Regulation of the Oil and Gas Industry in Brazil

Concession Regime for Oil and Gas

Under Brazilian law, the Brazilian federal government owns all crude oil and natural gas subsoil accumulations in Brazil. The Brazilian federal government holds a monopoly over the exploration, production, refining and transportation of crude oil and oil products in Brazil and its continental shelf, with the exception that companies that were engaged in refining and distribution in 1953 were permitted to continue those activities. Between 1953 and 1997, we were the Brazilian federal government's exclusive agent for exploiting its monopoly, including the importation and exportation of crude oil and oil products.

As part of a comprehensive reform of the oil and gas regulatory system, the Brazilian Congress amended the Brazilian Constitution in 1995 to authorize the Brazilian federal government to contract with any state or privately-owned company to carry out upstream, oil refining, cross-border commercialization and transportation activities in Brazil of oil, natural gas and their respective products. On August 6, 1997, Brazil enacted Law No. 9,478, which established a concession-based regulatory framework, ended our exclusive right to carry out oil and gas activities, and allowed competition in all aspects of the oil and gas industry in Brazil. Since that time, we have been operating in an increasingly deregulated and competitive environment. Law No. 9,478/1997 also created an independent regulatory agency, the ANP, to regulate the oil, natural gas and renewable fuel industry in Brazil, and to create a competitive environment in the oil and gas sector. Effective January 2, 2002, Brazil deregulated prices for crude oil, oil products and natural gas.

Law No. 9,478/1997 established a concession-based regulatory framework and granted us the exclusive right to exploit crude oil reserves in each of our producing fields under the existing concession contracts for an initial term of 27 years from the date when they were declared commercially profitable. These are known as the "Round Zero" concession contracts. This initial 27-year period for production can be extended at the request of the concessionaire and subject to approval from the ANP. Law No. 9,478/1997 also established a procedural framework for us to claim exclusive exploratory rights for a period of up to three years, later extended to five years, to areas where we could demonstrate that we had made commercial discoveries or exploration investments prior to the enactment of the Law No. 9,478/1997. In order to perfect our claim to explore and develop these areas, we had to demonstrate that we had the financial capacity to carry out these activities, either alone or through other cooperative arrangements.

Starting in 1999, all areas not already subject to concessions became available for public bidding conducted by the ANP. All the concessions that have been granted to us since then were granted through our participation in public bidding rounds or by the Transfer of Rights Agreement. In 2016, the ANP granted us an extension of the production phase of the concession agreement related to Marlim Field and Voador Field until August 2052 and an extension related to Ubarana Field until August 2034. In 2017, the ANP granted us an extension of the production phase of the concession agreement related to Araçás Field until August 2052.

Taxation under Concession Regime for Oil and Gas

According to the Law No. 9,478/1997 and under our concession agreements for exploration and production activities with ANP, we are required to pay the government the following:

- Signing bonuses paid upon the execution of the concession agreement, which are based on the amount of the winning bid, subject to the minimum signing bonuses published in the relevant bidding guidelines (*edital de licitação*);
- Annual retention bonuses for the occupation or retention of areas available for exploration and production, at a rate established by the ANP in the relevant bidding guidelines based on the size, location and geological characteristics of the concession block;
- Special participation charges at a rate ranging from 0 to 40% of the net income derived from the production of fields that reach high production volumes or profitability, according to the criteria established in the applicable legislation. Net revenues are gross revenues, based on reference prices for crude oil or natural gas established by Decree No. 2,705 and ANP regulatory acts, less royalties paid, investments in exploration, operational costs and depreciation adjustments and applicable taxes. In 2017, we paid this tax on 18 of our fields, namely Albacora, Albacora Leste, Baleia Azul, Baleia Franca, Barracuda, Baúna, Caratinga, Jubarte, Leste do Urucu, Lula, Manati, Marlim, Marlim Leste, Marlim Sul, Mexilhão, Rio Urucu, Roncador and Sapinhoá; and

- Royalties, to be established in the concession contracts at a rate ranging between 5% and 10% of gross revenues from production, based on reference prices for crude oil or natural gas established by Decree No. 2,705 and ANP regulatory acts. In establishing royalty rates in the concession contracts, the ANP also takes into account the geological risks and expected productivity levels for each concession. Most of our crude oil production is currently taxed at the maximum royalty rate.

Law No. 9,478/1997 also requires concessionaires of onshore fields to pay to the owner of the land a participation fee that varies between 0.5% and 1.0% of the sales revenues derived from the production of the field.

Production-Sharing Contract Regime for Unlicensed Pre-Salt and Potentially Strategic Areas

Discoveries of large oil and natural gas reserves in the pre-salt areas of the Campos and Santos Basins prompted a change in the legislation regarding oil and gas exploration and production activities.

In 2010, three new laws were enacted to regulate exploration and production activities in pre-salt and other potentially strategic areas not subject to existing concessions: Law No. 12,351, Law No. 12,304, and Law No. 12,276. The enacted legislation does not impact the existing pre-salt concession contracts, which cover approximately 28% of the pre-salt areas.

Law No. 12,351/2010 regulates production-sharing contracts for oil and gas exploration and production in pre-salt areas not under concession and in potentially strategic areas to be defined by the CNPE. Under the production-sharing regime, we used to be the exclusive operator of all blocks. However, Law No. 13,365/2016 recently modified Law 12,3251/2010 in order to grant us the option to be the operator of the blocks offered under public bids under the production sharing regime. It is no longer mandatory for us to be the exclusive operator of all areas. CNPE will only offer us preference to operate the blocks under production-sharing regime. As part of this regulatory change, we must announce whether we will exercise our preference right for each of the areas offered, up to thirty (30) days after the notice by the CNPE and present our justifications. After our announcement, CNPE will propose to the Office of the Presidency which areas should be operated by us. The exploration and production rights for these areas will be offered under public bids. Regardless of whether we exercise our right of preference, we will also be able to participate, at our discretion, in the bidding process to increase our interest in these areas. Nonetheless, the winning bidder will be the company that offers to the Brazilian federal government the highest percentage of “profit oil,” which is the production of a certain field after deduction of royalties and “cost oil,” which is the cost associated with oil production.

