Pré-sal Petróleo

MINISTÉRIO DE MINAS E ENERGIA

GOVERNO FEDERAL BRASIL UNIÃO E RECONSTRUÇÃO

Perspectives for Brazilian Offshore:

Increasing the Balance Between Legacy and Renewable Projects

Tabita Loureiro, Technical Director

OFFSHORE TECHNOLOGY CONFERENCE

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Brazil at a glance

Brazil plays a relevant role in the Global O&G Industry

The largest economy in **Latin America**

Among the largest economies in the world

(Rank 9th in 2023 2,17 trillion USD - Austin Rating)

5th and 7th world's largest territory and population

7th

Largest **Oil** producer (IEA, Oil Market Report Dec, 2023)

8th

Largest **Oil Products Consumer** (Energy Institute, Statistical Review of World Energy 2023)

4th Largest automotive fuel market in the World (ANP)

A domestic market of over 215 million inhabitants

Among the 10 largest crude oil exporters in the world

1.6 million bpd in 2023

9th

Largest **Refining Capacity** (Energy Institute, Statistical Review of World Energy 2023)

But still need to import diesel, gasoline, jet fuel and LPG

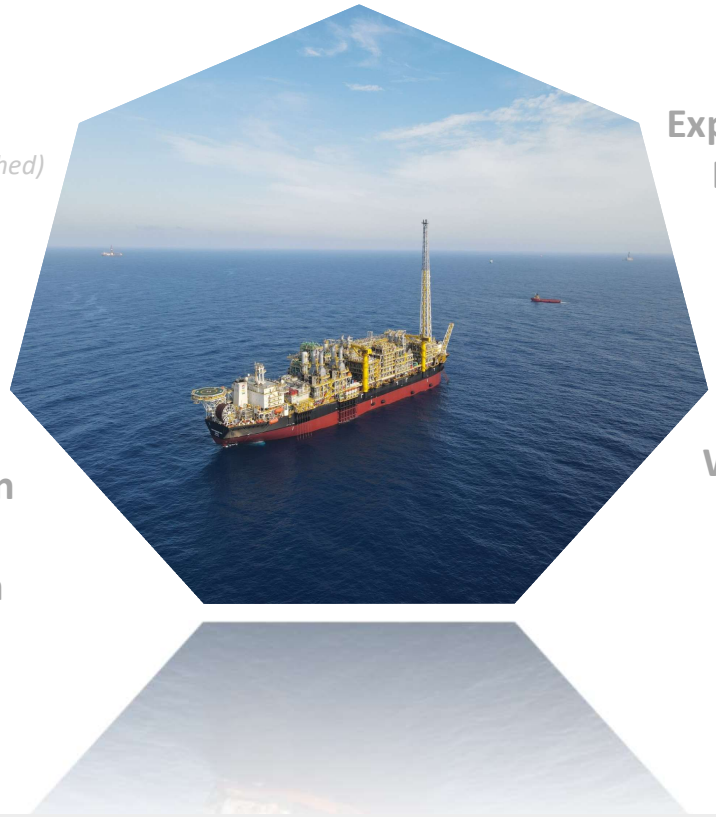
1
Offshore Exploration & Production Overview

Brazilian Offshore E&P in big numbers

221
E&P Contracts

141
Fields
(39 to be relinquished)

100
Exploratory Blocks



~70
Production Units in operation

7,075
Wells drilled

Production:
4 Million boed
Brazil: 4.4Mboed

3.3
Million bpd of oil production
(Feb 2024)
Brazil: 3.45 Mbpd

125
Million m^3/d of gas production
(Feb 2024)
Brazil: 149 MMm^3/d

Reserves:

15.4B
bbl in proved oil reserves
(Dec 2023)
Brazil: 15.9 Bbbl

417B
m^3 in proved gas reserves
(Dec 2023)
Brazil: 517 Bm^3

US$ 102B
in E&P investments (2024-2028)

USD 98.6B in D&P and USD 3.4B in Exploration

Source: ANP

Most of our production and reserves are offshore…

Offshore accounts for **95%** of total O&G production in Brazil

Offshore accounts for **97,4%** of total oil reserves and **83%** of total gas reserves *(Dec, 2023)*

Brazil is the second largest offshore crude oil producer

Brazil is a leader in offshore deepwater activities and technologies

Ranking	Country	Oil Production (kbbl/d)
1st	Saudi Arabia	4,247
2nd	Brazil	3,326
3rd	United States	1,958
4th	UAE	1,882
5th	Norway	1,815
6th	Mexico	1,298
7th	China	1,256

Source: Rystad, 2023

~37 Companies in Offshore E&P activities

(Main majors and independents investing in Brazil)

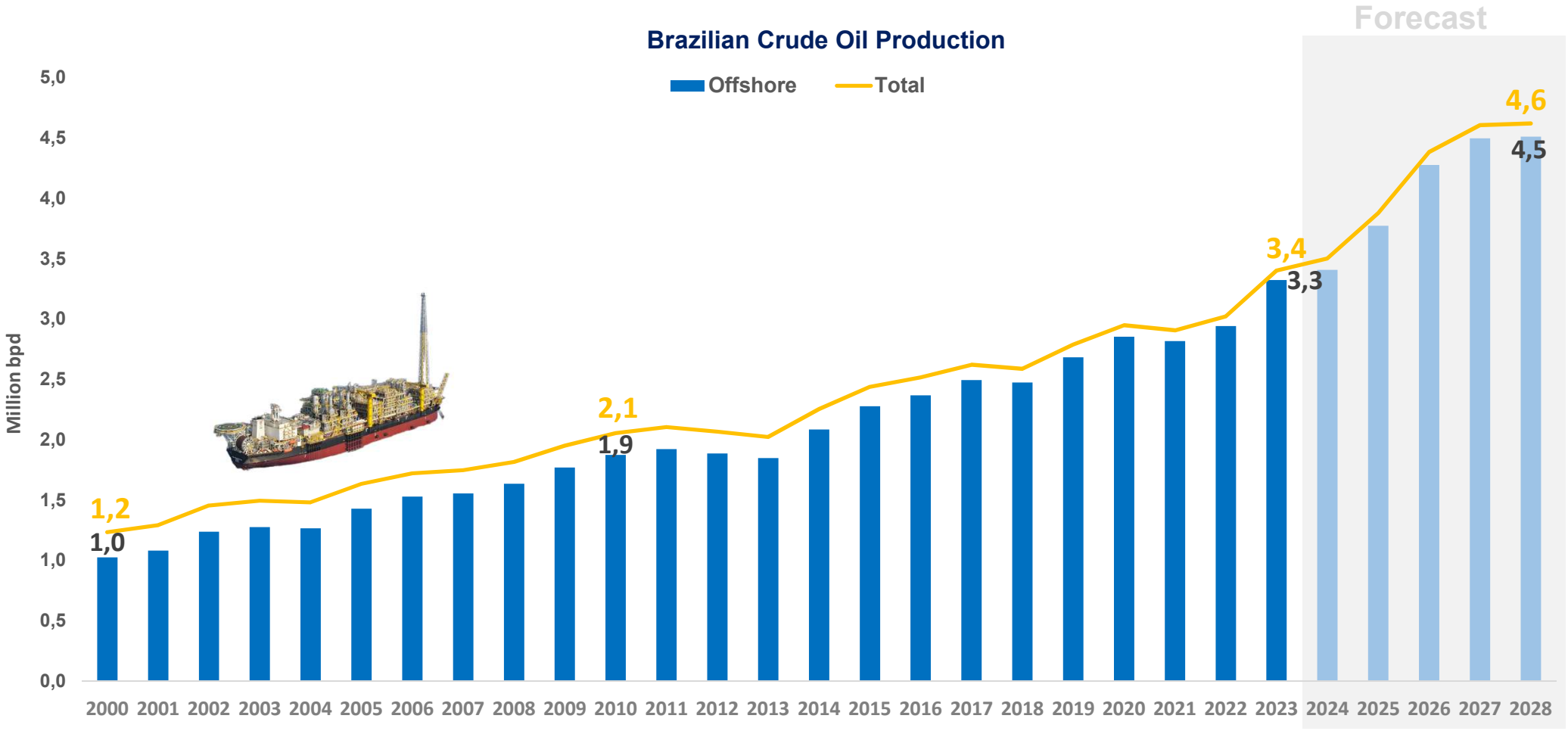
Production

64% Petrobras | 36% Others

Source: ANP

Offshore oil production in Brazil will continue to increase…

Brazil is poised to be one of the key sources of growth over the medium term



Source: ANP

Brazil is home for the majority of FPSOs under development

At least 18 new production units are going to start operation until 2030

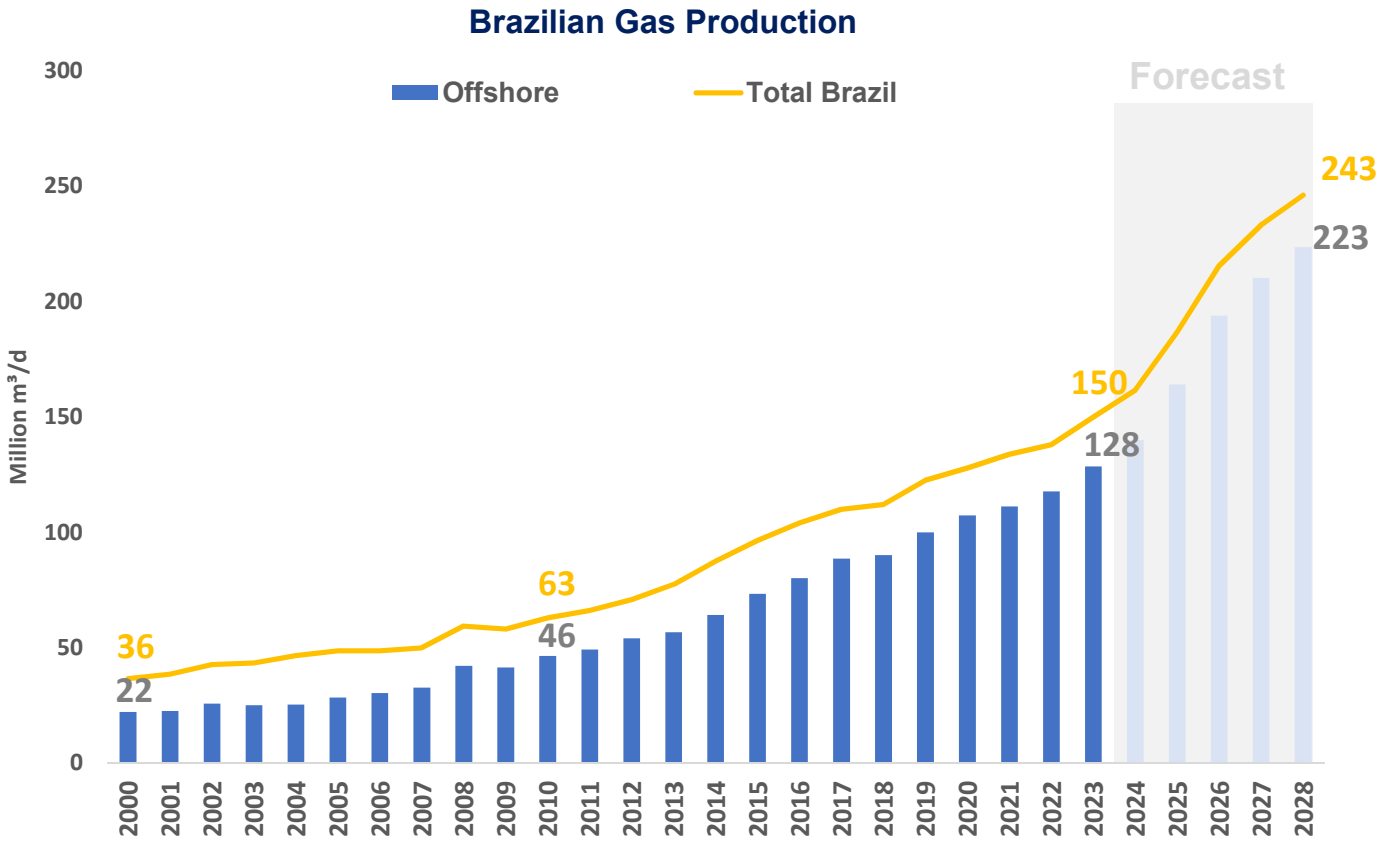
2024	2025	2026	2027	2028	After...
Mero 3 Mal. D. de Caxias	Búzios 7 Alm. Tamandaré	Búzios 8 P-79	Búzios 10 P-82	Revit BRC/CRT	Sépia 2
FPSO Atlanta	IPB Maria Quitéria	Búzios 9 P-80	Búzios 11 P-83	SEAP 1	Atapu 2
	Mero 4 Alex. Gusmão		Revit. Albacora	SEAP 2	
	Búzios 6 P-78			BM-C-33	
	FPSO Bacalhau				

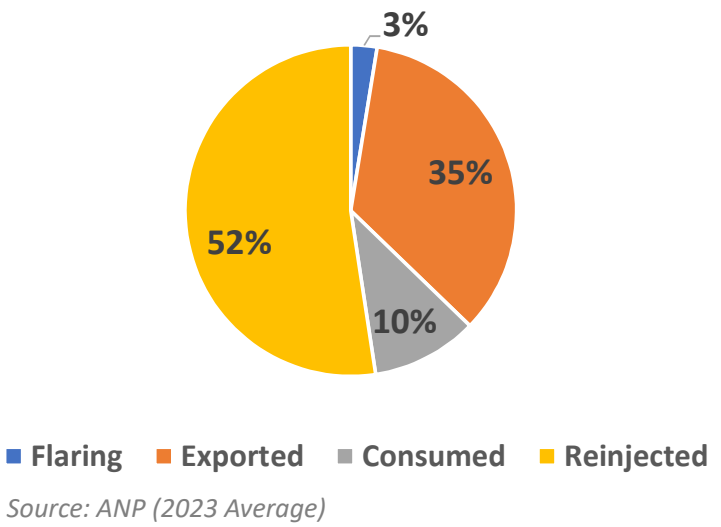
*Non-Petrobras Operator

Source: Petrobras, PPSA, ANP

Offshore gas production in Brazil is also increasing…

But we need to reinject a relevant amount to increase oil recovery
And we have a significant CO2 production (15% in 2024 of total gas production)



