

CLIMATE CHANGE Supplement





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Message from Senior Management

Letter from the Chairman and Lead Director of the HSE Committee

It is a pleasure to share this Climate Change Supplement with you.

This board plays a key role in ensuring that the Company's strategic plan reflects the best choices for the long-term sustainability of our business. In this sense, it is extremely important to recognize the challenges and opportunities associated with climate change and energy transition.

We have already taken meaningful steps. We have achieved significant reductions in operational emissions in recent years and analyzes and decisions on carbon intensity are now an integral part of our strategy and governance.

And we will go further. Our short and medium-term sustainability commitments consider additional emission reductions and are part of a pathway towards long-term operational emissions neutrality.

This Climate Change Supplement is part of the dialogue with stakeholders and shows the resilience of our portfolio and the alignment of the strategy with the Paris Agreement. We have increased transparency and structured this document in direct correlation with the TCFD (Task Force on Climate-Related Financial Disclosures).

Delivering sustainable results and contributing to a trajectory of decarbonization and energy security is a priority for us. We seek to make energy more accessible by applying our competences and technologies to develop more efficient processes and products for a world in transition.

Eduardo Bacellar Leal Ferreira

Chairman

Murilo Marroquim de Souza

Lead Director of the HSE Committee

Letter from our CEO and Chief Institutional Relations and Sustainability Officer

Mitigating climate change is a global, necessary and urgent demand.

Petrobras allies itself with governments, multilateral organizations, non-governmental institutions and responsible corporations for building solutions for a planet that converges with the ambitions of Paris.

Pragmatism and coordination between actors are essential to address the scale and the complexity of the energy transition that requires time and significant investments.

Large scale and secular energy systems must be structurally transformed. The world nowadays consumes the energy equivalent to 100 billion barrels of oil per year, the majority coming from: oil (31%), natural gas (23%) and coal (26%) (WEO 2021).

There are several decarbonization routes leading to similar GHG reductions, however, with different economic and social implications, adding complexity to the decision-

making process. For example, some countries may invest in growing rail-modal, others may invest in biofuels, depending on local vocations.

We understand that simultaneously promoting economic, social and environmental development is not a simple task but it is possible.

Petrobras contributes by (i) investing resources and technologies in the production of low carbon oil in Brazil, generating energy and relevant revenues to finance a responsible energy transition; (ii) supplying gas for dispatchable energy, enabling high share of renewables in the Brazilian electricity matrix; (iii) investing in new products and prospecting businesses with lower carbon intensity; (iv) promoting research and development of new technologies and low carbon solutions and (v) investing in socio-environmental projects for the recovery and conservation of forests.

Transparency is a value for Petrobras. With dialogue and planning, it will be possible to achieve the goals of the Paris Agreement.

Thus, the Climate Change Supplement presents the positioning of a sustainable Petrobras committed to a world undergoing decarbonization.

Joaquim Silva e Luna

Chief Executive Officer

Rafael Chaves

Chief Institutional Relations and Sustainability Officer

Executive Summary

Our Climate Change Supplement discloses how we incorporate the challenges of climate change into our choices and processes to ensure a sustainable company in a world aligned with the Paris Agreement.

In the **Targets, Metrics, Performance and Voluntary Investment** section, we present our sustainability commitments and our ambition to achieve operational emissions neutrality in activities under our control, in continuity with our decarbonization trajectory.

In **Energy and Climate Scenarios** we discuss our internal scenarios, which reflect the different rhythms of the energy transition and critical uncertainties and how they compare to public reference scenarios. In turn, the **Strategy and Portfolio** section presents the investment choices of our Strategic Plan 2022-2026 considering these scenarios and

the **Portfolio Resilience Evaluation** section debates over our value generation compared to Paris-aligned public scenarios.

The **Governance, Incentives and Risk Management** section shows how the theme of climate change is fully integrated into our internal processes and under oversight of the board and board committees.

To enable the fulfillment of our commitments and ambition, we seek operational excellence and invest in innovation as reported in the **Investments and Initiatives** section. These actions adapt to Brazil's unique emissions profile that is discussed in the section **Brazil: distinct emissions profile and complementarity between oil, gas and renewables**.

Acknowledging that climate change is an urgent global challenge, we value the active dialogue and cooperation that are reported in the **Transparency and Engagement** section. We emphasize that this Climate Change Supplement follows the recommendations of the Task Force on Climate Related Financial Disclosures (TCFD), whose compliance can be identified in the **Map for TCFD Requirements**.

Targets, Metrics, Performance and Voluntary Investment

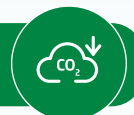
Operational Emissions (Scope 1 and 2): important results and ambition

In 2021, we assumed the ambition to neutralize our operational emissions of greenhouse gases within a timeframe compatible with the Paris Agreement.

This ambition was added to our 10 sustainability commitments with a horizon of 2025 and 2030, where 6 commitments are related to the mitigation of greenhouse gases, with 100% coverage of emissions under our operational control (scopes 1 and 2).

We have been working in decarbonization actions for more than a decade and have achieved a trajectory of progressive reduction of operational emissions. These are timely gains in carbon efficiency, the effect of which must be evaluated by the contribution accumulated in the period.

Reducing absolute emissions



Ambitions and Targets (Base of comparison 2015)

2015 total:
78.2
million tCO₂e



2021
61.8
million tCO₂e

21% reduction in total operational emission since 2015

18% reduction, without thermoelectricity emissions

Reduction of total operational absolute emissions by 25% by 2030

Ambition: Net zero within a timeframe compatible with the Paris Agreement

without thermoelectricity emissions 2015:
56.5
million tCO₂e



2021
46.5
million tCO₂e



More efficiency and less emissions in Exploration and Production



Emissions per barrel (intensity) have almost halved since 2009

12% reduction in absolute GHG emissions in E&P in the last decade

2021: 15,7 kgCO₂e/boe

Pre-salt oil (Tupi and Búzios) among the most decarbonized in the world (below 10 kgCO₂e/boe)

40% below the world average



Low flaring and high gas utilization - IUGA - associated gas utilization index: average of 97.2% in 2021

All new designs adopt zero routine flaring concepts.



CCUS growth
8.7 million tons of CO₂ reinjected in 2021, 30.1 million tons of CO₂ accumulated

In 2020 Petrobras operated the largest CCUS project in the world

(Annual reinjection, according to the Global Status of CCUS 2021 report)



Less emissions and more methane efficiency

Methane emissions intensity 2021: 0.33 tCH₄/mil tHC; 2015: 0.65 tCH₄/mil tHC

methane absolute emissions 2021: 79 mil tCH₄; 2015: 150 mil tCH₄

Ambitions and Targets

32% reduction in E&P carbon intensity by 2025

(15 kgCO₂e/boe, maintained until 2030)

(based on 2015)

Zero routine flaring by 2030

*According to the Zero Routine Flaring by 2030 initiative of the World Bank

~40 MM tCO₂ re-injection by 2025 in CCUS projects

40% reduction in methane emissions intensity in E&P by 2025

(based on 2015)

More efficiency and less emissions in Refining



Absolute GHG emissions from refining have reduced by around 9%, while carbon intensity has reduced by around 8% since 2015

2015: 43 kgCO₂e/CWT

2021: 39.7 kgCO₂e/CWT

Ambitions and Targets

16% reduction in refining carbon intensity by 2025, increasing to 30% by 2030 (30 kgCO₂e/CWT) (based on 2015)

Energy: security for renewable electricity in Brazil



Absolute emissions increased in 2021 (15 million tCO₂e)

Average electricity supply intensity 0.425 kgCO₂e/MWh

Segment affected in 2021 by atypical dispatch in response to the water scarcity

Ambitions and Targets

Net zero ambition

Lower emission in support logistics



Emissions from offshore operations reduced by 29% compared to 2015

Ambitions and Targets

Net zero ambition

Value chain emissions (Scope 3): transparency

We maintain transparency of our indirect emissions, called Scope 3. In addition to maintaining the disclosure of emissions in the main category, related to the use of our products (category 11), as of 2020, we also disclose category 10, referring to emissions from product processing. The two categories combined correspond to almost all of our estimated Scope 3 emissions, and in 2021 they totaled 436 million tCO₂e. In the period from 2015 to 2021, Scope 3 emissions amounted to approximately 87.5% of the total emissions reported for the value chain (Scopes 1, 2 and 3).

Voluntary investments in forest and climate: contribution

All emission performance results presented in this document are intrinsic, with no use of offsets.

We emphasize, however, that we have relevant voluntary initiatives in social responsibility projects focused on climate, supporting natural climate solutions.

Our actual portfolio presented an area of influence in more than 25 million hectares of native ecosystems, in addition to a new investment of R\$ 50 million in partnership with BNDES (National Bank for Economic and Social Development – Portuguese: Banco Nacional de Desenvolvimento Econômico e Social, abbreviated: BNDES) aimed at forest restoration of native species. The estimated benefit of the efforts made since 2013 to date by these projects is around 1.3 million tCO₂e for Brazilian society, with gains also for biodiversity, water and social and economic development.

Energy and climate scenarios

2021 was a year of acceleration of the climate agenda. Countries and companies have announced new goals and ambitions, and progress has been made, in particular, on methane and deforestation commitments. The world continues to coordinate in the Paris Agreement's purpose to limit the rise in the planet's temperature.

Oil market: retracting, but remaining relevant

Our scenarios consider the ongoing energy transition, which will, in the long term, lead to a retraction in global oil markets, with an impact on its price. Demand will decrease in the coming decades, with a 50% retraction in consumption in our most accelerated transition scenario (from 100 to 50 million barrels per day in 2050, in Petrobras Resilience Scenario).

Oil remains important since the challenge of decarbonizing mobility requires: (a) transforming infrastructure, with its modes of transport and vehicles; and/or (b) use alternative fuels to fossils adapted to existing infrastructure.

Transforming infrastructure is a decades-long, high-investment effort. In turn, alternative fuels currently still significantly impact the prices of goods and services or require public incentive policies with an impact on government revenue.

Considering that energy is a representative item in the cost of families and companies, which represents an average of 10% of GDP, and that oil revenues are significant, changes in the energy cost structure have a meaningful impact on the economy.

As mentioned, the need for infrastructure transition, technological gaps and the current cost of transitioning some oil services, explain why keeping oil in the matrix for decades is suitable and expected, even in accelerated transition scenarios and adhering to the ambition of the Paris Agreement.

It is in the interests of society to carry out decarbonization in the order of the best cost-effectiveness.

The relevance of oil in the matrix is also highlighted in external scenarios. The International Energy Agency, in the Sustainable Development Scenario (SDS), indicates demand of 47 million barrels of oil per day in 2050 and its *Net Zero Emissions by 2050* (NZE), with extremely accelerated transition, still indicates 25 million barrels of oil per day. by 2050. Demands are higher in the Stated Policies (STEPS) and Announced Pledges (APS) scenarios.

It is not a matter of planning considering the indefinite permanence of oil, but of recognizing the transition as gradual. Our scenarios consider an effective retraction in the international commodity market, a falling product price and a progressive inclusion of financial instruments (carbon prices). We perceive, however, relevant demand, with a role for responsible oil production.

In our three scenarios, the pace of transition varies.

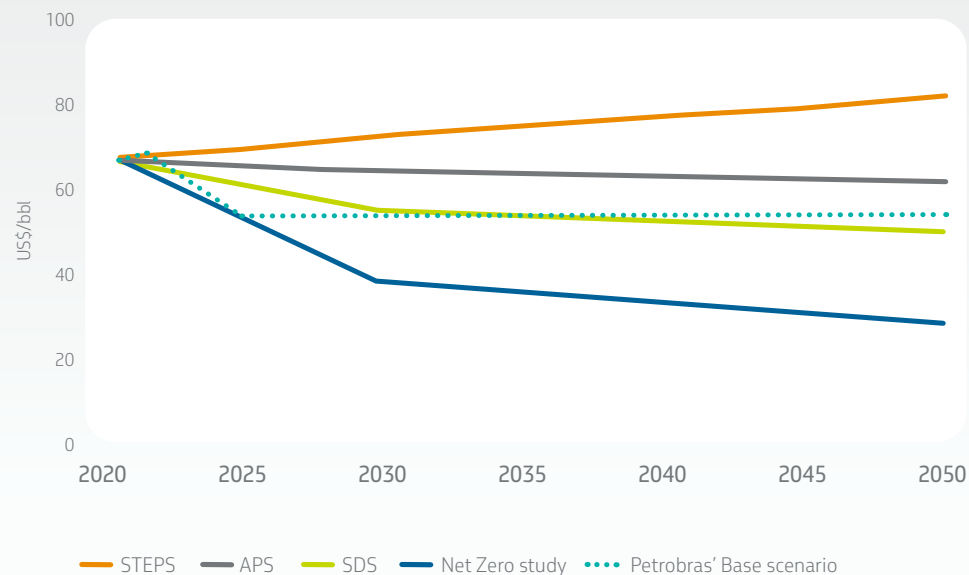
— **The Resilience Scenario** considers an accelerated energy transition pace and projects the oil price at US\$ 35/bbl, similar to the price predicted in the International Energy Agency's Net Zero Study (which has a 50% probability of limiting the temperature increase to 1.5°C, in line with the ambition of the Paris Agreement).

— **The Base Scenario** considers an oil price range between US\$72/bbl in 2022 and US\$55/bbl from 2025 onwards, that is, price expectations similar to the SDS scenario of the International Energy Agency (which is aligned at 50% probability of keeping below 1.65°C).

— **The Growth Scenario** presents a gradual pace of transition, reflecting the technological and policy coordination challenges. There is support from higher prices, converging to US\$ 75/bbl in the long term.

Our governance requires that all investments generate value in the three scenarios and the optimization of the portfolio takes place through the Base Scenario. It should be noted that any projects that do not generate value in the most restrictive scenario are excluded from the portfolio (Resilience, in the case of projects with revenues linked to the Brent price).

Oil price projection in the International Energy Agency scenarios, in the Net Zero study and in the Petrobras base scenario



Energy transition: growth in demand for decarbonized products

Our scenarios predict growth in the world's primary energy demand. With the fall in the demand for fossil fuels, there will be an increase in the demand for other energy sources.

In all scenarios, the market and the share of renewables in electricity production are expanded, maintaining thermoelectricity, predominantly with gas, as an enabler of the incorporation of renewables and reduction of carbon intensity in electricity generation.

In addition, we anticipate the expansion, with pace uncertainties, of the international markets for advanced biofuels, ammonia and hydrogen and other decarbonized fuels, in addition to the growth of emissions removal by geological capture and sequestration of CO₂ (CCUS) and by natural-based solutions.

Strategy and Portfolio

Exploration and Production (E&P): focus on low-cost, low-emission oil

Companies will be as competitive for the long-term market as they are able to produce at low cost and low emission, thriving in scenarios with decreasing oil prices, carbon pricing and product differentiation by carbon intensity.

Our strategy foresees the maintenance of Petrobras among the leaders in decarbonized oil in the world. It is in society's interest to produce the best oil with the lowest emissions while the transition takes place.

Reducing emissions in operations is a Petrobras commitment and a relevant opportunity to reduce emissions. That's 4 billion tons of greenhouse gases per year, which would be avoided if all oil and gas companies reached the neutrality of operational emissions.

As already highlighted, our strategy requires resilience to oil low prices. We continue to focus on exploration and production (E&P) in deep and ultra-deep waters, with an emphasis on the pre-salt layer, where Petrobras has competitive advantages and is able to produce low-emission oil while generating more value, transforming the resources of the Brazilian coast into wealth.

Our perspective is to operate with average E&P lifting costs (excluding charter costs and government participation) of US\$4.8/boe, potentially as low as US\$3.5/boe in the case

of pre-salt production, which will represent 79% of the company's total production at the end of 2026. The global prospective breakeven of our E&P portfolio is US\$ 20/bbl.

We reiterate that all our projects to be approved must be economically viable in the resilience scenario, with an oil price of US\$35/bbl.

Refining, Transport and Marketing: integration, excellence, and diversification

The basis of our refining, marketing and logistics strategy explores the competitive advantages of our assets, integrated logistics and regional synergy with exploration and production assets and with the main Brazilian markets.

We seek resilience in the energy transition environment, through operational excellence in energy efficiency, emissions, and reliability, with a dedicated program (RefTOP). In addition, the refining park continues to be modernized to incorporate renewable raw materials, expand production capacity for low sulfur fuels and non-energy products (e.g. base oil for lubricants).

Our Strategic Plan 2022-2026 foresees investments on a commercial scale for advanced biofuels, such as renewable diesel (HVO) and aviation biojet, conditioned to the evolution of public policies.

In maritime transport, we focus on optimize routes and control the speed of vessels and make progress in contracting vessels with better consumption performance and, consequently, lower emission of greenhouse gases.

Gas and Energy (G&E): energy security in the low carbon matrix

Our strategic plan maintains us as a relevant producer of electricity in Brazil, adapted to the high penetration of renewables in Brazil and focused on the commercialization of our own gas. Considering the intermittence of renewable sources (wind and solar) and the seasonality of hydropower, we maintain our position in providing efficient and dispatchable gas-fired thermoelectricity to facilitate the increasing incorporation of renewables.

In this sense, we continue with the objective of optimizing our portfolio, focusing on integration with natural gas, increasing the efficiency of the thermoelectric park and increasing the gas processing capacity.

New business

With the debt under control, the Strategic Plan 2022-2026 expanded the opportunity to mature businesses in low-carbon emerging markets.

In this sense, we kept the topic as a priority of our technological direction and created specific governance to evaluate diversification opportunities and we are attentive to opportunities that are synergistic with our skills, arising from the growth in the electricity market, decarbonized fuels and non-energy products.

Resilience evaluation: assumptions in line with the Paris Agreement

We carry out resilience and consistency analysis of the value of our portfolio considering the comparison with the International Energy Agency (IEA) public scenarios:

– **SDS Scenario** (Sustainable Development Scenario):
50% probability of limiting temperature rise to 1.65°C,
in line with the Paris Agreement objective

– **APS Scenario** (Announced Pledges Scenario)

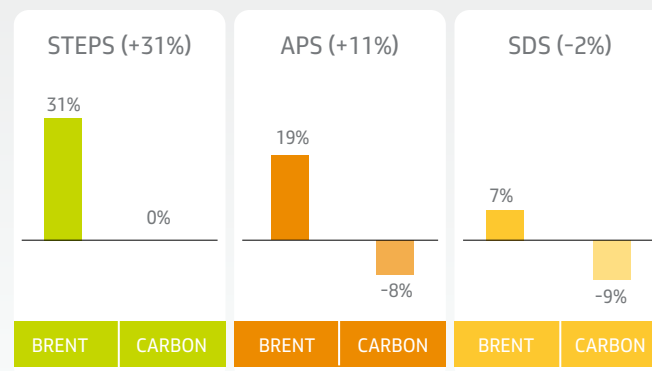
– **STEPS Scenario** (Stated Policies Scenario)

Impact simulations were performed on the net present value (NPV) of Petrobras' portfolio when adopting the oil price and carbon price of these public scenarios.

We found that the value of the portfolio in our base case is equivalent to the valuation with the IEA's SDS scenario. When using the assumptions of this external scenario, there is a combined effect of -2%, a result of +7% for the oil price variable and -9% for the incidence of the carbon price. The value of our portfolio would be significantly higher under the assumptions of the STEPS (+31%) or APS (+11%) scenario.

The result is consistent with Petrobras' decision to adopt conservative assumptions, in order to direct investments to assets that are resilient to the world in line with the Paris Agreement.

Impacts of the prices of the IEA scenarios on the value of Petrobras portfolio



It considers the impact of the Brent price only in the E&P segment. Pre-tax carbon price effect.

Note 1: The STEPS scenario considers carbon prices only for already regulated markets, without defining this price for Brazil and, consequently, without impacts on the value of the portfolio of this variable.

Note 2: The valuation of the portfolio in Petrobras' base scenario is carried out without the incidence of the carbon price. However, there is a carbon price curve associated with this scenario, used in portfolio risk analysis, investment sensitivity analysis and decision making for decarbonization investments in the Carbon Neutral Program, which is described in the Investments and Initiatives section.

We also carried out simulation with an external scenario linked to the ambition of the Paris agreement: *Net Zero Emissions by 2050* (NZE), also by the IEA. The study simulated significant changes in the energy demand profile to achieve neutrality by 2050 (50% probability of limiting the temperature rise to 1.5°C).

If the quantification in our base scenario is compared with that carried out with the price assumptions of the NZE study, it is observed that there would be a negative impact of 33% on the net present value, due to the combined action of lower oil prices and the incidence of carbon prices.

However, as already mentioned, all our projects must be economically viable in the Petrobras Resilience scenario, with an oil price of US\$ 35/bbl. Thus, this scenario is more appropriate for comparison to the NZE study.

In fact, the simulation found that the quantification of the portfolio with the oil and carbon price assumptions of the NZE study results in a higher value (+22%), than that obtained with the assumptions of our Resilience scenario, explaining the conservative option of Petrobras in portfolio choices. We emphasize that, although the oil price of our Resilience scenario is converging with that of the NZE study, our forecast for oil demand is higher (50 million barrels per day against 25 million barrels per day in 2050).

Governance, incentives and risk management

Strengthened governance and organizational structure

Our governance for the topic has been strengthened since 2019 and we count on the active oversight of the Safety, Environment and Health (HSE) committee of the Board of Directors, also on an executive committee that advises the Executive Board and on committees at the tactical level in all the segments.

In November 2020, we also strengthened our organizational structure, with the creation of the Climate Change Executive Management dedicated to the issue of emissions, climate and energy performance, linked to the Institutional Relations and Sustainability Office.

Strong incentives

Top metrics provide more explicit guidance on the company's key short-term goals. We are maintaining the top metrics with a focus on the creation of value, safety, and sustainability in operations. Three top metrics influence employees' variable remuneration, two related to sustainability and one related to value creation:

- Indicator of Compliance with the Greenhouse Gas Emissions Targets (IAGEE),
- Oil and Oil Product Leak Volume Indicator (VAZO) e
- Delta EVA indicator (Delta EVA®).

In the 2022-2026 Strategic Plan, we reinforced the incentives with an impact on the remuneration of all employees and managers related to the topic. The IAGEE metric attendance percentage affects between 5% and 15% of the bonus amount (decreasing percentage from the CEO to the employee without a managing role). Executives related to the E&P and Refining segments have an additional impact related to issuance in their respective segments.

Integrated and quantified risk management

Petrobras has a history of managing and quantifying risks related to climate change. Our risk management process is integrated, which allows for the standardization of analysis and effective management of all identified risks. The set of risks related to climate change and the energy transition was evaluated with a very high degree of severity and the actions to avoid, reduce, transfer, accept or exploit (applicable to opportunities) are periodically supervised by the company's high level administration.

In relation to the topic, the following risks were mapped, which are monitored and reviewed annually: Market Risk, Regulatory Risk, Legal and Reputational Risk, Technological Risk and Physical Risks of Climate Change.

In 2021, we highlight the quantification of Regulatory Risk on the value of the portfolio. The simulations considered a gradual implementation of an emissions regulation instrument and ranges of values that vary in time from US\$ 0/tCO₂ to US\$ 78/tCO₂ depending on the scenario. Currently, more than 99% of our operational emissions occur in Brazil, so our analyzes consider country-specific perspectives.



Investments and Initiatives

It is our priority to ensure that carbon risks and opportunities are adequately quantified and considered in our choices, and transparency is essential so that our stakeholders can understand the motivations for our decisions. In this regard, we highlight a few points:

CAPEX of US\$ 2.8 billion for decarbonization

The Strategic Plan 2022-2026 provides for CAPEX of US\$ 2.8 billion for reducing and mitigating emissions. This amount includes investments in the decarbonization of operations, bioproducts (renewable diesel and biojet) and low-carbon research and development initiatives.

