 2 illustrates the breakdown of the business plan investments and the focus on oil and gas expansion activities.

Figure 2. Petrobras 2025–2029 business plan investments



Source: Author's calculation based on Petrobras (2024).

[2] This data differs from 11.4 billion boe by Petrobras Agency (Agência Petrobras, 2025a).

[3] This data differs from 2.78 million boe/day in 2024 by the Dynamic Panel - Oil and Natural Gas Production (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2025).

[4] The company also has exploration and production activities in six other countries: Argentina, Bolivia, Colombia, São Tomé and Principe, South Africa, and the United States.

[5] The remaining USD 11 billion of the total USD 111 billion in investments from the plan is for low-carbon energy and gas and USD 3 billion for corporate activities.

There is an active debate in Brazil in both government and civil society on whether oil and gas expansion plans are compatible with positioning Brazil as a climate leader and a COP 30 President seeking to curb deforestation and transition away from fossil fuels in energy systems. In 2024, the Energy Research Company (Empresa de Pesquisa Energética, or EPE), a Brazilian government institution responsible for conducting studies and providing technical support for the planning of the country's energy sector, conducted a study arguing that the oil and gas sector is crucial for a fair, inclusive, and balanced energy transition and for the country's energy security (EPE, 2024). In this context, Petrobras projected that its oil and gas production would reach 3.2 million boe/day by 2029, a 33% increase from 2024, supported by the government guidelines and defying the urgent need to address climate change (Ministry of Mines and Energy, 2025).

However, Brazil's Environment Minister Marina Silva has called for a global "roadmap" to phase out fossil fuels and deforestation, reaffirming Brazil's previous commitments (Figueiredo, 2025). Analysis from the 2024 Civil Society Equity Review further indicates that while Brazil's dependence on oil and gas as a share of GDP is relatively low, it faces significant risks in terms of declining revenues (Holz et al., 2024).

Energy Scenarios and Implications for Oil and Gas Production

Insights from integrated assessment models[6] (IAMs) and energy scenarios are compared with oil and gas production forecasts to assess the gap between Brazil's and, more specifically, Petrobras's, oil and gas expansion plans with the Paris Agreement goals. Representations of energy, technology, and economic systems are modelled and integrated with climate models within IAMs, enabling the assessment of potential pathways by which the world can effectively limit greenhouse gas (GHG) emissions at the lowest cost possible to stay within the Paris Agreement temperature target by the end of the century.

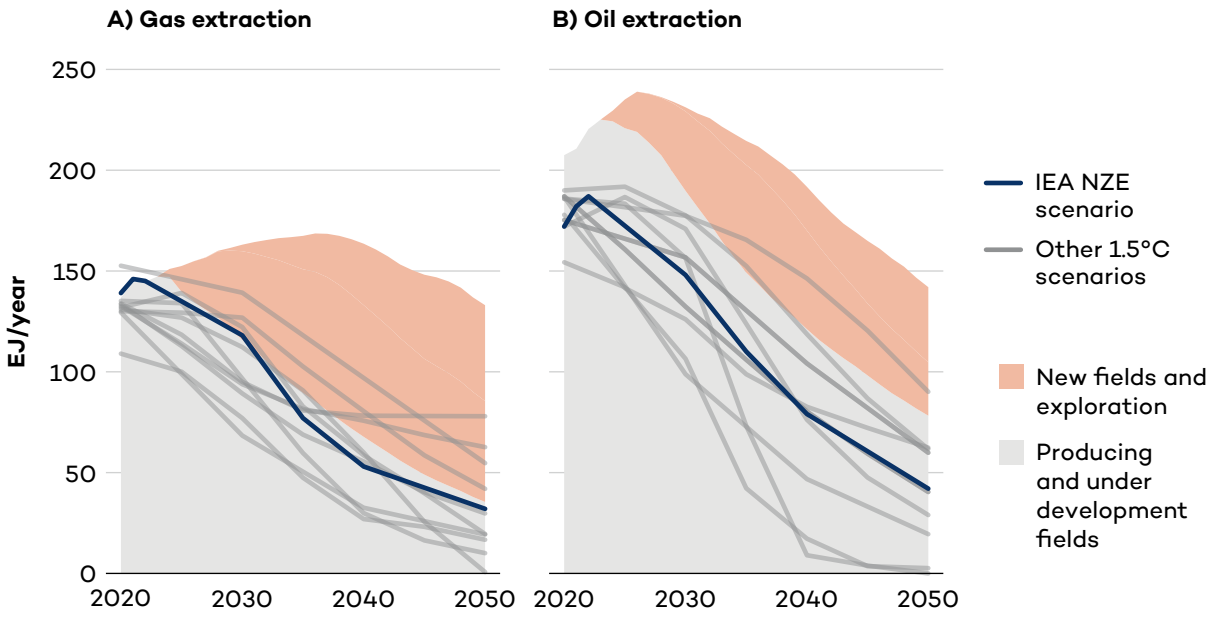
There are many IAMs offering different mixes of assumptions on technology choices, behavioural changes, and types of policies, leading to significant variations in how GHG emissions are reduced across sectors and geographies over the coming decades. The International Energy Agency's (IEA's) NZE scenario provides a source of widely recognized, authoritative, and credible modelling expertise. One of its main key conclusions is that there is no more room for new oil and gas fields: that is, fossil fuels in fields already operating or under development as of today would be more than sufficient to meet the 1.5°C-aligned demand (IEA, 2024).

This "no new fields" conclusion is not unique to the IEA's modelling assumptions. Assessments of scenarios published by the Intergovernmental Panel on Climate Change (IPCC), academic groups, and energy consultancies, shown in Figure 3, all indicate that oil and gas demand could be met without any new projects in 1.5°C-aligned scenarios (Green et

[6] IAMs are models of energy, economy, technologies, land-use changes, and societal trends. They are used to calculate ways to meet both international climate goals and global projected energy needs at the lowest overall economic cost. They are generally managed by academic research groups and include different levels of sectoral and regional disaggregation.

al., 2024). Moreover, "no new fields" is an essential but insufficient approach to align with the 1.5°C target, as a significant share of fields already in operation today would also need to be retired to align with the Paris temperature target. Preventing new fields from being opened is also generally more economically, politically, and legally feasible than closing existing capacity early (Green et al., 2024). Accordingly, the "no new fields" principle is a practical approach to transitioning away from oil and gas that balances political economy considerations.

Figure 3. Forecast global oil and demand under Paris-aligned scenarios



Source: Adapted from Green et al., 2024.

Several countries have already passed "no new fields" policies, such as the core members of the Beyond Oil and Gas Alliance (BOGA).[7] This first-mover coalition regroups countries that have made plans or aim to end all new oil and gas licensing and set an end date for their domestic production. While BOGA does not yet include any major exporting countries, it sets a strong example with practical policy and legal tools, together with support and guidance available for other oil and gas-dependent countries. Moreover, while not yet a BOGA member, the United Kingdom has pledged not to issue any new oil and gas exploration licences (McKieran, 2024).

[7] BOGA has three membership categories: full members, associate members, and friends. Full members of BOGA commit to ending new concessions, licensing, or leasing rounds for oil and gas production and exploration and to set a Paris-aligned date for ending oil and gas production and exploration on the territory over which they have jurisdiction. Associate members have taken steps to reduce oil and gas production but have not yet met the requirements of full membership. Finally, the friends of BOGA are not required to have taken any concrete steps to restrict fossil fuel production but are aligned with the initiative's goals.

Accordingly, this "no new fields" policy should be regarded as the minimum Paris-aligned benchmark policy for the oil and gas industry internationally and in Brazil.[8] This policy in Brazil would mean that domestic production would not expand beyond producing fields and the ones currently under development. It is also akin to a "Harvest Mode"[9] strategy where oil companies focus on maximizing cash flows and shareholder returns by avoiding new upstream capital expenditure (CapEx) investments (Harrigan & Porter, 1983; Kühne, 2024).

As seen in the previous section, Brazil has a large pipeline of projects under development. Hence, even if no new fields were being developed, domestic production would still reach more than 5 million boe/day in the next 3 years before decreasing in line with the natural rate of decline of the ongoing projects and dropping to 3.2 million boe/day by 2035 (Rystad Energy, 2025). Over these next 10 years, the government would still receive around USD 38 billion per year from taxes and royalties without having to approve any new production licences (Rystad Energy, 2025).

However, the government is actively granting such new production licences and awarding vast acreage of offshore areas—where essentially all new fields and discoveries are located—and in the so-called equatorial margins located in the mouth of the Amazon River for oil and gas exploration projects. The government issued 213 exploration licences over the last year, representing around 88 million boe, with Petrobras having stakes in about a third of them (Carbon Minefields, 2024). These upstream activities and new exploration licences clash with any credible 1.5°C scenario's oil and gas production pathways.

Oil extraction and transport along Brazil's coast—particularly near the mouth of the Amazon, where rich and vulnerable marine ecosystems thrive—significantly increase the risks of oil spills, which have severe and broad socio-economic impacts on local communities (Santos et al., 2022). An extensive review of offshore oil spill research in Brazil also shows a lack of adequate monitoring and tracking of spills along the coast, and response measures have been mostly ineffective in affected areas (Zacharias et al., 2024).

Most new reserves being explored could take more than a decade to begin commercial operation. As the IEA forecasts peak demand for oil and gas to come before 2030, even under more moderate energy transition scenarios—such as the IEA Announced Policy Pledges (APS) where no new climate policies are put in place—a large share of these new fields are likely to become stranded. Hence, a rational first step for the government would be to stop any new exploration licences.

[8] Methodologies designed to limit temperature rise to 1.5°C while taking into account dependence on fossil fuels and capacity to transition indicate that Brazil should actually be phasing out its oil and gas production significantly faster. For example, the Civil Society Equity Review—which looks at differentiated phase-out pathways for fossil fuels—indicates that Brazil should entirely phase out its domestic oil and gas production by 2035 (Holz et al., 2024). While the oil and gas industry plays a large role in Brazil, it represents only about 4.5% of government revenues and less than 1% of jobs (Holz et al., 2024).

[9] Harvest Mode strategy is generally understood as focusing on CapEx reduction and asset depletion. In the oil and gas sector, such a strategy could align with climate goals as the natural rate of decline of existing fields comes close to the 1.5°C-aligned oil and gas production pathways. It contrasts with traditional growth models by favouring dividend distribution, debt reduction, and is a strategic approach to operate in a declining market.

Several studies have tried to assess stranded asset risks, indicating that the oil and gas industry, investors, and banks holding their stocks or financing their projects face significant exposure to transition risks depending on the scenarios analyzed (Andres et al., 2023; Manley et al., 2023; Muttitt, forthcoming; Prince, 2023). Accordingly, assessment of the viability of NOC's production globally revealed that they are some of the most vulnerable companies to stranded assets risks. Since Petrobras dominates most of Brazil's production, the following section analyzes the risks of declining demand for both Brazil and Petrobras.