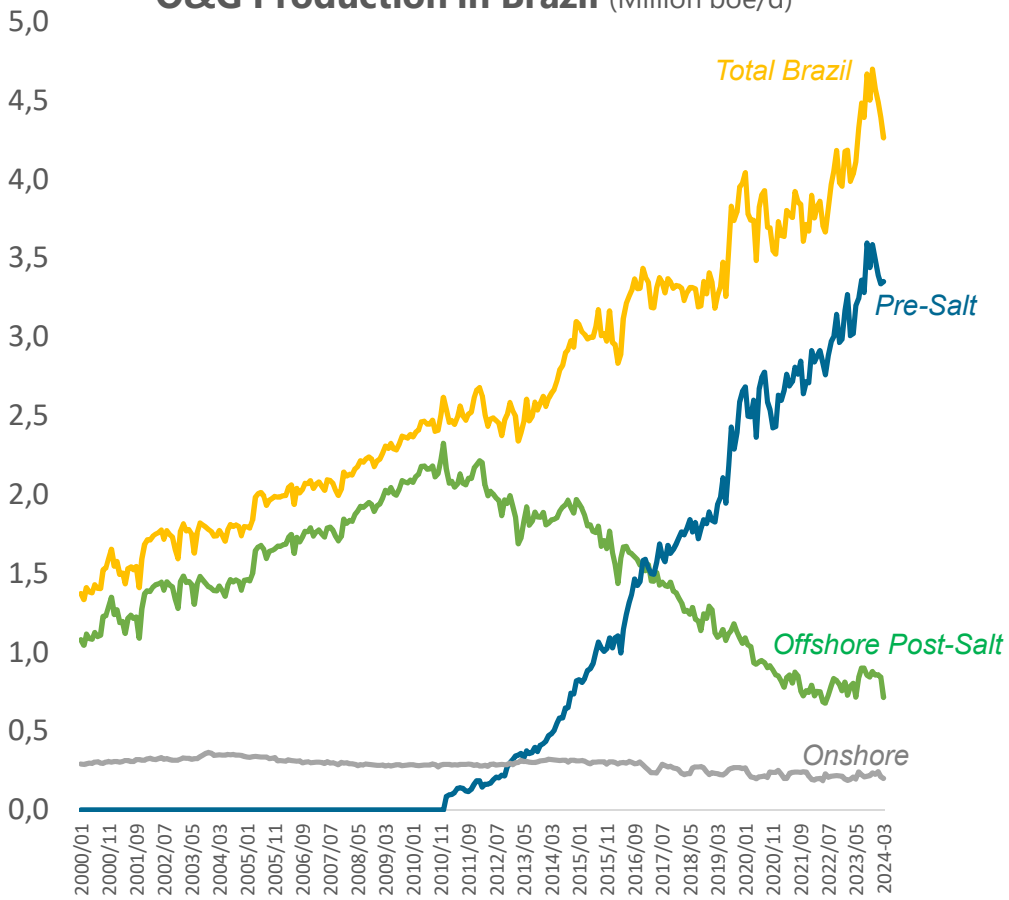


Source: ANP (2023 Average)

Pre-salt is the main responsible to Brazilian production growth

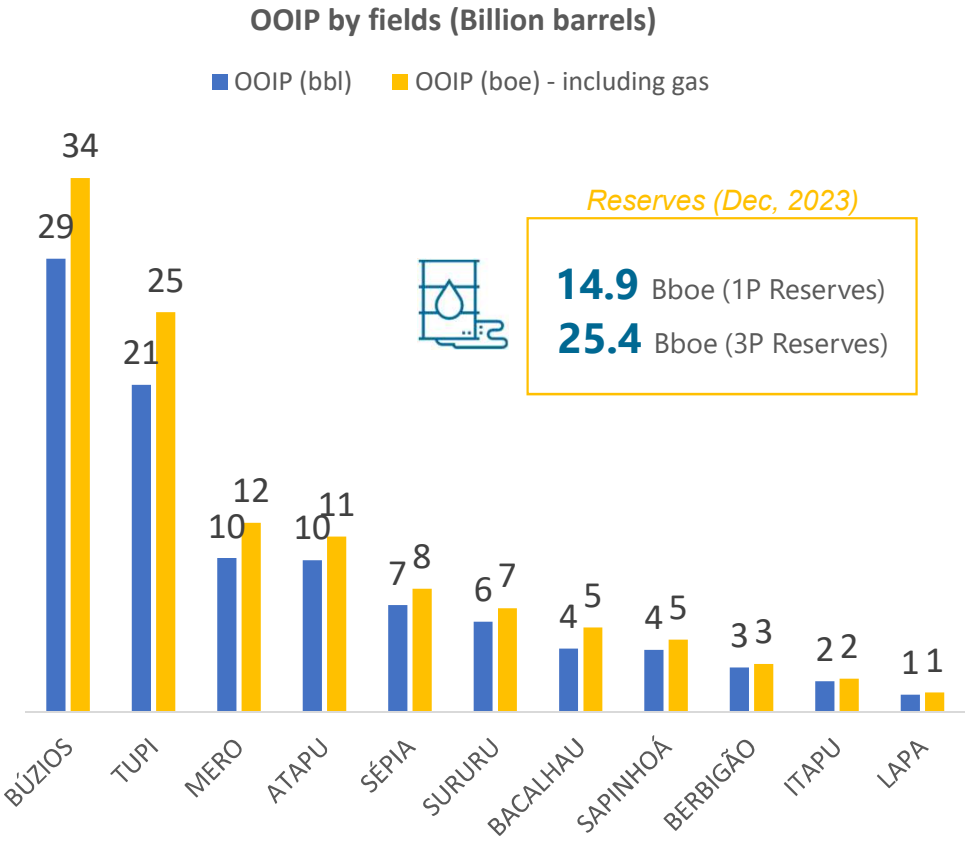
Home to the largest offshore oil discoveries in the last decade, pre-salt answers for **78%** of total Brazilian production

O&G Production in Brazil (Million boe/d)



Source: ANP

~100 billion barrels of oil in place were discovered in the Santos Basin pre-salt and are commercial

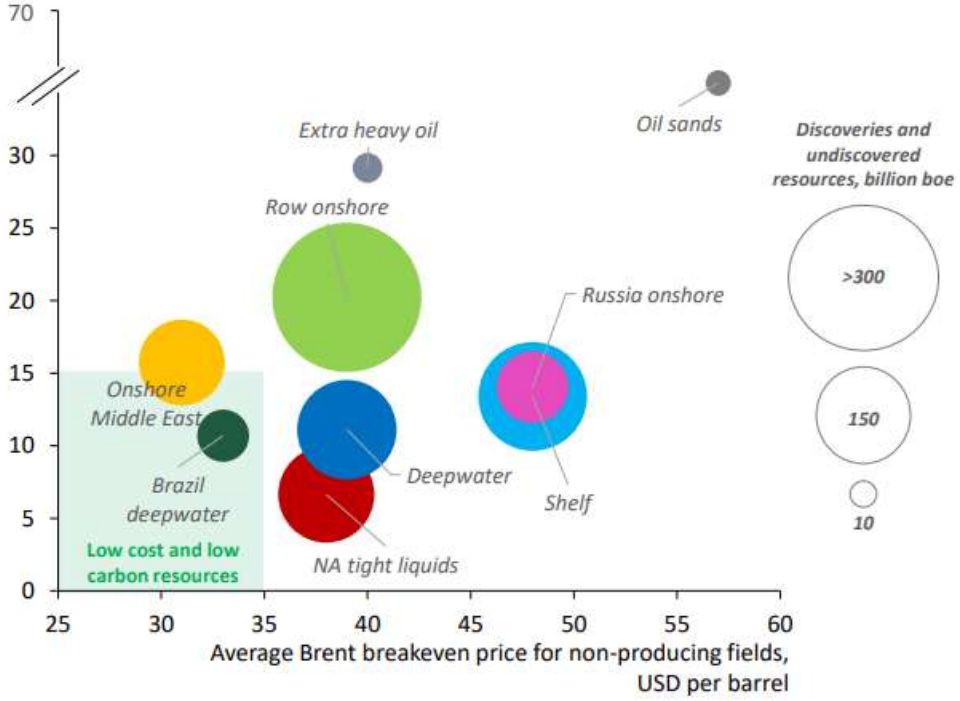


Pre-salt is a global competitive environment

The pre-salt main fields have triple resilience (technical, economic and environmental)

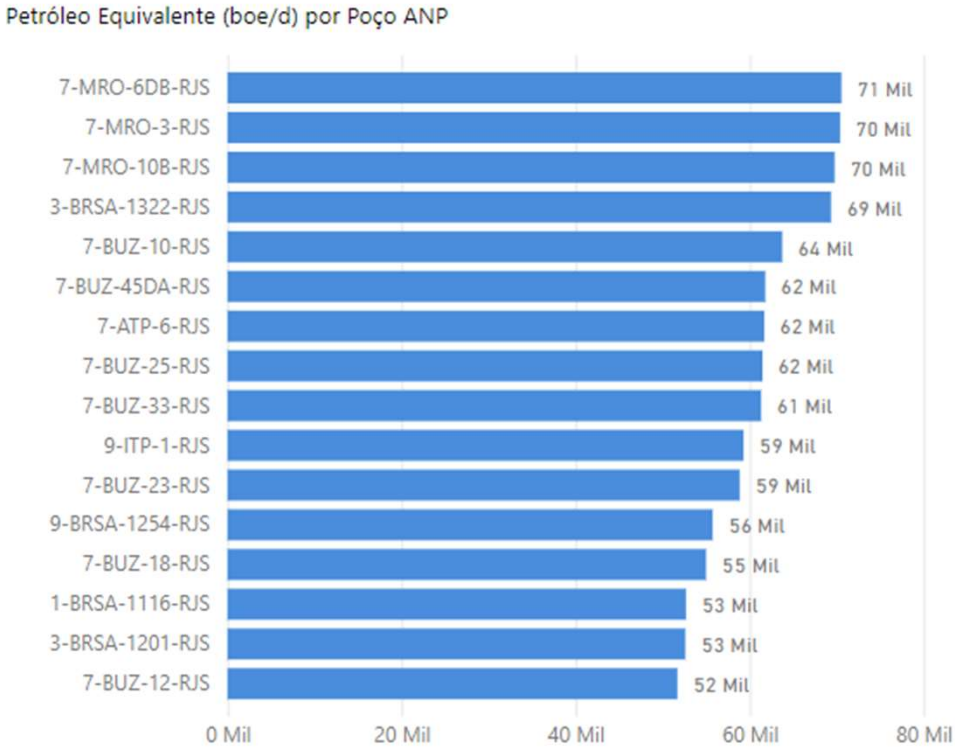
Emissions intensity and cost competitiveness for remaining global resources

Expected carbon intensity, $kgCO_2/boe$



RystadEnergy

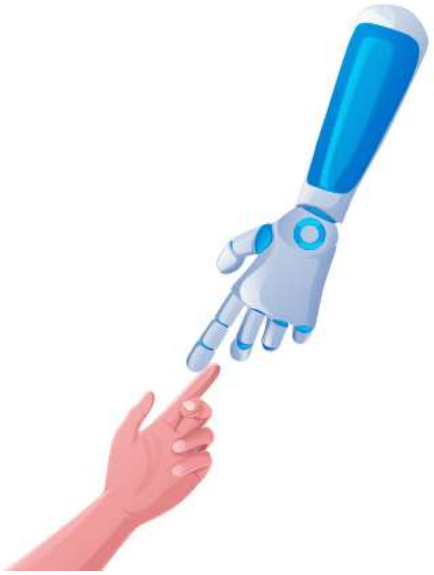
High Productivity Wells (kboe/d)



Source: ANP (September, 2023)

~150 wells in production

Innovative and impactful technologies applied in the pre-salt



Geosciences	OBN Seismic
	Complex Seismic Inversion
	4D Seismic
Reservoir Engineering	Pro-Active IC with AI Tools
	WAG
	Tracer Tests
Wells	Intelligent Open Well Completion (PACI)
	All-Electric Intelligent Well Completion
	Autonomous Inflow Control Devices (AICD)
Submarine Systems	HiSEP
	Daisy chain
	Subsea System Pre-Installation
Production Units	CO2/H2S Removal Membranes
	Combined Cycle Turbines
	Gas and Water HUBs
Offloading	CTV

Post-Salt: still a lot of opportunities

We are talking about all the offshore area besides the pre-salt fields, that answers for **17%** of total O&G production, with **348** wells in production

Post-Salt Reserves

3.1 Bboe (1P Reserves)

5.1 Bboe (3P Reserves)

01 A significant number of large **mature fields** with opportunities to increase RF

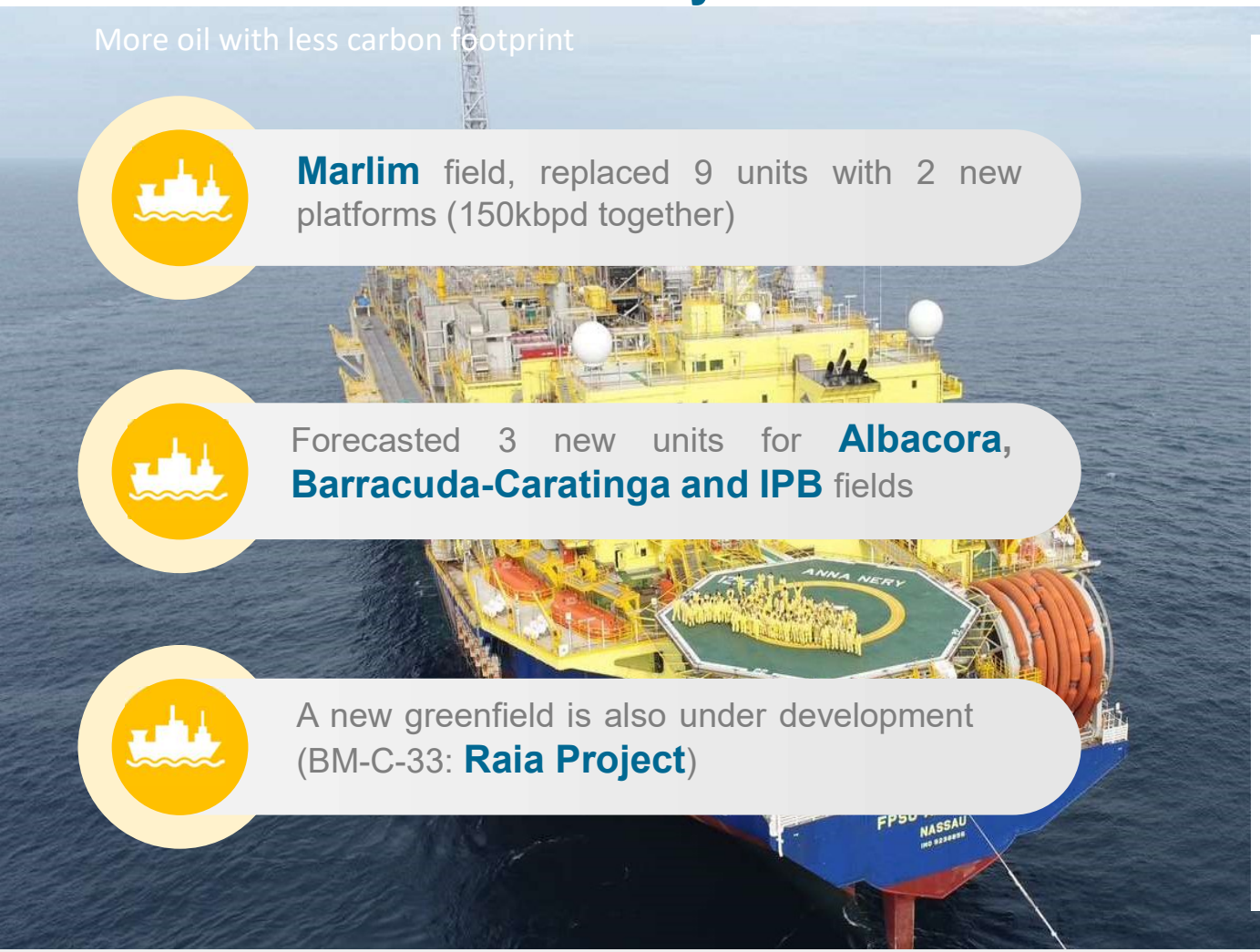
02 A diverse environment with independents and majors

