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Energy: reflections and perspectives

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The articles in this publication were written before and during the COVID-19 crisis, and may or may not include its full implications for the energy sector.

Energy: reflections and perspectives

Rio de Janeiro, June 2020

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PRESENTATION

The energy sector has increasingly demonstrated its relevance in the Brazilian market, with its ability to attract significant investments to the country in recent years. The recent regulatory changes, together with a schedule of auctions and events, have shown that predictability and clear rules have the potential to fuel the energy industry.

This scenario, alongside attractive perspectives in energy mix diversification (the New Natural Gas Market Program, renewable source incentives, etc.), in the past few years has made Brazil not only one of the most significant exploratory frontiers in O&G but also an authority within the energy sector in general.

This promising scenario was recently overshadowed by the COVID-19 pandemic, which presented the world and the energy sector with unprecedented challenges.

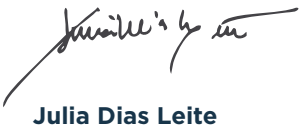
Although this book was initially conceived in a different setting, we understood that it would make sense not only to maintain the original plans but also to speed up the publication schedule.

It is not difficult to perceive that preparing the articles and formatting this book during this period required more effort than usual from the authors and organizers of this publication. However, if the challenge is great, the satisfaction is even greater.

With Catavento's help, it was possible to count on prominent authors who, in our understanding, truly enriched this publication. Our thanks to the authors Adriana Lontra, Alexandre Szklo, Minister Bento Albuquerque, Carlos Frederico Lucchetti Bingemer, Clarissa Lins, Cristina Pinho, Daniele Tavares, Felipe Botelho, Guilherme Ferreira, Jorge Camargo,

José Firmo, Luis Henrique Guimarães, Luiz Costamilan, Márcio Pereira, Rafael Bastos, Rafael Patrocínio, Renata Isfer, Roberto Schaeffer, Thiago Barral, and Vanderlei Martins.

We understand that publications like this foster debate and benefit the entire industry. We hope you enjoy and find this publication helpful.



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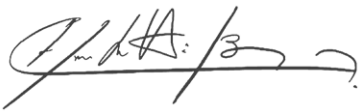

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THE O&G SECTOR AND ITS IMPORTANCE

BRAZIL: ABUNDANT AND DIVERSE ENERGY SOURCES

About the Publication

The energy sector is undergoing unprecedented changes. In the short-term, the outbreak of the COVID-19 pandemic has drastically reduced the demand for energy. Countries adopted measures that restrict circulation because specialists pointed out that social distancing is the primary, and only effective, measure to fight the virus to date. While the oil and gas (O&G) sector took a long time to adjust its supply when faced with an abrupt drop in energy demand – the barrel price dropping to the lowest level in 18 years –, the renewable energy sector faces the challenge of ensuring competitiveness and survival during a global recession.

In the medium- and long-term trends imposed by climate change, new consumption patterns, and technological innovations remain relevant, with profound implications on the way energy is produced and consumed. The electricity sector is shaped by the growing digitization and decentralization of energy resources, which enable greater penetration of renewable energy sources and changes the role of the consumer. In turn, the oil and gas sector is influenced by the production of North American shale, with implications for the geopolitics of oil, and by the increased competitiveness of renewable sources, which promote challenges and opportunities for the sector's companies.

With the countless uncertainties that persist regarding the impacts of COVID-19, this publication focused on medium- and long-term trends that affect the future of energy, from the perspective and analysis of several specialists.

In the first chapter, dedicated to climate change and the energy transition, the themes were analyzed from the perspective of geopolitical dynamics, which have been altered with the increasing competitiveness of renewable sources and the emergence of new players. The aspectual risks and opportunities for the energy sector in Brazil were also analyzed in this new context.

The outlook for nuclear generation and the technological challenges it brings were analyzed in the second chapter of the publication. Meanwhile, the Brazilian biofuels sector, its significance on the climate agenda, and the recent regulatory changes were noted in the third chapter.

The fourth chapter, focused on the Brazilian O&G sector, featured the largest number of articles and contributions. Several topics were investigated from the perspective of specialists from the private and public sectors. The articles were consistent in highlighting how competitive the sector is, specifying the fruitful pre-salt reserves, and pointing out different regulatory opportunities to promote an even more attractive and diverse business environment.

The last chapter maps out how to help Brazil, as well as Rio de Janeiro, become an energy power, supported by the diversity of sources and adhering to the future of energy. As for the O&G sector, its regulations could be improved to promote an even more competitive market. These aspects, in addition to the continuation of the promising and robust investment agenda, provide for a more diverse and innovative environment.

01

The Geopolitics of energy in transition

By Jorge Marques de Toledo Camargo, Vice Chairman of CEBRI's Board of Trustees

Article written in April 2020

The world energy industry is living in unimaginable times. In addition to the immense challenges that it was already dealing with – offering safe and affordable energy to billions of people, especially those still in a situation of energy exclusion, and contributing to the transition to a lower-carbon economy –, the industry is now facing a new and unusual scenario of the simultaneous collapse of oil prices and energy demand, due to the effects of the COVID-19 pandemic.

We are witnessing a profound energy transition, both for supply and demand (in the way that energy reaches consumers), and for factors that determine the relations of influence and power between nations and regions. A new geopolitics of energy is unfolding.

Since prehistorical times, when we mastered the use of fire, successive energy transitions have left impressions on the evolution of human productivity and quality of life. Each impression was characterized by the emergence of new technologies and sources of energy, such as the emergence of coal during the Industrial Revolution and oil after World War II.

The energy transition that we are experiencing today – under different forms and paces – has some unique characteristics. It is the first transition involving climate as a motivator. It will need to be more intense and faster than previous transitions, if we are to achieve the goals set in 2015 at the United Nations Conference on Climate Change in Paris. It is a task for a generation.

The modern geopolitics of energy was predominantly associated with the

global dynamics of oil. After all, oil and gas account for 60% of the world energy mix and were primarily responsible for the global growth spurt and prosperity since World War II. The expectation of the beginning of the decline in oil demand – the threat of peak oil being overcome by the prospect of peak demand – and the increasing penetration of renewable energies are the main foundations of the current energy transition. Given the profound economic impact of the current pandemic, it is essential to consider the time dimension and differentiate circumstantial events, even if extremely tough, from new and lasting global trends. The sharp drop in energy demand is expected to reverse when economic activity resumes gradually. On the other hand, oil prices may have suffered a structural reduction in the longer-term, reflecting the perspective of the future retraction of oil demand and the growing competition between producer countries for market share.

Since its genesis, OPEC has relied upon a logic of containing the supply of cheaper oil, yielding market to sustain prices, which allowed for the development of offshore production basins like Campos, off Brazil's coast, the North Sea, and, more recently, the pre-salt province and the American shale oil revolution. OPEC's logic has been weakened, like OPEC itself, due to the expectation of decreasing demand and future prices.

The American shale oil energy revolution has been a recent phenomenon tremendously impacting energy geopolitics. Between 2005 and 2019, the United States added 10 million barrels of oil to its daily production – equivalent to Saudi Arabia – and became the world's largest self-sufficient importer. Additionally, shale gas – abundant, cheap, and cleaner – displaced coal from the American power mix, causing a significant decline in CO_2 emissions.

This newly acquired energy self-sufficiency favored the current American isolationist policy and the distancing from insoluble rivalries and conflicts in the Middle East. The collapse of oil prices is expected to decimate financially vulnerable producers of shale oil and decrease America's energy independence.

With China leading the way in the emergence of Asia as the new leading destination for oil and gas exports, the main direction of the world's surplus energy flows has inverted from the West to the East, as well as the greatest vulnerability to possible interruptions in supply and the free circulation of oil and gas.

Unlike the USA, which never hesitated to defend energy security militarily, China seems to prefer to protect its strategic interests by following the paths of the New Silk Road (or Belt and Road Initiative),

its grandiose investment program for regional and global infrastructure.

In this new international context, Brazil emerges as a relevant and reliable actor in supplying Asian energy demand.

Although the scope of the energy theme is still unclear on the agenda of the growing tension and strategic competition between the United States and China, the new geopolitics of energy makes it possible to imagine – or dream – about the reduction of conflicts triggered by oil, as so many have been in the past.

Thus, it is reasonable to foresee that the upcoming decades will offer an abundant, diverse energy supply. This will stimulate the growth and competitiveness of renewable energies, whose steep drop in costs is one of the essential elements of the current energy transition. That is good news for consumers and the global economy, but it does not necessarily imply less tension and uncertainty.

In addition to expanding access to energy, which is going well, the other major challenge of the current energy transition is to reduce the emission of greenhouse gases globally. In this trench – which is going badly – Europe is demonstrating outstanding leadership, both with its ambitious public policy and the engagement of the population, mainly among young people, like Greta Thunberg. The UK has already reduced emissions to pre-industrial levels and aims to zero them by 2050, which is also the European Commission's target, through the recent European Green Deal.

The Eurocentrism that dominates the climate debate gives the topic the sense of urgency and seriousness it requires. However, due to the maturity of European economies and the consequent decline in energy intensity and demand, it proposes solutions and scenarios that are far from the reality of developing countries and regions, especially Asia where billions of people are emerging from energy shortages and exclusion.

The political goodwill and voluntary commitments that the signatory countries have manifested in the Climate Conferences, organized by the United Nations for 25 years, have produced timid consequences. Emissions continue on an unwavering trajectory. The depth and pace of the process of decarbonizing the Earth's atmosphere will be dictated, like almost everything in life, by the economic signs and their impacts on energy supply and demand. In this field, there are more questions than answers. Penalizing carbon emissions is fundamental. How can it be done in a politically viable way? Several investment funds have already declared themselves opposed to fossil fuel energy. Is the international financial system capable of curbing the unreasonableness to climate issues?

It is also necessary to assess how the current pandemic impacts the pace of the energy transition. Greater attention is expected to be paid to warnings stemming from the scientific community for the risks of calamities arising from the growth in greenhouse gas emissions, which, like COVID-19, are also of global scope and impact. However, renewable energies will face an even greater challenge in competing with fossil sources, should the prices of the latter stabilize at lower levels.

It's necessary to consider that climate-driven energy transition requires global cooperation and coordination. The pandemic brought some community solidarity and even more international dissolution. The climate-driven energy transition requires enormous investments. The epidemic impoverished us. The climate-driven energy transition is long-term. The pandemic is an emergency.

What is the outlook for Brazil in this new geopolitics of energy and the environment?

Our Brazil, due to its geographical, climatic and geological characteristics, occupies a unique and enviable position in the world energy scenario. Based on more than 40% renewable sources, the Brazilian energy mix is twice as clean as the world average, whose dependence on fossil fuels exceeds 80%.

We already occupy a prominent position in hydroelectric generation and ethanol production. We recently revealed Brazil's tremendous potential to generate solar and wind energy, with capacity factors much higher than the global averages.

In the framework of Brazil's extraordinary energy abundance and diversity, the pre-salt province stands out, whose dimensions and formidable productivity of the reservoirs sustain its economy even under oil prices in the 30 to the 50 dollar range. Its dimensions and productivity could double the national oil and gas production in the coming decades, even if at a slower pace than predicted before the pandemic and the collapse of oil prices due to the reduction in the companies' investment capacity.

We are already significant oil exporters. We will export even more in the future—pre-salt oil, which is light and has a low sulfur content. In the competition for the remaining oil demand, we are among the most economical and environmentally competitive. The suggestion for Brazil to join OPEC is astonishing. OPEC is the past. We want to belong to the future of energy.

However, despite the enviable quality of the Brazilian energy mix, the

country still has many obstacles before deriving maximum economic and geopolitical benefits from the current energy transition.

The World Economic Forum ranked Brazil 46th out of 115 evaluated countries in its Energy Transition Index. Our weakest attributes are our energy infrastructure and the inability to attract investments. Despite advances in recent years, there are still many opportunities for institutional, fiscal, and regulatory improvement, including making energy access cheaper, which is incoherently expensive in Brazil.

Since it requires worldwide coordinated efforts, the current energy transition implies complex international negotiations, in which the influential relations are more diffused and subjective. However, the commercial and economic consequences are palpable.

In this context, Brazil needs to regain international prominence and develop its soft power, valuing its many geopolitical, energy, and environmental assets, acknowledging and overcoming vulnerabilities.

Preserving the Amazon, for example, is synchronously an immense challenge, a threat, and an opportunity for our image and international insertion, which are increasingly associated with sustainability.

Brazil, an energy and environmental powerhouse: this is CEBRI's vision of the future.

ABOUT THE AUTHOR

Jorge Camargo is the Vice Chairman of CEBRI's Board of Trustees and has worked in the oil industry for more than 40 years. He is a member of the Boards of Directors for Prumo Logística Global, Grupo Ultra, and the Brazilian Petroleum, Gas and Biofuels Institute (IBP).

Previously, he was President of IBP and worked for 27 years at Petrobras (in Brazil and abroad), where he served as Director of Exploration and Production. He later was President of Braspetro and a member of the Petrobras Executive Board, responsible for the International Sector. He was Senior Vice President of Statoil[1] in Norway and President of Statoil in Brazil.

He holds a degree in Geology from the University of Brasilia and a Master's Degree in Geophysics from the University of Texas.

1. The Norwegian company Statoil changed its name to Equinor in 2018

02

Climate change and the energy sector in Brazil

By Alexandre Szklo and **Roberto Schaeffer**, professors at COPPE, at the Federal University of Rio de Janeiro (UFRJ)

Article written in April 2020

Crude oil is the main primary energy source consumed and produced in Brazil's energy system. At the same time, this system is also heavily based on renewable energy sources, the so-called "flow energies," as opposed to "nature-stored" energy sources such as coal, crude oil, natural gas, and uranium. Flow energies are, by definition, renewable on the time and space scales of human societies, because they are directly or indirectly a function of both the quantity and quality of the solar energy that reaches the Earth.

This characteristic puts Brazil in a good position in international negotiations associated with the mitigation of global climate changes. However, it highlights the vulnerabilities of renewable energy sources to climate change and, by extension, of the systems that are based on them. Such vulnerabilities are both physical (e.g., change in the potential of the energy resource due to the change in the rainfall regime in a region, or the brightness index, or the wind profile) and stochastic (it is difficult to forecast a resource whose availability has usually been evaluated according to a historical series).

In the case of hydroelectric plants in Brazil, for example, studies indicate that they can be affected by extreme events,[2] compromising their firm energy by about 30% in the Brazilian average (with variations per basin). This may imply only needing thermal plants to handle events that are difficult to predict, resulting in additional capital costs in the order of

2. LUCENA, A.F.P.; SZKLO, A.S.; SCHAEFFER, R. The vulnerability of renewable energy to climate change in Brazil. 2009

50 billion dollars,[3] and the regulatory challenge of including this risk in the system and sharing it among the agents that participate in it.[4] Studies also indicate a loss of predictability in Brazilian wind energy generation[5] or even from South America and the Caribbean.[6]

Climate change also affects the efficiency of some energy converters. The actual efficiency of photovoltaic cells, for example, could be reduced by up to 15% in the hottest hot spots in Brazil[7] as a result of global warming, not to mention the change in the brightness index that would affect not only the photovoltaic option but also the option of concentrated solar power.

