STRATEGY PAPER EIGHT

Department of War Studies

EUCERS European Centre for Energy and Resource Security

KING'S College LONDON

Drilling southwards:

presenting Brazil's hydrocarbon scenario in light of its growing E&P operations

Flávio Augusto Lira Nascimento
KAS Energy Security Fellow at EUCERS 2014-15

In cooperation with

Konrad Adenauer Stiftung

EUCERS advisory board

Media Partners

ENERGLOBE.DE / DAS ENERGIEPORTAL

energy post

EurActiv .de

ICIS

BIZZ energy today.

Published by

The European Centre for Energy and Resource Security (EUCERS) was established in the Department of War Studies at King's College London in October 2010. EUCERS is focused on promoting an understanding of how our use of energy and resources affects International Relations, since energy security is not just a matter of economics, supply and technological change. In an era of globalization energy security is more than ever dependent on political conditions and strategies. Economic competition over energy resources, raw materials and water intensifies and an increasing number of questions and problems have to be solved using holistic approaches and wider national and international political frameworks.
www.eucers.eu

The Konrad-Adenauer-Stiftung (KAS) is a political foundation, closely associated with the Christian Democratic Union of Germany (CDU). KAS has more than 80 offices abroad and projects in over 120 countries. We cooperate with governmental institutions, political parties, civil society organisations and handpicked elites, building strong partnerships along the way. We focus on consolidating democracy, the unification of Europe and the strengthening of transatlantic relations, energy and security policy. The KAS Energy Security Fellowship Programme has supported young scholars in their research at European Centre for Energy and Resource Security (EUCERS) Kings College London since 2012.
www.kas.de

About the author

Flávio Augusto Lira Nascimento is one of the KAS Fellows 2014/15 at EUCERS and his research focused on analysing the current status of the hydrocarbon industry in Brazil. He is also an adjunct professor at the Federal University of the Pampas in Southern Brazil and holds a PhD in International Relations from the University of São Paulo, where he focused on Chinese-Russian energy relations.

Impressum

Editorial

About EUCERS

Senior Research Associates

Research Associates

Contents

Figures

Tables

Foreword

In 2014/15, for the third time in a row, the Konrad-Adenauer-Stiftung (KAS) supported the Fellowship in Energy Security at EUCERS. This year we welcomed two fellows at the European Centre for Energy and Resource Security, Department of War Studies, King's College London. Both fellows submitted innovative research proposals on the overall topic of "(Re-) Emerging Energy Superpowers". The young researchers, Flavio Lira and Kalina Damianova, spent two semesters at King's College London to research their respective topics and assist in organising the EUCERS/ISD/KAS Energy Talks 2015 on"(Re-) Emerging Energy Superpowers". Kalina focused on the topic of Iran and Flavio, author of this strategy paper, focused on the case of Brazil's emergence as an energy superpower.

Brazil currently has 13.2 billion barrels of proved oil reserves according to the EIA, as well as 13.7 Tcf of natural gas. Crude oil production is 2.7 million barrels per day and natural gas production is 911 Bcf. The country's energy mix is very dependent on renewables and hydropower alone accounts for over 70% of the electricity generation (EIA, 2014). A larger hydrocarbon production is expected to arise from the offshore pre-salt layer in the upcoming years and greener projects such as solar and wind power generation have been gaining momentum in the country, although there is still a long way to go. The country has historically insisted on different forms of energy production as a way of decreasing foreign dependence and making use of its natural resources in a competitive manner. At the same time Brazil does not have the mission of championing cleaner energy production. This has rather happened due to the natural availability of strong river streams, wind and sunlight, as well as the centuries-long culture of sugar cane plantation that could also serve ethanol production. Brazil's current challenges of hydrocarbon production – low oil prices and difficulties of investment in the pre-salt layer – is an example that the country is currently operating in two energy fronts: the more traditional renewable base (hydropower and ethanol) and a newer hydrocarbon focus (particularly pre-salt) seeking ultimate independence in this area, notwithstanding the current shortcomings of its E&P sector. In his study, Flavio focuses on Brazil's hydrocarbon scenario in light of its growing E&P operations.

We would like to thank our KAS Energy Security Fellows 2014/15 for their research contribution as well as their support for EUCERS and KAS in implementing the workshop series on "(Re-) Emerging Energy Superpowers" in 2015.

EUCERS and KAS are delighted to host this exceptional Fellowship. We would like to take the opportunity to thank Hans-Hartwig Blomeier, Director of the KAS London office and the EUCERS team for their unwavering support of our joint projects and are looking forward to

Dr Gerhard Wahlers,
Deputy Secretary General,
Konrad-Adenauer-Stiftung (KAS)

and

Professor Dr Friedbert Pflüger,
Director, EUCERS,
King's College London.

Introduction

For the past years, Brazil has become an important player in the global hydrocarbon sector, particularly in the fields of oil and, to a lesser extent, natural gas. As time went by, the country's exploration and production (E&P) sector has developed specific technologies to deal with challenges arising from deep-sea activities, which account for Brazil's most significant oil and natural gas production, in addition to the somewhat successful government policies for biofuels.

From originally being a country heavily reliant on hydrocarbon imports, Brazil has diminished its oil dependence considerably in the past decade. The country's national oil company (NOC), Petrobras, has gained much expertise in light of continuous discoveries and many international oil companies (IOCs) have benefitted from the end of state monopoly on most hydrocarbon activities in the late 1990s. Since then, international corporations have turned to Brazil for a share of the country's rising production of oil and natural gas in the past decades.

If, on the one hand, Brazil's status concerning E&P operations has changed considerably in absolute numbers, which can be verified by the evolution of the import/export ratio, on the other, the country's downstream sector remains unable to process the necessary amounts of national crude oil (which is mostly heavy) in a secure and continuous manner for domestic demand, let alone carry exports of refined products in a massive scale. The constant reinvestment Petrobras (which, by and large, is responsible for most of Brazil's hydrocarbon production) has planned for the country's diversification in E&P operations is very much bound to both external factors – such as international oil prices and global demand – and internal ones, such as the recent corruption scandals that have affected part of the company's management. At the same time, private companies and IOCs operating in Brazil are an increasing part of the country's E&P sector through concession and production sharing agreement (PSA) regimes. The present-day situation of growing production and increased demand shows Brazil as an important player in the world energy realm, but it is still not clear if its status as an "energy superpower" is conclusive.

Therefore, by making use of statistical data from Brazilian and international agencies, as well as sources from the legal, political and international relations field, this study seeks to present the current scenario of hydrocarbon exploration in Brazil in order to answer the following questions: 1) what is hydrocarbon security for Brazil; 2) within the hydrocarbon sector, what is the role of the socio-political environment in Brazil; 3) Is Brazil energetically independent?

To answer those questions one shall first introduce a brief history of oil and gas exploration in the country (as well as biofuels, an important element in the Brazilian fuel market) along with numbers covering reserves, exploration, production and foreign trade. Secondly, the framework of Brazil's E&P operations will be presented through what the author believes to be the most relevant legal and political events in the history of this sector. After this, the current situation of pre-salt discoveries and exploration will be presented, followed by the country's public tenders, IOC presence and a note on the corruption scandal Petrobras currently faces. Finally, the question of whether Brazil is energetically independent when it comes to hydrocarbons shall be discussed in order to answer if both its supply-demand scenario and its current production model, coupled with the recent Petrobras scandal, allow it to safely enjoy the benefits of its E&P operations.

1. Hydrocarbon exploration in Brazil: a quick overview

Hydrocarbon exploration in Brazil is mostly based on petroleum. Although natural gas plays a relevant industrial role mainly at a regional level, it is oil that embodies the country's historical tradition of non-renewables. The production of both commodities usually overlaps geographically and only recently has the management of natural gas acquired more leverage in the country. Having a safe and continuous supply for its hydrocarbon demand, therefore, has usually been the aim of Brazilian hydrocarbon policies (this section will help the reader put the first question of this study (what is hydrocarbon security for Brazil) in perspective so that it can be answered in section 5).

Oil production in Brazil is predominantly offshore. Only 6% of the country's estimated oil reserves are located onshore (EIA, 2014a) and the region where most production takes place is the South/Southeast. The offshore reserves in the region of Rio de Janeiro state alone account for 80% of the country's crude oil estimates, which are somewhat between 13.2 billion barrels and 15.6 billion barrels according to the United States Energy and Information Administration (EIA) and Brazil's National Agency of Petroleum, Natural Gas and Biofuels (ANP), respectively – South America's second largest after Venezuela. Natural gas is usually found in the same areas petroleum is located and, after Bolivia, the country holds South America's largest proven reserves at between 13.7 Tcf, according to the EIA, and 16 Tcf, according to the ANP (EIA, 2014a). The country has several exploration basins throughout its territory and the main ones are Amazonas; Solimões; Amazonas River's Mouth; Pará-Maranhão; Barreirinhas; Ceará; Potiguar; Sergipe-Alagoas; Recôncavo; São Francisco; Cumuruxatiba; Camamu-Almada; Jequitinhonha; Campos; Santos; Espírito Santo and Paraná (FIG. 1). Both the Campos and Santos basins, located in Brazil's south-eastern region, account for around 80% of the country's crude oil production (EIA, 2014a). Brazil's pre-salt layer is believed to hold sizeable hydrocarbon reserves, which might shift the country's position concerning not only its crude oil output but also its somewhat underdeveloped natural gas industry as will be presented in section 3.

In the 1990s, Brazil, like many South American countries, found itself in a post-dictatorship period and economic and financial reforms reached many fields whose control had once been restricted to official agencies, such as roads, communication and hydrocarbon exploration. Thus, in 1997, amidst the many concessions the state was to make to relinquish control of what was then seen by many policymakers as ineffective and unprofitable managing, petroleum-related activities would no longer be a state monopoly. Law 9,478 – dubbed the Petroleum Law – was enacted to regulate and manage concessions to private companies while also establishing the National Agency of Petroleum, Natural Gas and Biofuels (ANP). As of April 2015 there were 313 concessions, 85 offshore and 228 onshore, operated by 24 companies in the country (ANP, 2015a: 5).

Figure 1. Brazilian sedimentary basins
(LUCCHESI, 1998).

In the Campos Basin, Roncador was the biggest oil producing field in the country in April 2015 (average production of 344.8 Mbbl/d), whereas the Lula field in the Campos Basin was the biggest producer of natural gas (average production of 14 MMm3/d in April 2015). In the beginning of 2015, 93.3% of the country's oil production and 76.5% of its natural gas production came from offshore fields (ANP, 2015a: 6). Due to continuous investment, mostly from the government, the oil and gas sector currently makes up 13% of Brazil's total GDP, up from 3% in 2000 (NUNES, 2014). The ever-increasing governmental push for varied sectors of the Brazilian industry to take part in the oil and gas sector has translated into a broader range of nationalised stages in hydrocarbon production. This is quite representative of the present E&P scenario in the country, which is based on the strengthening of the country's NOC after decades of accumulated expertise and the inclusion of private national and international companies in both individual and joint projects after the opening of this particular market in the late 1990s.

The scenario of petroleum, natural gas and biofuels in the country will now be presented so as to better understand what role each of these plays within the larger hydrocarbon mix. As it shall be seen, the former has had a very big prominence when compared to the other two, making Brazil's hydrocarbon sector largely petroleum-based.

1.1. Petroleum

Brazil's experience with petroleum dates back to imperial times, when the first bituminous field was discovered in the province of Bahia in 1858. In 1892, three years after Brazil became a republic, the first deep well drilling took place in the state of São Paulo – but only sulphur water was found (PRESIDENCY OF THE REPUBLIC, 2009). Since then the country has come a long way searching for the most appropriate methods of developing its oil production and the considerable gap between the late nineteenth century and the 1930s, when oil exploration finally started being part of a state strategy, demonstrates how long it took for this industry to thrive. Brazil's neighbour Bolivia, for example, had practical results to show from its oil drilling since the early 1920s (FUSER, 2011: 82) but, unlike the Andean country, Brazil did not include foreign companies so speedily in its modernisation projects.

This is an important factor to bear in mind as many South American countries have experienced oil exploration in different lights – and what usually gives each its own hue is how hydrocarbons are perceived as an alienable national resource. In Brazil, for instance, massive oil exploration was put in motion during a heavily nationalistic period with strong elements of state-planning and this has influenced corresponding national perceptions and official regulations to this day.

In April 1938 President Getúlio Vargas signed Decree 395 making national petroleum supply a matter of "public utility". The federal government would thus have control over "imports, exports, transportation and implementation of oil pipelines as well as the trade of petroleum and refined products", besides controlling oil prices (MORAIS, 2014). In 1939, the state of Bahia was home to the first oil field in the country (PRESIDENCY OF THE REPUBLIC, 2009). Although new discoveries presented themselves somewhat sparsely over the coming years, Bahia would be symbolic not only as the birthplace of Brazil's oil industry but also as one of the most important regions for oil exploration in the country to this day.

State control of oil exploration, thus, was embedded in the very inception of commercially viable oil wells in the country. During the 1940s this rationale gained momentum as nationalism was on the rise – building a resilient economy, especially during World War II, was now entangled with control over natural resources, particularly oil. Many sectors of the civil society, including students and armed forces staff, incorporated this into their discourse with increasing naturalness. In October 1953, President Getúlio Vargas signed Law 2,004 creating Petróleo Brasileiro S.A., – Petrobras – Brazil's national petroleum exploration company, a mixed-economy company with over 50% of state-owned shares (PRESIDENCY OF THE REPUBLIC, 1953). A decade later, shortly before the 1964 military coup, a new presidential decree made all oil imports and exports the sole responsibility of Petrobras – such activities had, until then, been open to national and foreign private companies (PRESIDENCY OF THE REPUBLIC, 1963). From then up to 1997, the history of oil exploration in Brazil was basically the history of Petrobras and its activities.

Figure 2. Oil-producing basins in the Southeast
IBP, 2009

Starting in the 1960s, the country's E&P industry took a strong offshore turn, first in the state of Sergipe (1968) and, in 1974, in Rio de Janeiro (MORAIS, 2013: 112-114). As Petrobras gained more expertise, the company would at times make agreements with foreign companies for risk-sharing activities. In the late 1970s it developed the anticipated production system, which allowed drilling and production at the same time – it was therefore no longer necessary to wait for the conclusion of an oil platform to start production (PRESIDENCY OF THE REPUBLIC, 2009). This translated into substantial leverage for self-funding as the viability of varied projects was no longer bound to the completion of oil rigs so production could start.

