

LATIN AMERICAN STATE OIL COMPANIES AND CLIMATE CHANGE

Decarbonization Strategies and Role in the
Energy Transition

Lisa Viscidi, Sarah Phillips, Paola Carvajal, and Carlos Sucre

Authors

- Lisa Viscidi, Director, Energy, Climate Change & Extractive Industries Program at the Inter-American Dialogue.
- Sarah Phillips, Assistant, Energy, Climate Change & Extractive Industries Program at the Inter-American Dialogue.
- Paola Carvajal, Consultant, Mining, Geothermal Energy and Hydrocarbons Cluster, Inter-American Development Bank.
- Carlos Sucre, Extractives Specialist, Mining, Geothermal Energy and Hydrocarbons Cluster, Inter-American Development Bank.

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Introduction

Oil and gas companies can play an important role in addressing the global threat of climate change, both by reducing greenhouse gas (GHG) emissions from their own operations and by investing in low-carbon forms of energy to produce cleaner products for consumers. The majority of the world's oil production and reserves lie in the hands of state-controlled entities,¹ thereby giving national oil companies (NOCs) a critical role in reducing emissions.² In 2017, the oil and gas industry—through the extraction, processing, and transport of oil and gas—produced 5.2 gigatons of carbon dioxide equivalent (CO₂e), about 10% of global GHG emissions, according to the International Energy Agency (IEA).³ An additional 22% of emissions come from oil and gas combustion by consumers and other industries.⁴

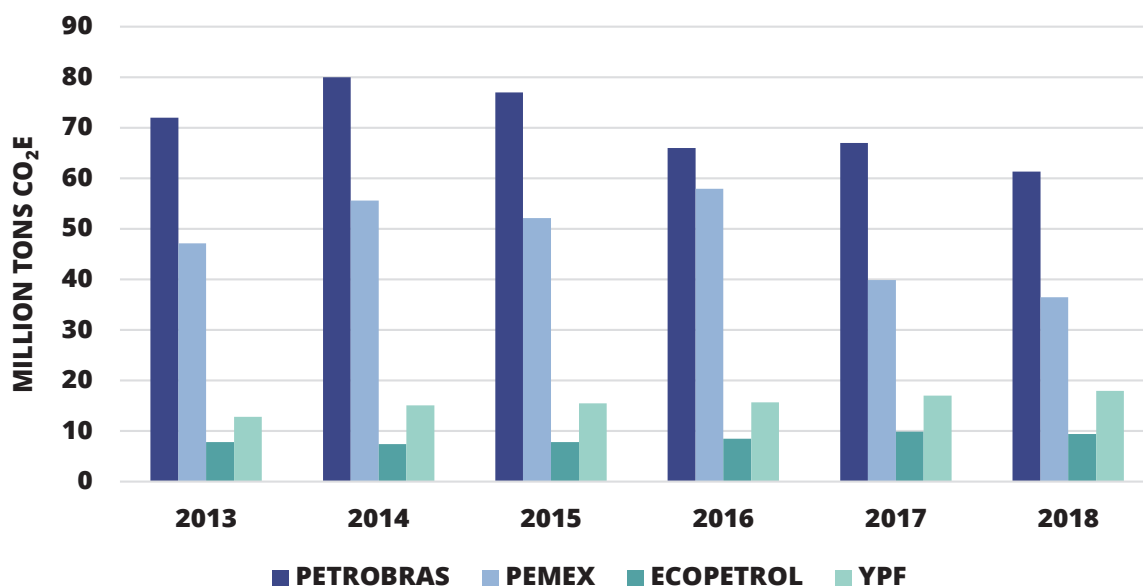
Like the major private companies, state firms are under increasing pressure to address both their direct (Scope 1) and indirect (Scope 2 and 3) emissions. Scope 1 emissions arise from sources directly owned or controlled by a company. For example, in the oil industry, flaring (the controlled burning of natural gas) produces emissions as a product of the company's upstream and downstream operations. Oil operations also require large amounts of electricity, and burning fossil fuels (e.g. heavy fuel oil, diesel, or natural gas) for electricity generation at plants owned by the company contributes to its Scope 1

emissions. Scope 2 emissions from oil companies come from the generation of electricity or heat purchased by the company and are usually negligible. Scope 3 emissions, those produced from fuel combustion by the consumer, are the largest source of emissions in the oil sector, with transport playing a predominant role.

Globally, most companies have focused their climate strategies primarily on reducing Scope 1 emissions, for which they are directly responsible. International oil companies (IOCs) have set targets to decarbonize operations, improve efficiency, reduce flaring and venting, invest in low-carbon technologies, and use more renewable energy for electricity generation in their operations. Shell, Total, and BP have also committed to net-zero direct emissions by 2050. Major oil companies are also increasingly under pressure from shareholders and the public at large to reduce their Scope 3 emissions by investing in and developing lower-carbon energy sources and technologies, such as wind, solar, hydropower, biofuels, and electric vehicles. Although low-carbon investments remain small relative to overall capital expenditures, in the last few years IOCs have increased investments in renewable energy, electric mobility, and other low-carbon technologies.⁵ For example, this year France's Total announced it will install 20,000 new electric vehicle chargers, while Shell recently signed an agreement to buy EOLFI, a French renewable company that specializes in wind energy.⁶ Many IOCs have also pointed

FIGURE 1: ANNUAL DIRECT EMISSIONS, LATIN AMERICAN NOCS*

Sources: Petrobras Sustainability Report (2018, 2016), Pemex Sustainability Report (2018), Ecopetrol Integrated Sustainable Management Report (2018, 2016), YPF Sustainability Report (2018, 2017, 2015)



*Petroamazonas not included due to lack of data. Company does not report direct emissions.

to an increasing share of natural gas relative to oil in their portfolios as part of their strategy to become a low-carbon energy producer.⁷

LATIN AMERICAN NATIONAL OIL COMPANIES

In Latin America—one of the world’s top oil-producing regions—NOCs are central to their respective industries

in every major oil-producing country, including Mexico, Brazil, Colombia, Argentina, Ecuador, and Venezuela. All of the Latin American NOCs analyzed have made important advances in reducing emissions from their own operations through techniques such as reductions in flaring, CO₂ injection for enhanced oil recovery, and renewable energy and energy efficiency programs for their own electricity consumption. Yet progress in producing lower-carbon

KEY DECARBONIZATION METHODS FOR THE OIL AND GAS INDUSTRY

Oil companies can implement a range of measures in both the upstream and downstream sectors to reduce direct greenhouse gas emissions from operations. According to research by McKinsey & Company, process changes and minor adjustments to reduce energy consumption provide the least-cost abatement options. The following are the key options for companies to reduce emissions from upstream and downstream operations:

UPSTREAM

Switch power sources: Companies can use cleaner power sources, including renewable energy and natural gas, in their operations.

Electrify equipment: Operators can electrify various units, for example, by replacing gas boilers with electric steam production systems to support separation units.

Reduce fugitive emissions: Operators can reduce methane emissions, for example, by improving leak detection and repair and by installing vapor recovery units.

Reduce flaring: Operators can reduce routine flaring through additional gas processing and gathering/transport infrastructure. Non-routine flaring can be reduced with predictive technologies and replacement of equipment.

Rebalance resource portfolio: Companies can reduce the share of carbon-intensive reservoirs, such as viscous heavy oil, in their portfolios.

Increase carbon capture, use, and storage (CCUS): Some companies use carbon capture for enhanced oil recovery and new technologies are being developed to accelerate CCUS.

DOWNSTREAM

Energy efficiency: Specific technologies for refineries, such as waste-heat-recovery technology and medium temperature heat pumps, can reduce the amount of primary energy used in distillation.

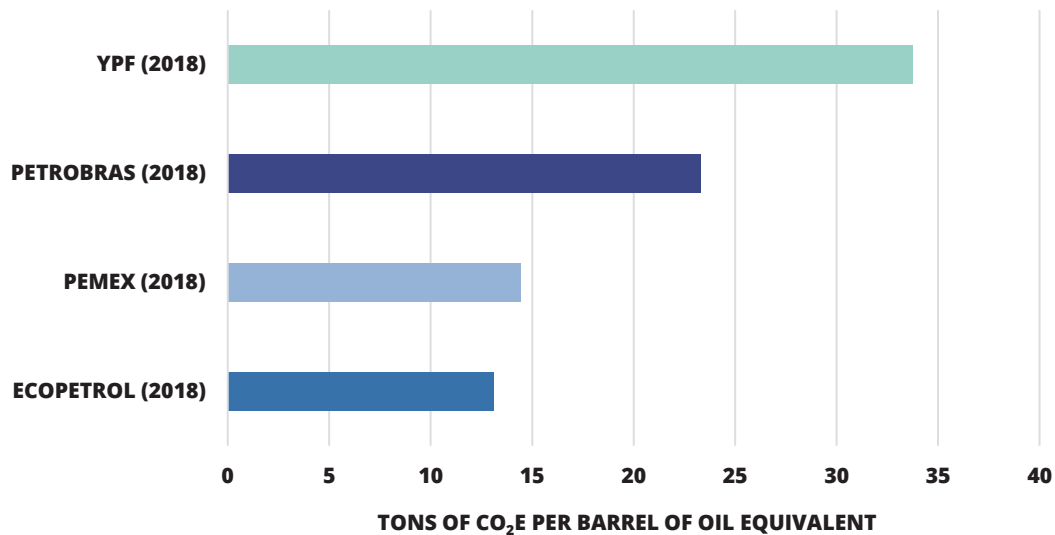
Greener feedstocks: Refiners can replace oil feedstocks with bio-based feedstocks or recycled plastic materials to reduce emissions.

Hydrogen: Hydrogen production through electrolysis can allow refineries to reduce emissions, although this is a new technology with few existing applications.

Source: Chantal Beck, Sahar Rashidbeigi, Occo Roelofsen and Eveline Speelmena. “The Future is Now: How Oil and Gas Companies Can Decarbonize” McKinsey & Company. January 2020.

FIGURE 2: EMISSIONS PER-BARREL OF OIL AND GAS PRODUCED

Sources: Authors' calculations based on data from respective sustainability reports, Pemex Statistical Yearbook (2018), and YPF Form 20-F (2018)



energy sources for consumers has been sluggish, no Latin American NOC has committed to net-zero emissions, and for some companies, emissions are on the rise.

This paper examines the emissions mitigation strategies of five major NOCs in Latin America: Brazil's Petróleo Brasileiro (Petrobras), Mexico's Petróleos Mexicanos (Pemex), Colombia's Ecopetrol, Argentina's YPF, and Ecuador's Petroamazonas. Although Venezuela's Petróleos de Venezuela (PDVSA) is also one of Latin America's largest NOCs, it is not included in this study due to lack of data. While the five companies examined here have varying ownership and management structures—some are 100% state-owned while others are majority state-owned but partially privatized—they all play a dominant role across the value chain in their respective countries' oil industries. In addition, all five companies are critical to their countries' respective economies, providing important sources of fiscal revenue and contributing to energy security. As the main players and, in some ways, the government's representative in the sector, these NOCs have the potential to set standards for private players and drive change in the industry.

CLIMATE MITIGATION STRATEGIES OF LATIN AMERICAN NOCS

The five companies examined here have focused their mitigation efforts in three categories: reducing operational emissions, investing in research and development (R&D), and transitioning their portfolios to cleaner energy sources. In the first category, operational climate strategies include

reducing gas flaring, venting, and leakage, improving efficiency and fuel switching in power plants, increasing energy efficiency at refineries, and reinjecting CO₂. These strategies have allowed Pemex and Petrobras to set their direct emissions on a downward trend over the past few years, while the emissions of Ecopetrol and YPF have been mostly on the rise in spite of such activities (see Figure 1). In 2018, the most recent year for which data is available, YPF had the highest emissions intensity, possibly because it has a much higher share of methane, a potent greenhouse gas, in its Scope 1 emissions (see Figure 2). Almost a quarter of YPF's Scope 1 emissions are methane compared to about 5-12% for the other companies. Petrobras also had significantly higher emissions per barrel of output than Pemex and Ecopetrol.