The physical vulnerability of the energy system can also be associated with the integrity of primary energy extraction facilities, the conversion of this energy into final energy, and the transport of energy carriers.[8, 9] This is even more true for systems that rely on long electricity transmission lines, typically hydrothermal systems.[10] Even the demand for final energy, especially electricity, can be affected by climate change. Because of that, the use of conventional forecasting tools for systems whose planning and operation are not adapted to this change becomes even more intricate.[11]

There is also an economic and financial vulnerability in addition to physical vulnerability in its different driving factors. The reduced predictability of delivery of an energy service exposes a supplier to economic and financial risks and, depending on how this risk is mitigated, it also exposes the consumer of that service. The reduction of hydroelectric generation in Brazil in the last decade, especially in the northern region, and the current mechanism for reallocating this reduction tend to penalize the electricity consumer.[12] Although the

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4. PAIM, M.A.; DALMARCO, A.R; YANG, C.H. Evaluating regulatory strategies for mitigating hydrological risk in Brazil through diversification of its electricity mix. 2019

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reduction in the predictability of the hydroelectricity supply in Brazil cannot be attributed entirely or mainly to global climate changes, the relevant fact is the increase in risk and the way to share it.

The case of the *California provider Pacific Gas and Electric Company* (PG&E) is even more emblematic (as a lesson), whose legal liability for an extreme damage-causing event led to its bankruptcy in 2019.[13] In fact, "PG&E's experience presents a stark example of how the legal system can abruptly transform climate risks from something that the energy sector can ignore without consequence into a massive liability and a spur to rapid change."[14]

Thus, climate change implies greater risks to the energy system, whose infrastructure is based on complex, capital-intensive systems, with a high degree of coordination needed in the value chain. These risks may fall not only on producers and consumers but also on the financial sector when associated with activities potentially impacted by climate change.[15] However, these activities cover not only the energy sector but also the agricultural sector,[16] which includes bioenergy production. Perceived as vulnerable to climate change, the energy sector will face increasingly higher capital opportunity costs to invest, including those related to climate change adaptation.[17] If the energy sector does not invest in adaptation, it will be increasingly vulnerable to extreme events and at greater risk of loss of revenue and lawsuits, a vicious cycle.

Interestingly, economic and financial vulnerability may be expressed even more clearly in the case of the fossil fuel industry, within the concept of stranded assets[18] or unburnt reserves.[19] In a recent study using a global Integrated Assessment model for energy and land use developed in Brazil, detailed results were obtained in case the average global temperature increase was restricted to 1.5°C in relation to 1850-1870, without allowing that increase to be exceeded at any time. In this case, compared to a scenario without climate targets, 300 Gb less oil would be produced worldwide (25% less), 50 billion Nm^3 less

13. The Wall Street Journal. PG&E: The First Climate-Change Bankruptcy, Probably Not the Last. 2019. Available at: <https://www.wsj.com/articles/pg-e-wildfires-and-the-first-climate-change-bankruptcy-11547820006>

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18. GRIFFIN, P.A. Energy finance must account for extreme weather risk. 2020

19. MCGLADE, C.; EKINS, P. The geographical distribution of fossil fuels unused when limiting global warming to 2°C. 2015

natural gas (28% less), and 370 Gt less coal (70% less) between 2015 and 2050.[20] The study also evaluated a scenario in which regions such as South America (including Brazil), Southeast Asia, and Africa would be allowed to maintain their fossil fuel production ramp until 2050 as a way to monetize their 2P reserves.[21] In this case, certain producers, such as Canada, Russia, and even the USA, would have to reduce their production to make room for those developing countries to have additional production. Global refining would also have to adapt to a reduction in the quality of the supply of crude (about 3-4 degrees API) and make investments to deal with it.

Paradoxically, the Brazilian energy system still has an additional risk associated with one of its historical virtues, the use of ethanol in light vehicles with internal combustion engines. This risk stems from the technological dynamics of the 21st-century energy transition, where driving forces such as the increased use of information technology and mitigation of greenhouse gas emissions[22] stand out. In this case, although ethanol and the production chain associated with it are options for mitigating greenhouse gas emissions from the current and future Brazilian energy system, there is strong evidence that the global auto industry is seeking a new dominant standard based on the electric powertrain. Although electric mobility is not incompatible with the use of liquid fuels, as the source of electricity can come from fuel cells fed by fuels with hydrogen in their composition (e.g., ethanol), a major bet has been made on battery-powered electric vehicles.

Predicting the future of an energy transition involves being modest for evaluating its dynamics and kinematics (what causes it and at what speed). Regardless of the virtues of ethanol based electromobility, this technological strategy would currently be restricted mainly to Brazil. This means that there is a need to search for opportunities where electromobility based exclusively on batteries (with reduced energy density and power) is not really a competitor. In this case, biofuels for aircraft,[23] ships,[24] and even larger trucks draw attention. This assertion is consistent with the results of scenarios developed with BLUES, a Brazilian Land Use and Energy System model developed at Cenergia

20. SCHAEFFER, R. Is a "Just Transition" Just When it Comes to Limiting Fossil Fuel Extraction? 2020

21. Under the aegis of a *Just Transition*, a concept that is barely canonical, but is already enshrined in international literature

22. SOVACOOL, B.K.; GEELS, F.W. Further reflections on the temporality of energy transitions: A response to critics. 2016

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Laboratory/COPPE/UFRJ.[25] In this case, Brazil would not only serve its own market, but it would also be a lower-cost producer of renewable fuels, being able to compete in a world where the International Air Transport Association (IATA) and the International Maritime Organization (IMO) have already has set ambitious targets for international aviation and for international maritime transport, respectively.

Such an opportunity becomes even more emblematic when we add the option of chemical bioplatforms production[26] and the option of capture and storage, or the chemical utilization of CO_2 associated with the biofuel production chain in Brazil.[27] This is the set of technologies called *bio-energy with carbon capture and storage* (BECCS), whose acronym does not capture all the variants that these options can introduce. BECCS are key technological alternatives in situations where there is a delay in actions to mitigate greenhouse gas emissions.[28] For example, an increase in emissions associated with deforestation in Brazil would mean that the country would have to increase its investment in BECCS[29] in an unlikely urgency and scale.

Global climate change does not only bring risks for Brazil's economic (crude oil and natural gas revenues) and energy (vulnerability of renewable sources) strategy. It also introduces opportunities. As a country, Brazil undertook emblematic technological developments for different energy chains for various reasons throughout the 20th century. It has an established base in science and technology and edaphoclimatic comparative advantages that can give it the role of the protagonist, instead of a victim, in a technologically transitioning world whose process has uncertain kinetics and final state. But this transition, like the others that preceded it, will depend on the pioneering spirit, ambition, and the perception of comparative advantages in relation to the other economies of a changing world.

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03

Energy and climate litigation

By Márcio Pereira, Partner in the Environmental Law area at BMA Law

Article written in April 2020

I. Introduction

Climate litigation has recently become a new strategy to compel and encourage public and private organizations to take responsibility for the impacts of global warming and climate change. This strategy goes hand-in-hand with negotiations between countries to agree on international treaties, regulations imposed by Federal Governments, and initiatives led by the market or the organized civil society, with a focus on reducing and neutralizing greenhouse gas emissions involving different sectors and economic segments, such as the energy sector.

II. Energy and climate change

The energy sector has always been at the center of attention when it comes to climate change, whether due to greenhouse gas emissions (fossil fuel), or Brazil's potential for alternative sources (renewable energy sources). The infrastructure vulnerability associated mainly with renewables[30] is even brought into the spotlight, which may lose potential because of the impacts of climate change. Climate change has a tremendous impact on hydroelectricity due to hydrological risk and extreme events associated with water scarcity.[31]

30. COPPE. Mudanças Climáticas e Segurança Energética no Brasil. 2008. Available at: <http://mudancasclimaticas.cptec.inpe.br/~rmclima/pdfs/destaques/CLIMA_E_SEGURANCA-EnERGETICA_FINAL.pdf>

31. PEREIRA, MS; MACIEL, M. Addressing the Impacts of Brazilian Drought in Hydropower Generation. 2018

The Brazilian Policy on Climate Change (PNMC, Law Nº 12187/2009), which defined Brazil's voluntary commitment to reduce projected emissions from 36.1% to 38.9% by 2020, also made the Ten-Year Energy Plan (PDE, Decree Nº 7390/2010) possible. The Plan's focus is on mitigating and adapting to climate change – through, for example, the expansion of the biofuels production and consumption, and of the generation of wind, solar photovoltaic and biomass energy, in addition to gains in energy efficiency.

Brazil has committed itself on the world's stage – through the Paris Agreement[32] – to adopt several indicative measures for the 2030 horizon: a) for bioenergy, increase the amount of ethanol, sugarcane biomass, biodiesel, and other biomass to 18% of the energy mix; b) increase the generated percentage of wind, solar and biomass (distributed generation and self-production) to 23% of the mix; c) achieve a 66% capacity of hydroelectric generation in Brazil's National Integrated System; d) increase the amount of renewable sources in the energy mix to a range of 28-33% (except hydroelectric plants); e) achieve 10% efficiency gains in the electricity sector; and f) achieve an estimated 45% share of renewable energy in the national energy mix.

In line with this international commitment and one of the most recent public policies instituted in Brazil, the National Biofuel Policy - RenovaBio (Law Nº 13576/2017) was innovative and added an unprecedented mechanism to the current regulatory framework. This mechanism will value fuels lighter in carbon dioxide and be linked to a financial asset (decarbonization credit - CBIO) traded on the stock exchange. This linking is proportional to the greenhouse gas mitigation enabled by these fuels, in relation to their fossil fuel substitutes. RenovaBio imposes mandatory acquisition of this credit on fossil fuel distributors, as a means of mitigating their emissions, according to annual targets (sectoral and individual), established by the government, thus creating conditions for reducing GHG emissions.

In the oil sector, one still cannot lose sight of the fact that there are already significant regulations, such as the Brazilian National Agency of Petroleum, Natural Gas and Biofuels (ANP) regulation for the

32. In December 2015, UNFCCC's 21st Conference of the Parties (COP21) was held in Paris, when the new agreement on global climate change was defined, valid for the post-2020 period and structured based on the Intended Nationally Determined Contribution (INDC). The Paris Agreement came into force on 4 November 2016 when it reached the required minimum of 55 countries, accounting for at least 55% of global GHG emissions. Brazil submitted its INDC to the United Nations in September 2015. Brazil committed to having 37% lower GHG emissions in 2025 than what was registered in 2005. After Brazil ratified the Paris agreement in September 2016, the Brazilian INDC automatically became its NDC (no longer just intended). Source: PEREIRA, MS; FRONTIN, B. Paris Agreement on Climate Change: Overview and Update. 2017. Available at: <https://www.bestlawyers.com/article/paris-agreement-on-climate-change-overview-and-update/1581>

burning of gas during E&P activities. That is also customarily controlled (eliminated, mitigated, or compensated) within the scope of the enterprise's environmental licensing.[33]

With the perception of this reality, and being part of this process, there are private initiatives. For instance, in the oil and gas sector, large companies have been moving forward with projects and advancing commitments to achieve the goal of minimizing the carbon footprint in their operations, reducing possible emissions and neutralizing those that are unavoidable. The strategy gradually increases the proportion of investments in businesses outside the oil and gas industry. It helps the company's customers to reduce their emissions by offering products with a lower carbon footprint (e.g., renewable projects).[34]

III. Climate litigation in the energy sector

Assuming that climate change is already underway and could worsen, as stated by the Intergovernmental Panel on Climate Change (IPCC),[35] organizations cannot neglect efforts to mitigate and adapt it. Such efforts are intended not only to limit GHG emissions by human activities but also to promote actions that make society and the environment less vulnerable to extreme events. This will consequently reduce the pace of climate change by avoiding harmful effects on society and natural systems in general.

In this scenario, organized civil society or public organizations dedicated to defending the environment, supported by the current legal system, can use judicially innovative measures, despite the theory of the separation of powers, including in filling regulatory gaps.

International climate litigation is on the rise throughout the world, especially in the United States of America, where there are already several cases and precedents that inspire and influence the other jurisdictional systems around the globe. International climate litigation precedents, which already total more than 300 cases globally, beyond

33. At the ANP, the subject is dealt with by Decree Nº 249/2000 which approves the Technical Regulation on the Burning and Losses of Oil and Natural Gas. At the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), normative instruction (IN) 12/10 establishes that IBAMA's Licensing Office must evaluate "the measures proposed by the entrepreneur to mitigate these environmental impacts, in compliance with Brazil's commitments in the United Nations Framework Convention on Climate Change," in activities capable of emitting greenhouse gases. However, there is no legal guideline imposing a "zero" burning restriction, nor establishing the way to mitigate or compensate for it

34. SMITH, E.E.; DZIENKOWSKI, J.S.; ANDERSON, O.L.; LOWE, J.S.; KRAMER, B.M.; WEAVER, J.L. Global Warming: The Greenhouse Effect. International Petroleum Transactions, 3rd Edition, Rocky Mountain Mineral Law Foundation, p. 848-881. 2010

35. IPCC. Global Warming of 1.5°C. 2019

the more than 900 in the USA's jurisdiction,[36] show that the impacts that climate change has on human rights have been argued as severe legal violations, serving as a basis to demand that companies and local and national governments take action.

Among the relevant climate litigation cases in the US courts are *Connecticut v. American Electric Power* (argued the limitation of greenhouse gases), and *Comer v. Murphy Oil.* The Comer/Murphy Oil case involved holding oil companies responsible for the numerous losses and damages that the plaintiffs had due to climate change since the defendant oil companies would have contributed to global warming, resulting in the intensification of extreme events, such as Hurricane Katrina. Also, in the *Massachusetts v. E.P.A.* case, the Environmental Protection Agency was accused of inaction due to the lack of regulation on greenhouse gases with regard to the establishment of emission standards under the *Clean Air Act*. This finding resulted in an important precedent favoring climate litigation cases. Then we have *Juliana v. the United States*, which discusses a limit on the emission of carbon dioxide by several companies in the energy sector.[37]

In short, most of the judicial cases that deal with the issue of accountability for climate change seek imputation for the responsible country or private organization, customarily for non-compliance, either by commission or by inaction, of the obligation to protect the environment, with consequences on human rights. Currently, energy companies, especially O&G, are involved in legal disputes over the sector's role in global warming. Activists have also filed lawsuits against the Federal Government, claiming that it has an obligation to protect the environment for both current and future generations.

IV. Final considerations - Climate justice in Brazil

Judicial decisions in climate litigation strengthen the role and responsibility of key players in controlling the emission of greenhouse gases (GHGs), as well as in adaptation cases, and this includes influencing the market logic (funds, financing, etc.).