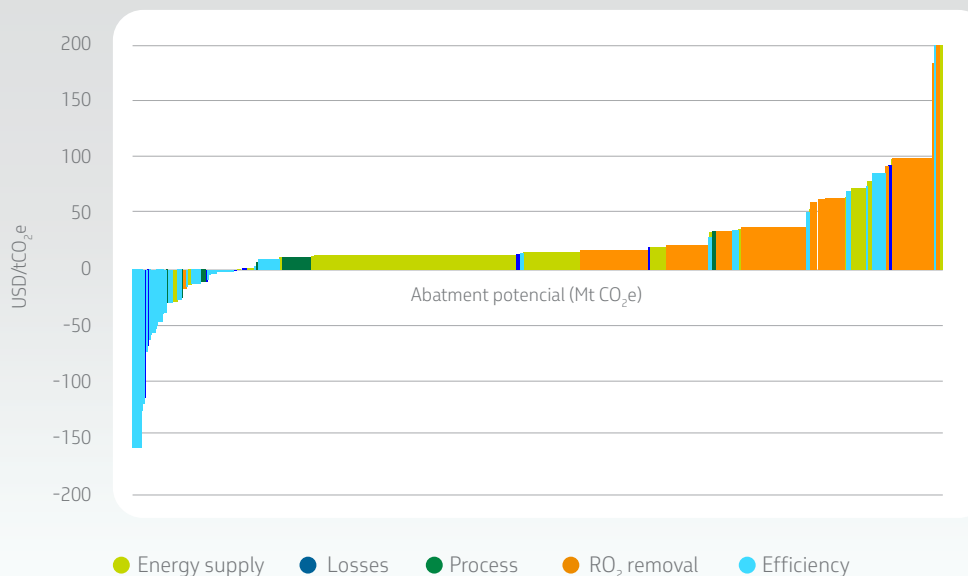
STRATEGIC PLAN 2022-2026



Integrated management of the decarbonization portfolio based on marginal cost

To support the best choices for the decarbonization trajectory, in 2021 we completed a review of our marginal abatement cost curve (MACC). The study mapped around 200 alternatives for reducing operational emissions in all our segments. Our approach is to manage the decarbonization portfolio in the company, subsidizing the choices for technological development for scopes 1 and 2, and also for scope 3, which will be included in a new phase of the study.

Integrated MACC, 2021



Corporate program and fund for accelerating decarbonization

The Strategic Plan for 2022-2026 consolidated Petrobras' Carbon Neutral Corporate Program, which aims to accelerate the identification and development of the best solutions for the decarbonization trajectory at the lowest cost, with action on emissions throughout the value chain (scope 1, 2 and 3). The analysis will be integrated into the portfolio of opportunities, involving criteria such as marginal abatement cost, technological maturity, application opportunity, among others.

The program is supported by a dedicated decarbonization fund, with a budget of US\$ 248 million for the five-year period. Internal carbon price curves were approved, with use restricted to the initiatives of this fund, allowing to expand the list of decarbonization initiatives.

Innovation and engineering as key to ambition

There are technological gaps relevant to the achievement of Petrobras' and society's net zero ambitions. We maintain our commitment to innovation, with at least 10% of the research and development budget dedicated to low carbon solutions, and under the coordination of our research center (CENPES), the largest in Latin America.

We highlight the incorporation of new technologies and low carbon concepts in our E&P projects developed in 2021, such as the All Electric concept (which increases efficiency and demands less fuel to generate energy on the platform), optimizations in the gas treatment process and deep water capture. These new technologies predict a carbon intensity reduction of 16% compared to the previous generation projects.

In the Refining, Transport and Commercialization and Gas and Energy segments, actions are anchored to RefTOP and GÁS+ programs, that focus for operational excellence in energy efficiency, emissions and reliability.

Removal by natural-based solutions

Given the Brazilian emissions profile, our Carbon Neutral Program will also evaluate the use of NCS (Natural Climate Solutions) credits associated with conservation, recovery and restoration of ecosystems, as an offset opportunity. Any compensation will be complementary, not substitutive, of the intrinsic mitigation efforts. The eventual use of these credits will follow strict criteria of transparency and integrity.

Third party verified gold standard inventory

And, as a base, our emissions inventory is integrated for the entire company and its subsidiaries, consolidating the data of each equipment, with about 10 thousand sources fed in an integrated system. We were founders of the Brazilian chapter of GHG Protocol and our inventory is verified by third-party and receives the gold seal from the Public Emissions Registry.

Brazil: distinct emissions profile and complementarity between oil, gas and renewables

Brazil has a specific profile in the decarbonization scenario, with low per capita energy consumption and the second most decarbonized energy matrix among the G20 (35.54 kgCO₂e/GJ).

The low intensity is a result of the high share of renewables, which, nowadays, is at the levels that most nations aim to reach in two or three decades (85% of renewables in the electricity matrix and about 50% in the energy matrix).

In Brazil, thermoelectric energy is not required on the basis of energy demand, but as a ballast to enable increasing proportions of seasonal and intermittent renewables. It allows flexibility and guarantees greater working reliability for the entire Brazilian electricity sector. In transport, there are about 23% of biofuels, the result of incentive policies, such as mandates, the RENOVABIO program and differentiated taxation policies.

Another peculiarity of the country is the high economic impact of replacing fossil fuels in transport. Road infrastructure results in one of the economies that most require liquid fuels in the world (1.2 boe/thousand US\$GDP) and, therefore, more sensitive to its cost. In addition, the country is an oil producer, a product of high tax collection with around 60% of its value reverted to public revenue, in the form of taxes, bonuses, royalties and dividends, in the case of companies such as Petrobras, with state participation.

The energy transition in Brazil is in an advanced stage and the country has a particular profile of costs and transition opportunities. Advancing decarbonization requires identifying the lowest cost options for society and aiming to make energy more accessible – a fundamental element of competitiveness and social well-being.

The production of lower emission oil in Brazil is allied to the global trajectory of decarbonization, reducing emissions in the country and generating foreign exchange to finance a new, more efficient and competitive infrastructure.

Brazilian target and land use change

Another particular characteristic of the Brazilian emissions profile is the representativeness of emissions from land use change due to loss of vegetation cover, whose emission is equivalent, in a unique way, to all the emission related to the production and use of energy in the country. (about one third of emissions).

Such materiality demonstrates the importance of controlling this emissions item, which has a favorable marginal cost of abatement among the decarbonization options*. The Brazilian target under the Climate Convention provides for the neutrality of greenhouse gas emissions in 2050 and a forecast to eliminate illegal deforestation by 2028 (Guidelines for a national strategy for climate neutrality, MMA, 2021).

* Studies such as the one by the World Economic Forum estimate a potential of 1 billion tons of CO₂e per year in forestry projects with a cost below US\$ 35/tCO₂e in Brazil, which means about 15% of the world potential for mitigating emissions through restoration and preservation of biomes at low cost.

Transparency and Engagement

Transparency as a core business value

In the development of this supplement, we used different performance and disclosure references, highlighting the TCFD (Taskforce for Climate Related Financial Disclosures), IPIECA (Global Oil and Gas Industry Association for Environmental and Social Issues), IOGP (International Association of Oil and Gas Producers) and SASB (Sustainability Accounting Standards Board). We are respondents to the CDP questionnaire (previously known as Carbon Disclosure Project) and we collaborate transparently with different evaluation and benchmarking institutions.

Advances in external perspective

As a highlight, in 2021, we rejoin the Dow Jones Sustainability Index World (DJSI World), one of the most important sustainability indices in the world. In addition, we are ranked in the first quartile of performance for "Carbon Emissions" in the MSCI ESG Rating. We were assessed at a score of 4 (Strategic Assessment) in the TPI (Transition Pathway Initiative) Carbon Management assessment.

Strength of cooperation

We believe in cooperation to overcome climate challenges and are active members of IPIECA and IOGP. Since 2018, we have been part of the Oil and Gas Climate Initiative (OGCI), which brings together twelve of the largest oil and gas companies in the world, responsible for more than 30% of the world's oil and gas production.

We also cooperate outside our industry, with reference institutions in the promotion of sustainable development, such as: Organization for Economic Cooperation and Development (OECD), World Economic Forum (WEF), Brazilian Business Council for Sustainable Development (CEBDS), National Confederation of Industry (CNI), Regional Association of Oil, Gas and Biofuels Companies in Latin America and the Caribbean (ARPEL), Brazilian Forum on Climate Change.

Petrobras Position

We endorse the position paper of the Brazilian Oil and Gas Institute (IBP), with the main objective of contributing to a decarbonization trajectory until 2050. We support the decarbonization of society, which aims a fair transition and at the lowest cost, including stimulating the infrastructure that consume less energy.

Bearing in mind the context of Brazilian emissions, we are in favor of incorporating natural climate solutions into public policies and corporate climate strategies, always as a complementary measure to the mitigation of emissions and through high integrity initiatives, verified by high standards and with environmental and social benefits.

1. TARGETS, METRICS, PERFORMANCE AND VOLUNTARY INVESTMENT



1.
Transparency:
carbon quantified
in critical
processes



2.
Resilience of fossil
position facing
the low carbon
transition



3.
Strengthening
of skills to
create value
in low carbon

Given our scenarios and strategy, our actions are supported by the following three pillars:

1. Transparency: carbon quantified in critical processes



Our decisions today affect the carbon performance and the value generation in the short, medium, and long term. Our priority is to warrant that carbon risks and opportunities are properly captured in scenarios, quantified, and considered in our choices, assuring the sustainability and resilience of our business, which requires attention to the continuous improvement of decision-making processes. We adopt transparency in carbon and highlight our public support to the TCFD – Task Force for Climate Related Financial Disclosures and the adoption of external disclosure and performance benchmarks SASB, IPIECA, GRI and IOGP.

2. Resilience of fossil position facing the low carbon transition



The Oil & Gas sector (O&G) currently provides more than half (53%) of the primary energy in the world, focused on meeting the needs of mobility, industrial production, residential cooking and heating, and electric power. Such demand is achieved by product with substantial variation of performance in carbon. Our scenarios indicate the persistence of oil in the global grid, although in lower volumes. Our priority is to operate at low costs and with superior performance in carbon, protecting the competitiveness of our oils in the global markets in a scenario of downturn and subsequent retraction of the demand.

In our understanding, companies will be as competitive to the long-term market as they are capable of producing at low cost and with lower greenhouse gases (GHG) emissions, with prosperity in scenarios of low price of oil, carbon pricing and possible oil differentiation practices based on their GHG emissions intensity in production.

3. Strengthening of skills to create value in low carbon



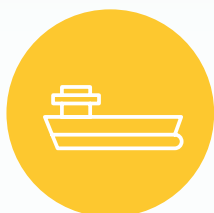
The objectives of the Paris Agreement require a deep reduction of GHG emissions and the transformation of energy supply. Our scenarios indicate an unequivocal energy transition, at uncertain pace. The risks and opportunities are different and depend on the markets, characteristics of each company, evolution of the innovation, and public policies.

To strengthen our low carbon positioning, we prioritize investment in decarbonizing our operations, developing bioproducts and skills for the future. We are advancing in the analysis of possible new businesses that can reduce exposure and dependence on fossil sources and, at the same time, be profitable, ensuring the company's long-term sustainability. In this sense, an analysis and approval governance was created for investments in new businesses focused on diversifying our portfolio, prioritizing businesses related to the energy segment and new products that are not yet foreseen in the current Strategic Plan.

Emissions Management¹

Our scenarios indicate that there will be persistent global demand for oil in the coming decades, albeit decreasing. We hold significant reserves, and it is our priority to continue to supply oil and gas in a competitive and environmentally responsible manner. In this context, operational performance in greenhouse gas emissions is one of the strategic requirements for the company’s long-term resilience, contributing to meeting the goals of the Paris Agreement and to the credibility and market opportunities for our products. Emissions from the O&G sector emissions are relevant (9% of global emissions) and the decarbonization contributions are of substantial import.

As an integrated energy company operating in the O&G and electricity markets, we monitor the absolute emissions and GHG emissions intensity of our activities and the value chain of our products.



INTEGRATED PERFORMANCE

O&G

Supply of crude oil, liquid fuels, and gas



INTEGRATED PERFORMANCE

ELECTRICITY

Supply of electric power, mainly by gas-fired power generation

Of our 10 public Sustainability Commitments, all monitored by the company’s senior management, 6 are related to the carbon theme. In this sense, we reinforce our cycle of sustainability commitments published for the 2025 and 2030 forecasts, continuing our trajectory of decarbonization and strategic alignment.

Among our actions, we developed a basket of metrics for carbon management, in addition to monitoring the targets related to gas flaring and energy efficiency (see Targets, Metrics and Performance). We have maintained teams dedicated to the topic of emissions and climate change for almost 20 years. We inventory all assets under operational control. We have a proprietary emissions management system with around 10,000 sources registered, the SIGEA® (Sistema de Gestão de Emissões Atmosféricas da Petrobras - Petrobras Atmospheric Emissions Management System), which also contains data modules including our emissions inventory. Our inventory of emissions has been published voluntarily since 2002 and verified by a third party annually, representing our pioneering spirit in GHG management. We are also founding members of the Brazilian GHG Protocol Program, and we publish our inventory in its Public Emissions Registry, currently recognized with the Gold Seal, a standard of excellence in data quality and availability.



Teams dedicated to the topic of emissions and climate change for almost 20 years



We have a proprietary emissions management system with around 10,000 sources registered, the SIGEA®



We are founding members of the Brazilian GHG Protocol Program



We are currently recognized with the Gold Seal at Public Emissions Registry

¹ The 2021 emissions performance results presented in this supplement will still be verified by a third party, so variations may occur, but no significant changes are expected

Sustainability Commitments

Sustainability commitments related to the carbon theme (based on 2015)¹

CLIMATE CHANGE

- | | | |
|---|--|---|
| <p>1.
25% reduction in absolute operating emissions by 2030</p> | <p>2.
Zero routine flaring by 2030²</p> | <p>3.
40MM ton CO₂ reinjection by 2025 in CCUS projects</p> |
| <p>4.
32% reduction in carbon intensity in the E&P segment by 2025 (15 kgCO₂e/boe, maintained until 2030)³</p> | <p>5.
40% reduction in methane emission intensity in the upstream segment by 2025</p> | <p>6.
16% reduction in carbon intensity in the refining segment by 2025, expanding to 30% by 2030 (30 kgCO₂e/CWT)⁴</p> |

¹ To all goals, the operational GHG emissions, both direct (Scope 1) and indirect resulting from the acquisition of electric and/or thermal power produced by third parties (Scope 2), are considered.

² The “Zero Routine Flaring by 2030” initiative of the World Bank aims to eliminate the routine flaring, i.e., that resulting from the impossibility of utilization of the gas produced in the E&P segment. Its scope does not include non-routine flaring, such as during startups, malfunction, or maintenance of assets, as well as flaring due to emergency reasons.

³ The kg CO₂e/boe indicator considers in its denominator the raw production of oil and gas (wellhead).

⁴ The kg CO₂/CWT indicator was developed by Solomon Associates specifically to refineries and was adopted by the EU Emissions Trading System – EU ETS and by CONCAWE (association of European companies of oil and gas refinement and distribution). The CWT (Complexity Weighted Tonne) of a refinery considers the potential of CO₂ emission, in equivalence to distillation, to each process unit. Therefore, it is possible to compare emissions of refineries of different sizes and complexities. Petrobras follows the kg CO₂/CWT indicator according to its original identity. We also accompanied an adapted indicator: kg CO₂e/CWT, to allow the inclusion of other GHG emissions (e.g. Methane), which, however, represent a small fraction of our refining emissions.

In addition to our short- and medium-term commitments, our long-term ambition is to achieve net zero emissions in activities under our control (Scopes 1 and 2) and influence partners to achieve the same ambition in non-operated assets, within a timeframe compatible with the Paris Agreement. Our commitments involve both working on existing assets and designing new projects.

>> See **Investments and Initiatives; Transparency and Engagement**

Metrics linked to GHG emissions intensity in our E&P and Refining operations are top metrics and, thus, influence the variable compensation of our entire workforce.

>> See **Governance, Incentives and Risk Management**

SCOPE 1

DIRECT GHG EMISSIONS

Direct GHG emissions occur from sources that are owned or controlled by the company.

SCOPE 2

INDIRECT GHG EMISSIONS

Scope 2 accounts for GHG emissions from the generation of purchased electricity, steam, and heating/cooling consumed by the company.

SCOPE 3

OTHER INDIRECT GHG EMISSIONS

Are a consequence of the activities of the company but occur from sources not owned or controlled by the company.

Absolute Operating GHG Emissions

Our emission reduction target encompasses 100% of the assets operated in all our activities, including energy generation, for all greenhouse gases, being a material, relevant, short- and medium-term contribution to mitigate climate change. Our GHG emissions intensity targets (E&P and Refining) represented a coverage of 67% of the emissions from the activities we operated in 2021.

Between 2015 and 2021, our absolute operating emissions decreased by 21%. In 2021, emissions totaled 61.8 million tCO₂e, higher than the result of the previous three years. This increase is a direct consequence of the atypical thermoelectric dispatch in a year of water scarcity.

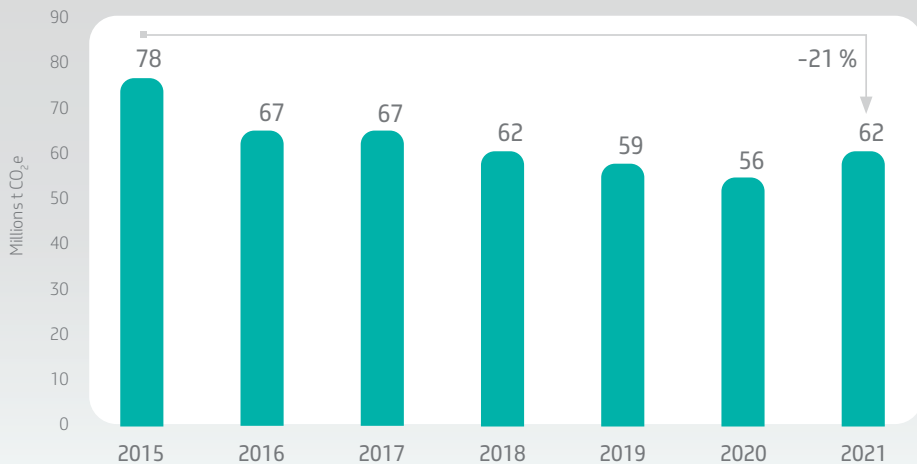
Scope 1 emissions represented 99% of our operational emissions in 2021. Scope 2 emissions, therefore, have low materiality.

2020 was an atypical year due to the impact of the COVID-19 pandemic on demand for our products. While the first half was marked by a strong retraction in demand, with the hibernation of less efficient production assets and a reduction in the processed load at our refineries, in the second half we observed a resumption of demand for oil and refined oil products. Additionally, in the second half of 2020, there was an increase in the demand for energy from thermoelectric power plants by the Brazilian National Electric System Operator (Operador Nacional do Sistema Elétrico – ONS), a measure taken to save water from hydroelectric reservoirs at the end of the dry season.

In 2021, the dispatch of thermoelectric plants coordinated by the ONS remained high, resulting in the highest average of thermoelectric generation in the last five years. This fact is the main cause for the increase in our GHG emissions in 2021, even in a scenario of reduction in our carbon intensities in E&P and Refining.



Absolute Operating GHG Emissions

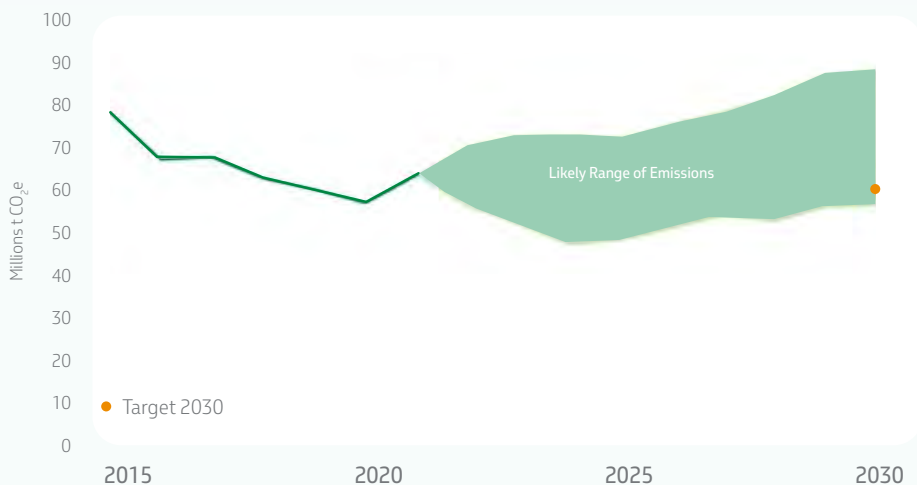


The target of reducing absolute operational emissions by 25% by 2030, compared to 2015, is related to the progressive reduction in our operational emissions, already considering the increase in production expected for the period, and is supported by a set of systemic actions to be implemented in the coming years.

>> [See Investments and Initiatives](#)

In 2021, the dispatch of thermoelectric power plants connected to the Brazilian National Interconnected System was considerably higher than in previous years. The main factor that motivated the increase in thermoelectric dispatch was water scarcity, which resulted in lower hydroelectric power generation.

Absolute Operating GHG Emissions



Thermoelectric Power Generation in Brazil



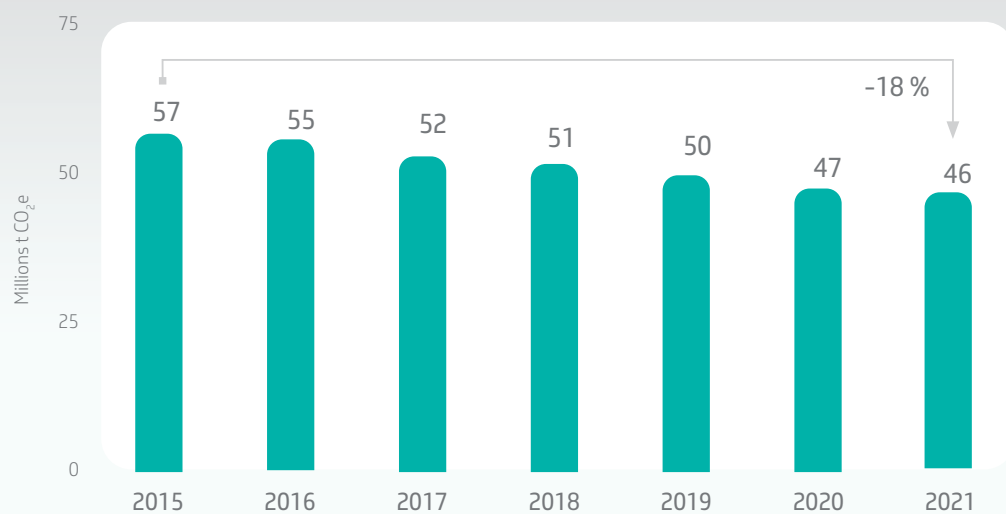
Source: ONS, 2022

Note: In the likely range of emissions, the upper line represents business as usual, with partial implementation of the mapped decarbonization opportunities and with higher thermoelectric dispatch. The lower line, in turn, represents the successful implementation of portfolio projects and new opportunities to be developed by our Carbon Neutral Program.

Operating Emissions from Oil and Gas Activities

We also monitor operational emissions from our O&G activities only, whose calculation does not include emissions from our operations in the thermoelectricity segment.

Operating Emissions from O&G Activities



Total operating emissions (Scope 1 and 2) from our O&G activities have shown a continuous downward trend over the last few years, reaching an 18% reduction between 2015 and 2021. This result comes from our actions in the segments that reflect on our performance in emissions intensity.



In the Maritime Transport segment, our ship contracting process prioritizes vessels with better consumption performance and, consequently, lower greenhouse gas emissions.

In 2020, we contracted 2 ECO type vessels of the VLCC (Very Large Crude Carrier) class, with a transport capacity of around 2 million barrels of oil. When compared to conventional vessels of the same class, they have the potential for a 24% reduction in average fuel consumption per ton-mile*. By the end of the contract (September 2022), the estimated avoided emission from these two vessels in the fleet is around 33,000 tCO₂e.

We also received 4 new Suezmax DP-2 ECO type vessels, with a capacity of 1.1 million barrels each and built-in dynamic positioning system, built exclusively for the relief operations of our production units in deep and ultra-deep waters in Brazilian coast. They were designed to reduce fuel consumption with an EEDI (Energy Efficiency Design Index) 15% below the benchmark for its class. In just over a year of contract, the average consumption per ton-mile of these vessels was 32% below that of other vessels of the same size in the fleet. In 2022, we will receive 3 more ships of this class, even more economical, with a projected EEDI 23% below the benchmark for its class.