Law No. 12,734 became partially effective on November 30, 2012, and amended Law 12,351, establishing a royalty rate of 15% applicable to the gross production of oil and natural gas under future production sharing contracts.

Law No. 12,304/2010, authorized the incorporation of a new state-run non-operating company that will represent the interests of the Brazilian federal government in the production-sharing contracts and will manage the commercialization contracts related to the Brazilian federal government’s share of the “profit oil.” This new state-owned company was incorporated on August 1, 2013, named Pré-Sal Petróleo S.A.—PPSA, and will participate in operational committees, with a casting vote and veto powers, as defined in the contract, and will manage and control costs arising from production-sharing contracts. Where production-sharing contracts are concerned, PPSA will exercise its specific legal activities alongside the ANP, the independent regulatory agency that regulates and oversees oil and gas activities under all exploration and production regimes, and the CNPE, the entity that sets the guidelines to be applied to the oil and gas sector, including with respect to the new regulatory model.

Assignment Agreement (Cessão Onerosa) and Global Offering

Pursuant to Law No. 12,276/2010, we entered into an agreement with the Brazilian federal government on September 3, 2010 (Assignment Agreement), under which the government assigned to us the right to conduct activities for the exploration and production of oil, natural gas and other fluid hydrocarbons in specified pre-salt areas, subject to a maximum production of five bnboe. The initial contract price for our rights under the Assignment Agreement was R$74,807,616,407, which was equivalent to US$42,533,327,500 as of September 1, 2010. See Item 10.“Additional Information—Material Contracts—Assignment Agreement.”

As a result of the activities under the Assignment Agreement, we have declared the commerciality for the fields of Búzios, Sépia, Itapu, Sul de Lula, Sul de Sapinhoá, Norte and Sul de Berbigão, Norte and Sul de Sururu and Atapu. The beginning of the commercial production is expected to occur in the first semester of 2018.

We have created an internal committee to negotiate the revision of the Assignment Agreement with representatives of the Brazilian federal government (MME, Ministry of Finance, and the ANP). Both the ANP and we have hired consultancy services provided by international companies specialized in the oil industry (DeGolyer and MacNaughton and Gaffney, Cline & Associates) to help out with the negotiation.

Natural Gas Law of 2009

In March 2009, the Brazilian Congress enacted Law No. 11,909, or Gas Law, regulating activities in the gas industry, including transport, processing, storage, liquefaction, regasification and commercialization. The Gas Law created a concession regime for the construction and operation of new pipelines to transport natural gas, while maintaining an authorization regime for pipelines subject to international agreements. According to the Gas Law, after a certain exclusivity period, operators *(transportadores)* will be required to grant access to transport pipelines and maritime terminals, except LNG terminals, to third parties in order to maximize utilization of capacity.

The Gas Law authorized the ANP to regulate prices for the use of gas transport pipelines subject to the new concession regime, based on a procedure defined in the Gas Law as a “chamada pública,” and to approve prices submitted by carriers (carregadores), according to previously established criteria, for the use of new gas transport pipelines subject to the authorization regime.

Authorizations previously issued by the ANP for natural gas transport will remain valid for 30 years from the date of publication of the Gas Law, and initial carriers (carregadores iniciais) were granted exclusivity in these pipelines for 10 years. All pipelines that our subsidiaries currently own and operate in Brazil are subject to an authorization regime. The ANP will issue regulations governing third-party access and carrier compensation if no agreement is reached between the parties.

The Gas Law also authorized certain consumers, who can purchase natural gas on the open market or obtain their own supplies of natural gas, to construct facilities and pipelines for their own use in the event local gas distributors controlled by the states, which have monopoly over local gas distribution, do not meet their distribution needs. These consumers are required to delegate the operation and maintenance of the facilities and pipelines to local gas distributors, but they are not required to sign gas supply agreements with the local gas distributors.

In December 2010, Decree No. 7,382 was enacted in order to regulate Chapter I to VI and VIII of the Gas Law as it relates to activities in the gas industry, including transportation and commercialization. Since the publication of this decree, a number of administrative regulations were enacted by the ANP and the MME in order to regulate various issues in the Gas Law and Decree No. 7,382 that needed to be further clarified. Among those is ANP Resolution No. 51/2013, which prevents a carrier from holding any equity interest in concessionaires of gas transport pipelines. Resolution No. 51/2013 applies only to the concessions granted after its publication, not affecting, therefore, the transportation of our natural gas production through pipelines operated by its subsidiaries and subject to the previous authorization regime.

Price Regulation

Until Law No. 9,478 in 1997, the Brazilian federal government had the power to regulate all aspects of the pricing of crude oil, oil products, ethanol, natural gas, electric power and other energy sources. In 2002, the government eliminated price controls for crude oil and oil products, although it retained regulation over certain natural gas sales contracts and electricity. Concurrently, the Brazilian federal government has periodically created and adjusted taxes applicable to crude oil, oil and natural gas products, which have been used as a tool to balance price stability to end consumers and also to increase its tax revenues.

Environmental Regulations

All phases of the crude oil and natural gas business present environmental risks and hazards. Our facilities in Brazil are subject to a wide range of federal, state and local laws, regulations and permit requirements relating to the protection of human health and the environment, and they fall under the regulatory authority of the *Conselho Nacional do Meio Ambiente* (National Council for the Environment, or CONAMA).

Our offshore activities are subject to the administrative authority of IBAMA, which issues operating and drilling licenses. We are required to submit reports, including safety and pollution monitoring reports to IBAMA in order to maintain our licenses. This way, we maintain an going communication channel with the environmental bodies, in order to improve issues connected with the environmental management of our exploration, production and refining processes of oil and natural gas. Recently, we designed actions and measures, together with Ibama, to adjust the disposal of water produced in some of our offshore platforms to recently issued requirements by Ibama.

Most of the onshore environmental, health and safety conditions are controlled either at the federal or the state level depending on the localization of our facilities and the type of activity under development. However, it is also possible for these conditions to be controlled on a local basis whenever the activities generate a local impact or are established in a county conservation unit. Under Brazilian law, there is strict and joint liability for environmental damage, mechanisms for enforcement of environmental standards and licensing requirements for polluting activities.