In Brazil, without significant cases, the transformative impact that has been observed in other countries has not yet been felt. In Brazil, the

36. Grantham Research Institute on Climate Change and the Environment at the London School of Economics and Political Science (LSE) and the Sabin Center for Climate Change Law - Columbia University. Climate Change Laws of the World and Climate Change Litigation of the World. Available at: <https://climate-laws.org/>

37. Cases cited by Délton Winter de Carvalho and Kelly de Souza Barbosa, in Litigância climática como estratégia jurisdicional ao aquecimento global antropogênico e mudanças climáticas. Revista de Direito Internacional, Vol. 16, n. 2, p. 55 et seq. 2019

courts only touch upon the issue as one of the fundamentals of a decision, especially when related to pollution (e.g., coal-fired electricity and burning sugar cane straw) and deforestation (especially in the Amazon).[38]

By the way, considering the current environmental liability regime in Brazil (art. 225, paragraph 3 of Brazil's Federal Constitution, and Law Nº 6938/1981), the possible characterization of the duty to repair requires the demonstration of three requisites: conduct (action or inaction), damage, and causation. The causation is the focal point in any case involving a particular organization and its activity, since it depends on evidence, in a universe of causes that can contribute to an impact associated with climate change (theory of adequate causality),[39] often a future impact, whose ability to be repaired is arguable in our legal system.[40]

As has been the case in other countries, the discussion goes beyond the traditional limits of environmental litigation (e.g., repairs for water pollution). Moreover, it includes systemic aspects (e.g., loss of environmental resilience due to extreme events related to climate change, such as water scarcity), involving mitigative and adaptive measures, to reduce or mitigate the negative impacts on communities and ecosystems.[41]

In this broader approach, climate litigation can be used to induce sectoral regulation on the part of Federal Governments through security measures to protect present and future generations from the damaging effects of climate change.[42] It can stimulate changes in the decision-making and behavior of public and private institutions (project finance and green bonds).[43] Climate litigation can demand that governments comply with their commitments (RenovaBio); address the impact of the energy sector, and its link with climate change and environmental resilience (hydroelectricity); attribute the immediate cause of adverse

38. For example, see Superior Court of Justice (STJ), internal interlocutory appeal in Motion for Clarification in appeal to the Superior Court of Justice 094.873/SP (illegality of using the straw burning technique in the sugarcane harvest as it causes negative impacts on the environment and CO_2 emissions, contributing to global warming). In the same sense, in appeal to the Superior Court of Justice 1.000.731/RO

39. RESP Nº 1602106 - PR

40. For future damages, see STF-RE 130.764

41. BERNARDO, V.L. Mudanças climáticas: estratégia de litigância e o poder do judiciário no combate às causas do aquecimento global no contexto brasileiro. Revista de Direito Ambiental, Porto Alegre, a. 22, v. 88, p. 517-548. 2017

42. In this sense, the Federal Supreme Court's (STF's) understanding of the legal scope of art. 225 of the CF: *"(...) it is the duty of the government and society to defend an ecologically balanced environment for present and future generations. 2. Thus, the Judiciary Branch, in exceptional situations, determines that the public administration adopts measures to ensure this right, deemed essential by the Federal Constitution, without this constituting a violation of the principle of separation of powers. (RE 658171 AgR/DF)"*

43. World Bank. Climate Finance. Available at: <https://www.worldbank.org/en/topic/climatefinance>

impacts of climate change (fossil fuels) to the emissions of private organizations; and attribute responsibilities for the failures (or efforts) of adapting to climate change (water management).

Courts can undoubtedly play a fundamental role in driving this change and denoting that climate litigation is not only a future possibility but a reality that cannot be overlooked by the energy sector while developing its business strategy, including in Brazil.

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ABOUT THE AUTHOR

Márcio Pereira is a partner in the Environmental Law area at BMA Law. His practice focuses on the regulation of the economical use of natural resources and sustainability issues.

Márcio has acquired experience in various economic sectors over the years. He has practiced business law, both as a litigator and in advisory work. He has worked in projects involving electric energy, oil and gas, infrastructure, transportation, mining, steelmaking, manufacturing, telecommunications, basic sanitation, management of water resources, agribusiness, forestry, civil construction, real estate, environmental services, forest management, climate change, and the green economy. He also spent some time at Vale S.A., where he took part in an international program in partnership with the law firm Reed Smith LLP.

Márcio has a bachelor's degree in Law, with a specialization in diffuse interests, from the Pontifical Catholic University of São Paulo (PUC-SP) and a graduate degree in Environmental Management from the University of São Paulo (USP).

04

Nuclear energy: opportunities for Brazil

By Bento Costa Lima Albuquerque, Minister of Mines and Energy (MME) of Brazil

Article written in April 2020

Nuclear energy has been part of the Brazilian power mix for over 30 years. Throughout this period, our plants have shown safety and productivity rates that place them among the best in the world. Over the past few decades, on several occasions, the power they generate has made a decisive contribution to the security of supply, as in the 2001 supply crisis and other problems in the electricity grid.

Our per capita consumption is still deficient and the need to bring a quality of life to the entire population continues to grow significantly. Basic sanitation, just to mention a currently trending topic, is a major consumer of electricity. To ensure the conditions for social development and economic recovery in the country, we need to provide new generation capacity, constantly and sustainably.

As one of the architects of public policy for electric energy, our mission is to guarantee this growth with a high level of security and reliability in supply, reduced costs, and, at the same time, limit the emission of greenhouse gases, a current social demand. In addition, the challenges arising from climate change provide uncertainties about rainfall patterns and influxes into our basins, alongside the increased incidence of extreme weather events, which pose risks to our power system which relies on transmission lines that cut across our continent-sized country.

Nuclear energy has an important role to play in this context. In addition to not emitting greenhouse gases, the nuclear plants are highly resilient, as they can be installed relatively close to locations with major consumption and are relatively immune to climatic factors. Also, their

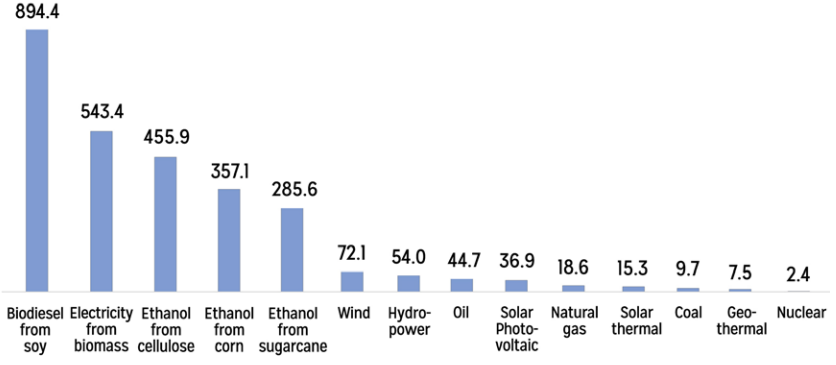
high capacity, of around 90%, translates into a firm-basis generation that provides the confidence and security of supply necessary for the extensive use of variable renewable sources, such as solar and wind. In addition, it is essential to highlight that, in a power system where more and more low-inertia rotating units (wind turbines) are added, high-inertia rotating machines, such as nuclear power station turbines, significantly contribute to the system's stability, as they compensate for transient network fluctuations and keep the frequency within adequate standards.

Socio-environmental benefits

Several socio-environmental benefits can be listed in favor of the expansion of nuclear generation:

- Due to the high installed power, the high capacity, and the small area they occupy, the plants have a high energy density, translated into MW installed per m^2 of occupied area, which makes them a significant source of energy, with reduced environmental impacts. The following graph shows the average energy density of varying energy sources.

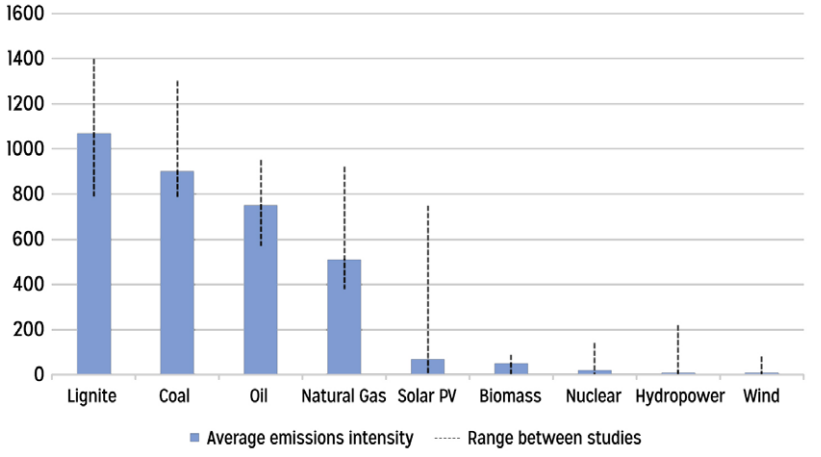
Fig. 1. **Projected Land-use intensity in 2030** (km^2/TW . hr/yr)



Source: MCDONALD. R. Energy Sprawl or Energy Efficiency: Climate Policy Impacts on Natural Habitat for the United States of America. 2009

- Nuclear thermoelectric plants are one of the sources with the lowest generation of greenhouse gases, even considering the entire life cycle of the installation and the fuel.

Fig. 2. **Greenhouse Gas Emissions** (tCO_{2eq}/GWh)



Source: WNA. Comparison of Lifecycle Greenhouse Gas Emissions of Various Electricity Generation Sources. 2011

- In terms of economic benefits, the implementation of nuclear power plants generates an expressive number of new quality jobs – direct, indirect, and induced – not only in their construction phase but throughout their existence. A 1,000 MW unit generates approximately 800 continuous, direct jobs, most of which are of higher education or specialized technical level. The indirect and induced are added to these jobs, which, according to a study by the Getulio Vargas Foundation (FGV), are 2.4 times the number of direct positions. A nuclear power complex, with six plants, generates approximately 5,000 direct jobs and about 12,000 indirect and induced jobs.

Based on what happened in Angra dos Reis, the installation of the plants also led to the opening of universities and technical courses. It could be said that the first wave of operators, in the 1970s and 1980s, came from other cities. It has become more common for current operators to be from the region itself, which makes the segment an essential vector for regional development. It is also worth mentioning that the sector provides significant revenue, at the municipal, state, and federal levels, both from the effective generation of energy and from induced economic activity.

Thermonuclear plants are leading development-inducing agents and are active participants in their surrounding communities. They get involved through socio-environmental responsibility programs, partnerships for infrastructure, sanitation, healthcare and education construction projects, and the plants' workforce participates in community and volunteer projects. The Angra dos Reis, Paraty, and Rio Claro municipalities neighboring the Angra dos Reis Nuclear Power Plant demonstrate unequivocally how much nuclear power has contributed and continues to contribute to the region's prosperity and social well-being.

The significant resources invested in construction, which have a nationalization index that can reach values up to 70%, have multiplier effects on the local, regional, and national economies. A study carried out by FGV in 2015 points out that the investments made revert to GDP according to a multiplier of 2.27. In other words, every 1.00 BRL invested adds 2.27 BRL to the Brazilian GDP.

Strategic aspects

Electricity generated from nuclear power is characterized as the sector's primary economic axis. The construction and operation of units of this nature bring significant benefits to the Brazilian Nuclear Program. These plants preserve national construction, operation, and maintenance jobs; the licensing, regulation, and inspection professions; and the positions required for the safety of activities and the physical protection of the facilities. Each of these benefits is based, above all, on the vital capacity-building, education, and continuous training of human capital.

The construction of these units also has positive impacts on the industrial sector. At this point, Indústrias Nucleares Brasileiras (INB) – which holds the Brazilian nuclear fuel monopoly – and Nuclebrás Equipamentos Pesados (NUCLEP) – which is the manufacturer of equipment for the plants – stand out.

The conventional industry, through the machinery and equipment segments, is also directly benefited. The refined technological requirements and the high-quality standards that the nuclear sector demands are developmental and training factors for the Brazilian industrial park. A continuous construction program for nuclear power plants is also justified due to investments in technology, and the training and improvement of the Brazilian industry, as has been verified in the Angra 1 and Angra 2 nuclear plants.

We cannot forget that Brazil has the sixth-largest uranium reserve in the world, having prospected only one-third of its territory and just the surface. The continuity of the plant construction program will allow the economical use of this natural wealth for the benefit of the whole society.

The sustainable expansion of the electric energy supply would involve the construction of new thermonuclear plants. That is being considered by the Ministry of Mines and Energy (MME) and related companies in their respective plans.

Final Considerations

In light of the above, here are some considerations:

- Based on the principles of Sustainable Development, the most recent analyses – including those of the UN Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency (IEA) – are not able to develop any scenario for the next thirty years in which nuclear power does not play a significant role in meeting the demands of basic, concentrated and large-scale energy generation so that, alongside renewables, it meets the needs of the energy transition for the decarbonization of the economy. The alternative would be to exhaust fossil fuels, brutally increasing greenhouse gas emissions; or deny the aspirations to improve the quality of life for billions of people in future generations;
- The use of nuclear energy often provokes heated debates, which is why we have established an objective, "unarmed" and transparent dialogue with the market and with all segments of society; and
- Brazil cannot and will not give up its rare and valuable competitive advantages in the international scenario:
    - The existence of substantial uranium reserves in our territory;
    - Technological mastery and dominance of the complete fuel cycle; and
    - The knowledge and experience in the design, construction, and operation of nuclear power plants that have been accumulated since the 1980s.

ABOUT THE AUTHOR

Admiral Bento Costa Lima Leite de Albuquerque Junior is Brazil's Minister of Mines and Energy.

Minister Bento Albuquerque began his military career in 1973, having attained the following significant Naval Positions: Commander of the "Tamoio" and "Tonelero" Submarines; Commander of the "Almirante Castro e Silva" Submarine Base; Chief Parliamentary Advisor to the Brazilian Congress; Commander of the Submarine Force; Head of the Navy Commander's Office; Commander in Chief of the Fleet; and Director General of Nuclear and Technological Development of the Navy, when he was in charge of the Nuclear Programs (PNM) and Submarine Development (PROSUB), the Navy's main Strategic Programs.

His international experience includes the post of Director-General of the Inter-American Defense Board (IADB), an entity linked to the Organization of American States (OAS), in Washington D.C., USA; and the post of the United Nations Military Observer (UNMO) during the Bosnian War – first, in the City of Sarajevo and, later, in Dubrovnik, Croatia.

In addition to completing several military courses at the *Escola de Guerra Naval* and *Escola Superior de Guerra* (Brazilian Naval War College and Brazil's Superior War College) and becoming a Doctor of Naval Science, Bento Albuquerque took graduate courses in Political Science at the University of Brasília and obtained an MBA in Public Management from the Getúlio Vargas Foundation, and an MBA in International Management from COPPEAD, at the Federal University of Rio de Janeiro (UFRJ).

05

Brazil at the forefront of biofuels

By Luis Henrique Guimarães, CEO at Cosan[44]

Article written in March 2020

In times of great discussions and global mobilization to reduce greenhouse gas (GHG) emissions and, consequently, reduce climate impacts, Brazil can be considered one of the leading countries in reaching the Paris Agreement's main commitment of limiting the increase in average global temperature below 2°C over pre-industrial levels.

According to the document signed by the Brazilian government for the Nationally Determined Contribution (NDC), which was presented in the United Nations framework on climate change, Brazil has committed itself to reducing greenhouse gas emissions by 37% below the levels of 2005, by 2025, and by 43% by 2030. Moreover, in the long run, the country will spare no effort in transitioning to energy systems based on renewable sources and the decarbonization of the world economy until the end of this century, in the context of sustainable development and the access to the financial and technological means necessary for this transition.

The goal is ambitious, we cannot deny it, and many deadlines are already knocking on our door. Still, it is possible to meet it, as noted in some historical data released by the federal government. Between 2004 and 2012, Brazil's Gross Domestic Product (GDP) increased by 32%, while the GHG emissions dropped by 52%. These numbers go against the premise that the greater the country's growth, the more challenging it is to reduce its emissions.