We aim to advance in contracting ECO type vessels in all classes, in addition to promoting initiatives to reduce emissions by optimizing itineraries and controlling the speed of vessels.

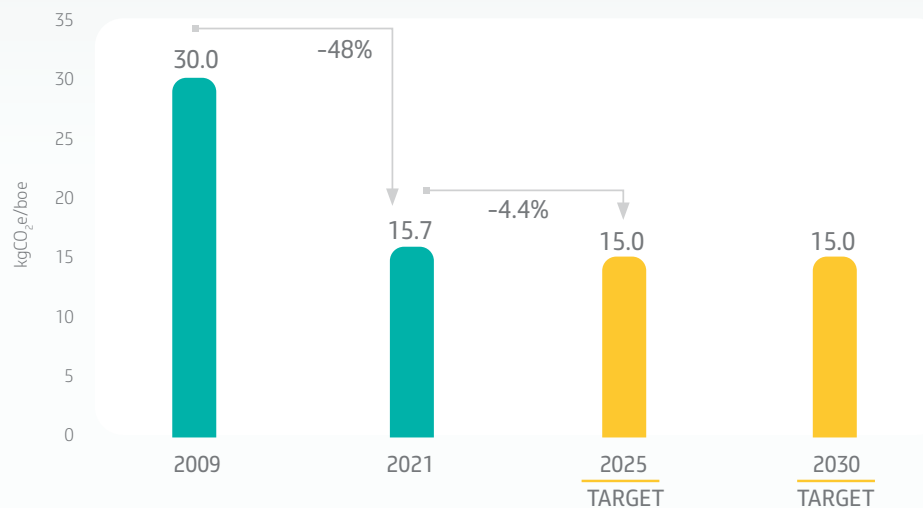
* ton x mile – product of the distance that the freight is transported, measured in nautical miles, and the cargo transported, measured in tons. So moving one ton by one mile generates one ton-mile.

GHG Emissions Intensity in E&P Operations

We currently have an outstanding performance in terms of GHG emissions intensity in the offshore oil and gas industry, being a low-emission, high-efficiency player, especially in the pre-salt fields.

Our commitment is to continue to improve GHG emissions efficiency of our E&P activities, with the target of reaching 15 kgCO₂e/boe in 2025, maintained until 2030.

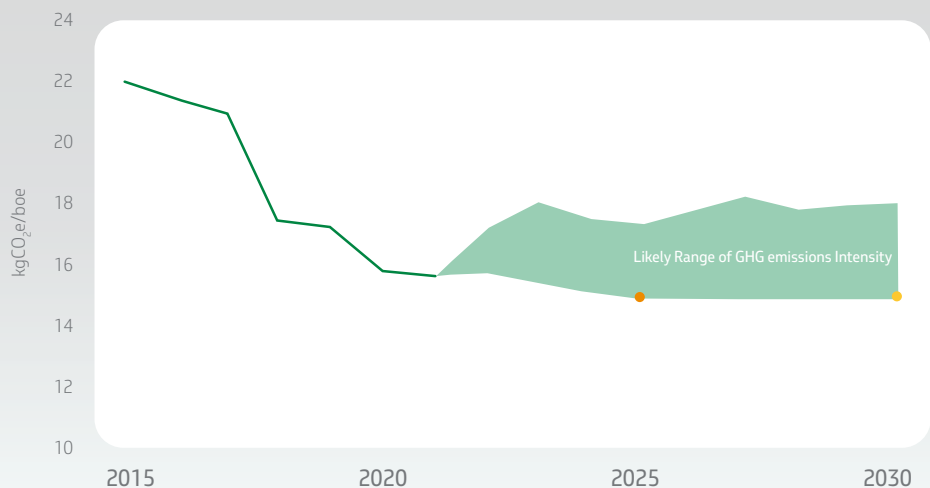
E&P GHG emissions Intensity



Key factors for reducing E&P GHG Emissions Intensity:

- _ Characteristics of new assets;
- _ Reduction of flaring, fugitive emissions and losses;
- _ Energy efficiency;
- _ Portfolio management;
- _ CCUS-EOR (re injection with Enhanced Oil Recovery).

E&P GHG Emissions Intensity



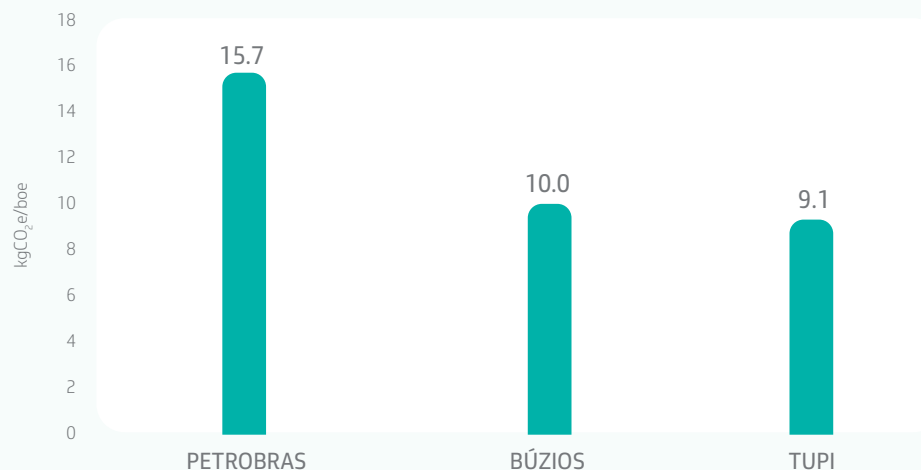
- Target 2025 - 15 kgCO₂e/boe
- Target 2030 - 15 kgCO₂e/boe

Note: In the likely range of GHG emissions intensity, the upper line represents business as usual, with partial implementation of the mapped decarbonization opportunities. The lower line, in turn, represents the successful implementation of portfolio projects and new opportunities to be developed by our Carbon Neutral Program.

After years of producing oil and gas, it is natural for the fields to mature. As a consequence, in order to expand its production levels, it is necessary to employ energy-intensive techniques, such as water and/or gas injection. Thus, the water production and energy demand of such mature fields tend to increase, and the rate of oil production tends to decrease. This affects GHG emissions intensity in both directions: in the numerator, as it requires more energy to produce oil and to separate and treat the additional water produced; and in the denominator, as the rate of oil production decreases. The closer we get to near-zero targets across the portfolio, the more challenging it is to offset GHG emissions intensity of mature fields. In this sense, the 15 new FPSOs that we plan to install over the next five years are expected to achieve very low GHG emissions intensity performance.

The main pre-salt oil streams that we produce have GHG emissions intensity that is even lower than the average value of our operations. Together, the Tupi and Búzios streams accounted for around 53% of our total production in 2021.

E&P GHG Emissions Intensity – 2021



Zero Routine Flaring

In 2018, we announced our support for the World Bank's "Zero Routine Flaring by 2030" initiative. Thus, meeting its criteria is one of our Sustainability Commitments. We emphasize that we already have a high rate of average use of produced gas, reaching 97.2% in 2021.

>> [See Investments and Initiatives](#)

COMMISSIONING AND OPERATION OF CLOSED FLARE SYSTEMS

Platforms P-66, P-70 and P-77, located in the Tupi, Atapu and Búzios fields, started to operate with minimum flaring, which will occur only in exceptional safety situations, reducing emissions of greenhouse gases. The flare of the units has the function of burning gas not used on the platforms, in order to safely dispose of it. The start-up of the Flare Gas Recovery Unit (FGRU) allows this gas to return for processing in the unit, preventing its burning and the consequent emission of greenhouse gases. The potential for reducing emissions using the system on these three platforms is around 80,000 tCO₂e per year.

In addition to the P-66, P-70 and P-77, we expect to start operating the FGRU of another 8 platforms in the Campos and Santos Basins in 2022. All our new projects also already have the FGRU, as it is already a standard in our company. The FPSO Almirante Tamandaré will be the first chartered unit to adopt the system as a standard in the project.



Methane Emissions

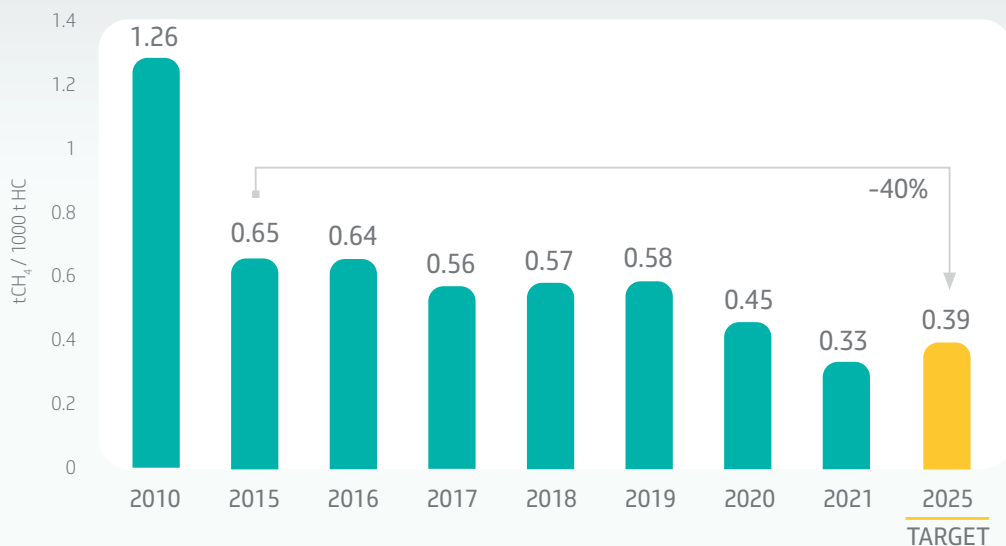
Our GHG emissions intensity targets incorporate different greenhouse gases, including methane. Nevertheless, given the characteristics of methane, whose global warming potential is very high in the short term, we assess this gas with a specific metric. In this context, one of the targets

in our Sustainability Commitments is a 40% reduction in the intensity of methane emissions in relation to the total operated production of hydrocarbons (tCH₄/thousand tHC) in the upstream segment by 2025 (2015 basis).

In 2021, the intensity of methane emissions in the upstream segment decreased by 27% compared to 2020. This result is mainly due to the adjustment of the flaring

emission protocol (combustion efficiency), to the increase in our Associated Gas Utilization.

Intensity of Methane Emissions in the upstream



Our target of reducing the intensity of methane emissions in the upstream also supports the target of reducing E&P GHG emissions intensity, the reduction of absolute emissions by Petrobras and the commitment established by Brazil at COP26, to reduce methane emissions by 30% by 2030 (basis 2020).

Key factors for reducing the intensity of methane emissions in the upstream:

- _ Implementation of the mitigation portfolio for flaring, venting and fugitive emissions, until 2025 (units already built), including monitoring of fugitive emissions with Optical Gas Imaging (OGI);
- _ New design guidelines: closed flare, low emission valves and gas recovery systems.



In the Refining, Transport and Commercialization segment, the fugitive emissions control program is already applied at refineries and will be extended to natural gas treatment units and thermoelectric power plants.

Between 2015 and 2021, we reduced our direct methane emissions by 47%:

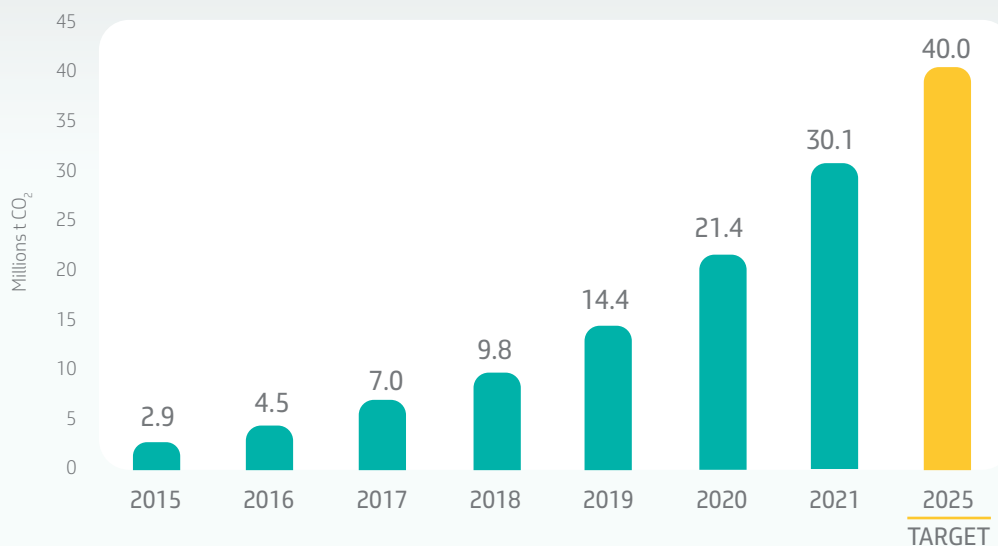
Direct Methane Emissions



CO₂ Reinjection

As one of our Commitments, we aim to achieve an accumulated total reinjection of 40 million tons of CO₂ by 2025. This will contribute to the technological evolution, cost reduction and demonstration of the safety of CCUS technology for application in the oil and gas industry and in other sectors. In 2021 alone, we injected 8.7 million tons of CO₂, and reached an accumulated volume of 30.1 million tons of CO₂ between 2008 and 2021. This program has allowed us to increase production efficiency, thereby reducing CO₂ emissions per barrel produced.

Accumulated CO₂ Reinjection



Key factors:

- _ Start-up of new FPSOs that will have installed CCUS-EOR technology.
- _ Confirmation of reinjection volume in our main upstream assets: Tupi, Mero and Búzios.

We are currently working on the development of new CO₂ capture technologies aimed at reducing the size and weight of processing units in FPSOs, in addition to reducing costs for operations. The HISEP[®] Technology is a good example of this. HISEP[®] is a technology patented by Petrobras and currently in the testing phase. With HISEP[®], the CO₂-rich gas that leaves the reservoir is separated from the oil and part of it is reinjected, by means of a system located on the seabed. As a result, field production increases, and it is possible to achieve lower GHG emissions for each barrel of oil produced.

>> See [Investments and Initiatives](#)

1.

The reinjection of CO₂ into production fields, associated with enhanced oil recovery (CCUS-EOR), will continue to play a relevant role in trajectory of reducing GHG emissions intensity in O&G production.

2.

In 2015, we received the Distinguished Achievement Award for Companies, Organizations and Institutions, the main award of the oil and gas industry, granted annually by the Offshore Technology Conference (OTC) in recognition of the set of ten technologies specially created for the production of pre-salt, among which the following stand out:

- _First separation of CO₂ associated with natural gas, with injection of CO₂ into production reservoirs;
- _Deepest underwater CO₂ gas injection well;
- _First use of the method of alternating water and gas injection.

3.

In 2020, we received the Firjan* Sustainability Award, which rewards the best business practices that contribute to advancing the sustainable development agenda, with a focus on environmental protection, economic balance and social well-being. We were recognized in the Climate Change and Energy Efficiency category, for our Carbon Capture, Use and Storage project associated with Enhanced Oil Recovery (CCUS-EOR) in the pre-salt fields.

* Rio de Janeiro Industry Federation.

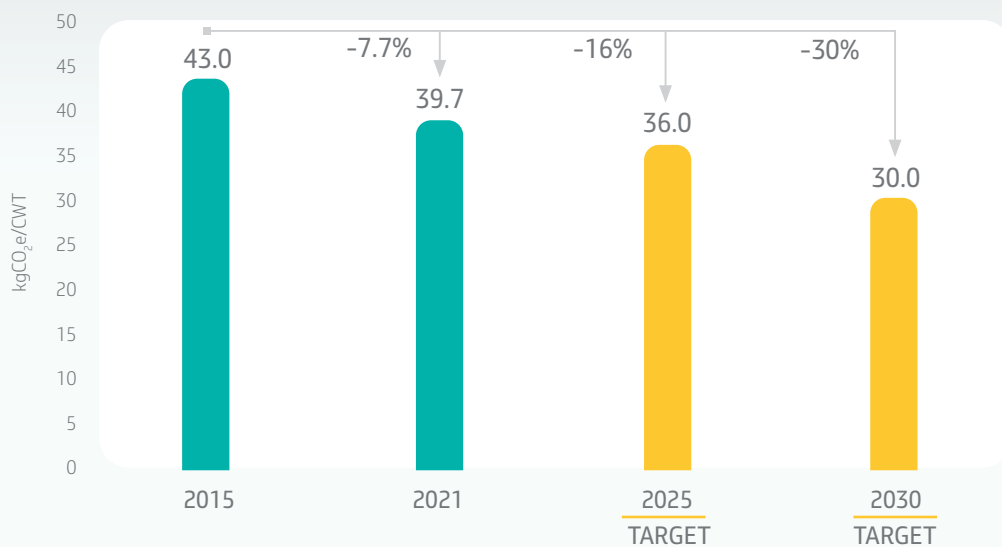


GHG Emissions Intensity in Refining Operations

We set a target of 16% reduction in GHG emissions intensity in the refining segment by 2025 (target of 36 kg CO₂e/CWT), expanding to 30% reduction by 2030 (target of 30 kg CO₂e/CWT). We emphasize that actions implemented to reduce GHG emissions intensity also have the potential to reduce emissions of other gases (particulate matter, sulfur oxides and nitrogen oxides).

In 2021, the Refining GHG Emissions Intensity followed the downward trajectory of recent years, reaching a result of 39.7 kgCO₂e/CWT. This demonstrates the good performance in emissions of our refining park during the year.

Refining GHG Emissions Intensity

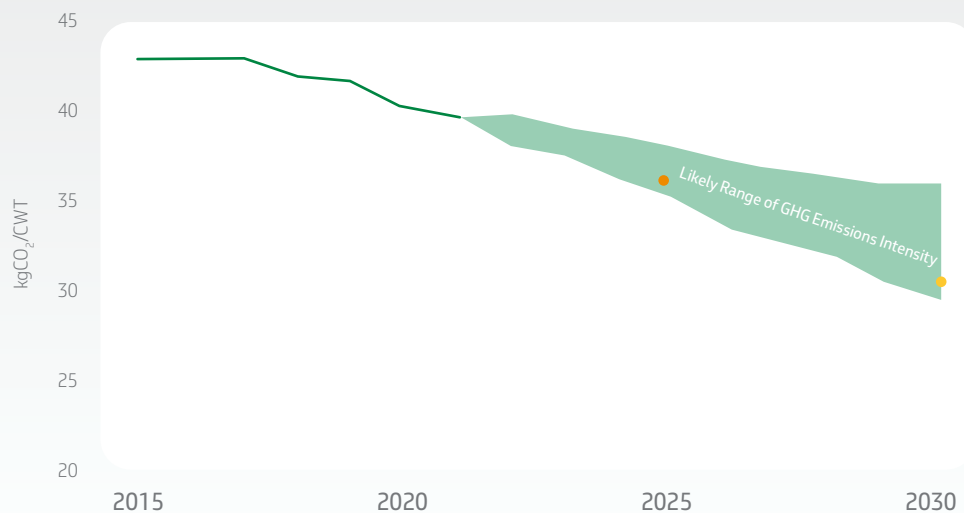


Key factors for reducing Refining GHG Emissions Intensity:

- _ Feed optimization;
- _ Reduction of flaring;
- _ Optimization of the heat and electricity balance;
- _ Improvements in energy performance.



Refining GHG Emissions Intensity



- Target 2025 - 36 kgCO₂e/CWT
- Target 2030 - 30 kgCO₂e/CWT

Note: In the likely range of GHG emissions intensity, the upper line represents business as usual, with partial implementation of the mapped decarbonization opportunities. The lower line, in turn, represents the successful implementation of portfolio projects and new opportunities to be developed by our Carbon Neutral Program.



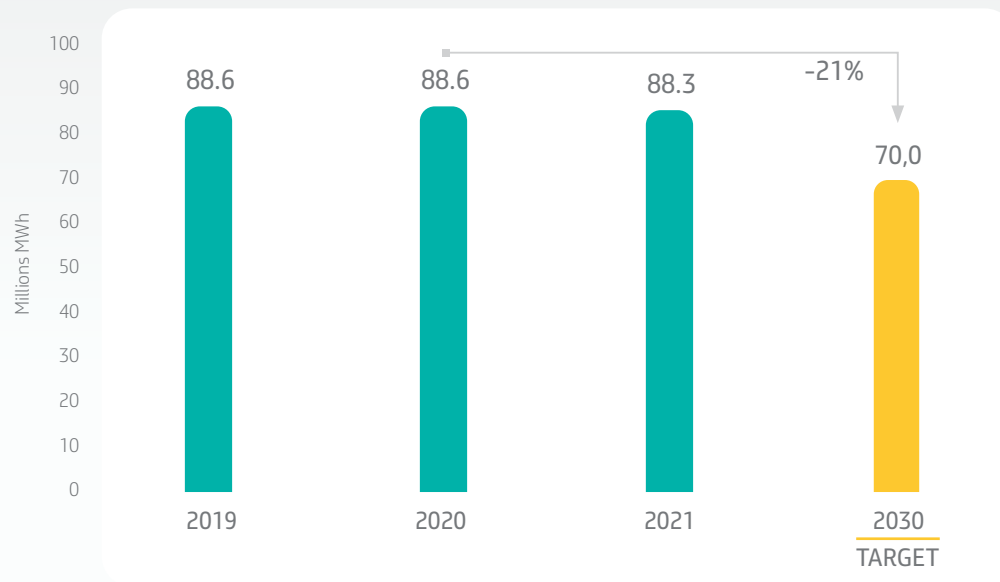
In our refining operations, we monitor our energy consumption intensity, which compares a refinery’s total primary energy consumption with the standard energy consumption for a refinery of similar size and complexity, considering the volume of processed load, the quality of the load, the complexity and severity of process units.

In 2021, energy consumption in Refining was reduced, even in a scenario of higher volumes of processed load compared to 2020. Our target is 21% reduction in energy consumption in Refining by 2025 (basis 2020).

Energy Intensity



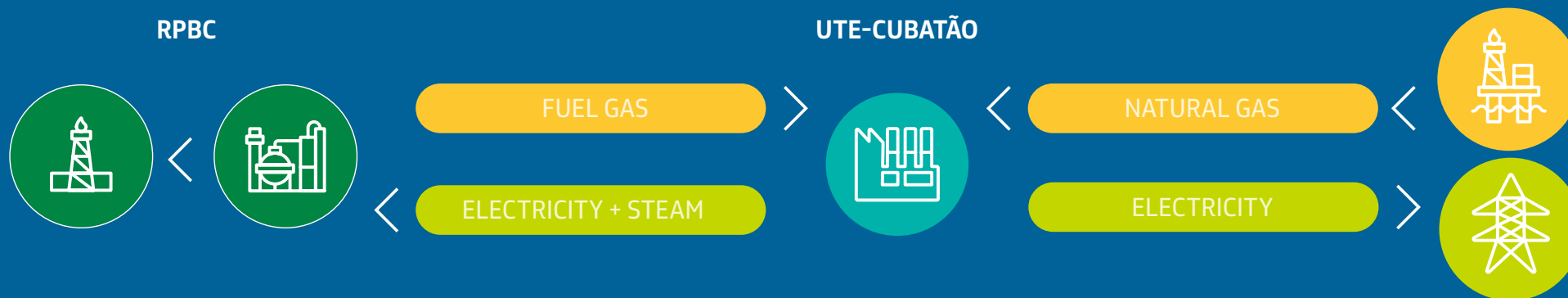
Energy Consumption in Refining



At the Duque de Caxias Refinery (REDUC), the implementation of the treatment of residual gas streams generated in the distillation units of the Lubricants plant, in 2021, enabled a 97% reduction in the emission of sulfur dioxides and also the recovery of gases. These gases are now being used to generate energy for the Refinery’s boilers and furnaces, replacing natural gas. Because of this initiative, around 33 thousand tCO₂ are no longer emitted annually.