3.0 Stranded Asset Risks for the Brazilian Oil Sector

This section estimates the risks of stranded assets for Brazil and Petrobras' oil production by providing estimates of the share of their forecast production that would become economically unviable under three IEA scenarios. It builds on methods developed by Carbon Tracker and updated by IISD to derive stranded asset risk at the global and domestic levels (Carbon Tracker, 2019, 2024a; Muttitt, forthcoming). For the purposes of this analysis, it excludes gas and focuses on oil, which constitutes 90% of Brazil's hydrocarbon production. This provides a reasonable estimate of the industry's viability under selected scenarios.

First, this method devises a global cost curve ranking global forecast production volumes with their respective breakeven oil prices between 2025 and 2040, based on the Rystad Energy base case scenario (Rystad Energy, 2025). These breakeven prices are a factor of production costs and represent the market price necessary for a project to make a return on investment as of today, excluding past and sunk capital expenditures and cash flows (Rystad Energy 2025). Hence, they represent the oil prices at which the future potential operation of the asset is commercially viable.

Second, assuming that oil demand will be supplied preferentially by the cheapest available suppliers (with the lowest breakeven prices), it derives global equilibrium average oil prices between 2025 and 2040 (Muttitt, forthcoming). These prices are calculated by matching the sum of global oil consumption during this period in the IEA Stated Policies (STEPS), APS, and Net Zero Emission (NZE)[10] scenarios with the cumulative forecast production on the global cost.

This generates a marginal equilibrium oil price of USD 37 per barrel in the NZE scenario, USD 47 in the APS, and USD 66 in the STEPS over the next 15 years (Muttitt, forthcoming). Accordingly, any fields with a breakeven oil price above these oil prices in these scenarios would be economically unviable as they have a negative net present value.[11] Therefore, these assets would not make a return on investment and would likely be stranded in these respective IEA scenarios.

Third, given that oil is generally traded as a global commodity and most Brazilian production is destined for export, the marginal prices in the IEA scenarios can be applied to the Brazilian and Petrobras cost curves. This provides the basis to observe what share of their respective production would remain competitive under each of these scenarios and to determine what

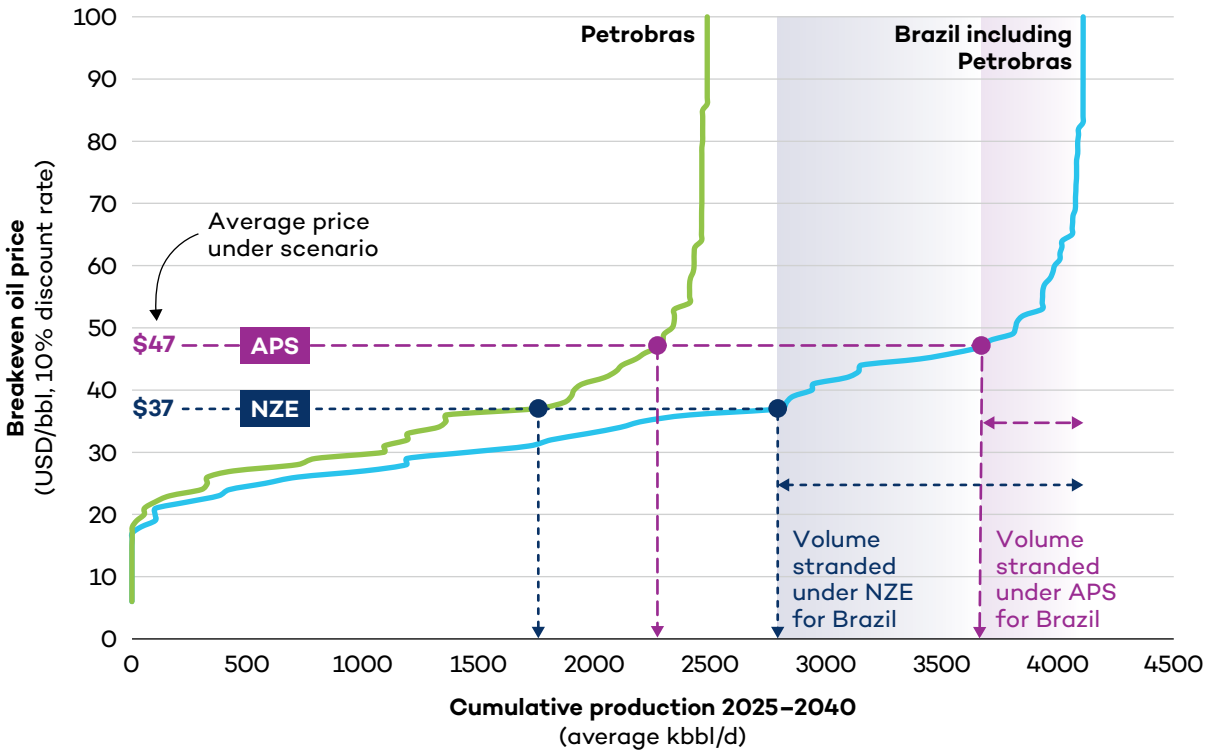
[10] Under STEPS, no new climate and energy transition policies are put in place, but the ones already in place are implemented and developed. The global energy transition is slow, barely counteracting the growth in global energy use. This scenario is consistent with a 2.4°C rise. Under APS, all climate pledges are implemented, regardless of whether they are written into legislation or policy. The global energy transition is significantly faster, with rapidly decreasing demand for oil and gas. This scenario is consistent with a 1.7°C temperature rise. The NZE scenario is consistent with a rapid energy transition where the global energy sector achieves net-zero CO_2 emissions by 2050. This is the IEA Paris-aligned energy scenarios where the world limits global mean temperature rise to 1.5°C.

[11] In current analysis, the net present value is defined as the cumulative value of all future cashflows (incomes, capital expenditures, operating expenditures, and tax payments), with a 10% discount rate.

part of the domestic production in Brazil and of the assets operated by Petrobras would become uncommercial and likely to become stranded assets.

Accordingly, Figure 4 shows these equilibrium prices in the IEA NZE and APS scenarios applied to Brazil and Petrobras's oil production cost curves. It shows the cumulative volume forecast to be extracted over the next 15 years, ranked by their breakeven price. Any production associated with breakeven prices higher than the red dotted lines would become stranded assets under these respective IEA scenarios. Therefore, this figure illustrates that a large share of Brazilian and Petrobras's production would become uncompetitive in the NZE scenario. While these numbers are significantly smaller in the APS, they remain non-negligible, especially in the case of new fields as described below.

Figure 4. Cost curve of Brazil and Petrobras oil production, showing equilibrium price for IEA APS and IEA scenarios



Source: Author's calculation based on Muttitt, forthcoming and Rystad Energy, 2025.

Hence, despite Brazil's relatively low domestic extraction costs, a significant share of its production is exposed to stranded asset risks if climate action is strengthened from the IEA STEPs scenario. Under the latter, Brazil's oil and gas expansion is commercially viable, but this means violation of the Paris Agreement targets that Brazil is also seeking to champion as the host of COP 30.

All three IEA scenarios indicate that global demand for coal, oil, and gas will peak by 2030. While Brazil would have the capacity to produce 3 million bbl/d on average over the next 15 years, countries such as Canada, Kuwait, the United States, the United Arab Emirates, Iran, Iraq, Russia, and Saudi Arabia, could all produce more than 3 million bbl/d and up to 12

million bbl/d over the same period (Rystad Energy, 2025). Hence, Brazil will face increasing competition in a declining market with significantly lower oil prices, and other low-cost and low-emissions exporters are likely to increase their market share (Mesa Puyo et al., 2024).

Table 1 shows the respective proportion of forecast oil production that would become economically unviable under the IEA NZE and APS scenarios in Brazil and for Petrobras. That is the share of production where future capital investments would fail to make a return on investment. The analysis shows that 13% and 37% of Brazilian oil production assets are at risk of becoming stranded in the IEA APS and NZE scenarios, respectively, while only 1% is at risk in STEPS. The data is also disaggregated in terms of the life-cycle categories to compare the share of fields that are producing or under development (which already have a final investment decision [FID]), with those yet-to-be-developed licensed reserves. As for the new fields that have not yet received an FID, the number of potentially stranded assets rises to 20% and 56% in the APS and NZE, respectively, in Brazil and rises to 26% and 85% in the case of Petrobras.

Table 1. Proportion of projected oil production in Brazil and from Petrobras that is economically unviable under the IEA STEPS, APS, and NZE scenarios (2025–2040)

	Scenario	Producing	Under development	New fields	Total
Brazil	**STEPS – 2.4°C**	2%	0%	0%	1%
	APS – 1.7°C	13%	8%	20%	13%
	NZE – 1.5°C	26%	46%	56%	37%
Petrobras	**STEPS – 2.4°C**	0%	0%	0%	0%
	APS – 1.7°C	8%	7%	26%	11%
	NZE – 1.5°C	17%	55%	85%	40%

Note: A 10% discount rate is applied to calculate the net present values of the forecasted production
Source: Author's calculations are based on Rystad Energy, 2025, and IEA, 2024.

Since the breakeven prices used to assess the stranded asset risks are forward looking, the representation of risks is best applied to new fields where an FID has yet to be made. The assessment of breakeven prices of fields already in production or under development does not account for past capital expenditures that have already been sunk. Accordingly, while the majority of the forecast production from existing fields is considered competitive under the APS and NZE scenarios and nearly all under STEPS, they will not necessarily achieve a commercial return on what has already been invested in the past. However, since the decisions to invest in them have already been made, this analysis focuses on future investment decisions and their economic viability.

Moreover, when considering fields that are projected to become economically unviable—that would be labelled as stranded assets under this analysis—it is essential to recognize that they would not necessarily stop operating even if the market price drops below their

breakeven price. Operators of such fields still have an incentive to pursue extraction if their operational costs are below the market price, which is typically much lower than the breakeven price. Hence, despite not being able to recoup their investment, operators are still able to attenuate their overall losses if market prices remain above their operational costs per barrel of oil extracted.

In this situation, the government will forego profit and other tax revenues from the oil and gas companies that are also likely to request more tax breaks and other subsidies from the government. This is a regrettable situation for investors, but also a damaging outcome for the energy transition and the climate, as the continued oil extraction is generated at an artificially low price.

Table 2 shows the proportion of the investments projected to be made in Brazil and by Petrobras to further develop their extraction capacities. The percentages of capital expenditures that become stranded in the APS and NZE scenarios look similar to those related to stranded volumes for both Brazil and Petrobras. However, it is interesting to observe that Petrobras holds a significantly higher share of the potentially stranded assets than Brazil as a whole. In the case of the NZE, this is more than USD 52 billion of the capital expenditures in new fields that risk being stranded in Brazil. About 2/3 of these investments at risk, or USD 34 billion, is forecast to be invested by Petrobras alone for growing its production over the next 15 years.

Table 2. Proportion of forecasted capital expenditure over 2025–2040 invested in uncompetitive projects in different IEA scenarios

	Scenario	Producing	Under development	New fields	Total
Brazil	**STEPS – 2.4°C**	10%	0%	1%	4%
	APS – 1.7°C	32%	0%	22%	20%
	NZE – 1.5°C	42%	41%	56%	47%
Petrobras	**STEPS – 2.4°C**	10%	0%	1%%	4%
	APS – 1.7°C	22%	0%	31%	19%
	NZE – 1.5°C	27%	64%	86%	58%

Note: A 10% discount rate is applied to calculate the net present values of the forecasted production.
Source: Author's calculations based on Rystad Energy, 2025 and IEA, 2024.