44. Luis Henrique Guimarães wrote the article as CEO of Raízen, a position he held from April 2016 to May 2020

But Brazil's success does not come from today. Many of these results began to be traced forty years ago with the launch of the *Proálcool* project – National Alcohol Program – at a time when little was said about climate change and greenhouse gases. In 1975, the Brazilian government launched this initiative to intensify the production of alcohol (ethanol) fuel as a way to replace gasoline. It is true that, at the time, the project was launched thinking more about the economic dimension, since Brazil was strongly impacted by the world oil crisis, which caused the product to reach very high values, than a genuine concern in reducing climatic impacts.

Based on this initiative, other positive measures have been created over the years. First, came the ethanol-powered vehicles, which Brazilians ended up preferring to such a degree that in 1991 the country registered 60% of its entire fleet (about 6 million) as being powered by biofuel. Years later, in 2003, also due to a new oil crisis, the ethanol vehicle market started to heat up again, and the automotive industry started to develop flex engines. Just to have an idea of the dimension of the gains the entry of flex cars had on the market, according to a survey made by the Sugarcane Industry Union (UNICA), from March 2003 to December 2019, consumption of ethanol (anhydrous and hydrous) reduced GHG emissions by 600 million tons of CO_{2eq}. It would be necessary to plant more than 4 billion native trees in the next twenty years to reduce the same amount of CO_2.

All of this market evolution culminated in one of the largest biofuel programs in the world, RenovaBio, a federal government program that aims to increase biofuel performance in the Brazilian transportation mix, based on predictability, environmental, economic and social sustainability, and compatible with the market's growth.

The program went into force at the end of 2019 and impacted biofuel producers and distributors across Brazil. Participation is voluntary for producers and allows *CBios* to be issued in the market. *CBios* are traded on the Stock Exchange and are generated proportionally to the amount of CO_2 emissions avoided by each of the producers.

As for fuel distributors, the program stipulates a mandatory annual target for the acquisition of *CBios*, which increases according to the sectoral target for that year and the fossil fuel market share from each player the previous year.

RenovaBio will require that the offer of biofuels incur a significant expansion to meet its objectives. Therefore, it should bring in investments in the next ten years. According to the Ministry of Mines

and Energy, more than one million jobs are expected to be generated as well as an investment in the sector of around 1.3 trillion BRL.

The expectation is that Brazil will reduce its energy vulnerability as the program evolves and start to depend less and less on the limited internal refining capacity and the variable exchange rate of imported fossil fuels.

As biofuels have a more profound penetration in the market, more attractive prices and a greater demand for flex vehicles are expected – a natural shift in the market. This tends to bring a consequent demand for investments in infrastructure for producing hybrid models for gasoline and ethanol, generate employment, and improve the economy.

From all these standpoints, it is possible to say that RenovaBio will empower the sugar energy sector as a whole since investments and new contributions will be needed to complete the goal set for the next ten years. This equips us with a sector more prepared and capable of exporting a 100% Brazilian technology: the use of ethanol for biofuel or hydrous ethanol.

The sugar-energy sector is a crucial ally on this endeavor since the national goal is to reach an 18% participation of biofuels in the energy mix (anhydrous ethanol, hydrous, and biodiesel) in the next nine years. This means including an additional 20 billion liters of ethanol production per year, almost doubling the national production that currently stands at around 27 billion liters per year.

However, a program like RenovaBio will not equalize all the challenges that lie ahead to reduce the effects of climate change, nor will it promote the total renewal of the Brazilian energy mix. Society and organizations still need to make a more serious commitment to make this a reality, as does the government in investing in new technologies and initiatives that stimulate the production of other renewable energy sources.

With Brazilian ethanol, for example, the country can become an international reference on sustainability and renewable energy. According to data from UNICA, the mixture of 27% ethanol in gasoline (E27) provides a 15% reduction in CO_{2eq} emissions per/km compared to pure gasoline. If E27 is used in a hybrid vehicle, the reduction can reach 35%.

Our ethanol's efficiency is already recognized internationally. The European Union has considered it the first-generation biofuel which most reduces GHG emissions when compared to fossil fuels. In Japan, its recognition reaches a level of 50% reduction in GHG emissions, and

it is considered as the only one to meet the reduction parameters of the Asian country.

It is no different in the USA. Under American law, our ethanol has an advanced fuel status, as the reduction in GHG emissions exceeds the 60% mark. It is so efficient and held in such high regard that we have already exported the product to California, the state with the most restrictive requirements in the world regarding GHG emissions.

In addition to first-generation ethanol, the second-generation ethanol (E2G), which is already produced by Brazil, can be considered one of the leading examples of better efficiency and should help make production more competitive. Also known as cellulosic ethanol, this fuel is made from several types of biomass. In Brazil, it is produced mainly from bagasse and sugarcane straw. E2G has countless advantages since it can be produced from the same sugarcane, using by-products that would otherwise be discarded, which reduces environmental waste. Its greenhouse gas emissions are even 30% lower than that of the first-generation ethanol.

Another differential of our biofuels portfolio is biodiesel, which has been gaining momentum and drawing market attention. Produced from vegetable oils or animal fats, since January 2008, biodiesel started to be mandatorily mixed with regular diesel. The addition of biodiesel began at 2%, and today it already exceeds 10%.

Together, ethanol and biodiesel enhance the amount of biofuels in the national energy mix and the image of Brazil as a country that values the diversity of energy sources. According to the Brazilian National Agency of Petroleum, Natural Gas and Biofuels (ANP), about 45% of the energy and 18% of the fuels consumed in Brazil are already renewable. In the rest of the world, 86% of the energy comes from non-renewable energy sources. A world pioneer in the use of biofuels, Brazil has reached a position sought by many countries that pursue the development of renewable energy sources as strategic alternatives to oil.

Recently, the ANP started a public consultation process on the specification of a new biofuel to be marketed in the national territory, green diesel. It is another option of renewable fuel for diesel combustion engines, and is produced from renewable raw materials, such as vegetable and animal fats, sugar cane, alcohol, and biomass.

The idea is for the new fuel to be added to regular diesel. With this new proposal, Brazil is moving towards an even stronger RenovaBio program. On the other hand, if the regulation of green diesel is approved, it may also positively impact the production and commercialization of

aviation biokerosene.

Even at the forefront of biofuel production, Brazil still has a lot of field to be explored, having the benefit of a vast territory, essentially agricultural, and the climatic advantages of being a tropical country. So, it is time to explore what it has best and fulfill its goals.

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Luis Henrique Guimarães has been the CEO of Cosan since March 2020. Previously, he held the positions of CEO of Raízen from April 2016 - April 2020 and CEO of Companhia de Gás de São Paulo (Comgás) from April 2013 - December 2015. Concurrent with his time at Comgás, he held the position of Investor Relations Officer from April 2015 - December 2015.

He also held the position of Executive Vice President of Sales at Raízen for two years, as part of the transition group that created the company. Luis Henrique has over twenty years of professional experience, predominantly at Shell, having occupied positions in Brazil, the USA, and England. He has a degree in statistics and an MBA in marketing from the COPPEAD Graduate School of Business – UFRJ.

06

Pre-salt's window of opportunity

By Clarissa Lins, founding partner at Catavento and Senior Fellow of CEBRI's Energy Program, **Rafael Patrocínio**, former partner at Catavento, and **Guilherme Ferreira**, partner at Catavento

Article written in March 2020

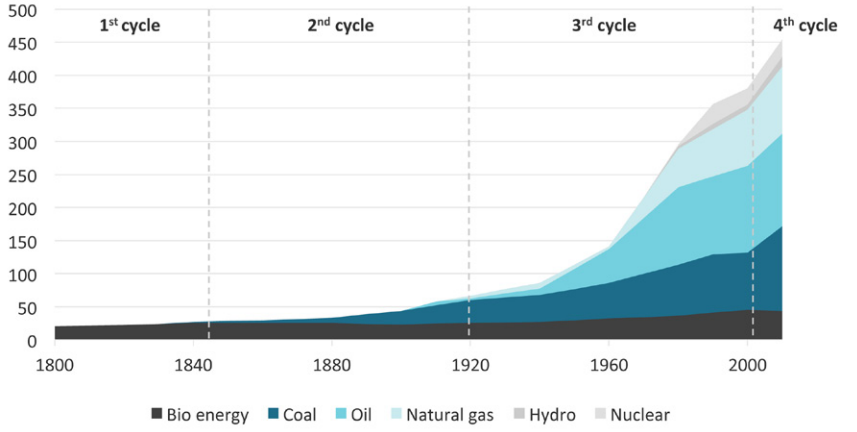
Energy transitions promote changes in the way energy is produced and consumed and remain constant throughout history. Such transformations contributed to shaping societal evolution, influencing the human capacity to establish complex relationships. Experts point to four major transitions or cycles, which were driven by technological, economic, and social issues.[45]

The first cycle, which began in the 19th century, was marked by the dominance of firewood and lasted until the first industrial revolution. The large-scale use of coal for generating electricity and heat gave rise to the second energy cycle, at the end of the 19th century. However, from the industrialization and invention of internal combustion vehicles, such as the Ford Model T in 1908, coal began to be replaced by oil, giving rise to the third energy cycle in the 20th century.[46]

During this period, oil established its position as the main source in the global energy mix due to its characteristics, notably high energy density and ease of transport and storage. An interesting fact to note is that the successive cycles never effectively provided a replacement for fuels, but rather stagnation, or reduction, in the growth rate of a given source in the years following the transitions.

45. Smil, Vaclav. Energy Transitions: History, Requirements, Prospect. 2010
46. Smil, Vaclav. Energy Transitions: History, Requirements, Prospect. 2010

Fig. 1. **Evolution of the energy mix** (EJ)



Source: Adapted from Smil, Vaclav. Energy Transitions: History, Requirements, Prospect. 2010

The transition to the fourth and final cycle is currently underway and is being driven by the need for decarbonization. Unlike previous transitions, the current one implies a less-absolute consumption of the dominant sources – fossil fuel energy. In this context, the ongoing transition results from new consumption habits, public policies, and technological advances, challenging the dominance of oil in the global energy mix.

Data from 2015 show that energy use was responsible for 74%[47] of global greenhouse gas (GHG) emissions. The energy industry's role in emissions puts it at the center of climate discussions. Given the commitments made at COP 21 in Paris, to limit the increase in global temperature by up to 2°C compared to pre-industrial levels, the decarbonization of the sector is an essential condition. It is even pointed out that climate negotiations today are, in reality, taking place around the production and use of energy.

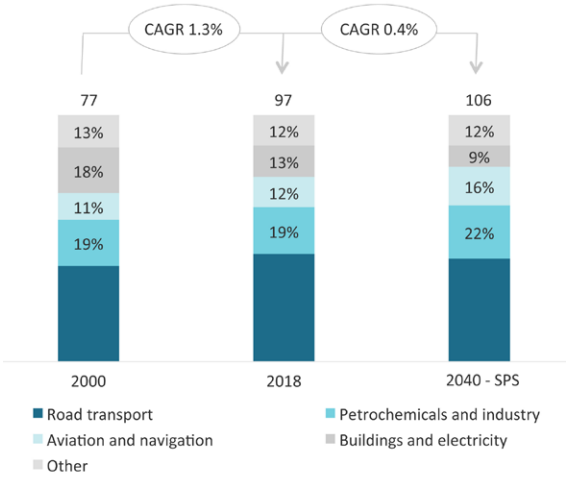
In this scenario, the advance of renewable energy sources and electrification appear as alternatives to the supply of fossil fuel sources. According to the scenario of the International Energy Agency (IEA), in line with the commitments agreed upon in Paris, the demand for oil will grow 0.4% p.a. from 2018 to 2040.[48] If compared to the growth of

47. IEA. CO2 emissions from fuel combustion. 2017
48. IEA. World Energy Outlook. 2019

1.3% p.a. from 2000 to 2018,[49] there is no doubt that competition for the supply of oil will be increasing.

Road transport stands out as the main vector for cooling off the demand for oil (CAGR of 0.2% from 2018 to 2040).[50] However, technological uncertainties regarding the decarbonization pattern of sectors such as aviation, navigation, the energy-intensive industry, and the petrochemical industry indicate that there will still be room for oil in the global energy mix,[51] as illustrated in the following chart.

Fig. 2. **Oil demand by sector** (Mb/d)



Source: IEA. World Energy Outlook. 2019. SPS – Stated Policies Scenario, World Energy Outlook, IEA

Still, the IEA scenario points to a peak in oil demand in 2040, while other projections point to such a peak between 2025 and 2050.[52] Such perspectives, therefore, imply a sense of urgency for the development of the most competitive oil reserves.

In light of the context described above, it is clear that countries with abundant reserves and an attractive regulatory environment should leverage opportunities for their utilization. The next few decades seem to indicate, in fact, the last window of opportunity for the oil sector.

49. IEA. World Energy Outlook. 2019

50. IEA. World Energy Outlook. 2019

51. JP Morgan. Mountains and Molehills: Achievements and Distractions on the Road to Decarbonization. 2019

52. Oxford Institute for Energy Studies. Peak oil demand and long-run oil prices. 2018

Brazil's case does draw attention. The country is currently the 10th largest producer in the world, a position achieved by the dramatic development of the industry in recent years. Since the sector opened, production in Brazil has gone from 1.2 million barrels per day to 2.8 million barrels per day,[53] which corresponds to a growth of 4.4% p.a.[54]

The technological advances that enabled the discovery of the pre-salt layer in 2007, together with the improvements provided in the regulatory environment since 2016, have positioned Brazil as one of the most attractive regions for oil exploration and production. In 2014, pre-salt corresponded to 17% of the national production, while it attained a total of 63% in 2019.[55] During the same period, the sharing and concession auctions have collected more than 41 billion BRL through subscription bonuses. It is also noteworthy that approximately 70 billion BRL were collected in the auction of the surplus from the transfer of rights, held in 2019.

The IEA points to a Brazilian oil production of 4.7 million barrels per day in 2040, representing 25% of the increase in global supply in the same period, behind only the USA, which would contribute with an impressive 53%[56] of the total increase. There is no doubt as to the opportunity for oil and gas production in Brazil, notably in our country's ultra-deep offshore basins, thanks to privileged geology.

However, the growing pressures from public policies, investors, and society in general – in favor of a low carbon economy – show that the time to explore such reserves is now, under the threat of being considered stranded assets.

The comparison of the breakeven price of oil production between different regions can be used to measure vulnerability at lower prices, making the level of competitiveness in the pre-salt layer clear (see the following graph). Furthermore, recent data show that, in addition to having a competitive cost, the Brazilian pre-salt is also carbon efficient.[57] In this manner, Brazil can place itself in a differentiated position within a market still thirsty for the energy density that oil provides, but aware of its unequivocal responsibility for reducing GHG emissions.