In 2020, we started the adaptation of the Heat Recovery Steam Generator at the Henrique Lage Refinery (REVAP), in two stages. In the first one, we performed partial alignment of the gases from the furnaces for heat recovery, using results from computer simulations. In the second stage, we will carry out the total alignment of the process gases, through modifications in the boiler’s steam circulation system. We estimate that the avoided emission is approximately 23 thousand t CO₂ per year.

Important initiatives to reduce emissions were implemented during 2021 in Cubatão, at the Presidente Bernardes Refinery (RPBC) and at the Cubatão Thermolectric Power Plant (UTE-Cubatão), aiming to make better use of fuel gas, reduce flaring and reduce natural gas consumption. At the RPBC, the CO boiler was adapted to use fuel gas instead of natural gas, in addition to actions that recover fuel gas from one of the refinery's hydrotreatment units. UTE-Cubatão started using the excess fuel gas from the RPBC to generate steam in the auxiliary boilers, thus reducing the consumption of natural gas. The steam produced is sent to the refinery for consumption. The avoided emission resulting from these actions is estimated at around 94 thousand t CO₂e per year.



In addition to the greenhouse gas reduction initiatives, we highlight two relevant projects for the reduction of SO_x, NO_x and particulate matter pollutants, with a positive impact on air quality.

At the Gabriel Passos Refinery (REGAP) we are revamping and modernizing the sulfur recovery units (SRU). In 2021, we started the assisted operation of the new SRU, which aims to reach high sulfur recovery as a solid product and improve the reliability of the refinery. Actions in REGAP also include the modernization of the existing SRU, scheduled to start in 2022.

At the Abreu e Lima Refinery (RNEST), we aim to increase the flexibility of processing high sulfur oils thanks to the resumption of the project to implement the Emissions Abatement unit with SNOX™ technology in 2021. In addition to ensuring the reduction of emissions, this technology allows the production of H₂SO₄ from the sulfur compounds present in the feed.

To learn more about the management of regulated pollutants, consult our Sustainability Report.

GHG Emissions Intensity in Power Generation

Our operations in the power sector are a reflection of the decisions of the Brazilian National Electric System Operator (Operador Nacional do Sistema Elétrico – ONS), which determines when a given power generating unit is dispatched. Our emissions in this segment, therefore, are dependent on a series of factors that include the availability of other power plants, climatic conditions and intrinsic seasonality of the Brazilian electrical system.

Although we do not have commitments referring exclusively to our power generation activities, we monitor our emission

intensity in these operations. Our power generation park is essentially powered by gas, and we have high energy efficiency units, with combined cycle and integrated with our other assets for steam export. In the last decade, we have implemented more efficient generation cycles (combined cycle) at the Três Lagoas, Baixada Fluminense and Canoas plants. In addition, investments were made to improve the efficiency of the turbogenerators at the Ibitié, Baixada Fluminense and TermoBahia plants, allowing for a reduction in fuel consumption per energy generated.

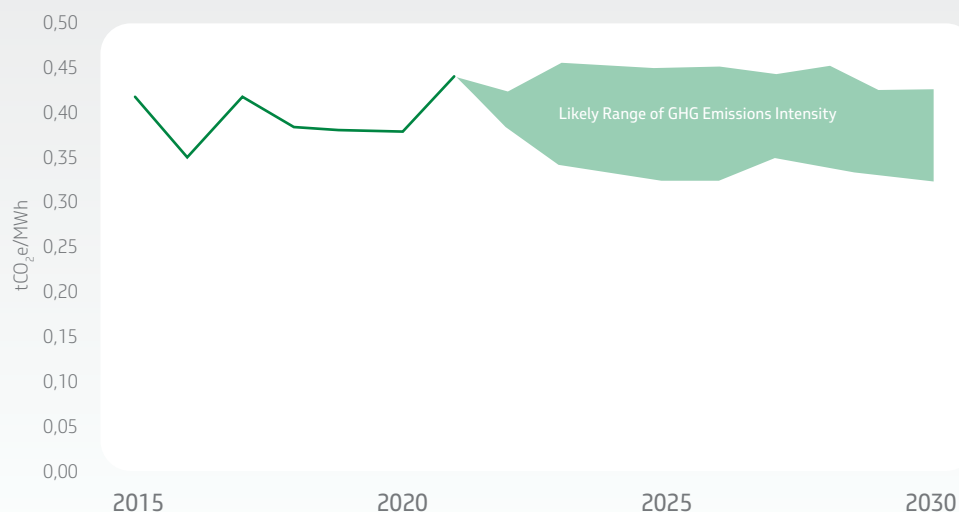
In 2021, our GHG emissions intensity in power generation was 0.425 tCO₂e/MWh. Our thermoelectric generation operates predominantly on demand from the Brazilian

National Electric System Operator, to avoid excessive depletion of hydroelectric reservoirs in unfavorable hydrological conditions, outside the baseload of the electric system and with partial dispatch to supply the seasonality and intermittency of renewables.

In this sense, GHG emissions intensity of this segment is affected by local electricity needs, depending on the hydrological regimes, which dictate the dispatch of the different thermoelectric plants in our generation park.



Carbon Intensity in Power Generation



IMPROVING THE EFFICIENCY OF OUR TURBO GENERATORS

Between 2018 and 2021, we invested in upgrading the turbo generators of the Baixada Fluminense, Cubatão, Ibitité and TermoBahia thermoelectric plants.

These investments consist of modifying internal components and updating the turbo generators' control systems, resulting in improved efficiency in the use of natural gas for power generation.

In these four projects the estimated reduction is around 15,400 tCO₂e annually, considering the forecast for dispatch in 2022.

Note: In the likely range of GHG emissions intensity, the upper line represents the highest expected dispatch scenario. The lower line, in turn, represents lower dispatch and the successful implementation of mapped decarbonization opportunities.

Key factors for reducing GHG emissions intensity of power generation:

- _ Portfolio management;
- _ Updating the technology used in turbo generators;
- _ Fugitive Emissions Control Program.



Value Chain Emissions

We are aware that the Paris Agreement requires neutrality in the net balance of greenhouse gas emissions in the second half of the 21st century, which exceeds the current voluntary commitments of the signatory countries of the Agreement and involves challenges for energy systems far beyond the operational emissions in energy production.

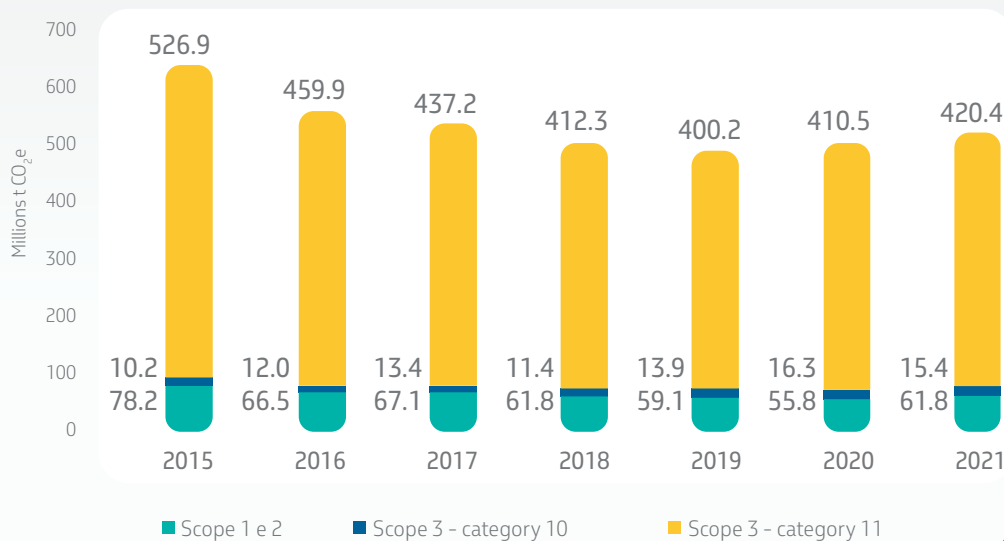
As an integrated energy company, we monitor the absolute emissions and GHG emissions intensity of the value chain of all our energy products. We also consider the carbon performance of each individual product to be relevant, as there are significant differences in GHG emissions intensity of different oils, natural gas streams and electricity from fossil fuels.

In the oil and gas value chain, most emissions occur at the stage of use by end consumers. Therefore, to know the real impact of our products, it is necessary to calculate their Scope 3 emissions.

For calculating Scope 3 emissions, we use two categories according to GHG Protocol: indirect emissions from processing sold products (Category 10) and indirect emissions related to the use of sold products (Category 11).

From 2015 to 2021, our Scope 1 (direct operating emissions) and Scope 2 (indirect emissions from the acquisition of electrical and/or thermal energy produced by third parties) emissions amounted approximately 12.5% of the total emissions reported for our value chain (Scopes 1, 2 and 3).

Value Chain Emissions



Value Chain GHG Emissions Intensity

Since 2019 (year 2018), we have used the value chain GHG emissions intensity metric as an element of analysis of our carbon risks and opportunities, aiming to monitor our operations and business.

$$\text{GHG EMISSIONS INTENSITY} = \frac{\text{Total Emissions (g CO}_2\text{ e)*}}{\text{Total power delivered by our products (MJ)}}$$

* Total Emissions = Scope 1 + Scope 2 + Scope 3 (Category 10 = Category 11)

This metric allows for the analysis of the amount of GHG emissions associated with each unit of energy delivered to our consumers. As an indicator of total emissions, the sum of our operational emissions (Scopes 1 and 2) with those related to processing (Scope 3 – Category 10) and the use of our products (Scope 3 – Category 11) is counted. Monitoring this indicator makes our analysis robust, allowing us to assess the impact of the decarbonization of our assets in operation, the intensity of our mix of liquid fuels and gas, and the effects of inserting renewable energies and removing CO₂.

In 2021, according to this metric, our value chain GHG emissions intensity was 82.6 gCO₂e/MJ.

In line with the ambition to achieve the neutrality of greenhouse gas emissions from the operations under our control (Scopes 1 and 2), we have the **Carbon Neutral Program**, which aims to accelerate and reduce the costs of decarbonization solutions, bringing greater competitiveness to our company. The program will also assess opportunities related to Scope 3 and is supported by a dedicated decarbonization fund, with an initial budget of US\$ 248 million over 5 years, which can be used in initiatives involving Scopes 1, 2 and 3.

>> See **Investments and Initiatives**

Metrics

In the table, we present our metrics used in the assessment of carbon risks and opportunities.

KPI	UNIT	COVERAGE	DESCRIPTION	METRIC USE
Absolute Operating GHG Emissions	tons of CO ₂ e	100% of the activities under operational control	Total GHG emissions, including Scope 1 and Scope 2, expressed as CO ₂ equivalent (CO ₂ e) for Petrobras and subsidiaries under our operational control.	Public Commitment: Reduction by 25% by 2030 (basis 2015)
Operating Emissions from Oil and Gas Activities	tons of CO ₂ e	Oil and Gas Exploration and Production, Natural Gas Processing and Treatment, and Oil Refining activities under operational control	Total GHG emissions, including Scope 1 and Scope 2, expressed as CO ₂ equivalent (CO ₂ e), excluding GHG emissions from Thermoelectric Power Plant operations.	Internal Monitoring
E&P GHG Emissions Intensity	kgCO ₂ e/boe	Oil and Gas Exploration and Production activities under operational control	GHG emissions, expressed as CO ₂ e, resulting from the E&P activities in relation to the total production operated of oil and gas (wellhead) registered in the same period. GHG emissions of Scope 1 and 2 are considered. This indicator represents GHG emissions rate per unit of barrel of oil equivalent produced, being used to analyze the carbon performance of assets in our current and future portfolio.	Public Commitment: 15 kgCO ₂ e/boe in 2025, maintained until 2030
Upstream methane emissions intensity (IOGP)	tCH ₄ /Thousand t Hydrocarbons	Oil and Gas Exploration and Production, and Natural Gas Processing and Treatment activities under operational control	The indicator uses the IOGP metric that represents the ratio between methane emission and total hydrocarbon production operated.	Public Commitment: Reduction by 40% by 2025 (basis 2015)
Upstream methane emissions intensity (OGCI)	%	Oil and Gas Production, and Natural Gas Processing and Treatment activities under operational control	The indicator uses the OGCI metric that represents the ratio between the volume of methane emission by the volume of gas delivered to the market.	Internal Monitoring
Refining GHG Emissions Intensity	kgCO ₂ e/CWT	Refining activities under operational control	GHG emissions expressed as CO ₂ e from Refining activities in relation to the activity unit called CWT (Complexity Weighted Tonne). CWT represents an activity measure, similar to UEDC (Utilized Equivalent Distillation Capacity), which considers the potential for CO ₂ emission, in equivalence to distillation, per process unit, allowing better comparability between refineries of different complexities. For the adapted indicator, monitored by the Company to enable the inclusion of emissions of other greenhouse gases, Scope 1 and 2 emissions are considered. This indicator is used to analyze the carbon performance of the assets in our current and future portfolio.	Public Commitment: 16% reduction by 2025, expanding to 30% by 2030 (basis 2015)

KPI	UNIT	COVERAGE	DESCRIPTION	METRIC USE
Energy Intensity	-	Refining activities under operational control	Compares a refinery's total primary energy consumption with the standard energy consumption for a refinery of similar size and complexity.	Internal Monitoring
Value Chain GHG Emissions Intensity	gCO ₂ e/MJ	100% of the activities under operational control and processing and use of products	Total GHG emissions from our operations (Scope 1 and Scope 2) and Scope 3 emissions (Category 10 and Category 11) in relation to the total energy delivered to our customers. This metric represents an analysis regarding the amount of GHG emissions associated with each unit of energy delivered to our consumers.	Internal Monitoring
Thermoelectric Power Generation GHG Emissions Intensity	tCO ₂ e/MWhe	Thermoelectric Power Generation activities under operational control	Total GHG emissions, expressed as CO ₂ e, from Thermoelectric Power Plants in relation to the total energy (electric and thermal) supplied by these plants. GHG emissions of Scope 1 and 2 are considered. This indicator is used to analyze the carbon performance of assets in our current and future portfolio.	Internal Monitoring
Average fuel consumption per ton-mile	ton x mile	Maritime Transport	Product of the distance the freight is transported, measured in nautical miles, and the cargo transported, measured in tons.	Internal Monitoring
Carbon Breakeven Price	US\$/tCO ₂ e	Projects under evaluation	The indicator represents the value of a carbon tax that would bring the NPV of the project under analysis to zero, using a simplified internal methodology.	Internal Monitoring
Sensitivity to carbon price	%	Projects under evaluation	The indicator represents the impact on the NPV of the project under analysis derived from a possible carbon pricing, using a simplified internal methodology.	Internal Monitoring
Portfolio NPV Loss	%	Company Portfolio	The indicator represents the impact on the NPV of the Company's Portfolio when compared with international scenarios, due to the effect of the oil and carbon price assumptions in the evaluated periods.	Internal Monitoring

Voluntary Socio-Environmental Investment with Impact on Climate Change

Our Social Responsibility Policy presents as a guideline investing in socio-environmental programs and projects, contributing to the communities where we operate and, in a broader way, to society. Our voluntary socio-environmental investment follows the Strategic Plan 2022-2026 as a tool to support the sustainability of our business.

These socio-environmental investments are one of the company's actions in climate resilience and low carbon transition, through which the company reaffirms its interest in overcoming the challenges related to its business. The socio-environmental projects in the Climate line of action contribute to the reduction of greenhouse gases and generate numerous social and environmental benefits where they operate, supporting natural climate solutions.

Our portfolio of projects focused on Climate of the Petrobras Socio-environmental Program is dynamic and, in 2021, it had 17 projects in execution and, in 2022, another four new ones, resulting from public selection, should be added to the portfolio. Around R\$ 69 million will be invested over the course of these 21 initiatives, considering contracts that began in 2018 and others that will carry out their activities until 2025.

In 2021, we supported projects that worked, throughout their implementation, in the direct recovery or conservation of around 175 thousand hectares of forests and natural areas of the Atlantic Forest, Amazon, Caatinga and Cerrado, contributing to the mitigation of greenhouse gas

emissions due to deforestation in Brazil and collaborating, in particular, for Sustainable Development Goals 13 (action against global climate change) and 15 (land life).

The estimated benefit of the efforts made since 2013 to date by these projects is around 1.3 million tCO₂e, of which 95,500 tCO₂e refer to net removal by recovery and productive reconversion actions and 1.2 million tCO₂e, to the emissions avoided through actions that prevent deforestation and forest degradation. These values represent the results accumulated until 2021 in projects in force in that year, considering, on average, a period of 5 years. The results were reported by the projects with which we shared a methodological guide prepared in 2019, with the objective of guiding the quantification of carbon through the establishment of technical references.

In addition to the contribution in carbon, social and environmental benefits are generated, such as the

conservation of associated biodiversity, income generation by supporting local production chains, promoting gender equity, food security, maintaining ecosystem services, developing forest inventories, training communities in addition to generating knowledge and setting up a georeferenced database.

One example is the Guapiaçu Project, supported by Petrobras since 2013, which aims to reforest 100 hectares of Atlantic Forest area in Cachoeiras de Macacu (RJ), in addition to conserving 160 hectares that have already been recovered. The project will enable the reintroduction of tapirs (*Tapirus terrestris*) in its area of operation – Guapiaçu Ecological Reserve – and can act as an important



conservation tool. At the beginning of the 20th century, these animals came to be considered locally extinct. But, due to the partnership between Projeto Guapiaçu and Projeto Refauna, they are returning to nature. This reintroduction of tapirs establishes the first population of the species after more than 100 years of extinction in the state. Known as “gardeners of the forest”, tapirs have a diet that includes fruits and an enormous ability to disperse seeds, favoring forest regeneration.

We also highlight that the projects in force in 2021 contributed to the strengthening of more than 25 million hectares¹ of protected areas such as Conservation Units and Indigenous Lands. They included actions such as fire monitoring, biodiversity monitoring and sustainable management with income generation through sociobiodiversity products. They also acted in several forums or councils with the participation of civil society and public authorities, such as Management Councils of Conservation Units, Municipal and State Environmental Councils and Hydrographic Basin Committees. In this way, these initiatives support the management of these areas and enhance the conservation capacity, also contributing to the generation of income through the valorization of sociobiodiversity products.

The Florestas de Valor project is an example of how the bioeconomy can generate income and preserve a standing forest. Sponsored by Petrobras since 2013, the project encourages the creation of sustainable production chains in protected areas of the Amazon, in the Calha Norte regions of the Amazon River and in the municipality of São Félix do Xingu. Sponsored by Petrobras, from 2018 to 2020 the project implemented 20 forest nurseries,

133 hectares of agroforestry systems and promoted the sustainable management of 449 thousand hectares. We estimate that the project has contributed to the net removal of more than 28,000 tCO₂e from the atmosphere. With the sale of socio-biodiversity products (nuts, copaíba, cumaru, cocoa, açaí, among others) and family farming, R\$ 1.4 million in income has already been generated for the people involved in the project. With the support of the Institute for the Development of Social Investment (IDIS), a cost-benefit analysis was carried out, showing that for every R\$ 1 that Petrobras invested in the project, R\$ 7.94 was generated in environmental benefits and social benefits, a value considered expressive for this type of investment in Brazil. Over the next three years, the project will continue to strengthen sustainable production techniques and extractive activities with a view to valuing the standing forest, and 180 hectares will be implemented between sustainable production systems and productive reconversion of degraded areas.

Starting our work in the generation of carbon credits based on natural climate solutions (NCS), in 2021 we announced a partnership with the BNDES to join efforts in supporting forest restoration projects, through the Floresta Viva initiative, where public selection process will be held, starting in 2022. Petrobras intends to invest around R\$ 50 million over the next five years in this initiative.

[>> See Investments and Initiatives](#)

¹ Value refers to the area covered by the set of projects in force in 2021. The profile of the projects and type of action affect this value and reflect the composition of the portfolio, whose dynamics can lead to annual variations.

ENVIRONMENTAL COMPENSATION

In addition to voluntary investments, since 2009 we have offset more than 1.6 million tCO₂ in compliance with licensing conditions.



2. ENERGY AND CLIMATE SCENARIOS

Great advances occurred in the last years regarding the science of climate change impacts. At the same time, society keeps looking for actions and effective commitments towards a greenhouse gases net zero emissions by the middle of this century. This ambition is challenging, but it is essential to achieve this goal to avoid huge, widespread and irreversible impacts due to the global warming (IPCC 2014). The rise in global temperature leads to huge changes in extreme events, such as heat waves, storms and droughts (IPCC 2021).

At the end of the 2021 United Nations Climate Change Conference (COP 26) held in Glasgow, Scotland, 154 countries, representing more than 80% of global emissions, made new commitments or revised their voluntary commitments by increasing emission reduction targets. About 90% of the world's GDP is committed to achieving net zero emissions.



**154 countries
made new
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or revised
their voluntary
commitments
at COP 26**



**About 90% of the
world's GDP**



**80% of global
emissions**

The energy production and consumption are facilitators and belong to economic and social development. Historically, these activities were responsible for $\frac{3}{4}$ of the emissions that have raised the planet's average temperature by 1.1°C compared to pre-industrial levels (IPCC, 2021). Currently, population growth continues to accelerate, and it is expected to reach the mark of 9.7 billion inhabitants in 2050 (United Nations, 2019). The world needs to face the challenge of drastically reducing the intensity of emissions per energy delivered while ensuring the energy access necessary for social and human development. Thus, reconciling the expansion of energy access, energy security and the reduction of greenhouse gas emissions within the necessary timeframes and at cost-effectively way is a challenge to be faced together, and that is impossible to be achieved separately by a government or sector.

Despite the joint challenge, each society needs to develop its path in the transition to a low carbon future, according to its social and economic needs, emissions profile and mitigation options, in order to achieve an effective decarbonization and a just transition.

At Petrobras, we are committed to the transition to a low carbon economy. We believe that achieving climate and sustainability goals is critical for social well-being and economic resilience, contributing to increased productivity and, combined with other measures, reducing inequality.

We reaffirm our commitment to contribute to Paris Agreement, focusing on operational excellence and energy innovation.



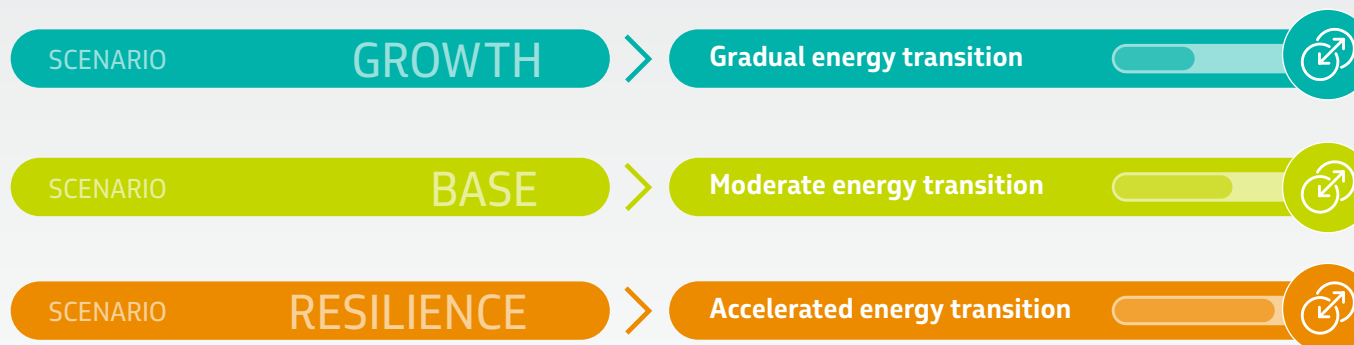
Petrobras' scenarios

Scenario building is an instrument that qualifies the strategic analysis and the consequent long-term positioning decisions. We have been developing our own scenarios for more than a decade, which guide our vision of future and serve as support for our strategic planning, both for quantification of assumptions and for risk assessment.

Our scenarios indicate that there will be persistent world demand for oil in the coming decades, albeit decreasing. We hold significant reserves and it is our priority to continue to supply oil and gas in a competitive and environmentally responsible manner.