Individuals or entities whose conduct or activities cause harm to the environment are subject to criminal and administrative sanctions. Government environmental protection agencies may also impose administrative sanctions for noncompliance with environmental laws and regulations, including:

- Fines;
- Partial or total suspension of activities;
- Requirements to fund reclamation and environmental projects;
- Forfeiture or restriction of tax incentives or benefits;
- Closing of establishments or operations; and
- Forfeiture or suspension of participation in credit lines with official credit establishments.

We are subject to a number of administrative and legal proceedings relating to environmental matters. For more information about these proceedings, see Item 8. "Financial Information—Legal Proceedings." and Note 30 to our audited consolidated financial statements included in this annual report.

In 2017, we invested US$0.8 billion in environmental projects, compared to US$0.9 billion in 2016 and US$1.1 billion in 2015. These investments continued to be primarily directed at reducing emissions and wastes from industrial processes, managing water use and effluents, remedying impacted areas, implementing new environmental technologies, upgrading our pipelines and improving our ability to respond to emergencies.

New Taxation Model for the Oil and Gas Industry

On December 28, 2017, the Brazilian federal government enacted Law No. 13,586, which outlines a new taxation model for the oil and gas industry and, along with the Decree 9,128/2017, establishes a new special regime for exploration, development and production of oil, gas and other liquid hydrocarbons named Repetro-Sped.

Due to the application of this new model, we expect greater legal stability in the oil and gas industry in Brazil, which may encourage higher investments and reduce the number of litigations involving the industry players.

Regarding the Repetro-Sped, this regime enhances the former Repetro (Special Customs Regime for the Export and Import of Goods designated to Exploration and Production of Oil and Natural Gas Reserves), notably providing for tax relief over goods permanently held in Brazil in addition to the previous relief related to temporary admissions. Therefore, we are assessing transfers in the ownership of certain oil and gas assets from foreign subsidiaries to the parent company in Brazil. The regime will expire in December, 2040.

Following the creation of Repetro-Sped, the Brazilian states, pursuant to a decision of the Brazilian National Council of Finance Policies (CONFAZ), agreed to allow tax incentives relating to VAT (ICMS) to the extent each state enacts its specific regulation providing for the tax relief on oil and gas industry.

For additional information on the main provisions under Law 13,586/17, Decree 9,128 /17 and VAT (ICMS) tax incentives over the Repetro-Sped, see notes 21.4.1 and 21.4.2-c to our audited consolidated financial statements.

Health, Safety and Environmental Initiatives

The protection of human health and the environment is one of our primary concerns, and is essential to our success as an integrated energy company.

We have a Health, Safety and Environmental (HSE) Committee (*Comitê de Segurança, Meio Ambiente e Saúde*) composed of three members of our board of directors who are responsible for assisting our board in the following matters:

- Definition of strategic goals in relation to HSE matters;
- Establishment of global policies related to the strategic management of HSE matters within our group of companies; and
- Assessment of the conformity of our strategic plan to its global HSE policies, among others.

Our efforts to address health, safety and environmental concerns and ensure compliance with environmental regulations (which in 2017 totaled an investment of R$5.2 billion, or US$1.6 billion) involve the management of environmental costs related to production and operations, pollution control equipment and systems, projects to rehabilitate degraded areas, safety procedures and initiatives for emergency prevention and control, health and safety programs as well as:

- An HSE management system that seeks to minimize the impacts of operations and products on health, safety and the environment, reduce the use of natural resources and pollution and prevent accidents;
- The *Frota Nacional de Petroleiros* (National Fleet of Vessels) has been fully certified by the International Maritime Organization (IMO) International Management Code for Safe Operation of Ships and for Pollution Prevention (ISM Code) since December 1997;
- Regular and active engagement with the MME and IBAMA, in order to discuss environmental issues related to new oil and gas production and other transportation and logistical aspects of our operations;
- A strategic goal to reduce the intensity of greenhouse gas emissions, along with a set of performance indicators with targets to monitor progress with respect to this goal; and
- We evaluate each of our operational projects to identify risks and to ensure compliance with all of our HSE requirements and the adoption of the best HSE practices throughout a project’s life cycle. In addition, we conduct more extensive environmental studies for new projects when required by applicable environmental legislation.

In 2017, our emissions were 67 million tons of CO_2 equivalent. In 2016 we issued 66.5 million tons of CO_2 equivalent and in 2015 78.2 million tons of CO_2 equivalent. We are committed to reducing the intensity of greenhouse gas emissions from our processes and products through several initiatives, including reduction of gas flaring, energy efficiency measures and operational improvements.

In March 2018, Petrobras’ Board of Directors has approved the company’s participation in the Oil and Gas Climate Initiative (OGCI). This is one of the main initiatives of the oil and gas sector to mitigate greenhouse gas emissions. The commitment provided by OGCI Climate Investments, the initiative’s investment arm, to support the development, deployment and expansion of low-emission technologies is US$ 1 billion over the next ten years, with the disbursement distributed equally among all OGCI members during this period. The participation in OGCI is aligned to Petrobras’ strategy to prepare the company for a future based on a low carbon economy, as disclosed in its 2018-2022 Business and Management Plan, and reinforces the company’s commitment to reduce emissions and to a more efficient energy matrix.

Eliminating fatal accidents and achieving performance levels comparable to the best international oil and gas operators when it comes to the prevention of injuries to our employees and third parties are the two most important goals set by our safety management. Although we develop prevention programs in all of our operating units, we recorded 6 fatalities involving our own and contractors’ employees in 2017 (compared to 3 in 2016). In addition, on December 18, 2017 there was an accident involving a man who fell into the sea and has not been found – we are currently waiting for a legal declaration of presumed death to compute such accident. We investigate all accidents reported in order to identify their causes and then take preventive and corrective actions, which are regularly monitored once they are adopted. In cases of serious accidents, we send out company-wide alerts to enable other operating units to assess the probability of similar events occurring in their own operations.