53. ANP. Anuário Estatístico Brasileiro de Petróleo, Gás Natural e Biocombustíveis 2019. 2019. Available at: <http://www.anp.gov.br/publicacoes/anuario-estatistico/5237-anuario-estatistico-2019>

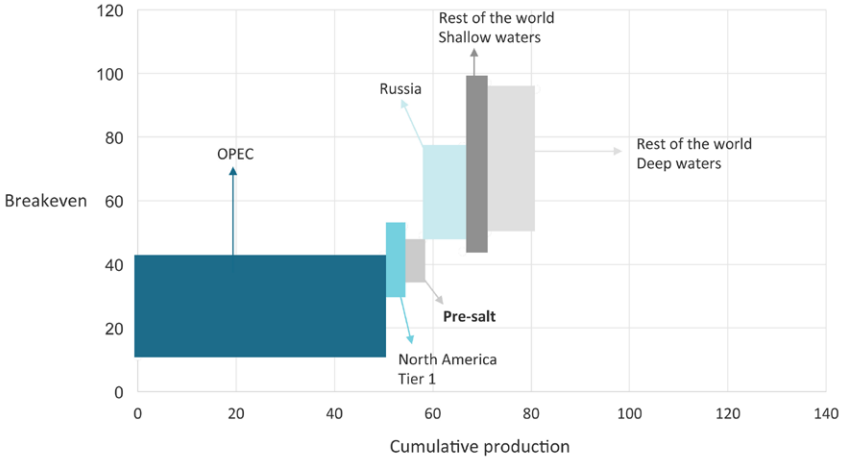
54. IEA. World Energy Outlook. 2019

55. IBP. Evolução da produção de petróleo e gás natural no pré sal. Available at: <https://www.ibp.org.br/observatorio-do-setor/producao-nacional-de-og-e-pre-sal/>

56. IEA. World Energy Outlook. 2019

57. Petrobras. Petrobras Day 2019 – London. 2019

Fig. 3. **Competitiveness in oil production**
Breakeven (US$/bbl) x cumulative production (mbd)



Source: Petrobras. Investor Day Londres. 2018

The challenges imposed on the future of energy are marked by the need, on the one hand, to respond in a coherent and consistent manner to climate pressures and, on the other, to deal with the growing competitiveness of renewables and electrification. If the scarcity of oil frightened analysts in the 20th century, today, the discussion at hand is the peak demand date.[58] Global scenarios show the share of oil in the global energy mix reducing from 34% in 2018 to 28% in 2040.[59] Therefore, it is essential to transform our pre-salt reserves into wealth for Brazil with a competitive, predictable, and safe environment. There is no doubt that the business environment is increasingly challenging and that there is no time to waste.

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ABOUT THE AUTHORS

Clarissa Lins is the founding partner at Catavento Consultoria, since 2013, and Senior Fellow at CEBRI, where she is responsible for structuring the Energy Program (July 2017). Clarissa is the President of the Brazilian Petroleum, Gas and Biofuels Institute – IBP (November 2019), where she was a member of the Executive Committee (2016-2019). She is also a member of Suzano's Sustainability Committee (August 2019) and the Global Future Council on Advanced Energy Technologies at the World Economic Forum (September 2018).

Clarissa was a member of the Petrobras Board of Directors (May 2018 to December 2019), an independent member of the Sustainability Committee of Vale's Board of Directors (May 2017 to 2019), and Executive Director of the Brazilian Foundation for Sustainable Development (2004-2013). She worked in the public sector for several years, at the Ministry of the Economy (1993-94), at BNDES as special advisor to the CEO (1995-99), and at Petrobras as special advisor to the company's CEO and executive manager of Corporate Strategy (1999-2002).

Clarissa Lins is an economist with a Master's Degree in Economics from PUC-Rio, Brazil.

Rafael Patrocínio was a partner at Catavento Consultoria from January 2018 to February 2020. His area of expertise focused on analyzing trends and sectoral perspectives with an emphasis on energy transition, infrastructure sector challenges, the impact of climate change, and national energy policies. Rafael is co-author of "*O setor de infraestrutura em 2022*" (The Infrastructure Sector in 2022) policy paper - August 2018, and "Transição energética no setor marítimo" (Energy Transition in the Maritime Sector) - August 2019. Rafael previously worked in the area of mechanical equipment for infrastructure projects at Promon Engenharia as an intern (January 2016 to February 2017).

He has a Master's Degree in Corporate Finance from COPPEAD (August 2017 to October 2019) and a bachelor's degree in Mechanical Engineering from PUC-Rio, Brazil (2017).

Guilherme Ferreira has been a partner at Catavento Consultoria since January 2018. He is an expert on mapping and identifying trends and their respective risks and opportunities for corporate strategy, with an emphasis on climate change, urban mobility, and energy transition. Guilherme is co-author of different studies, including "Belt and Road Initiative: *Oportunidades e aprendizados para investimentos em infraestrutura e energia no Brasil*" (Opportunities and Learning for Investments in Infrastructure and Energy in Brazil) - 2019, "Revolução elétrica: um cenário possível para o Brasil?" (Electric Revolution: A Possible Scenario for Brazil?) - 2019, "O setor energético em 2022" (The Energy Sector in 2022) - 2018, and "Novas tecnologias e digitalização do setor energético" (New Technologies and Digitalization of the Energy Sector) - 2018.

Guilherme holds a graduate degree in Business Management from Fundação Dom Cabral – RJ (January 2019 – July 2020) and a bachelor's degree in Production Engineering from PUC-Rio (2018), with an additional certificate in Entrepreneurship.

07

How to guarantee greater competitiveness to the Brazilian Oil & Gas E&P sector?

By Renata Isfer, former Secretary of Oil, Gas, and Biofuels at the Ministry of Mines and Energy,[60] and **Rafael Bastos**, Director of the Oil and Natural Gas Exploration and Production Policy Department of the Ministry of Mines and Energy

Article written in April 2020

Today, Brazil has 123 contracted companies (ANP, 2020) to carry out exploration and production activities for oil and natural gas, belonging to 97 different groups. It is a timid number when compared to more developed markets such as the United States, with more than nine thousand independent agents (Independent Petroleum Association of America - IPAA, 2020).

Such differences cannot be explained by the natural conditions of our subsoil. On the contrary, Brazil has a unique diversity of sedimentary environments conducive to generating and accumulating hydrocarbons. In this article we address the necessary measures to attract investments, considering the specificities of each of these environments.

Mature basins have a considerable collection of geological and geophysical data, which have had fields in continuous production for some decades and are in full decline of their production curve. For these basins, maximum use should be made of the resources already discovered by increasing the reservoir recovery factor. The average

60. Renata Isfer wrote the article as Secretary of Oil, Gas, and Biofuels of the Ministry of Mines and Energy, a position she held from October 2019 to April 2020

recovery factor of these fields in Brazil is expected to be of 24% (ANP, 2017), and the same index in the world is around 35% (Eni, 2012). For each percentage point of increase in the recovery factor, we can add about 160 million barrels of oil to national reserves.

It turns out that 88% of production in mature basins occurred under Petrobras' operation (ANP, 2020). Nonetheless, the state company's strategic objectives and financial efforts turned to exploration and production in deep waters, especially in the Brazilian pre-salt. For this reason, Petrobras started a major project to assign land production concessions in 2016.

This initiative was driven by regulatory measures from Brazil's Ministry of Mines and Energy (MME), the Brazilian Energy Policy Council (CNPE), and the Brazilian National Agency of Petroleum, Natural Gas and Biofuels (ANP), which determined rules for the return or assignment of terrestrial fields with investments considered insufficient. The divestment plan is allowing a range of new small and medium-sized companies to start operating such assets. It brings the expectation of implementing reservoir management systems on an appropriate scale, reducing costs and advancing in hydrocarbon recovery techniques (EOR).

This fact alone should stimulate an increase in the diversification and competitiveness of producing companies in the Brazilian onshore market, as well as an increase in the number of goods and services suppliers. However, additional initiatives are essential for this diversification model to be successful.

Having access to refineries and selling oil under fair market conditions are among these necessary initiatives. On that subject, it is worth mentioning that Petrobras is selling eight refineries in Brazil, which will increase competitiveness in the refining sector. It is also essential to create regulatory incentives for building small and medium refineries and ensure that a possible future dominant agent offers competitive prices for the acquisition of oil and gas production.

Another important measure for the diversity of players in the onshore market is the reduction of production royalties, now set at 10% for almost all of Brazil's producing fields. When reaching the final stages of production, the very incidence of this governmental participation can make the continuity of activities unstable. On the other hand, reducing this percentage to the legal limit of 5% can maximize the use of petroleum resources, increasing the lifetime of the field and maintaining tax payments and government shares for a longer time.

We now move to exploratory frontier basins, which do not have enough geological and geophysical data to make a reliable assessment of their potential to discover oil and gas reserves. In addition to the Campos and Santos Basins, the Brazilian offshore market has an immense capacity to be explored. The recent discoveries in the deep waters of the Sergipe-Alagoas Basin and massive fields off the coast of Guyana and Suriname indicate a similar potential in the basins of the Brazilian equatorial coast.

However, despite the substantial aptitude for generating revenue and creating jobs, its effective exploration depends on overcoming the difficulties concerning environmental licensing. For example, we can cite the fact that there was no licensing of any well in the blocks of the 11th Round of Concession, held in 2013.

It is essential to adopt measures that seek predictability in the licensing process so that the main industry players become interested in the opportunities offered in these areas. These measures include developing decision-making guidelines, such as the prior definition of studies about the main impacts and mitigating measures, and establishing specific procedures to support sectoral planning and block offers.

Also, it would be beneficial if the tax reform promoted the simplification of taxation and focused on taxing the profit and not the revenue. The current system established by Brazilian legislation imposes more taxation in the exploration phase, which ends up contributing to the fact that many potentially great areas are not economically viable. If the same tax burden were transferred to the production phase, we could have more projects in the Brazilian basins.

We now take one step further to address the exploratory land basins. Brazil has immense land sedimentary areas that are barely explored or almost unexplored. The Paraná, Solimões, Amazonas, and Parnaíba Basins total almost 3 million km^2 of sedimentary area and only 908 wells drilled (ANP, 2020).

The lack of exploratory data can be mitigated through government investments with the acquisition of regional data that allow interested companies to have minimal knowledge about the geological framework and the identification of possible petroleum systems. Research, Development, and Innovation (RD&I) funds, currently corresponding to approximately 2 billion BRL per year, could possibly be another financial source to put towards data acquisition.

Alternatively, a legal change could be made to adopt the same rules as in Mining Law. In this system, the federal government would first grant a research permit to a company interested in the exploration phase and, if the field is declared commercial, the same company will receive the production right. With that, there is more incentive for a player to perform studies and invest in a certain area since they will have the right to produce any quantity of oil and gas they discover.

The locations of these areas are another investment obstacle, far from consumer centers and with logistical and monetization difficulties. The development of a liquid and competitive market is fundamental to increasing the attractiveness of these fields, especially concerning natural gas. Developing this market would encourage the construction of flowline and transportation infrastructure, and integration with the electricity sector.

There's an additional initiative concerning improvements to the exploratory model of the bidding documents. The possible solution is to bid for much larger blocks, or even entire sectors, that would allow the concessionaire to survey basic regional data, with the partial return of areas according to the evolution of the studies.

Finally, in relation to the basins of the pre-salt polygon, the applicability of the production sharing regime should be assessed. Ten years after the Law Nº 12.351 was published, and after seven bidding rounds, this model is worn out. It is a consensus among geoscientists that there are no more opportunities within the polygon that provide the binomial low geological risk and high production potential, premises used at the time to change the legal framework.

On the other hand, with regard to areas not yet contracted, there is considerable potential for exploring the post-salt horizons, characterized by more modest volumes and considerably higher exploratory risk than the pre-salt.

The choice of regime, concession or sharing, must be rationally based on the possibility of foreseeing or not the amount to be collected by the Brazilian government in each area, which depends on its oil potential and geological risk. When the geological risk is high, it becomes difficult to establish an appropriate sharing percentage, whether by the Union or by market agents.

The sharing contract has a greater cost and is considered to be more complex due to the need to approve the incurred expenses. Other

aspects considered as negative are Petrobras' preemptive right and PPSA's mandatory participation in the consortium and operational committee – with 50% of the votes and veto power –, without assuming any risk related to the execution of the contracts.

Therefore, the increase in competitiveness of the pre-salt polygon depends on the flexibility of the production sharing regime, to allow areas of greater exploratory risk to be auctioned under a concession regime.

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Renata Isfer was Secretary of Oil, Gas, and Biofuels of the Ministry of Mines and Energy (MME), a position she held from October 2019 to May 2020. She was also Legal Adviser to the MME from 2016 to 2019. She was active in creating public policy that enabled the recovery of the gas, oil, electricity, and mining sectors, in addition to coordinating the project for the *Mega Leilão dos Excedentes da Cessão Onerosa*.

She has twelve years of experience as General Counsel for the Federal Government. Renata has a bachelor's degree in Law from the Curitiba Law School, with a Graduate Degree in Tax Law from the same institution. Renata is currently getting a Master's in Law, Public Policy, and Economic Development at the University Center of Brasília (UNICEUB). She has participated in an extension course at Harvard Kennedy School on female leadership and was the co-creator of the *Sim, elas existem* ("Yes, they exist") Project.

Rafael Bastos da Silva is a geologist holding a bachelor's degree from the State University of Rio de Janeiro (UERJ) and a Master's in Geology from the Federal University of Rio de Janeiro (UFRJ). As a servant of the Brazilian National Agency of Petroleum, Natural Gas and Biofuels (ANP), since 2005, Rafael has worked mainly in the agency's exploration and production areas, having held the positions of Exploration Superintendent, Development and Production Advisor, and Advisor of the Board. Since January 2020, he has served as Director of the Oil and Natural Gas Exploration and Production Policy Department of the Ministry of Mines and Energy.

08

Opportunities for the Brazilian Oil & Gas Industry's supply chain

By José Firmo, President at Porto do Açu (PdA)

Article written in April 2020

Conclusion

When trying to read a new article, I often find myself reading the conclusion first, with the intention to go directly to the answers to the questions that are almost always listed in the title. So, here are my conclusions.

At the end of 2019, the supply chain began to move towards a new wave of exploratory activity that had already started in Brazil and which had and still has the potential to be celebrated as the best phase of the goods and services industry since the 2014 collapse.

We know this equation well: ...once the economics of reserves in the blocks bid upon since 2016 have been proven during the "reopening of the industry," a new wave of production development projects will be formed. Each ultra-deepwater development project requires investments of around 4 to 5 billion USD, with approximately 75% of this amount flowing into the revenue line of companies in the goods and services chain in order to feed their very malnourished balance sheets, consequently creating jobs, taxes, and socioeconomic development in the regions where these operations are located.

The Brazilian O&G sector had its most powerful moment marked by the statistics of December 2012, when it counted 71 floating rigs operating in Brazilian waters, almost 1,000 wells drilled on land, and more than 200

wells drilled at sea. At that time, we had exploration and development activities on land, shallow water, deep post-salt water, and pre-salt's deep and ultra-deepwater. At that time, fueled by twelve years of market opening in the industry since the 1999 regulatory framework that broke Petrobras' monopoly on E&P, our industry was investing an unbelievable 33 billion USD a year just in upstream.

Compared to those booming times, in the 2018/19 biennium after the disastrous hiatus of bidding rounds and numerous regulatory misunderstandings, the sector was experiencing the worst level of activity in the supply chain, reaching numbers below fifteen operating floating rigs and almost no onshore drilling activity, except for Eneva's highly successful operations, which maintained two rigs operating uninterruptedly in the Maranhão Basin.