In these scenarios, consolidated trends and critical uncertainties combine to shape transition trajectories. Economic growth models, environmental and climate policies, innovation and behavioral changes play a decisive role in the transition and substantially modify our sector economic fundamentals (demand and price of oil). The intrinsic competitiveness of liquid fossil fuels remains anchored in its high energy density, possibility of transport and storage, as well as in the existence of already developed infrastructure, factors with greater or lesser importance in different energy services. The determining aspect in the resilience of each product in the transition to low carbon is the viable scale of substitutes, so that innovation is a particularly relevant factor in the transition. Even in the accelerated transition scenario, we estimate persistent, albeit decreasing, demand for oil products in the coming decades, which should be progressively supplied with lower carbon intensity substitutes.

The energy transition in these scenarios differs in pace and extent:



The price of oil is a variable that decisively influences the definition of the portfolio and the identification of non-performing assets in a context of accelerated transition. In the current context, in addition to the uncertainties inherent in the functioning of the oil market, there are also issues brought about by the COVID-19 pandemic, which led to excessively low oil prices in mid-2020, testing the economic resilience of the companies' portfolio. In line with this context, the scenarios consider the potentially permanent effects of this short-term situation, as well as permanent changes in consumer habits and public policies to encourage the energy transition. The transition to a low carbon economy mainly affects two variables of our value creation: Brent price and carbon price. We currently perform our value quantification and portfolio decisions based on the assumptions of our Base scenario.

We also observe the consolidation of trends towards electrification of mobility, as well as a drop in cost and scale-up of modern renewable energy production and energy storage.

We monitor the progress of carbon market regulation in Brazil, the main market where we operate, through a specific risk analysis methodology, identifying threats and opportunities for our business

>> See Governance, Incentives and Risk Management

To test the resilience of our assumptions, we performed simulations of the impact of the International Energy Agency's scenarios on the value of Petrobras' portfolio, including a scenario adhering to the Paris Agreement (2°C), in compliance with the TCFD recommendations.

Our Scenarios

SCENARIO

GROWTH

In the short term, shows a rapid recovery of the economy after the effects of COVID-19. The impacts are limited to the period in which measures to restrict the flows of people, goods and services were used to control the pandemic. After mass vaccination of the world population and control of the number of cases, social habits and consumer behavior are returning to the previous state before COVID-19. There is little coordination between developed and developing countries on the need for and financing of policies for transitioning to a low carbon economy. The energy matrix continues to be concentrated in fossil sources and commodity prices, particularly energy, are higher.

SCENARIO

BASE

In the short term, this scenario is characterized by a more gradual recovery trajectory after the effects of COVID-19. Even after the mass vaccination of the population and drop in the number of cases, there are important consequences. In this sense, the increase in unemployment and poverty, as well as the level of indebtedness of the private sector, affect the dynamics of demand in a structural way. This fragility and the increase in uncertainty are reflected in the level of household consumption in a lasting way. In the medium and long term, economic growth is average, there is greater concern with mobility and air quality in large centers. The global articulations for the transition to a low carbon economy still face coordination and financing problems, but a series of more dispersed initiatives are starting to take shape in an important way. More direct solutions driven by large cities and popular pressure characterize this scenario. The world energy matrix has undergone important changes, especially with regard to the share of coal and renewable sources, and commodity prices, especially energy, have grown in line with historic trends.

SCENARIO

RESILIENCE

In the short term, this scenario is characterized by delay in solving the pandemic and a slow recovery trajectory. Resistant strains and the public's choice not to get vaccinated cause sporadic outbreaks that hamper robust recovery. Furthermore, the social and economic scars are significant. There is a change in the habits, behaviors of consumers and economic agents. There are structural impacts both on the demand side and on the supply side. In addition to uncertainty and unemployment affecting consumption, the lower level of investment has a negative impact on productivity. Global value chains are disrupted and global trade declines. In the medium and long term, there is lower global growth, greater environmental risk and greater concern with these issues. Countries are encouraged to cooperate and coordinate efforts for a rapid transition to a low carbon economy. Despite the increase in speed of the energy transition, reducing investments in the expansion of production of fossil energy sources, restricting their supply, total energy demand is increasingly met by alternative sources, reducing demand pressure on fossil energy prices.

International Energy Agency Scenarios used as a reference

STEPS

Stated Policies Scenario

It reflects the possible trajectory of energy systems in the light of current policies and ambitions, according to an analysis of the regulatory, market, infrastructure and financial circumstances of countries.

APS

Announced Pledges

Considers all climate commitments made by governments around the world, including Nationally Determined Contributions (NDCs), as well as long-term net zero targets, and assumes that they will be fully met and on time. The remaining gap in global emissions between the APS and the targets in the NZE study or the Sustainable Development Scenario (SDS) shows the “ambition gap” that needs to be closed to achieve the targets agreed in the Paris Agreement in 2015.

SDS

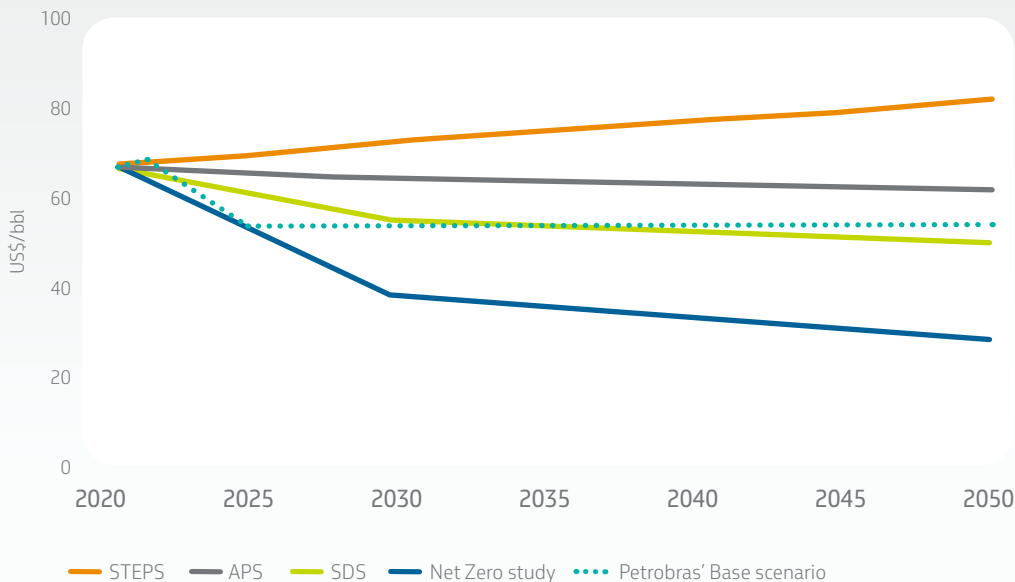
Sustainable Development Scenario

It establishes a path for transforming energy systems compatible with the goals of the Paris Agreement. In this scenario, global emissions from energy systems decrease from 34 billion tCO₂e in 2018 to around 8 billion tCO₂e in 2050. The scenario is aligned with a 66% probability of keeping the temperature increase below 1.8°C and 50 % probability of keeping the temperature rise below 1.65°C.

NZE (*Net Zero Emissions by 2050*): study composed by the IEA that outlines an ambitious trajectory for the global energy sector to achieve net zero CO₂ emissions by 2050. This vision also meets the main energy-related United Nations Sustainable Development Goals (SDGs), in particular universal access to energy by 2030. The NZE does not rely on emission reductions from outside the energy sector to achieve its targets, but assumes that non-energy emissions will be reduced accordingly. The trajectory is consistent with limiting global temperature rise to 1.5°C (with a 50% probability). In this study, the International Energy Agency emphasize the necessary changes and implications for public policy and industry. It shows a roadmap with the actions and conditions necessary to achieve such results. In this context, the demand for energy and fuels changes and the energy supply adapts. For this, public policies, international coordination, investments, and new technologies are made available at a very fast speed, with effect from 2030, reaching neutrality of world emissions in 2050.

In October 2021, the International Energy Agency published an update on the assumptions of its scenarios in the World Energy Outlook (WEO).

Oil price projection in the International Energy Agency scenarios, in the Net Zero study and in the Petrobras base scenario



Our base case considers a range of oil prices ranging from the average of US\$ 72/bbl in 2022 and reaching US\$ 55/bbl from 2025, price expectations similar to SDS scenario of the International Energy Agency, which is aligned to a 66% probability of keeping the temperature rise below 1.8°C and a 50% probability of keeping the temperature rise below 1.65°.

Our resilience scenario, in which we project an oil price of US\$ 35/bbl, is similar to the price assumptions in the NZE study by the International Energy Agency, which has a 50% probability of limiting the temperature increase to 1.5°C, in line with the ambition of the Paris Agreement.

Our growth scenario considers higher prices, assuming a long-term price of US\$ 75/bbl.



3. STRATEGY AND PORTFOLIO

Energy transition involves uncertainties that affect our markets and our cost structure. Our role in the transition process to a low carbon future require us to remain as a healthy economic agent, creating value to Society. Due the intensive capital nature and long-cycle of our business, considering carbon properly risk evaluation due to climate change will be fundamental.

Our Strategies

Our strategic model remains anchored in producing oil and gas compatible with scenarios of accelerated decarbonization of society, adopting the concept of dual resilience: economic, resilient to low oil price scenarios, and environmental, with low carbon production footprint.

The set of nine strategies in our 2022-2026 Strategic Plan emphasizes the balance between profitability and risk. Relevant issues such as transparency and sustainability, in particular the decarbonization of operations, strengthening the integration of commercialization and logistics activities and our management model are also addressed in the Strategic Plan 2022-2026. Business strategies ensure that our resources are used at the right time and in the right assets, in order to guarantee a greater return on invested capital, in a safe and sustainable way.

To be the best energy company in value generation, with a focus on oil and gas, sustainability, safety, and respect for people and the environment.

Portfolio

E&P

Due to the quality of our reserves, technology and assets, we consider that we are able to maintain ourselves as a competitive producer, providing oil and gas with superior quality in terms of carbon intensity and resilient to low oil prices.

The value of our E&P portfolio stems from our strengths in deepwater and ultra-deepwater oil exploration and production. Our portfolio resilience assessment ensures that every investment is viable at an oil price of US\$ 35/bbl.

The cost of production is an important element of resilience in all scenarios and, in particular, in scenarios of accelerated transition to low carbon economy. In this sense, our perspective is to operate with average E&P lifting costs of US\$ 4.8/boe*, being as low as US\$ 3.5/boe* in the case of pre-salt production, which will represent 79% of the company's total at the end of the five-year period. Our prospective breakeven is US\$ 20/bbl.

We understand that the management of our portfolio, costs and carbon efficiency, will help us to be competitive even in long term scenarios of reduction in oil demand compatible with the trajectory to comply with the Paris Agreement.

* Charter and government participation are not included

Exploration and Production

_ Maximize portfolio value, focusing on deep and ultra-deep waters

Gas & Energy

_ Operate competitively in trading own natural gas, completely withdrawing from gas distribution and transportation

_ Optimize the thermoelectric portfolio focusing on self-consumption and trading of own natural gas

Refining, Transportation, and Trade

_ Operate with assets focused on the proximity of the oil supply and the consumer market, adding value to the refining park with more efficient processes and new products, moving towards a low carbon market

_ Act competitively in the oil and oil product trade, maximizing value capture through integration and the safe and efficient operation of the upstream and downstream logistics chain

_ Withdraw from fertilizers and biodiesel businesses completely

ESG and Competitiveness

_ Transform Petrobras digitally and develop critical skills for a culture of high performance, integrity, and competitive costs, creating innovative solutions for new challenges, with a high standard of information security

_ Promote social and environmental responsibility associated with the business, generating a positive impact on society and the environment, strengthening Petrobras' reputation

_ Use Petrobras' innovative potential to generate solutions in new energies, decarbonization, and new lines of business

DECISION-MAKING PROCESS OF INVESTMENTS, ACQUISITIONS, AND DIVESTMENTS

The assessment of HSE (Health, Environment and Safety) factors are part of the decision making process of investment projects. These investments are approved only if they keep economic feasibility in all our scenarios, including the resilience scenario. Such premise is applicable to all projects and represents the guarantee that our investments maintain their economic feasibility even in less favorable price scenarios.

The evaluation process of new ventures incorporates the exposure to the carbon risk, including the proposition of actions to reduce emissions intensity and to improve the resilience to carbon prices. The metrics of carbon breakeven price and the analysis of sensitivity to carbon price scenarios are calculated in the venture evaluation process and are part of the decision-making process for each investment.

>> See [Targets, Metrics, Performance and Voluntary Investment](#)

Similarly, the process in force for acquisitions, partnerships, and divestments foresees the assessment of HSE factors, including information about the impact of such acquisition, partnership, or divestment over the total GHG emissions and metrics of intensity.

Refining, Transport and Commercialization

The basis of our Refining, Transport and Commercialization strategy involves portfolio management and the regional synergy among exploration and production assets and the main Brazilian markets. We seek resilience through operational excellence in energy efficiency, emissions and reliability, anchored in the RefTOP Program.

The second source of transformation, in a context of energy transition, is the adaptation of our production to the evolution of the market. The refining park continues to be modernized, expanding the production capacity of low-sulfur fuels and high added value products such as Group II lubricating base oils. In addition, we have the opportunity of capturing value by applying our technological skills to the development of markets and production of less carbon-intensive fuels through advanced industrial routes. For example, the focus of our BioRefino program is the production of Biojet and renewable diesel in plants integrated with oil refineries.

>> See [Targets, Metrics, Performance and Voluntary Investment; Investments and Initiatives](#)

In maritime transport, we aim to optimize the routes and the speed of the vessels and making progress in contracting vessels with better consumption performance and, consequently, lower emission of greenhouse gases.

>> See [Targets, Metrics, Performance and Voluntary Investment; Investments and Initiatives](#)

G&E

Our G&E strategy adapts to the high share of renewables in the Brazilian power matrix. Considering the intermittence of modern sources (wind and solar) and the seasonality of hydropower, dispatchable thermoelectric plants are necessary to provide energy security in the presence of a growing share of renewables. In this sense, we continue with the objective of optimizing our portfolio, focusing on the integration with natural gas, and also seeking efficiency gains in the park, in accordance with actions planned in GÁS+ program.

>> See [Targets, Metrics, Performance and Voluntary Investment; Investments and Initiatives](#)

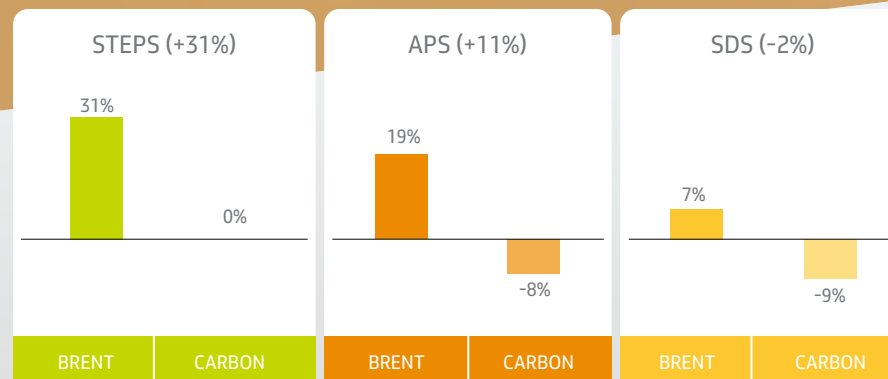
New Business

With the debt now under control, the 2022-2026 strategic plan has expanded the opportunity to mature the discussion about businesses in low-carbon emerging markets.

In this sense, we created specific governance to evaluate diversification opportunities and we are attentive to opportunities that are synergistic with our skills, arising from the growth in the electric energy market, decarbonized fuels and non-energy products.

4. RESILIENCE EVALUATION: ASSUMPTIONS IN LINE WITH THE PARIS AGREEMENT

We performed the assessment of the net present value of Petrobras' portfolio according to the Base scenario, through a sensitivity analysis of Brent and carbon prices considering three external reference scenarios and the NZE study. The total impact in each scenario is the sum of the two outcomes.



Considering the impact of the Brent price only in the E&P segment. Carbon price is considered before taxes.

Note: The STEPS scenario considers carbon prices only for already regulated markets, without defining this price for Brazil. Thus, this variable does not impact the portfolio value.

Using the assumptions of the STEPS external scenario, given the higher oil prices, there would be a substantial increase in the portfolio value when compared with the one calculated assuming the premises from Petrobras (31%). Regarding the external APS scenario, which already considers carbon taxation for countries that are not yet regulated and the influence of the highest oil price, there would be a positive impact (11%) on the value of the portfolio calculated with the internal assumptions. In the SDS scenario, the portfolio value is equivalent (-2%) to the portfolio value considering the assumptions of the internal scenarios.

The results show the conservative price premises of the internal scenarios adopted by Petrobras in the Strategic Plan 2022-2026, as well as our strategic choice of a portfolio with high resilience to price volatility regarding the energy transition.

The adoption of conservative assumptions aims to direct investments towards assets that are resilient to a

world aligned with the goals of the Paris Agreement. As an external reference to our resilience assessment, we used the NZE Study (*Net Zero Emissions by 2050*), also from IEA. The study simulated significant changes in the energy demand profile to achieve neutrality in 2050 (50% probability to limit temperature rise to 1.5°C).

When the results by our base scenario are compared with the NZE study, it can be verified that there would be a negative impact of 33% on net present value (NPV), both due to the incidence of carbon prices and the price of oil.

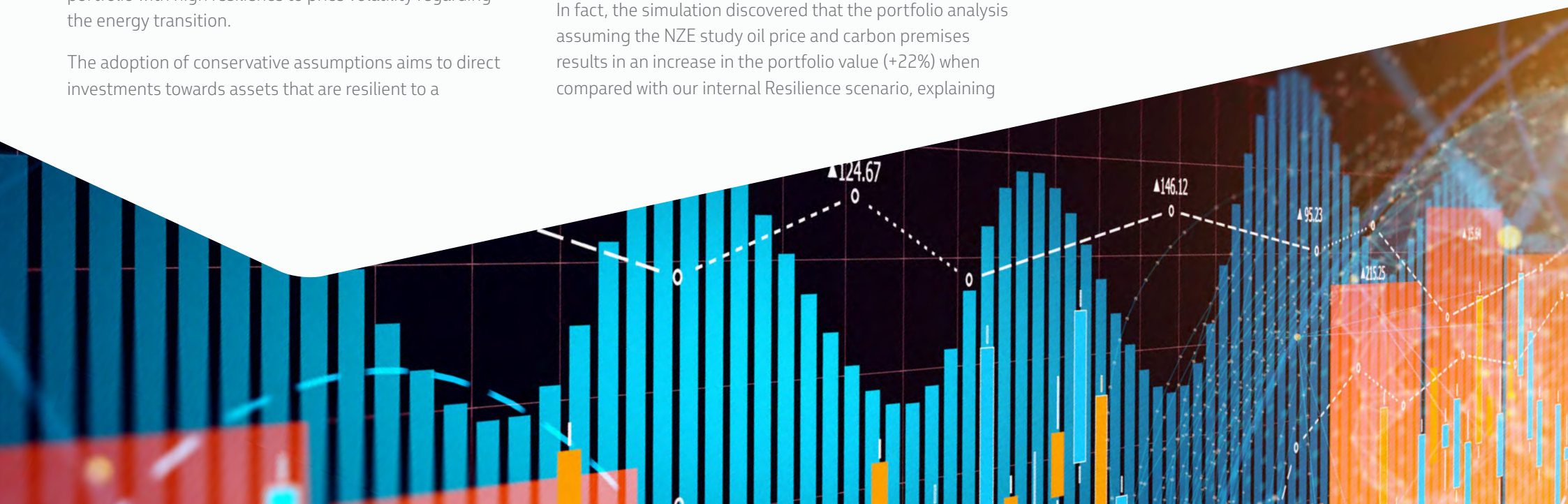
However, as already mentioned, all our projects must be economically viable in the Petrobras Resilience scenario, with an oil price of US\$ 35/bbl. Thus, this scenario is more appropriate for comparisons with the NZE study.

In fact, the simulation discovered that the portfolio analysis assuming the NZE study oil price and carbon premises results in an increase in the portfolio value (+22%) when compared with our internal Resilience scenario, explaining

Petrobras' conservative portfolio choices. We emphasize that, despite the oil price of our Resilience scenario being convergent with that of the NZE study, our forecast for oil demand is higher (50 million barrels of oil/day against 25 million barrels of oil/day in 2050).

We do not consider carbon pricing when valuing the portfolio, however, we use carbon price curves associated with the scenarios in the portfolio risk analysis and in the Carbon Neutral Program.

>> See Governance, Incentives and Risk Management; Investments and Initiatives



5. GOVERNANCE, INCENTIVES AND RISK MANAGEMENT



The theme of climate change is part of our Health, Safety, and Environment (HSE) and Social Responsibility (SR) Policies.

OUR POLICIES



HSE Policy

Consider HSE requirements and climate change in business decisions;



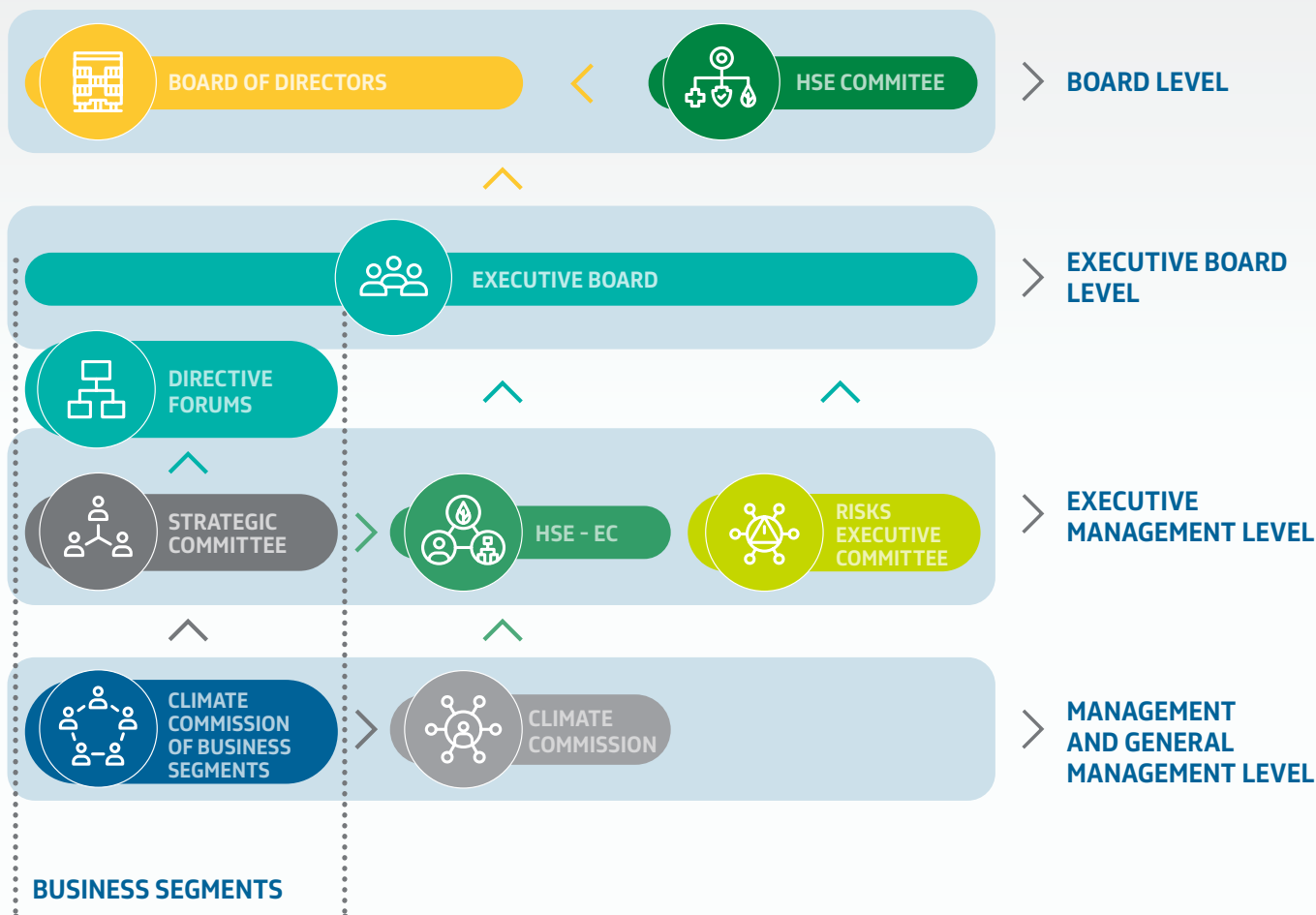
SR Policy

Contribute to sustainable development and to climate change mitigation in alignment with national and international commitments which we are signatory

Our governance has been improving with the incorporation of new discussion and deliberation forums, so that the impacts and opportunities of climate change and the transition to a low-carbon economy are addressed at all levels of the company.