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Environmental Remediation Plans and Procedures

As part of our environmental plans, procedures and efforts, we maintain detailed response and remediation contingency plans to be implemented in the event of an oil spill or leak from our offshore operations. In order to respond to these events, we have dedicated oil spill recovery vessels fully equipped for oil spill control and firefighting, support boats and other vehicles, additional support and recovery boats available to fight offshore oil spills and leaks, containment booms, absorbent booms and oil dispersants, among other resources. These resources are distributed in 12 environmental protection centers in strategic areas in which we operate throughout Brazil and in emergency response centers (distributed over 24 sites) in order to ensure rapid and coordinated response to onshore or offshore oil spills.

We have more than 200 trained workers available to respond to oil spills 24 hours a day, seven days a week, and we can mobilize additional trained workers for shoreline cleanups on short notice from a large group of trained environmental agents in the country. While these workers are located in Brazil, they are also available to respond to an offshore oil spill outside of Brazil.

Since 2012, we have been a participating member of the Oil Spill Response Limited—OSRL, an international organization that brings together over 160 corporations, including oil major, national/independent oil companies, energy related companies as well as other companies operating elsewhere in the oil supply chain. OSRL participates in the Global Response Network, an organization composed of several other companies dedicated to fighting oil spills. As a member of the OSRL, we have access to all resources available through that network, and we also subscribe to their Subsea Well Intervention Services, which provides swift international deployment of response-ready capping and containment equipment. The capping equipment is stored and maintained at bases worldwide, including Brazil. An OSRL Brazilian base opened in March 2014 and is now operational.

In 2017, we conducted 15 emergency drills of regional scope with the Brazilian navy, the civil defense, firefighters, the military police, environmental organizations and local governmental and community entities.

We set up a Zero Spill Plan, aiming at optimizing management and reducing the risk of oil spills in our operations. This plan encompasses investments to improve the management of processes and to ensure the integrity of our equipment and installations. Additionally, we have a model of communication, processing and recording of oil spills that permits the daily monitoring of these incidents, their impacts and mitigation measures.

We continue to evaluate and develop initiatives to address HSE concerns and to reduce our exposure to HSE risks. In 2017, we had oil spills totaling 35.8 m^3, compared to 51.9 m^3 in 2016 and 71.6 m^3 in 2015.

Insurance

We maintain several insurance policies, including policies against fire, operational risk, engineering risk, property damage coverage for onshore and offshore assets such as fixed platforms, floating production systems and offshore drilling units, hull insurance for tankers and auxiliary vessels, third party liability insurance and transportation insurance. The coverages of these policies are contracted according to the objectives we define and the limitations imposed by the global insurance and reinsurance markets. Although some policies are issued in Brazil, most of our policies are reinsured abroad with reinsurers rated A- or higher by Standard & Poor’s, or B + or higher by A.M. Best.

Our policies are subject to deductibles, limits, exclusions and limitations, and there is no assurance that such coverage will adequately protect us against liability from all possible consequences and damages associated with our activities. Thus, it is not possible to assure that insurance coverage will exist for all damages resulting from possible incidents or accidents, which may negatively affect our results.

Specifically, we do not maintain insurance coverage to safeguard our assets in case of war or sabotage. We also do not maintain coverage for business interruption, except for a minority of our international operations and some specific assets in Brazil. Generally, we do not maintain coverage for our wells in operation in Brazil, except when required by a joint operating agreement. In addition, our third-party liability policies do not cover government fines or punitive damages.

Our national property damage policies have a maximum deductible of US$180 million and their indemnity limits can reach US$2.5 billion for refineries and US$2.1 billion for platforms, depending on the replacement value of our assets. We self-insure less valuable assets, including but not limited to small auxiliary vessels, certain storage facilities and some administrative facilities.

Our general civil responsibility policy with respect to our onshore and offshore activities in Brazil, including losses related to third parties due to sudden environmental risks, such as oil spills, has a maximum indemnification limit of US$250 million with an associated deductible of US$10 million. We also maintain marine insurance with additional protection and indemnification (P&I) against third parties related to our domestic offshore operations with an indemnity limit of US$50 million up to US$500 million, depending on the type of vessel. For activities in Brazil, in the event of an explosion or similar event on one of our non-fixed offshore platforms, these policies may provide third party combined liability coverage of up to US$750 million. In addition, although we do not insure most of our pipelines against loss of equity, we have insurance against damages or losses to third parties arising from specific incidents, such as unexpected infiltration and oil pollution.

Outside Brazil, we have operations in eight countries and maintain different levels of third party liability insurance, as a result of a variety of factors, including our country risk assessments, if we have onshore and offshore operations, or legal requirements imposed by the particular country in which we operate. We maintain separate "well-control" insurance policies in our international operations to cover liabilities arising from the uncontrolled eruption of oil, gas, water or drilling fluid, as well as to cover claims of environmental damage caused by wellbore explosion and similar events as well as related clean-up costs with coverage limits of up to US$500 million depending on the country.

Additional Reserves and Production Information

In 2017, our oil and gas production in Brazil averaged 2,408 mboe/d, of which 89% was oil and 11% was natural gas. The Campos Basin is one of Brazil's main and most prolific oil and gas offshore basins, with over 60 hydrocarbon fields discovered, eight large oil fields and a total area of approximately 115 thousand km^2 (28.4 million acres). In 2017, the Campos Basin produced an average 1,212 mbbl/d of oil and 215 mmcf/d (6 mmm^3/d) of natural gas, comprising 52% of our total production from Brazil. We also carry out limited oil shale mining operations in São Mateus do Sul, in the Paraná Basin of Brazil, and convert the kerogen (solid organic matter) from these deposits into synthetic oil and gas. This operation is conducted in an integrated facility and its final products are fuel gas, LPG, shale naphtha and shale fuel oil. Our business unit does not utilize the fracking method or the hydraulic fracturing method for oil production, since they are not appropriate in the context of our operations. Also, we do not inject any water or chemicals in the soil in connection with our open pit oil shale mining operations. Our process consists of crushing, screening and subsequently heating all the shale at high temperatures (pyrolysis) and we have in place a proper segregation process for the by-products derived from such process.