Based on Rystad data, more than USD 200 billion of CapEx is projected to be invested in Brazil from 2025 to 2040, with USD 75 billion dedicated to developing new fields. Of this amount, 22% of CapEx in new fields (USD 16.6 billion) is expected to get stranded in the APS scenario, and 56% (USD 42.3 billion) gets stranded in the NZE scenario. As for Petrobras specifically, the company is forecast to invest a total of USD 118 billion (57% of Brazil's total oil CapEx) over the next 15 years, with USD 42 billion invested in new fields. Of this amount, 31% of CapEx in new fields (USD 12.8 billion) is expected to get stranded

in the APS scenario, and 86% (USD 36 billion) gets stranded in the NZE scenario. There is only a minor share of investments that get stranded in STEPS scenarios, as Rystad's forecast assumes that the oil industry would follow a trajectory that is essentially similar to the IEA's business-as-usual scenario.

As shown in this section, the global oil market's competitiveness will become increasingly fierce. Despite Brazil's relatively low production costs, its oil industry is far from immune to transition risks, and 56% of new fields that have yet to receive an FID would be stranded under the NZE scenario and more than one-fifth under the APS scenario.

Beyond oil and gas production pathways, it is also important to examine Petrobras's transition plan to understand the implications for Brazil's ability to transition away from oil and gas. Company-level transition plans are an important tool to shift companies' priorities and provide more accountability to track their climate impacts.

4.0 Evolution of Petrobras's Transition Plan

As shown in previous research from the World Benchmarking Alliance (WBA), IISD, and University of California Santa Barbara (UCSB) 2035, there are several measures that governments, regulating agencies and financial actors can take to increase the scope and ambition of transition plans[12] in the oil and gas sector and for NOCs (WBA et al., 2023). Currently, NOCs' transition plans rank three times lower than their international peers on average, based on the Accelerate Climate Transition (ACT) methodology[13] developed by the French Agency for Ecological Transition, CDP, and WBA.

Advancing credible, robust, and just transition plans was a key priority of the Brazil G20 Sustainable Finance Working Group in 2024 (WBA & London School of Economics, 2024). In 2023, Brazil's finance ministry and Security and Exchange Commission further announced the shift to mandatory climate disclosure requirements for listed companies as of 2026. The Central Bank of Brazil also requires financial institutions to outline their pathways to decarbonization (Brazil Central Bank, 2021). Brazil is therefore active in net-zero regulation both in terms of mandatory climate disclosure requirements for companies and transition planning for financial institutions (Borges Ramos Dios et al., 2024).

However, research by the Assessing Transition Plans Collective, comprising 90 experts from 40 organizations, emphasizes the importance of defining the credibility of companies' transition plans (WBA, 2024). This is vital for ensuring that net-zero policies effectively impact businesses. To establish this credibility, it is essential to examine a triple consistency. This entails evaluating credible local and sectoral pathways for companies to meet the 1.5°C international climate goals, how these objectives align with national NDCs, and the external and internal factors that influence the implementation of companies' transition plans. A recent poll in Brazil by Pollfish for Climainfo revealed that 81% of respondents think that Petrobras should shift into renewable energy immediately, against 19% who said it should remain a fossil fuel company (Oliveto, 2024). This indicates a broad constituency in Brazil support ambitious transition planning from Petrobras.

WBA's climate and energy benchmarks assess nine leading Brazilian companies[14] on their transition planning across multiple sectors, including electric utilities, buildings, heavy

[12] Drawing on existing guidance, guidelines, standards, disclosure frameworks, and assessment methodologies, a transition plan is defined as a component of a company's broader long-term strategy. It sets out a series of short-, medium-, and long-term targets, actions, and resource allocations, underpinned by accountability mechanisms, to align the company's business operations with a net-zero greenhouse gas (GHG) emissions pathway. This alignment aims to achieve real-economy emissions reductions, support the objective of limiting global warming to 1.5°C, and reduce the company's exposure to systemic climate transition risks (WBA, 2024).

[13] The ACT Initiative (formerly Assessing Low-Carbon Transition) was launched in 2015, to pioneer the concept and assessment of corporate low-carbon transition plans and actions to hold organizations accountable. Following the pilot phase up to 2017 and subsequent development phases up to 2022, it has evolved into the most comprehensive assessment framework for real-economy climate strategies and transition plans. The ACT initiative supports and assesses how ready an organization is to transition to the low-carbon economy using a future-oriented, sector-specific methodology (ACT, n.d.-a).

[14] These include Ultrapar, Votorantim Cimentos, Gerdau, Even Construtora, Eletrobras, Cyrela Brazil Reality, MRV Engenharia, and InterCement.

industries, and oil and gas. Out of these nine companies, Petrobras is by far the highest emitter. Its total Scope 1, 2, and 3 emissions in 2023 are almost eight times higher than the cumulative GHG emissions of eight other leading Brazilian companies assessed by WBA. In contrast to other Brazilian companies in sectors such as heavy industries that are showing leading practices in their decarbonization strategies, important gaps remain for Petrobras, linked to its locked-in emissions, targets, sold product performance, and business models, amongst others (see Figures 5 and 6). While it is true that Petrobras shows better performance in terms of its operational emissions (Scope 1 and 2) as reflected in the ACT module for material investments—where the company scores 100% for the alignment of its Scope 1 and 2 emissions to its low-carbon pathway in the period 2018–2023—this represents a minor share of GHG emissions, and the gaps mentioned above remain areas of concern.

As shown by Carbon Tracker (2024b), in the case of oil and gas companies, transition plans should account for both climate impact reduction and climate-related risk response. For oil and gas companies, the latter amount to energy transition response plans due to the threat of demand substitution. Key metrics to assess the credibility of energy transition response plans are linked to production and exploration plans and other aspects, such as capital investments and diversification plans. In particular, planning for production declines against credible climate scenarios is the litmus test to assess the credibility of energy transition response plans for oil and gas companies.

While it has some noteworthy practices, Petrobras is not on track to align with the IEA's NZE scenario. One red flag is that planned investments in crude oil exploration, production, transportation, and refining between 2025 and 2029 are six times higher than energy transition investments (Petrobras, 2024).[15]

As part of its energy transition investments worth USD 16.3 billion, Petrobras plans to dedicate nearly 30% of its low-carbon CapEx to bioproducts, including ethanol, biorefining, biodiesel, and biogas. Along with low-carbon energies (including hydrogen, onshore and offshore wind, solar, and carbon capture and storage), Petrobras identifies these investments as part of a profitable diversification strategy (Petrobras, 2024). In the Brazilian context, biofuels in particular play an important role, with the country standing as the second largest producer in the world. Bioenergy, which represents 32% of the country's primary energy supply, has a highly sophisticated value chain (EPE, 2024). The bioethanol and biodiesel segments are responsible for 856,000 jobs in the country, meeting part of the road fleet demand: 38% of demand for light vehicles and 12% of demand for heavy vehicles (EPE, 2024).

However, there are also challenges for the effective expansion of biofuel production: the use of monoculture crops, although offering high productivity, contributes to biodiversity loss

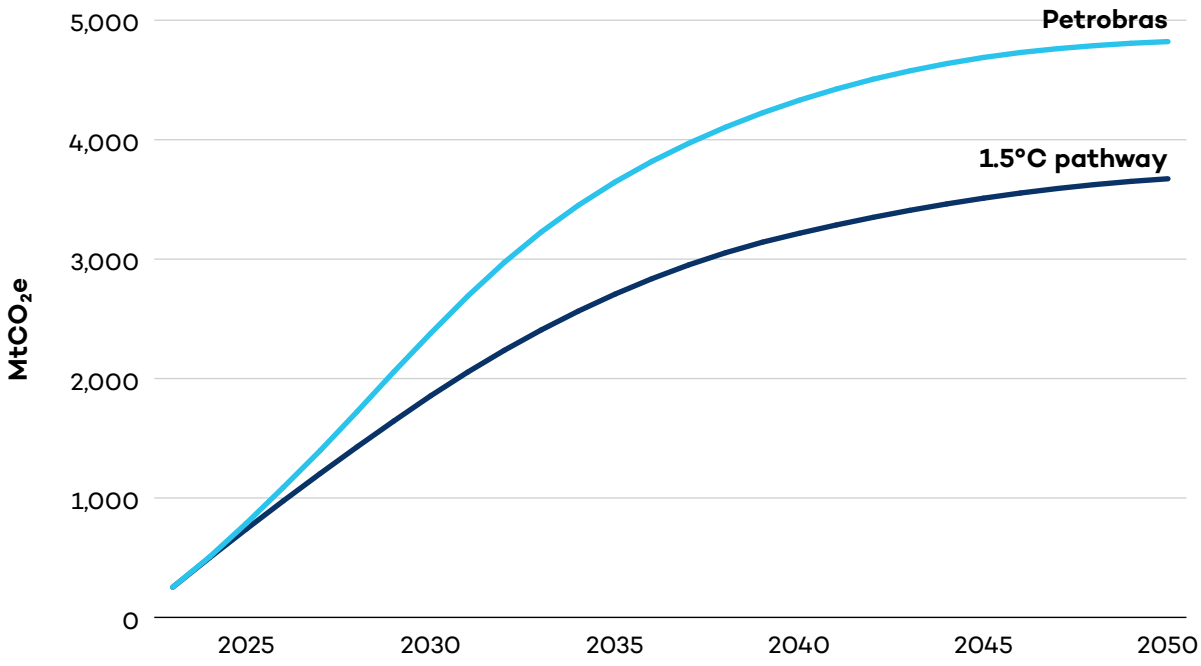
[15] It is worth noting that transition plans should not be prescriptive regarding the type of transition as long as oil and gas companies wind down their oil and gas production (Carbon Tracker, 2024b). NOCs may also not always be the best placed nor have the technical and institutional capacity (and in some cases, e.g., Ghana, face legal barriers) to invest significantly more in renewables (Heller et al., 2021). In the case of Brazil, this deserves more attention, specifically regarding the relationship between Petrobras and Electrobras. However, despite these considerations, credible 1.5°C-aligned scenarios converge in showing the need for no new fossil fuel expansion (Green et al., 2024). Whether through the NOC or the host country, redirecting oil and gas investments to align with 1.5°C is central to this.

and can displace more traditional crops, including food crops, affecting supply and price and, ultimately, inducing deforestation. Production models based on the integration of crops and forests offer more benefits for CO_2 sequestration and biodiversity enhancement, but often face resistance from producers due to their greater complexity.

As also shown in Section 5 of this report (Investing in a Sustainable Future), a host of other investment needs can be met by reorienting Petrobras' planned investments in new oil and gas fields to close the clean energy investment gap in Brazil. This includes investment needs for solar, wind, geothermal, and crucially, transmission and distribution infrastructure as well. Petrobras can invest in both the electrification and advanced fuels pathways, as Brazil has a clear demand for both alternatives, which are likely to coexist for at least a few decades.

Figure 5 shows Petrobras's locked-in emissions from their current and under-development assets compared to its carbon budget until 2050 following the IEA's NZE scenario. It is evident that the company's cumulative emissions are off track with its 1.5°C low-carbon pathway.