In the second category, R&D investments center on biofuels, carbon capture, utilization, and storage (CCUS), and renewables. Figures are difficult to compare across the five companies due to differences in how companies report R&D. However, while it is not clear exactly what percentage of each company's R&D budget is allocated to climate change mitigation, it appears the amount is low relative to total capital expenditures.

In terms of transitioning to cleaner energy sources, the third category, the main focus has been on boosting natural gas output. Except for YPF, which has a roughly 50-50 oil to gas ratio, all the companies produce vastly more oil than gas (see Figure 3). This contrasts with the production of the IOCs, which have oil to gas ratios closer to 50-50. Although

it should be noted that NOCs are largely limited by the oil and gas resources in their own countries while IOCs can create a global portfolio of reserves, many Latin American NOCs cite transitioning to a more gas-rich portfolio as part of their plans to address climate change. Some of the Latin American NOCs have also invested in biofuels and renewable energy operations.

Transparent emissions reporting is also important to provide a baseline to measure progress. All the companies except Petroamazonas report independently verified Scope 1 emissions data, while Petrobras alone reports Scope 3 emissions.

The emissions mitigation strategies of these five oil companies are driven by a variety of factors. Since they are state-controlled entities, the government’s stance on climate change can either impede or encourage their adoption of greener policies. The considerable sway that governments hold over their NOCs has led to erratic climate mitigation strategies, and indeed, some efforts to reduce emissions that were introduced under one government have later been undone by the next.

This study finds that a desire to improve efficiency and reduce costs generally provides the strongest impetus for climate action among the Latin American NOCs. This

suggests that climate actions that serve other profitability or operational objectives are the most likely to be implemented and the most resilient in the face of changes in government. But it is also worrying in light of the current collapse in oil prices and global economic crisis related to the Covid-19 pandemic, which will force many governments to reduce or redirect expenditures. However, environmental regulations that require the NOC’s full compliance could help ensure continuity between governments. Some NOCs are also driven to pursue climate action by the international context in which they operate, including doubts about the long-term viability of the oil sector and the practices of their counterparts, especially IOCs with which they partner on oil projects. Additionally, in contrast to their IOC counterparts, many of the NOCs studied have a mandate to ensure reliability of energy supply, which also influences their climate mitigation actions. For example, countries looking to diversify their matrix may increase natural gas production, and in some cases, expand the share of biofuels or renewables. Unlike the oil majors, NOCs appear to have faced little public pressure to decarbonize, despite their large share of oil and gas reserves and production. In order for continued progress, it is crucial to understand what factors have shaped emissions reduction goals and implementation for these NOCs, and how their position as a state-controlled company impacts their climate strategies.

FIGURE 3: SHARES OF PRODUCTION FROM NATURAL GAS AND OIL (IN BARRELS OF OIL EQUIVALENT)

Sources: BP Annual Report (2018), Equinor Annual Report (2018), ConocoPhillips Overview Fact Sheet, Chevron Annual Report (2018), ExxonMobil Summary Annual Report (2018), Total Q4 Results (2018), Shell Annual Report (2018), Pemex Statistical Yearbook (2018), Ecopetrol Form F-20 (2018), Petrobras Sustainability Report (2018), YPF Form F-20, Petroamazonas Internal Documents (2018)

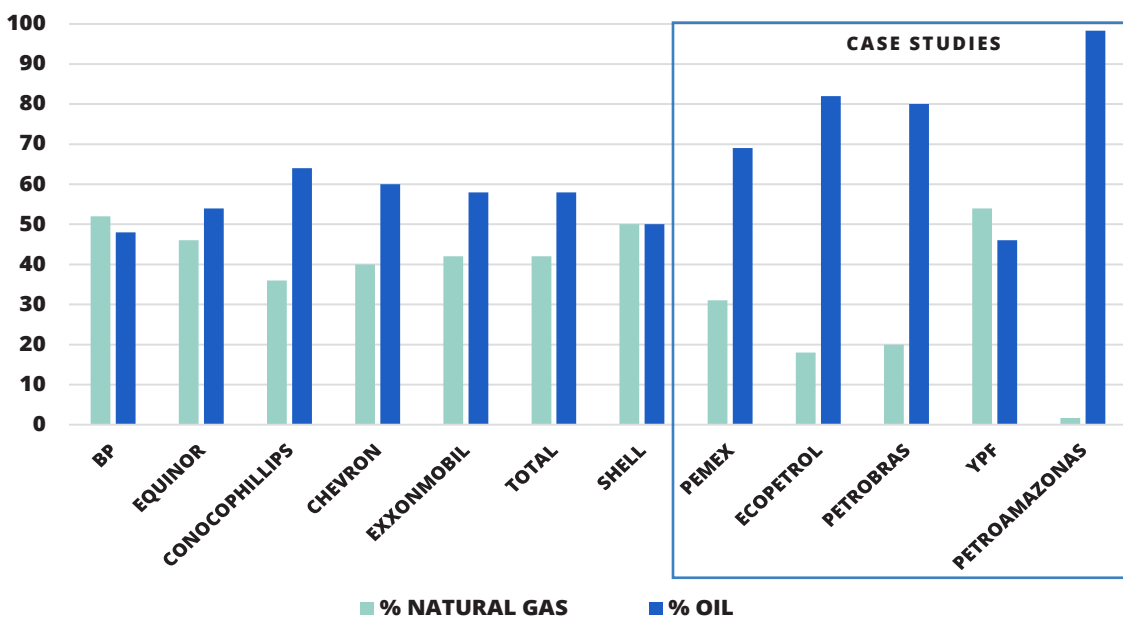


FIGURE 4: BENCHMARKING CLIMATE STRATEGIES AND OUTCOMES, LATIN AMERICAN NOCS

Sources: Petrobras Sustainability Report (2018), Pemex Sustainability Report (2018), Pemex Statistical Yearbook (2018), Ecopetrol Integrated Sustainable Management Report (2018), Ecopetrol Form F-20 (2018), YPF Sustainability Report (2018), YPF Form F-20 (2018), Petroamazonas Sustainability Report (2018), Petroamazonas Internal Documents (2018), Climate Action Tracker, UNDP NDC Support Programme

	CRUDE PRODUCTION (2018)	GAS PRODUCTION (2018)	TOTAL DIRECT EMISSIONS	EMISSIONS TARGET (COMPANY)	KEY CLIMATE STRATEGIES	UNCONDITIONAL EMISSIONS TARGET IN PARIS AGREEMENT
PETROBRAS	2.03 million b/d	2.97 billion ft ³ /d	61.7 million tons CO _{2e}	Achieve zero growth of operational emissions in 2025 compared to 2015 figures.	Reduce flaring, improve energy efficiency, reinject CO ₂ in pre-salt fields, develop pilot projects for wind and solar generation.	BRAZIL: 37% GHG emissions reduction below 2005 levels by 2025.
PEMEX	1.8 million b/d	4.85 billion ft ³ /d	36.5 million tons CO _{2e}	Reduce emissions from operations by 25% between 2017 and 2021.	Reduce flaring, improve energy efficiency, switch from fuel oil to natural gas in power plants, build new cogeneration plants.	MEXICO: 22% GHG emissions reduction compared to business-as-usual scenario by 2030.
ECOPETROL	549,000 b/d	729 million ft ³ /d	9.4 million tons CO _{2e}	Reduce emissions from operations by 20% by 2030 compared to 2010.	Reduce emissions from company operations and supply chain, contribute to national climate policy.	COLOMBIA: 20% GHG emissions reduction compared to business-as-usual scenario by 2030.
YPF	227,000 b/d	1.48 billion ft ³ /d	17.95 million tons CO _{2e}	Reduce the intensity of direct operational CO _{2e} emissions by 10% by 2030 compared to 2018.	Efficient energy management, reduce flaring and venting, electrify operations, use low-carbon energy sources.	ARGENTINA: 15% GHG emissions reduction compared to business-as-usual scenario by 2030.
PETRO-AMAZONAS	400,968 b/d	39 million ft ³ /d	Does not report direct total emissions.	Lacks an official emissions reduction target.	Reduce flaring, replace crude and diesel with natural gas in power generation, improve energy efficiency.	ECUADOR: 37.5% GHG emissions reduction in the energy sector compared to business-as-usual scenario by 2025.

Brazil's Petrobras

COMPANY OVERVIEW

Petrobras is Latin America's largest NOC in terms of oil production, with crude output of 2.03 million barrels per day (b/d) and roughly \$95 billion in sales revenue in 2018.⁸ Until 2019, Petrobras owned 98% of Brazil's refining capacity, and it continues to control the country's pipeline infrastructure.⁹ The vast majority of Petrobras' oil and natural gas production comes from Brazil, but the company also has operations in various countries around the world.¹⁰ Petrobras was partially privatized in 1997, and the government continues to own a controlling share of the company and appoints its CEO, though Brazilian and foreign investors can also purchase shares through the São Paulo and New York stock exchanges. While Brazil's large and diversified economy means oil revenue does not account for a large share of GDP, taxes, royalties, and fees from the oil and gas sector provide needed funds to the central government and are critical to some state and local governments, particularly those of Rio de Janeiro.

Founded in the 1950s to help Brazil become self-sufficient in oil production, the company under the administrations of Luiz Inácio Lula da Silva and Dilma Rousseff (2003-2016) expanded its operations beyond its core oil business to invest in fertilizers, petrochemicals, biodiesel, electric power generation, and other areas, which transformed it into a broader energy company. However, the expansion

also contributed to very high debt levels. As a result, under the previous president, Michel Temer, and now under President Jair Bolsonaro, Petrobras' leadership is undertaking a major drive to shed assets and refocus the business on the more profitable oil exploration and production segment, particularly the deepwater pre-salt fields, an oil-rich zone under a layer of salt off the southeastern coast of Brazil. Government officials have also argued publicly that Brazil should try to develop its pre-salt reserves as quickly as possible because they could become stranded assets as global oil demand eventually declines because of climate policy. For example, Décio Oddone, former director-general of the National Agency of Petroleum, Natural Gas, and Biofuels (ANP), recently argued publicly that Brazil needs to accelerate investments in oil in order to take advantage of "a great window of opportunity to enjoy oil while it still has value."¹¹

MITIGATION STRATEGY AND OUTCOMES

In its 2018 sustainability report, Petrobras outlined a concrete plan to reduce direct GHG emissions. It pledged zero growth year-to-year of its operational emissions in 2025 compared to 2015 figures (which totaled 78 million tons of CO₂ equivalent (CO₂e)).¹² Petrobras also promised in 2018 to allocate \$500 million to GHG mitigation projects between 2019 and 2023.¹³ The company's climate strategy, according to its most recent sustainability report, seeks to decrease carbon intensity in its operations to address Scope 1 emissions by reducing gas flaring, improving

FIGURE 5: ANNUAL OIL & GAS PRODUCTION AND DIRECT EMISSIONS, PETROBRAS

Sources: Petrobras Sustainability Report (2018, 2016)