Throughout the 1980s important new discoveries were made in Brazil, particularly the giant offshore fields of Albacora and Marlim (both in the Campos Basin in Rio de Janeiro state), as well as in the Urucu River field in the state of Amazonas (PETROBRAS, 2015a). In 1996, another giant offshore oil field, Roncador, was discovered in the Campos Basin (PETROBRAS, 2013). Large oil fields were continuously discovered in the Southeast, which remains the country's most productive area (Fig. 2).

Historically, Brazilian oil consumption has been considerably larger than its domestic supply. Since the early 1990s, Brazil's yearly oil production has generally increased and the mid-2000s were noteworthy as petroleum supply finally matched consumption. From then on, a somewhat unsteady relationship between consumption and supply has been verified, but they were usually harmonious during the 2006-2010 period. Starting in 2010, however, consumption has once again exceeded national production (Fig. 3) particularly due to higher demand for refined products, which has increased at a faster rate than the country's downstream capacity to keep up.

Overall, production remained relatively stagnant between 2010 and 2013, although there was an 11% increase in petroleum and NGPL output in 2014 according to the country's Ministry of Mines and Energy (2015a); significant, yet too episodic to signal an increasing trend. According to the EIA (2015c), Brazil's processing gain[1] averaged around 3% from 1990 to 2013 (Fig. 4), 50% higher than the world average of 2% (EIA, 2015d) and twice as high as total Central and South American processing gain in the same period, which amounted to 1.5% (EIA, 2015c; 2015e).

Figure 4. Brazil: total petroleum production (1,000 bpd).
Source of data: EIA (2015a; 2015f; 2015c)

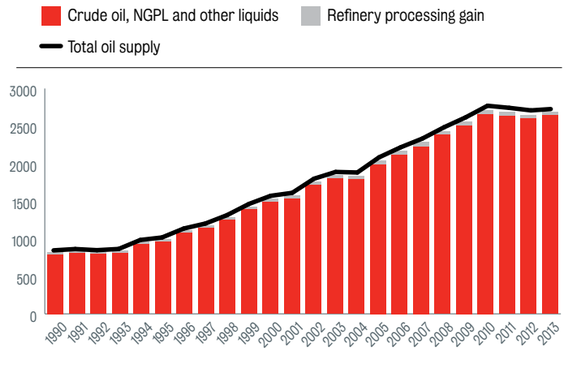
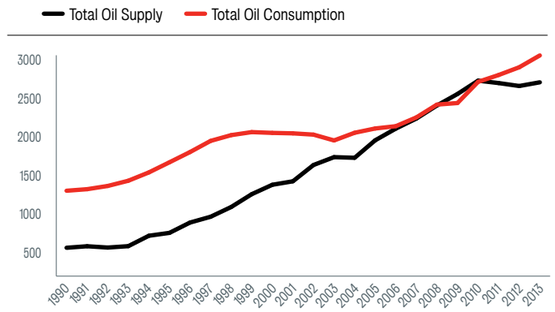


Figure 3. Brazil: production vs. consumption of petroleum (1,000 bpd)
*Includes crude oil, NGPL and other liquids, as well as the refinery processing gain. Source of data: EIA (2015a; 2015b)



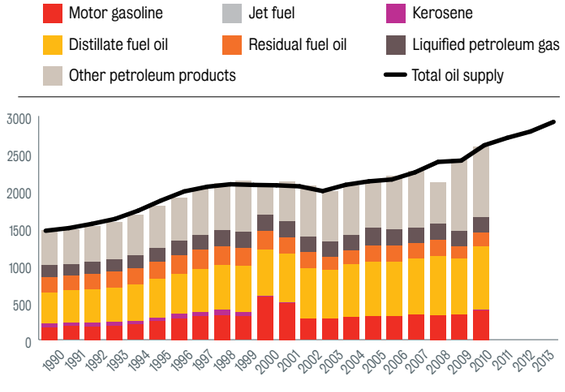
There were 9,064 wells in Brazil (820 offshore and 8,244 onshore) as of April 2015 (ANP, 2015b). However, Brazil still does not have enough capacity to transform a large part of its crude oil into products. Around half of its proved reserves consists of heavy oil, whereas Brazilian refineries have been historically equipped to deal with lighter crudes. Most Brazilian oil has an average API of 25.1o as of April 2015 (ANP, 2015b: 7), an additional problem for a country whose refining sector is still far from being fully developed[2]. Therefore, the 2012/2016 business plan disclosed by Petrobras indicates that of the total US$236.5 billion[3] supposed to be invested by Petrobras in that period, US$ 65.5 billion would go to the refining sector, something around 28% of that amount (LEMOS et al., 2013). This is part of an overall government strategy to develop self-sufficiency on a widespread level, as the planned refineries (in the state of Rio de Janeiro, in the Southeast, and in the states of Pernambuco, Maranhão and Ceará, in the Northeast) would be closer to significant offshore producing areas, both currently and planned, as pre-salt production was expected to keep increasing. Pre-salt crude oil is lighter than the average offshore Brazilian oil at a 28.5o API gravity (PETROBRAS, 2009). The government expects all levels of crude to be processed nationally in the future while there is still a major gap between extracted and industrialised hydrocarbons in the country. Figure 5 presents the details of the country's total petroleum consumption.

1 When crude oil is refined the output ends up being higher than the input. The extra volume of petroleum products being made is the (refinery) processing gain.

2 The API – American Petroleum Institute – gravity is a scale expressing "the gravity or density of liquid petroleum products" (EIA, 2015g). Basically, the lighter the API gravity, the lighter the petroleum liquid. An API gravity higher than 38 degrees indicates light oil; a degree between 38 and 22 indicates medium oil; and 22 degrees or below indicates heavy crude. The ANP, however, has a different classification system as stated in Ordinance 09/2000. According to the Brazilian agency:
• light oil has an API gravity ⭘ 31o
• medium oil is ⭘ 22o API and <31o API;
• heavy oil is <22o API
For the purposes of this study, we have adopted the non-ANP classification since it is widely applied worldwide.

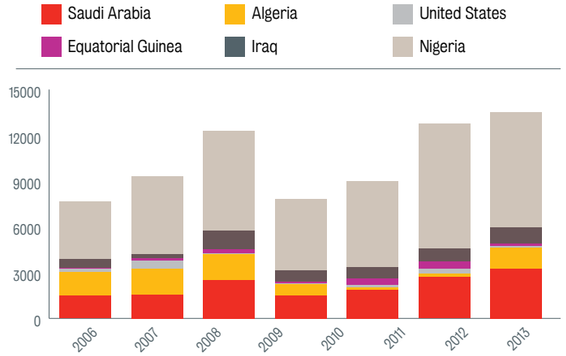
3 All values in Brazilian Reals have been converted to US dollars at the exchange rate of 06 December, 2015.

Figure 5. Brazil: total petroleum consumption (1,000 bpd)
Source of data: EIA (2015b; 2015d; 2015e; 2015f; 2015h; 2015i; 2015j; 2015k).



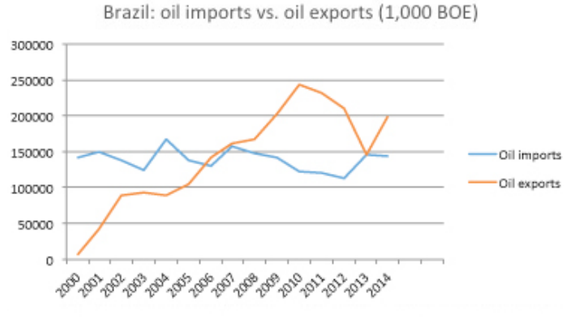
Nigeria has been Brazil's main petroleum supplier, averaging US$6.3 billion FOB of exports from 2006 to 2013 (Fig. 6). According to the EIA, Nigeria accounted for 52.4% of total crude oil exports to Brazil in 2014, with 75.5 million barrels (EIA, 2015l).

Figure 6. Brazil: origin of petroleum imports (main countries) US$1,000,000 FOB
Source: IBP, 2014



Neighbouring countries with a significant production, therefore, do not account for an important share of Brazil's oil imports. Venezuela, at 2.49 million bpd, is the fifth largest oil producer in the Americas (after the US, Canada, Mexico and Brazil) but the largest portion of its exports is destined to the United States (EIA, 2014b). Hydrocarbon trade with neighbouring countries is usually much more visible at the natural gas level. Therefore, Brazil's oil imports on average did not grow from 2004 to 2014, having overall diminished instead, from around 167 million BOE in 2004 to 113 million BOE (barrels of oil equivalent) in 2012 (although they have remained somewhat stable between 2000 and 2004, averaging 139 million BOE). This decreasing trend was interrupted in 2013 due to the rising imports of gasoline to fuel the increasing number of cars in the country. As for exports, they have seen a very sharp increase from 7 million BOE in 2000 to around 200 million BOE in 2014, with a peak of 242 million BOE in 2010 (Fig. 7). On the one hand, this means Brazil's oil exports increased twenty-eight-fold in 14 years; on the other hand, there was a remarkable decrease in exports was from 2010 to 2013, particularly due to the increase in domestic refining so that consumption could be met along with imports (BONATO; LORENZI, 2014).

Figure 7. Brazil: oil imports vs. oil exports (1,000 BOE)
Source: ANP, 2015a



Concerning all operating companies as of April 2015, Petrobras was responsible for 94% of the country's total oil production, followed by Shell at 2.2% and Statoil and Chevron, at 1.4% and 1.1% respectively (ANP, 2015b: 15). Petroleum and its products accounted for 39.4% of Brazil's energy mix in 2014 (MINISTRY OF MINES AND ENERGY; N3E, 2015).

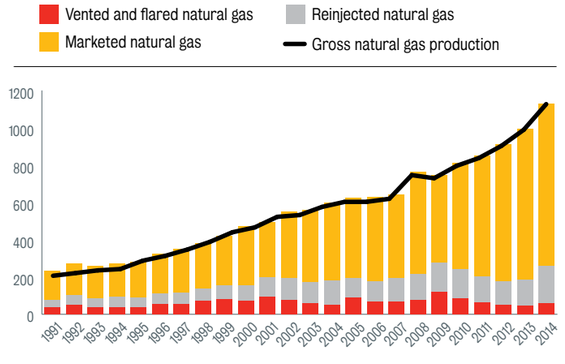
Up to now, it is not possible to take Brazil's major oil exporting capacity for granted. This is not to say it shall not eventually happen but the late fluctuations might at best indicate a period of uncertain adaptation during the transition from a highly imports-dependent economy to a more autonomous one. In any case, the country's estimated oil reserves do not yet match its upstream – let alone midstream and downstream – capabilities.

1.2. Natural gas

More than two thirds of the natural gas recently produced in Brazil has been associated gas[4] (EIA, 2014a). As already presented, the focus of Brazil's hydrocarbon industry has been oil ever since its inception; therefore, natural gas has at many times been seen mostly as a by-product of petroleum exploration, a situation that has recently started to change. In 2014, Brazil's natural gas production accounted for 13.5% of the country's total energy consumption (MINISTRY OF MINES AND ENERGY; N3E, 2015: 4). Again, the Campos Basin, in the Southeast, holds the largest proved reserves. Eighty-five percent of the country's reserves (which total 13.7 Tcf/16 Tcf according to EIA/ANP estimates) are located offshore and 66% of these can be found in this particular basin. Most onshore natural gas reserves (72%) are located in the northern state of Amazonas (EIA, 2014a).

Brazil's gross natural gas production more than quadrupled since 1990 due to continuous search for alternatives to traditional energy sources, such as petroleum, coal and hydroelectricity, having reached 1,126 Bcf in 2014 (Fig. 8). The percentage of natural gas vented/flared averaged 15% from 1990 to 2010. From 2011 on, however, the country started to significantly reduce its gas flaring/venting to an average of 5.6% in the 2011-2014 period. The share of re-injected natural gas has ranged from 14% to 22% of total gross production, averaging 18% in the 1990-2014 period (EIA, 2015l; ANP, 2013a: 77, 78; 2014a: 83, 84; 2015b).

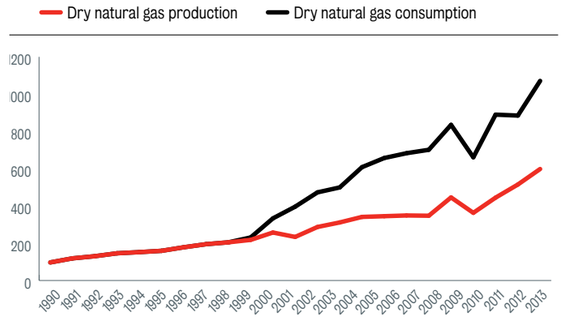
Figure 8. Natural gas production in Brazil (Bcf)
Source: data from the EIA (2015m); ANP (2013: 77, 78; 2014a: 83, 84; 2015b)



If the trend to decrease gas flaring and venting continues, the country might be able to nearly eliminate those in the near future. ANP ordinance 249 from November 2000 set the limits for gas flaring and venting throughout the country. According to the ANP, the amount of associated gas flared/vented monthly in a field must not exceed 15% of the maximum monthly level set by the Agency in any given month and the amount of associated gas flared/vented yearly in a field must not exceed 10% of the maximum yearly level as calculated by the ANP (ANP, 2000). The amount of gas allowed to be flared/vented is published by the agency in its Annual Production Programme.

The consumption of dry natural gas has usually been significantly larger than production since the early 2000s (Fig. 9) and the country has had a long interaction with neighbours in this area, particularly Bolivia; Petrobras has been an important stakeholder in the latter's gas sector, not without the occasional bilateral skirmishes[5].

Figure 9. Brazil: production vs. consumption of dry natural gas (Bcf)
Source: data from EIA (2015m; 2015n).



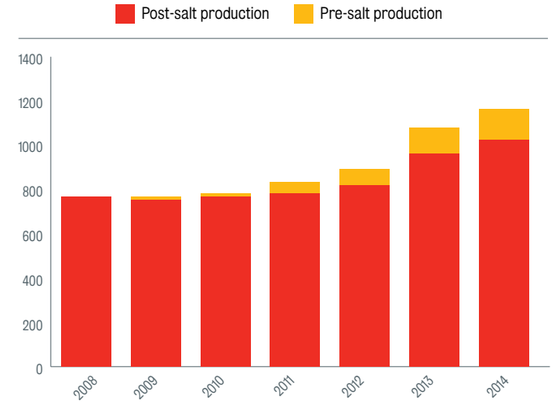
Overall, around 80% of Brazil's natural gas production (as of 2013) was dry natural gas. When it comes to non-associated natural gas, the states of Bahia, Espírito Santo and São Paulo account for 72% of the country's total production. As mentioned above, the state of Amazonas holds fairly sizeable onshore reserves but lack of transport infrastructure results in a mostly local consumption (EIA, 2014a); the same holds true for the state of Bahia. In the past years the pre-salt layer has accounted for an increasing share of Brazil's natural gas output (Fig. 10).