Figure 5. Petrobras' 2024 locked-in emissions compared with the IEA NZE



Note: The locked-in emissions are calculated as the ratio between the company's total cumulative GHG emissions from the use/combustion (Scope 3) of fossil fuels until 2050, implied by current and under-development assets, and the benchmark's carbon budget for the same time frame. The benchmark used is the IEA's Net Zero by 2050 scenario. For reference, see ACT (2021).

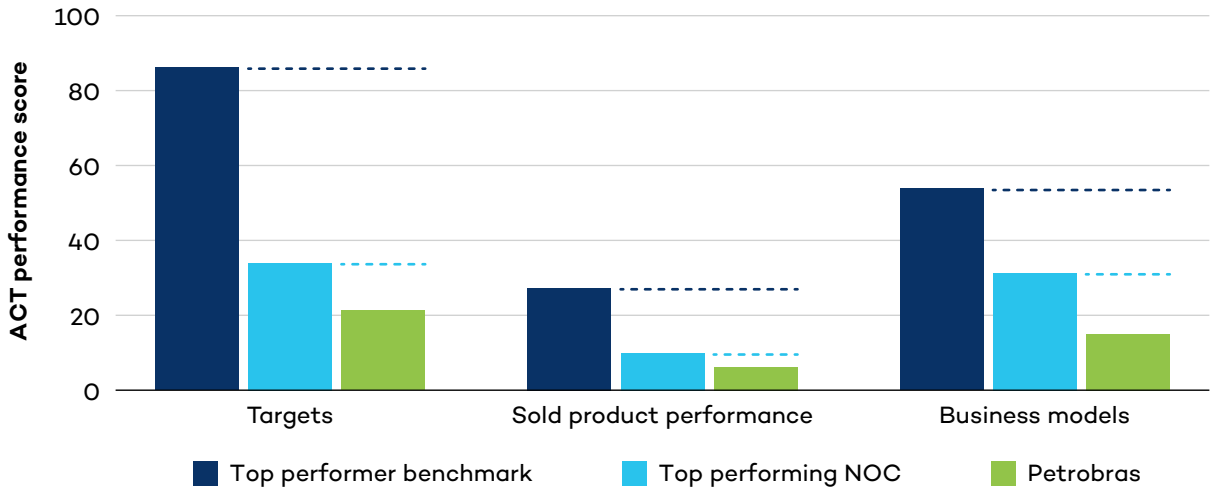
Source: Author's calculation using ACT (2021) oil and gas methodology.

Even though Petrobras's Scope 1+2+3 emissions intensity slightly decreased from 2018 to 2023, this is not aligned with the company's 1.5°C pathway, which requires Petrobras to reduce its emissions intensity at an annual rate of nearly 4.5% to align with the NZE scenario, contrary to the rate of reduction of 0.8% that the company has been experiencing in the previous 5 years. According to its 2023 annual report on direct emissions, Petrobras achieved the target of reducing its Scope 1+2 absolute emissions to 55 million tCO_2e by

2030 in 2022, and has not raised the ambition of this target, despite achieving it 8 years in advance. Moreover, Petrobras has not set any targets to reduce its Scope 3 emissions, which represent the most significant share of the company's total emissions (around 90%). In addition, although Petrobras has set a target to reduce its methane emission intensity by 55% by 2025, research by Madhavi (2024) shows there is little to corroborate the figures reported by Petrobras.

Figure 5 shows an overview of Petrobras' performance scores compared to the top performers from WBA's Oil and Gas Benchmark 2023 and the top-performing NOCs in selected indicators (WBA, 2023). Module 1 (Targets) includes the alignment of Scope 1+2 and Scope 1+2+3 emissions targets, as well as the time horizon covered by the targets. As mentioned before, Petrobras has not set targets that include its Scope 3 emissions, and it reports only an "ambition" to reach net-zero by 2050 on its direct emissions, contrary to Eni (minority owned by the Italian government), the best performer in the Oil and Gas benchmark, which has set a target to reach net-zero emissions by 2050 for all its Scope 1, 2, and 3 emissions. Moreover, Equinor, the top-performing NOC in the benchmark, has also set targets to reduce its Scope 1, 2, and 3 emissions intensity, considering targets for the use of sold products.\ Module 4 (Sold Product Performance) evaluates the trend in past and future emissions performance (Scope 1+2+3), as well as low-carbon products and energy efficiency services. Petrobras scores 6.17 in this module, in contrast to Origin Energy (the best performer), which scores 27.7, and Emirates National Oil Company, (the best NOC performer), which scores 9.9. Petrobras has started slightly reducing its Scope 1+2+3 emissions intensity in the last 5 years. However, the top performer has been reducing it at a rate of more than 2% per year. Even though this is still not fully aligned with its low-carbon pathway, the top-performing company increased its share of zero-carbon electricity by almost 150% between 2021 and 2022. Nevertheless, NOCs generally perform worse than international oil companies in this module, with the top-performing NOC projected to exceed its Scope 3 carbon budget by 80% between 2022 and 2050 (WBA, 2023).

Figure 6. Top oil and gas company performance on key elements of transition planning versus Petrobras



Source: WBA, 2023.

Lastly, Module 9 (Business Models) evaluates whether companies are actively developing business activities for a low-carbon future. Petrobras scores 15 in this module, while ENGIE, the top-performing company in the benchmark, scores 53.8, and China National Petroleum Corporation, the top NOC, scores 31.3 (WBA, 2023). Even though Petrobras discloses low-carbon business opportunities, such as hydrogen and carbon capture, usage, and storage, and the expansion of renewable electricity capacity in its 2025–2029 Strategic Plan, these still do not represent a significant share of the company's activities. In contrast, the top-performing company in WBA's benchmark is integrating low-carbon activities as an integral part of its business model, with 18% of the company's earnings coming from its renewable electricity segment and a planned expansion of its renewable hydrogen and biomethane businesses through 2030. Moreover, the top-performing NOC reports interest in new energy projects, putting into operation 39 such projects, including wind and solar power generation, and carbon capture, usage, and storage evaluation and test projects. However, the company still heavily relies on oil and gas and plans to expand its extraction and production (WBA, 2023).

5.0 Role of Net-Zero Policy in Advancing Petrobras's Transition Plan

Linking Public–Private Sector Transition Plans

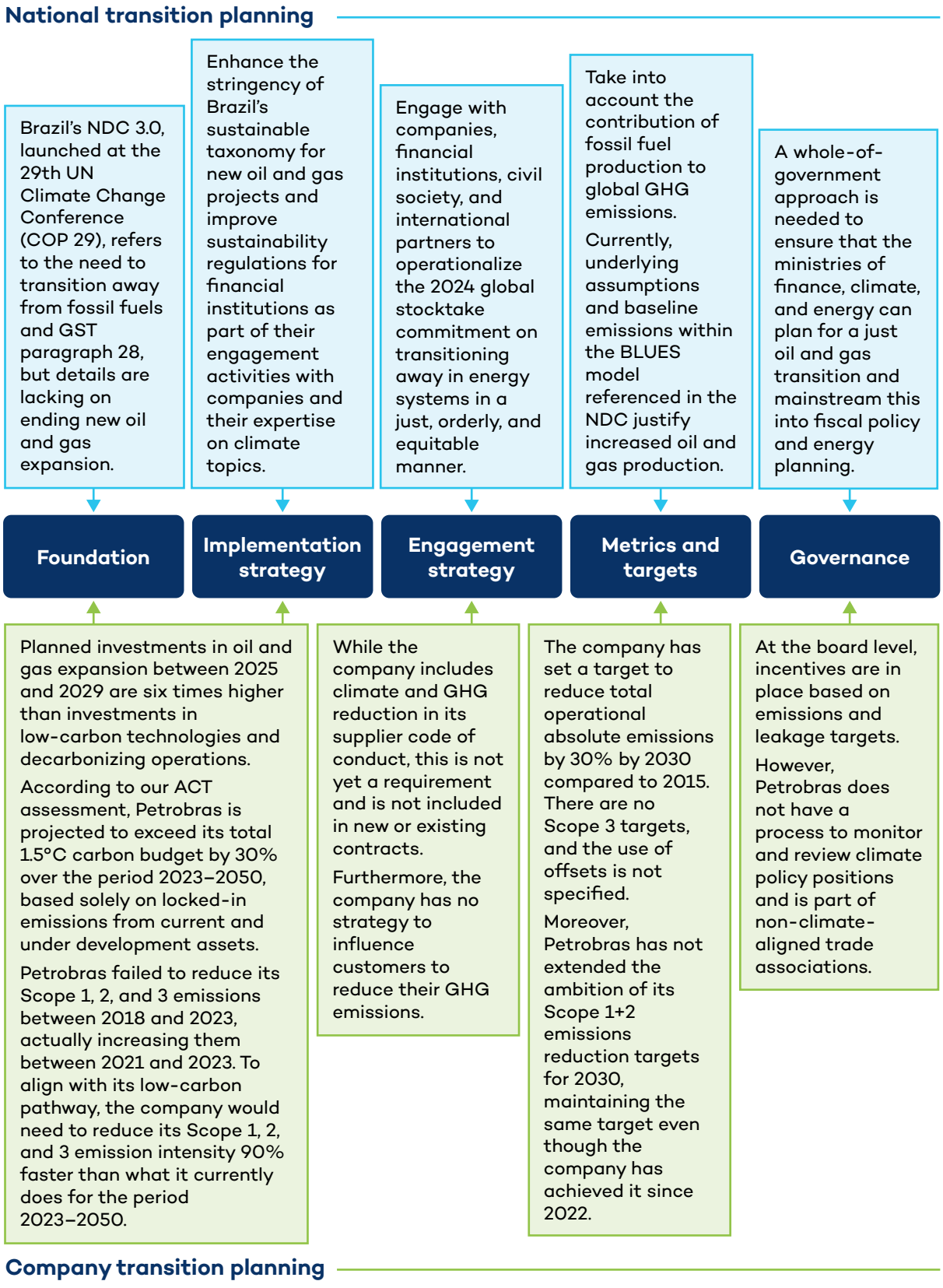
Enacting robust net-zero regulation is critical to ensuring the credibility and accountability of companies' transition plans (UN Principles for Responsible Investment [PRI], 2024). Brazil already has several climate policies in place relating to transition planning, disclosure, and procurement (Climate Policy Monitor, n.d.). However, these could be made more ambitious, comprehensive, and stringent.[16] To align with 1.5°C, these policies should integrate the importance of transitioning away from fossil fuels, which is also one of the 10 recommendations from the UN High-Level Expert Group on non-state actor accountability. In particular, to drive change for NOCs such as Petrobras, policy-makers in Brazil should link national transition planning mechanisms with credible sectoral or local pathways and their implementation at a company level (see Figure 7) (Manning et al., 2024). In practice, this means greater interministerial coordination on climate action and addressing policy contradictions that currently prevent a change in the government-mandated business model of Petrobras (Hochstetler & Lippolis, 2024).[17] In other words, Brazil's future energy strategies require more policy coherence and a whole-of-government approach.