03 New **greenfields** under development in different basins (SEAL, Campos...)

04 Exploration in **new frontier areas**

Campos Basin is receiving the biggest revitalization projects from the offshore industry

More oil with less carbon footprint



Marlim field, replaced 9 units with 2 new platforms (150kbpd together)

Forecasted 3 new units for **Albacora, Barracuda-Caratinga and IPB** fields

A new greenfield is also under development (BM-C-33: **Raia Project**)

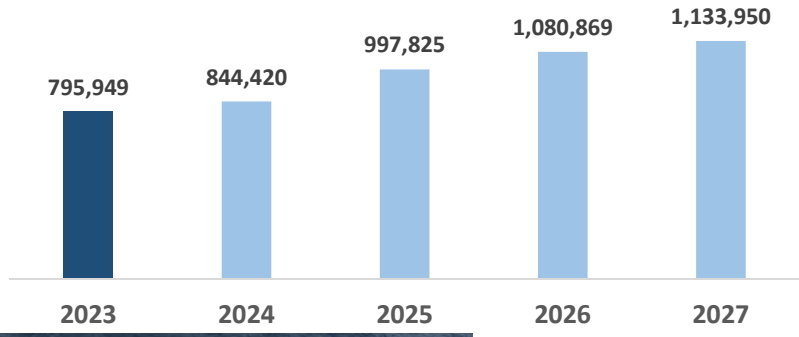
Campos Basin Recovery Factor

3P Reserves — 22% — 7.2 Bboe

1P Reserves — 19% — 4.5 Bboe

Recovered — 15% — 16 Bboe (already produced)

Campos Basin Forecast Oil Production (bpd)



Well activities in Brazil are relevant

Significant demand for offshore activities with rigs, including plug & abandonment, new developments and infill drilling wells

33 rigs

Approved to operate in offshore Brazil

(Among the 10th countries with more offshore rigs in operation)

Source: Esgian

7,075 Offshore Wells drilled in Brazil

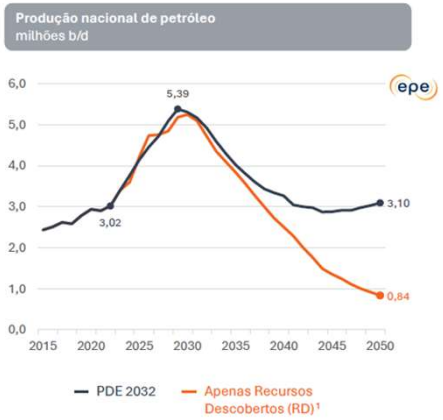
	2024	2025	2026
P&A	97	135	202
Drilling in Fields	107	94	80
Drilling in Expl. Blocks	14	8	1
Recompletions	56	27	5

Source: ANP

But we need to increase offshore exploratory activities

Number of Offshore Exploratory Wells Drilled

Source: ANP



Brazilian oil production curve is expected to peak until 2030. If we don´t want to become a crude oil importer from the late 2030s we need to increase exploration to find new commercial and relevant discoveries…

We need to continue exploration within the pre-salt polygon, but is crucial to open new frontier basins

Exploration within the pre-sal polygon

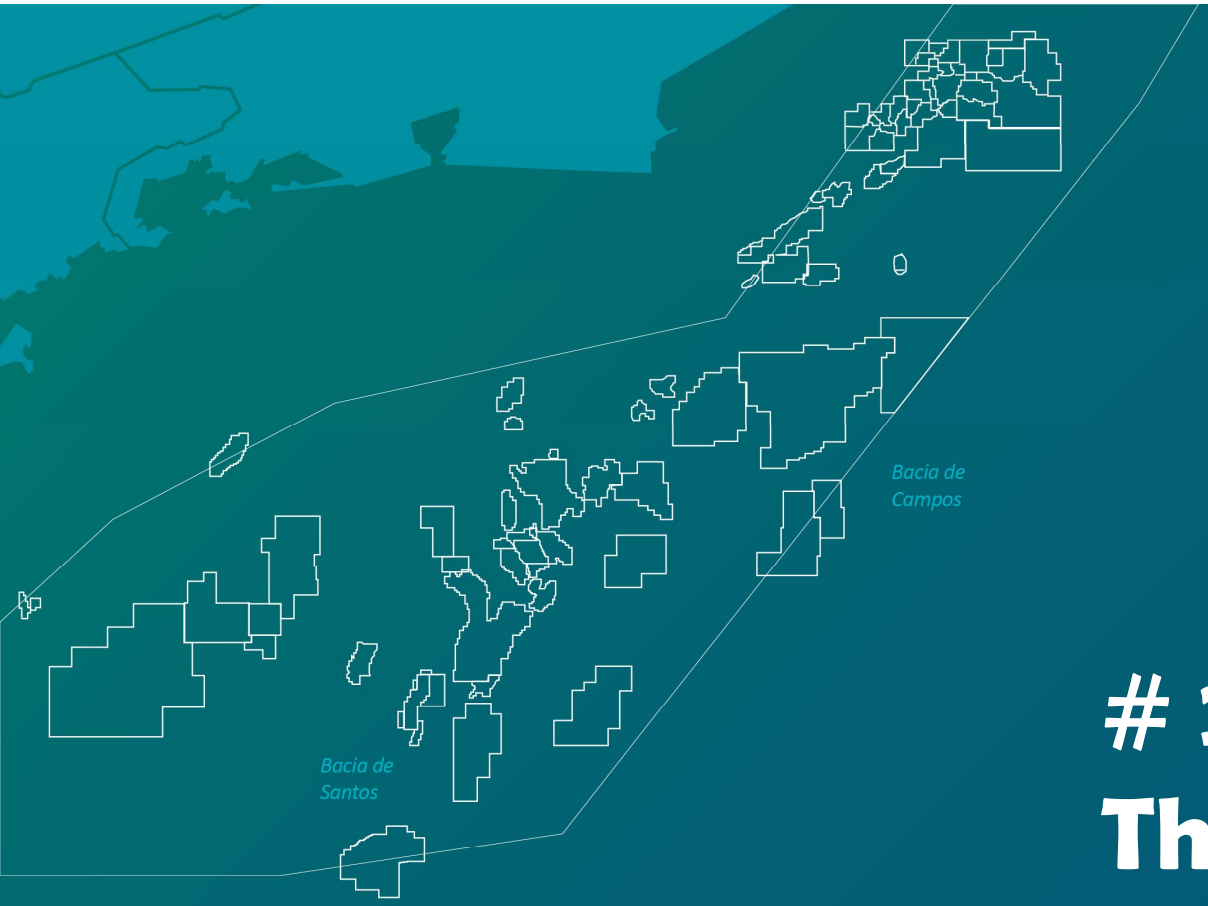
Past

1. Giant Discoveries in the pre-salt
2. Lower Risks in the pre-salt
3. High Government Take applied
4. Post-salt exploration forgotten

Today

1. Smaller discoveries
2. Exploratory risks as the world average
3. BID Parameters adjusted
4. Post-salt started to be target

Brazil needs new frontier areas like Equatorial Margin and Pelotas basin to keep its production in the future...



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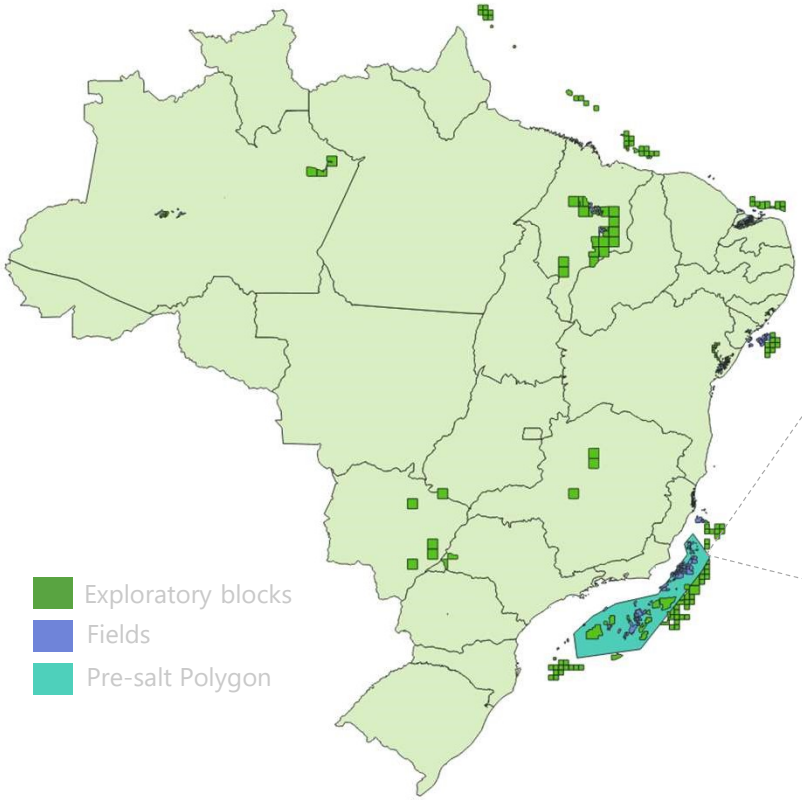
2
The Production Sharing Contracts

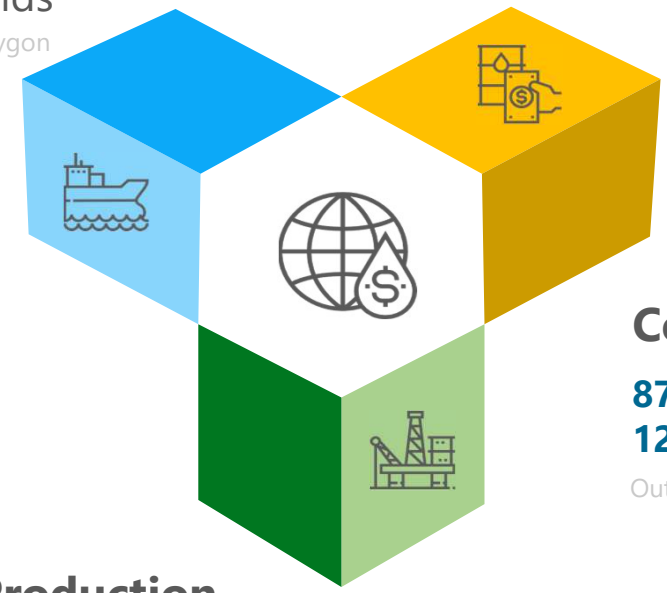
Types of Contracts in the offshore environment



Transfer of Rights

10 fields

Inside the pre-salt polygon



Concession

87 exploratory blocks

120 fields

Outside the pre-salt polygon

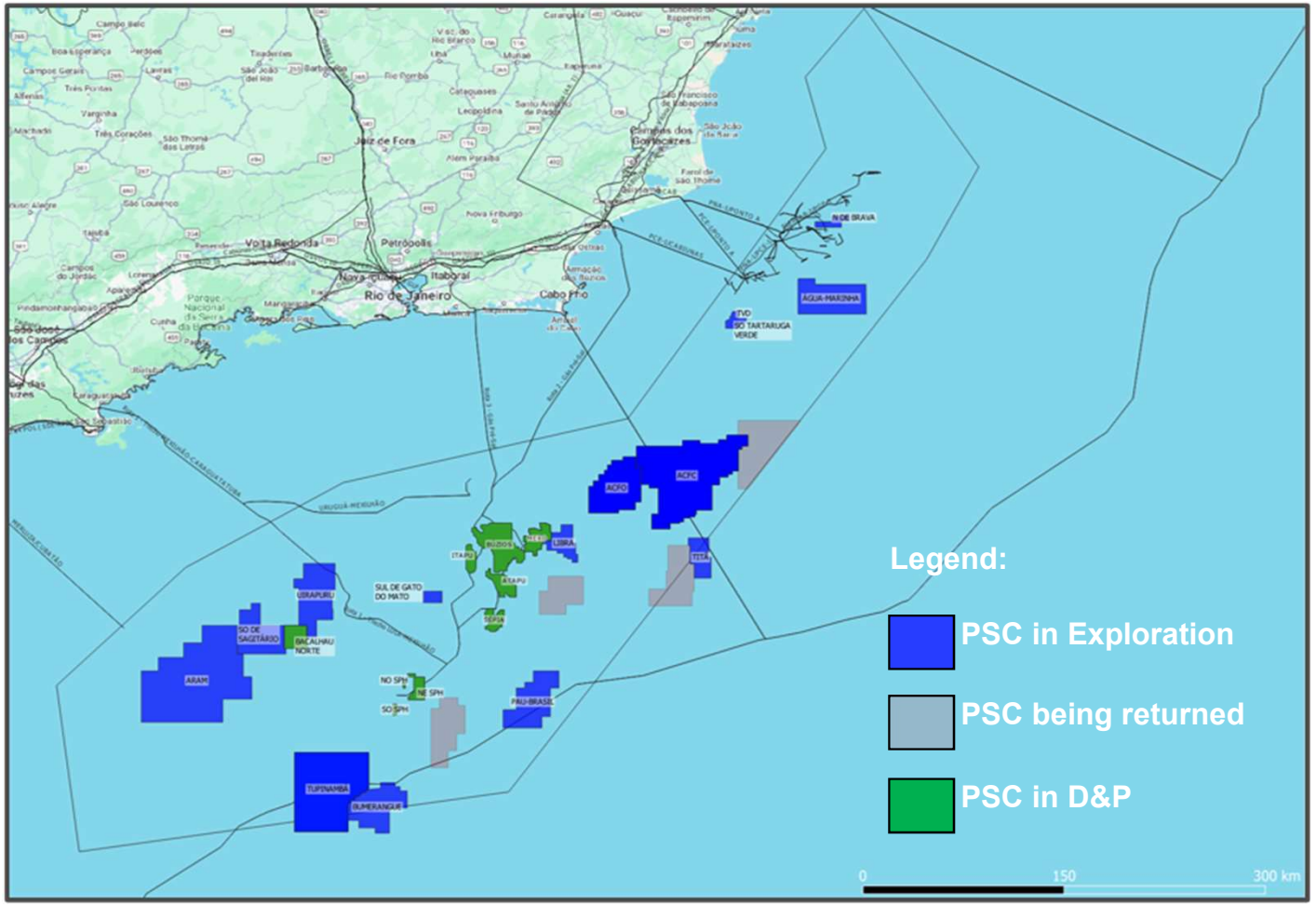
Production Sharing Agreement

13 exploratory blocks

11 fields

Inside the pre-salt polygon

The Production Sharing Contracts overview



9
Commercial Contracts, out of 23 PSC signed

1,000,000
Bpd Oil Production

29%
of National O&G Production

45%
Of Total Crude Oil Reserves

About PPSA

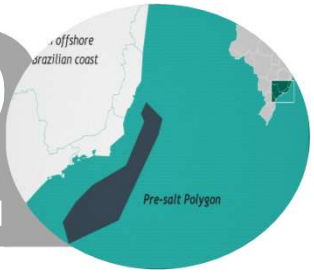
PPSA is a state owned company, linked to the Ministry of Mines and Energy (MME)