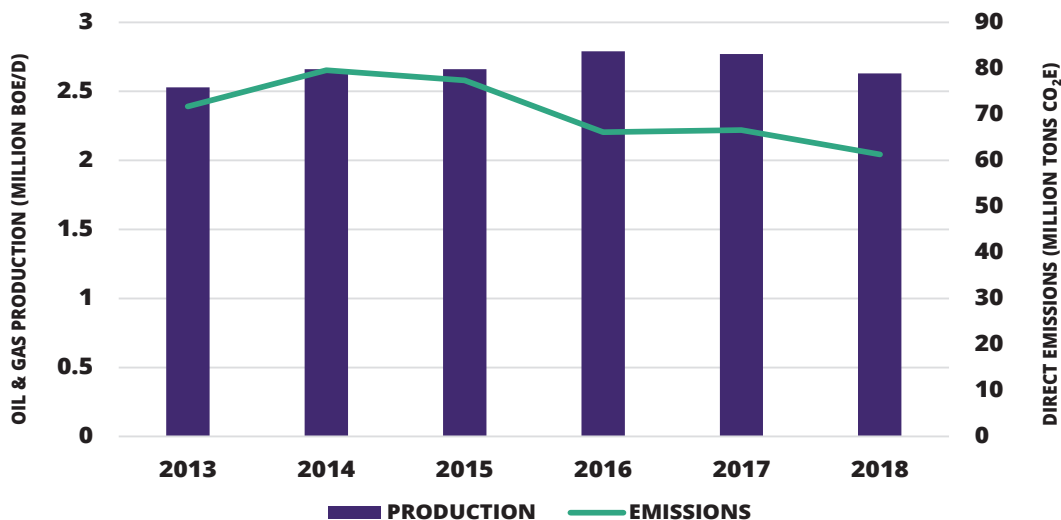
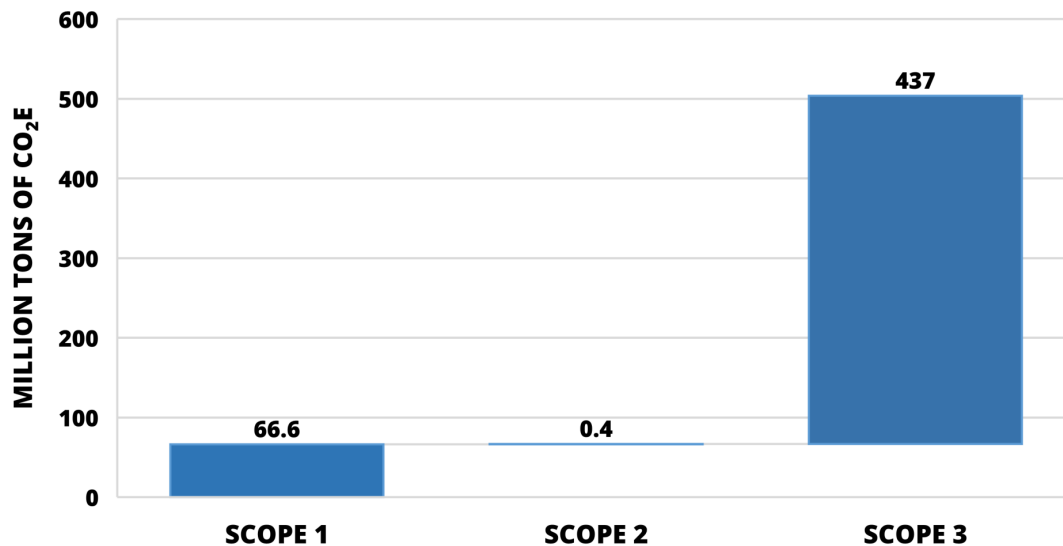


FIGURE 6: TOTAL EMISSIONS, PETROBRAS VALUE CHAIN (2018)

Source: Petrobras Climate Change Supplement (2018)



efficiency in thermoelectric plants, reinjecting CO₂ in its pre-salt fields, and developing pilot projects for renewable energy generation. Petrobras reduced its GHG emissions from 80.4 million metric tons of CO₂e in 2014 to 61.7 million metric tons in 2018 (see Figure 5).¹⁴

Petrobras has transparent and robust reporting mechanisms to track operational emissions. It uses the Atmospheric Emissions Management System to inventory emissions that are later submitted for third-party verification. As a state oil company, Petrobras' inventories are included in the public registry of the Brazilian GHG Protocol Program, a voluntary group to help stakeholders with GHG accounting and reporting, of which it is a founding member.

Increased natural gas use and a reduction in flaring have helped trim Petrobras' methane emissions. Flaring was cut by 74% between 2009 and 2015.¹⁵ As oil production grows in the pre-salt areas in the coming years, Petrobras is looking to monetize the associated gas and avoid flaring. In the refining sector, better detection methods and leak management systems improved flare gas management. In 2018, the company announced its participation in the World Bank's "Zero Routine Flaring by 2030" initiative, which it is on track to meet. Petrobras also reduced emissions from thermal power plants significantly by improving efficiency.

Re-injection of CO₂ as part of enhanced oil recovery techniques has also helped reduce GHG emissions in Petrobras operations, particularly in the pre-salt, which has high associated CO₂ content. By 2025 the company plans

to re-inject some 40 billion tons of CO₂, a significantly larger share than the three million tons reinjected between 2009-2015.¹⁶ Petrobras generates small volumes of renewable energy for its own operations. The company currently generates only 21 megawatts (MW) on average of renewable energy compared to 2,200 MW of thermal power.¹⁷ Its own power generation is equivalent to 3% of the entire country's electricity demand, so a further transition to renewables would make a significant contribution to Brazil's national emissions abatement.¹⁸ The company currently owns four wind power plants, two hydropower plants, and one solar photovoltaic (PV) plant. In addition, Petrobras is planning to implement a pilot project for the first offshore wind plant in the country. To further its activities in renewable energy technologies, Petrobras signed memoranda of understanding with France's Total and Norway's Equinor, though in November 2019 the company pulled out of its partnership with Total.¹⁹

Petrobras' climate strategy also includes investment in R&D focused on CCUS, advanced biofuels, and renewable energy. The company pledged to allocate at least 10% of its annual investment to R&D in 2018 through 2025.²⁰ Petrobras also joined the Oil and Gas Climate Initiative (OGCI), a group composed of 13 of the world's largest oil and gas companies which have committed to jointly invest at least \$1 billion in R&D for low-carbon solutions over the course of a decade. Petrobras alone will contribute \$100 million over the next 10 years. Its research center Cenpes is one of the largest centers of energy innovation in the world and the biggest in Latin America. Petrobras is the only company included in this study that

Petrobras' actions have often served political and economic objectives, at times to the detriment of climate-friendly policy.

reports its Scope 3 emissions and in 2018 these totaled 437 million tons of CO₂e, or 87% of the company's total emissions profile (see Figure 6).²¹ This ratio is similar to that of most IOCs. Petrobras has for years invested in producing a diverse range of energy sources, including low-carbon sources. Brazil is the largest biofuels exporter in the world, and Petrobras' subsidiary Petrobras Biocombustível has been a major player in selling this fuel for decades. Petrobras also announced plans to increase natural gas production as a transition fuel in the medium term while studying opportunities to expand renewable energy generation for third-party consumers in the longer term.

However, this diversification strategy has recently taken a back seat to the company's financial goals. Petrobras has begun to sell its stakes in ethanol and biodiesel production as part of its broader divestment campaign. Beyond biofuels, Petrobras has made only feeble efforts to reduce its Scope 3 emissions. It does not have investments in renewable energy other than self-generation and says it will not invest in more renewables in the short term. In late January 2020, the company announced it would begin the process of divesting its stakes in two wind farms, stating that the decision better aligned with its goals to improve capital allocation.²²

CHALLENGES AND OPPORTUNITIES FOR CLIMATE ACTION

Petrobras' dual role as Brazil's largest oil company and a majority state-owned enterprise has clearly impacted the development of its climate change strategy. Petrobras' largest shareholder, the Brazilian government, has been faced with the need for a delicate balance between addressing domestic political and economic concerns and enacting climate change mitigation, which has led to inconsistency in its climate strategy. Under former presidents Lula and Rousseff, Petrobras'

actions often served political and economic objectives, at times to the detriment of climate-friendly policy. For example, the company began to freeze fuel prices rather than aligning them with international oil prices, which were on the rise. This policy was intended to contain inflation and avoid a backlash from consumers. However, subsidizing gasoline below market prices encouraged drivers to switch away from lower-carbon ethanol and encouraged demand, which was counterproductive to climate change mitigation. Petrobras assumed the high costs of the subsidies, which contributed to its massive debts.

The current government has overhauled Petrobras' business strategy to implement a more market-oriented approach. The government is now prioritizing cost-cutting to shore up the company's finances. This strategy has led Petrobras to sell stakes and postpone investments in non-oil areas like biofuels and renewables, undermining efforts to reduce its Scope 3 emissions. CEO Roberto Castello Branco at a recent meeting at the Fundação Getúlio Vargas said, "Petrobras does not intend to invest in renewable energy in the short term. The company believes that its expertise and advantages are in the exploration and production of oil in deep and ultradeep waters, and that it does not yet have the necessary ability to compete in the field of renewables."²³ Like other Petrobras CEOs before him, Castello Branco was appointed by the president in order to carry out his administration's vision for reforming the company's strategy.

In addition, President Bolsonaro has not expressed support for fighting climate change and has threatened to pull out of the Paris Agreement, a position that critics say sends a signal that climate change mitigation should not be a priority for Petrobras. This is a stark change from the Lula administration, which established a national climate change policy and created a fund to finance conservation, scientific R&D, and sustainable development projects in the Brazilian Amazon.²⁴ The shift in Brasília's position on climate change undermines the company's ability to make a consistent commitment to an emissions abatement strategy.

To date, there has been no significant pressure from private investors or the broader public for Petrobras to implement a more ambitious climate strategy. However, regulations have helped counter this political influence and led Petrobras to curb emissions and enact more consistent climate policy. For example, in 2016, the Ministry of Mines and Energy introduced the RenovaBio program, which set annual carbon intensity reduction targets for the next 10

years to help meet Brazil's climate commitments. The regulation increases the biodiesel-diesel blend to be sold at gas stations nationwide by 1% each year until 15% is reached in 2023. In addition, the oil sector regulator ANP has set strict rules to limit flaring by defining the acceptable methane burn and loss volumes, which holds the NOC accountable to track and manage flare volumes.²⁵

Regardless of the government in power, Petrobras has generally prioritized emissions abatement measures that also bring economic benefits for the company, according to several independent experts interviewed for this report. Looking ahead, as the current administration seeks to cut costs further amid the oil price collapse, climate change mitigation activities that do not bring economic benefits or are viewed as too costly appear unlikely to be implemented.

the country's refining capacity. A major energy reform in 2013 opened Mexico's oil sector to private competition, allowing new companies to engage in exploration and production as well as fuel distribution. Yet Pemex is expected to remain at the center of Mexico's oil industry for many years to come. One hundred percent owned and controlled by the government since its founding in 1938, the company has long been an iconic symbol of national pride and sovereignty.