Positively, Brazil has put forward several relevant climate plans and legislation (see Table 3), including its latest NDC published at COP 29, its Industrial and Climate Plan, Ecological Transformation Plan, Country platform, and a proposal for its sustainable taxonomy. However, while Brazil's NDC does refer to the need to transition away from fossil fuels, keeping in mind common but differentiated responsibilities, it is not specific on how to achieve this. This should include plans for winding down production and exports and decommissioning oil and gas infrastructure. Similarly, many of Brazil's climate plans, including its investment platform, focus on reducing fossil fuel demand in end-use sectors, such as heavy industry or transport. This includes, for example, Brazil's 2024 Fuels in the Future Law to increase biofuel production (Agência Brasil, 2024).

[16] For more details, see the Climate Policy Monitor's methodology and evaluative framework. This framework assesses whether net-zero policies incorporate key elements such as a double materiality approach, requirements for implementing transition plans, and comprehensive coverage—including Scope 3 emissions and non-CO_2 greenhouse gases such as methane (Climate Policy Monitor, n.d.).

[17] As an example, the EPE, in its annual 10-year planning documents, separates oil and gas projections from other parts of the energy sector that address climate change (Hochstetler & Lippolis, 2024).

Figure 7. Linking national and company transition planning in the context of Petrobras and Brazil



Source: Authors drawing from Manning et al., 2024.

Table 3. Brazilian climate and energy policies that contribute to the transition away from oil and gas

Climate policy	Contribution to the transition
New NDC	Sets overall targets for emissions reduction and indicates policies to foster the transition, including transitioning away from fossil fuels
Climate Plan	Defines mitigation strategies for economic sectors, including energy
Ecological Transformation Plan	Translates Brazil's NDC into an investment roadmap, fostering the expansion of renewable energy
Emissions Trading System Act	Creates the basis for the Brazilian carbon markets, including the mandatory market and its obligations
Offshore Wind Act	Defines the general framework for allocating and permitting offshore wind development The final bill vetoed provisions related to fossil fuels that were initially included.
Low-Carbon Hydrogen Act	Defines new legal framework and incentives for the production of low-carbon hydrogen
Fuels in the Future Act	Aimed at increasing the biofuel share on fuel use, including gasoline, diesel, and kerosene blends
Sustainable Taxonomy Proposal	Still under proposal, the taxonomy would apply a classification system for low- and high-carbon activities but contains loopholes to transition away from fossil fuels.
RenovaBio Law	Establishes the necessity to decrease carbon intensity on fuels through the increase of biofuels share
Distributed Generation Framework	Provides legal framework and incentives to support distributed generation for consumers and firms
Tax exemption for renewable energy project bonds	Tax incentive to boost clean energy investments, makes investments in fossil fuels less attractive
Proinfa	Offers power grid usage discounts to distributed renewable electricity

Source: Authors, based on existing climate and energy policies in Brazil.

While central to reducing fossil fuel demand domestically, these policies, in addition to Brazil's NDC, do not tackle the importance of curbing fossil fuel supply (Observatório do Clima, 2024). There is a blind spot in United Framework Convention on Climate Change accounting rules at present. Brazil has some relevant climate policies in the context of enhancing Petrobras' transition plan. These include mandating climate scenarios and stress testing for financial institutions, which the Central Bank of Brazil analyzed in its Financial Stability Board Report published in 2023 (G20 Sustainable Finance Working Group, 2024).

However, to be more effective, this policy should be coupled with requirements from the Securities and Exchange Commission of Brazil that financial institutions have better expertise on sustainability-related topics (2C Investing Initiative France, 2023). This is necessary so that financial institutions can better evaluate their investee companies' low-carbon investment plans, the scenarios they use, and their underlying assumptions.

Brazil has also put in place guidelines for financial institutions to identify and disclose climate risks and disclosure on divestment from carbon-polluting assets and locked-in emissions as part of transition risk assessments (UN Principles for Responsible Investment, 2024). However, more efforts are needed to link these policies to the need for a transition away from fossil fuels in an orderly and equitable manner. This involves, among other things, better integrating climate under the stewardship and engagement activities of financial institutions, requiring disclosure of fossil fuel CapEx and phase-down targets, and no longer issuing new oil and gas licences. In addition, Brazil can ensure its Sustainable Taxonomy—through its classification system—applies stringent criteria, especially for new oil and gas projects.

Advancing Fossil Fuel Transitions in the Implementation of Brazil's NDC

Brazil's updated NDC demonstrates progress in aligning with international climate goals, but it still lacks concrete measures for phasing out fossil fuels, as shown in the analysis conducted by the Climate Observatory in Brazil (Observatório do Clima, 2024). In fact, Brazil's recently published second NDC is based on a modelling framework including contentious assumptions that do not challenge the continued expansion of domestic oil and gas production. The Brazilian Land Use and Energy Systems model incorporates several problematic assumptions, as highlighted in a recent assessment of Brazil's climate strategies for oil and gas production (Coutinho et al., 2024).

The model's 1.5°C scenario assumes that Brazil could sequester 500 $MtCO_2$/year by 2050 through reforestation, which would require approximately 38,000 square kilometres of land to be restored. Additionally, it also assumes that another 400 $MtCO_2$/year could be sequestered using bioenergy with carbon capture and storage by 2050, which requires even more land per ton of CO_2 sequestered (Zhao et al., 2024). These assumptions are highly ambitious given the IPCC's assessment of the feasibility of bioenergy with carbon capture and storage deployment and the sustainability concerns associated with afforestation and reforestation (Fuss et al., 2018; IPCC, 2022).

Higher levels of carbon sequestration are generally inversely correlated with the pace at which oil and gas production declines (Bois von Kursk et al., 2024). The over-reliance on carbon sequestration in Brazil's NDC and in Petrobras's plans fails to consider real-world technical and non-technical factors that can limit practicable CO_2 injection rates (Grant et al., 2022). Hence, using overly simplistic assumptions on carbon sequestration increases the cumulative volumes of fossil fuels that can be produced in the climate models for the same temperature target.

Moreover, the same model assumes that carbon capture and sequestration technologies could mitigate over a quarter of Brazil's upstream oil and gas emissions (Scopes 1 and 2). While

this would be a challenging achievement, it would still fail to address 80%–85% of oil and gas emissions, which occur when they are combusted (Scope 3). As the world's 10th largest oil exporter, Brazil's Scope 3-related emissions account for nearly 300 $MtCO_2$ annually (Gonzales-Zuniga et al., 2024). This represents nearly a quarter of Brazilian territorial emissions (excluding land use, land-use change, and forestry) and is set to grow dramatically over the coming decades if oil and gas expansion plans are implemented (UNEP, 2024). Brazil must take responsibility for its "sphere of influence" for contributing to global GHG emissions and account for the full climate impact of its fossil production (Green & Finighan, 2012).

6.0 Investing in a Sustainable Future

Aligning Investments With 1.5°C

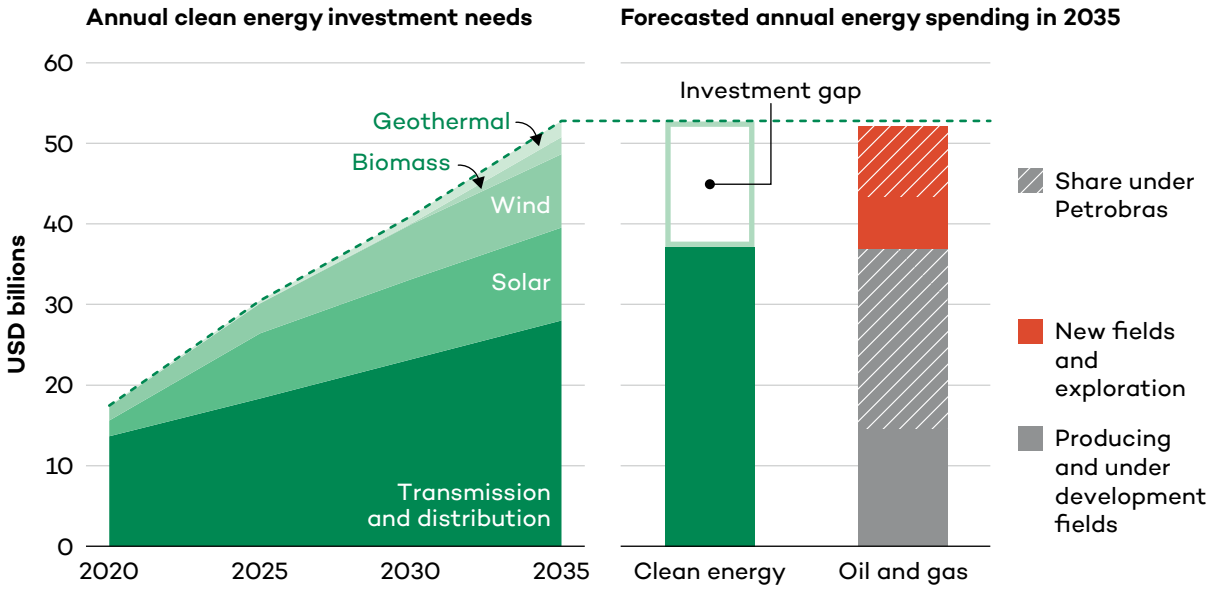
There are significant opportunities to redirect financial flows away from fossil fuels and toward clean energy in Brazil. As shown in the IEA's 2025 *World Energy Investment Outlook*, there is a positive trend of global clean energy investments being twice as high as fossil fuel investments (IEA, 2024). Brazil is also emerging as a leader in terms of renewable power investment in emerging market and developing economies (EMDEs) outside China. This includes more than doubling its grid investments in 2023 (IEA, 2024). Brazil has also put forward much-needed initiatives to accelerate public and private finance to meet its new NDC announced at COP 29. This includes the Brazilian Development Bank's (BNDES's) Climate Fund and the issuance of Brazil's first sustainable sovereign bonds. It also includes the launch of Eco-Invest Brazil to reduce the cost of capital and currency hedging risks and attract long-term low-cost financing and, most notably, the Brazil Platform for Climate Investments and Ecological Transformation. The latter, which serves as Brazil's Country Platform, has the potential to translate the NDC into detailed investment plans and to catalyze public and private investments across multiple sectors to align with 1.5°C.

Like many EMDEs, Brazil faces a high cost of capital and increasing general government debt higher than other Latin American countries and the average level in EMDEs (Sant'Ana, 2024). In this context, it is key to rethink how public investments are aligning with 1.5°C and their financial viability. This is necessary not just from a climate point of view but to support just transitions and economic diversification while avoiding revenue shortfalls (Muttitt & Yanguas Parra, 2024). Conversely, the investment required for Brazil to effectively transition away from oil and gas and align with a net-zero CO_2 pathway by 2050 would be substantial but could largely be met by reorienting capital flows currently earmarked for growing hydrocarbon production. Figure 8 shows the largest annual investment needed to enable a renewable energy system consistent with a net-zero pathway in Brazil. Figure 8 shows that clean energy investment needs will rise sharply over the coming years, reaching more than USD 50 billion annually by 2035—the target year for Brazil's new NDC.