PPSA is responsible for maximizing economic results for the Brazilian State in the Pre-Salt Polygon and strategic areas

1

Manage the Production Sharing Contracts

2



Negotiate the **Unitizations** inside the Pre-Salt Polygon and Strategic Areas, representing the Brazilian State

3

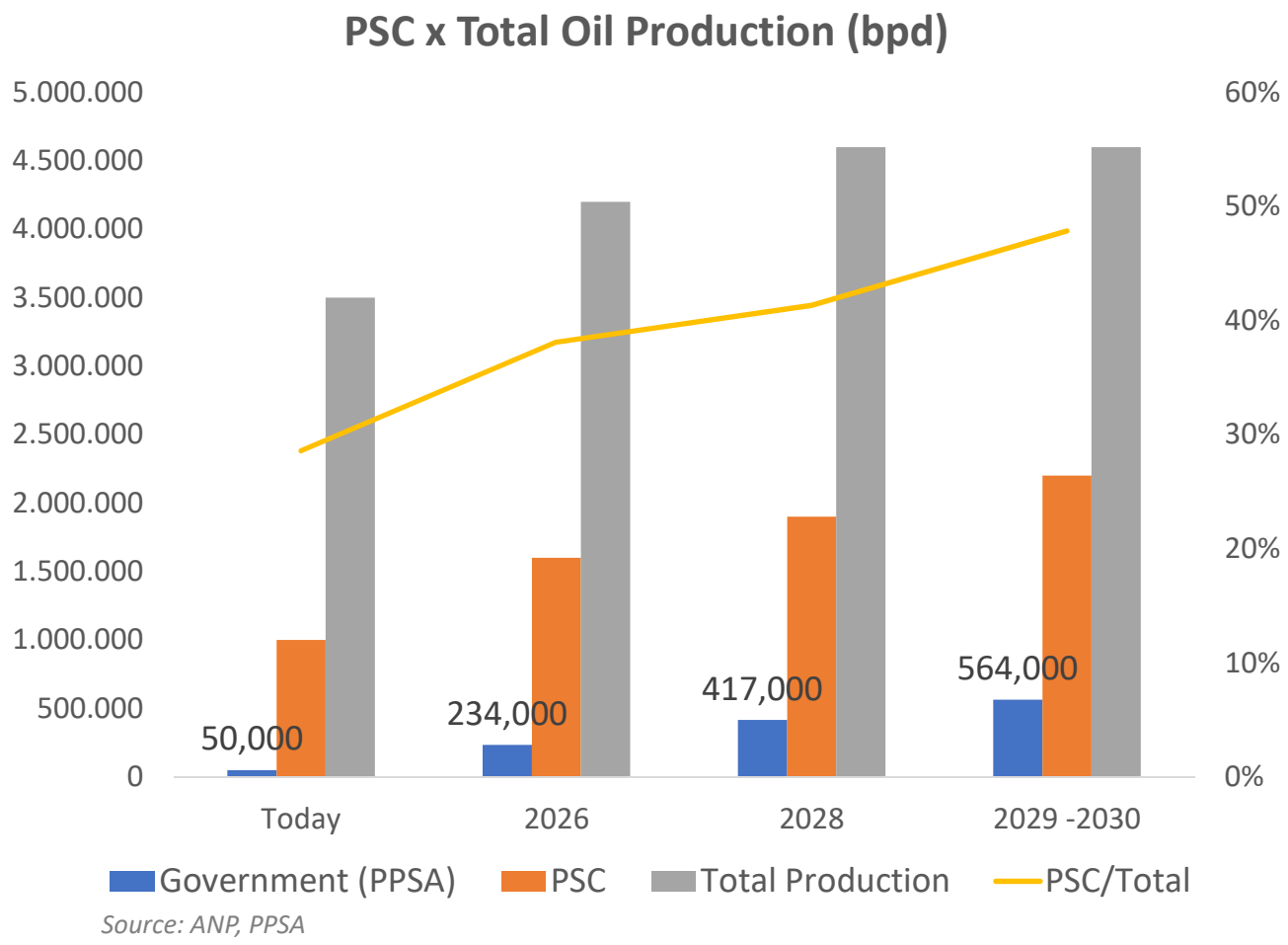
Trade the Brazilian State profit oil and natural gas share

LARGEST O&G PRODUCERS IN BRAZIL - JANUARY/2024

		K BOE/D			K BOE/D
1st	PETROBRAS	2.877	8th	CNODC	66
2nd	SHELL	467	9th	PETRONAS	58
3rd	TOTAL	183	10th	REPSOL	57
4th	PETROGAL	122	11th	PPSA	51
5th	CNOOC	99	12th	3R	47
6th	PRIO	97	13th	SINOCHEM	41
7th	EQUINOR	92	14th	ENEVA	37

Source: ANP

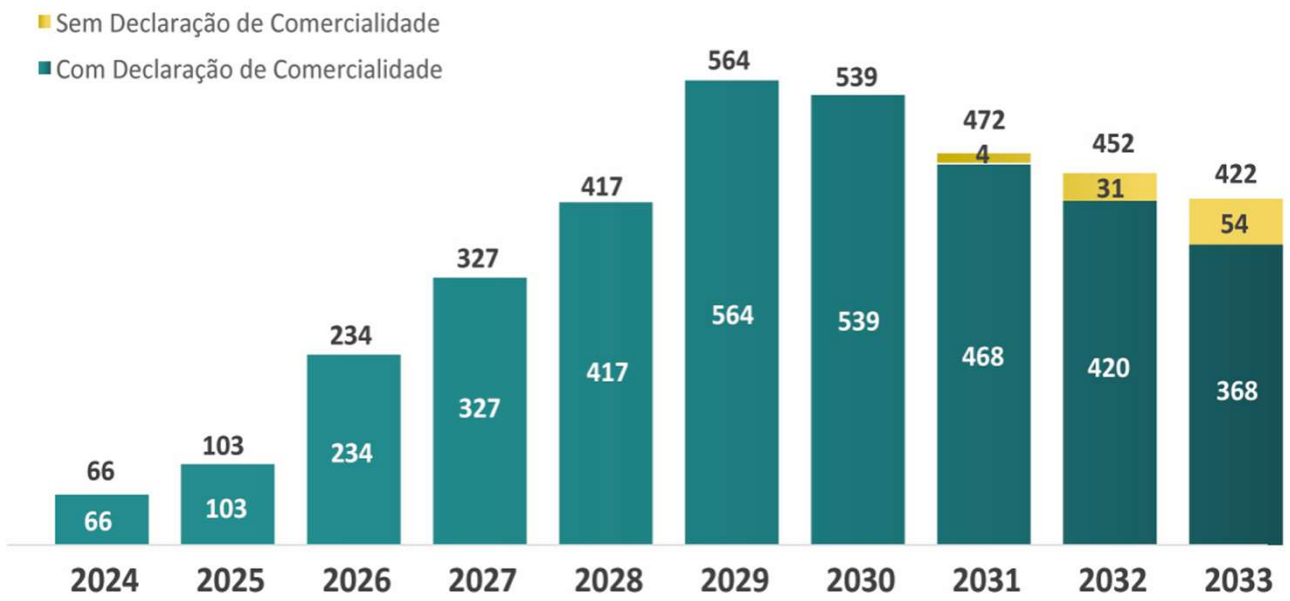
The PSCs are responsible for great portion of the Brazilian production growth



Source: ANP, PPSA

The oil profit forecast

Estimation for the oil profit (kbpd)



Source: ANP, PPSA

Opportunities in the next PSA open acreage cycle

A new tender to be published by ANP with no data yet announced.
Still updating the draft regarding the LC changes and also waiting for the joint environmental manifestation that allows the new areas to be included

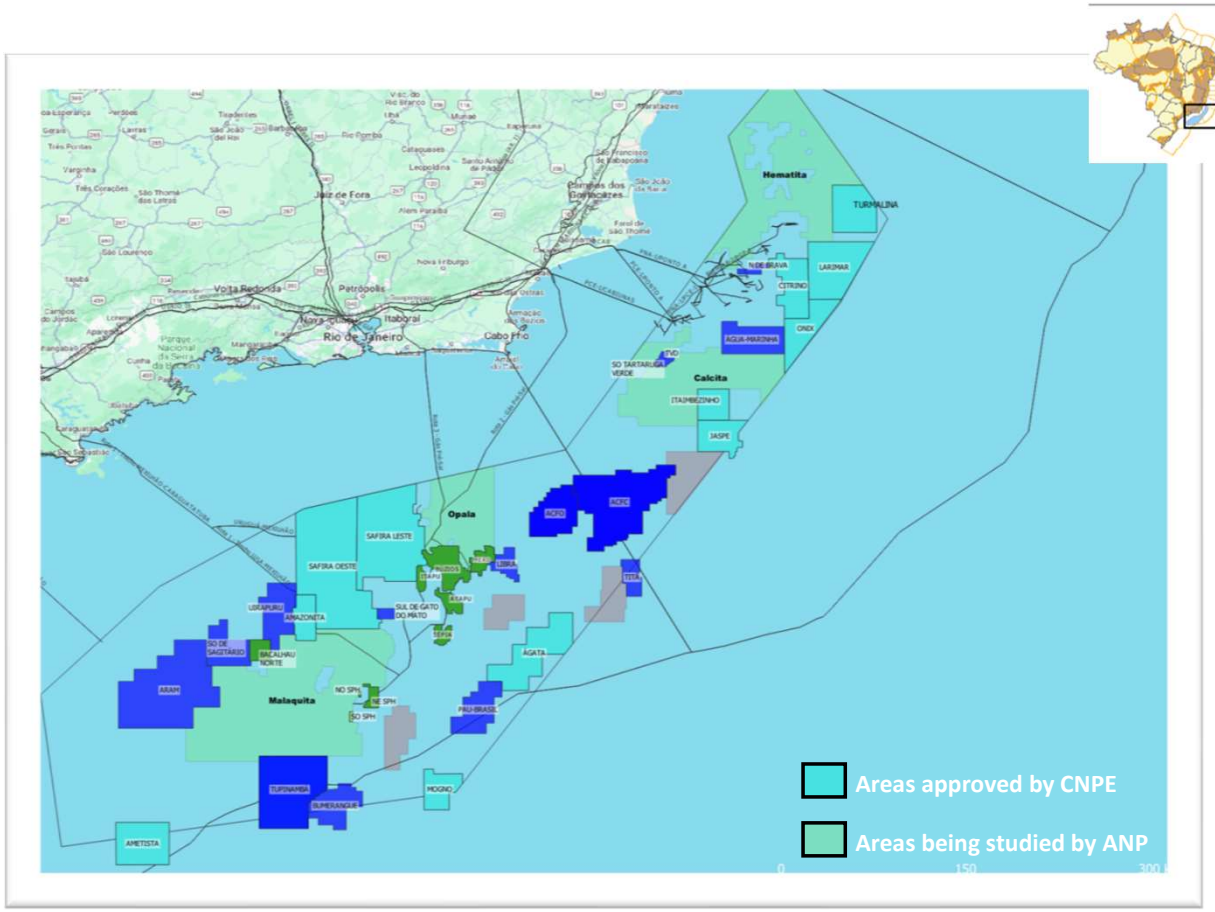
11 New Areas
approved by the CNPE

blocos	bônus de assinatura (R$)	alíquota mínima de partilha
Larimar	36.469.743,39	10,65%
Citrino	5.689.435,33	8,87%
Ônix	21.299.775,37	10,59%
Mogno	32.766.127,53	8,81%
Jaspe	52.234.042,42	16,72%
Amazonita	86.591.721,01	12,91%
Safira Oeste	123.019.652,15	23,01%
Safira Leste	140.113,58	9,03%
Itaimbezinho	11.008.615,95	6,67%
Ágata	30.355.184,66	6,48%
Ametista	1.060.087,39	6,41%

+

4
Areas

Already in stock
*Esmeralda, Ágata, Jade e Turmalina



Opportunities in the next CONCESSION open acreage cycle

5th cycle of concession regime open acreage

Tender protocol for next cycle is expected to be published at the beginning of next year

Around
400
Exploratory blocks

In
12
Sedimentary basins

Source: ANP

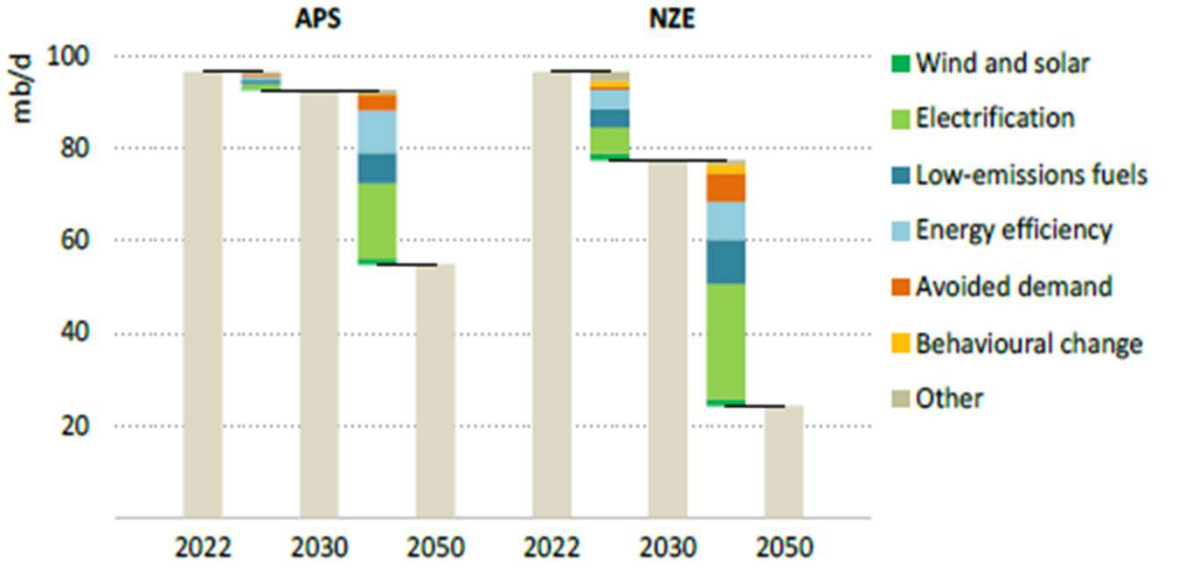
3

Decarbonization in the O&G activities

A net zero world is not a world without O&G

Even if the big technological, economic and social challenge of achieving the net-zero emissions scenario will be fully overcome from now on, it is projected that 15% of primary energy in 2050 will come from oil and gas. Oil consumption would be around 23 million barrels per day.