However, in the last three years, exploratory block bids have attracted more than 10 billion USD, which correspond to more than 75% of the total volume of capital that oil companies have invested in exploratory areas worldwide. This means that after the removal of Petrobras' obligation to be the only operator in the pre-salt layer and the implemented regulatory advances, a new phase of activity in the O&G sector has already been contracted and is in progress.

Up until March 2020, I could stop my arguments here. Nevertheless, at the close of this first quarter of 2020, the COVID-19 pandemic and its humanitarian, social, and economic effects put all these plans on hold.

The breadth of this new wave of activity, as well as its timing, will be defined by the investment appetite that large companies will show after the cloud of confusion caused by the virus and by the historical drop in demand that occurred in the last three months.

We are experiencing a flock of black swans that has the potential to transform our industry. Will we be able to develop our "*antifragility*"?[61]

61. "'Antifragility' is a property of systems that increase in capability to thrive as a result of stress, shocks, volatility, noise, mistakes, faults, attacks, or failures," Nassim Nicholas Taleb

Now I can start the article in a more traditional fashion...

The oil and gas industry (O&G) is part of almost every daily activity and in the lives of every inhabitant on the planet who enjoy modern and technological life. However, despite being so close to us, in general, this is perhaps also one of the least known industries and most affected by legends and ideological dogmas that hinder it from being understood well.

As such, it is perhaps more prudent to stick to a better definition of the players before going directly to the merit of the opportunities.

The first major division to be made to improve the understanding of this issue is to define the three major primary chains in this industry: the upstream, which involves all the exploration, production development, production, and decommissioning of the projects; the midstream, mainly responsible for oil and gas pipeline infrastructure and production transportation; and the downstream, characterized by refineries and the distribution/marketing of the final products (i.e., diesel, gasoline, etc...).

All the following content refers specifically to the upstream O&G supply chain, which is basically composed of the following main players:

- **Resource holders** - they own the rights to the subsoil and its mineral wealth. Throughout most of the world, the resource holder is the country where the oil fields are located. This empowers the government to be responsible for defining the exploration model, the policies for restricting or opening the O&G market, and the speed (measured in decades) at which the reserves will be converted into production and, consequently, wealth for the population. In the USA, as an exception, the rights of the subsoil belong to the owner of the land, that is, the property right extends vertically and allows the owner of the land to control any mineral extraction or hydrocarbon production (O&G) activity;

- **Operators** - in Brazil, they are more commonly known as the oil companies. These are the companies that acquire the exploratory lots or blocks and the exploration and production rights through a fixed-term concession or sharing contract (usually 25 to 30 years). This group is mainly characterized by its specialized management of the extremely-high exploratory risks, and the development of knowledge science and O&G reservoir management. This activity requires long-term investments, almost always in the billions of dollars, associated with the high

risks of exploration and production. The investment is similar to that of infrastructure in volume and term, but without the guarantee of return customarily associated with projects in the infrastructure sector;

- **Supply chain** - commonly called suppliers. This group of companies exists in all other industrial segments, but in O&G, it goes far beyond the simple activity of delivering goods and services required by operators. The O&G supply chain has its origin and central pillar of responsibility in the technological development that has enabled the industry to succeed in exploring onshore fields, during its early steps, in wells 150 m deep with investments in the order of thousands of dollars, to the technological revolution needed to find, explore and produce O&G in wells 300 km offshore, with more than 3,000 m of water depth, final depths above 5,000 m, and investments of tens of billions of dollars.

It is essential to breakdown the supply chain for a better discussion of opportunities in this sector. The supply chain is fundamentally divided into three major groups:

- Seismic and well construction consist of a group of companies that, in partnership with the operators and after the acquisition of the exploratory blocks, define the exploratory program; build and test the wells necessary to evaluate the projects' economics; participate in the detailed definition of the production development program (if the project is considered to be economical); and build the development wells. For example, in a typical project in a Brazilian pre-salt field, this phase has an investment of approximately 1.5 billion USD;

- The subsea pipe and flowline infrastructure consist of a group of companies that – after defining the production parameters (i.e., type of oil, gas characteristics, pressure, and temperature of the reservoir, etc...) – perform the engineering, construction, and installation of the entire infrastructure that it is located between the water surface line and the seabed, necessary for the safety, control, and flow of production that comes from each well to the surface production facility (topside). For example, in a typical Brazilian pre-salt project, this phase also has an investment of approximately 1.5 billion USD;

- Production facilities (topside) consist of a group of EPCI companies (engineering, procurement, construction,

installation) that are responsible for the installation and, in the case of chartering operation, the production facilities that can be fixed (supported onto the seabed) or floating in deeper sections of water. The most well-known production systems in Brazilian projects are called FPSO ships – floating production storage and offloading vessels. For example, in a typical Brazilian pre-salt project, this phase has an investment of approximately 2 billion USD.

Once the players and components of this complex upstream tanker supply chain are well defined, we can then describe how Brazil fits into this environment of global competition for resources.

The Brazilian supply chain originally developed onshore with the start of exploration in northeastern Brazil, more specifically in the Candeias field, in Bahia, even before the creation of Petrobras. However, it was Petrobras and its unequivocal ability to venture out and conquer the deep water that defined the development of suppliers and, consequently, the technology that describes the environment here today.

With the massive offshore development in the Campos Basin, Brazil quickly became a center of subsea excellence. The development of technologies capable of exploring and installing production systems underwater at depths of 1,000 and then 2,000 and 3,000 meters were achievements stemming from technological partnerships between Petrobras and its suppliers, combining all international investments of the global subsea supply chain in research, development, and innovation (RD&I).

This sector has already experienced volumes and backlogs of hundreds of pieces of equipment (i.e., ANM – wet christmas trees, subsea manifolds, flexible production lines, etc.), and today its factories are on hold for the restart of numerous production development projects.

In summary, Brazil produces cutting edge technology and has installed one of the largest and most competitive subsea clusters in the world, exporting equipment for various international projects. Brazil's local industry is absolutely prepared for the ongoing activity increase in this segment.

Within the well construction segment, there are large service companies that, besides producing equipment, concentrate on developing technology, training, and validating highly-certified labor for the operation of complex service activities such as seismic services, drilling, and finalizing wells. Here, there are the largest number of jobs

and also the greatest impact on the socioeconomic development of regions such as the northern part of the State of Rio de Janeiro.

According to a study by UFRJ, approximately 26 thousand direct and indirect jobs are created for every 1 billion USD invested in E&P CAPEx. Thus, a total of 33 billion USD in annual investments, generating more than 800 thousand jobs, mostly located in the State of Rio de Janeiro. At the beginning of the industry's development, Macaé received an avalanche of foreigners who were necessary for implementing projects. During the high activity of 2013/2014, ABESPETRO's estimates indicated a total reversal of this situation, with 94% of the jobs filled by Brazilian specialists.

In this segment, the divestment and layoffs that occurred in recent years imposed a challenge that is still infrequently discussed in the sector. The fact is that all companies today have human resources, machines, and equipment reduced to a fraction of what was available in 2012. On average, the workforce was reduced to 1/3 of the levels at that time, and all equipment that had the opportunity to be exported went on to other projects in the world.

Considering that we will have a material increase in activity when several companies enter the production development phase at almost the same time, we will undoubtedly have a shortage of qualified labor and equipment that will result in increased risks and operational costs. We will confront many challenges to attract, develop, and retain the talents necessary for increasing progress in this segment.

Finally, the pursuit to construct production platforms was initially developed because Petrobras was motivated to bring to Brazil the engineering and construction capacity to produce fixed platforms for the shallow waters of the Northeast and for the Campos Basin. As Petrobras set every world record in deep waters, the need for floating solutions arose, and, once again, through its impressive research capacity and technical staff, the company created innovations such as the PP de Morais vessel. The term FPSO was internationally formalized in 1992, but, well before that – under the name of PP-Moraes – it already produced, stored, and transferred oil in the 1980s and 1990s, when I had the opportunity to land there several times during my adventures with a Schlumberger engineer.

Today, almost all of Brazil's daily oil production is in deep waters and consequently comes from FPSOs. In the future, when developing the pre-salt, Brazil will continue to be the most significant and largest market for new FPSOs in the world, attracting everyone in the supply

chain to this sector. According to estimates by several experts, more than 50% of all FPSOs that will be contracted in the next decade will come to the Brazilian market. Unsuccessful experiences and exaggerated requirements for unachievable competitive percentages of local content have already destroyed billions of dollars and caused irreparable damage to every link in this chain. The industry supports the fact that Brazil must continue to seek to maximize the use of its engineering, construction, and integration capabilities on these platforms, but always striving for global competitiveness and economically sound projects. We have already learned the hard way that "100% of zero projects" means a halt to activities and catastrophic economic destruction.

Finally, throughout the life of the oil and gas industry, suppliers of goods and services have systematically invested billions of dollars annually in technology, innovation, and the training of highly specialized human capital. For many decades, this has enabled the industry to conquer technical challenges, find and produce oil and gas in extreme conditions, lower costs, and feed the planet with energy.

In the last decade, operators have managed to transform the business environment, and simple observation of the balance sheets of the largest companies in the goods and services sector demonstrates not only the fragility of the entire sector but also the almost total reduction of their investment capacity.

The effect of this massive reduction of investments in technology and less building of capital in the goods and services sector will only be seen over the next few years. This is happening just when alternative energy sources, OPEC's weakening, COVID-19, and the biggest shock of demand in our history met to challenge us...

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09

New Natural Gas Market: Prospects for a more competitive market

By Luiz Costamilan, Executive Secretary for Natural Gas at the Brazilian Petroleum, Gas and Biofuels Institute (IBP), and **Felipe Botelho**, specialist at the Brazilian Petroleum, Gas and Biofuels Institute (IBP)

Article written in March 2020

Since its launch in 2019, the *Novo Mercado de Gás* (New Natural Gas Market Program) has been mobilizing the natural gas industry and the government in structuring new governance.[62]

The program took shape from Decree Nº 9616/18 (capturing relevant aspects of the *Gás para Crescer* Program) and from the two resolutions of the National Energy Policy Council (CNPE) in 2019, Res. Nº 4 (creating the *Comitê de Promoção da Concorrência*, Competition Promotion Committee in English) and Res. Nº 16 (establishing the transition guidelines and criteria for opening the market). Concurrently, and fundamental to the opening, the Cease and Desist Agreement (TCC, in Portuguese) signed by the Administrative Council for Economic Defense (CADE) and Petrobras determined actions and conducts that the company must respect in order to restructure the market with new players.[63]

62. COSTAMILAN, Luiz; TAVARES, Felipe. Texto sobre o Novo Mercado de Gás. Newsletter Fluxo 38. 2019. Available at: <http://www.fluxosolutions.com.br/newsletter-38/a-abertura-do-mercado-de-gas-natural-no-brasil-o-caminho-do-crescimento>

63. The Petrobras/CADE TCC commitments are:

i. the sale of assets and interests in the transport sector (Nova Transportadora do Sudeste - NTS, TAG, and Transportadora Brasileira Gasoduto Bolívia-Brasil S.A. - TBG) and distribution of the company (especially Gaspetro);
ii. transparency in the volumes removed and injected during transportation;
iii. declining exclusivity as a carrier;
iv. negotiated access to essential infrastructure;
v. no contracting new volumes of natural gas; and
vi. lease of a regasification terminal in Bahia.

In this sense, a series of steps must be taken so that the market can take shape, and its effects are actually observed.

What are the objectives of the New Natural Gas Market Program?

Among the different objectives of market opening, we could highlight the following: competition, liquidity, market prices, transparency, unbundling, access, expansion and entry of new agents, clear rules, equality, new governance, and government coordination at its various levels.

The New Natural Gas Market Program intends to transform the governance of the chain as a whole. Starting with the supply of natural gas, the focus is placed on **expanding the number of providers and securing negotiated access to essential infrastructure**, which eliminates potential barriers to access. At the **transportation segment**, the strategy was to promote a profound reorganization under an **Inputs and Outputs (I/O) model**, with a systemic vision of democratizing access to transport (sharing the nomination with those who inject and remove gas from the system). Additionally, the Program opted to **use the authorization regime to facilitate investments in expanding transport**, instead of the concession regime, also **ensuring the independence of carriers** with other agents participating in the market. Finally, **the role of states** stands out at the other end of the chain, using their regulatory agencies **to create the market environment** necessary for new players to emerge, **aligning the regulation of natural gas distribution**.

In practical terms, by creating this opening strategy to attract new gas producers/providers, the rules for negotiated and non-discriminatory access to essential infrastructures will be established, such as the outlet gas pipelines, processing units, and liquefaction/regasification and natural gas storage terminals.[64] In addition to the liberalizing aspects of purchasing and selling the molecule, the goal was to expand the diversity of agents in the regulated segments, particularly in transport. Transport is the backbone of a natural gas system, and it is crucial that gas providers and customers have free access to transport. The conditions referring to transport access, capacity, service, and the remuneration of transporters (to define tariffs) are all established by the Brazilian National Agency of Petroleum, Natural Gas and Biofuels (ANP).

In the distribution segment, the program aims to separate marketing

64. Although not yet available in Brazil, the importance of storage infrastructures will become increasingly evident as the need for coordination grows with the number of agents (balancing, typical variations in supply and demand, batch purchasing Liquefied Natural Gas - LNG, system security)

activities (competitive regime) from the molecular handling service (monopoly). It is the responsibility of the states, through their regulatory agencies, to promote this opening process, as well as to establish prioritized, well-defined conditions for free consumers, self-producers, and self-importers.

In this sense, the coordination of the chain's segments is connected to the coordination and alignment of the levels of the federation, not only in regulatory but also in tax matters.

Where are we and where are we going?

Several action fronts are being deployed simultaneously to develop the guidelines and objectives that were established for the New Natural Gas Market Program.

First, the **Petrobras/CADE TCC** has advanced. Among the actions taken (in the first six months) and those that have already started, we have:

Actions Performed	Initiated Actions
1. Declined from exclusivity in natural gas transportation contracts entered into with carriers; 2. Indicated Petrobras' injection and withdrawal capabilities in the Transport System; 3. Made a draft contract for the provision of processing services in the natural gas treatment units (UTGs) available to the counterparties; 4. Appointed independent directors for the boards of directors of TAG, TBG, Gaspetro, NTS, and TSB (for the functional unbundling of companies); 5. Hired a Monitoring Trustee to monitor compliance with the TCC terms.	1. Pre-qualification process for those interested in leasing the Bahia Regasification Terminal and its gas pipeline; 2. The Commitment Agreement was signed with the ANP within the scope of TBG's Public Bid (CPAC), to provide surplus transport capacity; 3. The Transition Agreement was signed within the scope of the Petrobras/Yacimientos Petrolíferos Fiscales Bolivianos (YPFB) Natural Gas Supply Agreement (GSA), to change certain commercial conditions contained in the GSA, during a transition period (1/1/2020 to 3/10/2020), considering the new context of the natural gas market in Bolivia and Brazil, and new opportunities for the parties. Reducing the daily contracted quantity is among the conditions, which would immediately release gas to other potentially interested parties; 4. Sale of the share of transport assets (TAG, NTS, TBG) and distribution (Gaspetro); 5. Negotiations regarding access to gas lines and processing.