The NGFS scenarios apply well established and authoritative IAMs published in IPCC reports to explore a range of plausible outcomes in the energy transition. Based on the NGFS scenarios used in Figure 8, Brazil would need to more than double its 2035 current annual investments in wind and solar capacity, transmission, and distribution infrastructure, along with geothermal and biomass, to align with a 1.5°C pathway.[18] Investments in these clean energy technologies are further projected to reach only USD 37 billion by 2035, leaving an annual investment gap of USD 16 billion.

[18] These numbers remain roughly similar in the NGFS Delayed Transition and Below 2°C scenarios, indicating that these are competitive investments regardless of the urgency to transition to a renewable energy system for limiting global mean temperature rise.

Figure 8. Clean energy investment needs and investment gaps



Source: NGFS Phase 5 Scenarios Explorer database hosted by International Institute for Applied Systems Analysis (Richterss et al. 2024), Rystad Energy UCube.

Note: Annual clean energy investment needs do not constitute an exhaustive list of total needs for the energy transition in Brazil. They compile the largest needs based on Network for Greening the Financial System (NGFS) net-zero scenarios

However, by 2035, more than USD 15 billion annually—with USD 8.7 billion by Petrobras—is forecast to be spent to explore, develop, and operate new oil and gas fields that are incompatible with any credible 1.5°C scenarios (Green et al., 2024; Rystad Energy, 2025). Nearly USD 37 billion (USD 22 billion by Petrobras) is already guaranteed to be invested to pursue and operate existing fields and develop the ones currently under development over the next 20 years. Accordingly, this illustrates that capital needs for the energy transition in Brazil are not scarce and could, in large part, be met by reorienting capital expenditure that Petrobras projects to spend on new oil and gas projects. These capital expenditures in new fields have not yet been committed, and the government could redirect them to invest in a sustainable future in Brazil, including restoration: estimates indicate that it would cost USD 38 billion to restore 12 million ha of land in Brazil, which would remove 4.3 billion tons of CO_2 from the atmosphere (Escolhas, 2023).

In addition to redirecting Petrobras' capital expenditures, there are significant opportunities to align public and private financial flows with 1.5°C in Brazil and support the country's NDC and investment needs. In fact, in 2019, the financing of infrastructure projects through debenture issuances (BRL 34 billion, roughly USD 8.5 billion) surpassed the participation of BNDES, the main Brazilian public financing instrument, which provided BRL 30 billion (Cohen & Urrutia, 2024). In 2023, the amount of infrastructure debentures denominated in Brazilian reais reached BRL 68 billion (USD 14 billion), demonstrating the appetite of private

investors in the infrastructure sector, particularly in electric power, which accounted for 42.4% of the incentivized debentures[19] in 2024.

Reforming oil and gas production subsidies and better conditioning Petrobras's financing to transition plan implementation are also central to accelerating climate finance, tapping into domestic resources, and aligning investments with 1.5°C. This is particularly relevant as domestic funds currently account for 70% of climate finance in EMDEs, as shown by the third report of the Independent High-Level Expert Group on Climate Finance (Bhattacharya et al., 2024). Even more options, as in the case of fossil fuel subsidy reform, exist to leverage domestic funds and translate NDCs into more robust financing plans (Rahi et al., 2024). In the case of oil and gas production subsidies, according to the Fossil Fuel Subsidy Tracker in 2023 these amounted to USD 4.3 billion, even though there has been a notable decrease since 2012 (Organisation for Economic Co-operation and Development, 2025). A comparison of oil and gas production subsidies with production subsidies to renewables conducted by the Instituto de Estudos Socioeconômicos (2023) further shows that the former were still about three times higher than the latter in 2022.

Investors and banks also play an important role in enhancing companies' transition plans, especially through their portfolio allocation[20] (WBA et al., 2023). In the case of Petrobras, investors provided (either in the form of debt or equity) USD 54 billion in funding but with few—if any—green or social strings attached (Urgewald, 2024). While there are some signs of Petrobras raising funds and linking these to sustainability targets, such conditionalities should be strengthened. For example, in 2022, Petrobras raised a USD 1.25 billion sustainability-linked loan with its key performance indicators tied to reducing operational emissions intensity (Scope 1 and 2) (Saraiva, 2022). However, such financial instruments should better integrate the full spectrum of transition planning elements.[21] This includes the need for companies to plan for reducing Scope 3 emissions which account for almost 90% of its emissions in the case of Petrobras. This is needed to ensure that the funds companies receive are better linked to transition plan implementation. Integrating credible, robust, and just transition plans in the design of financial instruments is a central means of safeguarding the integrity of transition finance, allowing it to scale and supporting just transitions (WBA & London School of Economics, 2024).

In the context of Petrobras, it is also worth noting that, excluding the federal government, U.S. and Brazilian investors hold significant shares and debt in the company (Urgewald, 2024). Brazilian investors represent 30% of investments in the company, worth USD 16 billion. In addition, there are some noteworthy initiatives by Brazilian investors to integrate climate considerations into their investment decisions. This includes the launch by fama re.capital, an asset manager in Brazil, of the LatAm Climate Turnaround Fund in 2023 (fama re.capital,

[19] The Brazilian government offers tax incentives to stimulate investment in infrastructure projects necessary to national development, including sectors such as transportation, energy, and sanitation. Specifically, it exempts individual investors from income tax on the returns generated by these securities, known as "incentivized bonds." This tax exemption significantly increases their appeal compared to standard bonds, which do not benefit from such fiscal advantages.

[20] For further details on this aspect specifically see ACT Finance methodologies for banks and investors (ACT, n.d.-b).

[21] This finding is corroborated in other research. See for example, Madhavi (2024).

n.d.). This investment vehicle specifically targets high-emitting companies (>1 million tCO_2e) and engages with the companies to improve their decarbonization plans. The asset manager, for example, led discussions directly with companies' senior management, an approach that proved more effective than engaging with their board. However, the change in leadership of Petrobras and the current political signals act as important barriers in transforming Petrobras's business model (Hochstetler & Lippolis, 2024; Reuters, 2024).

In addition, such initiatives from investors in Brazil should be scaled up to manage transition risks and contribute to the investments needed for decarbonization in the real economy. A 2023 study from 2° Investing Initiative and RMI, in partnership with the Securities and Exchange Commission of Brazil, and the German International Cooperation Agency, shows the extent of alignment of Brazilian funds' portfolios with the Paris Agreement goals (Braga et al, 2023).[22] Importantly, Brazilian asset managers have a high concentration of their portfolios (30%) in climate-relevant sectors and invest in a select number of domestic high-emitting companies.[23] As a result, Brazilian investors are also significantly exposed to assets, such as oil and gas, that will need to be phased out to address climate change (Braga et al., 2023). However, given the concentration of investments in select companies, this also means investors have more leverage to influence companies such as Petrobras in adopting credible transition plans, provided the right enabling conditions are also put in place (see Section 4 on the role of net-zero policy).

Finally, public development banks such as BNDES can also play a role in supporting a just transition away from oil and gas in Brazil and defining alternative climate and energy and development pathways. For further insights on this see Box 1.

Box 1. BNDES's role and the need to finance a just transition away from oil and gas

BNDES plays a pivotal role in scaling clean energy financing through its long-term low-cost financing. Through initiatives such as Eco-Invest and the Climate Fund and its ability to lend in the local currency it has been able to leverage private financing and reduce currency hedging risks (Camelo Vega, 2024). However, in addition to scaling clean energy financing, the public development bank could work with multilateral development banks, other domestic financial institutions, and policy-makers in Brazil to support a just transition away from oil and gas.[24]

[22] The report uses the Paris Agreement Capital Transition Assessment methodology to assess the alignment of investor's portfolios with climate and energy scenarios.

[23] The share of assets under management (corporate bonds; listed equity) allocated to climate-relevant sectors in Brazil stands at 30% compared to a usual global average of 5%. Climate-relevant sectors include oil and gas, coal mining, power, automotive, aviation, steel, and cement, but fossil fuels, power, and steel account for 90% of this allocation in Brazil.

[24] There are currently no estimates of just transition costs for a transition away from oil and gas in Brazil. However, considering Petrobras's direct and indirect jobs (616,000 in 2023) and the estimated cost per worker of USD 61,000 (rehiring, income compensation, and health support), this would amount to about USD 40 billion over the time of the transition. This would only be a fraction of the total cost, though, since it does not include just transition planning costs nor the costs of environmental rehabilitation and decommissioning of oil and gas infrastructure, among other costs.

Integrating just transition aspects in net-zero policies is another critical way for governments to address the just aspects of non-state actors' transition plans, as shown by the Interconnected Justice Report launched at COP 29 (UN PRI, 2024b). In the context of Petrobras, the company does have some just transition-related policies in place, such as a commitment to engage in social dialogue with workers and unions (WBA, 2023). However, as shown by WBA, many gaps remain across other areas of just transition, including planning, decent green job creation, and social protection. BNDES could take several steps to enhance Petrobras's transition plan and just transition aspects and reduce the company's transition risk. BNDES does exclude financing for coal-fired thermal plants and new generation using oil derived from petroleum products. However, it could go further to make its financing conditional on no new oil and gas expansion. As the second largest investor in Petrobras, with USD 8 billion in shares in the company, it could use its leverage to engage with Petrobras and enhance its transition plan, particularly the gaps identified in this report (Urgewald, 2024).

BNDES could also work with other financial actors in the region, such as Inter American Development Bank, in integrating the need for no new oil and gas expansion within the issuance of financial instruments. As an example, there is growing momentum around the issuance of just transition-related bonds (Robins et al., 2023). These can be one way to prevent so-called "transition washing" and increase social acceptance in the transition while ensuring the proceeds from such instruments are channelled to regions that will face higher social impacts. The latter includes major oil-producing regions, such as Northern Rio de Janeiro state (Hochstetler & Lippolis, 2024). In addition, there are inspiring examples of development banks working with countries to support economic diversification and a just transition away from fossil fuels. This is the case of the French public development bank (Agence Française de Développement) and Colombia, which collaborated to assess the socio-economic impacts of the transition away from fossil fuels (Godin et al., 2024). This is particularly relevant for BNDES, as its just transition efforts highlight the importance of leveraging synergies and transferring knowledge from the oil and gas sector to emerging industries such as biofuels, offshore wind, and solar energy (BNDES, 2022).

Brazil is further kickstarting just transition tracking work, including through the development of indicators that can help define pathways and policies to support equitable transitions away from oil and gas production (Initiative for Climate Action Transparency, 2024). Finally, Brazil can leverage international forums that advocate for global frameworks that support just transitions. This includes proposed climate country platforms, for example, the Transition Fund of BOGA, that support governments considering policies to transition away from oil and gas. It is also critical to consider just transition both in terms of transitioning out of fossil fuels and into clean energy. Just transition policies should incorporate free prior and informed consent, revenue sharing, and co-ownership models when scaling clean energy investments (Business & Human Rights Resource Centre, 2024).

7.0 Recommendations

A timely and well-managed transition away from fossil fuel production requires clear policy direction, robust transparency measures, and strategic financial realignment. Based on the findings from this report, three recommendations stand out for Brazil to operationalize the 2024 global stocktake commitment on "transitioning away in energy systems in a just, orderly and equitable manner."