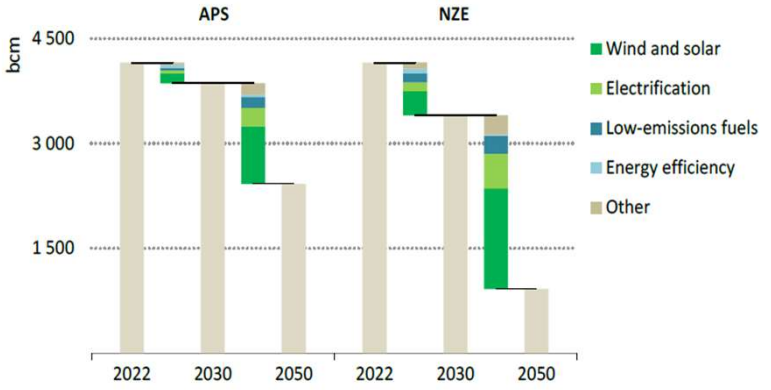
Figure 1.6 ▷ Reductions in oil demand in the APS and NZE Scenario



IEA. CC BY 4.0.

Source: IEA

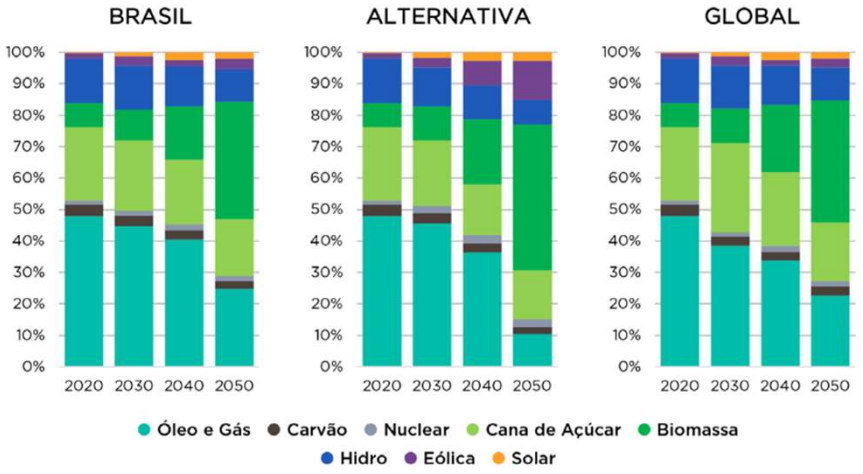
Figure 1.9 ▷ Reductions in natural gas demand in the APS and NZE Scenario



IEA. CC BY 4.0.

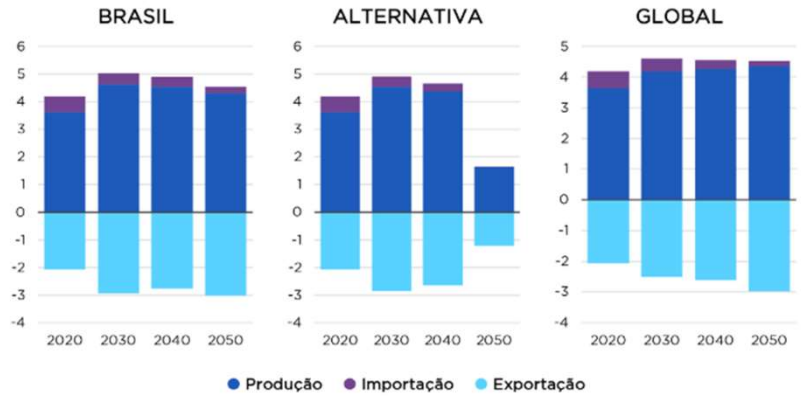
In Brazil, studies show that O&G production and demand will continue in the net zero scenario…

	TRANSIÇÃO BRASIL	TRANSIÇÃO ALTERNATIVA	TRANSIÇÃO GLOBAL
Ambiente internacional	Cooperação limitada ("blocos regionais")		Cooperação global ("Vila global")
Neutralidade de emissões no Brasil	CO2 em 2040 GEE em 2050	CO2 em 2040 GEE em 2050	CO2 em 2035 GEE em ~2050
Abordagem	Mínimo custo para NetZero GEE	Mínimo custo, com restrições de CCS e disponibilidade hídrica e premissa de produção de hidrogênio e nuclear	Mínimo custo para um ótimo global 1,5°

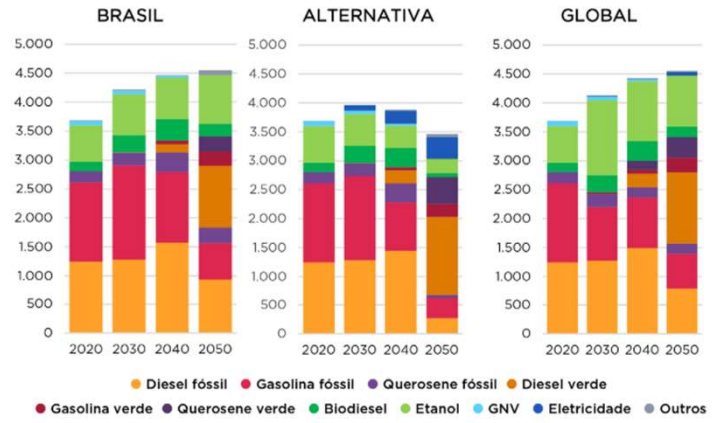


Source: CEBRI

PRODUÇÃO, EXPORTAÇÃO E IMPORTAÇÃO DE PETRÓLEO NO BRASIL



MATRIZ ENERGÉTICA DO SETOR DE TRANSPORTES (EJ)



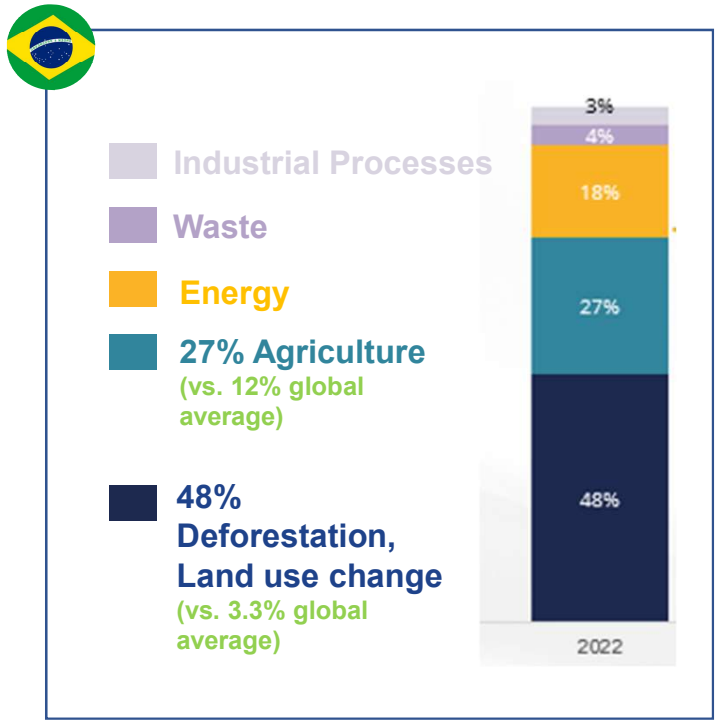
Because emissions profile in Brazil differs from the global average

Energy makes up nearly three-quarters of global emissions, but not in Brazil. Although Brazil ranks 6th in the largest emitters, the biggest challenge is deforestation and land use change. If we can work on that we will may be the first G20 economy to reach carbon neutrality and Brazil is committed to the Paris Agreement

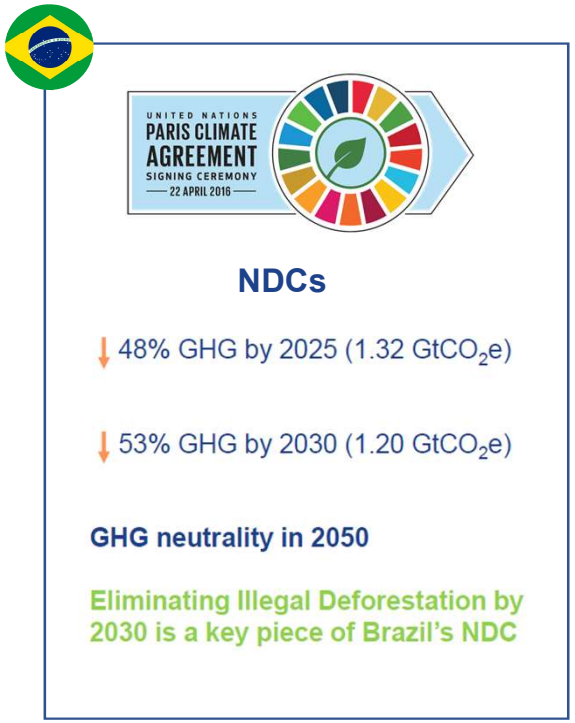
Brazil: 2,57% of global emissions

Country	Emissions Est.
01. China	15,563.90 MT of CO_2e100
02. USA	6,877.18 MT of CO_2e100
03. India	4,002.27 MT of CO_2e100
04. Russia	3,753.19 MT of CO_2e100
05. Indonesia	1,597.69 MT of CO_2e100
06. Brazil	1,501.04 MT of CO_2e100

Source: Climate Trace, 2022



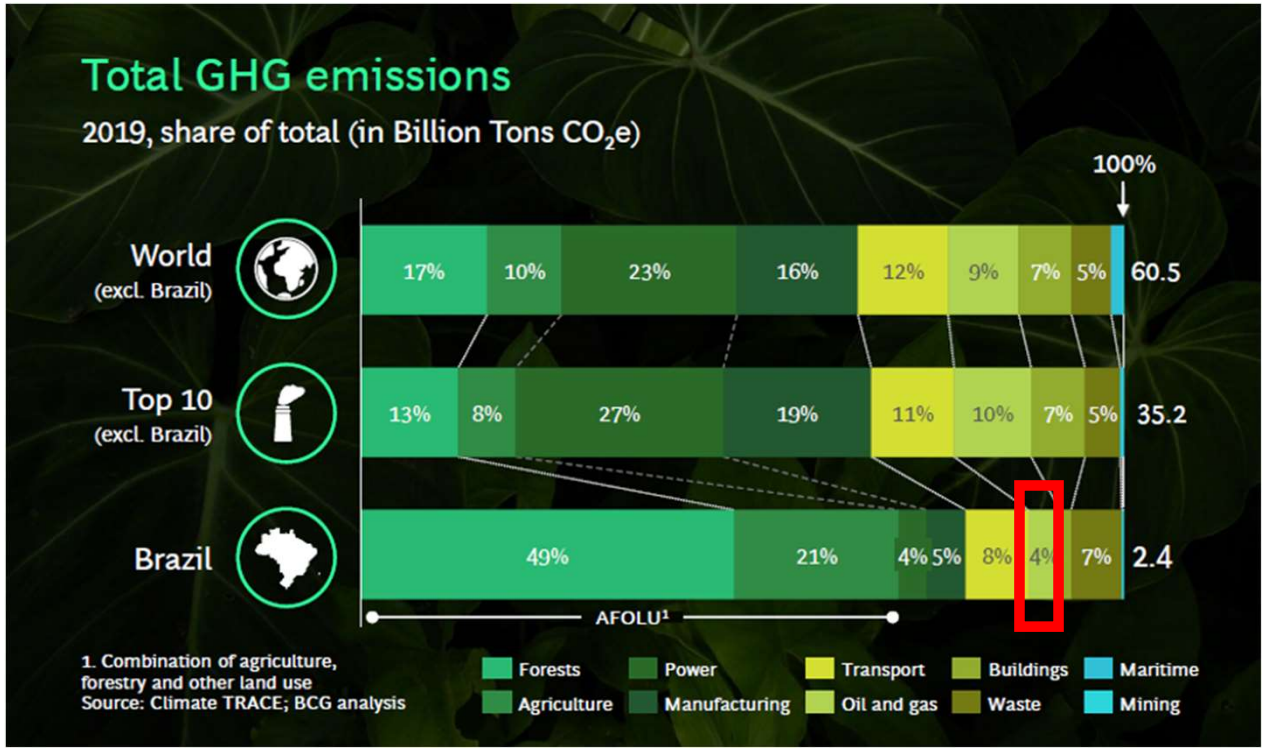
Source: SEEG, EPE, BNDES



Source: BNDES, UNFCC

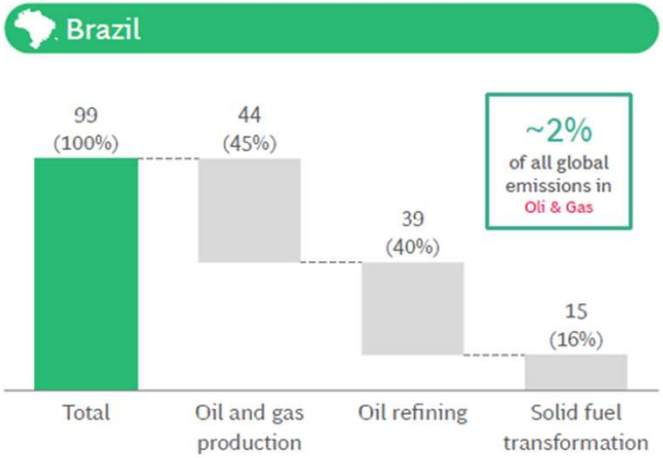
Upstream sector GHG emissions represent less than 2%

According to Climate Trace, Fossil Fuel Operations represent 17% of total global emissions (2022).
In the graph below (2019), Brazil O&G operations answer for 4% of total emissions, less than half world average (9%). If we consider only the upstream sector (45% of O&G operations) is less than 2%. According to EPE, this number in 2022 was 1%.