As already presented, the focus of Brazil's hydrocarbon industry has been oil ever since its inception; therefore, natural gas has at many times been seen mostly as a by-product of petroleum exploration, a situation that has recently started to change.

4 Unlike non-associated gas, associated petroleum gas is found in fields alongside petroleum.

5 In 2006, the Bolivian state nationalised natural gas production in the country, putting an end to Petrobras's activities in the country. Cf. FUSER, 2011.

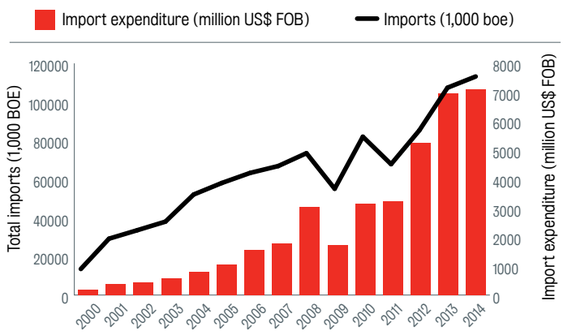
Figure 10. Brazil's natural gas production by type (Bcf)
Source: adapted from EIA, 2015l



Among natural gas operators in the country, Petrobras accounted for 95% of total production in 2015, followed by Parnaíba Gás at 3.9%. Shell and Chevron come next at 0.6% and 0.3% respectively (ANP, 2015b).

In 2013, Brazil produced 911 Bcf of gross natural gas (752 Bcf of which were dry). However, it did consume 1.3 Tcf, mostly addressed to national gas distributors (EIA, 2014a). This excess in demand has led to growing imports, although production in the pre-salt layer might change this scenario in the future. The country has only recently started to import natural gas (1999) and both production and consumption have increased at similar rates. Import expenditure has increased accordingly overall and reached US$ 7.1 billion FOB in 2014 (Fig. 11). Transpetro, Petrobras's subsidiary dealing with hydrocarbon transport, controls most of the country's internal pipeline systems (around 95%). In 2010 the southernmost and northeastern-most regions of Brazil were finally connected via gas pipelines; nationwide, these amount to 5,700 miles. Internationally, the Bolivia-Brazil Pipeline has been the most significant route bringing natural gas from the neighbouring country to Brazil. Close to 70% of Brazil's natural gas imports come from Bolivia and domestic demand has been on the rise. In the region, Argentina is a secondary supplier whereas Liquefied Natural Gas (LNG) mostly comes from Nigeria, Qatar, Spain and Trinidad and Tobago. Most of the continuous rise in imports throughout the years is due to increasing LNG purchases (EIA, 2014a).

Figure 11. Natural gas in Brazil (including LNG): total imports and import expenditure
Source: data from ANP (2015c).



There have been some domestic discussions on how LNG imports should be handled by the Brazilian government since they have accounted for an increasingly larger share of the country's imports of natural gas. Brazil currently has three regasification terminals in Pecém (off the coast of Ceará state), Guanabara Bay (Rio de Janeiro state) and another one in Bahia state (PETROBRAS, 2014a; 2015b; 2015c), all of which amount to a combined capacity of 1.4 Bcf/d (EIA, 2014a). All terminals are floating regasification and storage units (FRSUs).

1.3. Ethanol and biodiesel

The Petroleum Crises of the 1970s impelled Brazil to diversify its sources of fuels and to have larger control over its energy production. Some of the nationalistic policies of the military regime were aimed at releasing the country from high dependency on imports (a tidal wave in Brazilian industrial policy since the early 20th century), which were propelled by the uncertainties related to energy during that decade.

Sugar cane, one of the most iconic agricultural produce of Brazil, revolving around a deeply embedded culture of plantation, would now be used for fuel generation. The National Alcohol Programme (Pro-Alcohol) was established under the administration of President Ernesto Geisel - 1974-1979 – (SOUZA, 2015) in a time when international sugar prices were low, leading to a very significant transformation of national production of fuel and correlated products. Cars now came out of Brazilian factories with engines running on ethanol and sugar and ethanol plants benefitted from state subsidies.

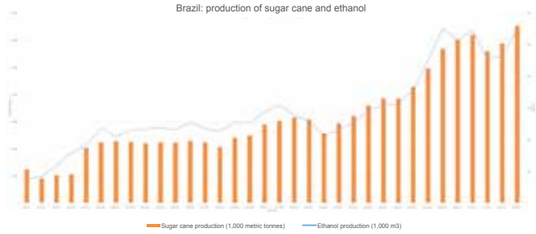
Ethanol production in the country had, nevertheless, started long before. In the 1920s the country started experimenting with it as fuel and, some years later, President Getúlio Vargas created the Institute of Sugar and Alcohol, making it mandatory to add ethanol into gasoline (CHAMBER OF DEPUTIES, 1938). Decades later, in 1975, when Pro-Alcohol came into force, Brazil used to import 80% of the oil it consumed, which corresponded to 50% of its balance of trade (CORTEZ, LEITE, 2015). After the fall of the military regime in 1985 and the end of massive state subsidies to the ethanol industry some years later, the ethanol boom quickly subsided. Ethanol might not have been particularly viable economically had it not been for subventions and the lack of competitiveness of petroleum in the 1970s, which helps explain its implementation and popularity during a whole decade. At the same time, this period provided the Brazilian scientific community and the national market with a specialised know-how of ethanol production, implementation and commercialisation.

Whether aimed at sugar or at alcohol production, the sugar cane industry in Brazil remains strong. Whenever oil prices are high, the ethanol industry increases production – and this is coupled with the considerable reduction in production costs that have been attained in the past decades. The recent popularity of flex-fuel vehicles[6] in Brazil has added to the industry's competitiveness but, unsurprisingly, the recent fall in oil prices has diminished its momentum. The state of São Paulo alone accounts for roughly 50% of the country's ethanol production (both hydrous and anhydrous) and, when it comes to tanking capacity, 52% of Brazil's tanks and 54% of the country's total available volume are located in that particular state (ANP, 2014b).

6 Flex-fuel vehicles run on any percentage of ethanol in the fuel mix, i.e., any share of ethanol + gasoline.

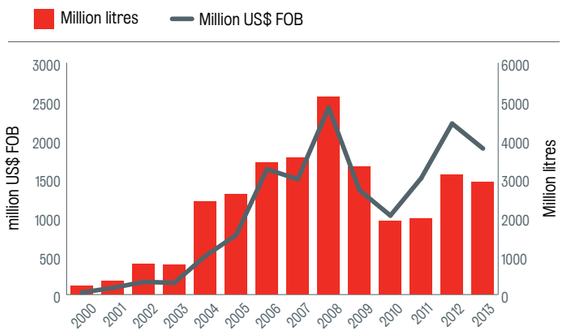
In order to stimulate the country's sugar-alcohol sector, since the 1970s there has been a legal share of mandatory ethanol addition to regular gasoline, having started at 4.5% in 1977 up to 15% in 1979. From 1985 on, this has ranged from 20% to 25% of the fuel mix (ANP, 2014b) and in March 2015 the share was increased to 27% (PORTAL BRASIL, 2015). During the 2013/2014 harvest, Brazil produced 653 million tonnes of sugar cane and 27 million m3 of ethanol, a 5.2 and 7.4-fold increase when compared to the 1980/1981 production, respectively (Fig. 12).

Figure 12. Brazil: production of sugar cane and ethanol
Source: data from UNICA (2015a; 2015b)



In addition to domestic consumption, ethanol has only recently started to be exported. The US has remained the main importer of the product, which stems from the American demand of so-called advanced biofuels – a quota established by the US government (REUTERS BRASIL, 2014a). An increase or decrease of that quota has a direct impact on Brazilian foreign ethanol trade, since the US accounted for 56% of total exports in 2013 (Fig. 13)[7]. This means ethanol prices vary considerably and, while calculated differently in different regions of Brazil, they are also quite dependant on both domestic and foreign demand (the former tends to be quite more stable than foreign demand particularly due to government promotion).

Figure 13. Brazil: ethanol exports by volume and value
Data from UNICA (2015c).



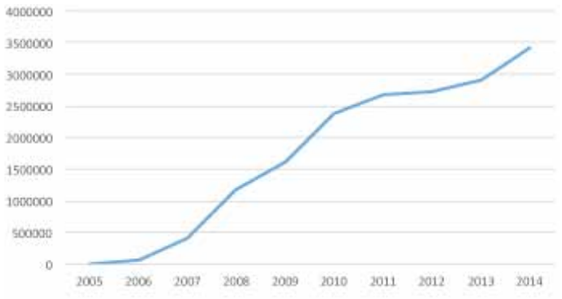
Biodiesel is another biofuel whose consumption has increased significantly in Brazil in the past years. Besides animal fat, which can be used to produce it, traditional Brazilian crops such as babassu, castor beans, nettlespurge, palm, peanuts, soy and sunflower are common materials for it. Basically, vegetable oil is turned into biodiesel through transesterification so it can run on diesel-burning engines[8]. Biodiesel can only be produced in ANP-authorised plants.

There are two main reasons for government promotion of biodiesel, which are similar to the above-mentioned ethanol policies. First, the replacement of 7% of petroleum-derived diesel with biodiesel reduces the country's dependence on fuel imports. This is supposed to strategically promote the national fuel industry from a domestic management standpoint. Secondly, biodiesel is environmentally cleaner than regular diesel, a factor that has gained more importance at a national level. Biodiesel BX is the name given to petroleum-derived diesel plus 7% biodiesel, which is now mandatory in all petrol stations throughout Brazil (ANP, 2014c).

Law 11,097/2005 introduced biodiesel in the country's energy matrix (ANP, 2005) and in 2008 mixing it with standard diesel became mandatory. ANP-sponsored tenders also take place from time to time, through which refineries purchase biodiesel to have it mixed into standard diesel fuel thus promoting national production. Biodiesel producers need to register with the ANP and meet certain criteria before starting production (ANP, 2013b).

From 2005 to 2014, Brazil's biodiesel production increased from 736 m3 to 3.4 million m3. While fairly stagnating in the 2011-2012 period, continuous rise picked up once again in 2013 (Fig. 14) and from January to April 2015 the country's accumulated production had reached 1.2 million m3, which represents a 26% increase from the same period the year before (DADOS.GOV.BR, 2015).

Figure 14. Brazil: total biodiesel production (cubic metres)
Source: Data from dados.gov.br (2015).



7 There has not been any stable trend on exports to the US in the past decade, though. The share of total Brazilian ethanol exports to the United States has been as low as 7.4% in 2005, increasing to 51% in 2006, falling to 8% in 2009 and peaking at 66% in 2012 (UNICA, 2015c; 2015d; 2015e).

8 The production of biodiesel through transesterification comprises several steps from the preparation of raw materials to the purification of ethers and glycerine. Cf. Encarnação (2008: 22-25).

The country has not exported biodiesel in any steady manner, having started such activities only in 2012; it is therefore quite early to verify a trend, particularly given the sharp decline from 2013 to 2014 (Table 1). Since the main purpose of official policies is to stimulate a level of production that will allow the legal share of biodiesel to be added to standard diesel at a domestic level, exports are still not the focus. Imports have not taken place in any significant amount.

Table 1. Brazilian exports of biodiesel
Source: Aliceweb, 2015.

	2012	2013	2014
m3	35267.05	34339.55	0.045
1,000 US$ FOB	33983.38	32775.17	1.101

Biofuels have been a continuous part of Brazil's strategy of energy diversification and ethanol has been particularly relevant for that, both at the political-economic and at the environmental level. On the one hand, it represents the promotion of a fuel industry that is cleaner and more "eco-friendly" than the usual E&P activities; on the other hand, the massive production is coupled with traditional agro-industrial methods quite prevalent in the country such as the plantation monoculture, which is socially and environmentally controversial due to extensive and incessant use of land for a small number of crops. Whether uninterrupted sugarcane monoculture and biodiesel production do lead to significant industrial diversification remains debatable, although, coeteris paribus, they would have a positive impact on the country's self-sufficiency of energy management.

2. Politics, E&P laws and regulations

Deeply connected with the official discourse of national modernisation, hydrocarbon exploration has been a sensitive issue in Brazil since the first half of the twentieth century (see section 5). Oil – particularly –, natural gas and ethanol have been subjected to different legal and political approaches. Whether left- or right-leaning, whether economically conservative or liberal, the various governments have promoted laws and regulations that said a lot about how the country's development was advanced. The most recent instruments, which have opened the country's oil and gas sector to non-state actors, have allowed for more competition and diversification and are more directly connected with the two waves of Brazilian foreign and domestic models of economic policy: the neoliberal phase (1990-2002) and the logistic-state phase (2003-present), which will be further presented.

In this section one shall find a discussion about the most recent laws and regulations that concern E&P activities in Brazil, while placing them within a wider political framework, which will begin to answer questions 1 and 2 of this study: what is hydrocarbon security for Brazil; and, within the hydrocarbon sector, what is the role of the socio-political environment in Brazil? As shall be seen, Brazil´s latest democratic period, as politically varied as it has been judging from the different parties involved, has shown some continuity when it comes to the oil, gas and biofuel industry. From the late 1990s liberalisation to the mid-2010s silent protection of national corporations, this sector has become more complex and has counted with an increasing number of private actors (some of them involved in the current corruption scandal that has afflicted the NOC).

2.1. Recent legislation and political environment

Brazil's oil and gas industry has revolved around Petrobras since its beginning, even after the 1997 Petroleum Law, which allowed other companies to fully engage in E&P operations in Brazil. The reasoning for most of the years following the Petroleum Law was that the government would now allow private companies to operate in the country under a concession regime. The "Principles and Objectives of the National Energy Policy" as outlined in the Petroleum Law are:

I to preserve national interests;
II to promote development, growth of the labour market, and the valuation of energy resources;
III to protect the consumers' interest also in relation to price, quality and availability of products;
IV to protect the environment and promoting energy saving;
V to secure the supply of oil products throughout the national territory, pursuant to paragraph 2 of article 177 of the Constitution;
VI to promote the increase of natural gas use on an economic basis;
VII to identify the most adequate solutions for electric energy supply in the various regions of the country;
VIII to make use of alternative energy sources through the economic use of available inputs and applicable technologies;
IX to promote free competition;
X to attract investment in energy production;
XI to promote the growth of the country's competitiveness in the international market.