- **make a roadmap to curb domestic oil and gas expansion.** Stop issuing fossil fuel exploration licences and phase out development licences, starting with assets most likely to become stranded under low-carbon pathways. Link national transition planning with credible sectoral and regional pathways and implementation at the company level.
- **redefine Petrobras's mandate.** Work with Petrobras on a credible, ambitious transition plan in line with climate and sustainable development goals. Adopt a "harvest mode" strategy to maximize cash flows and shareholder returns by avoiding capital expenditure on oil development. Address policy contradictions that hold back Petrobras's transition through whole-of-government coordination.
- **shift financial flows from oil and gas to clean energy.** Encourage Petrobras to redirect investment into clean energy. Preventing the development of new fields that are still in the exploration phase could help Petrobras avoid between USD 13 and 36 billion in stranded asset losses, depending on the speed of the energy transition. Create a level playing field for different energy technologies and companies through fossil fuel subsidy reform and sustainability regulations on financial institutions.

Investors also have a role to play. BNDES, through its investment arm, is the second largest investor in Petrobras and can influence its transition plan. It could condition its financing on ending oil and gas expansion and work with other financial actors in the region, such as the Inter-American Development Bank, to normalize this standard.

References

Accelerate Climate Transition. (n.d.-a). *The ACT initiative.* https://actinitiative.org/en/about-us/

Accelerate Climate Transition (n.d.-b). *ACT methodologies.* https://actinitiative.org/fr/act-methodologies/

Accelerate Climate Transition. (2021). *Oil and gas methodology.* https://actinitiative.org/wp-content/uploads/pdf/act_og_methodology.pdf

Agência Brasil. (2024). *Lula signs law to expand production of sustainable fuels.* https://agenciabrasil.ebc.com.br/en/politica/noticia/2024-10/lula-signs-law-expand-production-sustainable-fuels

Agência Nacional do Petróleo, Gás Natural e Biocombustíveis. (2025). *Painel Dinâmico de Produção de Petróleo e Gás Natural.* Agência Nacional do Petróleo, Gás Natural e Biocombustíveis. https://app.powerbi.com/view?r=eyJrIjoiNzVmNzI1MzQtNTY1NC00ZGVhLTk5N2ItNzBkMDNhY2IxZTIxIiwidCI6IjQ0OTlmNGZmLTI0YTYtNGI0Mi1iN2VmLTEyNGFmY2FkYzkxMyJ9

Agência Petrobras. (2025). *Petrobras informs about proved reserves in 2024.* https://agencia.petrobras.com.br/en/w/negocio/petrobras-informa-sobre-reservas-provadas-em-2024

Andres, P. Mealy, P., Handler, N., & Fankhauser, S. (2023). Stranded nations? Transition risks and opportunities towards a clean economy. *Environmental Research Letters 18*(2023), Article 045004. https://www.diw.de/de/diw_01.c.870064.de/publikationen/externe_referierte_aufsaetze/2023_0004/stranded_nations__transition_risks_and_opportunities_towards_a_clean_economy.html#:~:text=Using%20methods%20from%20economic%20geography%20and%20complexity%2C%20we,countries%27%20export%20profiles%20are%20locked-in%20to%20brown%20products.

Bhattacharya, A., Songwe, V., Soubeyran, E., & Stern, N. (2024). *Raising ambition and accelerating delivery of climate finance.* Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science. https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2024/11/Raising-ambition-and-accelerating-delivery-of-climate-finance_Third-IHLEG-report.pdf

Bois von Kursk, O., Culbert, V., Darby, M., Gerasimchuk, I., Jones, N., Kuehl, J., Picciariello, A., Ullah, F., & Yanguas Parra, P. (2024). *Transitioning away from oil and gas: A production phase-out primer.* International Institute for Sustainable Development. https://www.iisd.org/publications/report/transitioning-away-from-oil-gas

Bois von Kursk, O., & Posada, C. (2025). *Carbon minefields oil and gas exploration monitor. April 2025 edition.* International Institute for Sustainable Development. https://www.iisd.org/publications/newsletter/april-2025-carbon-minefields

Bois von Kursk, O., Muttitt, G., Picciariello, A., Dufour, L., Van de Graaf, T., Goldthau, A., Hawila, D., Adow, M., Tienhaara, K., Hans, F., Day, T., Mooldijk, S., Abbot, M., & Logan, A. (2022). *Navigating energy transitions: Mapping the road to 1.5°C.* International Institute for Sustainable Development. https://www.iisd.org/publications/report/navigating-energy-transitions

Borges Ramos Dios, L. I., Elera, A., McGivern. A., Macklin, F., Axelsson, K., & Unterstell, N. (2024). *Accelerating the transition to net zero: Insights and recommendations from G20 regulations.* T20. https://www.t20brasil.org/media/documentos/arquivos/TF02_ST_07_Accelerating_the_Tr66cdef216869c.pdf

Braga, C., Lalechere, A., & Pacheco, D. (2023). *Too big to fail: Measuring the alignment of the Brazilian Fund's industry with climate goals.* Climate Policy Programme Brazil, 2 Degree Investing Initiative & RMI, in partnership with the Securities and Exchange Commission of Brazil and the German International Cooperation Agency. https://cooperacaobrasil-alemanha.com/PoMuC/toobigtofail.pdf

Brazilian Development Bank. (2022). *Climate and development: The BNDES's contribution to a just transition.* https://wfdfi.org/en/climate-and-development-the-bndess-contribution-to-a-just-transition/

Business & Human Rights Resource Centre. (2024). *Shared prosperity models & Indigenous Peoples' leadership for a just transition.* Shared prosperity models & Indigenous leadership for a just transition.

Brazil Central Bank. (2021). Resolução CMN n° 4.945 de 15/9/2021. https://www.ancord.org.br/wp-content/uploads/2021/09/Resolu%C3%A7%C3%A3o-CMN-n%C2%B0-4.945-de-15_9_2021.pdf

Bressler, R. D. (2021). The mortality cost of carbon. *Nature Communications, 12.* Article 4467. https://www.nature.com/articles/s41467-021-24487-w

Camelo Vega, A. M. (2024). *Financing pathways for the energy transition: A regional approach.* Columbia Center on Sustainable Investment. https://ccsi.columbia.edu/sites/default/files/content/docs/publications/ccsi-financing-pathways-energy-transition.pdf

Carbon Tracker. (2019). *Breaking the habit – Methodology.* https://carbontracker.org/wp-content/uploads/2023/12/Breaking-the-Habit-Methodology-Final-1.pdf

Carbon Tracker. (2024a). *Oil and gas least-cost methodology.* https://carbontracker.org/reports/oil-and-gas-least-cost-analysis/

Carbon Tracker. (2024b). *Oil and gas transition plans user guide.* https://carbontracker.org/reports/oil-and-gas-transition-plans-user-guide/

Climate Policy Monitor. (n.d.). *Brazil.* https://climatepolicymonitor.ox.ac.uk/jurisdictions/brazil

Cohen, I., & Urrutia, R. (2024). *Mercado de capitais cresceu no financiamento da infraestrutura, mas e o BNDES?* JOTA. https://www.jota.info/opiniao-e-analise/colunas/infra/mercado-de-capitais-cresceu-no-financiamento-da-infraestrutura-mas-e-o-bndes?tps://www.jota.info/opiniao-e-analise/colunas/infra/mercado-de-capitais-cresceu-no-financiamento-da-infraestrutura-mas-e-o-bndes?utm_so

Coutinho, L. C., Império, M., Angelkorte, G., da Silva, G. N., Bergman-Fonte, C., Draeger, R., Cunha, B. S. L., Rochedo, P. R. R., Szklo, A., & Schaeffer, R. (2024). Climate strategies for oil and gas production under the lens of an integrated assessment model: The case of Brazil. *International Journal of Greenhouse Gas Control 137*, Article 104231. https://doi.org/10.1016/j.ijggc.2024.104231.

Energy Research Company. (2020). *Estudo Ambiental de Área Sedimentar na Bacia Terrestre de Solimões (EAAS)*. Empresa de Pesquisa Energética. https://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublishingImages/Paginas/Forms/Publicaes/EAAS%20Solim%C3%B5es%20-%20vers%C3%A3o%20completa.pdf

Energy Research Company. (2024). *BEN: Summary report 2024.* https://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-819/topico-715/BEB_Summary_Report_2024.pdf

Energy Research Company. (2025). *O Papel do Setor de Petróleo e Gás Natural na Transição Energética.* Empresa de Pesquisa Energética. www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/o-papel-do-setor-de-petroleo-e-gas-natural-na-transicao-energetica Accessed 7 Mar. 2025.

Escolhas. (2023). *Quanto o Brasil precisa investir, hoje, para recuperar 12 milhões de hectares de florestas?* Instituto Escolhas. https://escolhas.org/wp-content/uploads/2023/12/Onepage_12mi.pdf

Fama re.capital. n.d. *LatAm climate turnaround fund.* https://famarecapital.com/eng/investments/latam-climate-turnaround-fund/

Figueiredo. N. (2025). *Brazil's Marina Silva warns global unity is key to COP30 success.* Valor International. Sao Paulo. https://valorinternational.globo.com/environment/news/2025/04/28/brazils-marina-silva-warns-global-unity-is-key-to-cop30-success.ghtml

Fuss, S., Lamb, W. F., Callaghan, M. W., Hilaire, J., Creutzig, F., Amann, T., Beringer, T., de Oliveira Garcia, W., Hartmann, J., Khanna, T., Luderer, G., Nemet, G. F., Rogelj, J., Smith, P., Vicente Vicente, J. L., Wilcox, J., del Mar Zamora Dominguez, M., & Minx, J. C. (2018). Negative emissions—Part 2: Costs, potentials and side effects. *Environmental Research Letters, 13*(6), Article 063002. https://doi.org/10.1088/1748-9326/aabf9f.

G20 Sustainable Finance Working Group. (2024). *2024 G20 sustainable finance report.* https://g20sfwg.org/wp-content/uploads/2024/10/2024-G20-Sustainable-Finance-Report.pdf

Godin, A., Yilmaz, D., & Moreau Santo, A. (2024). *Modelling low-carbon transitions in Colombia: Macro financial opportunities and risks.* Agence Française de Développement. https://www.afd.fr/en/ressources/modelling-low-carbon-transitions-colombia-macrofinancial-opportunities-and-risks

Gonzales-Zuniga, S., Riaz, D., & Moisio, M. (2024). *Highlighting the hypocrisy: Fossil fuel export emissions.* Climate Action Tracker. https://climateactiontracker.org/blog/highlighting-the-hypocrisy-fossil-fuel-export-emissions/

Grant, N., Gambhir, A., Mittal, S., Greig, C. & Köberle, A. C. (2022). Enhancing the realism of decarbonisation scenarios with practicable regional constraints on CO_2 storage capacity. *International Journal of Greenhouse Gas Control 120,* Article103766. https://doi.org/10.1016/j.ijggc.2022.103766.

Green, F., & Finighan, R. (2012). *Laggard to leader: How Australia can lead the world to zero carbon prosperity.* Beyond Zero Emissions. https://nla.gov.au/nla.obj-3160786144/view

Green, F., Bois von Kursk, O., Muttitt, G., & Pye, S. (2024). No new fossil fuel projects: The norm we need. *Science, 384,* Article 6699, 954–57. https://doi.org/10.1126/science.adn6533.