Source: BCG, Climate Trace

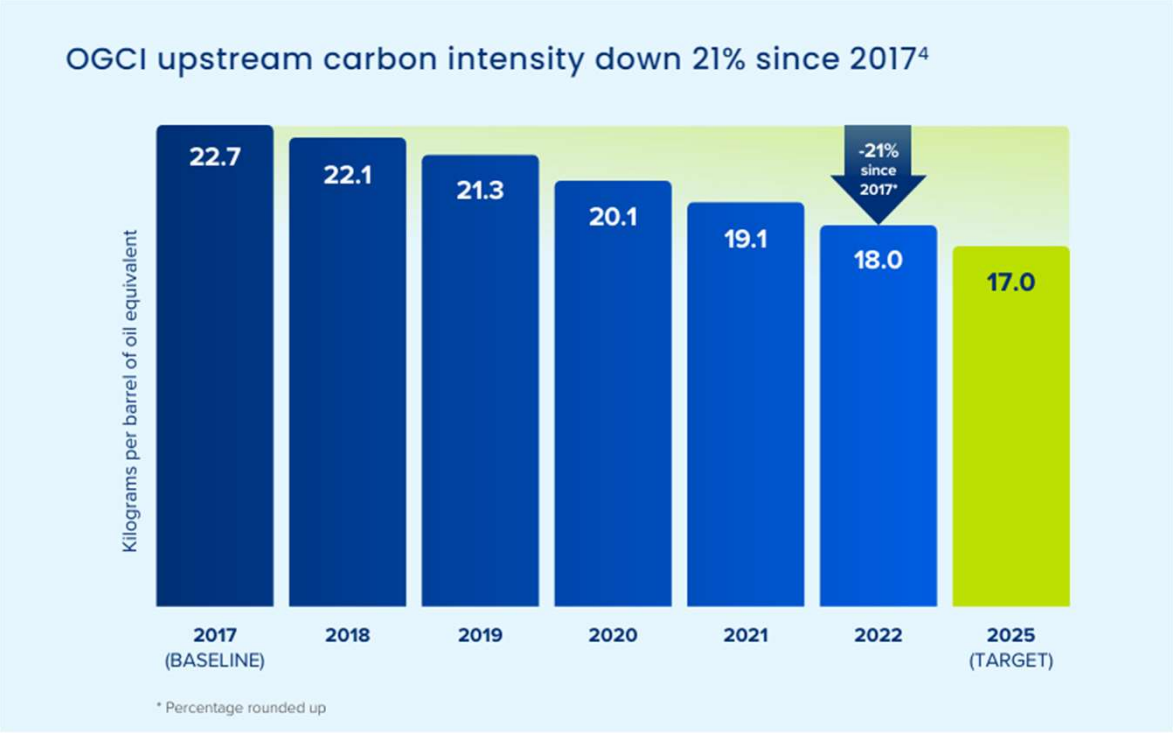
Emissions in the O&G sector



Source: BCG, Climate Trace

Our oil is less carbon intensive comparing to the world average

If we stop producing we are going to import with higher carbon intensity



Common O&G operators goals:

- Reduce emissions by 50% by 2030
- Reach NET ZERO by 2050

RD&I investments in renewables and decarbonization themes: an important contribution of the O&G sector in Brazil

Number of projects (2019-2023)	
Solar	15
Biofuels	104
CCUS	20
Environmental impact of E&P	41
Hydrogen	22
Tidal power	4
Wind power	25
Hybrid systems	29
Greenhouse gas emissions	46
Waste reduction	12
Environmental impact prevention	39
O&G impacts monitoring	16
Recovery of affected areas	26
TOTAL	**399**

3.9

Billion reais to RD&I in Brazil in 2023

16%

Invested in energy transition themes (2023)

Petrobras commitment: from 15% of the PD&I budget (2024) to 30% in 2028

Source: ANP

RD&I Projects related to decarbonization in the offshore sector

- Reduction of diesel and GHG consumption with the use of hydrogen in internal combustion engines of drilling rigs
- Technologies to increase energy efficiency of Drilling Rigs and Light Workover dynamically positioned (injection of hydrogen and generation optimization simulator)

- HISEP
- Libra Winds
- Subsea Electrification
- Blue Offshore Ammonia (NH3) Production

Source: ANP

Main sources of GHG in production offshore assets and potential paths of decarbonization

POWER GENERATION

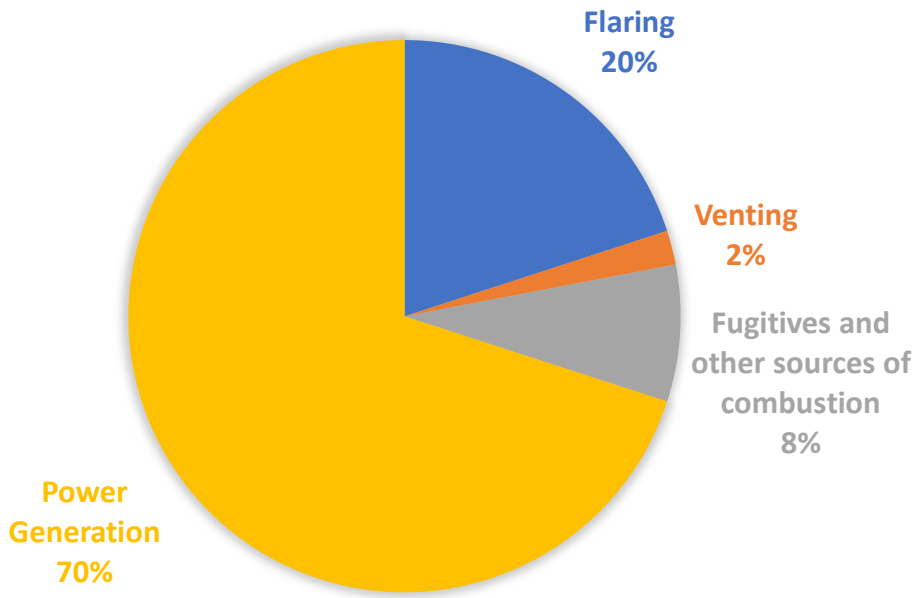
Today:

- Increase of energy efficiency (ex: through operation optimization of turbogenerators)
- Combined cycle turbines: The Bacalhau FPSO will be the self-powered FPSO with the lowest GHG emissions in the world. The use of this technology increases energy efficiency and reduces 110 thousand tons of CO2 per year (-25%).

Future:

- External Power Supply (eletrification)
- CCUS

MAIN SOURCES OF GHG IN OFFSHORE ASSETS

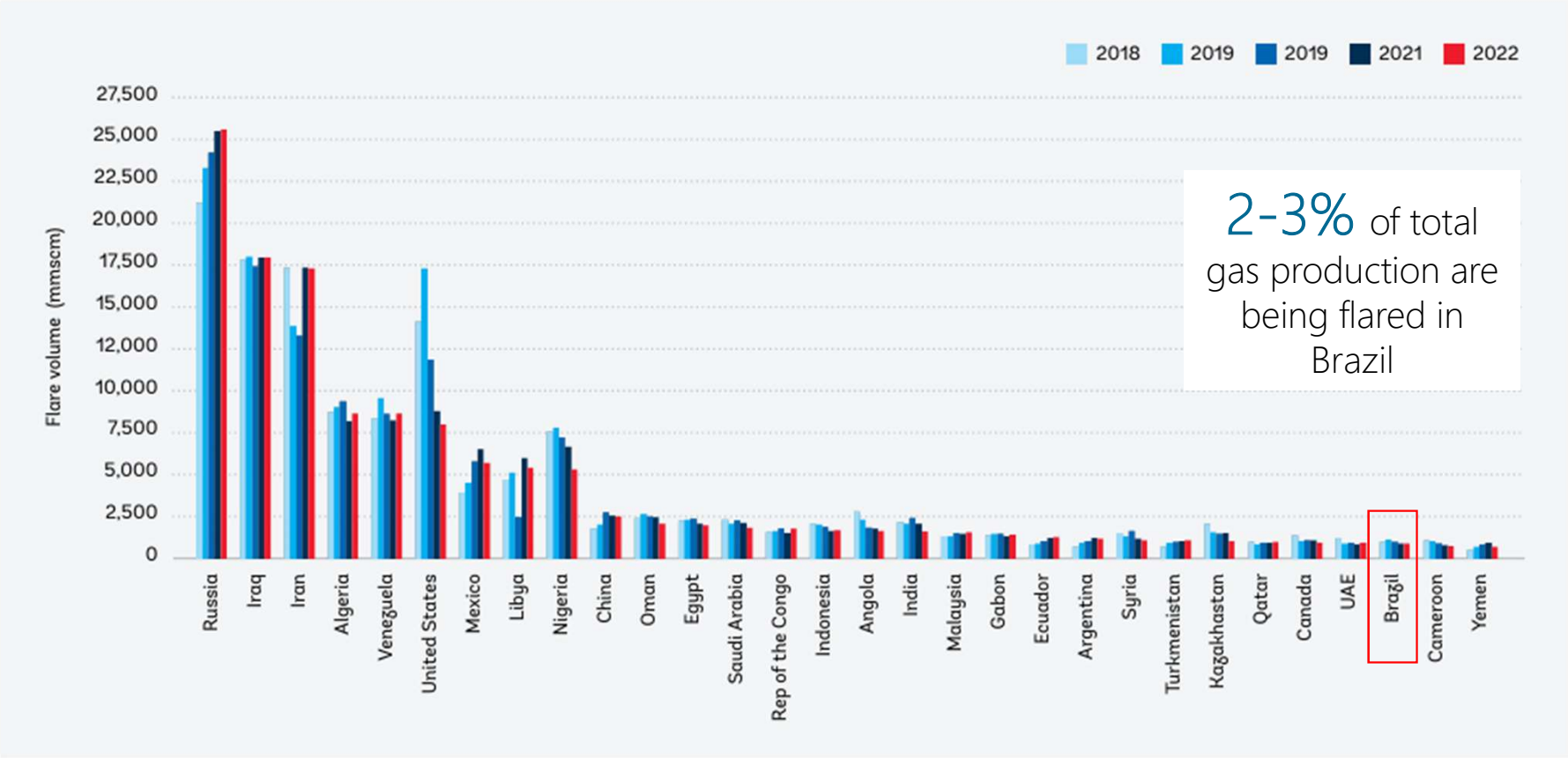


Today:

- Zero routine flaring by 2030
- Methane reduction pledges (68% of reduction annnounced by Petrobras – 2023 compared to 2015)
- Technology being tested and applied to monitore fugitive emissions
- Flare recovery systems and recovery of gases from cargo tanks
- Optimization of oil separation stabilization

Brazil is ranked 28th in the top flaring emitters

Figure 3 Flare volumes for the top 30 flaring countries from 2018 to 2022 (sorted by 2022 flare volume)



Source: NOAA, Payne Institute and Colorado School of Mines, GGFR

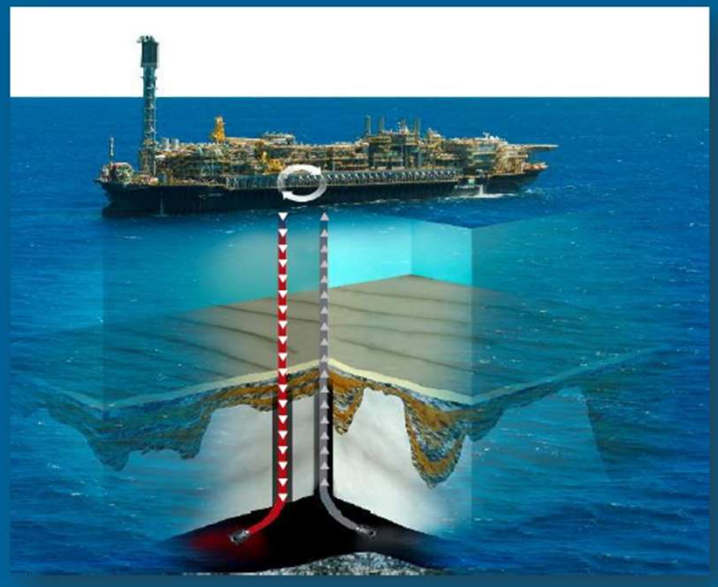
CCUS in Brazil is already a reality in the pre-salt

PIONEERING AND LARGEST CCUS PROJECT IN THE WORLD

Reducing emissions and increasing reservoir's recovery

CARBON CAPTURE, UTILIZATION AND STORAGE

- ✓ **Currently, the largest CO2 injection project in the world:**
- ✓ First CCUS project in ultra-deep waters (started in 2010)
- ✓ Increasing recovery factor



2022

40.8 $MtCO_2$ accumulated

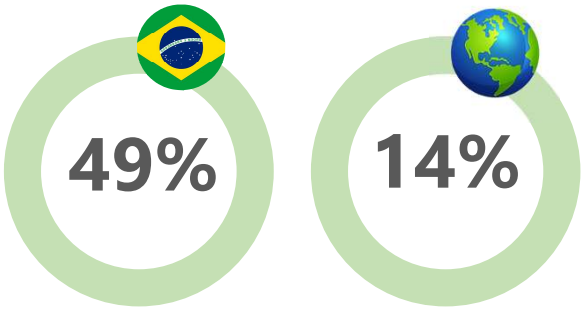
- >10 $MtCO_2$/y injection
- 25% of the world's CO_2 injection capacity
- 20% increase in CO_2 injection last year
- 21 FPSOs with CCUS technology

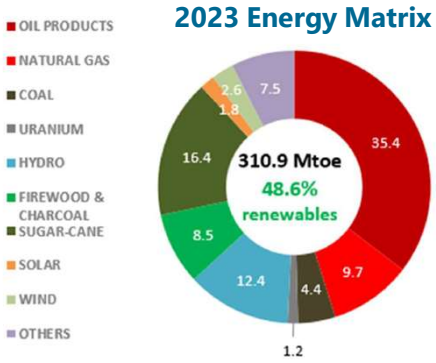
PETROBRAS

4
Energy Transition in Brazil

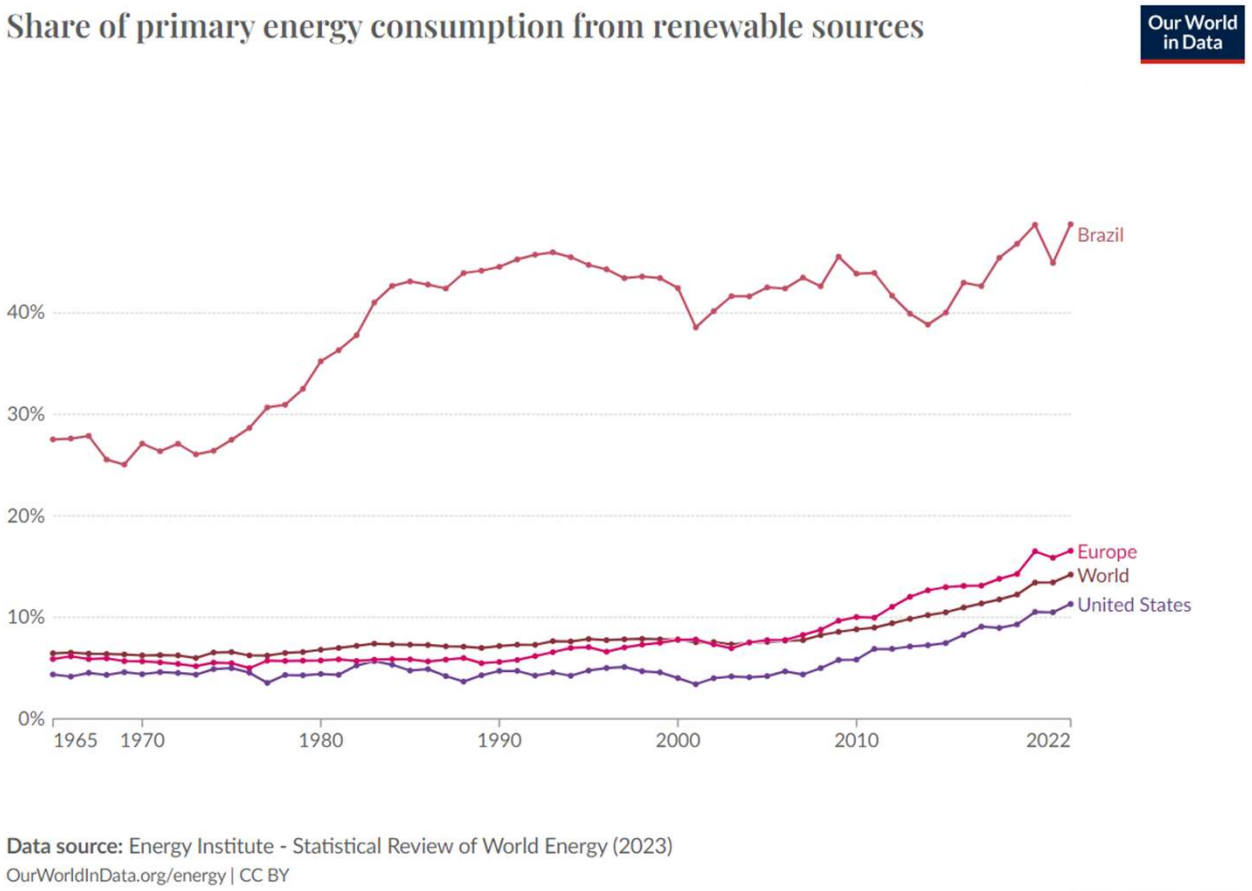
Brazil is already a leading player in the energy transition