Presidency of the Republic (1997)

During President Fernando Henrique Cardoso's administration (1995-2002), Brazilian public companies went through a significant process of de-statisation both at the federal and at the state level. Therefore, E&P operations became more open to private participation (both national and international) and much of the economic vocabulary present in Brazil within the 1980s/1990s neoliberal momentum can be easily perceived in the above-mentioned legislation. Still, the traditional role played by Petrobras meant its centrality was still upheld by the state in order to preserve "national interest" more broadly.

The bidding rounds the ANP has put forward on an almost yearly basis, the Brasil Rounds, granted E&P concessions to foreign companies from many different countries (see section 3). Under the concession regime, companies have been given property and control of the production and the government's revenue from such operation comes from royalties (to municipalities and states), signature bonuses (paid to the ANP by winning companies upfront so they can have the right to start E&P operations in the country) and taxes. In extraordinary cases of highly productive areas, a particular compensation named special participation is payable to municipalities, states and the federal government (PRESIDENCY OF THE REPUBLIC, 1997).

After the discovery of oil in the country's pre-salt layer (see section 4) new bills were presented to Congress introducing the Production Sharing Agreement (PSA) regime to this specific geologic area, as well as the government's assignment to Petrobras of rights for the exploration and production of 5 billion BOE in pre-salt zones. Federal Law 12,351, enacted in 2010, also known as the PSA Law, set the framework for such contracts from then on. PSAs would now be managed by the newly created Brazilian Company for the Administration of Petroleum and Natural Gas, also known as PPSA. In addition, the sovereign fund was created so that the government could receive oil revenues (LEMOS et al., 2013). Both the pre-salt areas and areas deemed "strategic" by the federal government were to be developed by the new contracting system. The PSA Law defines strategic area as any region that is important for "national development, to be demarcated by Executive Branch act, characterized by low exploratory risk and high potential for the production of oil, natural gas and other fluid hydrocarbons" (PRESIDENCY OF THE REPUBLIC, 2010). However, unlike the former bidding rounds that have already taken place, Petrobras is to be the sole operator of PSA exploration in the country. This means that while foreign companies may take part in the new bidding rounds, they will all have to work alongside Petrobras, which will be granted a minimum 30% participating interest in auctioned areas. In PSA pre-salt E&P activities, the government is also remunerated by royalties and signature bonuses, as well as its portion of the profit oil.

In addition, the policy of "local content", defined as the "proportion between the amount of goods produced and the services rendered in the Country for execution of the contract and the total amount of the goods used and the services rendered for that purpose" (PRESIDENCY OF THE REPUBLIC, 2010) was set forth to develop the local supply chain (LEMOS et al., 2013). All in all, the PSA regime seems to be more "state-friendly" than the former concession models and this is quite an accurate reflection of the political moment Brazil was living at the time such law was enacted. From 2003 on, the new administration made it a priority to redefine the role of the Brazilian state in hydrocarbon exploration, being less of an "enabler" for private investment and more of a promoter of official protection for national companies (both private and public).

It might be risky to say there was a complete E&P overhaul between Cardoso's policies and those of Luiz Inácio Lula da Silva (2003-2010) and Dilma Rousseff (2011-present). Many of the country's E&P capabilities were greatly enhanced by the inclusion of private companies in the sector, especially during the 1990s (as well as the overall control of inflation brought about by the country's new currency, the Brazilian Real, introduced in 1994, which made it significantly easier to plan both private and public spending). There has, however, been a considerable shift between how E&P activities have been prioritised in Cardoso's and da Silva's/Rousseff's administrations.

In the 1990s and early 2000s (during the Collor, Franco and Cardoso administrations) the aforementioned de-statisation period adopted in Brazil meant that traditional state activities such as energy, banking and communications were no longer under sole government management. This represented a re-strategisation movement, namely, that the elected government and many representatives no longer saw complete state control of those areas as highly relevant, desirable or (even) strategic. Government control was replaced by government oversight, which meant private companies were free to pursue activities that might not necessarily follow state planning – so government and private priorities could either intersect or not. The best way to have a say on the preferable course of action for private E&P companies (according to government standards) was to promote the Brasil Rounds, by which the ANP would publicize the areas to be developed.

During Lula da Silva's administration, however, there was a sharp increase in offered areas by the ANP and subsequent participation of local companies being integrated within the supply chain, especially in smaller E&P projects. So, very large ventures were either developed by Petrobras and major IOCs while smaller ones were very much diversified. The path from the enactment of the Petroleum Law in 1997 to the PSA Law in 2010 was marked by the gradual consolidation of the ANP and the growth of Petrobras. Overall economic recovery was a part of that and, now, two tendencies took place in Brasilia: on the one hand, the strengthening of the public sector and, on the other, the substantial inclusion of private companies, both national and international, in E&P activities. The very newly adopted rules frame both the participation and the operations of companies, particularly in the pre-salt area, and subject them to the rules defined by the ANP. Although there has been an economic scenario, particularly based on inflation control (mostly successful during Cardoso's first term in office, from 1995 to 1998), conducive to higher governmental ability to plan its spending since 1995 – in spite of the 1999 Brazilian real crisis (OLIVEIRA; TUROLLA, 2003) –, starting in 2003 government agencies were again given high priority and the state started acting as a promoter of domestic initiatives carried by public and private national companies. Cardoso's administration had been marked by low state investment and a high interest rate, notwithstanding the inflation control that was fairly new in Brazil's business mind-set. In fact, the very high value of the Brazilian currency between 1995 and 1999, paired with the above-mentioned investment constraints, had a negative impact on both the national industry as a whole (and national E&P operations as a result) and Brazilian exports, which recovered after the post-1999 Brazilian real devaluation. The resulting growth of large segments of the national industry from then on – notwithstanding the now higher foreign debts many of them had acquired when the real had a value equivalent to the US dollar – paved the way for stronger national companies in the E&P sector. This happened not only at the up-, mid- and downstream sectors, but also with many companies that made up the extended E&P supply chain, such as contractors.

"The ideology that underlies the logistic state connects a foreign element, liberalism, to a domestic one, Brazilian developmentalism. It fuses the classical doctrine of capitalism with Latin American structuralism. It thus accepts to remain within the order of the Western system which has recently been globalised."

Cervo (2003)

In 2003 government priorities concerning the public sector changed. State companies had their role reignited as lower state control over "relevant" operations was frowned upon as being one of the causes of the generalised poor reliance on official capabilities for national production and industrial growth. This bears resemblance to what Cervo (2003) has dubbed the "logistic state":

Such attitudes also refer to continuous government support of Brazilian companies both domestically and abroad as a way to stimulate the country's presence internationally and reaffirm its control over strategic activities: finances, communication, energy and so forth. At the same time, this has not resulted in foreign companies being shunned away from the entrepreneurial environment as they would participate in tenders of all sorts, particularly E&P. Nevertheless, this new period meant national companies were now comparatively more equipped (when considering the pre-1999 industry scenario) to participate in bidding processes as they had had the opportunity to grow considerably in the former years due to state-sponsored credit programs and the aforementioned rekindling of national production due to the lower value of the Brazilian currency.

Another factor that traditionally lingers in the country's political-economic mind-set is the significant divide between resource-rich Brazil and its historically poor processing capacity. The current drive for intensifying national refining capabilities might be seen as yet another attempt at transforming Brazil into a regional and global hub for the aggregation of value within the oil industry as part of a larger movement towards import substitution that has historically been present in the country. Whether or not the current strategy of involving medium and large national companies in this trend is actually strengthening Brazilian industrial competitiveness and bearing long-lasting fruits remains to be seen.

2.2. E&P activities, environmental regulations and operation permits

Since all Brazilian hydrocarbons belong to the federal government in situ, that is, before being extracted, permission must be granted for E&P exploration. In addition, certain rules apply both before, during and after operations start whether companies are private or public. The most relevant points are the Environment Impact Assessments (EIAs), regulations on gas flaring and venting, waste and decommissioning.

The National Environment Council requires an EIA from concessionaires and, depending on the risk of pollution a given E&P operation might carry, an environmental licence is required. Depending on the nature of the concerned area, environmental licensing may be carried at a federal, a state or a municipal level. The Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA) deals with licensing of activities that are:

I located or developed jointly in Brazil and in neighbouring countries; on territorial waters; on the continental shelf; in exclusive economic zones; in indigenous territory or in conservation units under the Union's domain.
II located or developed in two or more states of the Union;
III whose direct environmental impacts go beyond the country's territorial limits or the limits of one or more states of the Union.(...)

(MINISTRY OF THE ENVIRONMENT, 1997, art. 4)

Environmental licensing at the state/Federal District level is required when activities are:

I- located or developed in more than one municipality or in conservation units belonging to the state or the Federal District;
II- located or developed in forests and other types of natural vegetation of permanent protection (...);
III- whose direct environmental impacts go beyond the territorial limits of one or more municipalities;
IV- delegated by the Union to the states or to the Federal District via legal instrument or covenant.

(MINISTRY OF THE ENVIRONMENT, 1997, art. 4)

Finally, at the municipal level, only E&P operations that are very localised within municipal limits and whose activities do not fall under any of the above-mentioned federal and state competencies are to be dealt with by city governments (MINISTRY OF THE ENVIRONMENT, 1997, art. 6).

In any case, the necessary studies for the granting of environmental licences must be carried by "legally qualified professionals at the entrepreneur's expense" (MINISTRY OF THE ENVIRONMENT, 1997, art. 11) and, whenever government agencies are required to perform certain assessments to the benefit of the concessionaire, such activity will also be at the latter's expense.

ANP Ordinance 249/2000 regulates flaring and venting and sets limits for their authorised volume. The Annual Production Programmes approved by the ANP accompany the permitted volumes for flaring and venting that are not subjected to the payment of royalties and the volume of associated gas flared in any given month cannot exceed 15% of the monthly limit, while the yearly limit cannot surpass the 10% exceeding volume as set out in the Annual Production Programme in 2000, except in case of recognised operational need (ANP, 2000). The flaring of natural gas has seen a remarkable decrease in Brazil in the past years (having been as low as 5% in 2014, whereas 18% of it was reinjected).

Law 9,966/2000 deals with waste management according the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (Marpol 73/78), the International Convention on Civil Liability for Oil Pollution Damage of 1969 (CLC/69) and the International Convention on Oil Pollution Preparedness, Response and Co-operation of 1990 (OPRC/90), all ratified by Brazil. Prevention, control and fight against pollution are covered by the law, which also lays out guidelines for transportation of oil and dangerous substances (PRESIDENCY OF THE REPUBLIC, 2000).

Finally, when it comes to decommissioning, companies are required to pay all costs upon abandonment of operations as well as extra costs that guarantee the field and the activities will be abandoned. Technical aspects for decommissioning and sale of assets are laid out by ANP Resolution no 25 (ANP, 2014d).

Any company can purchase and sell oil and natural gas, as long as the agreements are registered with ANP. Concerning international transactions, companies or consortia incorporated in Brazil can apply for authorisation from the Ministry of Mines and Energy when it comes to natural gas. As for oil, all companies must be incorporated in the country following the ANP's conditions according to Ordinances no 147/1998 and 7/1999 for imports and exports, respectively. The distribution of gas is responsibility of each local state distributor wherever self-production and self-imports by E&P concessionaires are not concerned. As Petrobras controls domestic refineries, it is almost the sole acquirer of oil in the Brazilian market (LEMOS et al., 2013).

The country's tax system is complex in all levels and this is also the case when it comes to oil and natural gas. There are federal and state taxes that might be applied to any transaction as long as one or more of these entities are concerned (MACIEL, 2011). Imports tend to be taxed not only as a means of increasing state revenue but also of stimulating national industry and exports. The imports of petroleum products, however, have been exempt of some of those duties due to rising national demand and lack of self-sufficiency.

3. Tenders for non-renewables in Brazil

After the creation of the ANP in 1997 the Brazilian government has promoted public tenders to attract companies, both foreign and local, to develop its fields of oil and natural gas. These licensing rounds were promoted by the ANP and since the late 1990s bidding companies have been able to compete for exploration blocks according to the agency's concession rules. This section shall briefly present these rounds due to their importance for E&P diversification in Brazil in light of new ANP-established rules. From 1998 to 2015 these rounds have seen both Brazilian and international oil companies bidding for fields in traditional and newly developed basins. Throughout the years, Petrobras has remained the biggest winner. There has been a slow but rising participation of smaller companies, particularly for marginal fields, but larger companies still hold the highest stake. Although the opening of the Brazilian E&P market has been a legal reality since 1998, it remains highly concentrated in the hands of Petrobras, which might be a concern in times of severe financial losses and credibility crisis for the NOC, as will be later presented in this section.

3.1. The Brasil Rounds[9]

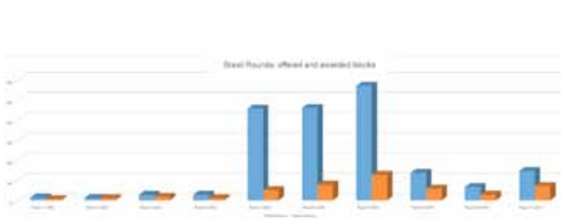
In 1998 the so-called Brasil Round Zero was the starting point for hydrocarbon licensing in the country now that the state no longer held a monopoly on exploration. Since Petrobras already operated all fields throughout the country the new law required it to abide to the new concession rules, even if it was the sole participating company.

During this first round, 397 concession contracts were signed between Petrobras and the ANP. Of these, 115 were exploration blocks, 51 were development concessions and 231 were production concessions. The aforementioned Law 9,478 established a three-year term for exploration results to be presented to the ANP; thirty-six concession agreements had their exploration phase extended and eight of them were later terminated as no discoveries were made. The remaining blocks yielded results for oil/gas in some of their areas. As early as in 1999, however, Petrobras already signed partnerships with private companies; 29 blocks were relinquished that year and three more in the following year (ANP, 2015e).

In short, Round Zero was a government procedure mainly aimed at making the operations Petrobras already had on many developing fields comply with the new law, since the ANP now had to provide concessions to all hydrocarbon operators in the country, whether state-owned or not.

From then on, the Brasil Rounds have been somewhat more competitive, although some years saw quite few companies interested. Rounds One through Seven took place yearly whereas the later ones were increasingly spread out. The amount of blocks offered varied greatly from round to round, with as few as 23 in 2000 and as many as 1,134 in 2005. The amount of awarded blocks has never exceeded 251 (2005) (Fig. 15)[10]. Rounds Five, Six, Seven and Thirteen were the ones in which the ratios between awarded/granted blocks and offered blocks were the smallest (between 11% and 22%).