Source: Petrobras[65]

65. Petrobras. Petrobras acelera iniciativas para abertura do mercado de gás. Fatos e Dados. 2020. Available at: <https://petrobras.com.br/fatos-e-dados/petrobras-acelera-iniciativas-para-abertura-do-mercado-de-gas.htm>

At the same time, Bill N° 6.407/13, which will repeal the Natural Gas Law, if passed, would cover the various dimensions and transformations necessary for establishing the new gas market, which was not addressed by the previous Law. The Bill brought forth some noteworthy advances:[66]

(i) The negotiated access to essential infrastructures (natural gas lines, Gas Processing Units (UPGNs), and LNG terminals), ensuring preference to the owner;

(ii) Adaptations to the transport segment such as access, authorization regime for new gas pipelines, contracting capacity by I/O, and its unbundling;

(iii) Clarification of which agents can commercialize natural gas;

(iv) Uniformity of state regulations.

In the regulatory sphere, a new ANP Regulatory Agenda was established when the New Natural Gas Market Program was launched. There are great challenges in sequencing and coordinating actions for orderly implementation and transition to the I/O model and creating the new market.

ANP Regulatory Agenda Actions

2020

- Carrier autonomy and independence criteria
- Interconnection between transport pipelines
- Criteria for calculating transport fees

2021

- Guidelines for Common Access Codes
- Rules for Loading and Trading natural gas in the I/O model
- Criteria for increasing transport capacity
- Pass-through mechanisms between transporters

2022

- Rules that include transportation services, capacity assignment, CPACs, and others in the I/O model

2023

- Conflict Resolution Regarding Access to LNG Terminals
- Characterization of the Natural Gas Transport System

Source: ANP[67]

66. Cartilha IBP/ABRACE. O que você precisa saber sobre a Modernização do Setor de Gás Natural no Brasil. 2019. Available at: <https://www.ibp.org.br/material/publicacoes/o-que-voce-precisa-saber-sobre-a-modernizacao-se-setor-de-gas-natural-no-brasil/ >; Cartilha IBP/ABRACE. Cartilha sobre o consumidor livre. 2020. Available at: <https://www.ibp.org.br/material/publicacoes/cartilha-sobre-o-consumidor-livre/>

67. ANP. ANP divulga agenda regulatória no âmbito do Novo Mercado de Gás. 2020. Available at: <http://www.anp.gov.br/noticias/5278-anp-divulga-agenda-regulatoria-no-ambito-do-novo-mercado-de-gas>

Within the scope of states, some regulatory agencies are already delimiting the role of distributors and creating an environment for free consumers, self-producers, and self-importers. The Federal Government created incentives for this movement by the states through the *Programa de Equilíbrio Fiscal* (Fiscal Balance Program, or PEF)[68] and the *Programa de Fortalecimento das Finanças Estaduais* (State Finance Empowerment Program, or PFE).[69] In addition to the possibility of inclusion in these programs, the prospect of making new projects viable mobilizes Brazilian states like Sergipe and Rio de Janeiro to reevaluate their state regulations.

In Rio de Janeiro, the Energy and Sanitation Regulatory Agency of the State of Rio de Janeiro (AGENERSA) established a new regulatory framework, serving as a model for the other states.[70] Among the established changes are: (i) the definition of the Free Consumer; (ii) the reduction of the minimum consumption to 10,000 m^3/day of natural gas; and (iii) the creation of a specific tariff (TUSD-E) to remunerate distributors for the use of the dedicated distribution system.

The challenges along the way...

The opening does not dispense with the rules. On the contrary, it requires an even broader set of rules to support a more diverse model of agents, as proposed by the New Natural Gas Market Program. As the natural gas sector overcomes its dependence on Petrobras, new institutional arrangements must be formed; otherwise, there will be a vacuum in the governance of the sector, inhibiting entrants and creating uncertainties.

ANP's effective role in rapidly establishing a regulatory framework for the transport sector, allowing new shippers and having rules that establish an appropriate allocation of risks among agents, is vitally important to guarantee the opening of the market. The ANP must have the necessary resources to carry out this incredibly complex task (the European Union needed more than ten years to establish its regulations).

On the other hand, free consumers will only be able to see the benefits of being free to negotiate directly with suppliers when clear and

68. The PEF is aimed at states with fiscal problems and directs federal guarantees in credit operations to those who commit to improvements and fiscal transparency. States are required to adopt reforms that reflect good regulatory practices, structural and behavioral measures in the provision of natural gas services (including to free consumers)

69. The PFE deals with the transfer of funds from government oil and gas holdings in the Union that are being distributed based on state regulation improvement indicators for natural gas

70. IBP. Posicionamento IBP sobre a Abertura do Mercado de Gás no Rio de Janeiro – Novas Regras da AGENERSA. 2020. Available at: <https://www.ibp.org.br/noticias/posicionamento-ibp-abertura-do-mercado-de-gas-no-rio-de-janeiro-novas-regras-da-agenersa/>

competitive conditions are established in state regulations. It is worth mentioning that the policymaker (CNPE) reinforces the Constitutional precept, where the regulation of natural gas distribution reflects the state's interest, focusing on its priorities.

The issue of the tax applied to transport is no less important. The SINIEF Adjustment – a differentiated tax treatment for natural gas operations in gas pipeline in Brazil – led to a temporary adjustment that is yet to be structured in the complementary legislation. The Tax Reform now pending in the Brazilian National Congress is a good opportunity for this.

Therefore, the natural gas industry and the government (in its various spheres) have a long and complicated road ahead to better structure this new market design. The action fronts are numerous, and establishing an adequate sequence is crucial. As long as the reform guidelines and objectives are clearly defined for each agent, the destination is set, and the paths are open for the establishment of a new natural gas market in the country.

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10

The role of energy planning: Brazilian challenges and opportunities

By Thiago Barral, President at the Brazilian Energy Research Office (EPE)

Article written in April 2020

One of Brazil's striking features is its wealth of natural resources, including energy resources. Although, if the abundance and variety of energy resources are an excellent opportunity for the country, transforming this energy potential into effective, sustainable, socioeconomic development is something that can only be achieved with a qualified and permanent planning effort. Effective energy planning provides the foundation for action in public policy and regulation to be consistent with each other and maintain a long-term vision, as well as establishes credible references to guide the much-needed private investments, also minimizing asymmetrical information in the market. Moreover, based on the planning process, transparency in the fundamentals of energy policy allows citizens to inspect the quality of decisions being made.

Planning methodology and instrumentation have evolved to accompany an increasingly complex, globalized, competitive environment, where accelerated transformations are observed in social, economic, environmental, political, and technological dimensions. In this challenging context, the driving force of energy planning must be a clarity of purposes, and sometimes it is necessary to admit a hierarchical order among them. The search for geopolitical advantages, social development, economic development, competitive gains, and sustainability stand out, including the challenge of facing climate change.

In the current concept, undertaking energy planning does not mean predicting, controlling, or determining the future. This approach would be doomed to fail in light of the many uncertainties and variables involved, as well as the complexity (and unpredictability) of the relationships and behaviors that affect the energy sector. In addition, government control over the economy has also been substantially reduced in recent decades. This is still evolving today, which further diminishes the room for determinative planning based on command and control.

If we don't control the future, how can we prepare for it? In this context, planning in the energy sector takes on an indicative and, at times, exploratory character. In other words, it focuses on bringing useful information to aid policymakers in decision making under uncertainty, as well as assisting in coordinating the expectations of private agents and their investment plans. Basically, planning, through the conception and modeling of multiple scenarios (probable, possible, desirable...), prepares us to make more robust decisions and reduce regrets, anticipating possible results that different choices may have, under different circumstances.

The planning horizon is an essential aspect. By temporarily extending the planning horizon, we have to accept increasing levels of uncertainty, including those related to disruptive events or innovations. On the other hand, this brings evidence of the benefits that can be realized in the long-term, stimulating decisions that transcend the typical political electoral cycle. By shortening the planning horizon, decision making can lose sight of its transformative effect in the long run. For this reason, planning instruments must reach different time horizons, but without ever losing sight of the long-term, considering that – in the energy sector – today's decisions reverberate for decades ahead.

Another aspect that is extremely important for the planning process is the ability to analyze the energy sector in an integrated manner (electricity, oil and oil products, biofuels, natural gas, energy efficiency, etc.). This is an irreversible trend in the context of the energy transition and the decarbonization of the global energy mix. An integrated planning perspective is what will allow us to obtain better results in terms of optimizing the use of energy resources and technological transformation, driven by digitization and artificial intelligence, which do not only change the structure of the sector profoundly but also replace the foundations of the economy and economic power relations.

Understanding the role and nature of energy planning in the current global and national context, we move on to identifying and analyzing

the critical elements that must be taken into account to achieve its purposes. There are basically four elements, and I will comment on them next. First, the dynamics and conditions of socioeconomic development. Second, the availability and spatial distribution of energy/environmental resources. Third, access to technology and the dynamics of innovation. And, finally, the established legal-regulatory environment.

Energy consumption is, at the same time, the result of the socioeconomic development process and a catalyst for it. On the one hand, energy consumption is essential for carrying out productive activities and for raising income and social welfare standards, including health, education, leisure, etc. On the other hand, access to modern forms of energy provides a better promotion of education, science, innovation, and even the protection of the environment. Brazil still has a much lower pattern of energy consumption when compared to other more developed countries, let alone being very uneven. One can see that the energy supply per capita in South Korea is four times, and in Germany 2.5 times, higher than in Brazil.

Regarding the availability of energy resources, Brazil is a very well served country, with oil, natural gas, uranium, excellent wind and solar radiation, water, and biomass. In fact, one of the challenges is how to precisely manage this abundance, knowing how to choose the combination of the best overall cost/benefit amongst the various alternatives. This management involves building a supply basket that combines competitiveness (cheaper solutions), diversification (risk management with a portfolio effect), resilience (ability to withstand critical events), and sustainability (reduction of negative impacts).

Besides having energy resources, a successful national strategy also involves promoting access to the most advanced technology for exploration, production/generation, transformation, transportation/distribution/logistics, and efficient energy consumption. The secure digitization of energy systems is also increasingly impacting. Thus, the quality of the national innovation system is a critical element in achieving the energy planning objectives. And it is not just about how much is spent on research, but the effectiveness and impact of these investments in the medium- and long-term.

Last but not least, the integrity and credibility of the legal-regulatory and institutional environment that governs how the energy sector and its markets function are crucial for reducing inefficiencies and attracting new companies and investments in infrastructure and energy supply, competitively. Predictability, legal certainty, clarity of principles, and accountability are all attributes that will determine the success,

or lack thereof, of Brazil's energy strategy. Possible market failures must be identified and addressed, with instruments designed to limit the sector's exposure to unbalanced interventions and, whenever necessary, account for positive and negative externalities.

In this sense, Brazil faces the opportunity and rises to the challenge of designing and implementing modernizing reforms in the legal-regulatory frameworks of the energy sector. Based on the energy planning studies developed by EPE, I emphasize the pressing need for improvements in the market design and regulation of the electric, natural gas, and fuel supply sectors, including biofuels. After intense debates in recent years, it is generally possible to identify a high-level consensus needed to approve the advances, which are reviewed by legal and regulatory instruments. In every case, the proposed reforms incorporate new technologies and business models, favoring technological neutrality, and economic signals and price points that induce the efficient allocation of always-limited resources. The reforms also promote being more open to free enterprise, reducing barriers to new entrants, and, consequently, increasing competition. Naturally, it does not mean that the Brazilian Government relinquishes its role of supervising and guaranteeing energy security for the country, but rather that it creates the appropriate occasions and mechanisms, so management remains transparent, responsible, and balanced. Regulatory agencies must also be staffed with a well-trained and diversified technical team.

With a qualified and well-equipped energy planning structure, good institutional governance, and reforms that are well implemented and uncompromised by private interests or specific segments, Brazil can leverage on its comparative advantage in energy resources and make a big jump in energy transition, with competitive gains.

The private sector, an investment engine and a significant driver of innovation in the energy sector, can make a decisive contribution to building strategic consensus around reforms, avoiding fragmented interests that, in the long run, only result in a delay for the country. A private sector engaged in the frank debate around energy planning and strengthening institutions in the energy sector will help pave the way for an increasingly favorable environment for safe, profitable, and sustainable investments, which is ultimately a necessity for Brazil's development.

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Thiago Barral is the President of the Brazilian Energy Research Office (EPE), having held different positions at the institution since 2007. Before assuming the presidency, he served as Director of Economic-Energy and Environmental Studies (2018-2019), where he was mainly responsible for carrying out studies on the market and energy demand, distributed generation, energy efficiency, environmental studies of hydroelectric plants and transmission lines, emission reduction targets for the energy sector, management of georeferenced bases, long-term energy, and technology. Previously, Thiago held the position of Generation Projects Superintendent and Deputy Superintendent (2013-2016).

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11

Rio de Janeiro: The energy capital

By Cristina Pinho, General Secretary at the Brazilian Petroleum, Gas and Biofuels Institute (IBP), **Daniele Tavares**, Legal Manager at the Brazilian Petroleum, Gas and Biofuels Institute (IBP), and **Vanderlei Martins**, specialist in energy planning, regulation and public policy

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In 1974, Garoupa produced the first barrels of oil in the Campos Basin. Thus, American geologist Walter Link's forecast was confirmed. He correctly stated that the future of the oil and natural gas industry would be at sea and not on land.

Billions of barrels have been produced in the offshore environment since then, a successful saga that went between the productivity of Campo de Marlim with an incredible 20,000 barrels per day and the spectacular Mero wells in the pre-salt layer of up to 60,000 barrels per day.

In this context, the State of Rio de Janeiro has become the largest producer of oil and gas in Brazil and will remain so for the next decade. With the recent developments in Campo de Buzios, oil production is expected to increase by 96% and gas production by 70% by 2030.

The insurmountable wealth of fossil fuels established its natural function as the Energy Capital of Brazil:

i. It is physically close to the offshore production fields, which already have projects to build flowline routes to the continent;

ii. It has a privileged connection to Brazil's onshore gas pipeline network and proximity to the main gas-consuming cities;

iii. It has a port infrastructure for importing LNG, complementary to national demand;

iv. It is the third-largest generator of electricity, the sole producer of nuclear energy, and the largest thermoelectric park that uses natural gas.

Thanks to these characteristics, Rio is primarily responsible for national energy security in Brazil. Since the 2001 blackout and with the Thermoelectric Priority Program, it has become an essential thermoelectric player in Brazil.

It is responsible for 10% of the Brazilian power mix, distributed among thermal (58.3%), nuclear (30.4%), hydro (11.1%), wind (0.16%), and solar (0.04%). Despite the low share of renewables, the thermoelectric plants guarantee electricity supply to the Brazilian Interconnected System. The gas produced here fuels the energy transition as it provides stability to help deal with intermittent renewables, ensuring that these sources expand within the Brazilian mix.

There is an excellent opportunity to re-industrialize the country through the gas associated with the pre-salt layer. Here, energy-intensive companies may be attracted, since the recent opening of the gas market may promote a reduction in the prices due to the competition between producers and importers.

After the economic crisis, not to mention the problems in the public accounts as well as administrative problems, Rio's state government must promote an attractive environment for investments and resume its role more than ever. Moreover, Rio cannot once again miss the opportunities and transformations underway in the industrial agenda.