In recent years, however, Pemex has faced a steep decline in oil production and rising debt. Crude production fell from over 3.4 million b/d in 2004 to 1.8 million b/d in 2018.²⁶ At the same time, the government remains heavily reliant on tax and royalty payments from Pemex. In 2019, Pemex taxes funded 20% of the national budget²⁷ and over the last 20 years, 95% of the pretax profits from the company went to the state.²⁸ Because the government relies on these transfers, Pemex has been discouraged from retaining earnings. Due to its heavy tax burden and dwindling oil production, Pemex recently surpassed Petrobras as the world's most indebted oil company.²⁹

Mexico's Pemex

COMPANY OVERVIEW

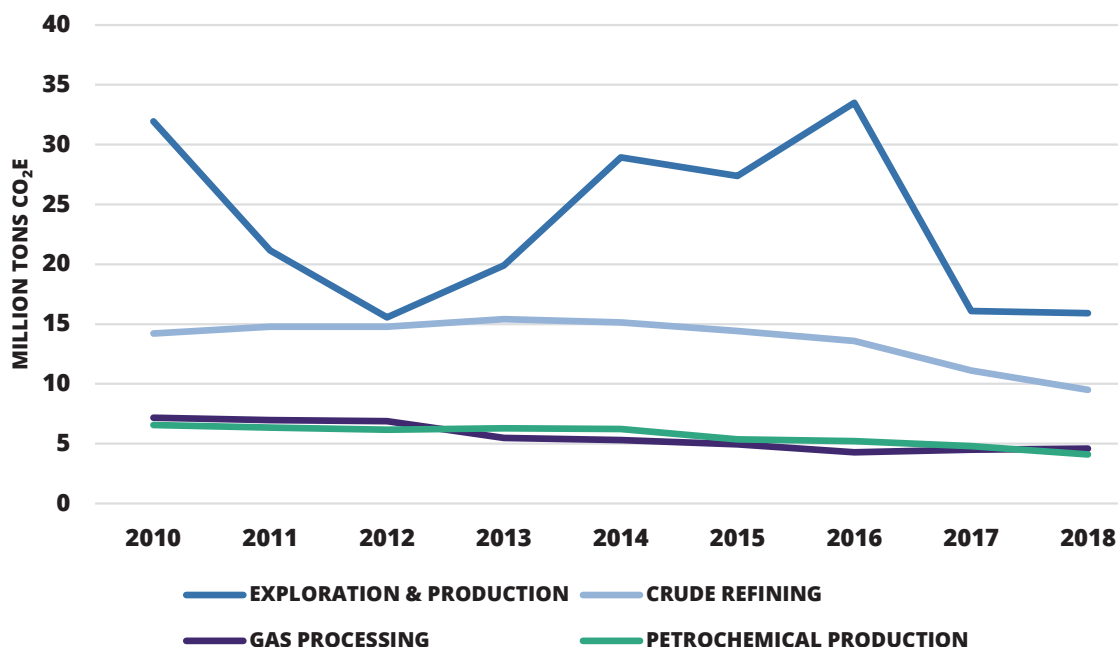
Pemex is the largest company in Mexico and operates in every aspect of the oil and gas value chain. It is by far the largest producer of crude oil and natural gas in Mexico and holds the majority of the country's reserves. Pemex also controls a large share of Mexico's oil and gas transport infrastructure and retail fuel stations and manages all of

MITIGATION STRATEGY AND OUTCOMES

As the dominant player in Mexico's oil industry, Pemex generates the largest volume of emissions of any oil company in the country, and its ability to address climate

FIGURE 7: DIRECT EMISSIONS FROM MAIN PROCESSES, PEMEX

Sources: Pemex Sustainability Report (2018, 2017, 2016, 2015, 2014, 2013)



change therefore has a major impact on GHG emissions from Mexico's oil sector (Pemex accounted for 11% of Mexico's total emissions in 2015, for example).³⁰ The company is aiming to further reduce emissions from its operations by 25% between 2017 and 2021.³¹ Pemex has sought to cut its Scope 1 emissions by reducing flaring, improving energy efficiency, switching from fuel oil to natural gas in its power plants, and building new cogeneration plants for its operations. After trending upward since 2012, emissions from exploration and production declined markedly between 2016 and 2018 thanks to a sharp decrease in flaring. Downstream emissions (from crude refining plus gas processing) saw some improvements between 2010 and 2018. Emissions from refining declined by 33% while emissions from gas processing fell 35% over the period (see Figure 7). Meanwhile, the company has not begun to address its Scope 3 emissions by transitioning toward a portfolio of low-carbon sources.

Pemex has strong transparency and accounting mechanisms for emissions reporting. The company uses the tool SISPA (by its acronym in Spanish) to calculate its direct GHG emissions. This system uses a robust set of criteria to track emissions, such as standards set by the US Environmental Protection Agency and the Intergovernmental Panel on Climate Change. The data must be submitted to the Ministry of Environment and Natural Resources and

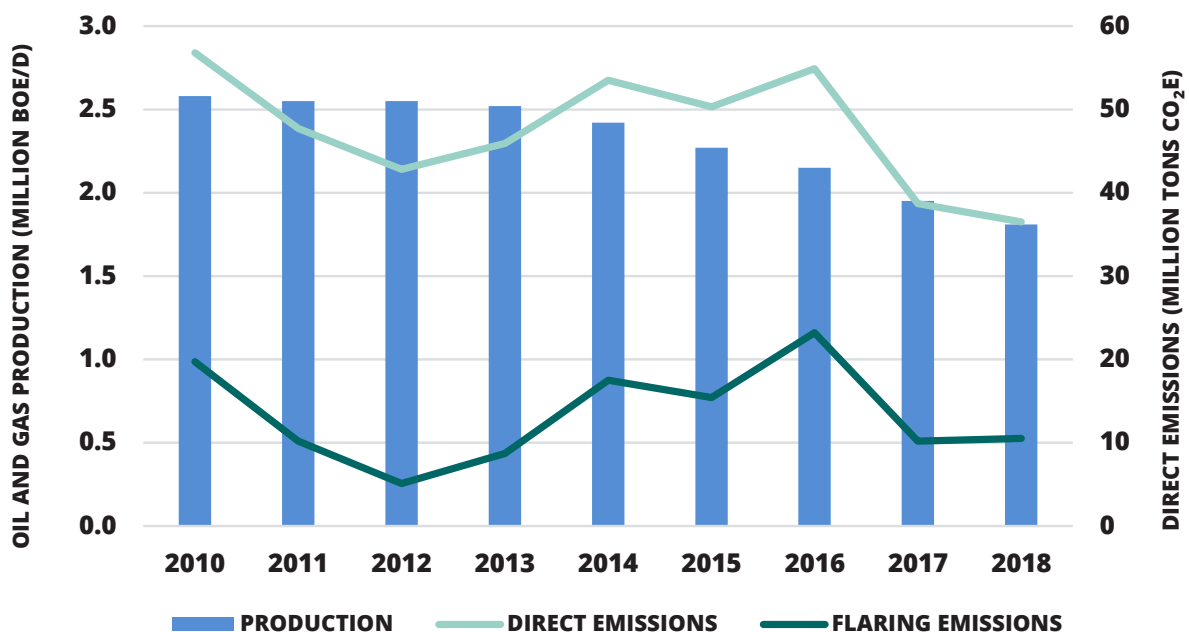
verified by an accredited third party. This has allowed for reliable, accurate, and publicly available emissions data. Gas flaring, mainly at offshore facilities in the Gulf of Mexico, remains a major source of Pemex's emissions, despite significant decreases between 2016 and 2018. As a result, almost half of its emissions come from the exploration and production segment. Under the administration of Enrique Peña Nieto, Mexico, along with the United States and Canada, agreed to reduce methane emissions in the oil and gas sector by 40-45% by 2025.³² Pemex is also part of the World Bank's "Zero Routine Flaring by 2030" initiative and has pledged funds for low-carbon research as a member of OGCI. Flaring was cut in half between 2016 and 2017 and declined further in 2018 (see Figure 8).³³ This reduction was owed largely to the expansion of pipeline capacity in shallow water operations.

Pemex also began switching from residual fuel oil to natural gas, primarily in its 330,000 b/d³⁴ Salina Cruz Refinery, under its 2017-2021 Business Plan. Natural gas, which generates about 30% less carbon emissions than coal when burned and is much cheaper than fuel oil, will be used to power equipment such as boilers and heaters.

Over the past five years, Pemex has taken steps to reduce its electricity consumption. In 2014, the company began to employ energy management systems (EMS) in its gas processing centers and some of its storage and

FIGURE 8: ANNUAL OIL & GAS PRODUCTION, DIRECT EMISSIONS, AND FLARING EMISSIONS, PEMEX

Sources: Pemex Statistical Yearbook (2018), Pemex Sustainability Report (2018)



distribution terminals. After various pilot projects in 2015 and 2016, in 2017 an EMS was implemented in Pemex's Cadereyta refinery. Additionally, Pemex has reduced power consumption by operating a cogeneration project in its Salamanca Refinery. Cogeneration optimizes energy supply by simultaneously generating heat and power through an integrated system. Rather than wasting the excess heat created during fuel combustion, it is captured and used for other purposes.

Pemex also invests in R&D, principally in CCUS projects. The company participates in a working group created under the Secretariat of Energy's CCUS Technology Roadmap. Pemex has begun to evaluate a project that would take the CO₂ generated in its ammonia production plants and inject it into the Brillante oil field. In 2017, the NOC received funds from the World Bank to put in motion the first phase of the pilot, which is expected to reduce venting and increase the recovery factor at the field. While Pemex does use photovoltaic solar modules and battery banks in some of its offshore installations, the company does not use renewable energy sources at any of its main operations. Perhaps more importantly, it has not developed a strategy to diversify its portfolio to produce lower emission products for its customers. Nor does the company report its indirect emissions related to consumption.

CHALLENGES AND OPPORTUNITIES FOR CLIMATE ACTION

While the strategies mentioned above represent significant efforts to reduce emissions, bolder action on climate mitigation has been in some ways stymied by Pemex's critical role in Mexico's economy. When competing objectives, such as boosting energy independence, do not align with climate change mitigation strategies, the former tend to take priority, according to several experts interviewed for this study. Nevertheless, some gains have been made. To the extent that Pemex has reduced its emissions, the main drivers have been economic gains, political pressure, and regulations.

Because the public budget is heavily dependent on oil revenues, the government has pushed Pemex to focus on reversing its declining oil production rather than transitioning away from oil. With a mandate to ensure oil and gas supplies for the population, create employment, and generate funds for the government, Pemex cannot generally justify investing in climate change mitigation strategies that would reduce its returns.³⁵ Indeed, Pemex has generally prioritized Scope 1 emissions abatement

While Pemex has made significant efforts to reduce emissions, bolder action on climate mitigation has been in some ways stymied by the company's critical role in Mexico's economy.

measures that are also economically beneficial, such as switching fuel oil to cheaper natural gas or reducing energy consumption through efficiency. Oil production generates greater returns than production of natural gas and renewable energy, deterring Pemex from cutting its Scope 3 emissions. In addition, climate change mitigation projects that require additional investments compete for any extra funds with social projects meant to improve community relations.

As the state's oil company, Pemex's strategy is also heavily influenced by the administration in power at any given time.³⁶ Pemex's board includes several members of the federal government, including the finance minister. In addition, all Pemex projects must be approved by the Finance Ministry, and investments that are not profitable will likely not be approved. The president has the power to appoint the CEO of Pemex, and each new administration selects a new CEO, giving the president enormous control over the company. Former President Felipe Calderón championed climate change mitigation and signed a sweeping climate law to cut GHG emissions by 30% by 2020. This signaled to Pemex that it should invest in emissions reduction strategies, according to experts. Pemex's emissions did decline in the latter half of Calderón's term between 2010 and 2012. In contrast, the current administration has sought to incentivize the use of fossil fuels to boost energy security and economic development. For example, with the goal of reducing dependence on fuel imports from the United States and creating jobs in his home state of Tabasco, current President Andrés Manuel López Obrador has directed Pemex to build a new \$8 billion refinery, which will divert funds from other potential areas of investment. López Obrador argued that "there is no justification for not having built a new refinery in 40 years" and that the project "will generate jobs that are needed in Tabasco...more than

20,000 workers will be employed in the construction stage alone."³⁷

As the government is its sole shareholder, Pemex is also insulated from outside, third-party pressure to engage in climate action. Meanwhile, there has been no real pressure from the general public to improve Pemex's climate mitigation strategy.³⁸

While economic and political pressures can either encourage or deter Pemex from pursuing a more ambitious climate change mitigation strategy, regulations have proven to be an effective incentive to curb the company's emissions. Compliance with laws and regulations is a top priority in Pemex's budget allocation process.³⁹ As a result, Pemex executives can justify allocating resources for compliance with laws and regulations, even over activities that are more profitable or urgent. For example, in 2018 Mexico introduced new methane regulations that are expected to reduce oil industry emissions in the country by 75% by 2025.⁴⁰ The regulations increase equipment standards, which means Pemex will need to update its equipment in order to comply. Requirements include leak detection and repair, use of vapor recovery systems and reduced emission completions, and retrofitting compressor stations.