Figure 15. Brasil Rounds: offered and awarded blocks
Source: data from Brasil Rounds, 2015a, 2015b.

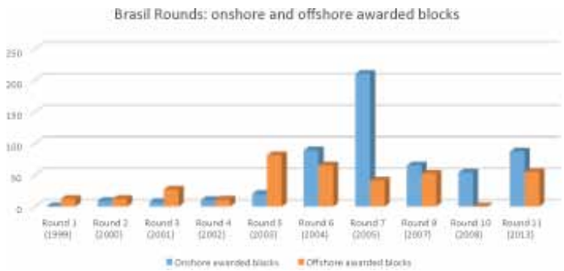


Up to 2003 offshore awarded blocks continuously outnumbered onshore ones but this trend reverted in 2004, which may indicate ANP's attempt at developing this less productive side of the Brazilian hydrocarbon industry (Fig. 16).

9 Data for the 13th Round were incomplete by the time this study was finished, thus some graphs include information about it while others do not.

10 Round 8 turned out to be quite controversial since its rules limited winning offers by area. The tender was suspended on its first day due to a court injunction and was never resumed.

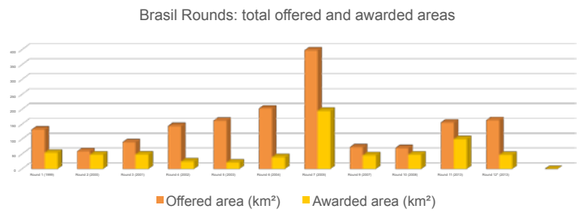
Figure 16. Brasil Rounds: onshore and offshore awarded blocks
Source: data from Brasil Rounds, 2015a



The number of companies qualified for bidding has not always matched the number of bidders, either because the participation fee ended up not being paid or because many of them did not take active part in the process from the beginning by not making any offer. In terms of total area, the awarded/offered-blocks ratio has ranged from as high as 81% in 2000 to as low as 14% in 2003, with a median of 49% for all rounds up to 2013 (Fig. 17).

In 1998 the so-called Brasil Round Zero was the starting point for hydrocarbon licensing in the country now that the state no longer held a monopoly on exploration. Since Petrobras already operated all fields throughout the country the new law required it to abide to the new concession rules, even if it was the sole participating company.

Figure 17. Brasil Rounds: total offered and awarded areas
Source: data from Brasil Rounds, 2015a.



Companies from many countries have taken part in the bidding rounds, as will be later presented, and except for 2007, 2008, 2013 and 2015, most of the winners were foreign (Table 2).

Table 2. Brasil Rounds: winning companies per public tender

Public Tender	Winning companies
Brasil Round 1	Amerada Hess, BP, British Borneo, Eni, Esso, Kerr-McGee, Petrobras, Shell, Texaco, YPF, Unocal
Brasil Round 2	Amerada Hess, BG, Chevron, Coastal, Ipiranga, Odebrecht, PanCanadian, Petrobras, Petrogal, Queiroz Galvão, Rainier, Santa Fé, Shell, SK, UPR, YPF
Brasil Round 3	Amerada Hess, El Paso, Enterprise, Esso, Ipiranga, Kerr-McGee, Koch, Maersk, Ocean, PanCanadian, Petrobras, Petrogal, Petroserv, Phillips, Queiroz Galvão, Rainier, Repsol-YPF, Samson, Shell, Statoil, Total Fina Elf, Wintershall
Brasil Round 4	BHP Billiton, Devon Energy, Dover, El Paso, Maersk, Newfield, Partex, Petrobras, PetroRecôncavo, Queiroz Galvão, Shell, Starfish, Statoil, Unocal
Brasil Round 5	Aurizônia Empreendimentos Ltda., Maersk Olie og Gas AS, Newfield Exploration Company, Partex Oil and Gas (Holdings) Corporation, Petróleo Brasileiro S.A., Synergy Group Corp
Brasil Round 6	Arbi Petróleo Ltda., Aurizônia Empreendimentos Ltda., Devon Energy Corporation, EnCana Corporation, Epic Gas International Serviços do Brasil Ltda., Kerr-McGee Corporation, Partex Oil and Gas (Holdings) Corporation, Petróleo Brasileiro S.A., Petróleos de Portugal – Petrogal S.A., PetroRecôncavo S.A., PortSea Oil & Gas NL, Queiroz Galvão Perfurações S.A., Repsol YPF Brasil S.A., Shell Brasil Ltda., SK Corporation, Starfish Oil & Gas S.A., Statoil ASA, Synergy Group Corp, W. Washington Empreendimentos e Participações Ltda.
Brasil Round 7	Amerada Hess Corporation, ARBI Petróleo Ltda., Aurizônia Petróleo Ltda., BG Energy Holdings Limited, Brazalta Resources Corp, Companhia de Des. Eco. De Minas Gerais – CODEMIG, Delp Engenharia Mecânica Ltda., Devon Energy Corporation, Encana Corporation, ENGEPET – Empresa de Engenharia de Petróleo Ltda., Eni SpA, Geobras – Pesquisas Minerais Ltda.*, Koch Petróleo do Brasil Ltda., Logos Engenharia S.A, Norse Energy Corp ASA, Oil M&S S.A, Orteng Equipamentos e Sistemas Ltda., Partex Oil and Gas (Holdings) Corporation, Petróleo Brasileiro S.A. – Petrobras, Petróleos de Portugal – Petrogal S.A, Phoenix Empreendimentos Ltda., Repsol YPF S.A, Shell Brasil Ltda., Silver Marlin Exploração e Produção de Petroleo e Gás Ltda., Starfish Oil & Gas S.A., Statoil ASA, Synergy Group Corp, Tarmar Terminais Aero-Rodo-Marítimos Ltda., Vitória Ambiental Engenharia e Tecnologia S/A, W. Washington Empreendimentos e Participações Ltda.
Brasil Round 8 (suspended)	BrazAlta Resources Corp., Brownstone Ventures Inc., COMP Exploração e Produção de Petróleo e Gás S/A, Construtora Cowan S.A, Delp Engenharia Mecânica Ltda., Ecopetrol S.A, Eni SpA, Hocol S.A, Inpex Corporation, Logos Engenharia S.A, Norsk Hydro ASA, ONGC Videsh Limited., Orteng Equipamentos e Sistemas Ltda., Petróleo Brasileiro S.A – Petrobras, Queiroz Galvão Perfurações S.A, Ral Engenharia Ltda., Repsol YPF Brasil S.A, Rich Minerals Corporation, Severo Villares Projetos e Construções Ltda., Starfish Oil & Gas S.A, Synergy Group Corp., Tarmar Terminais Aero-Rodo Marítimos Ltda., W. Whashington Empreendimentos e Participações Ltda.
Brasil Round 9	Anadarko Petróleo Ltda., Brasoil do Brasil Exploração Petrolífera S.A, BrazAlta Resources Corp., Comp E&P de Petróleo e Gás S.A, Companhia Vale do Rio Doce, Construtora Cowan S.A, Construtora Pioneira S.A, Delp Engenharia Mecânica Ltda., Devon Energy do Brasil Ltda. Eaglestar Petróleo do Brasil Ltda., Ecopetrol S.A., EMPA S.A. Serviços de Engenharia, Karoon Gas Australia Limited, Lábrea Petróleo Ltda., Maersk Oil Brasil Ltda., Norse Energy do Brasil Ltda., OGX Petróleo e Gás Ltda., Ongc Videsh Ltd, Orteng Equipamentos e Sistemas Ltda., Perenco S.A, Petro Latina do Brasil E&P de Petróleo e Gás Natural Ltda., Petrogal S.A., Petróleo Brasileiro S.A, PetroRecôncavo S.A, Queiroz Galvão Óleo e Gás S.A., RAL Engenharia Ltda., Rich Minerals Corporation, Silver Marlin E&P de Petróleo e Gás Ltda., Somoil Internacional de Petróleo do Brasil – SIPEB Ltda., Starfish Oil & Gas S.A, Statoil Hydro ASA, STR Projetos e Participações Ltda., Synergy Group Corp., Tarmar Energia e Participações Ltda., Vitória Ambiental Engenharia e Tecnologia S.A, W.Washington Empreendimentos e Participações Ltda.
Brasil Round 10	Agemo Comercial e Industrial Ltda., Alvorada Petróleo S.A., Comp E&P de Petróleo e Gás S.A., Companhia de Desenvolvimento Econômico de Minas Gerais S.A., Companhia Energética de Minas Gerais, Integral de Servicios Tecnicos S.A., Nord Oil and Gas S.A., Orteng Equipamentos e Sistemas Ltda., Partex Brasil Ltda., Petróleo Brasileiro S.A., Petróleos de Portugal – Petrogal, S.A., Severo Villares Projetos e Construções Ltda., Shell Brasil Ltda., Silver Marlin E&P de Petróleo e Gás Ltda., Sipet Agropastoril Ltda., STR Projetos e Participações Ltda., Synergy Group Corp.
Brasil Round 11	Alvopetro S.A. Extração de Petróleo e Gás,BG Energy Holdings Limited, BHP Billiton Petroleum Pty Ltd., BP Exploration Operating Company Limited, Brasoil Manati Exploração Petrolífera Ltda., Chariot Oil & Limited, Chevron Brazil Ventures Aps., Compañia Española de Petróleos S.A.U., Cowan Petróleo e Gás S.A., Ecopetrol S.A., Exxonmobil Química Ltda., G3 Óleo e Gás Ltda., Geopark Holding Limited, Gran Tierra Energy Brasil Ltda., Imetame Energia Ltda.,Irati Petróleo e Energia Ltda., Niko Resources Ltd., Nova Petróleo S.A. – Exploração e Produção, OGX Petróleo e Gás S.A., Ouro Preto Óleo e Gás S.A., Pacific Brasil Exploração e Produção de Óleo e Gás Ltda., Petra Energia S.A., Petróleo Brasileiro S.A., Petróleos de Portugal – Petrogal, S.A., Premier Oil PLC, Queiroz Galvão Exploração e Produção S.A., Sabre Internacional de Energia S.A.,Statoil Brasil Óleo e Gás Ltda., Total E&P do Brasil Ltda., UTC Óleo e Gás S.A.
Brasil Round 12	Alvopetro S.A. Extração de Petróleo e Gás Natural, Bayar Empreendimentos e Participações Ltda., Companhia Paranaense de Energia, Cowan Petróleo e Gás S.A., GDF Suez Energy Latin America Participações Ltda., Geopark Brasil Exploração e Produção de Petróleo e Gás Ltda., Nova Petróleo S.A. – Exploração e Produção, Ouro Preto Óleo e Gás S.A., Petra Energia S.A., Petróleo Brasileiro S.A., Trayectoria Oil & Gas, Tucumann Engenharia e Empreendimentos Ltda.
Brasil Round 13**	Alvopetro S.A. Extração de Petróleo e Gás Natural, BPMB Parnaíba S.A., GDF Suez E&P Brasil Participações Ltda., Geopar - Geosol Participações S/A, Geopark Brasil Exploração e Produção de Petróleo e Gás Ltda., Imetame Energia Ltda., Oil M&S Perfurações Brasil Ltda., OP Energia Ltda., Parnaíba Gás Natural S.A., Parnaíba Participações S.A., Petrosynergy Ltda., Phoenix Empreendimentos Ltda., Queiroz Galvão Exploração e Produção S.A., Tarmar Energia e Participações Ltda., Tek Óleo e Gás Ltda., UTC Exploração e Produção S.A., Vipetro Petróleo S.A.

*Did not sign the concession contract

**Took place in October 2015 and the awarded blocks have not yet been confirmed.

Source: data from ANP, 2015f; 2015g; 2015h; 2015i; 2015j; 2015k; 2015l; 2015m; 2015n; 2015o; 2015p; Brasil Rounds, 2015b.

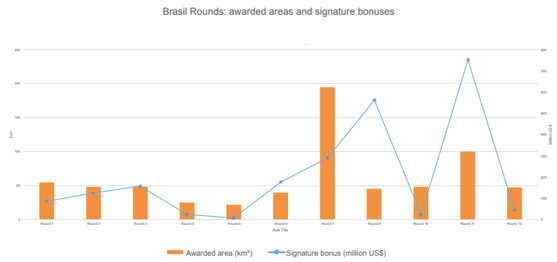
The opening of Brazil's hydrocarbon exploration to foreign companies through public tenders has attracted international participants in a seemingly risk-free business environment, since national bidding processes started to match those of more internationalised markets. When dividing blocks by region, the ANP is actually implementing a schedule for the development of hydrocarbon operations Petrobras alone would not be able to carry, which could potentially hinder the economic gains such commodities could bring to the country when well explored. The decades-long maturation process E&P projects usually entail, particularly in light of significantly capital-intensive operations, drive many international companies towards cooperation for risk diffusion. ANP's concession model has attracted both individual companies and consortia to the rounds and many of the latter have been winners. From Brasil Round 5 (2003) on, a new bidding system was put forward, whereby a company's/consortium's commitment to local goods and services acquisition accounted for a specific share of the assessment method. In addition, basins were now divided by sectors and, within these, blocks would be the awarded unit. During Round 7 areas with marginal accumulation were offered for the first time as part of some of the blocks, which attracted many medium-sized companies. The exploration of both blocks and marginal areas has at times been divided during the public tender process for the zone's more thorough – and competitive – development. In total, between the first and thirteenth round, out of the 1016 blocks that have been awarded, 63% of the offered fields were won by single companies and 37% of them were won by consortia. Some years have witnessed consortia win as many as 50% (1999) and as few as 3% (2003) of the total awarded blocks. The year 2003 was quite unusual in this regard, however, and the median winning share for consortia, when opposed to single companies, has been 37% in the 1999-2015 period (Table 3).