On December 31, 2017, our estimated proved reserves in Brazil totaled 9.5 bnbbl of oil equivalent, including 8.3 bnbbl of crude oil, condensate and synthetic oil and 7.7 tcf of natural gas and synthetic gas. As of December 31, 2017, our domestic proved developed crude oil, condensate and synthetic oil reserves represented 52% of our total domestic proved crude oil, condensate and synthetic oil reserves, and our domestic proved developed natural gas and synthetic gas reserves represented 59% of our total domestic proved natural gas and synthetic gas reserves.

We calculate reserves based on forecasts of field production, which depend on a number of technical parameters, such as seismic interpretation, geological maps, well tests, reservoir engineering studies and economic data. Our calculation of reserves also includes 2.6 tcf of fuel gas volumes, which represent 34% of our proved reserves of natural gas. All reserve estimates involve some degree of uncertainty. The uncertainty depends primarily on the amount of reliable geological and engineering data available at the time of the estimate and the interpretation of that data. Our estimates are thus made using the most reliable data and technology at the time of the estimate, in accordance with the best practices in the oil and gas industry and regulations promulgated by the SEC.

Internal Controls over Proved Reserves

The reserve estimation process begins with an initial evaluation of our assets by geophysicists, geologists and engineers. Corporate Reserves Coordinators (*Coordenadores de Reservas Corporativos*, or CRCs) safeguard the integrity and objectivity of our reserve estimates by supervising and providing technical support to Regional Reserves Coordinators (*Coordenadores de Reservas Regionais*, or CRRs) who are responsible for preparing the reserve estimates. Our CRRs and CRCs have degrees in geology and engineering and are trained internally and abroad in international reserve estimates seminars. CRCs are responsible for compliance with SEC rules and regulations, consolidating and auditing the reserve estimation process. In 2017, we replaced the technical person primarily responsible for overseeing the preparation of our reserves. The recently retained technical person has 14 years of experience in the field and has been with us for 15 years. Our reserve estimates are approved by our board of executive officers, which then informs our board of directors of its approval.

D&M used our reserve estimates to conduct a reserve audit of 95% of the net proved crude oil, condensate and natural gas reserves, in terms of oil equivalent, as of December 31, 2017 in Brazil. In addition, D&M used our reserve estimates to conduct a reserve audit of 100% of the net proved crude oil, condensate and natural gas reserves as of December 31, 2017 in properties we operate in the United States. The reserve estimates were prepared in accordance with the reserves definitions of Rule 4-10(a) of Regulation S-X of the SEC. For further information about our proved reserves, see "Supplementary Information on Oil and Gas Exploration and Production" beginning on page F-132. For disclosure describing the qualification of D&M's technical person primarily responsible for overseeing our reserves audit and reserves evaluation, see Exhibit 99.1.

D&M audited 93% of our total proved reserves, in terms of oil equivalent, on December 31, 2017. The proportion of our total reserves covered by the D&M reports and the geographic area in which the covered reserves are located are summarized in the table below.

Country/Region	SEC Proved Reserves* (in mmboe)	Audited Reserves (in mmboe)	Unaudited Reserves (in mmboe)	Proportion of Reserves Audited (%)
Brazil	9,528.8	9,078.3	450.5	95%
Brazil Synthetic Oil and Gas	7.4	—	7.4	—
North America Operated	36.5	36.5	—	100%
North America Non-Operated	85.0	—	85.0	—
Other Countries	94.1	—	94.1	—
Total Proved Reserves	**9,751.7**	**9,114.8**	**636.9**	**93%**

Changes in Proved Reserves

In 2017, our total proved reserves resulted in 9,751.7 million boe in 2017, a net increase of 79.6 million boe compared to 2016. We incorporated 670.1 million boe of total proved reserves by revisions of previous estimates, including 355.4 million boe due to economic revisions , mainly due to the increase in prices, and 314.7 million boe due to technical revisions, mainly due to better than forecasted outcome from reservoirs, in the pre-salt of Santos and Campos basins, both in Brazil. In addition, we added 246.7 million boe in our proved reserves resulting from positive responses from improved recovery (water injection), and added 82.5 million boe in our proved reserves due to extensions and discoveries, mainly in the pre- salt of Santos basins. The production of 919.8 million boe in 2017 partially offset these increases. This production does not consider the production of Extended Well Tests (EWTs) in exploratory blocks and production in Bolivia, since the Bolivian Constitution prohibits the disclosure and registration of its reserves.

At year-end 2017, our company-wide proved undeveloped reserves increased 151.0 million boe when compared to year-end 2016. This increase was mostly related to positive responses from improved recovery (water injection) amounting to 246.7 million boe, in Brazil, and 82.3 million boe due to extensions and discoveries, mainly in the pre- salt of Santos basins. Economic revisions of previous estimates resulted in an increase of 175.9 million boe, mainly due to higher prices, and technical revisions of previous estimates incorporated 27.2 million boe. The total increase was partially offset by conversion of some of our proved undeveloped reserves to proved developed reserves, mainly due to the FPSO P-66 start of operation, in Lula field, and offshore and onshore drilling and tieback operations. In 2017, we invested a total of US$12.1 billion in development projects, of which 96% (US$11.6 billion) were invested in Brazil, and converted a total of 381.1 million boe of proved undeveloped reserves to proved developed reserves, approximately 95.4% (363.7million boe) of which were Brazilian reserves.

As of December 31, 2017, we had a total of 4,592.1 million boe of proved undeveloped reserves company-wide, approximately 9.0% (414.1 million boe) of which have remained undeveloped for five years or more as a result of several factors affecting development and production, including the inherent complexity of ultra-deep water development projects, particularly in the Santos Basin and in the Campos Basin, in which we are making investments to develop necessary infrastructure.

Most of our investments relate to long term development projects, which are developed in phases due to the large volumes, and extensions involved, the deep and ultra deepwater infrastructure and the production resources complexity. In these cases, the full development of the reserves related to these investments can exceed five years.

All reserve volumes described above are "net" to the extent that they only include our proportional participation in reserve volumes and exclude reserves attributed to our partners.