Brazil's energy matrix is one of the cleanest in the world and has significant comparative advantages when compared to global average peers



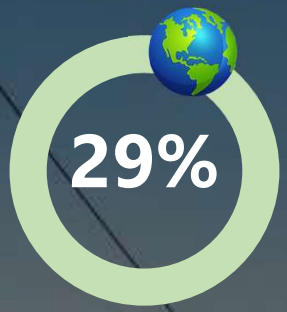


Source: MME



Brazil has one of the largest share of electricity production from renewables

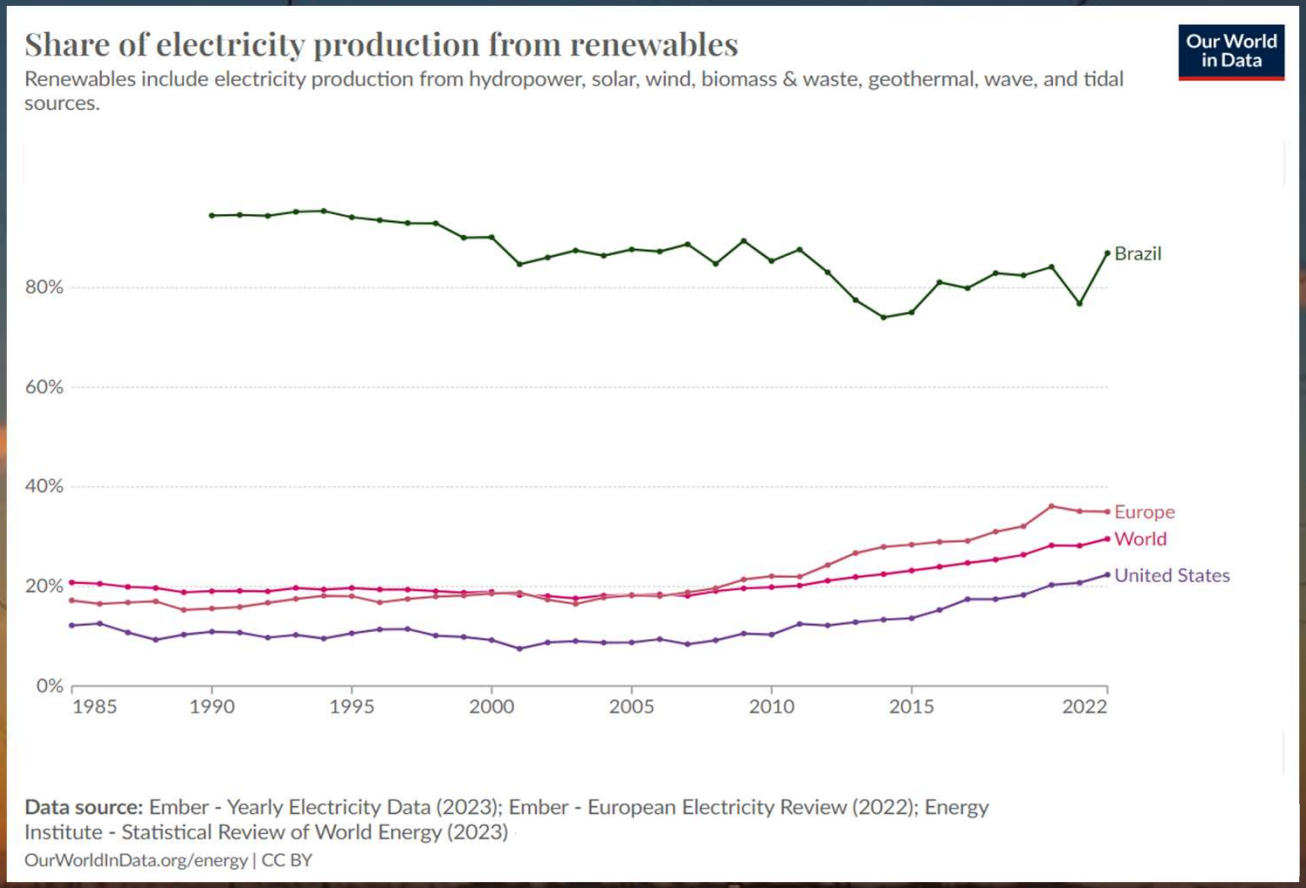
Brazil
(2023)



World Average
(2022)

Source: MME

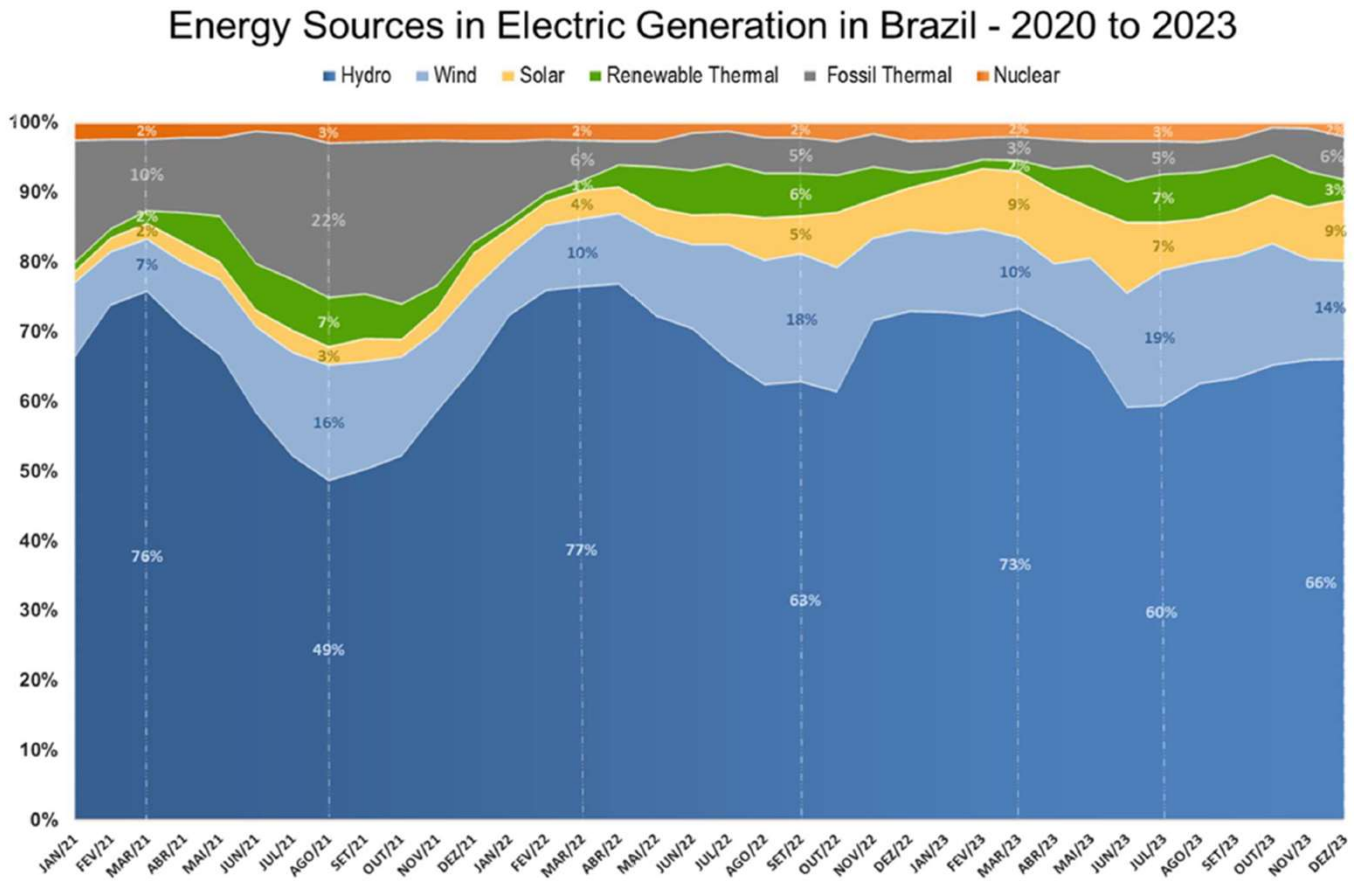
Brazil also has an integrated system with over 180,000 km of transmission lines that allows delivering clean power in practically the entire national territory



And Brazilian industry and transport benefit from lower GHGs

Brazil has the largest share of clean & renewables in its power matrix within G20

2022	
Brazil	89.11%
France	87.83%
Canada	82.60%
European Union (27)	60.00%
United Kingdom	56.02%
Germany	49.88%
United States	40.35%
G20 (Ember)	39.83%
World	38.73%
China	34.90%



Dec, 2023

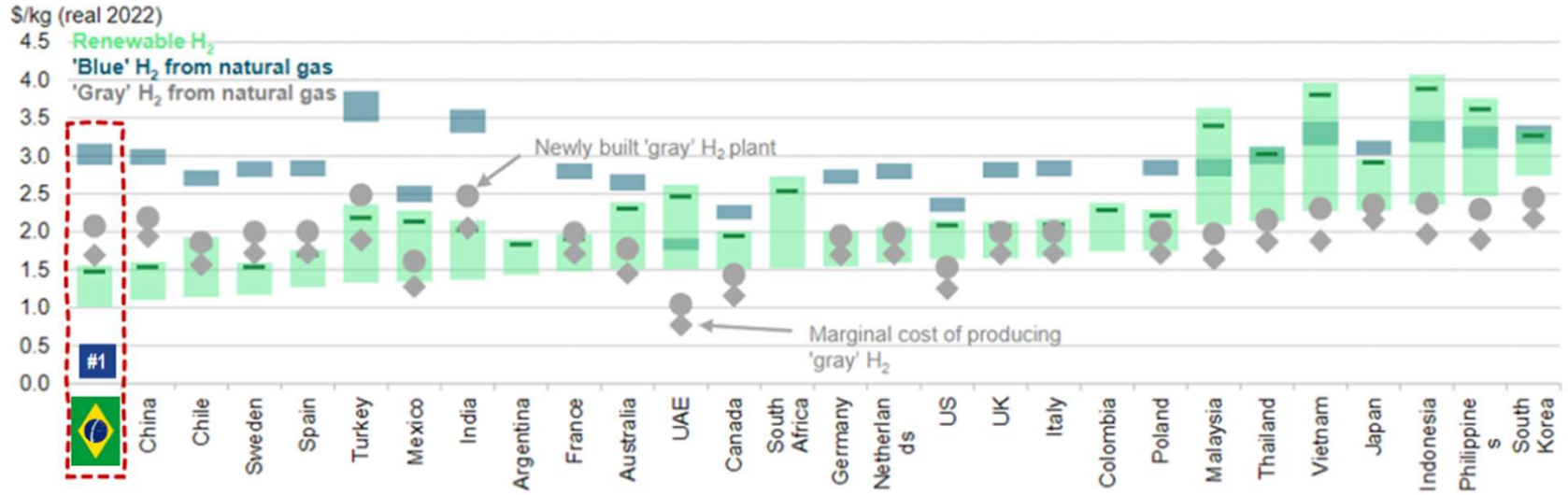
- *2% Nuclear*
- *6% Fossil*
- *3% Renewable Thermal*
- *9% Solar*
- *14% Wind*
- *66% Hydro*

Source: MME

This is also a competitive advantage for renewable H2 opportunities

Low Carbon Hydrogen Opportunities: Abundant and high-quality renewable position Brazil as a potential LC H_2 leader, being one of the lowest cost producer in the world.

Levelized cost of hydrogen in 28 markets, 2030



Source: BloombergNEF, NETL. Note: Based on project financing year. Assumes our optimistic electrolyzer cost scenario. Renewable $LCOH_2$ range reflects a diversity of electrolyzer type, Chinese alkaline (low) to PEM (high). The electrolyzer's electricity is sourced from the cheaper renewable resource. Capital and operational costs for blue hydrogen are sourced from the National Energy Technology Laboratory. Gas prices derived from BNEF's 1H 2023 LCOE Update (web | terminal). Grid electricity prices assumed at $75 (real 2022) for all modeled markets.

Source: BNDES

Brazil has one of the most competitive wind resources in the world

Brazil occupies 3rd place with the highest number of installations in 2023 with 4.8 GW, behind only China and the United States, and 6th place in the ranking of Total Installed Capacity of Onshore Wind Energy.