Table 3. Brasil Rounds: number of blocks won by individual companies and consortia
Source: Brasil Rounds, 2015a

Public Tender	Year	Number of awarded blocks	Number of blocks won by individual companies	Number of blocks won by consortia
Brasil Round 1	1999	12	6	6
Brasil Round 2	2000	21	11	10
Brasil Round 3	2001	34	21	13
Brasil Round 4	2002	21	16	5
Brasil Round 5	2003	101	98	3
Brasil Round 6	2004	154	90	64
Brasil Round 7	2005	251	161	90
Brasil Round 9	2007	117	71	46
Brasil Round 10	2008	54	32	22
Brasil Round 11	2013	142	100	42
Brasil Round 12	2013	72	47	25
Brasil Round 13	2014	37	25	12
All Brasil Rounds	-	**1016**	**678**	**338**

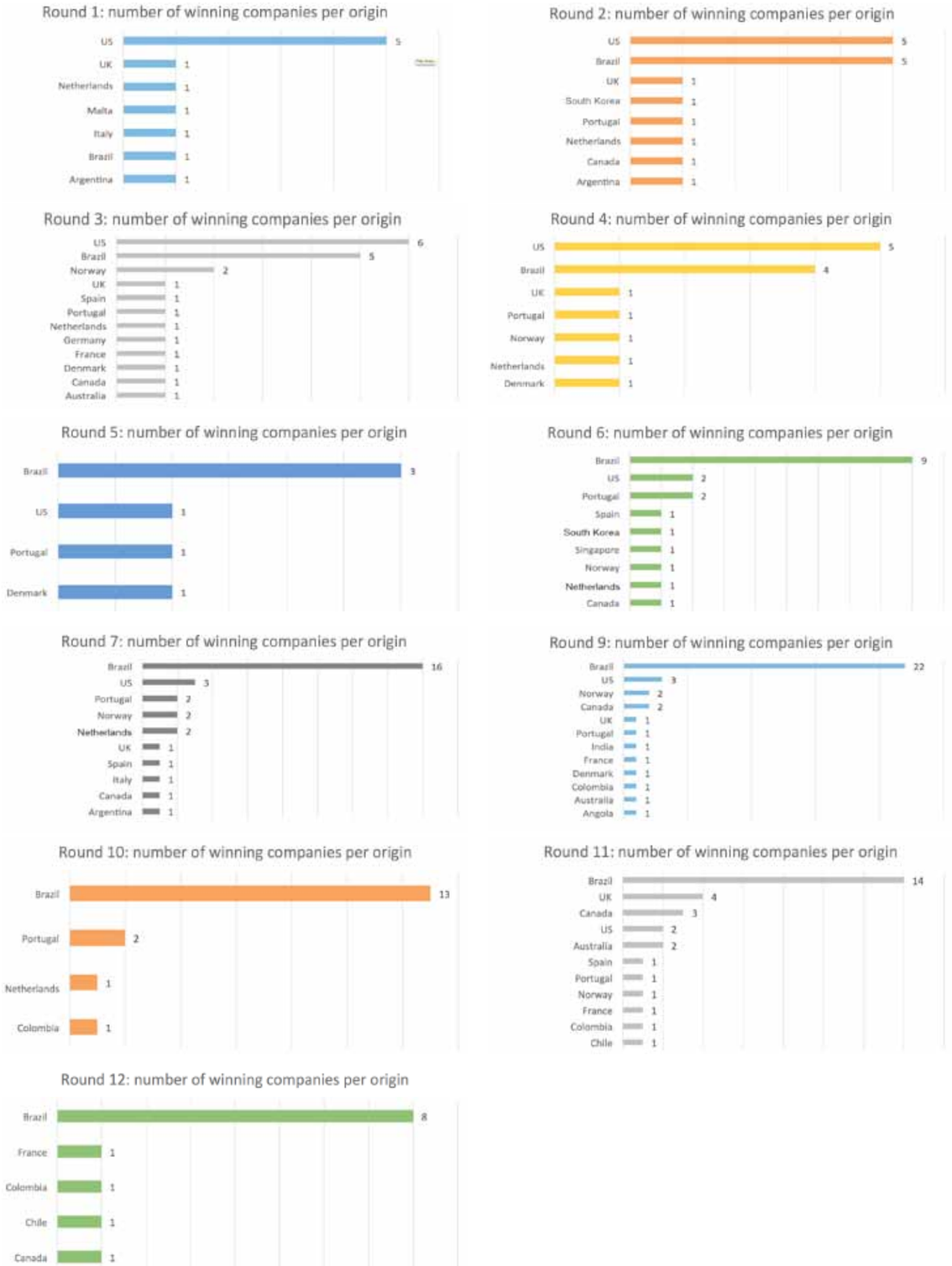
In order to have permission to carry prospection and exploration activities in Brazil, winning companies/consortia need to pay a signature bonus, whose minimum value is set by ANP prior to the bidding process. Throughout the years the total value of collected signature bonuses per round has varied greatly and, on average, the ratio between the latter and the total awarded area has been as low as US$ 319.000 per square kilometre in Round 5 and as high as US$ 12.3 million per square kilometre in Round 9 (Fig. 18).

Figure 18. Brasil Rounds: awarded areas and signature bonuses
Source: data from Brasil Rounds, 2015a, 2015b.



The total value of signature bonuses up to 2013 has amounted to US$ 2.23 billion for a combined 674 km² of awarded area. Brazilian and US companies have accounted for the majority of contracts. As Rounds became more traditional and marginal fields began to be included in the bidding offers, Brazilian companies has usually outnumbered foreign ones. As larger fields have been discovered, marginal fields have been included. Many of the smaller companies now dealing with oil have started as contractors and are increasingly more active in existing fields, particularly the marginal ones (Fig. 19).

Figure 19. Brasil Rounds: number of winning companies per origin
Source: data from Brasil Rounds, 2015a, 2015b.

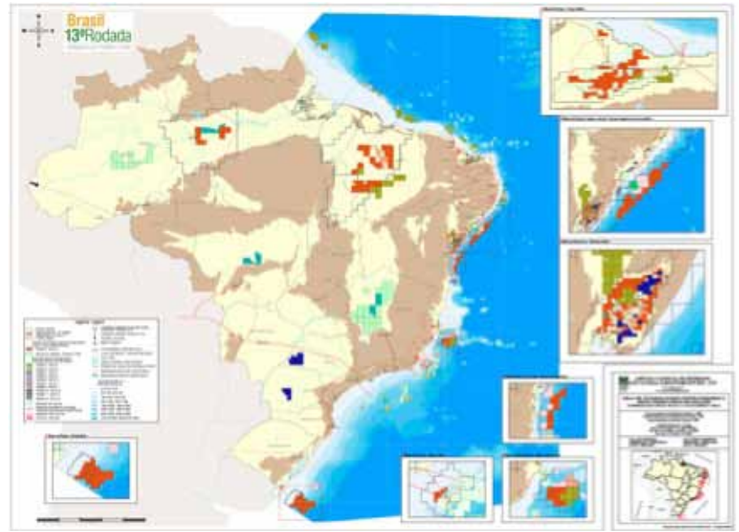


Rounds 1 through 12 varied greatly in both area and bonuses and this indicates how seasonable the movement of national and international companies around the offers have been, as well as how the tenders have been divided since Round 5, when blocks were grouped in sectors (and the latter within particular basins). The inclusion of marginal fields by ANP was a significant manoeuvre as it has allowed more companies, some of them not particularly large, to take part in exploration and (occasional) production while paying relatively smaller bonuses to the government. Marginal fields produced 88.3 bbl/d of oil and 24.9 Mm3/d of natural gas in April 2015 (ANP, 2015a: 7).

The latest round, Round 13, took place in October 2015. Ten sedimentary basins contained offered blocks: Amazonas, Camamu Almada, Campos, Espírito Santo, Jacuípe, Parnaíba, Pelotas, Potiguar, Recôncavo and Sergipe-Alagoas (Fig. 20).

In 2009 Law 11,909 (also known as the Gas Act) implemented the concession regime for natural gas transport (ANP, 2015q), which led to Ordinance 317 of September 2013 proposing the construction of a gas pipeline between Itaboraí and Guapimirim in the state of Rio de Janeiro. The bidding guidelines were later published in Brazil's Official Gazette in December of the same year. In May 2015 Brazil's Federal Court of Accounts put this tender on hold until Petrobras manifests its interest in carrying on with such concessions since other engineering works are still to be synchronised with a possible bidding process for natural gas transport.

Figure 20. Brasil Round 13: offered areas
Source: Brasil Rounds, 2015b.



3.2. A note on corruption at Petrobras

In spite of the alleged openness and accessibility of public tenders and other Petrobras operations stated above, since March 2014 the NOC has been investigated for deep-rooted corruption involving the company's high ranks. A money-laundering scheme including politicians and business people may have embezzled US$2.6 billion, some of it coming from Petrobras, according to Brazil's Federal Police (FOLHA DE SÃO PAULO, 2014).

According to the investigations, Paulo Roberto Costa, the NOC's former Head of Supply and Refining from 2004 to 2012, was the head of the embezzlement scheme, along with Alberto Youssef, responsible for the money laundering, which has led politicians, some of which from the ruling Labour Party and other allies, to receive their share. "Costa was first arrested in March 2014 and as investigations continued, the Federal Police would discover bank accounts linked to him in Switzerland. As investigators keep on bringing new evidence to light, heads of the country's biggest contractors (such as Odebrecht, Queiroz Galvão and Camargo Corrêa) have been associated with the scheme" (LIRA NASCIMENTO, 2014) .

Current and former state representatives, senators and governors are thought to have been involved in this scheme, either directly or indirectly. Signs of illegal overpricing were found in refineries in the states of Pernambuco and Rio de Janeiro, and also in Texas (bought and/or developed by Petrobras), sometimes up to 10 times their original value. In addition, doubtful relations between national and foreign contractors and the NOC related to public tenders are being investigated. In early February 2015, Graça Foster, Petrobras' CEO, resigned after constant coverage of her noticeable failure to make the company more transparent after the accusations (CARTA CAPITAL, 2015). From January to September 2015, Petrobras's net income was only US$ 560 thousand, 58% lower than in January-September 2014. The net debt was US$ 101.27 million as of September 30, 2015 (PETROBRAS, 2015d).

The debate about the ongoing investigations is politically carried in Brazil, where opponents of the ruling Labour Party and its sympathisers are at constant odds concerning the alleged involvement of politicians from the current administration, as well as from the opposition. Although investigations are still uncompleted, virtually all major parties have members who have been accused of taking part in the scheme, which has added to the very polarising political scenario one could see in Brazil in 2015[11].

11 The serious scandal involving Petrobras is not the focus of this work, although its impact has been very severe for the company. For more information on the corruption scheme at Petrobras, cf. LIRA NASCIMENTO (2015).

4. Pre-salt layer

Around 160 million years ago, the Brazilian pre-salt cluster structure was created when the continental superstructure Gondwana split to form the American and the African continents. Oil accumulated into microbiolites (carbonate rocks) that originated in secretion from bacteria highly adapted to the high salinity environment. Differently from oil that is found in post-salt regions, the pre-salt one is subjected to higher temperature and pressure because of the greater depths, while also being shielded from bacteria that consume the lighter part of the oil. This makes for higher quality oil, which, on the other hand, given its location, is harder to retrieve (WAISBERG, 2011). For a decade, Petrobras has focused on this specific portion of Brazil´s offshore region to enhance its operations in which has been dubbed a "revolution" for the Brazilian oil industry. Hoping to present this newer E&P procedure in Brazil as a recent and perhaps promising phenomenon, this section will quickly explain what this so-called revolution is and the importance the country has given to this yet risky business.

4.1. Fields and production

Since 2005, the pre-salt layer has played a significant role in Brazil's hydrocarbon industry. In that year, Petrobras drilled exploratory wells near the Tupi oil field (today known as the Lula oil field) in the Santos basin, finding enough hydrocarbons to insist on the enterprise. Two years later, along with BG Group and Petrogal, the company discovered an estimated 5-8 billion BOE in the pre-salt zone, around 18,000 feet below the ocean surface (EIA, 2014a). As explorations continued, most of the offshore basins in the country's southeast were found to have oil in its pre-salt layer such as the Campos, Espírito Santo and Santos basins (Fig. 21).

Figure 21. Pre-salt polygon
Source: Portal Brasil, 2014.

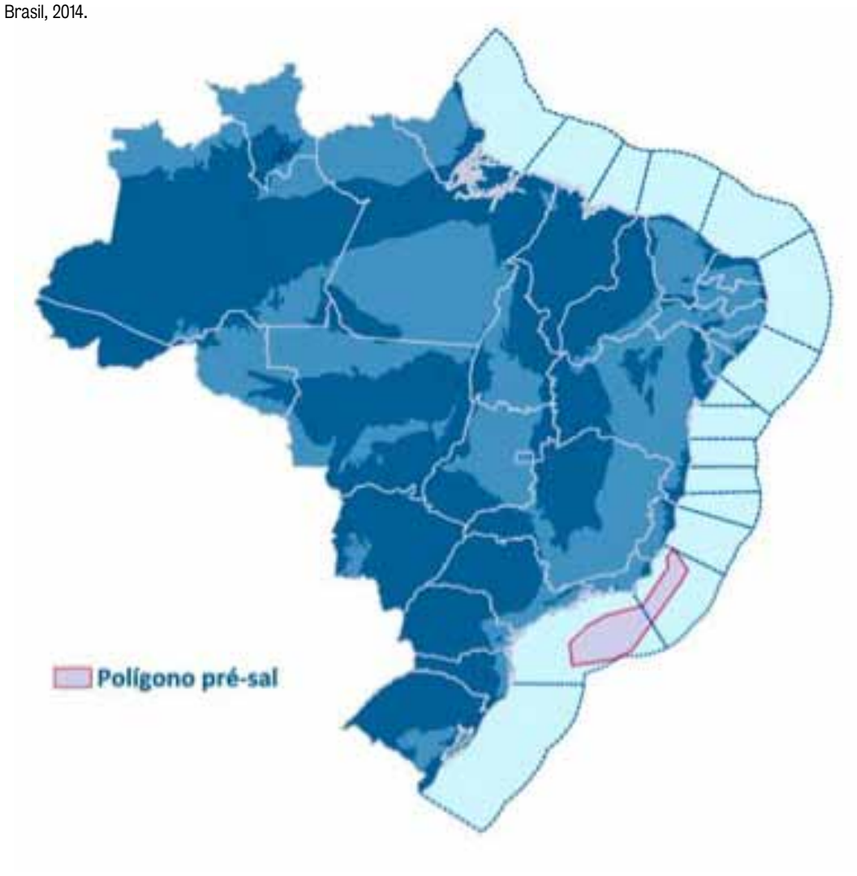
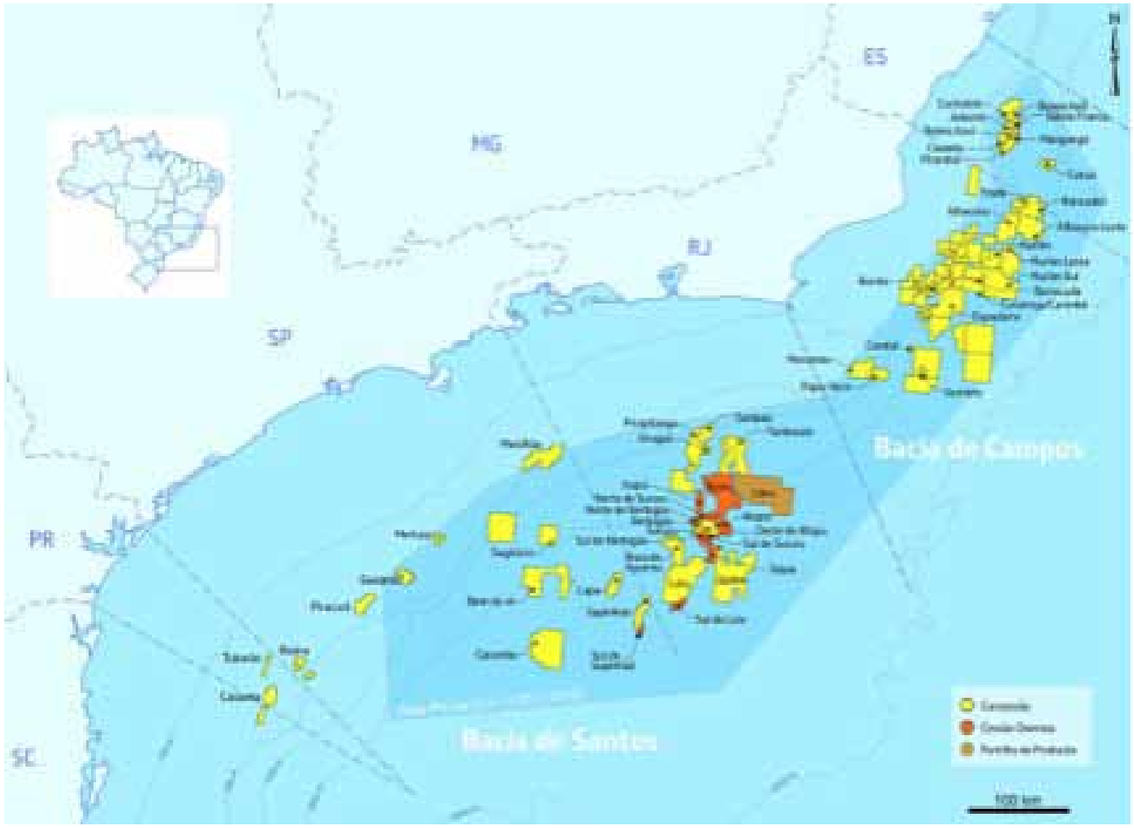