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The following tables set forth our production of crude oil, natural gas, synthetic oil and synthetic gas by geographic area in 2017, 2016 and 2015:

Hydrocarbon Production by Geographic Area

	2017					2016					2015				
	Oil + NGL (mbbl)(5)	Synth. Oil + NGL (mbbl)(4)	Nat. Gas (mcf)(1)	Synth. Gas (mcf) (1)(4)	Total (mboe)	Oil + NGL (mbbl)(5)	Synth. Oil + NGL (mbbl)(4)	Nat. Gas (mmcf) (1)	Synth. Gas (mmcf)(1) (4)	Total (mboe)	Oil + NGL (mbbl)(5)	Synth. Oil + NGL(mbbl) (4)	Nat. Gas (mmcf)(1)	Synth. Gas (mmcf)(1) (4)	Total (mboe)
Brazil*	785,161.1	969.7	555,820.9	183.6	878,798.2	783,862.2	915.0	533,815.1	209.0	873,801.8	775,807.5	1,022.0	563,085.5	328,5	870,707.5
Lula field(2)	175,663.0		140,931.4		199,151.6	125,459.6		93,711.1		141,078.1	77,592.1		51.914.0		86,244.4
Búzios field(2)	717.5				717.5	3,262.4				3,262.4	2,386.8				2,386.8
Other	608,780.6	969.7	414,889.5	183.6	678,929.1	655,140.2	915.0	440,103.9	209.0	729,461.3	695,828.6	1,022.0	511,171.5	**328.5**	**782,076.3**
International:															
South America (outside of Brazil)	1,872.5	—	85,388.2	—	16,103.8	8,007.7		144,728.7		32,129.2	14,089.0		173,338.5		42,997.0
North America	13,164.5	—	21,450.4	—	16,739.5	12,093.3		32,054.7		17,435.8	11,169.0		24,528.0		15,257.0
Total International	15,037.0	—	106,838.6	—	32,843.3	20,101.0		176,783.4		49,564.9	25,258.0		197,866.5		58,254.0
Total consolidated production	800,198.1	969.7	662,659.5	183.6	911,641.5	803,963.2	1,040.0	710,598.5	209.0	923,366.7	801,065.5	1,163.1	760,952.0	3,285.0	928,961.5
Equity method investees(3):															
South America (outside of Brazil)	—	—	—	—	—	476.3		126.7		497.4	1,241.0		310.3		1,277.5
Africa	8,190.2	—	—	—	8,190.2	8,705.3				8,705.3	9,709.0				9,709.0
Worldwide production	808,388.3	969.7	662,659.5	183.6	919,831.7	813,144.9	1,040.0	710,725.2	209.0	932,569.5	812,015.5	1,163.1	761,262.3	**3,285.0**	939,948.0

(1) Natural gas production figures are the production volumes of natural gas available for sale, excluding flared and reinjected gas and gas consumed in operations
(2) Búzios and Lula fields are separately included as they contain more than 15% of our total proved reserves each
(3) Equity-accounted investees
(4) We produce synthetic oil and synthetic gas from oil shale deposits in São Mateus do Sul, in the Paraná Basin of Brazil
(5) Oil production includes production from EWTs – Extended Well Tests and NGL . In the last three years, NGL production represented 5.0%, 4.4%, and 4.0% of our worldwide oil production respectively

The following table sets forth our estimated net proved developed and undeveloped reserves of crude oil and natural gas by region as of December 31, 2017.

Estimated Net Proved Developed and Undeveloped Reserves

Reserves category	Reserves						
	Oil (mmbbl)	Natural gas (bncf) (1)(2)	Total oil and natural gas (mmboe)	Synthetic oil (mmbbl)(3)	Synthetic gas (bncf)(3)	Total synthetic oil and gas (mmboe)	Total oil and gas products (mmboe)(4)
Proved developed:							
Brazil	4,282.2	4,515.9	5,034.9	6.0	8.1	7.4	5,042.2
International							
South America (outside of Brazil)	0.7	56.7	10.2	—	—	—	10.2
North America	72.1	24.2	76.1	—	—	—	76.1
Total International	72.8	80.9	86.3	—	—	—	86.3
Total consolidated proved developed reserves	4,355.0	4,596.8	5,121.2	6.0	8.1	7.4	5,128.5
Equity method investees							
Africa	29.6	9.3	31.1	—	—	—	31.1
Total proved developed reserves	**4,384.6**	**4,606.0**	**5,152.3**	**6.0**	**8.1**	**7.4**	**5,159.6**
Proved undeveloped:							
Brazil	3,967.2	3,160.2	4,493.9	—	—	—	4,493.9
International							
South America (outside of Brazil)	0.5	103.5	17.7	—	—	—	17.7
North America	42.6	16.7	45.3	—	—	—	45.3
Total International	43.0	120.2	63.1	—	—	—	63.1
Total consolidated proved undeveloped reserves	4,010.2	3,280.5	4,557.0	—	—	—	4,557.0
Equity method investees							
Africa	33.8	8.0	35.1	—	—	—	35.1
Total proved undeveloped reserves	**4,044.0**	**3,288.5**	**4,592.1**	**0.0**	**0.0**	**0.0**	**4,592.1**
Total proved reserves (developed and undeveloped)	**8,428.6**	**7,894.5**	**9,744.4**	**6.0**	**8.1**	**7.4**	**9,751.7**

(1) We estimate our oil and gas reserves at a reference point prior to the gas processing plants. Therefore, we book reserves of oil and wet natural gas only and, as such, we do not separately estimate reserves of natural gas liquids (NGLs).
(2) Our disclosure of proved gas reserves also includes fuel gas volumes, which represent 34% of our total proved reserves of natural gas.
(3) Volumes of synthetic oil and synthetic gas from oil shale deposits in the Paraná Basin in Brazil have been included in our proved reserves in accordance with the SEC rules for estimating and disclosing reserve quantities.
(4) The total proved reserves includes 292.7 millions of barrels of oil equivalent related to assets classified as held for sale.