Harrigan, K. R., & Porter, M. E. (1983). *End-game strategies for declining industries.* Harvard Business Review. https://hbr.org/1983/07/end-game-strategies-for-declining-industries

Heller, P., Muttitt, G., Gillies, A., Mahdavi, P., Manley, D., Marcel, V., Roth, J., Melgar, L., Monaldi, F., & Picciariello, A. (2021). *National oil companies and climate change: Insights for advocates.* Natural Resource Governance Institute & International Institute for Sustainable Development. https://resourcegovernance.org/publications/national-oil-companies-and-climate-change-insights-advocates

Hochstetler, K., & Lippolis, N. (2024). *Prosperity post fossil fuels: Policy briefing for a just energy transition in Brazil.* Climate Strategies. https://climatestrategies.org/wp-content/uploads/2024/11/PPFF-Briefing-Brazil-Final.pdf

Holz, C., Kartha, S., Muttitt, G., & Athanasiou, T. (2024). *Methodology appendix for "An equitable phase out of fossil fuel extraction."* https://doi.org/10.5281/ZENODO.2595508.

Initiative for Climate Action Transparency. (2024). *Brazil kicks off just transition tracking project.* https://climateactiontransparency.org/brazil-kicks-off-just-transition-tracking-project/#:~:text=The%20project%20aims%20to%20establish%20a%20just%20transition,action%20requires%20a%20fundamental%20transformation%20of%20economies%20worldwide

International Energy Agency. (2024). *World energy outlook.* https://www.iea.org/reports/world-energy-outlook-2024/

International Energy Agency. (2025). *World energy investment 2025.* https://iea.blob.core.windows.net/assets/1b241aed-501c-4612-947e-8b4ad0d234a0/WorldEnergyInvestment2025.pdf

Instituto de Estudos Socioeconômicos. (2023). *Subsidies for fossil and renewable energy 2018-2022.* https://inesc.org.br/wp-content/uploads/2023/12/subsidies-for-fossil-and-renewable-energy-2018-2022.pdf?x69356

Kühne, K. (2024). *Harvest mode* [Brief]. Leave it in the Ground Initiative. https://www.leave-it-in-the-ground.org/wp-content/uploads/2024/11/Harvest-Mode.pdf

Madhavi, P. (2024). *Collaborative levers for methane abatement in national oil companies.* Environmental Defense Fund. https://blogs.edf.org/wp-content/blogs.dir/90/files/2024/12/Collaborative-Levers-for-Financial-Engagement-at-NOCs-1.pdf

Manley, D., Furnaro, A., & Heller, P. (2023). *Riskier bets, smaller pockets: How national oil companies are spending public money amid the energy transition.* Natural Resource Governance Institute. https://resourcegovernance.org/publications/riskier-bets-smaller-pockets-national-oil-companies-public-money-energy-transition

Manning, M., Bowhay,R., Bowman, M., Knaack, P., Sachs, L., Smolenska, A., Stewart, F., Tayler, T., Toledano, P., & Walkat, H. (2024). *A handbook to strategic national transition planning: Supplementary guidance and examples.* https://www.lse.ac.uk/granthaminstitute/publication/a-handbook-to-strategic-national-transition-planning-supplementary-guidance-and-examples/

Mesa Puyo, D., Panton, A. J., Sridhar, T., Stuermer, M., Ungerer, C., & Tianbo Zhang, A. (2024). *Key challenges faced by fossil fuel exporters during the energy transition* [Staff climate notes]. International Monetary Fund. https://www.imf.org/en/Publications/staff-climate-notes/Issues/2024/03/26/Key-Challenges-Faced-by-Fossil-Fuel-Exporters-during-the-Energy-Transition-546066

Ministry of Mines and Energy (2025). *Exploração e Produção de Petróleo e Gás Natural: Perguntas Frequentes.* Ministério de Minas e Energia. https://www.gov.br/mme/pt-br/acesso-a-informacao/perguntas-frequentes/exploracao-e-producao-de-petroleo-e-gas-natural

Muttitt, G. (forthcoming). *Canadian oil and gas production in the global clean energy transition: Outlook and economic risks.*

Muttitt, G., & Yanguas Parra, P. (2024). *Costing a fossil fuel phaseout.* University College London Energy Institute. https://www.ucl.ac.uk/bartlett/energy/sites/bartlett_energy/files/costing_a_fossil_fuel_phaseout_final.pdf

Observatório do Clima (2024). A Quick Analysis of Brazil's Second NDC. https://oc.eco.br/wp-content/uploads/2024/11/A-QUICK-ANALYSIS-OF-BRAZILS-NDC.docx.pdf

Oliveto, P. (2024). *Brasileiros querem que país lidere a transição energética.* Correio Braziliense. https://www.correiobraziliense.com.br/ciencia-e-saude/2024/11/6988955-brasileiros-querem-que-pais-lidere-a-transicao-energetica.html

Organisation for Economic Co-operation and Development. (2025). *Country trends in fossil-fuel subsidies.* https://fossilfuelsubsidytracker.org/country/

Petrobras. (2024). *Strategic plan 2050: Business plan Petrobras 2025-2029.* https://api.mziq.com/mzfilemanager/v2/d/25fdf098-34f5-4608-b7fa-17d60b2de47d/636e93d5-0ecc-5244-1806-eda80d311500?origin=2

Petrobras. (2025a). *Profile.* https://petrobras.com.br/en/quem-somos/perfil

Petrobras. (2025b). *Shareholding structure.* https://www.investidorpetrobras.com.br/en/overview/shareholding-structure/

Prince, G. (2023). *PetroStates of decline: Oil and gas producers face growing fiscal risks as the energy transition unfolds.* Carbon Tracker. https://carbontracker.org/reports/petrostates-of-decline/

Rahi, G., Postic, S., Cardenas Monar, D., Eschalier, C., & Bendahou, S. (2024). *Thinking about the implications. How countries plan to finance their climate transition.* I4CE. https://www.i4ce.org/en/publication/thinking-implications-how-countries-plan-finance-climate-transition/

Reuters. (2024). *Petrobras' new strategic plan to have greater focus on oil and gas, CFO says.* https://www.reuters.com/business/energy/petrobras-new-investment-plan-have-greater-focus-oil-gas-cfo-says-2024-09-16/

Richterss, O., Kriegler, E., Bertram, C., Cui, R., Edmonds, J., Fawcett, A., Fuhrman, J., George, M., Hackstock, P., Hurst, I., Ju, Y., Kotz, M., Liadze, I., Min, J., Piontek, F., Sanchez Juanino, P., Sferra, F., Stevanovic, M., van Ruijven, B., … Zhao, X. (2024). NGFS Climate Scenarios Data Set (5.0) [Data set]. Zenodo. https://doi.org/10.5281/zenodo.13989530

Robins N., Curran, B., Plyska, O., Burge, L., & Van Coppenolle, M. (2023). *Mobilising global debt markets for a just transition.* Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science. https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2023/12/Mobilising-global-debt-markets-for-a-just-transition-policy-insight.pdf

Rystad Energy. (2024, Dec. 4). *Upstream industry: Staying steady - Energy transition risk for the upstream industry* (7th edition).

Rystad Energy. (2025a). *Client portal dashboards.*

Rystad Energy. (2025b). *Rystad Energy UCube v.2.3.2* (Proprietary data).

Sant'Ana, J. (2024). *Fiscal policy watchdog sees Brazil's debt rising to 84% of GDP by 2026.* Valor International. https://valorinternational.globo.com/economy/news/2024/10/18/fiscal-policy-watchdog-sees-brazils-debt-rising-to-84percent-of-gdp-by-2026.ghtml

Santos, M. O. S. D., Nepomuceno, M. M., Gonçalves, J. E., Medeiros, A. C. L. V., Machado, R. M., Santos, C. P. D. S., Alves, M. J. C. F., Gurgel, A. D. M., & Gurgel, I. G. D. (2022). Oil spill in Brazil—Analysis of vulnerabilities and socio-environmental conflicts. *BioChem, 2*(4), 260–268. https://doi.org/10.3390/biochem2040018

Saraiva, A. (2022). *Petrobras signs $1.25bn sustainability loan.* Valor International. https://valorinternational.globo.com/business/news/2022/07/11/petrobras-signs-125bn-sustainability-loan.ghtml

United Nations Environment Programme. (2024). *Emissions gap report 2024: No more hot air … please! With a massive gap between rhetoric and reality, countries draft new climate commitments.* https://doi.org/10.59117/20.500.11822/46404

United Nations Principles for Responsible Investment. (2024a). *Net zero policy matters: Assessing progress and taking stock of corporate and financial net zero policy reform.* https://www.unpri.org/taskforce-on-net-zero-policy/net-zero-policy-matters-assessing-progress-and-taking-stock-of-corporate-and-financial-net-zero-policy-reform/12852.article

United Nations Principles for Responsible Investment. (2024b). *Interconnected justice: Understanding the cross-border implications of climate transition policies.* https://www.unpri.org/taskforce-on-net-zero-policy/interconnected-justice-understanding-the-cross-border-implications-of-climate-transition-policies/12853.article

Urgewald. (2024). *Investing in climate chaos.* https://investinginclimatechaos.org/data?org=Petroleo+Brasileiro+SA+%E2%80%93+Petrobras

World Benchmarking Alliance. (2023). *Oil and gas benchmark.* https://www.worldbenchmarkingalliance.org/publication/oil-and-gas/

World Benchmarking Alliance. (2024). *Assessing the credibility of a company's transition plan: framework and guidance.* https://www.worldbenchmarkingalliance.org/research/assessing-the-credibility-of-a-companys-transition-plan-framework-and-guidance/

World Benchmarking Alliance, International Institute for Sustainable Development, & University of California Santa Barbara 2035 Initiative. (2023). *Assessing national oil companies' transition plans: an essential tool for banks, investors and regulators.* https://www.worldbenchmarkingalliance.org/news/assessing-national-oil-companies-transition-plans-an-essential-tool-for-banks-investors-and-regulators/

World Benchmarking Alliance & London School of Economics. (2024). *How finance can unlock credible, robust and just transition plans.* https://g20sfwg.org/wp-content/uploads/2024/07/WBA-GRI-G20-SFWG-final-input-paper.pdf

Zacharias, D. C., Lemos, A. T., Keramea, P., Dantas, R. C., Da Rocha, R. P., Crespo, N. M., Sylaios, G., Jovane, L., Da Silva Santos, I. G., Montone, R. C., De Oliveira Soares, M., & Lourenço, R. A. (2024). Offshore oil spills in Brazil: An extensive review and further development. *Marine Pollution Bulletin, 205,* Article 116663. https://doi.org/10.1016/j.marpolbul.2024.116663

2C Investing Initiative France. (2023). *Four public policy avenues for scaling up sustainable finance in Brazil.* https://sustainablefinanceobservatory.org/wp-content/uploads/2023/05/Four-policy-avenues-for-SF-in-Brazil.pdf

Published by the International Institute for Sustainable Development

Head Office

111 Lombard Avenue, Suite 325
Winnipeg, Manitoba
Canada R3B 0T4

Tel: +1 (204) 958-7700
Website: www.iisd.org
𝕏: @IISD_news

IISD

iisd.org