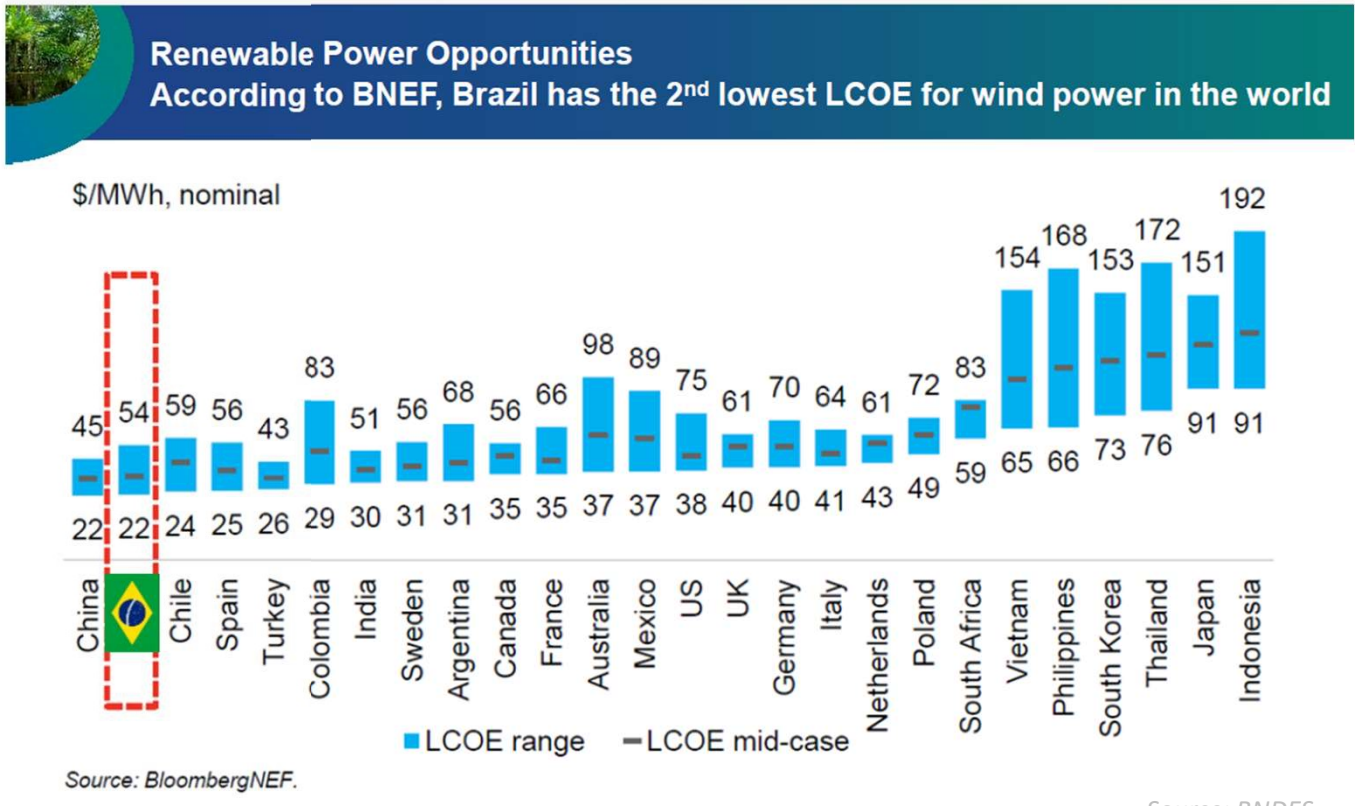
Levelized Cost of Equity (LCOE") – Wind Power:

Brazil: US$25-30/MWh vs.
Global LCOE US$46/MWh[2]

Wind Power Capacity Factor:

Brazil: 45% vs.
USA 40% vs. Europe 20-30%[3]

Source: BNDES



Source: BloombergNEF.

Source: BNDES

Brazil is the second largest producer and consumer of biofuels

Biofuels are a well established business since 1975, when the National Alcohol Program (Proálcool) was launched, based on the crisis of high oil prices.

More than **20%** of biofuels in the transportation matrix

~75%

of car fleet in BR adherent to biofuels in 2020 (for full-cycle, ethanol emits ~45g vs. ~150g CO_2e/km for pure gasoline)

Source: BCG, 2022

Mandate of **ethanol** in gasoline

Today	18%	27,5%
		27%
Fuel of the Future Bill	22%	35%

Mandate of **biodiesel** in diesel

Today	14% (2025:15%)
Fuel of the Future Bill	20% until 2030

Brazil's others comparative advantages for a carbon neutral world

A country of plenty and diverse energy resources. Brazil also has the world's largest fresh water renewable sources, besides hosting the largest tropical forest and biodiversity in the planet

Abundant Resources & Food Security

- #1 Tropical Forest
- #1 Biodiversity
- #1 Fresh Water
- #3 Food & #4 Grains producer
- #1 Beef, Soybeans, Coffee and Sugar exporter

Clean Energy Matrix and Key Minerals Reserves

- G20's cleanest energy & power matrixes
- Globally competitive wind and solar LCOE
- Mineral reserves (#2 iron ore, #3 nickel, #7 lithium)
- Interconnected system + Hydro serving as batteries

Source: BNDES, BCG

... and #1 NBS potential across the globe (1-2 Gt CO_2e & up to US$15bi/y)

We host 33% of global opportunities for reforestation and 25% for forest conservation

Up to ~10%

lower GHG footprint in BR Cement (vs. world avg.), annually avoiding >2 Mn tons CO_2e (equivalent to >500,000 cars)

Up to ~30%

lower GHG footprint in BR Steel (vs. world avg.), annually avoiding >30 Mn tons CO_2e (equivalent to >7,000,000 cars)

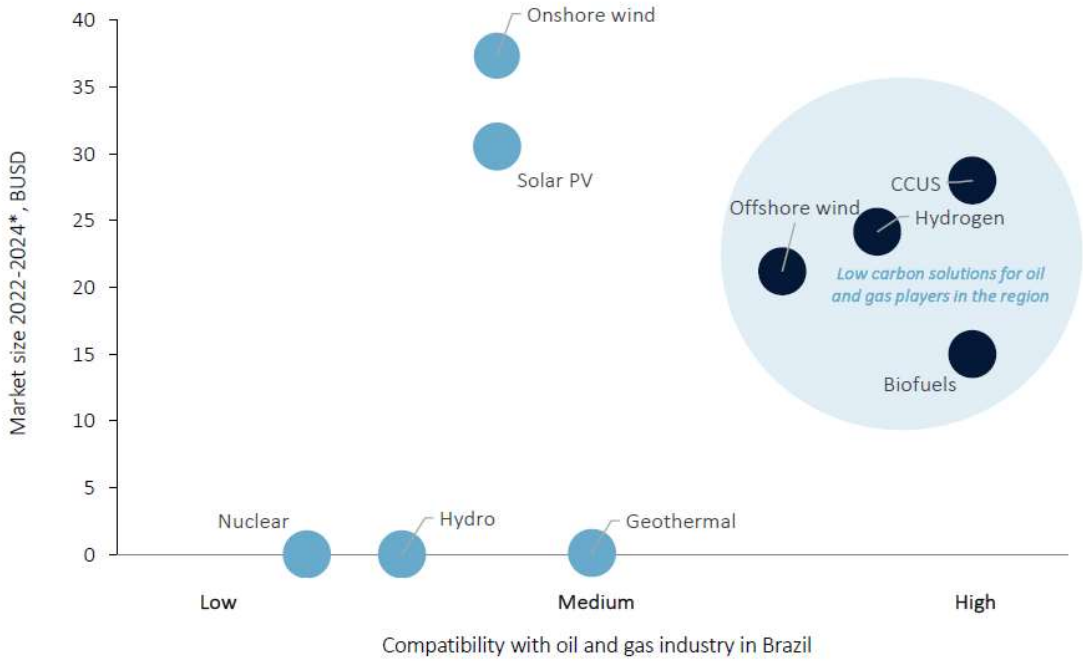
Brazil is working on bills to attract investments to low carbon sectors…

Bill 576/2021
Bill 725/2022
Bill 1878/2022
Bill 2308/2023
Bill 3173/2023
Bill 3452/2023

Bill 1425/2022
Bill 4196/2023
Bill 4516/2023

Bill 576/2021

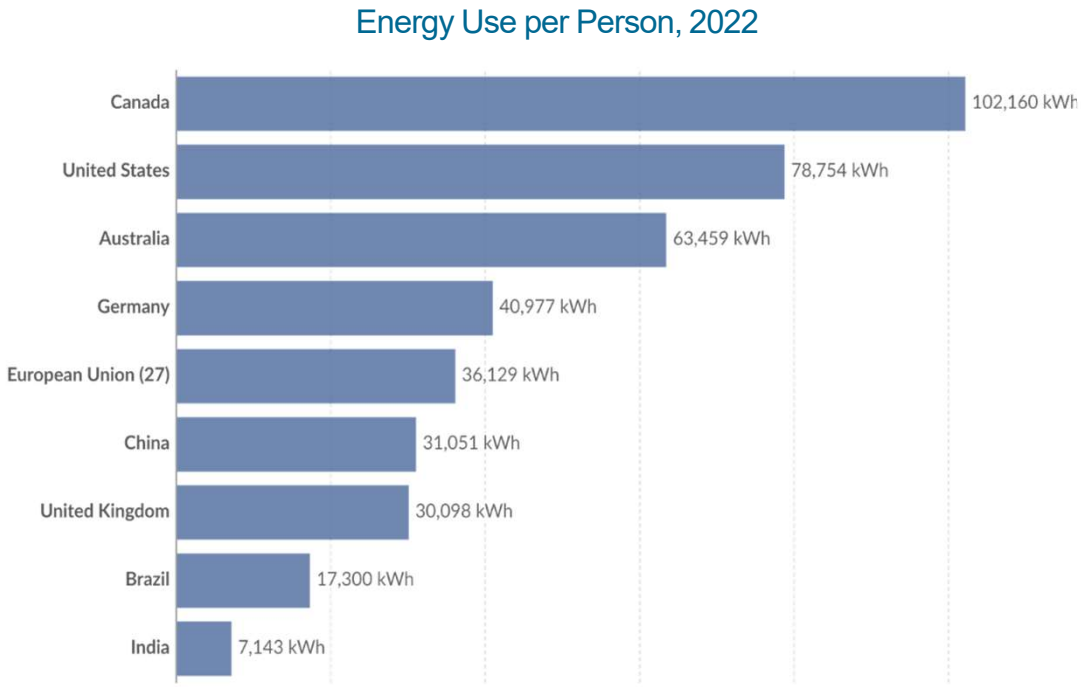
Source: ANP

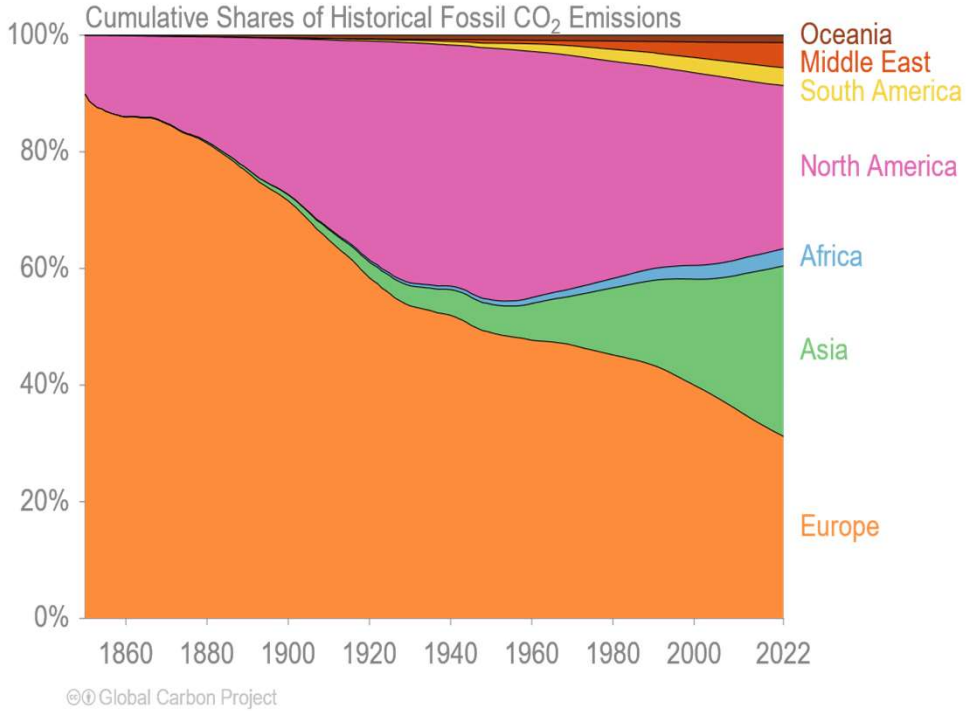


Source: Rystad (2023)

5
Closing Remarks

The Energy Transition and decarbonization of the economy is a path of no return, however, the transition is not just about energy and must be socially just



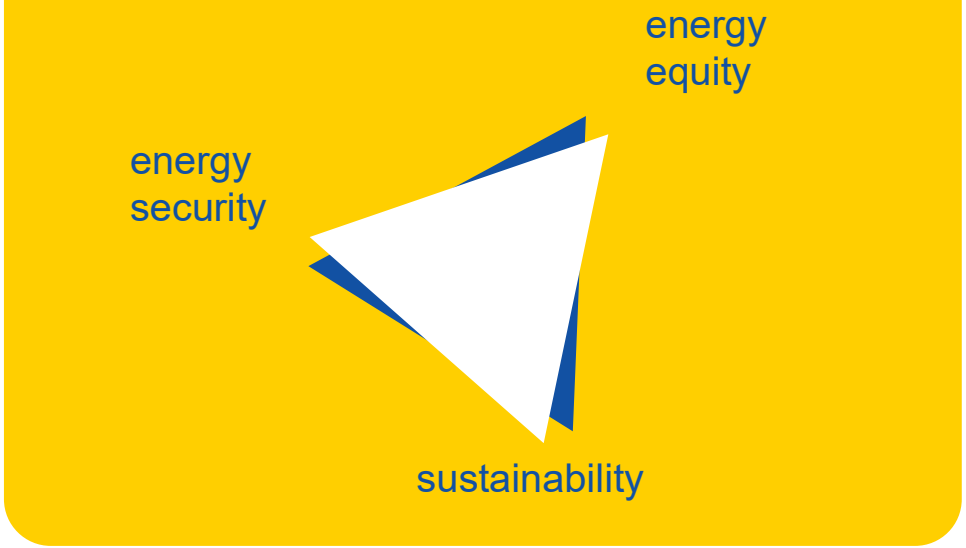


Energy Transition in Brazil are also related to development goals

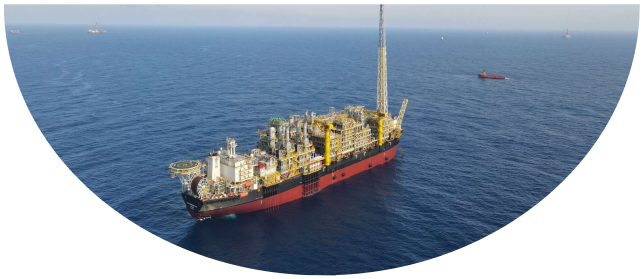
Development goals

- Employment and income
- Social inclusion
- Reduction of socioeconomic and regional inequalities
- Economic growth
- Reindustrialization
- Combating climate change
- Preservation of biodiversity and environmental quality
- Improving quality of life

The energy trilemma



Source: MME



The O&G sector is decisive for a **fair**, **inclusive** and **balanced** energy transition

Brazil is a **developing country**, with 31,6% of population living below the poverty line. **We need all the resources available** to grow our economy and create opportunities and wealth for our society.

According to EPE, the interruption of investments in E&P in Brazil could mean government revenue losses of around **R$ 4 trillion**. Also, the development of undiscovered resources would unlock trillions of investments until 2050**.**

Brasil is **positioned to continue O&G production**, as it has **comparative advantages in the energy matrix**. Also, the upstream emissions are **less than 2%** of total emissions and our oil is less carbon intensive than the world average.

O&G is part of the solution because the world cannot dismantle today's fossil fuel energy system before the low-carbon energy system is ready to take over. **Energy security** is a priority. Also, industry contribute with **expertise, finance and stability for energy transition.**

Thank You!

tabita.loureiro@ppsa.gov.br

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