The table below summarizes information about the changes in total proved reserves of our consolidated entities and equity method investees for 2017, 2016 and 2015:

Total Proved Developed and Undeveloped Reserves(1)(2)(3)(4)

	Consolidated Entities							Equity method investees	
	Oil (mmbbl)	Natural gas (bncf)	Total oil and natural gas (mmboe)	Synthetic oil (mmbbl)	Synthetic gas (bncf)	Total synthetic oil and gas (mmboe)	Total oil and gas products (mmboe)	oil and gas product (mmboe)	Total for all product (mmboe)
Reserves quantity information for the year ended December 31, 2017									
January 1, 2017	8,160.3	8,595.1	9,592.8	6.8	9.2	8.3	9,601.1	71.1	9,672.2
Revisions of previous estimates	680.9	(87.0)	666.4	0.2	0.1	0.2	666.6	3.5	670.1
Improved recovery	212.7	204.2	246.7	—	—	—	246.7	—	246.7
Purchases of proved reserves	—	—	—	—	—	—	—	—	—
Extensions and discoveries	69.4	78.4	82.5	—	—	—	82.5	—	82.5
Production	(758.0)	(913.5)	(910.3)	(1.0)	(1.2)	(1.2)	(911.4)	(8.3)	(919.8)
Sales of proved reserves	—	—	—	—	—	—	—	—	—
December 31, 2017	8,365.3	7,877.2	9,678.1	6.0	8.1	7.4	9,685.5	66.3	9,751.7
Reserves quantity information for the year ended December 31, 2016									
January 1, 2016	8,687.0	10,406.8	10,421.5	6.9	9.3	8.5	10,430.0	86.0	10,516.0
Revisions of previous estimates	197.6	(472.6)	118.8	0.8	1.2	1.0	119.8	11.2	131.0
Improved recovery	—	0.1	0.0	—	—	—	—	—	—
Purchases of proved reserves	0.7	93.3	16.3	—	—	—	16.3	—	16.3
Extensions and discoveries	87.8	92.1	103.2	—	—	—	103.2	—	103.2
Production	(766.3)	(892.6)	(915.1)	(0.9)	(1.4)	(1.2)	(916.2)	(9.2)	(925.4)
Sales of proved reserves	(46.6)	(631.9)	(151.9)				(151.9)	(16.9)	(168.8)
December 31, 2016	8,160.3	8,595.1	9,592.8	6.8	9.2	8.3	9,601.1	71.1	9,672.2
Reserves quantity information for the year ended December 31, 2015									
January 1, 2015	11,037.5	12,081.0	13,051.0	7.9	10.6	9.6	13,060,7	79.9	13,140.6
Revisions of previous estimates	(1,990.8)	(1,178.3)	(2,187.2)	0.1	0.2	0.1	(2,187.1)	0.9	(2,186.2)
Improved recovery	1.1	27.9	5.8	—	—	—	5.8	16.2	21.9
Purchases of proved reserves	—	—	—	—	—	—	—	—	—
Extensions and discoveries	411.9	492.2	494.0	—	—	—	494.0	—	493.9
Production	(766.0)	(924.5)	(920.1)	(1.0)	(1.4)	(1.3)	(921.3)	(11.0)	(932.3)
Sales of proved reserves	(6.8)	(91.4)	(22.0)	—	—	—	(22.0)	—	(22.0)
December 31, 2015	8,687.0	10,406.8	10,421.5	6.9	9.3	8.5	10,430.0	86.0	10,516.0

(1) We estimate our oil and gas reserves at a reference point prior to the gas processing plants. Therefore, we book reserves of oil and wet natural gas only and, as such, we do not separately estimate reserves of natural gas liquids (NGLs).

(2) Natural gas production volumes used in this table are the net volumes withdrawn from our proved reserves, including flared gas and gas consumed in operations and excluding reinjected gas. Oil production volumes used in this table are net volumes withdrawn from our proved reserves and exclude NGL and production from EWTs. As a result, the oil and natural gas production volumes in this table are different from those shown in the production table above, which shows the production volumes of natural gas available for sale.

(3) Our disclosure of proved gas reserves also includes fuel gas volumes, which represent 34% of our total proved reserves of natural gas.

(4) In December 31, 2017, the total proved reserves includes 292.7 millions of barrels of oil equivalent related to assets classified as held for sale.

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The following tables show the number of gross and net productive oil and natural gas wells and total gross and net developed and undeveloped oil and natural gas acreage in which we had interests as of December 31, 2017. We do not have any material acreage expiring before 2025.

Gross and Net Productive Wells(1)

	As of December 31, 2017							
	Oil		Natural gas		Synthetic oil		Synthetic gas	
Gross and net productive wells(1):	Gross	Net	Gross	Net	Gross	Net	Gross	Net
Consolidated subsidiaries								
Brazil	7,185.0	7,161.0	199.0	191.0	—	—	—	—
International								
South America (outside of Brazil)	59.0	25.2	182.0	91.2	—	—	—	—
North America	22.0	9.0	2.0	0.8	—	—	—	—
Total international	81.0	34.2	184.0	91.9	—	—	—	—
Total consolidated	7,266.0	7,195.2	383.0	282.9	—	—	—	—
Equity method investees:								
South America (outside of Brazil)	—	—	—	—	—	—	—	—
Africa	47.0	2.5	0.0	0.0	—	—	—	—
Total gross and net productive wells	7,313.0	7,197.7	383.0	282.9	—	—	—	—

Gross and Net Developed and Undeveloped Acreage(1)

	As of December 31, 2017							
	Oil		Natural gas		Synthetic oil		Synthetic gas	
	(in acres)							
Gross and net developed acreage:	Gross	Net	Gross	Net	Gross	Net	Gross	Net
Brazil	4,533,610.0	4,216,411.4	353,741.2	331,812.3	332.9	332.9	0.0	0.0
International								
South America (outside of Brazil)	2,525.7	848.6	33,311.2	11,192.6	—	—	—	—
North America	11,663.4	6,163.6	788.8	261.3	—	—	—	—
Total international	14,189.1	7,012.2	34,100.0	11,453.9	—	—	—	—
Total consolidated	4,547,799.1	4,223,423.6	387,841.3	343,266.2	332.9	332.9	0.0	0.0
Equity method investees:								
Africa	428,866.8	32,003.7	—	—	—	—	—	—
Total gross and net developed acreage	4,976,665.9	4,255,427.3	387,841.3	343,266.2	332.9	332.9	0.0	0.0