Pemex's climate change strategy is motivated by a variety of factors. Whether driven by internal operational and economic improvements (such as increasing efficiency) or external pressures (in the form of regulations and policy), the company has made advances in reducing emissions. Yet its weak financial position and the current government's emphasis on fossil fuel production over clean energy expansion would appear to imperil further progress.

Colombia's Ecopetrol

COMPANY OVERVIEW

Ecopetrol is Colombia's largest company and one of the region's top NOCs. In 2018, Ecopetrol generated approximately \$29 billion in revenue⁴¹—equivalent to roughly 8% of Colombia's GDP.⁴² That year, Ecopetrol produced 549,000 barrels of crude oil per day—this is equivalent to 70% of Colombia's total output. The company also produces small quantities of oil abroad.

Ecopetrol is active in every aspect of the oil and gas industry—from exploration and production to transport and refining. It owns most of Colombia's oil pipeline

FIGURE 9: ANNUAL OIL & GAS PRODUCTION AND DIRECT EMISSIONS, ECOPETROL

Source: Ecopetrol Integrated Sustainable Management Report (2018, 2017)

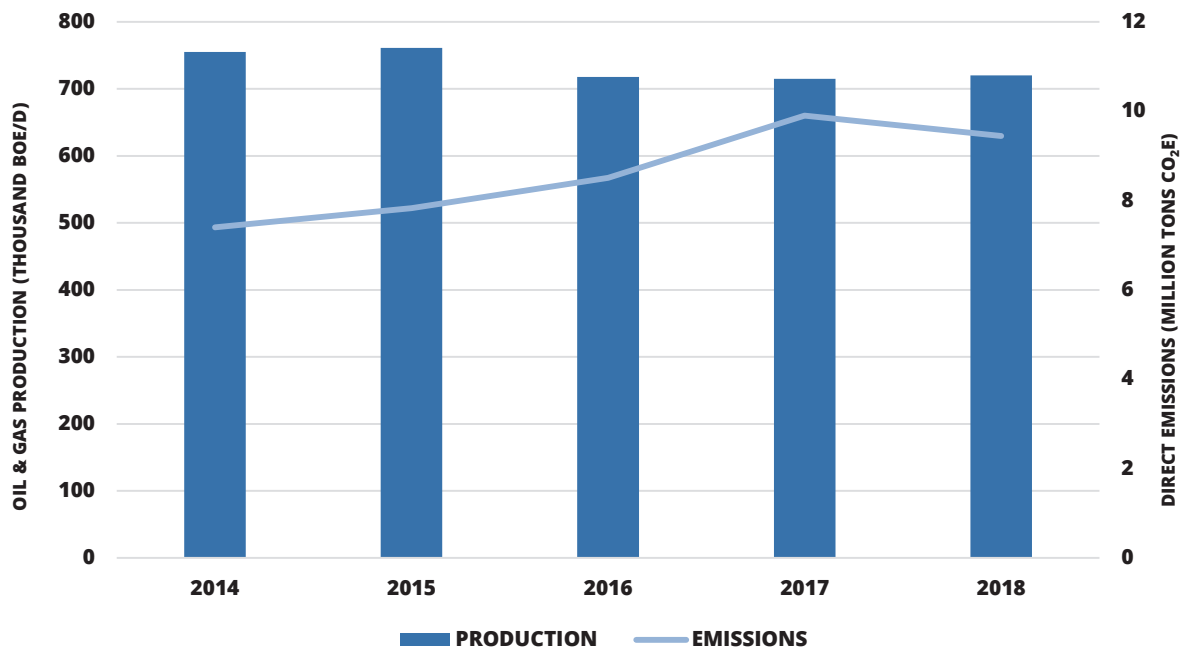
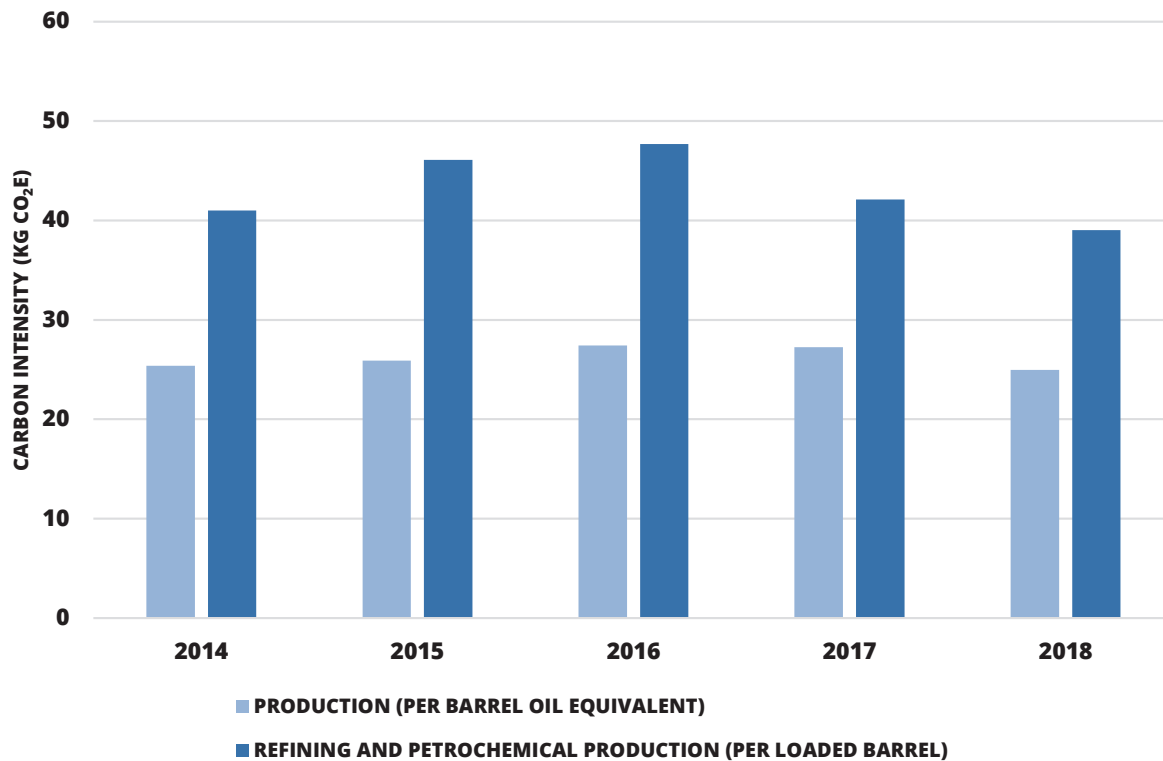


FIGURE 10: CARBON INTENSITY BY OIL VALUE CHAIN SECTOR, ECOPETROL

Source: Ecopetrol Sustainability Report (2018)



infrastructure and controls all of its refineries. The national government is by far its largest shareholder with an 88.49% ownership stake, and the company floats the remaining shares on the Bogotá and New York stock exchanges.

In recent years, Ecopetrol has struggled to replace reserves as new discoveries in Colombia have dwindled, prompting the company to acquire more oil assets abroad and advocate in Colombia for the development of the country's untapped shale oil and gas potential. Colombia's natural gas production is currently insufficient to meet demand, requiring the country to import liquefied natural gas (LNG). In 2018, gas demand outpaced production, 63% of which came from Ecopetrol.⁴³ However, estimates suggest that Colombia holds sizable natural gas resources in unconventional plays and offshore areas, which Ecopetrol hopes to develop alongside private companies.

MITIGATION STRATEGY AND OUTCOMES

As state oil company, Ecopetrol "participates in the construction of climate change policy set by the national government," according to its sustainability report, and in many ways the company sets a standard for practices in the industry. Ecopetrol is seeking to reduce emissions

from its operations by 20% by 2030 compared to 2010,⁴⁴ mirroring the country's Nationally Determined Contribution under the Paris Agreement, which commits to reducing the country's overall emissions by 20% over the same period.⁴⁵ As Ecopetrol's direct emissions make up 4.8% of Colombia's total emissions, the company's contribution to cutting emissions is critical for the country to meet its climate goal. In 2018, it reduced or offset 1.2 million tons of CO₂e compared to a business-as-usual scenario through mitigation strategies and carbon offset programs.⁴⁶ However, the company's total annual GHG emissions—both Scope 1 and Scope 2—have been trending upward since at least 2014, though they did decline slightly between 2017 and 2018. Emissions increased even while the company's total crude oil and natural gas production declined from 761,000 barrels of oil equivalent per day (boe/d) in 2015 to 720,000 boe/d in 2018 (see Figure 9). This was due to new acquisitions of non-producing assets, which increased emissions but did not lead to a rise in output. Ecopetrol's carbon intensity in production did not improve significantly over the period (see Figure 10). Its carbon intensity (24.96 kg CO₂/boe) is roughly average by global standards according to the company, as it produces a mix of lower emissions light oil and heavy crudes, which require more electricity to produce.

As a state-controlled company, Ecopetrol's activities are aligned with the national government. In some cases, it has been at the forefront of helping construct public policy.

In 2009, the company developed its emissions inventory to establish a baseline of total emissions. In 2010, Ecopetrol launched its current climate change strategy, which includes monitoring and reporting on GHG emissions, reducing emissions from company operations and its supply chain, engaging in research and development, and contributing to national climate policy.

In the refining sector, which accounted for 55% of emissions in the inventory baseline,⁴⁷ Ecopetrol has improved energy efficiency. At the Barrancabermeja refinery, Ecopetrol implemented an energy efficiency program which included the deployment of new equipment to produce steam and energy for consumption in the refinery.

Ecopetrol has made strides in reducing upstream emissions, which accounted for 43% of emissions in the inventory baseline,⁴⁸ via a variety of technological improvements. The company, along with its partner Occidental Andina, installed decarbonator towers in La Cira-Infantas, which is one of its oldest fields. Decarbonators are designed to strip and remove CO₂ and hydrogen sulfide from water, and the implementation of this technology will reduce Ecopetrol's carbon footprint by almost 500,000 tons per year, or roughly 5% compared to 2018 figures.⁴⁹

Ecopetrol's mitigation strategy also involves reducing natural gas venting, flaring, and leakage. Gas flaring represents a very small share of Ecopetrol's emissions, but venting and fugitive emissions remain a more significant source.⁵⁰ The company has developed a work plan to reduce gas flaring and venting and has already carried out projects to reduce methane leaks from its equipment. In January 2020, Ecopetrol signed on to the World Bank's "zero routine flaring by 2030" initiative and in the shorter

term will aim to reduce flaring by 8 million tons of CO₂ by 2021.⁵¹ The company also joined the Climate and Clean Air Coalition, a United Nations-led initiative designed to reduce methane emissions. As part of this agreement, it committed to reporting and implementing technology to mitigate methane emissions. Ecopetrol has started to use satellite and flyover technologies to more accurately calculate methane emissions.