The integration of the topic at different levels of the Company is carried out by the **Climate Change Executive Management**, created in 2020, whose function is to conceive and coordinate the positioning, strategies and corporate actions related to carbon management, atmospheric emissions, energy efficiency and climate change, with a view to maximizing the company's value generation in the face of the risks and opportunities associated with the transition to a low-carbon economy.

Roles and responsibilities of the several governance bodies of the company in decisions related to climate change:



Board of Directors (BD): sets the Company's global policies, approves the strategic plan, investment plans, analyzes the achievement of goals and results.

HSE Committee: composed of appointed directors and external members, it is responsible for advising the BD in defining the establishment of global policies and guidelines on the subject and in the definition and monitoring of strategic objectives and goals. This committee also assesses performance and monitors the management and mitigation of key risks.

Executive Board: composed of the CEO and Executive Directors, responsible for managing our business in accordance with the mission, objectives, strategies, and guidelines established by the Board of Directors. The Institutional Relations and Sustainability Director is responsible for overseeing all matters related to sustainability, including climate and the transition to a low carbon economy.

The Advisory Committees of the Executive Board are formed by executive managers from the corporate and operational areas who report directly to the members of the Executive Board:

- **HSE Executive Committee (HSE-EC):** it meets monthly and its attributions, regarding the HSE theme, is to analyze and make recommendations to the Executive Board on: strategies, policies, guidelines and their implementation and unfolding; objectives, goals and investment plans for the development of the strategy; performance monitoring and recommendation of improvement actions to the company's units and

its Equity Interests; audit recommendations; project proposals and improvement actions; demands of the HSE Committee of the Board of Directors.

Risks Executive Committee: monitors business risk treatment actions, analyzing and issuing recommendations on risk management policies and processes, as well as actions to mitigate the main risks, monitoring metrics and risk exposure limits, forwarding relevant issues to senior management.

Directive forums for the business segments (E&P, Refining and Natural Gas, and Commercialization and Logistics): composed of the director of the respective business segment and its executive managers, with the participation of a representative of the Climate Change Executive Management, for discussion and deliberation of particular subjects of each segment.

Strategic committees of the business segments (E&P, Refining and Natural Gas, and Commercialization and Logistics): composed of the executive managers of the business segment, with the participation of a representative of the Climate Change Executive Management, to discuss specific matters in each operational area and recommendation of topics for deliberation in the Directive Forums.

Climate Commissions of business segments: bring together general managers or managers directly below the executive managers of the business segments for joint deliberations on the subject.

Climate Commission: brings together representatives from all areas for joint deliberations under the coordination of the Climate Change Executive Management.

There is also the Energy Emissions and Efficiency Forum, an integrated technical forum for discussion with representatives from all areas and which supports the Climate Commission, and technical forums related to the topic that take place within the business areas.

The Climate Change topic is on the agenda of the ESG Corporate Forum, which brings together professionals from areas related to sustainability and governance to assess opportunities for Strategic Planning.

Top metrics provide more explicit guidance on the company's key short-term goals. These are metrics that unfold throughout our organizational structure, from top to bottom, to make sure that the individual actions each of us conduct are aligned with the Plan's main commitments.

In the 2022-2026 Strategic Plan, we are maintaining the top metrics with a focus on the creation of value, safety, and sustainability in operations. We only excluded the gross debt metric considering the results that have already been achieved in reducing gross debt in 2021. We will continue monitoring the level of gross debt, which, in fact, is a trigger for reaching the target of the Delta EVA® indicator.

The Indicator of Compliance with the Greenhouse Gas Emissions Targets (IAGEE) and the Oil and Oil Product Leak Volume Indicator (VAZO) reflect the alignment with the 2022-2026 Strategic Plan low carbon and sustainability commitments.

We are maintaining our zero-leak ambition, in the sense of reaffirming Petrobras' commitment to the environment. In our view, life is a non-negotiable value, and strengthening risk control measures associated with TAR (Recordable Accident Rates) monitoring is a fundamental tool for achieving our ambition in terms of safety: Zero fatality.

Executives, like all employees, have variable compensation linked to E&P and Refining carbon intensity metrics.

Variable compensation is calculated based on individual goals and global performance metrics, two environmental and one financial: Indicator of achievement of greenhouse gas emission targets (IAGEE), Leaked Volume of Petroleum and Derivatives (VAZO) and Value Added Variation (Delta EVA®).

Impact of global performance measurements on bonus varies by role, currently being 85% for the CEO, 60% for directors and 35% for employees without an executive position. The amount is calculated based on the percentage of achievement of targets. In the case of IAGEE, specifically, it impacts between 15% for CEO and 5% for employees without a position. Executive officers of E&P and Refining segment have additional 5% impact.

Corporate Risk Management

Our corporate risk management policy establishes guidelines and responsibilities and is based on the following fundamental principles:

-  > Respect for life and life diversity
-  > Full alignment and consistency with our Strategic Plan
-  > Ethical behavior and compliance with legal and regulatory requirements
-  > Integrated risk management
-  > Risk response actions consider the possible long-term cumulative consequences, the possible impacts on our stakeholders and should be oriented towards preserving or adding value and for business continuity

Our corporate risk management is guided by an integrated and systemic view, which allows standardization and uniformity of risk analysis and the management of risk responsibilities. Our risk-management process is coordinated by a corporate area, that is under the supervision of our CFO, responsible for corporate risk management governance process and establishing a corporate methodology for risk management.



Risks and opportunities are identified by each of our organizational units, considering the specific risks of operations and objectives. The risks to which we are exposed are classified into three groups, which reflect the possible origin of the risks, namely: operational, financial or compliance. The risks are then evaluated, considering the probability of occurrence and the impacts on four dimensions: Financial, Image/Reputation, Legal/Compliance, and Environmental/Life.

We classify the risks in the following groups:



OPERATIONAL

Includes risks arising from our core activities, in addition to risk arising from failures, deficiencies or inadequacies of internal process, the supply of goods and services, systems, as well as natural disasters and/or actions from third parties.



FINANCIAL

Includes risks arising from market fluctuations, defaults on counterparties and mismatches between assets and liabilities.



COMPLIANCE, LEGAL AND REGULATORY

Includes risks arising from legislation and regulations applicable to our business, as well as our Code of Ethical Conduct and other internal policies and procedures.

The risks are presented in a Risk Matrix, which presents the risks, properly identified, evaluated for their dimensions, and prioritized in degrees of severity. The severity of the risk, which is its level of intensity, is the result of cross-analysis between the probability of its occurrence and the impacts.

All identified business risks must have one or more associated actions, which define the risk response. Actions can be of the following types: avoid, reduce, transfer, accept or exploit (opportunities only) risk. For risks whose severity assessments are Very High,

High or Medium with Very High impact, it is not allowed to “accept the risk” as an action and a treatment action must be established, with defined responsible and deadline.

Risks are monitored through processes and controls, and those which higher degree of severity assessments are periodically reported to Audit Committee, an advisory committee of our board of Directors in matters involving risk management. Additionally, the risk committee, which advises our Board of Executive Officers in matters involving risk management, and the Executive Board, periodically communicate to Senior Management the main risks

involved. The risk management and the measures taken to mitigate the risks we are exposed are communicate to Risk Committee, Executive Board, Audit Committee and Fiscal Council.

The set of risks related to climate change and energy transition is assessed with a very high degree of severity, being monitored according to the governance described.



Risks and Opportunities on Climate Change and Energy Transition

Risks identified as climate-related are transition risks – market, regulatory, reputational and technological risks – and physical risks of climate change. They are evaluated into an integrated company-wide assessment.

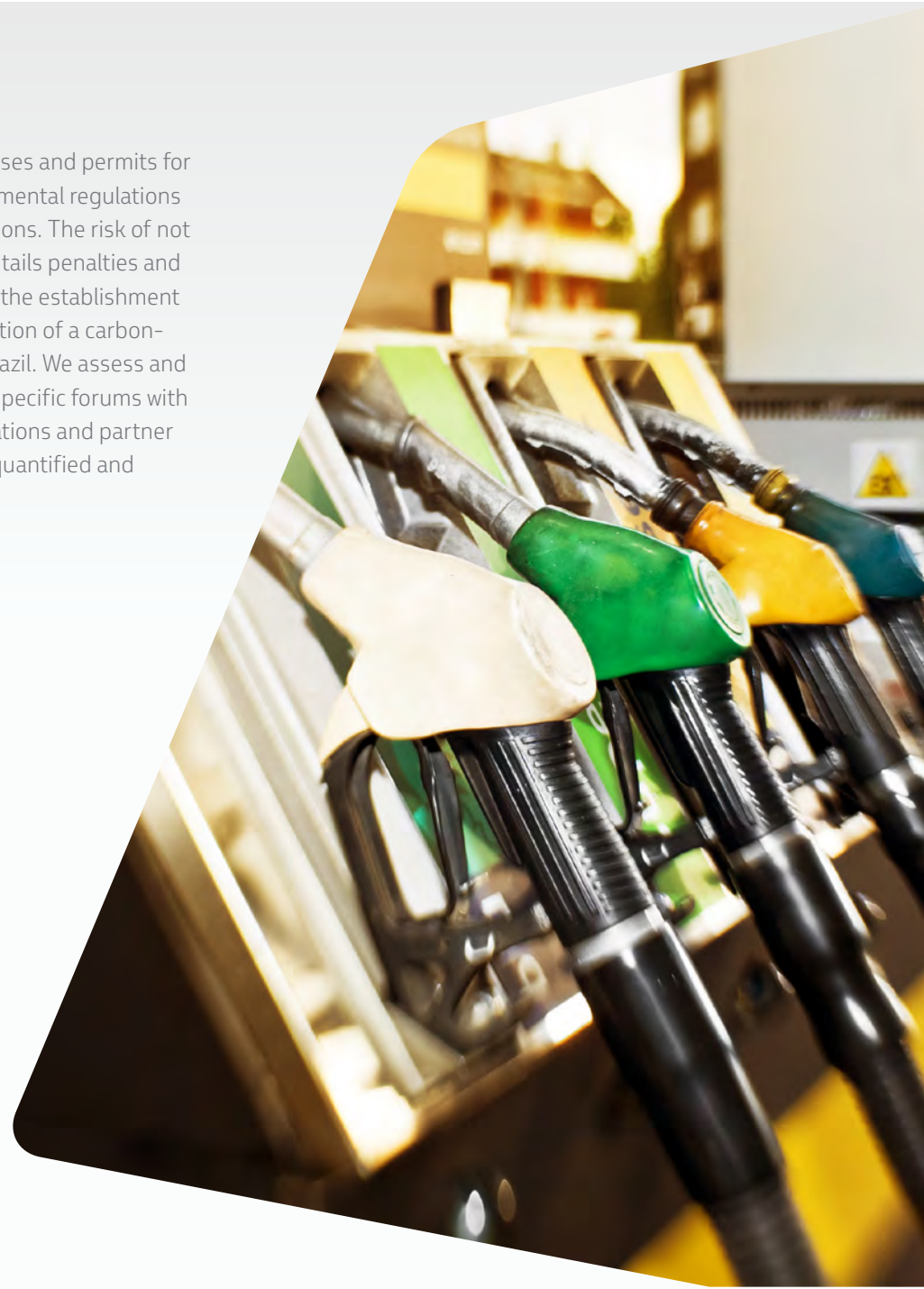
Market

Our main market risk is a lower levels of oil prices in response to market fluctuations due to transition to a low carbon economy, associated to a possible preference of consumers for alternatives with lower carbon intensity.

In Brazil, the demand for our products may also be affected by the increase demand for biofuels and the use of electricity for urban mobility. Brazil is a global leader in the use and production of biofuels, with public policies to encourage the decarbonization of energy matrix, such as Renovabio Program, with annual reduction of carbon emission targets for fuel sector, to stimulate the production and the share of biofuels in the transport energy matrix. We monitor and assess the risk of reduced demand for our products as a result of the energy transition, estimating their possible impacts. Additionally, we evaluate new business opportunities, and we launched the 2030 BioRefining Program in 2020. These market uncertainties contributed to our decision to announce a long-term ambition of carbon neutrality and also our Carbon Neutral Program.

Regulatory

Legal Risk involves environmental licenses and permits for operation, with more stringent environmental regulations associated with greenhouse gas emissions. The risk of not attending these specific regulations entails penalties and restrains. Regulatory risk also includes the establishment of a regulatory framework for the adoption of a carbon-pricing instrument to reduce GHG in Brazil. We assess and monitor this risk with participation on specific forums with government agencies, industry associations and partner entities. Its potential impacts are also quantified and integrated into our business activities.



PRICING RISK STUDY

The quantification of carbon pricing risk was made from portfolio value simulations, considering the possibility of the implementation of a carbon market in Brazil and its impact on cost resulting from a national cap and trade system. Currently more than 99% of our operational emissions occur in Brazil, and this is the reason our analysis considers the specific characteristics and perspectives of Brazil in our carbon prices scenarios. The Brazilian carbon markets instrument is in stages of approval, with the definition of sectorial scope to be determined by executive instances of the federal government. We consider the gradual implementation of the instrument and carbon prices that range from US\$ 0/tCO₂ to US\$ 78/tCO₂.

achieved, at different levels of governance, including senior management. We promote social and environmental responsibility associated with business, generating a positive impact on society, strengthening Petrobras' reputation.

Physical Risk

We evaluate and monitor physical risk associated with the climate changes that may cause changes in patterns into our operations of our assets, such as water scarcity and meteoceanographic conditions. We evaluate this risk with research and development of climate regionalization with renowned institutions in Brazil and abroad (Universidade Federal de São Paulo – USP, Instituto Nacional de Pesquisas Espaciais – INPE and the National Oceanic and Atmospheric Administration – NOAA), generating qualified information to adapt our operations.

>> See [Investments and Initiatives](#)

Technological

We monitor the evolution of low-carbon technologies by expert review and participation on specific forums and initiatives of the industry. New technologies bring competitiveness to low carbon process and products. These opportunities are evaluated by technical-economic analyses and are incorporated if they create value for the business.

Legal and Reputational

Society's increasing concerns over climate change and recent increases in number of climate litigation around the world demands transparency of climate change mitigation about targets and mitigation plans. Evidence shows that good ESG performance can contribute to improved financial performance, improving access to capital. We adopt transparency and support TCFD recommendations. We have established ambitious goals to reduce GHG emissions, with continuous monitoring and periodic evaluation of the results



Our investment strategy incorporates the assessment of transition risks. The assessment of GHG intensity and the impacts on Net Present Value (NPV) of carbon taxation are included in a sensitivity analysis demonstrating the potential impact on Net Present Value (NPV). Opportunities related to the adoption of low carbon technologies are quantified in this sensitivity analysis. In addition to deterministic analysis of NPV in various strategic scenarios, and sensitivity analysis of carbon taxation, we conduct risk analysis considering the most relevant uncertainties: prices of oil, gas and oil products markets, exchange rate, investment costs, operating costs, project schedule, oil production and forecasts for the oil products market.

>> See **Strategy and Portfolio**

Opportunities of Climate Change

Climate change brings new business opportunities. Profitable new businesses arising from the stimulus to low carbon products and services leveraged by public policies can lead to revenue diversification and reduction of carbon exposure. Our priority is innovating and creating models to maximize value creation and our competitiveness in low carbon businesses, aiming at diversification. The development of low carbon solutions is important in our technological direction, with a minimum allocation of 10% of our investment in Research and Development (R&D).

>> See **Investments and Initiatives**

6. INVESTMENTS AND INITIATIVES



Petrobras continues to strengthen its initiatives related to environmental, social and governance (ESG) aspects, with the firm commitment to accelerate its decarbonization and to always act in an ethical and transparent manner, with safety in its operations and respecting people and the environment.

The strategic model adopted remains anchored on the premise of producing oil and gas compatible with scenarios of accelerated decarbonization of society, adopting

the concept of double resilience: economic, resilient to scenarios of low oil prices, and environmental, with low carbon.

Over the past few years, as a result of systemic actions, we have reached the position of specialist in low carbon oil production, with emphasis to pre-salt fields. We have built a portfolio of greenhouse gas emissions mitigation projects that aim at ensuring the achievement of the sustainability commitments disclosed. So far, we have already advanced

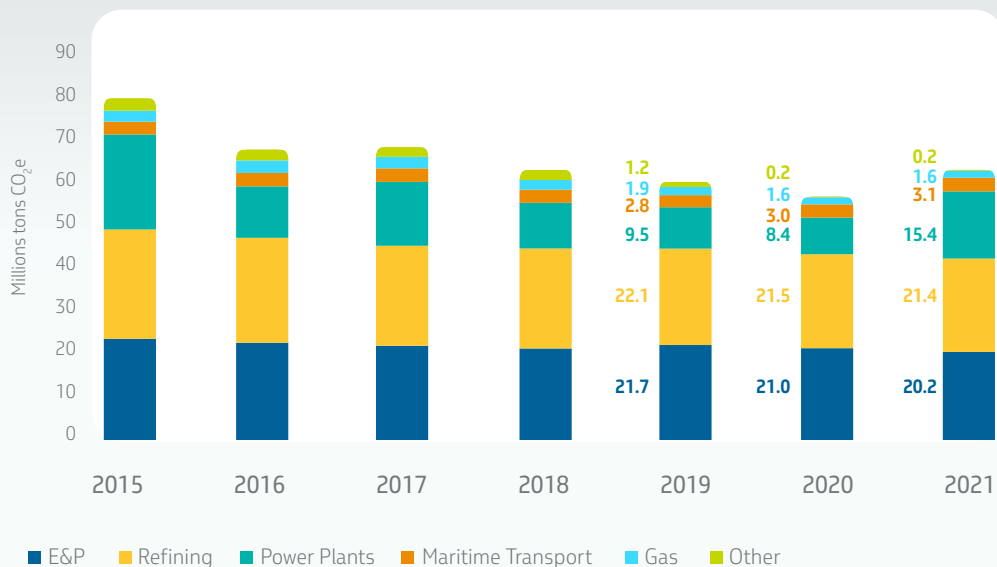
in a series of decarbonization actions in our processes, which involve reduction of natural gas flaring, reinjection of CO₂ associated with EOR, energy efficiency gains and operational losses reduction.

In 2021, our E&P operations emitted 15.7 kg of CO₂ equivalent per barrel of oil and gas produced, with emphasis to the pre-salt fields. It is noteworthy that the improvement in carbon intensity from 2009 to 2021 was 48%. In the refining segment, it can be noticed the

continuous improvement of the carbon intensity indicator, with a reduction of 7.7% in 2021 compared to the base year 2015. Significant actions to reduce the gas flow to the torch, as well as the increase of the availability of energy recovery systems, contributed to these expressive results. Our absolute operating emissions, which followed a downward trend until 2020, increased in 2021, as a result of the high thermal electric generation in a year strongly impacted by the water scarcity.

>> See [Targets, Metrics, Performance and Voluntary Investment](#)

Greenhouse Gas Emissions



Note:

Maritime Transport: vessels chartered by TCP (Petrobras LOG and Transpetro)

Gas: Includes Natural Gas Processing and Treatment Units, TBG, LNG Terminals, Transpetro's gas transportation activities

Other: Includes Petrobras administrative activities and operational activities not previously described: Petrobras Biocombustíveis; Fertilizers (until 2020); Liqueigás (until 2019); BR Distribuidora (until 2018).

In 2020, we created a Climate Change Executive Management Team, reporting to the Institutional Relations and Sustainability Department, reinforcing the importance of the activities related to low-carbon transition at Petrobras.

The Board of Directors approved Petrobras' Strategic Plan 2022-2026 with important elements that reinforced our sustainability agenda and low carbon positioning, allocating CAPEX of US\$ 2.8 billion for emissions reduction and mitigation. This amount includes investments in operational efficiency projects to mitigate emissions (scopes 1 and 2), bioproducts (renewable diesel and aviation biokerosene) and research and development (R&D).



Decarbonization initiatives prioritized through the marginal abatement curve

To meet Petrobras' 6 carbon-focused sustainability commitments, a mapping of opportunities for mitigating greenhouse gases was carried out. As the main product of this work, in 2021 we obtained a set of options for mitigating operating GHG emissions in all segments in which we operate, using the Marginal Abatement Cost Curve (MACC) methodology.

The MACC methodology allows the evaluation and comparison of emission mitigation projects through their Marginal Abatement Costs (MAC). The MAC is represented by the ratio between the financial cost of the project and its GHG abatement potential, in US\$/tCO₂e:

$$\text{MAC} \left(\text{USD} / \text{tCO}_2\text{e} \right) = \frac{\text{– Net Present Value of the project (US\$)}}{\text{Total GHG abatement through the project (tCO}_2\text{e)}}$$

Based on this ratio, it is possible to sort the projects in a graph (MACC), facilitating the identification of cost-effective solutions.

Petrobras' Integrated MACC comprises around 200 mitigation options, with different technological maturities, subdivided into 5 categories:

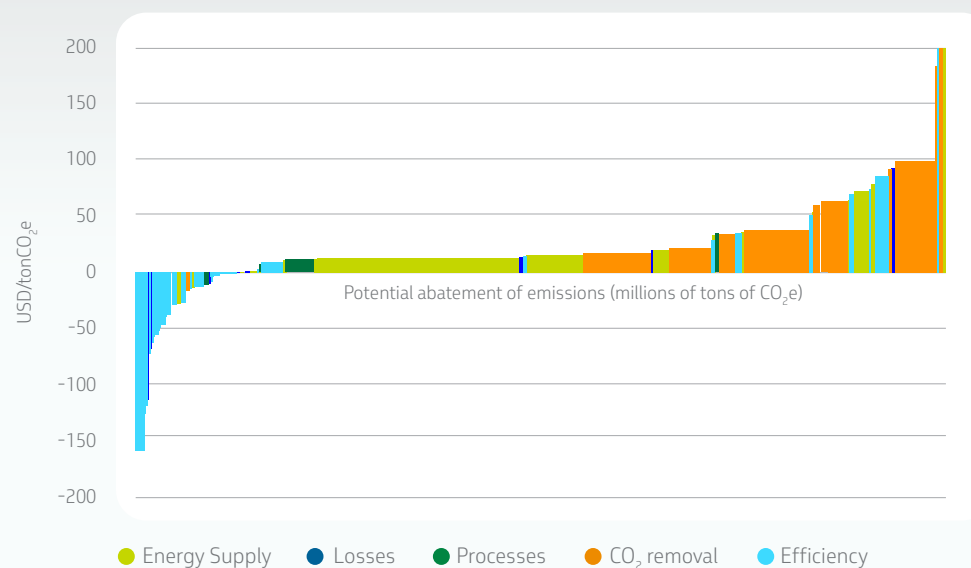
- 1. Efficiency:** mitigation opportunities focused on energy efficiency, optimization of systems and equipment (e.g. combined cycle, all electric, deep water capture)
- 2. Energy supply:** mitigation opportunities focused on the adoption of energy sources with lower carbon intensity (e.g. offshore energy, power plants with CCUS, hybrid vessel and fuel substitution)
- 3. Losses:** mitigation opportunities focused on reducing energy and product losses (e.g. vent reduction, fugitive emission inspections with optical gas imaging – OGI, flare gas recovery unit – FGRU)

4. Process: mitigation opportunities focused on intrinsic emissions from refining processes (e.g. co-processing of bio-oil, reduction of emissions related to hydrogen production)

5. CO₂ removal: opportunities in CO₂ removal (e.g. CCUS, oxycombustion)

The MACC presents the estimate of MAC and allows the comparison of the potential for abatement of operating emissions of each opportunity for short, medium and long terms.