	As of December 31, 2017							
	Oil		Natural gas		Synthetic oil		Synthetic gas	
	(in acres)							
Gross and net undeveloped acreage:	Gross	Net	Gross	Net	Gross	Net	Gross	Net
Brazil	761,820.4	629,105.4	131,925.5	127,777.7	0.0	0.0	0.0	0.0
International								
South America (outside of Brazil)	1,650.9	554.7	60,860.1	20,449.0	—	—	—	—
North America	9,145.1	4,561.0	790.4	202.8	—	—	—	—
Total international	10,796.0	5,115.7	61,650.5	20,651.8				
Total consolidated	772,616.4	634,221.1	193,576.0	148,429.5				
Equity method investees:								
Africa	215,707.6	19,671.7	—	—	—	—	—	—
Total gross and net undeveloped acreage	988,324.0	653,892.8	193,576.0	148,429.5				

(1) A “gross” well or acre is a well or acre in which a working interest is owned, while the number of “net” wells or acres is the sum of fractional working interests in gross wells or acres.

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The following table sets forth the number of net productive and dry exploratory and development wells drilled for the last three years.

Net Productive and Dry Exploratory and Development Wells

	2017	2016	2015
Net productive exploratory wells drilled:			
Consolidated subsidiaries:			
Brazil	7	7.7	41.1
South America (outside of Brazil)	—	2.2	3.7
North America	—	—	0.1
Africa	—	—	—
Other	—	—	—
Total consolidated subsidiaries	—	9.9	44.9
Equity method investees:	—		
South America (outside of Brazil)	—	—	—
Africa	—	—	—
Total productive exploratory wells drilled	7	9.9	44.9
Net dry exploratory wells drilled:			
Consolidated subsidiaries:			
Brazil	0.4	5.1	14.9
South America (outside of Brazil)	0.4	1.0	
North America	—	—	0.5
Africa	—	—	—
Other	—	—	—
Total consolidated subsidiaries	—	6.1	15.4
Equity method investees:	—		
South America (outside of Brazil)	—	—	—
Africa	—	—	—
Total dry exploratory wells drilled	0.8	6.1	15.4
Total number of net exploratory wells drilled	7.8	16.0	60.2
Net productive development wells drilled:			
Consolidated subsidiaries:			
Brazil	174.8	194.4	523.5
South America (outside of Brazil)	2.4	24.5	70.9
North America	0.6	0.4	0.7
Africa	—	—	—
Other	—	—	—
Total consolidated subsidiaries	177.8	219.3	595.1
Equity method investees:			
South America (outside of Brazil)	—	0.0	0.7
Africa	1.0	1.7	0.0
Total productive development wells drilled	178.8	221.0	595.8
Net dry development wells drilled:			
Consolidated subsidiaries:			
Brazil	—	1.0	3.0
South America (outside of Brazil)	—	—	0.5
North America	—	—	—
Africa	—	—	—
Other	—	—	—
Total consolidated subsidiaries	—	1.0	3.5
Equity method investees:			
South America (outside of Brazil)	—	—	—
Africa	—	—	—
Total dry development wells drilled	—	1.0	3.5
Total number of net development wells drilled	178.8	222.0	599.3

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The following table summarizes the number of wells in the process of being drilled as of December 31, 2017. For more information about our ongoing exploration and production activities in Brazil, see "—Exploration and Production—Activities in Brazil." Our present exploration and production activities outside of Brazil are described in "—Exploration and Production—Activities Abroad." Also, see Note 15 to our audited consolidated financial statements for further information about our capitalized exploration costs and the unaudited supplementary information on oil and gas exploration and production contained in our audited consolidated financial statements.

Number of Wells Being Drilled as of December 31, 2017

	Year-end 2017	
	Gross	**Net**
Wells Drilling		
Consolidated Subsidiaries:		
Brazil	11	11
International:		
South America (outside of Brazil)	2	0.7
North America	—	—
Africa	—	—
Others	—	—
Total International	2	0.7
Total consolidated	13	11.7
Equity method investees:		
South America (outside of Brazil)	—	—
Africa	4	0.5
Total wells drilling	17	11.5

The following table sets forth our average sales prices and average production costs by geographic area and by product type for the last three years.

	Brazil	South America (outside of Brazil)	North America	Total	Equity method investees (2)
			US$		
During 2017					
Average sales prices					
Oil and NGL, per barrel	50.48	34.18	47.92	50.42	53.87
Natural gas, per thousand cubic feet(1)	6.30	3.53	3.31	6.10	—
Synthetic oil, per barrel	42.42	—	—	42.42	—
Synthetic gas, per thousand cubic feet	3.97	—	—	3.97	—
Average production costs, per barrel – total	11.15	3.65	9.17	10.99	27.00
During 2016					
Average sales prices					
Oil and NGL, per barrel	39.36	54.50	37.70	39.47	44.03
Natural gas, per thousand cubic feet(1)	5.22	3.83	2.72	4.99	—
Synthetic oil, per barrel	32.98	—	—	32.98	—
Synthetic gas, per thousand cubic feet	3.13	—	—	3.13	—
Average production costs, per barrel – total	10.36	6.95	6.83	10.18	35.11
During 2015					
Average sales prices					
Oil and NGL, per barrel	42.16	65.96	45.31	42.60	51.77
Natural gas, per thousand cubic feet(1)	6.04	3.97	2.75	5.77	—
Synthetic oil, per barrel	48.20	—	—	48.20	
Synthetic gas, per thousand cubic feet	5.68	—	—	5.68	—
Average production costs, per barrel – total	12.97	8.80	3.16	12.61	32.16

(1) The volumes of natural gas used in the calculation of this table are the production volumes of natural gas available for sale and are also shown in the production table above. Natural gas amounts were converted from bbl to cubic feet in accordance with the following scale: 1 bbl = 6 cubic feet.

(2) Operations in Venezuela and in Africa-PO&G. After our divestment of PESA in 2016, we no longer have equity investments in Venezuela.