Ecopetrol has also introduced renewables into its operations and aims to generate more of its power from renewable sources in the coming years. In October 2019, the company inaugurated the \$20 million Castilla solar farm to generate power for its second largest oil field under a 15-year power purchase agreement.⁵² Ecopetrol also recently announced it will develop a second 50-MW solar park in the department of Meta, which will be owned by the company's hydrocarbon transport subsidiary Cenit. Expected to be fully operational later this year, the plant will supplement part of the power demand for two pumping stations as well as various oil fields.⁵³ Since Ecopetrol generates 65% of its own electricity, investments in renewable technologies make a sizable impact on the reduction of its emissions associated with electricity generation.⁵⁴

To transition its portfolio toward lower-emissions products, Ecopetrol has been active in the production of biofuels. The company has a 50% stake in biofuels producer Ecodiesel. It blends 2% biodiesel in its Barrancabermeja refinery and 4% in its Cartagena refinery. Beyond biofuels, however, Ecopetrol has not significantly diversified its portfolio into low-carbon energy sources. It does not generate any renewable energy for direct consumption outside of its own operations. Its oil-to-natural gas ratio has remained roughly constant over the last five years at about 80% crude oil to 20% natural gas, indicating that it has focused more on acquiring oil-producing assets than on natural gas-producing assets.

However, Ecopetrol does have plans to transition its portfolio to cleaner energy sources and reduce its Scope 3 emissions. Though currently in the initial strategic planning phase, Ecopetrol plans eventually to generate renewable energy connected to the national grid for third-party consumption. The company has the potential to expand its renewable energy portfolio from installed capacity of 64 MW to more than 300 MW and is evaluating the potential of geothermal, hydrogen, and small hydroelectric projects.⁵⁵ It also expects to increase the share of natural gas relative to crude oil in its portfolio. In the short term, the company will also begin quantifying Scope 3 emissions.⁵⁶

CHALLENGES AND OPPORTUNITIES FOR CLIMATE ACTION

Ecopetrol's climate change mitigation strategy is driven by a variety of factors. The national government's climate agenda is perhaps the main driver. Among Latin American countries, Colombia has been a leader in climate talks and the governments of Juan Manuel Santos and Iván Duque have established fairly ambitious overall climate goals while projecting their country as an environmental leader on the global stage. For example, in the lead-up to the United Nations climate talks in December 2019, President Duque played a leading role in coordinating regional agreements to preserve and reforest the Amazon and increase the share of renewable energy in Latin America's energy matrix to 70% by 2030.⁵⁷ As a state-owned company, Ecopetrol's activities are aligned with policies of the national government. In some cases the company has been at the forefront of helping to construct public policy. For example, Ecopetrol worked with the Ministry of Environment and Sustainable Development to help design policies that promote low-carbon development for the oil and gas sector.⁵⁸ It has also helped develop climate change mitigation strategies at a municipal level.⁵⁹

One former Ecopetrol executive also said in an interview for this study that the company sees its climate strategy as a matter of survival in a world where oil consumption should be curtailed to combat climate change. Although public opinion has not focused on Ecopetrol's contribution to climate change, company representatives said in interviews that private investors are evaluating climate-related criteria.

Ecopetrol's strategy is also tied to the country's goals of self-sufficiency and energy security, which could motivate it to produce lower-carbon energy sources. For example, Colombia hopes to diversify its energy matrix by developing wind and solar resources in order to reduce its heavy reliance on hydroelectric dams for power generation. The government is also looking to develop the country's natural gas reserves to diversify Colombia's electricity sources and reduce reliance on imports. These objectives motivate Ecopetrol to invest in increasing its natural gas production and eventually in renewable energy generation. However, Ecopetrol must also ensure its long-term financial sustainability and returns for its main shareholder, the government. The company's financial position deteriorated amid the sharp decline in global oil prices in 2014, and in recent years its leadership has imposed stricter fiscal discipline. Company representatives noted in interviews that this likely explains Ecopetrol's decision to prioritize emissions reduction projects that are most cost-effective.

The recent oil price decline could put pressure on the company to cut costly expenditures such as satellite imaging of flaring. Whether Ecopetrol can significantly boost its investment in renewables while still providing needed revenues for the government remains to be seen.

Ecopetrol's strategy is tied to the country's goals of self-sufficiency and energy security, which could motivate it to produce lower-carbon energy sources.

Argentina's YPF

COMPANY OVERVIEW

YPF is an integrated energy company involved in all aspects of the value chain. Despite declining production, YPF remains the largest oil company in Argentina's oil and gas sector and in 2018 the company's crude output of roughly 227,000 b/d⁶⁰ made up 45% of Argentina's total production.⁶¹ The company holds vast acreage in Argentina—93,000 square kilometers total, and roughly 40% (or 12,000 square kilometers) of Vaca Muerta's total acreage.⁶² In the downstream sector, YPF holds half of Argentina's refining capacity and controls 58% of the retail gasoline and diesel market.⁶³ With investments amounting to 95.4 billion pesos (roughly \$3.5 billion),⁶⁴ YPF's revenue generation is important for the broader economy. YPF also operates outside of the oil and gas sphere—the company has several activities beyond its core business, including biofuels, electric power generation, fertilizers, and petrochemicals.

Although YPF, created in 1922, was the first national oil company in the world outside of the Soviet Union, it was later privatized and purchased by Spanish company Repsol SA in 1993. Almost 20 years later, YPF was nationalized again under the Cristina Fernández de Kirchner administration with overwhelming bicameral support.⁶⁵ The administration argued that Repsol had failed to increase oil and gas output to reduce the country's dependence on imports. During the Fernández de Kirchner years (2007-2015), oil and gas consumption rose while domestic production declined, leading Argentina to become a net

YPF may be forced to eliminate or delay costly emissions reduction projects and prioritize its core business of oil and gas production.

hydrocarbons importer for the first time since 1984.⁶⁶ Though Argentina remains a net importer, thanks to the recent exploitation of the giant Vaca Muerta shale play, 2019 marked the first time in nearly 10 years that exports of natural gas grew.⁶⁷ Today the government retains a 51% share of YPF and floats the remaining 49% on the New York and Buenos Aires stock exchanges.

MITIGATION STRATEGY AND OUTCOMES

YPF has a detailed climate plan to reduce GHG emissions, both direct and indirect, from a variety of sources. The company's overall emissions target is to reduce the intensity of direct operational CO₂e emissions by 10% by 2023. Activities to achieve this goal include more efficient

energy management, reduction of flaring and venting, electrification of operations, and use of low-carbon energy sources.⁶⁸ YPF has started introducing internal carbon pricing in the selection of projects.⁶⁹ YPF's emissions intensity has held nearly level since 2015, although it increased between 2017 and 2018 due to new thermal power plants coming online.⁷⁰ However, the company has not made progress in reducing total direct GHG emissions, which rose from 15.48 million tons of CO₂e in 2015 to 17.95 million tons of CO₂e in 2018 (see Figure 11).⁷¹

YPF has a robust reporting system to track and classify its Scope 1 emissions, although it does not report Scope 3 emissions. Main facilities are subject to annual monitoring and all emissions are verified by a third party. In 2018, YPF's sustainability practices were assessed by RobecoSAM, an international investment firm, to score environment, social and governance (ESG) methodologies and bolster its report on climate action. The company is also looking to improve its financial disclosures of climate-related risks.⁷²

YPF's mitigation strategy includes reducing natural gas venting, flaring, and leakage. Agreements such as the United Nations Development Programme's Clean Development Mechanism have provided an effective incentive to avoid flaring. Projects under this agreement include the capture and use of residual gas to heat

FIGURE 11: ANNUAL OIL & GAS PRODUCTION AND DIRECT EMISSIONS, YPF

Sources: YPF Sustainability Report (2018, 2017, 2015), YPF Form 20-F (2018, 2016, 2015, 2013)

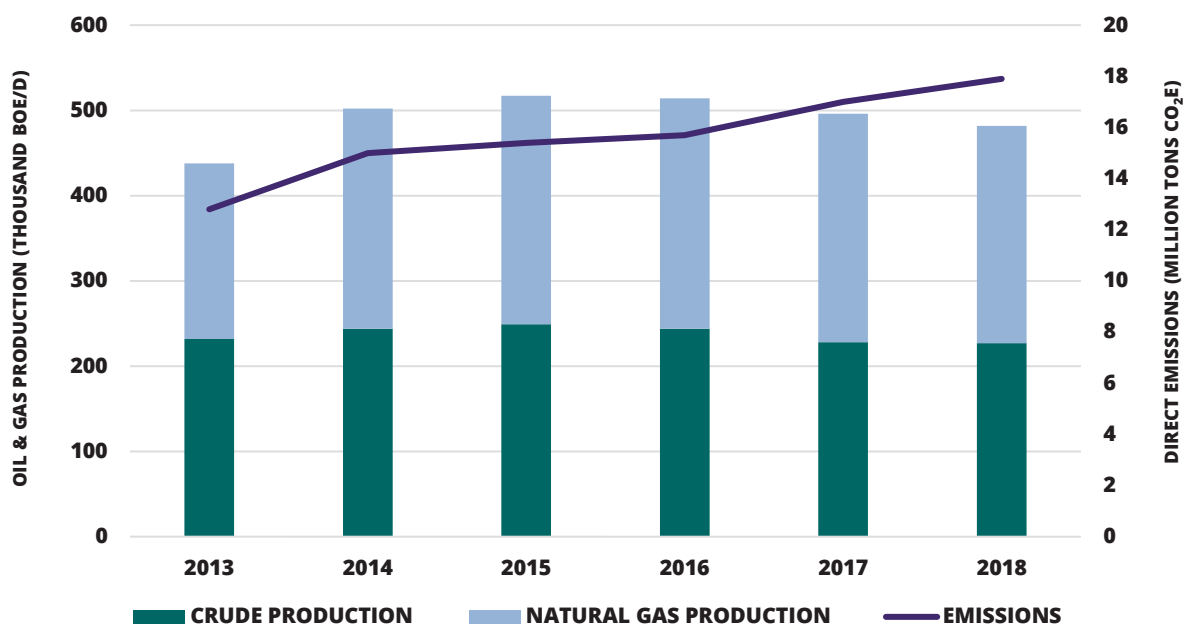
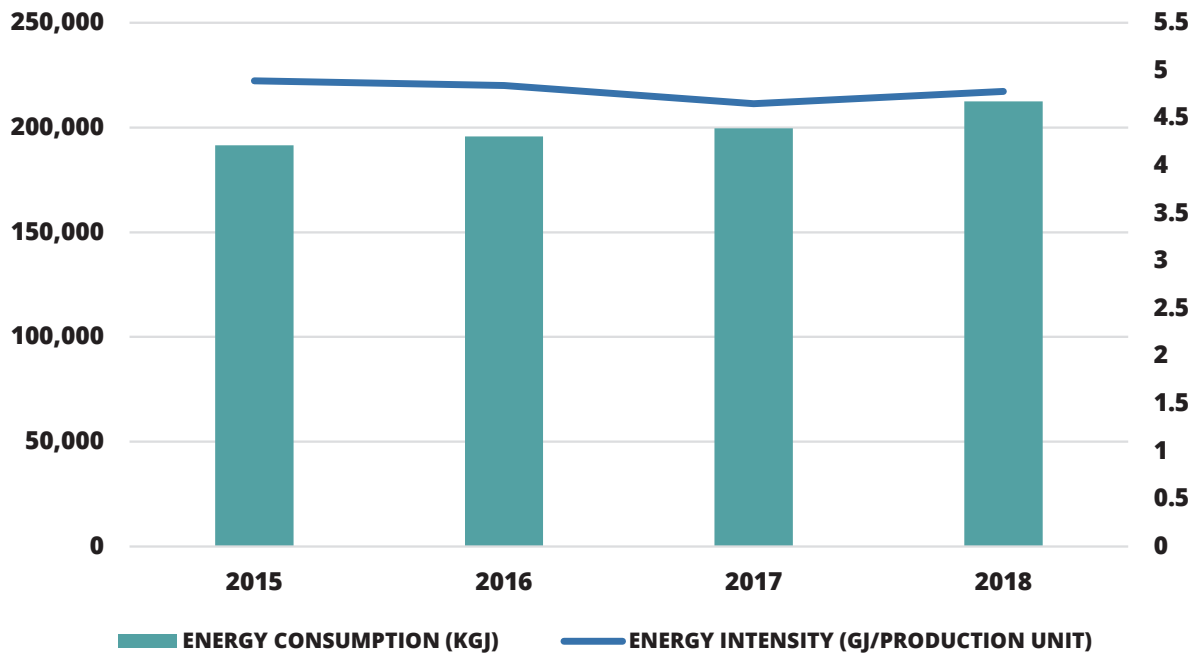


FIGURE 12: ANNUAL ENERGY CONSUMPTION AND INTENSITY, YPF

Source: YPF Sustainability Report (2018)



furnaces and boilers, resulting in a reduction of 173,000 tons of CO₂ in two of YPF's industrial complexes. YPF also captures vented gas at the wellhead to produce LNG, allowing an estimated 5.3 million cubic feet of gas to be used daily.⁷³ The company established a program to detect methane leaks through satellites, flyovers, and drones. YPF reduced flaring by about 5% between 2015 and 2018 and cut venting by 11% over the period. In aging fields, YPF injects gas as well as CO₂ for enhanced oil recovery.