Figure 22. Types of contracts in the pre-salt area
Source: Portal Brasil, 2014.

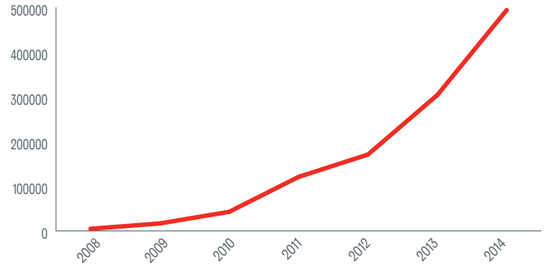


The exploration and extraction of oil from the pre-salt layer presents engineering challenges that are not yet met by most oil companies in an economically viable way. Even Petrobras, which has a generally successful history of underwater exploration and extraction, does not have enough resources (both financial and technical) to undergo such expensive activities alone through all the fields at present. According to the EIA (2014a), however, Brazil has doubled its pre-salt oil production from 2013 to 2014 (303,000 bbl/d to 607,000 bbl/d). In spite of the high costs of exploration and extraction, most pre-salt areas have been granted to Petrobras alone with no public tenders. The first exception was Libra, Brazil's largest oil field with an estimated recoverable amount of 12 billion barrels, whose public tender took place in October 2013 – the first for a pre-salt area. The new E&P regulatory framework for the pre-salt fields (starting with Libra) is a production sharing agreement (PSA) regime in which the National Treasury owns the pre-salt oil later sharing the production according to the contracted amounts. The PSA is valid for 35 years, four of which at least are meant to be for exploration (PRESIDENCY OF THE REPUBLIC, 2010; BUSTAMANTE, 2015: 19). With an estimated peak of 1.4 million bpd during the production stage, its signature bonus cost US$ 4 billion, a considerably larger sum than the roughly US$2.3 billion of accumulated bonuses since the beginning of the Brasil Rounds (O TEMPO, 2013). The winning consortium (actually the only bidder for the field) was formed by Petrobras, CNOOC, CNPC, Shell and Total. The consortium has offered 41.65% of the production to the state (AMATO et al., 2013), the very minimum threshold stated in the public tender.

In August 2013 a new agency was created by decree 8,063: the Brazilian Company for the Administration of Petroleum and Natural Gas (Pré-Sal Petróleo SA or simply PPSA), three years after the approval of Law 12,304. The PPSA has the duty to manage PSA contracts for the pre-salt layer for all kinds of hydrocarbons as well as its trading (MINISTRY OF MINES AND ENERGY, 2015b) Law 12,235, also from 2010, allowed the government to capitalise Petrobras (EIA, 2014a) and defined a minimum stake of 30% for the state company in all pre-salt PSAs, in addition to making it their sole operator (PRESIDENCY OF THE REPUBLIC, 2010). During the licensing round for the Libra field, for example, the winning consortium comprised of Petrobras, with a 40% stake, Shell and Total, with 20% each, and CNPC and CNOOC, with 10% each (BARBOSA et al.,2013). Therefore, as of July 2015, Lula was the sole field under a PSA agreement in Brazil amongst the usual concession contracts that are traditional in the country (Fig. 22)

When divided between pre-salt and non-pre-salt in origin, the share of Brazilian oil production made up by the former has grown considerably over the past years. In 2010 the average pre-salt oil production was 41 thousand barrels per day, having increased almost twelve-fold in 2014 to 428 thousand bpd (Fig. 23). This represented 20% of Petrobras's total production in that year. In April 2015 total pre-salt production surpassed 800 thousand BOE in both the Campos and the Santos Basin.

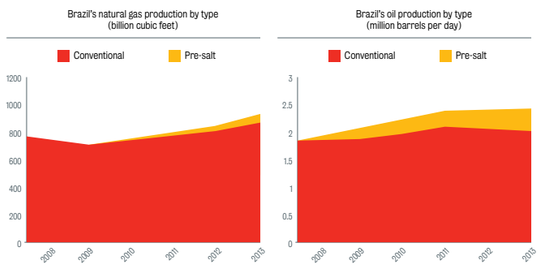
Figure 23. Petroleum production in the pre-salt layer (bbl/d).
Source: Petrobras (2014; 2015e; 2015f).



When it comes to the pre-salt layer, therefore, international oil companies have only recently started to take an active part in exploration, firstly because of the monopoly granted to Petrobras during the initial discoveries and later because of the minimum stake of 30% the NOC is supposed to hold in future operations. This arrangement strengthens Petrobras's operations in the pre-salt polygon and diversifies its potential partnerships while simultaneously risking not attracting many players. The fact that the number of bidders for the Libra field has been allegedly lower than what the ANP expected might be a sign of caution from IOCs unwilling both to embark on a strong compromise with Petrobras (which would hold a considerably high stake in a consortium) and to heavily invest in a still fresh upstream area worldwide with very high production costs.

Concerning Brazilian natural gas, the share of pre-salt production has also increased. In 2013 it represented 14% of the total 1 trillion cubic feet production of gross natural gas up from 0.5% in 2008, whereas a similar share can be seen for the oil production in the same period (15%) (Fig. 24).

Figure 24. Brazil oil and natural gas production by type (Bcf)
Source: adapted from EIA, 2015o



In 2010, through a transfer of rights agreement, Petrobras received government permission for the E&P of 5 billion BOE by transferring US$42 billion in company shares to the government. Four years later the company was granted the rights to produce surplus volumes ranging from 9.8 to 15.2 billion BOE in Búzios, Entorno de Iara, Florim and Tupi's Northeast (EIA, 2015o). Recent discoveries in the pre-salt layer have been made in the Franco field (AGÊNCIA BRASIL, 2013), which might hold even larger reserves than Libra, and a finding in the Entorno de Iara block , which might hold 5 billion BOE according to the ANP (REUTERS BRASIL, 2014b).

Investments in the pre-salt layer might however be affected by two major factors: the dollar exchange rate and the international oil price. From mid-2014 to the second half of 2015 the US dollar has gone from R$2.23 to R$4.00, which has had a negative impact on Petrobras's operations due to the dollarised nature of many of the company's E&P contracts. Since exploratory costs tend to be higher in pre-salt projects, the whole exploration and production chain would not be considerably affected only if domestic suppliers were equivalent to their international counterparts when it came to the quality of products and services. The former contracts that have already been signed, however, are still costly. At the same time, the falling oil prices (hardly ever exceeding US$60 per barrel of crude in 2015) have made the occasional revenues Petrobras would get from exports less substantial, which may threaten its working capital. This might eventually diminish Petrobras's firm grasp on pre-salt activities and make the company more open to foreign participation. There is, nevertheless, the always-present question of how attractive such investments are. Notwithstanding the substantial discoveries under the pre-salt layer, how fast economies of scale will come about should play a major role. If international oil prices remain low such investments might just not be worth the risk in the minds of many IOCs.

Since exploratory costs tend to be higher in pre-salt projects, the whole exploration and production chain would not be considerably affected only if domestic suppliers were equivalent to their international counterparts when it came to the quality of products and services.

5. Hydrocarbon control as a nationalistic phenomenon

This section will present the historical development of state planning of E&P operations in Brazil so that this study´s first and second questions (what is hydrocarbon security for Brazil and, within the hydrocarbon sector, what is the role of the socio-political environment in Brazil) may be answered. To understand Brazil's official stance on hydrocarbons, it is important to first consider the country's foreign interactions and the formation of its global priorities, which shall be quickly outlined. Widely regarded as a regional power in Latin America, Brazil has sought geopolitical prominence starting from its inception as an independent country. Since it has never been a major international power, the sphere of influence where it is located says much about its international priorities and courses of action. From a "purely" geopolitical perspective to one allegedly based on values, the country has usually found itself standing on the shoulder of giants, yet in continuous anticipation of walking towards enhanced international agency.

5.1. Empire, Republic and the quest for hydrocarbon autonomy

During the Brazilian Empire (1822-1889), the country's domestic and foreign modus operandi was very much associated with the European monarchic order and alliances, which made most of its foreign policy considerations gravitate around historic ties with the Old World, either economically or politically. After the Crown's demise, the beginning of the Republic in 1889 and the somewhat sudden Pan-Americanism adopted by much of the country's military, who nurtured considerable admiration for the rising power of the United States and its federal system, Brazil took a continuous turn towards regional alignment and be under strong influence from Washington (SANTOS, 2004). Now, the country once again aligned itself with a major power throughout the 20th century and this had important implications for its foreign policy and economic transactions. However, notwithstanding changes in foreign and domestic policy and the search for more commercial partners, one characteristic remained: Brazil would still rely heavily on primary resources as the basis of its global insertion[12]. Every economic cycle brought changes within the country's socio-political order, regardless of the similarity of its exploratory nature, but the roots of regional and global inclusion were still mainly based on this rationale: a large territory with a vast amount of resources, which has, traditionally, resorted to low added-value production and exports as the basis of its international trade relations.

Such has been the common background: a country with enormous potential for "growth" – in whatever conception this abstract notion might be applied – and a traditional socio-political order based on oligopolistic extractivism and the sale of primary goods. Over the decades, the Brazilian Republic found itself in a sporadic, yet continuous, push for modernisation and global recognition as a great power, both at the political and at the economic level. Notwithstanding important periods of export substitution and industrialisation in the 20th century, the socio-economic inertia (caused by historical domestic processes and traditional external interactions) has solidified Brazil's position as that of a country of commodities. In this sense, throughout its history, rough natural resources and their management have been an indispensable part of government strategies as a means of economic growth, of securing revenues and of advancing the country's global relevance (which does not mean they have been prioritised in the same way by different governments, but that they are hardly regarded as secondary). Brazil's socio-economic scenario has thus traditionally been conducive to very large activities (agriculture, mining, extraction) that result in low value-added products which, in turn, make up a large part of the country's balance of trade.

In this scenario, hydrocarbons slowly became an important part of Brazil's group of commodities and, due to their strategic nature, the state took a hold of its development from a very early moment during the second administration of Getúlio Vargas (1951-1954). A quite controversial historic figure nation-wide, Vargas is the epitome of many significant social reforms in the country – but also of the staunchest form of Brazilian populism (FONSECA, 2010). Even though at this particular time Vargas had been elected by popular vote (unlike his previous centralistic administration from 1930 to 1945), the fact that Petrobras was created and advanced during his second term in office, which was marked by extremely polarised competing political tendencies, meant that, under his promotion (as well as of other nationalists), control over Brazilian hydrocarbons was identified as a matter of strong national interest, particularly during a time when groups of both left- and right-wingers were suspicious of the prospects of stronger participation of IOCs in the country's E&P activities (MOREIRA, 1998). This does not mean there was no defence of the opening-up of the hydrocarbon sector in Brazil but rather that during an internally conflicting period those domestic resources were easier to be consensually regarded as intrinsically "national" even by opposing groups that equally claimed to stand up for the country's interests.

The 1947-1953 popular movement then dubbed O Petróleo é nosso ("The Petroleum is Ours") sought to ensure the state's grasp of hydrocarbons as essential to the country's economic and energetic independence (MIRANDA, 1983) serving as a historic point of inflection that has continuously built up into how energy resources – and oil in particular – are seen as strategic by a significant part of the Brazilian public opinion (Fig. 25)[13]. The upcoming military regime (1964-1985) kept the emphasis on state management of strategic resources and on the development of energy capabilities, particularly hydropower, with the large projects of the Itaipu Hydroelectric Dam in the 1970s (a joint project with Paraguay) and the nuclear energy complex in the city of Angra dos Reis in the 1980s.

12 There have been different economic cycles that promoted a variety of major products as the core of Brazilian exports throughout the centuries (such as brazilwood, sugar, coffee and rubber). For more information on Brazil's economic cycles, cf. FURTADO (1963).

13 The "grassroots" nature of the "O Petróleo é Nosso" movement is highly debatable. Its strong nationalistic undertones point to heavy military involvement during the conception and development of this so-called popular undertaking. Cf. Sá (2000).