In addition to its vocation in energy resources, Rio has other strategic attributes to emerge as the Capital of Energy: headquarters of the main companies in the energy sector; technological development and incentive for innovation; the management of knowledge and the development of qualified human resources; the local infrastructure; the goods and services industries, agencies, institutions, and think tanks.

Rio has the best engineering schools in Brazil when it comes to research and technology centers, in addition to the UFRJ Technological Complex (*Parque Tecnológico na Ilha do Fundão*). This is an environment conducive to innovation, in which companies and universities, through their facilities and laboratories, develop solutions for their businesses, test equipment, and collaborate to solve real-world problems, providing new frontiers for student knowledge, which will be the driving force of the labor market.

Much of the goods and services industry is dedicated to the oil and gas sector, as related to subsea systems and wells. This industry is world-renowned for the high degree of internationalization of its products. And still quite resilient, as it survived the severe economic crisis.

Rio also has a privileged port infrastructure and a bay that houses several naval industry agents. The privilege of having these areas on its coast attracts new investors, such as those who bet on the development of a large complex in the Port of Açu, located in São João da Barra, in the northern part of the State of Rio de Janeiro.

This industrial complex consists of several segments, such as ports, thermoelectric plants, a natural gas regeneration unit, a park for large factories, and a structure for receiving ore to process and export. Not to mention that this region is home to Brazil's only operational ZPE project (Export Processing Zone). Indeed, another opportunity for expansion would be connecting energy-intensive sectors and gas being used as fertilizers, petrochemical, steel, ceramics, and glass.

It is the only state in Brazil that produces electricity from two nuclear power plants (Angra I and II), located in the southern part of the state. They move a significant part of the nuclear productive chain, and provide labor supply and training with the support of Indústrias Nucleares do Brasil (INB), Nuclebras Equipamentos Pesados (Nuclep) and the Comissão Nacional de Energia Nuclear (CNEN).

The construction of Angra III is underway, which, for many economic and political reasons, was paralyzed for many years. Now with construction resumed, the investment planned for the next six years is 17 billion BRL. Nine thousand direct and indirect jobs are expected to be created and have a multiplier impact on the regional economy.

Rio de Janeiro has many structural advantages over other states. However, the regulatory and fiscal environment also affects competitiveness, and there are current obstacles to overcome.

Rio has the highest ICMS (State Goods and Services Tax) for electric energy and a severe theft problem, which result in the highest electricity cost in Brazil, and industries being displaced to other locations.

Likewise, tax inefficiency also affects the natural gas chain. Making the sale of electricity immune to the legal regime violates the constitutional precept of the principle of non-cumulative ICMS. Unlike hydroelectric plants, thermoelectric plants depend on using inputs

that are taxed by the ICMS, generating a gap in the tax treatment applied to the consumption of the input (gas) and the output of the product (electricity).

This scenario is further aggravated by the Tax Recovery Method, as it is necessary to give legitimacy to the improvement of any tax legislation, whether via tax benefit or postponing the ICMS payment.

Some actions have already been initiated with the *Rio Capital da Energia* (Rio, The Energy Capital) government program to reduce these disparities. The state uses guidelines and technical fundamentals to coordinate working groups with specialists and runs sectoral diagnostics.

The regulatory agency, AGENERSA, used this program and pioneered updated regulations for the New Natural Gas Market Program. There was an adjustment in volume to accommodate free consumers; new models for the self-producer and self-importer; definitions of migration of captive consumers to the free environment; regulation on the construction of dedicated gas pipelines and new tariff modalities.

Still, on the regulatory agenda, a partnership agreement was signed with ANEEL. Through this initiative, AGENERSA will assume the inspection and mediation authority over the electricity market in order to improve the quality of the service provisions for the population of Rio de Janeiro and the relationship with the state's concessionaires.

Another detail is how the state government deals with the naval crisis. The shipyards still in operation could operate in the decommissioning process of platforms and more profitable services such as dismantling, maintaining, and repairing vessels, replacing the traditional construction activity, which is already more competitively done by Asian countries.

Last but not least, we cannot fail to mention the energy transition. Rio de Janeiro is among the few states with a sufficient potential of wind, solar, and hydraulic energy. In addition, Rio has a decree that defines the policy to encourage biogas. For renewables, the big challenge is to cut the red tape by simplifying and modernizing environmental licensing processes and attracting the supply chain from these sources.

All of these measures are commitments made on the government's sustainable development agenda in the coming years. Therefore, legal certainty is an important issue, where the entrepreneur has predictability in investments under stable norms, even after possible modifications, as determined by the Constitution in art. 5, item XXXVI

"the law will not jeopardize the acquired right, the res judicata, and the perfectly legal act."

The energy produced in Rio is an essential input for Brazil's development and competitiveness, with the potential to improve the business environment, foster the generation of jobs and income, and foster new opportunities and investments in the State of Rio de Janeiro.

It is Rio de Janeiro, the Energy Capital!

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Cristina Pinho is Secretary-General at the Brazilian Petroleum, Gas and Biofuels Institute (IBP). Cristina has also been a member of the IBP Diversity Committee since 2018, acting as Mentor in the institution's Mentoring Program for women. She also holds the position of President of the Instituo Luísa Pinho Sartori. This non-profit association encourages education for the conservation and scientific development aimed at preserving the environment.

With extensive experience in the oil and gas sector and senior management roles, Cristina worked at Petrobras for 31 years, where she exercised leadership in Exploration and Production, and Logistics.

Before IBP, she served as undersecretary for Oil, Gas, and Energy in Rio de Janeiro's state government, a position in which she actively participated in the debates and actions for the resumption of the sector. Her experience communicating with the different stakeholders of the industry will add to the renovation and restructuring of the institute.

Daniele Tavares has been a legal manager at the Brazilian Petroleum, Gas and Biofuels Institute (IBP) since January 2020. She has over 18 years of experience in the Oil and Gas sector, working in the legal and tax areas. She was also Tax Coordinator of the Secretariat of Economic Development of the State of Rio de Janeiro. Daniele is a lawyer with a bachelor's degree in Law from the Federal University of Rio de Janeiro (UFRJ).

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Investment opportunities in the energy sector

By Carlos Frederico Lucchetti Bingemer, Partner in the Corporate practice, Oil & Gas, and Energy areas at BMA Law, and **Adriana Lontra**, Associate at BMA Law

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With the world's eighth-largest economy and an open business environment, Brazil is among the ten countries that receive the most foreign direct investment. It is a country of continental dimensions with projected growth in energy demand of 3.6% per year until 2029.[71]

The energy sector has attracted significant investments to Brazil, as was the case with auctions with new energy generation (13 billion BRL) and transmission lines (13.2 billion BRL).[72]

In 2019, oil exploration block auctions also attracted large investments. The 16th Bidding Round raised 8.9 billion BRL in signature bonuses, and the 6th Production Sharing Bidding Round raised 5.05 billion BRL under the same item. In the same year, the first bidding round for the surplus of the transfer of rights raised an impressive 69.9 billion BRL in subscription bonuses.

These successful events, combined with the prospect of structural reforms in the liberal economic agenda, gave Brazil promising skies that were overshadowed by the COVID-19 pandemic. The pandemic led companies in the most diverse segments to adopt temporary emergency measures to create conditions that would allow them to survive the scenario better and overcome the effects of the expected economic and financial crisis as a result of the pandemic. Businesses

71. EPE. Plano Decenal de Expansão de Energia 2029. 2020

72. Apex Brasil. Investment Guide to Brazil. 2019

are taking measures that are primarily aimed at protecting cash and preserving liquidity. Still, they are also renegotiating contracts, reducing costs, and revising their investment plans and previously agreed-upon budgets.

Despite the intensity and importance of the pandemic, investment opportunities remain, especially mergers and acquisitions (M&A) of companies in the energy sector. There are expectations that others may still emerge, as market agents have a more effective vision and concrete view of the extent and effects of the pandemic. If in the short-term, the pandemic may mean a limitation in the volume of direct investments, in the medium- and long-term, there are many opportunities in M&A.

The first of these opportunities arises from the uncertainties, which already affect the sector and which are likely to drag several companies in the energy sector into a situation of financial distress. In this scenario, companies in the sector are expected to sell assets to re-balance their finances, and investors with an appetite for risk will be attracted to firm up positions in strategic assets.

In a scenario as such, it will be a challenge to structure operations in the energy sector, which is plural in nature. Properly allocating the risks involved and guaranteeing minimal security to new investors capable of making such investments feasible are even greater challenges in a situation of distress. Hybrid debt instruments, enabling future conversion into equity interest (equity kicker); maintaining the original partners with payments of part of the acquisition price subject to performance (earn-out); earnest measures to verify certain conditions are in current trending use in M&A operations in an extreme situation, and may also be found in the Brazilian energy sector in the coming years.

In the case of a regulated market in a country with a diversified energy mix, there are also different possibilities arising from Federal Government initiatives, which will surely attract investors and generate opportunities in the short-, medium-, and long-terms.

Petrobras' divestment plan

Upon assuming the presidency of Petrobras, Castello Branco highlighted the opening of the Brazilian market to new agents in all links of the chain, citing exploration and production, refining, and the natural gas segment.

Petrobras has historically held a dominant position in all links of the oil and gas chain, from production to resale. Under a new administration, since 2019, the state-owned company has been rapidly complying with

an active portfolio management plan, focusing its activities on high-return assets, such as the pre-salt layer production fields. In 2019, portfolio management predicated 16.3 billion USD in asset divestments.[73]

Amid the coronavirus crisis and the drop in the price of a barrel of oil, in relation to Petrobras' investments, the priority is related to the preservation of the company's liquidity. This means that its focus will be redirected towards the postponement of disbursements of cash and cost reduction.

Notwithstanding such a redirection, the company maintained its interest in proceeding with the divestment plan of its assets as structured in the pre-crisis scenario. However, it considered the possibility of altering the originally foreseen calendar due to the preventive measures adopted by the company.

Currently, Petrobras has several divestment processes in progress in different segments, including refineries, exploration and onshore production, thermoelectric plants, mature fields, gas distribution, biofuels, etc., and these operations are expected to be completed in 2020 and 2021.

Investment Partnership Program

There is a list of energy sector projects in the Investment Partnership Program (PPI), established by Federal Law Nº 13334 of September 2016, that are equally relevant and have good prospects.

The PPI proposes to expand and strengthen the interaction between the Federal Government and the private sector through partnership contracts for public infrastructure projects and other privatization measures. Projects qualified as part of the PPI are recognized as being of strategic interest, with priority given to public agents in the administrative and controlling spheres of direct public administration entities.

As defined by law, the objectives of the PPI are (i) to expand investment and employment opportunities and to stimulate technological and industrial development, following Brazil's social and economic development goals; (ii) guarantee the quality expansion of public infrastructure with adequate tariffs; (iii) promote wide and fair competition when entering into partnerships and in the provision of services; (iv) ensure stability and legal security, guaranteeing minimum

73. Petrobras. Performance in 2019. 2020. Available at: <https://www.investidorpetrobras.com.br/servicos-aos-investidores/central-de-downloads/>

intervention in business and investments; (v) strengthen the Federal Government's regulatory role and the autonomy of state-owned regulatory entities; and (vi) strengthen national policy for integrating different modes of transporting people and goods, following the policies of national, regional, and urban development, national defense, the environment, and the security of populations, formulated by the various spheres of government.

Financial support is provided by the Brazilian Development Bank (BNDES), which analyzes the financing capacity of the projects and may offer possible lines of financing.

Since its establishment, 52 projects have already been concluded, with 110 projects in progress in April 2020. Twenty of the ongoing projects are from the energy sector. Of the completed projects, there are eighteen from the energy sector, including five hydroelectric generation, two energy distribution, four energy transmission, and seven oil and gas projects. The finalized projects include nine hydroelectric generation, four energy transmission, and seven oil and gas projects.

Auctions

There are many ongoing PPI projects. There are two new energy auctions and two existing energy auctions, all scheduled for 2020. Other projects entail two auctions for the concession of transmission facilities, the 7th Production Sharing Bidding Round,[74] and the 17th Concession Bidding Round for oil and gas exploration and production fields.

The Brazilian Electricity Regulatory Agency (ANEEL) has already announced the 31st New Generation Project Energy Auction ("A-4" Auction), to purchase electricity from new generation projects—hydroelectric, wind, solar photovoltaic sources, and biomass thermal. The auction will be held in the Regulated Contracting Environment (*Ambiente de Contratação Regulada*, or ACR), and supply will start on January 1, 2024, as well as the 23rd and 24th Electricity Purchase Auctions from Existing Generation Projects (Auctions "A-4 and A-5").

However, considering the need to adopt measures to face the international public health emergency resulting from the coronavirus, the auctions were postponed by Ordinance Nº 134 of the Ministry of Mines and Energy (MME). Also postponed were the New Energy "A-6" Auction for 2020, established by MME Ordinance Nº 151, of March 1, 2019, and the Auctions for the Public Electricity Transmission Service

74. Although scheduled for 2020, the 7th Round of Sharing is in the planning stage

Concession, established by MME Ordinance Nº 15, of January 13, 2020.

Also facing the situation of pandemic and economic slowdown, the National Agency of Petroleum, Natural Gas and Biofuels (ANP) announced the suspension of the 17th Bidding Round for the concession of exploratory blocks, following through with the second stage of the 72nd Biodiesel Auction, which had initially been suspended.

The MME maintained the original plans for 2021 for holding the auction of the Atapu and Sépia surpluses, the Santos Basin pre-salt fields. The auction involves the volumes offered but not contracted in the first round of bidding for the surplus of the transfer of rights in 2019.

Renewable energy opportunities

Although the Brazilian energy mix has a predominance of non-renewable energy sources, with a large representation of oil and its derivatives and natural gas, renewable energy sources, driven mainly by hydroelectric generation, are very significant in Brazil's power mix.

With global warming and the search for a cleaner energy mix, renewable energy sources become a safe bet for energy projects.

Hydroelectricity is already a mature technology in Brazil, and solar energy must also be highlighted as another renewable energy source along with wind power, which is already being explored mainly in the Northeast Region. Ocean energy is very incipient. Although, Brazil's long coastline and vast areas of territorial sea are natural conditions that open up vast possibilities for using the sea resources for energy.

As a major agricultural, cattle, and forestry producer, Brazil assumes a prominent position in the international bioenergy scene, which is essential not only for maintaining the low carbon intensity of the Brazilian economy but also for rural development.

The sugar and alcohol segment, in particular, should be seen as an example of the importance that bioenergy has for Brazil. However, attention should be paid to other resources, such as firewood, charcoal, and black liquor, which also play a prominent role in the Brazilian energy mix. Other biomass alternatives such as agroindustrial waste and vegetable oils used in the production of biodiesel are also worth mentioning.[75]

75. EPE. Potencial dos Recursos Energéticos no Horizonte 2050. 2018

Conclusion

The investment scenario in the Brazilian energy sector is quite rich and promising. Despite the natural postponements resulting from the global pandemic, once this challenging situation is overcome, planned projects are expected to resume, with opportunities in fossil and renewable energy sources.

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Adriana advises the oil and gas production industry, focusing on drilling, pipeline installation, oil and gas extraction, and corrective and preventive maintenance services. She has also experience in contracts for construction and repair of oil and gas units, such as rigs, FPSO, and support vessels.

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