With a goal of reducing energy consumption intensity by 10% by 2023, YPF created an energy efficiency committee composed of seven specialists from its various business lines, including upstream, gas and energy, and downstream. In the upstream, YPF carried out more than 40 projects in 2018 to reduce energy consumption by implementing projects that centered on water injection, heating, fuel gas networks, fugitive emissions, and lighting replacement. These projects resulted in a reduction of 4 MW of electricity. In the downstream, improvements in energy consumption were made at refineries and overall the sector saw a reduction in total energy consumption of 959,203 gigajoules (GJ). Despite sectoral improvements however, the total intensity of energy consumed increased from 2017 to 2018, mostly due to the start-up of new thermal power plants and a cogeneration plant (see Figure 12). A 3% increase in downstream energy intensity due

to scheduled shutdowns also slightly increased overall energy intensity.

YPF introduced renewables into its operations with the 2013 launch of YPF Energía Eléctrica SA, now known as YPF LUZ, an electric utility owned by the group. YPF Luz aims to expand installed capacity from 1,819 MW to 5,000 MW over the next five years, based mostly on adding efficient thermal generation.⁷⁴ In 2018, only 5% of the company's generation was renewable (compared to 95% thermal), but of the projects under construction, 54% of installed capacity will come from thermal and 46% from renewable sources. The company also aims to have 20% of its own generation come from renewables by 2023, which appears likely given its progress. Currently the company meets 17% of its energy demand from the grid from wind technologies, well above the government target of 12% participation of renewable energy sources in the country's total power matrix. YPF's Manantiales Behr wind farm, located on a mature oil field, has one of the highest energy yields and capacity factors in the world.⁷⁵

YPF's climate strategy includes investments in R&D through its company Y-Tec, the largest applied research institute in Argentina and a qualified consultant for Argentina's renewable energy auction program RenovAr. In 2018, YPF-Tec's New Energies program was launched

Of the NOCs included in this study, YPF has made among the most progress in offering low-carbon alternatives for consumers.

with the aim, according to YPF, of helping the company transition from an oil and gas company to an “energy company” more broadly. While YPF is not a member of OGCI, its climate strategy is aligned with the guiding principles of the group. Like OGCI members, the company invests in research to find low-carbon alternatives, including projects to advance studies on hydrogen, ion-lithium cells, biogas, sustainable fertilizers, CO₂ capture, and more.

In addition to emissions reduction projects, YPF engages in carbon offset programs such as its reforestation efforts in the Neuquén province, which will allow for the capture of 760,000 tons of carbon over the course of 30 years.⁷⁶

Of the NOCs included in this study, YPF has made among the most progress in offering low-carbon alternatives for consumers. In compliance with Argentine regulations, YPF maintains a 10% biodiesel blend in diesel fuels and 12% bioethanol blend in gasoline, investing \$900 million per year in these efforts.⁷⁷ YPF also claims to promote natural gas consumption as a bridge fuel. YPF LUZ, which is positioning itself to be the third-largest electric generator in Argentina by 2023, also generates renewable energy for third-party consumption. The company has a target of generating 20% of its electricity from renewable energy sources by 2023. It will provide Toyota with renewable energy to meet 100% of its electricity demand in Argentina for the next 10 years, as well as Coca Cola FEMSA for 15 years, through the Los Teros Wind Farm.⁷⁸ The 174-MW farm is still under construction but is expected to save 5.5 million tons of CO₂ emissions over 20 years once in operation. The Cañadón León wind farm, awarded to YPF LUZ through the competitive RenovAr auctions, is another project under construction and will operate under a 20-year PPA scheme with CAMMESA, the national power system operator.⁷⁹ Beyond wind, YPF Ventures, a corporate venture capital fund, invests in electric mobility through Bird

Technologies and has plans to start providing services directly to end-users by supporting the use of solar energy.

CHALLENGES AND OPPORTUNITIES FOR CLIMATE ACTION

YPF’s climate change mitigation strategy is driven by a variety of factors. Argentina’s role as host of the G20 World Summit in 2018 under President Mauricio Macri was one major driver. YPF’s chairman served as chair of the Energy, Resource Efficiency and Sustainability Taskforce of the B20 (the G20’s business group), which designed recommendations for G20 leaders to accelerate the transition to a low-carbon future. This focus on climate change on a global level also encouraged action at the domestic level, as it was an impetus for YPF to enact a more ambitious strategy to reduce its own emissions. As a state-controlled company, YPF’s activities are tied to the country’s broader climate commitments, such as the United Nations Sustainable Development Goals and the Paris Agreement. The ratification of these two agreements also encouraged YPF to contribute to the government’s climate action goals.

YPF’s mitigation strategy has also been influenced by its interaction with other IOCs, one expert noted in an interviews. It has worked alongside companies like BP, Shell, Total, and Equinor, which have been operating under contracts to develop the country’s unconventional resources, leading it to align to international practices.

YPF’s strategy is also tied to the company’s long-term financial goals and, like any company, is constrained by the need to provide returns to shareholders. Argentina is currently grappling with a severe financial crisis. The value of the local currency has plummeted and inflation rates and external debt continue to rise. The government has outlined ambitious plans to double oil and gas production by 2023 to ensure fiscal stability as this sector has the capacity to quickly generate significant revenues. As the largest player in the oil and gas sector, YPF’s mitigation strategy must balance emission reduction projects with costs, leading to the prioritization of projects that are the most cost-effective.

In some areas, government regulations have also not been strict enough to push YPF to reduce emissions. For example, stricter regulations against venting and flaring at both the national and provincial levels would obligate YPF to further reduce methane emissions. Moreover, there has not been significant external pressure from private shareholders for YPF to develop an ambitious climate

change strategy. Obtaining financing is challenging in Argentina due to high interest rates, and YPF has had difficulty accessing international capital markets. In addition, government entities lack investment-grade ratings because of the country's past defaults on its debt, making investments in Argentina high-risk. Investors are more focused on ensuring payments on YPF debt than on imposing sustainability targets.

It remains to be seen whether YPF's climate strategy will be maintained under Alberto Fernández, who took power in December 2019. On one hand, Fernández has not made changes to the Argentinian National Climate Change Cabinet (GNCC), which is led by the head of the ministerial cabinet and brings together representatives from various ministries to discuss and impose climate action. This appears to signal plans for continuity. On the other hand, the government has yet to publicly announce a national climate change strategy for the country or commit to meeting targets to increase the share of renewable energy in the matrix. Furthermore, the oil price collapse and economic downturn from measures to contain the Covid-19 outbreak will challenge Argentina's ability to renegotiate its debts. As a result, YPF may be forced to eliminate or delay costly projects to reduce its emissions and prioritize its core business of oil and gas production.

While Ecuador is a smaller producer, the country's heavy dependence on oil exports means Petroamazonas plays a crucial role in the economy.

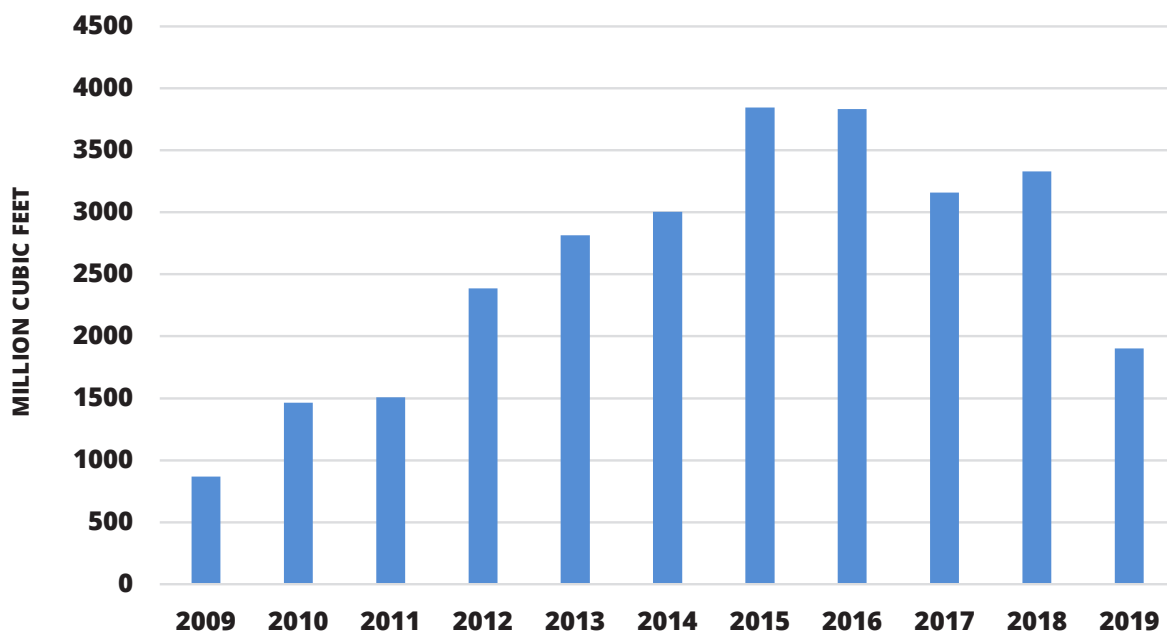
Ecuador's Petroamazonas

COMPANY OVERVIEW

Ecuador's state oil company is among the more recently established NOCs in Latin America. In 1971, Ecuador began large-scale oil exports and a new hydrocarbons law gave way to the creation of the Corporación Estatal Petrolera Ecuatoriana (CEPE). Eighteen years later, the legal charter of the state-owned oil company was changed to that of a holding company, consisting of six

FIGURE 13: ANNUAL AVOIDED NATURAL GAS FLARING VOLUMES, PETROAMAZONAS

Sources: Petroamazonas powerpoint, "Programa de Eficiencia Energética", June 2019



subsidiaries under the new name Petroecuador. In 2012 the sector was reorganized again, creating two separate state-owned companies—Petroamazonas, in charge of upstream operations, and Petroecuador, which handles midstream and downstream operations. In accordance with the constitution, the state gives preferential E&P rights to Petroamazonas, and preferential distribution rights to Petroecuador, which also owns 100% of the state’s refining capacity and storage as well as some major pipelines.⁸⁰ In 2019 the companies began the process of a merger, which is set to be completed sometime in 2020.⁸¹ Petroamazonas accounts for 80% of the country’s oil production and in 2018 produced 400,968 b/d of crude oil.⁸²

While Ecuador is one of Latin America’s smaller oil producers, the country’s heavy dependence on oil exports mean Petroamazonas plays a crucial role in the economy. For example, refined products made up 41% of total exports in 2018,⁸³ and in 2016 oil sector revenue accounted for roughly 25% of public sector revenues.⁸⁴ Faced with high debts, Ecuador continues to rely on oil revenues for fiscal stability.