Integrated MACC, 2021



Note: Estimates based on Petrobras' internal studies, literature data and benchmark, containing uncertainties inherent to the studies. The initiatives are not sorted in terms of time horizon or maturity for implementation.

MACC METHODOLOGY IMPLEMENTED SYSTEMICALLY

It covers all our operations and is reviewed whenever new alternatives are identified, when there is an increase in the readiness level of the technology and projects, when there is a revision of corporate economic premises and/or environmental impact and scope.

The analysis of the opportunities of the integrated MACC supported, in 2021, our communication of ambition of long-term neutrality, based, at the moment, on the realization of an exclusively internal MACC.

The challenge of achieving emissions neutrality is great and we recognize that we have many, but not yet all, answers on how to get there.

To support our actions, we have the Carbon Neutral Program, which aims not only to strengthen Petrobras' current positioning in low carbon, but also to accelerate and reduce the costs of decarbonization solutions, bringing greater competitiveness to the Company.

This program brings together our fronts of action, with the following priorities:



CARBON NEUTRAL PROGRAM

OPERATIONAL EXCELLENCE

Reduction of
operational
emissions

DISRUPTION

Develop projects
differently aiming
to emit less without
increasing costs

SUPPLY CHAIN

Seek to engage
suppliers to increase
the decarbonization
impact

LOWER EMISSION OF OUR PRODUCTS

Mitigate scope 3
emissions

REMOVAL

Looking for
CO₂ removal
opportunities
through
technological or
nature-based
solutions

The program has a dedicated decarbonization fund, with an initial budget of US\$ 248 million for the five-year period (2022–2026), which can be used in initiatives involving scopes 1, 2 and 3. The governance of both the program and the decarbonization fund involves the analysis of opportunities and the prioritization of decarbonization alternatives, using criteria such as MAC, total amount of avoided GHG, technological readiness, project phase (window of opportunity) among others. We also consider the assessment of the Net Present Value of the alternatives assuming carbon price and the evaluation of selected projects in specific governance. We highlight two guiding principles: (i) the use of expected revenue from emission abatement at the proposed carbon price is restricted to the initiatives within the scope of the decarbonization fund and (ii) the fund's budgetary limit.

Supply Chain

The strategic initiative to unfold our sustainability commitments with the supply chain is in progress. In 2021, studies were started to implement the Sustainable Contracting guidelines, which include: adjustment of standards and procedures; relationship with the supplier market; teams training; implementation of ESG-aligned contractual levers; review and update of technical and contractual requirements; improvement of the supplier performance evaluation system and development of structuring projects together with other O&G companies, through reference entities in the oil industry. Based on these studies, several actions were taken, such as the revision of the Code of Ethical Conduct for Petrobras Suppliers, the HSE policy and guidelines and the use of new technical specifications considering sustainability requirements. In addition, pilot projects will continue to be prioritized for the development of contracting strategies aligned with supplier incentives, a practice already adopted by the Company.

>> [See Transparency and Engagement](#)

Decarbonization of the Product Portfolio

In the 2022-26 Strategic Plan, we are advancing in the analysis of possible new businesses that can reduce the exposure and dependence on fossil sources and, at the same time, be profitable, ensuring the company's long-term sustainability (profitable diversification strategy). In this sense, a governance is being created for approving the entry into new businesses focused on diversifying our portfolio, prioritizing businesses related to the energy segment or new products that are not included in the current strategic plan. We have been operating in the Brazilian electricity market since the early 2000s and we believe in innovation and synergies with our assets to build business models with competitive advantages in the long term, enabling diversification with generation of value.

In the Strategic Plan 2022-2026 there is no CAPEX committed to investment in profitable diversification businesses. Other opportunities already anticipated in the segments, such as Biorefining, are mentioned later in this Climate Change Supplement.

Carbon Credits

We believe that offsetting emissions through projects to remove carbon from the atmosphere or through the purchase of carbon credits can be used as a complementary tool in our decarbonization trajectory. These removals can be natural, taking advantage of the removal potential involved in the recovery and preservation of forests, soils, oceans and marine algae, or through technological solutions such as CO₂ capture, use and storage (CCUS) and direct CO₂ capture from the air (DAC).

Nature-based climate solutions (NCS) have been developed by many stakeholders, involving a strong component of social, governmental and intersectoral collaboration. We understand carbon removal and fixation solutions by natural processes as complementary to reducing the carbon intensity of operations and products delivered to society and they should be considered as additional contributions to intrinsic mitigation efforts, not replacing the need for energy supply with less carbon intensity for society. The credits generated by projects of this nature must be used sparingly, prioritizing the mitigation hierarchy of our industry, especially while the emission reduction options present high costs or very challenging scales.

We support voluntary and regulated market based mechanisms and public policies for high environmental integrity NCS, socially fair and economically appropriate that encourage the potential of GHG removal from nature. In a country like Brazil, where land use emissions accounted for 27% of total emissions in 2016 (SIRENE/MCTI, 2020), this potential is even clearer.

Our short and medium goals informed throughout this Climate Change Supplement are related to the actual performance of our processes and products and do not consider the use of offsets to be reached. However, our definition of neutrality considers the possibility of using compensation for marginal emissions. So far, we have never used carbon credits to achieve our carbon goals and commitments, but we believe that this tool could be important in the future given our challenges.

Therefore, we consider including high quality NCS credits as an offset opportunity in our Carbon Neutral Program, following an order of merit that prioritizes all viable direct GHG reductions before any eventual generation or purchase of carbon credits for offset purposes.

"FLORESTA VIVA" INITIATIVE

In 2021, we announced an increase of approximately R\$ 50 million in investments in projects aimed at forest restoration of native species in Brazilian biomes, which contribute to the sequestration and fixation of carbon and to avoid greenhouse gas emissions. The investment, planned over the next five years, is part of the "Floresta Viva" initiative, launched by BNDES.

"Floresta Viva" will operate under the principle of combining BNDES resources with resources from other companies. The partnership between Petrobras and BNDES will total an investment of R\$ 100 million by the two institutions, over five years, to finance reforestation projects, through public selection and shared management. For the operationalization of the initiative, a managing partner will be selected (by a public call) which will be responsible for selecting and monitoring the projects. The first public notice is planned for the first half of 2022.

Petrobras' participation in the initiative aims to expand the company's socio-environmental investment in natural climate solutions focused on forest restoration. The notices will have environmental and social requirements for the selection of projects, which must be aligned with international certification standards for possible carbon certification. This initiative is in addition to the investments we have made since 2008 in voluntary projects of the Petrobras Socio-environmental Program's Climate line.

>> See [Targets, Metrics, Performance and Voluntary Investment](#)

Physical impacts of Climate Change

In terms of operational safety, we seek to improve the predictability of physical climate changes, in order to minimize the risk of emergency shutdowns and damage to facilities as a result of extreme events, in addition to optimizing expenditures associated with the adaptation to the climate changes. Thus, there are some ongoing R&D activities related to climate regionalization studies with renowned institutions in Brazil and abroad (USP - University of São Paulo, Brazil; INPE - National Institute for Space Research, Brazil; e NOAA - National Oceanic and Atmospheric Administration, USA) about the parameters that are potentially more susceptible to these changes, such as water availability for our onshore units (refineries and thermoelectric plants) and wave, wind and current patterns for our offshore facilities.

Regarding the environmental variables in the oceanic region, we currently have a technological partnership with the IAG / USP (Institute of Astronomy, Geophysics

and Atmospheric Sciences, IAG) to simulate atmospheric conditions and extreme waves under the effect of RCP 4.5 and 8.5 climate projections of the MPI and HadGEM Earth System Models, using dynamic downscaling for adequate representation of the physical phenomena of interest in the Santos, Campos and Espírito Santo Basins, using regional atmospheric models RegCM4 and WRF and the wave model WW3. The time horizon for these simulations will be 2060, with a time lapse of 10 years.

For environmental variables in the oceanic region, we carry out physical risk assessments of our operations due to changes in hydrodynamic circulation (currents and vortices) and found that, over the useful life of our assets, the magnitude of impacts is within safety parameters already considered in our projects.

As partial results of this study we have that, in the wave climate projections, a reduction in wave height was identified both for the near future climate (2006-2030) and for the distant future (2031-2060), when the WW3 model was forced by the conditions of RegHad and RegMPI; for the projection of the near future climate forced with the

WRFHad, an increase in the height of waves was observed, mainly in the region close to the coast. In addition, in the projections of winds for the distant future (2031-2060) with the RCP 8.5 scenario of RegMPI and RegHad, there is a trend of intensification of summer winds south of 25 °S and continental winds, in addition to a trend of an increase in the frequency of occurrence of extremes in the three southeastern basins studied. The conclusion of the results associated with this technological partnership is planned for the end of 2022.

To assess the risk of water scarcity in our onshore utilities, we have a partnership with LabSid and USP to develop a decision support system to analyze the water vulnerability of critical assets, based on precipitation results available from the regionalized projections generated by the ETA atmospheric model, from INPE, and tested against global models (CMIP5 HadGEM2-ES, BESM, MIROC5 and CanESM2).



Decarbonization Of Operations

All electric

Regarding the E&P sector, one of the highlights is the evolution about the all electric concept, which consists of electrifying as many equipment and applications as possible on an oil and gas production platform. In this way, we can use centralized generation of electricity, in a more optimized way, distributing the electrical energy to the equipment. This configuration is more efficient than having decentralized power generation and, therefore, reduces fuel consumption. Using less fuel also generates less emissions, both greenhouse and other gases, such as nitrogen oxides.

An all electric plant can emit up to 20% less greenhouse gases and pollutants. This is a relevant concept for the fulfillment of Petrobras' sustainability commitments and for the competitiveness of our oil.

Previously, due to regulatory limitations, this concept could not be implemented in offshore plants that required electricity generation greater than 100MW. As of November 3, 2021, the revision of Conama Resolution 382/2006 came into force, which allows oil and gas platforms operating beyond the Brazilian territorial sea, to generate more than 100 MW, if a fully electrified concept is in place. Thus, with this regulatory revision, it was possible to foresee the adoption of the all electric concept for future production development projects.

HISEP

HISEP, an acronym for High Pressure Separation, is a technology developed by Petrobras that allows the separation and the subsea reinjection of the CO₂ present in the associated gas produced. The pre-salt oil is characterized by a high concentration of CO₂.

This first separation and reinjection of the CO₂-rich gas occurs in the seabed, preventing this volume from being processed on the platform, significantly reducing the Gas-Oil Ratio (GOR) of the produced fluids. The smaller GOR allows the unit to have a smaller and simpler gas processing plant, as part of the gas was previously removed, allowing the unit's oil processing to be increased.

In addition to the positive effects resulting from the simplification of the plant, the separation and injection of CO₂ can be used to maintain the pressure of the pre-salt reservoirs, functioning as a secondary oil recovery mechanism. The HISEP technology also has a positive impact on the unit's greenhouse gas emissions intensity, by reducing emissions from gas processing and enabling increased production.

RefTOP

In 2021, we launched the RefTOP program with the objective of placing Petrobras among the best oil refining companies in the world. This program consists of a set of initiatives that seek to implement improvements to increase the efficiency and operational performance of refineries that are not in the divestment portfolio - Presidente Bernardes Refinery (RPBC), Duque de Caxias Refinery (REDUC), Capuava Refinery (RECAP), Paulínia Refinery (REPLAN) and Henrique Lage Refinery (REVAP) - and to increase Petrobras' competitiveness during the opening of the refining market in the country. The investments initially planned in RefTOP until 2025 are approximately US\$ 300 million, including actions to improve energy performance and reduce emissions.

Since then, RefTOP promoted a detailed analysis of refining assets, identifying opportunities for increase value generation in Energy Performance and Climate Dimension, with partnership with operational, innovation and engineering teams. The analysis is based on benchmark



studies by Solomon, a specialist institution in refining benchmark, with Petrobras participation since 1992.

The program will promote the intensive use of digital technologies, automation and robotization in Petrobras refineries. One of the examples of digital technologies that have already been adopted by the company and will be expanded with RefTOP is the Digital Twin – digital representations of operational facilities – for real-time monitoring and optimization. RefTOP also foresees initiatives to increase the energy performance of refineries, for example, through the reduction of losses, energy recovery and optimization of the thermoelectric system, resulting in better use of the inputs such as natural gas, electricity and steam.

In 2021, we implemented 8 new projects and a series of operational initiatives, which together led to a 2.4% reduction in Energy Intensity at Program's refineries. Approximately 242 thousand tons of CO₂ equivalent were avoided (approximately 6 months of emissions by bus fleet in the city of São Paulo, according to data from the Institute of Energy and Environment – IEMA) in greenhouse gas emissions.

We will follow this path until 2025, with the challenge of implementing new projects, currently in planning and execution phase, with 15 projects scheduled to start operating from 2022 and another 13 from 2023, considering all dimensions of the Program (Energy and Climate Performance, Reliability, Optimization and

Productivity in Refining). Other opportunities are being studied, according to the typologies below:

Dimension	Opportunities*
Energy and Climate Performance	194
Optimization and Productivity	65

*variable number depending on maturity level of opportunities

New Energy Performance and Climate Dimension Projects are focused on reducing primary energy consumption in refineries (natural gas, electricity and steam) and in optimizing energy generation and distribution. We foresee the energy integration of processes, modernization of thermoelectric plants in refineries, more efficient machines and others. As example:

- _ New thermoelectric plant at Reduc
- _ More efficient compressors in Catalytic Cracking Unit at RPBC
- _ Increased heat recovery in Catalytic Cracking Unit at RECAP
- _ Increased heat recovery for steam Generation at REVAP
- _ Increased condensate recovery at RPBC
- _ Energy integration in distillation and propene separation units at REVAP
- _ Increase in the efficiency of heat recovery batteries at REPLAN, RECAP and RPBC

GÁS +

In 2021, we launched the GÁS+ Program, with strategic projects for natural gas processing assets and thermoelectric plants. The Program's initiatives consist of implementing investment projects to modernize process facilities. The Program aims to increase operational availability and energy efficiency, in addition to reducing the use of water resources.

In terms of increasing the energy efficiency, stand out the projects to improve the gas turbines of the thermoelectric plants TermoBahia (BA) and TermoRio (RJ), which, in addition to gains such as increased power, greater efficiency and increased mean time between maintenance, will result in a reduction in emissions of 3 thousand tonCO₂ at TermoRio e 13 thousand tonCO₂ at TermoBahia, in our SP 2022-2026 horizon.

At UTGCA, the GÁS+ Program will implement an initiative to redirect part of the gas flow that would be flared, allowing this gas to be recovered into LPG, C5+ or sales gas. The reduction in emissions is around 5.8 thousand tCO₂e annually.

New Generation of Fuels

In 2020, we launched the Biorefino 2030 Program, which foresees projects for the production of a new generation of fuels, more modern and sustainable than the current ones, such as renewable diesel and aviation biokerosene (Biojet).

The co-processing of renewable raw materials in existing refineries is the fastest and cheapest way to offer fuels with renewable content to the market and to start the decarbonization journey of the company's products.

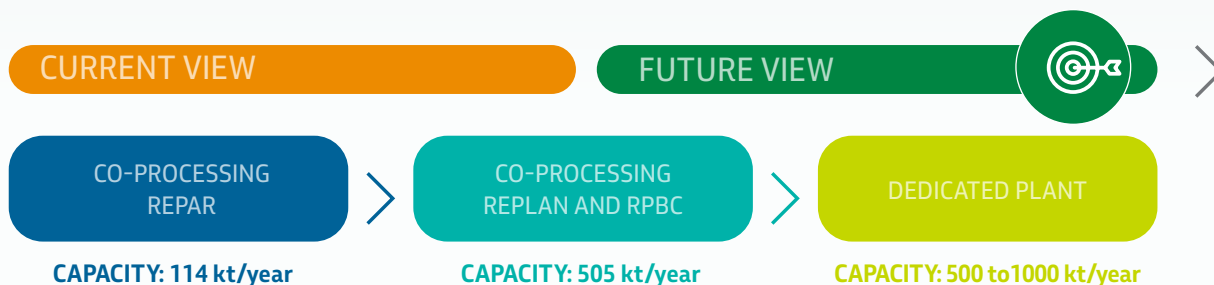
The co-processing technology was patented by Petrobras in 2006 for the co-processing of vegetable oils using the process called HBIO. Another alternative is the construction of a dedicated industrial unit, where renewable diesel and aviation biokerosene (Biojet) can be produced.

Renewable diesel is a modern biofuel, chemically similar to mineral diesel (derived from petroleum) but is produced from renewable raw materials. This new fuel can be added to mineral diesel oil (derived from petroleum) at any percentage volume.

In this journey towards a sustainable and resilient refining, we are planning to produce petroleum derivatives with lower greenhouse gas emissions. We have already concluded the adaptation of Presidente Getúlio Vargas Refinery (REPAR) to co-process refined soybean oil and diesel in our HDT (Hydrotreatment) unit, enabling the production of Diesel with 5% of renewable content.

Considering a future where an evolution of the regulation is necessary for recognizing renewable diesel for mandatory addition to fossil diesel, we are planning to carry out co-processing also at REPLAN and RPBC to produce Diesel with renewable content between 5% and 7%.

Technologies for the production of renewable diesel and Biojet have also been developed aiming the implementation of dedicated biofuel units. This will allow the company to contribute to the decarbonization of the road and air transport segments, while diversifying its portfolio with more sustainable products. Our vision of the future includes a dedicated plant with a capacity between 500 and 1000 kt/year of Renewable Diesel and Biojet produced from renewable raw materials.



Innovation and strengthening of skills to create value in low carbon

Petrobras' strategy includes the use its innovative potential to generate solutions in new energies, decarbonization, and new lines of business.

Innovation is an important factor to enable trajectories of significant reduction in carbon intensity with energy arrangements that do not increase the cost of energy for society. We are committed to invest in low carbon research, development and innovation. Our research portfolio explores opportunities in the oil and gas chain and also in renewables, looking for opportunities to be competitive, for example, in bioenergy and modern renewables.

Brazil presents particular challenges, as it already has an energy matrix with a high share of renewable energies (48.4% in 2020, according to data from the Brazilian Energy Balance - BEN 2021, and with 84.8% of the Brazilian domestic supply of electricity) and largely relies on long-distance road transport (cargo and passenger transport represented 31.2% of energy use in Brazil in 2020). In this context, several of the low-cost emission mitigation options in energy use have already been partially or fully implemented, restricting the energy decarbonization options with low cost for society.

It is our priority to innovate and create models to maximize both value creation and our competitiveness in low-carbon businesses, aiming at long-term diversification. The development of low carbon solutions is important in our technological routing, with a minimum allocation of 10% of our investment in Research and Development (R&D).

We believe that the competitiveness of renewable generation technologies, less carbon-intensive liquid fuels, less energy-intensive processes, energy storage, mobility efficiency, urban innovation, CCUS, among others, will be essential for the creation of new energy paradigms based on low carbon, generating value for society.

MAIN FOCUS

- _ Improvement in energy efficiency.
- _ CCUS (carbon capture, use and geological storage).
- _ Subsea separation of CO₂.
- _ Methane emissions.
- _ Renewable diesel, Biojet and Biobunker.
- _ Renewable energy.
- _ OGCI (Oil and Gas Climate Initiative): partnership in the initiatives.

To this end, we have developed and evaluated technologies that contribute to achieving the decarbonization goals established, reducing emissions in internal processes (Scope 1) and adding greater sustainability to our products (Scope 3).



Processing of renewable raw materials

We are evaluating the co-processing of bio-oils from lignocellulosic residues in furnaces/boilers in process units. The co-processing routes of biomethane and renewable loads are being evaluated for the production of Hydrogen, an important industrial input for the production of high quality fuels.

The growing demand for sustainable chemicals and petrochemicals has motivated the development of solutions for the production of renewable petrochemical intermediates, which can be implemented through the adaptation of existing refining units or new processes.

Reduction of methane losses

We have invested in innovation with technologies to reduce losses, through tools for detection and quantification of methane emissions for the entire O&G chain of the company, such as optical imaging of emitted gases (OGI), drones and sensors.

CCUS - Cost reduction and efficiency gains

We are developing a tool to monitor and evaluate the existing CO₂ removal system in production units that have CCUS-EOR technology installed. With it, we will monitor the selectivity of the membranes and the losses of hydrocarbons by the permeate current in real time, with direct gains in reducing the intensity of emissions. In 2021, a pilot project was carried out in one of our production units, with an increase in scope planned for 2022.

Additionally, we are developing new materials for application in these CO₂ removal membranes. We seek greater capacity, selectivity and durability and, consequently, reduction of energy demand for the compression of the current to the reservoir, reducing CO₂ emissions throughout the process and reducing costs.

Reduction of flare losses

Torch burning occurs for operational safety and uses steam to control the quality of the burn. This steam is generated in boilers, and its excess must be avoided, as it increases fuel consumption for its production and, consequently, the emission of greenhouse gases.

We developed the Smart Torch system to promote an optimized burning condition most of the time. Through continuous image processing of the torch burn and machine learning, the system recognizes burn patterns and classifies the images. Thus, it identifies both excess steam and soot generation conditions and acts directly on the steam control system, maintaining the most efficient and safe burning for the environment.

The Smart Torch had its pilot application at REPAR and is in operation at REPLAN, REVAP, RECAP, and REDUC. These installations have the potential to reduce steam consumption by approximately 170 thousand tons per year, contributing to energy efficiency and emissions reduction, in addition to reducing soot emissions from torches and possible odors arising from the operation.



Petrobras - Connections for Innovation

Low carbon solutions were also established as a priority in the relationship with technology-based companies (startups). In 2019, Petrobras launched a new investment cycle, the Petrobras Connections for Innovation program – Startups Module, an initiative to promote R&D and innovation, aimed at startups and innovative micro and small companies.

The first call, in partnership with Sebrae (the Brazilian Support Service for Micro and Small Enterprises), was published in July 2019, with results disclosed in December of the same year. Seven innovative companies were selected to receive from R\$ 750 thousand and R\$ 1.5 million, with the purpose of transforming their ideas into products. Among the focus areas of this first call were the themes “Carbon Capture and Storage” and “New Energies”.

In May 2020, we began the second cycle of the Call with the invitation to technological bids. The Call included 4 challenges related to the performance in carbon of the operations and products, with the selection of companies in 3 challenges.

THE CHALLENGES OF THE STARTUPS CALL

CALL

CHALLENGE

STARTUP

2019

Compact technologies for CO₂ separation and capture in offshore structures. Reduce costs and increase the efficiency of CO₂ capture and reinjection processes in offshore structures.



Pam Membranas

2020

Identification and quantification of steam losses in heated systems.



Immer Messen

2020

Reduce losses from the refining process related to the torch system, through intelligent network for detection and analysis of the data about the currents sent to the torch.



Energética

2020

Reduce greenhouse gas emissions (CO₂ and methane) from Petrobras' processes and operations with greater efficiency and lower costs.



Alfa Sense

Innovation Ecosystem

Petrobras participates in the Massachusetts Institute of Technology's Regional Entrepreneurship Acceleration Program (MIT Reap). In 2020, MIT selected Rio de Janeiro to participate in this Program that involves universities, companies, government, entrepreneurs and venture capital investors. The objective of the initiative is to develop a methodology for structuring and governance of the world's first innovation ecosystem (iEcosystema) in energy and sustainability.