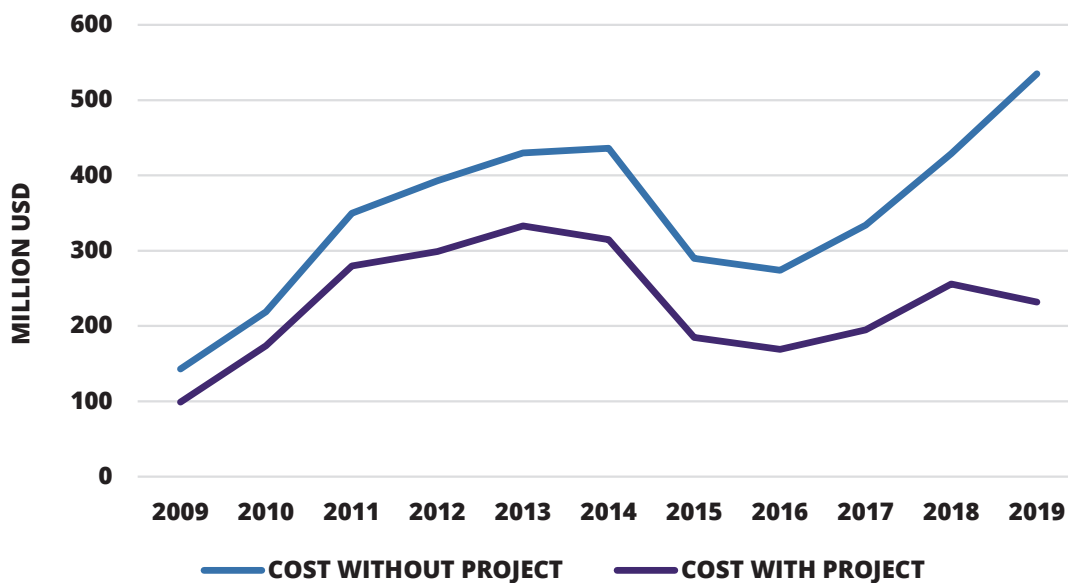
MITIGATION STRATEGY AND OUTCOMES

Petroamazonas has made limited progress on climate change mitigation compared to the other companies analyzed in this study and it does not report total direct

or indirect emissions in its sustainability report. However, although Petroamazonas does not track GHG emissions from its operations, the company does provide data on achieved emissions reductions. In 2018, it cut 133,000 metric tons of CO₂ compared to a business-as-usual scenario.⁸⁵ Petroamazonas’ strategy to reduce direct emissions is primarily focused on cutting down on gas flaring, replacing crude oil and diesel with natural gas in power generation, and improving energy efficiency. The company lacks an official goal or strategy to reduce its indirect emissions.

In 2009, Petroamazonas began its Optimization of Electricity Generation and Energy Efficiency program (OGE&EE), which was largely focused on reducing flare volumes in order to monetize associated gas. Petroamazonas has been responsible for the lion’s share of flaring in the country—for example, in 2015 it accounted for around 92% (35 billion cubic feet) of the total volume.⁸⁶ During the 30 years prior to the OGE&EE program, Petroamazonas (at the time known as Petroecuador prior to the separation of the upstream and downstream companies) burned an average of 100 million cubic feet of gas per day, roughly 180 billion boe.⁸⁷ The OGE&EE plan was challenging due to the range of gas volumes and compositions present at the company’s facilities (for example, the CO₂ content of fields varied significantly).⁸⁸ However, it has been successful, allowing the company to avoid burning 26,214 million cubic feet of natural gas

FIGURE 14: ANNUAL ENERGY GENERATION COSTS WITH AND WITHOUT OGE&EE, PETROAMAZONAS
Source: Petroamazonas Sustainability Report (2018)



by 2018 (see Figure 13).⁸⁹ To further its flaring reduction efforts, the company joined the World Bank's "Zero Routine Flaring 2030" initiative in 2015.

By reducing flare volumes, Petroamazonas has been able to consume the gas and thus reduce reliance on diesel and crude oil for power generation in its operations, which has in turn lowered its emissions. Mobile generators were brought in to capture and store associated gas so it could later be used as a fuel source for power generation. Fuel switching between 2009 and 2019 resulted in savings of 647 million gallons of diesel for the company.⁹⁰ In the second implementation phase of the project, the company connected its oil field facilities to the national grid, allowing it to access new sources of power, particularly hydro. In 2018, 11% of the company's power was generated from hydroelectric sources, compared to 0% in 2009.⁹¹ While the volumes of hydro and natural gas consumption increased during this period, so did the volumes of diesel and crude, meaning the share of lower-carbon energy sources in the matrix did not increase significantly. The combination of flare reduction and fuel switching not only garnered environmental benefits but also brought economic advantages. In total these actions saved the company roughly \$177 million in 2018 (see Figure 14).⁹²

Petroamazonas has not made significant progress in reducing Scope 3 emissions. It does not generate renewable energy for third-party generation, and there have been no formal plans indicating the company will shift its operations to include anything outside its core oil and gas business.

CHALLENGES AND OPPORTUNITIES FOR CLIMATE ACTION

In the case of Petroamazonas, the impetus to engage in climate action was primarily bottom-up, coming from technical professionals inside the company who were knowledgeable about emissions reduction programs, according to experts interviewed for this paper. To some extent, the practices adopted through the OGE&EE program have been maintained, thanks to momentum from earlier efforts. For example, the company formed a unit for reduction of gas flaring and has added skilled personnel for it. Associated gas also continues to be used for power generation in its operations.

The national government has also influenced the practices of Ecuador's state oil companies over the years. Under the Rafael Correa administration, the NOC faced increased pressure to adopt climate policies, experts said in

interviews. Correa introduced a small carbon tax on oil exports and highlighted climate on the national agenda in the run-up to the Paris Agreement. In 2007, the government launched the Yasuní-ITT Initiative, which proposed a drilling suspension in the Amazon in return for \$3.6 billion from the international community. Ecuador ultimately received only a small portion of the anticipated funds and later backtracked on the offer. Meanwhile, pressure from the Ecuadorian public to improve climate commitments has been weak, although Petroamazonas has received pressure from local communities to limit flaring, according to one expert.

Although technical expertise and political objectives have impacted the climate strategies of Ecuador's state oil company, economic considerations have ultimately been the biggest driver of decisions. The OGE&EE program was embraced during the Correa administration largely because high international oil prices between 2009 and 2014 meant that using natural gas for power generation would allow the company to sell more valuable crude and oil products. In more recent years, however, climate change has become less of a priority on the political agenda as the country's economic situation has worsened, according to the experts interviewed. In the wake of the 2014 oil price decline, the government slashed its national budget. Ecuador's public debt reached \$64 billion in 2019, and an unsuccessful attempt to end fuel subsidies and shore up finances in October 2019 further strained government coffers.⁹³ In this context, Petroamazonas lacks funds to implement climate mitigation projects. Petroamazonas does not sell its own crude and is entirely reliant on the budget allocated by the Finance Ministry. Additionally, the company is not permitted to take on debt, meaning it cannot use debt financing as an avenue to fund new projects.

Petroamazonas is not permitted to take on debt, meaning it cannot use debt financing as an avenue to fund climate projects.

CONCLUSIONS

THE GOVERNMENT'S STANCE ON CLIMATE CHANGE CAN EITHER IMPEDE OR ENCOURAGE THE NOCS ADOPTION OF CLIMATE STRATEGIES.

As state-controlled firms, the five companies' emissions abatement strategies are influenced by government priorities. The government's position on climate change can often lead the state oil company to either step up or roll back its mitigation strategy. In some cases, such as those of YPF during the Macri administration and Ecopetrol under Santos and Duque, the government's strong commitment to tackling climate change led the country's NOC to take more ambitious action. But in other cases, government influence has been detrimental to climate change mitigation as governments prioritized political and economic objectives over environmental goals.

In Latin America, the CEOs of state oil companies are appointed by each administration to carry out the government's strategy for the energy sector. The ability to hand-pick company leadership enables the government to utilize the state oil company to achieve its political and economic—or environmental—objectives. The considerable sway that governments hold over their NOCs has led to erratic climate mitigation strategies, and indeed, some efforts by one government to reduce emissions have been reversed by the following government.

ECONOMIC CONSIDERATIONS APPEAR TO PROVIDE THE STRONGEST IMPETUS FOR CLIMATE ACTION.

Economic and efficiency considerations (a desire to cut costs or improve productivity) appear to be the strongest drivers of emissions abatement strategies for Latin American state oil companies, which suggests that climate actions that serve other profitability or operational objectives are the most likely to be implemented and the most resilient in the face of changes in government. Most Scope 1 mitigation efforts center around techniques that have economic co-benefits, such as improving efficiency of equipment and monetizing associated natural gas rather than flaring or venting it. And when company or national finances are tight, costly climate mitigation projects that have no direct economic benefit are often cancelled or delayed. Economic concerns have also hindered progress on the more ambitious step of reducing Scope 3 emissions. All the state companies included in this study are primarily focused on maintaining and increasing crude oil production, from which they can expect higher returns than lower-carbon energy sources such as natural gas, biofuels, and renewables. This is particularly worrisome in the current environment of economic crisis and historically low oil prices amid the Covid-19 pandemic, as emissions reduction measures that do not bring clear economic benefits may be cut.

ENVIRONMENTAL REGULATIONS ARE A USEFUL TOOL TO ENSURE POLICY CONTINUITY BETWEEN DIFFERENT ADMINISTRATIONS.

Regulations that require oil companies to measure, report, and reduce their emissions can help counter inconsistent government policies by forcing continuity in operational practices. In several countries, for instance, regulations limit gas flaring or require biofuels blending in fuels, forcing NOCs to adopt these practices regardless of the stance of the particular government in power.

LATIN AMERICAN NOCS' ROLE IN BOLSTERING ENERGY SECURITY CAN BE A DRIVER OF CLIMATE CHANGE MITIGATION.

National oil companies in Latin America also play an important role in ensuring reliability of energy supply, which can drive climate mitigation actions. For example, several companies are seeking to increase natural gas production, and in some cases biofuels and intermittent renewables, to diversify their countries' electricity and fuel mixes. This may reduce the companies' indirect emissions as they shift their portfolios from oil to gas and other cleaner sources.

SOME NOCS ARE INFLUENCED BY INTERNATIONAL TRENDS AND PRACTICES. HOWEVER THEY HAVE FACED LITTLE PUBLIC PRESSURE WITHIN THEIR OWN COUNTRIES TO DECARBONIZE.

Some NOCs' climate strategies are also influenced by international trends. For example, some companies expressed concerns about the long term viability of the oil sector and the need to embrace the energy transition. Others are influenced by the emissions abatement practices of their counterparts, especially IOCs with which they partner on oil projects. However, in all of the case studies, experts we interviewed asserted that pressure from the public as a whole has been minimal. The general public may be largely unaware of their state oil company's climate change strategy, or this issue may not rank as a high priority for most consumers. However, as public pressure increases for IOCs to take more ambitious steps to address climate change, the spotlight may eventually turn to Latin American NOCs. If governments and management of these companies fails to take the lead, outside pressure may eventually force Latin America NOCs to step up their mitigation efforts.

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