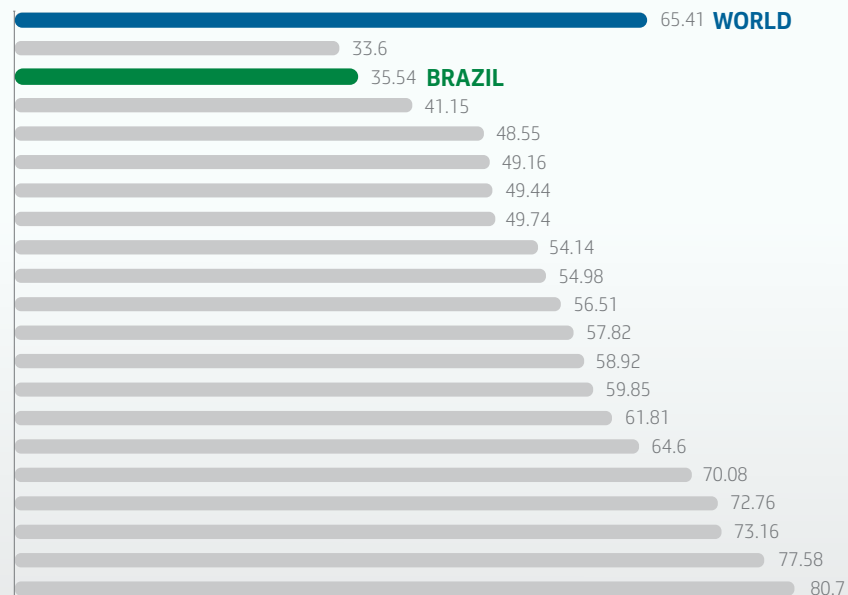
The program started in June 2021, involving all regions that are part of Cohort 8 of the Program: Rio de Janeiro – Brazil, Egypt, Northern Ireland – UK, Los Angeles – USA, Manizales – Colombia, Wallonia – Belgium. With an estimated duration until May/2023 the program foresees the proposition and implementation of initiatives to accelerate the entrepreneurship in the region.

7. BRAZIL: DISTINCT EMISSIONS PROFILE AND COMPLEMENTARITY BETWEEN OIL, GAS AND RENEWABLES

While emissions from energy production and use predominate worldwide (74%), in Brazil emissions related to land use and land use change (27.1%) along with agriculture emissions (33.2%) represent the majority of the country’s GHG emissions. Deforestation is a major driver of land use change emissions, representing a growing trend since the last official inventory of 2016.

Brazil has a specific profile in the decarbonization scenario, with low per capita energy consumption and the second most decarbonized energy matrix among the G20 (35.54 kgCO₂e/GJ).

G20: GHG Intensity in Energy Sector per Primary Energy Consumption (kgCO₂eq/GJ), Data from 2016

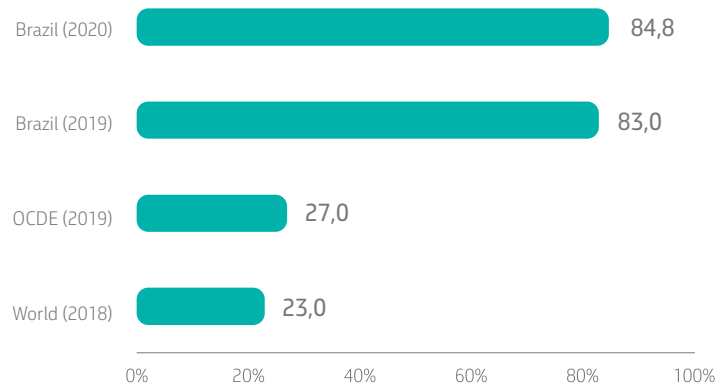


Source: adaptation from BP Statistical Review of World Energy 2020, CAIT/WRI, 2021, UNFCC 2021, SIRENE/MCTI, 2020

The carbon intensity of the Brazilian energy sector, which represents the amount of CO₂ emitted per unit of energy supplied, is about 40% lower than the G20 average, largely because of its high share of renewables.

Renewable energy corresponds to 85% of our electricity matrix, 50% in the energy matrix, levels far above the world average and expected only within 2 or 3 decades in most countries.

Renewables in the energy matrix (%)



Source: EPE - Brazilian Energy Balance 2021, Summary Report 2021. base year 2020.

Long distance road transport (cargo and passenger transport) represented 31.2% of energy use in Brazil in 2020. Brazil is highly dependent on the road modal, and the replacement of fossil fuels in the context of infrastructure transformation of transports represents a high economic impact.

Transforming infrastructure is a decades-long, high-investment effort. In turn, alternative fuels currently significantly impact prices of goods and services as well as government revenue, in the form of the cost of public incentive policies.

Considering that energy is a representative item in families and companies' budgets, with an average impact of 10% on GDP, and that oil revenues are significant, changes in the energy cost structure have a significant impact on the economy. It is in the interests of society to carry out decarbonization in the order of the best cost-effectiveness.

Nevertheless, Brazil has made progress in mitigating GHG emissions in recent years. Brazil is a leader in production and use of biofuels, achieving 23% share in the transport segment. Effective contributions to this results are incentive policies such as the RENOVABIO program, mandates of blending biofuels into fuels and differentiated taxation policies.

Brazil promotes public policies to improve energy efficiency in the transport sector such as Rota 2030 program, which seeks to increase energy efficiency goals that will lead to a reduction in the average fuel consumption of new vehicles by at least 11%, compared to 2017.

Advancing decarbonization requires identifying the lowest cost options for society and aiming to make energy more accessible – a fundamental element of competitiveness and social well-being.

The country is an oil producer, a product of high tax collection with around 60% of its value reverted to public revenue, in the form of taxes, bonuses, royalties and dividends, in the case of companies such as Petrobras, with state participation. The production of lower emission oil in Brazil is allied to the global trajectory of decarbonization, reducing emissions in the country and generating foreign exchange to finance a new, more efficient, and competitive infrastructure.

The need for infrastructure transition, addressing the technological gaps and the current cost of transitioning some oil services, explain why keeping oil in the matrix for decades is suitable and expected, even in accelerated transition scenarios and adherent to the ambition of the Paris Agreement.

Brazilian target and land use change

Another characteristic of the Brazilian emissions profile is the representativeness of emissions from land use change due to loss of vegetation cover, whose emission is equivalent, in a unique way, to all the emission related to the production and use of energy in the country. (about one third of emissions).

Such materiality demonstrates the importance of controlling this emissions item, which has a favorable marginal cost of abatement among the decarbonization options*. The Brazilian target under the Climate Convention provides for the neutrality of greenhouse gas emissions in 2050 and a forecast to eliminate illegal deforestation by 2028 (Guidelines for a national strategy for climate neutrality, MMA, 2021).

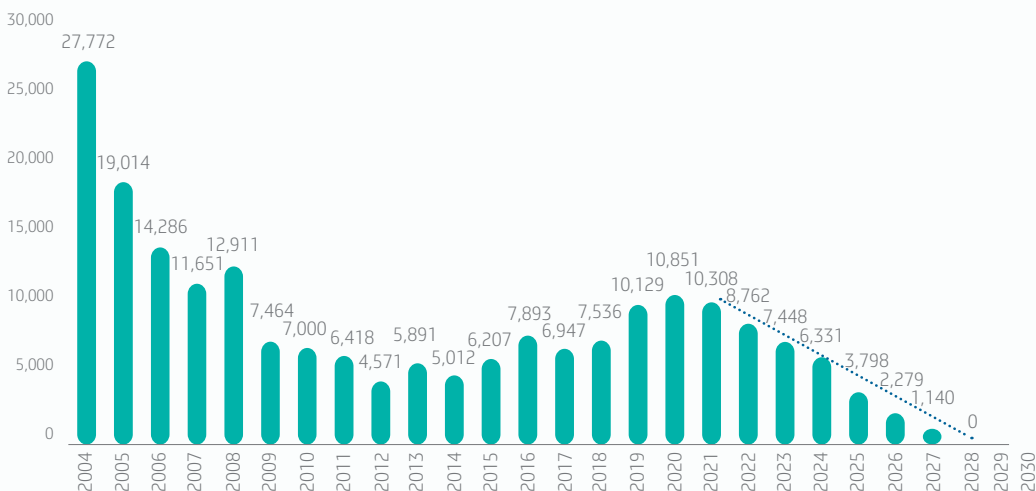
At COP26, in Glasgow, there was a relevant agreement to eliminate net emissions from deforestation by 2030. Brazil is a signatory to the agreement, as 109 other countries. In addition, Brazil has committed to:

- Reduce illegal deforestation, starting in 2022, by 15% per year until 2024, 40% in 2025 and 2026, and 50% in 2027, reaching the goal of zero illegal deforestation in 2028
- Restore and reforest 18 million hectares of forests, for multiple uses, by 2030.

Through NDC (Nationally Determined Contribution), Brazil committed to ambitious emission reduction targets. Brazil has also committed to achieving neutrality in greenhouse gas emissions by 2050. Achieving targets of such magnitude without reducing deforestation would require disproportionate cost reductions on Brazilian productive activities and on the energy sector, which is already today of the most decarbonized in the world. Controlling deforestation tends to be the frontier with the lowest marginal cost in reducing emissions.

* Studies such as the one by the World Economic Forum estimate a potential of 1 billion tons of CO₂e per year in forestry projects with a cost below US\$ 35/tCO₂e in Brazil, which means about 15% of the world potential for mitigating emissions through restoration and preservation of biomes at low cost.

Brazilian historical annual deforestation rates and projections towards the country's zero deforestation target (km²)



Source : Adapted from Brazil's Environmental Ministry publication on national strategy for climate neutrality (MMA 2021).



8. TRANSPARENCY AND ENGAGEMENT

We value transparency in our interactions with stakeholders, guided by our social responsibility and HSE policies, our Code of Ethical Conduct and Guide to Ethical Conduct for Petrobras Suppliers. We follow the main global codes on conduct and reporting, including the guidelines to reporting sustainability of the Global Reporting Initiative (GRI Standards), DJSI requirements, CDP and TCFD (Taskforce for climate related financial disclosures), the complementary reporting methodology of IPIECA (Global Oil and Gas Industry Association for Environmental and Social Issues – guideline for Voluntary Reports of the Oil and Gas Industry) and the assumptions and methodologies committed with OGCI (Oil and Gas Initiative).

We publicly support the TCFD (Task Force on Climate Related Financial Disclosure), reference to our carbon management process since 2018. This Climate Change Supplement follows the TCFD recommendations, and its contents are structured based on TCFD'S core elements: Governance, Strategy, Risk Management and Metrics and Targets.

TCFD is an initiative of the Financial Stability Board (FSB), requested by the G20 and announced in 2015, with a mission to develop climate change-related financial risk disclosure recommendations for use by companies in providing information to investors, creditors, insurers and other interested parties. The TCFD recommendations contribute to companies' understanding of what financial markets expect in terms of measurement and disclosure of data related to climate change risks.

We are among the most transparent companies in sustainability in Brazil, recognized by GRI transparency observatory in Brazil. The Advisory Committee recognized Petrobras based on the assessment of our annual and sustainability reports, based on GRI principles such as clear and reliability reports and material analysis.

We also present the correlation of our activities with the Principles of the Global Compact and with the Sustainable Development Goals (SDG) of the United Nations.

We publicly support TCFD (Task Force on Climate Related Financial Disclosure), a reference for our carbon management process since 2018, and we have advanced in incorporating its guidelines in a profound way in our decision-making processes. Since 2004, we have answered the questionnaire from CDP, a non-profit institution that manages its transparency platform used by institutional investors with assets of around US\$ 110 trillion. In 2021, we maintained our score of B grade (management level) in CDP. Also, we believe that the transition to a low carbon economy is a topic where collaboration is essential, and, therefore, we have partnerships with other companies and with the science, technology and innovation community.

>> See [Investments and Initiatives](#)

Our approach of engagement with stakeholders on climate change is carried out through a systematic methodology, in order to incorporate the position of our stakeholders in material decision-making processes for climate change, performing gap analysis, evaluating synergies and incorporating insights for our communication both within the company and outside of the organization.

Public Position related to Climate Change and best practices in O&G and Energy Sector

The O&G Industry can do a lot to respond to the climate change challenge and assumes its role in the context of decarbonization of the energy sector, providing energy security and bringing down emissions.

We participate in several initiatives that promote coordinated and collaborative actions on climate change, involving the oil and gas sector at national and international levels, as well as other segments of industry and business sector.

In Brazil, the Brazilian Oil and Gas Institute (IBP) is the O&G institutional representative and develops, together with its associates and experts, policies and lines of action for all segments of the oil, gas and biofuels industry. With IBP, we work directly in four Working Groups linked to sustainability: Energy Efficiency, Nature-Based Solutions, Carbon Pricing and Methane Abatement.

In 2021, IBP reinforced its commitment to contribute to the decarbonization of the O&G industry by 2050, through investments in technologies that increase carbon efficiency of operations and reduce emissions (IBP, 2021). As an associated company, we endorse this commitment, aiming to generate wealth from our oil and gas reserves while supporting the decarbonization of the national economy, in line with the commitment made by Brazil in the Paris Agreement, which aims to neutralize emission until 2050.

OGCI

Since 2018 we are part of the Oil and Gas Climate Initiative (OGCI), which gathers twelve of the largest oil and gas companies of the world, responsible for more than 30% of the global production of oil and gas.

In OGCI, we work at Executive Committee (ExCom) and Climate Investments (CI), and others workstreams:

- _ Carbon capture, use and storage (CCUS);
- _ Role of Gas;
- _ Energy Efficiency;
- _ Low Emissions Opportunities (LEO);
- _ Nature Climate Solutions;
- _ Transport.

In 2021 OGCI announced an updated set of ambitions including reducing upstream methane emissions intensity and carbon intensity from upstream operations by 2025. These are important near-term steps and will help accelerate the energy transition through deep reductions in greenhouse gases. In the same year, OGCI announced that all OGCI member companies aim to reach net zero emissions from operations under their control, consistent with the Paris Agreement. OGCI member companies have a key role in working with their customers, partners, other industries and policymakers to reduce greenhouse gas emissions and help accelerate the transition to a net zero society.

OGCI supports initiatives such as the Methane Guiding Principles, Global Methane Alliance and the World Bank's Zero Routine Flaring by 2030, in which Petrobras is a direct signatory, with a commitment to eliminate routine flaring in fields in operation by 2030.

The companies that are members of the OGCI undertake to invest, in conjunction, more than USD 1 billion, in the next ten years, to develop technologies and initiatives that contribute with the reduction of the GHG emissions.

IPIECA

Global Oil and Gas Industry Association for Environmental and Social Issues (IPIECA) develops, shares and promotes good practice and knowledge to help the industry improve its environmental and social performance, for more than 40 years. Petrobras works directly on Climate Change Group (CCG).

IOGP

The International Association of Oil and Gas Producers (IOGP) acts for almost 50 years as an upstream global forum in which members identify and share best practices to achieve improvements in safety, social responsibility and sustainability in operations.

We work on the following Low Carbon Agenda topics:


- _ Carbon Capture and Storage,
- _ Electrification,
- _ Energy Efficiency,
- _ Flares & Vents,

and also at Task Force for Methane Emissions Detection and in Quantification Technologies, in Environment Committee.



Global and Regional economic development

We aim to collaborate outside the industry, dialoguing and searching for solutions, working with reference institutions for the promotion of sustainable development, such as Organization for Economic Co-operation and development (OECD), World Economic forum (WEF), the Brazilian Enterprise Council for Sustainable Development (CEBDS), the National Industry Confederation (CNI), Regional Association of Oil, Gas and Biofuels Companies in Latin America and the Caribbean (ARPEL), Brazilian Forum on Climate Change, and others.



We participated in the 2021 cycle of the **FGV Iniciativas Empresariais**, which promoted dialogues on practices and frontiers for business action on climate change, including its interfaces with biodiversity and social justice. The combination of business experiences and research, by the Center for Sustainability Studies at the Fundação Getúlio Vargas School of Business Administration (FGV EAESP), resulted in a practical guide 'Frontiers of Business Action on Climate Change', available on FGV website, as a reference for pathways to advance on climate agenda in corporate sustainability management.

Engagement with Suppliers

We acted on the decarbonization challenge in our supply chain, and its impacts on value chain. Our Strategic positioning at O&G sector promotes technological advances, new business models and cultural changes in organizations and societies.

Our logistic operations rely on a Strategic Initiative with actions aimed at reducing GHG in the operations of maritime support vessels and drilling rigs. We seek logistic fleet efficiency, through vessel speed management, inclusion of CO₂ factor in the schedule of routes, air route optimization and the use of emissions and carbon intensities indicators.

We introduce our sustainability commitments to CEOs of our suppliers and service providers, promoting changes on organizational behavior.

The initiative, although recent, has already shown good results reducing vessel emissions through speed management, without impacting customer service or fleet growth. We expect significant GHG reductions in actions planned to be incorporated in the coming years, such as incentives for the use of marine diesel, lower fuel consumption by contracted vessels, electrification of ports and fuel with renewable content.

About engagement with suppliers, we promote annually the Petrobras Best Suppliers Award, a recognition of our suppliers' best performance. The contracted companies are

evaluated with regard to quality, schedule, management, HSE, conformity and integrity. Some of the scoring criteria of HSE are emissions and energy efficiency.

In 2021, as a result of a review of our Guide to Ethical Conduct for Petrobras Suppliers, Climate Change Mitigation criteria was incorporated together with the principles, values and guidelines of HSE, including an item of traceability of wood origin.

We believe that compliance with this Guide by our suppliers leads to more transparent management, strengthens mutual trust, provides quality and credibility to business, contributing to the country's economic and social development in addition to reinforcing our commitment to ethics, transparency and respect for the environment and human rights.

Additionally, Petrobras is the first company to obtain the Association for Supply Chain Management (ASCM) certification for environmental, ethical and economic excellence in the procurement and supply chain of goods and services. Three dimensions are evaluated for a company to obtain ASCM certification: ethical, economic and ecological. For this assessment, supply chain planning, supply, and delivery processes are compared with worldwide industry and academic standards.

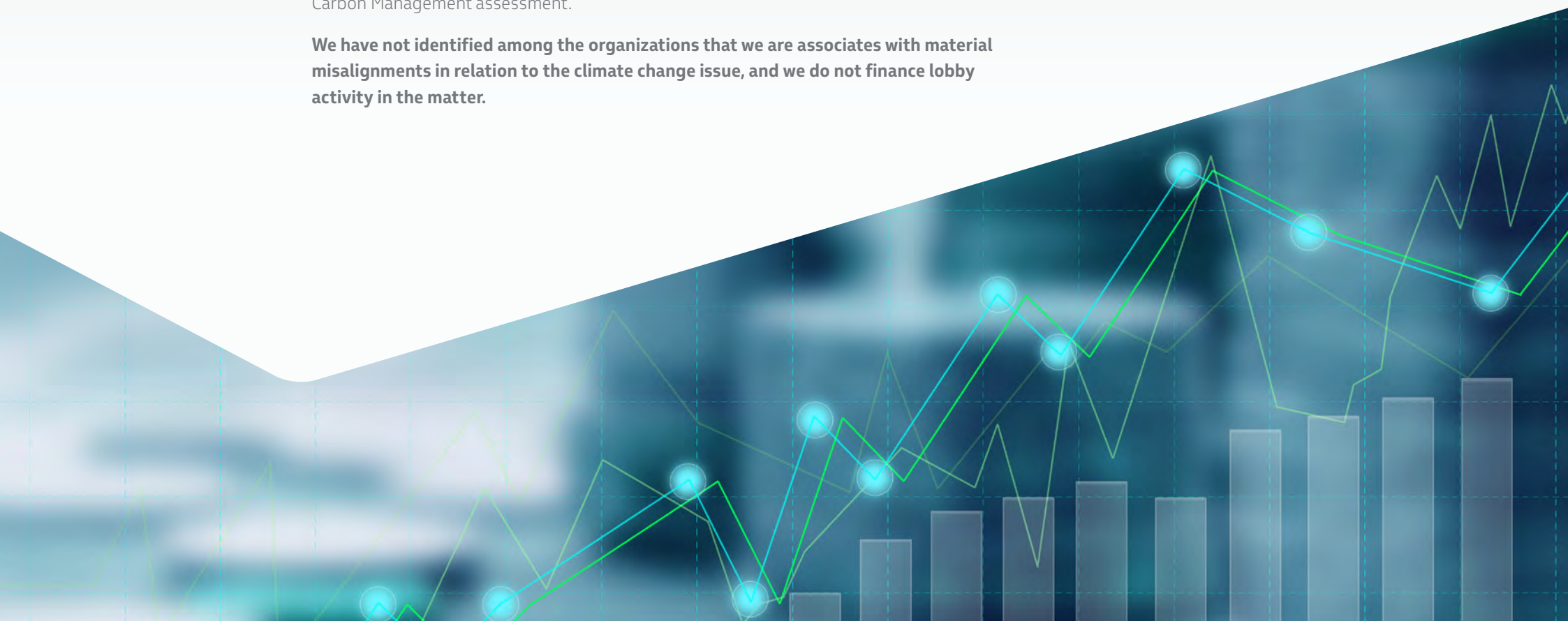


Climate Change Performance recognized by our stakeholders

We integrate the Dow Jones Sustainability Index World (DJSI World) of S&P Global's Corporate Sustainability Assessment, with emphasis in the criteria of Climate Change and Operational Eco-Efficiency. The DJSI World is one of the most important sustainability indexes in the world, which assesses the best social, environmental and economic management practices.

We are in first quartile of performance in "Carbon Emission" criteria of MSCI ESG Rating, and we had a 4 degree (Strategic Assessment) in the Transition Pathway Initiative (TPI) Carbon Management assessment.

We have not identified among the organizations that we are associates with material misalignments in relation to the climate change issue, and we do not finance lobby activity in the matter.



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TCFD Map

TCFD RECOMMENDATION	DISCLOSURE	LOCATION
Governance: Disclose the organization's governance around climate-related risks and opportunities		
a) Describe the organization's governance around climate-related risks and opportunities.	Governance, Incentives and Risk Management	pp. 52 - 56
b) Describe management's role in assessing and managing climate-related risks and opportunities.	Governance, Incentives and Risk Management	pp. 52 - 56
Strategy: Disclose the actual and potential impacts of climate-related risks and opportunities on the organization's business, strategy, and financial planning where such information is material.		
a) Describe the climate-related risks and opportunities the organization has identified over the short, medium, and long terms.	Governance, Incentives and Risk Management	pp. 57 - 59
b) Describe the impact of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning	Strategy and Portfolio Governance, Incentives and Risk Management	pp. 46 - 48; 57 - 59
c) Describe the resilience of the organization's strategy, taking into consideration different climate-related scenarios, including a 2° C or lower scenario.	Resilience Evaluation: Assumptions in line with the Paris Agreement	pp. 49 - 50
Risk management: Disclose how the organization identifies, assesses, and manages climate-related risks		
a) Describe the organization's processes for identifying and assessing climate-related risks.	Governance, Incentives and Risk Management	pp. 54 - 56
b) Describe the organization's processes for managing climate-related risks	Governance, Incentives and Risk Management	pp. 54 - 56
c) Describe how processes for identifying, assessing, and managing climate-related risks are integrated into the organization's overall risk management	Governance, Incentives and Risk Management	pp. 54 - 56
Metrics and targets: Disclose the metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material.		
a) Disclose the metrics used by the organization to assess climate-related risks and opportunities in line with its strategy and risk management process.	Targets, Metrics, Performance and Voluntary Investment	pp. 36 - 37
b) Disclose Scope 1, Scope 2, and, if appropriate, Scope 3 GHG emissions and the related risks	Targets, Metrics, Performance and Voluntary Investment	pp. 19 - 21; 34
c) Describe the targets used by the organization to manage climate-related risks and opportunities and performance against targets	Targets, Metrics, Performance and Voluntary Investment	pp. 18 - 33

Disclaimer

This Climate Change Supplement follows the recommendations of the Task Force on Climate Related Financial Disclosures (TCFD), being structured according to the initiative's four thematic areas: Governance, Strategy, Risk Management, Metrics and Targets.

The 2021 emissions performance results presented in this supplement will still be verified by a third party, so variations may occur, but no significant changes are expected.

Translation of a report originally issued in Portuguese. In the event of a discrepancy, the Portuguese language version prevails.

This document contains possible scenarios that only reflect our managers' expectations. The terms "anticipates", "believes", "expects", "projects", "intends", "plans", "forecasts", "aims", "shall", as well as other similar terms, aim at identifying such expectations, which, evidently, involve risks or uncertainties whether or not forecasted by the Company. Therefore, the future results of our operations may be different of the current expectations, and the reader shall not be based exclusively on the information contained herein. The Company is not responsible for the update of such forecasts in view of new information or future developments. The goals, ambitions, and perspectives presented throughout this supplement may be reevaluated due to external and/or internal factors. Among the factors that could cause future results to materially differ from our expectations, we refer to the factors described in the "Risk Factors" section on pages 32 to 57 of Petrobras' Form 20-F for the year 2020.

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