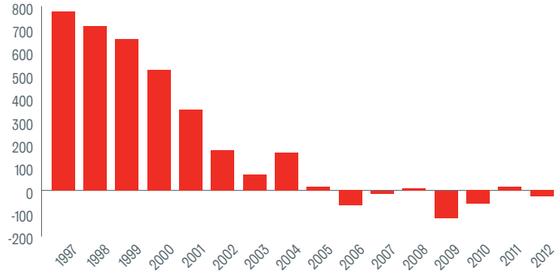
Figure 25. Poster of the Third National Convention for the Defence of the Petroleum in 1952, which favoured state monopoly on oil exploration
Source: Miranda, 2015

The nationalistic ventures set forth by Brazil's military government, now internationally aligned with the United States during the Cold War, meant that large state participation was the norm when it came to strategic planning. As time went by, Brazil became, to a certain extent, considerably independent to pursue the expansion of its strategic projects without major external interference. In addition to the continuation of a domestic trend of industrialisation and completion of energy projects that had originated before the military coup, the country would not align itself automatically with Western powers in all spheres of its foreign policy and official strategy making – namely, in spite of being under an extremely politically conservative government, the search for *international independence* was very much present throughout the regime's existence.

This had significant impact on how Brazil's energy capabilities developed, both renewable and non-renewable resources. An interesting point is how these two different realms were quite independent from one another if one takes the perspective of external-domestic dependence: namely, in the renewable sector (which, in Brazil, is essentially made up of hydropower) the country was basically shielded against external turbulence and mostly subjected to occasional natural incidents such as droughts. Concerning non-renewables, such as oil and natural gas, Brazil was much more fragile and very much dependant on foreign energy flows, which became patent during the Oil Crises of the 1970s, prompting the country to speed up its ethanol programme and broaden its participation in its energy matrix. Throughout much of the 20th century, therefore, there was a considerable gap between the renewable and the non-renewable sector, which roughly translated into a gap between electricity generation (over which the State had, more or less, full control) and hydrocarbon demand mostly for transportation and industry (which the State could not completely meet). Such disproportion hampered full Brazilian control over its own energy management and attempts at self-sufficiency.

Brazil has sought to even out this disparity throughout the years as Petrobras continuously developed its E&P capabilities. However, demand for oil still has been considerably higher than domestic supply both during the military and post-military regime era (from 1985 on); Brazil has historically been a net petroleum importer, particularly of refined products. The ANP makes use of the "dependence on foreign petroleum and refined products" concept to measure the country's self-sufficiency in the oil sector. Only recently has Brazil ceased to import large amounts of oil as shown in the graph below (Fig. 26). Data from the Brazilian Institute of Petroleum, Natural Gas and Biofuels (IBP) allow us to observe the country's currently unstable dependence on foreign petroleum, which, although not continuously negative, is currently much lower than 18 years ago[14].

Figure 26. Dependence on foreign petroleum and refined oil products (1,000 bpd)
Data: IBP (2013).



14 The IBP takes condensate and LNG as part of the "petroleum" production. Also, the imports include condensate.

Brazil's dependence on oil imports has dropped dramatically since 2002. Judging from the continuous attempts towards energy independence verified since the 1950s (hydropower, nuclear power and larger E&P operations), one could infer that there has been a "state motivation" seeking to permanently build Brazil's energy self-reliance in spite of the differing characteristics of rulers and groups in power. However, this perceived movement has been much dependent on government and party tendencies, particularly during the democratic period. This has reflected on legislation concerning hydrocarbons, on the focus Petrobras has received from the government in different periods and on the NOC's participation in recent activities. As stated in the beginning of this section, however, E&P activities still have been an economic priority for all policymakers concerned, whether directly state-sponsored or not.

One can take the pre-salt layer's oil and natural gas reserves as a case in point. Such discoveries have been celebrated by many in Brazil not only as a great triumph for Petrobras but also as a major "victory" for the country. Throughout its more than 60 years of existence, the many breakthroughs the NOC has achieved have hardly ever been paralleled with what the pre-salt findings represent due to their volume and occasional large-scale production. This walks in tandem with the historical notion of Petrobras as a chief arm of the Brazilian state. The link between national development and indigenous resources, although by all means not only a Brazilian phenomenon, has been an element of the country's socio-political identity for a long time. Notwithstanding the non-existing "logical" connection between owning large amounts of natural resources and achieving development as a result, this rationale is embedded in the mind-set of a big portion of the Brazilian civil society. It then follows that a very large territory endowed with richness of all sorts must be managed well enough to grant the country the growth and development it constantly seeks. Whenever Petrobras does well both in the E&P and the downstream sector this is usually sold by the government as a "public" triumph or a national victory.

Petrobras had not been exactly celebrated as the big answer for Brazil's plans of growth long after its creation in 1953. The previous 1940s movement for the nationalisation of all oil reserves and the subsequent birth of the national oil company turned out to be one of the many nationalistic actions stemming from both the civil society and the government from then on, especially as the country abandoned its short democratic interlude (1945-1964) and the military seized power. During the 1980s, although Petrobras kept on increasing its production in the southeast, the overall economic picture was dim for the country as a whole as foreign debt crises plagued many Latin American nations. In this scenario, state agencies and companies were the object of much domestic and international criticism due to their inability to sustain states that had traditionally purported them as the bulwark of financial independence and an indispensable source of economic welfare. The privatisation movement was therefore grounded on these increasingly negative perceptions of the burden represented by public agencies and, as a result, the 1990s witnessed a large degree of de-statisation in many areas, including the energy sector. As presented in the beginning of this study, although Petrobras was not privatised, the oil and gas sector was open to competition in the late 1990s. Particularly through the concession regime model, IOCs started to operate more freely in Brazil and they have taken an active part in developing projects both on their own and in partnership with Petrobras.

Finally, starting in 2003 the company's operations were continuously linked to President Lula's (2003-2010) and later Rousseff's (2011-) political performance – once again as an example of the "necessity" of state control over strategic resources by celebrating contracts and making agreements with international and national private actors, such as other oil companies (but without relinquishing major state control). By stressing the NOC's importance from 2003 on the Brazilian government has rekindled the old idea of state control over hydrocarbons as vital. Petrobras's and ANP's current activities, however, differ vastly from the official planning of the early stages of Brazil's hydrocarbon industry. The public-private symbiosis that is now characteristic of many national agencies in Brazil has taken a strong hold since the 1990's and both the government and many private actors have grown accustomed to such practices in the hydrocarbon sector, whether these have been seen as optimal or not by all actors involved.

The public-private symbiosis that is now characteristic of many national agencies in Brazil has taken a strong hold since the 1990's and both the government and many private actors have grown accustomed to such practices in the hydrocarbon sector, whether these have been seen as optimal or not by all actors involved.

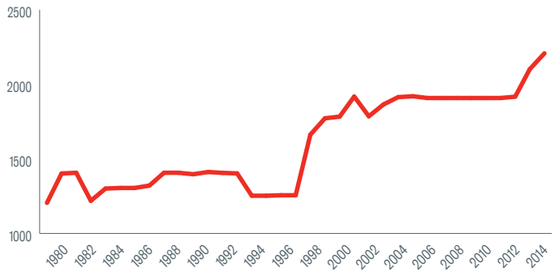
6. Is there a Brazilian prominence in hydrocarbons?

It shall finally be discussed whether Brazil is a prominent player when it comes to hydrocarbons, which relates to the third question of this work: is Brazil energetically independent? In any area, an independent actor must have self-sufficiency and room for manoeuvre. By broadening this characteristic, an independent country can become a superpower if it has enough leeway and margin to not only be independent but also to influence other actors and their actions. When it comes to energy, this means being able to influence energy-related decisions of countries that rely on a particular source. Oil, natural gas and biofuels have been Brazil's most internationalisable energy resources. However, factors such as refinery capacity, pre-salt operations, low oil prices and the Petrobras´s corruption scandal have shed some doubts on how Brazil can be an international energy player when its own domestic environment still seems very fragile in this area.

6.1. Refining capacity, oil prices and the impact of corruption

As a large energy producer and consumer, Brazil has increased not only its output and E&P activities, as seen in the previous sections, but also the reach of its downstream sector. The country has enhanced its capacity of refining in the past 25 years by 83% (Fig. 27).

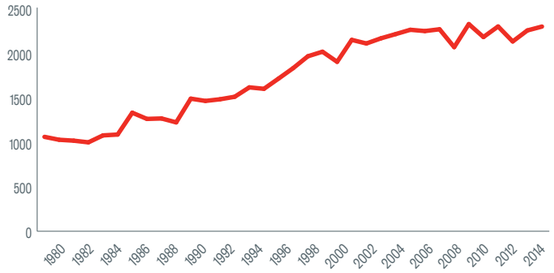
Figure 27. Brazil's refinery capacity (1,000 b/cd)
Source: OPEC (2014; 2015: 34).



As seen in the previous sections, however, the improvement of its downstream sector has not been enough to keep up with the country's demands. Brazil's dependence on foreign oil is a good indicator of how much of a prominence the country has in matters of hydrocarbon self-sufficiency: the more negative this dependence, the more secure a state is and the more flexibility it has to globalise its E&P policies. In the case of Brazil, such margin is still quite blurry and not very reliable as factors that impact the planning of larger hydrocarbon security, such as international prices, have a considerable impact on developing countries. Not having a stable throughput capacity year-round and being more dependent on refined products from abroad, the sheer challenge of providing the domestic market with enough oil products to meet demand is noteworthy in Brazil. Coupled with this, the necessary continuous investment for the improvements of (not only, but mostly) its downstream capacity relies heavily on revenues from E&P operations that are very much bound to the sector's competitiveness. Therefore, even Petrobras, which is in disproportionate advantage when compared to other oil companies operating in Brazil, is quite affected by international oil prices, exchange rates and shareholder behaviour. Notwithstanding some problems arising from highly fluctuating rates, two recent points seem to have affected the country's development of E&P operations: the aforementioned drop in world oil prices and the corruption scandal of the past two years.

The output of refined products has seen an increase of 97% in the same period, having on average fairly stagnated in the past 4 years at around 2.167 million bpd (Fig. 28).

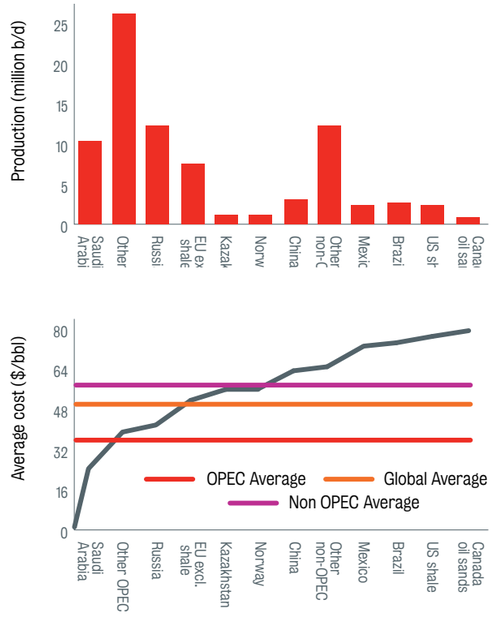
Figure 28. Brazil: output of refined products (1,000 bpd)
Source: OPEC (2014; 2015: 34).



For Brazil, when inflation and currency depreciation are not considered, the fall in oil prices might have the advantage of making oil products cheaper, as well as making it easier to import the light crudes that are more suitable for Brazilian refineries. Still very much dependent on petroleum products, much of which it cannot produce on a large scale, this might benefit the end consumer if lower costs are passed on. However, this tends not to be the case in Brazil as the general savings incurred into by lower oil expenses means that regular prices paid by the consumer usually do not fall since the very drop in world oil prices also means that the country's oil industry is not doing so well with its revenues. To put it more bluntly, since Brazil's E&P industry is not making the same profits it used to make before the price of the oil barrel began to fall, the government can somehow compensate this deficit by making the consumer, for example, pay the same (or a higher) price for gasoline even when oil prices are much lower globally. In short, the Brazilian consumer subsidises the national oil industry, mostly consisting of Petrobras in its up-, mid- and downstream sector[15]. On the other hand the government has subsidised gasoline when the price of the oil barrels was higher to alleviate inflationary pressure, which has impacted Petrobras's cash flow (ALVARENGA, 2015).

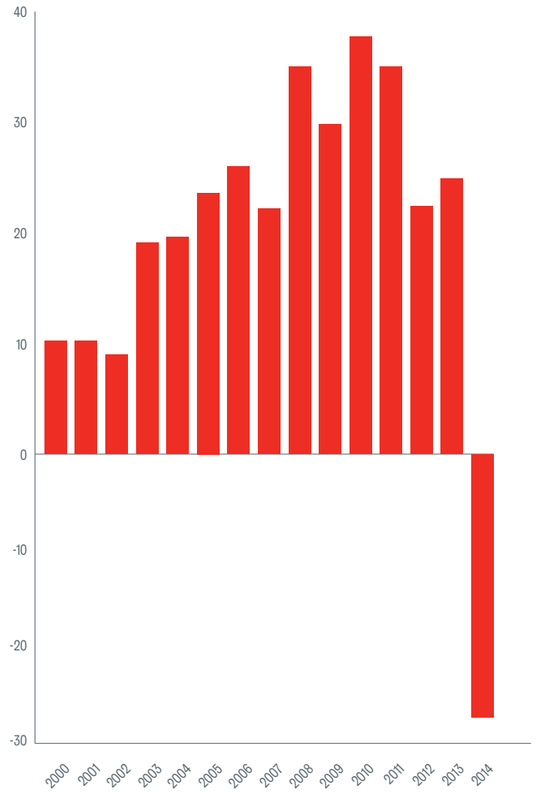
Within a broader E&P scope crude oil prices may particularly affect production, exploring and finding costs, among other expenses inherent to many industries such as transportation and administration. An oil barrel at US$50-US$60 is unlikely to make up for the break-even prices of many regular operations such as the deep-water production already in place in Brazil. According to Energy Aspects (apud RAVAL, 2014), Brazilian production costs for oil were US$75 per barrel in the end of 2014 (Fig. 29).

Figure 29. 2014 cost curve for crude oil (cost of production, excluding dividend or interest payments)
Source: adapted from Raval, 2014



The gap is, therefore, visible and whether subsidies from gasoline and diesel consumers are likely to fill it remains uncertain. At a moment when Brazilian inflation is on the rise, this might become a more relevant problem in the near future.

Figure 30. Petrobras's profits (in BRL)
Source: adapted from Alvarenga et al., 2015



Highly costly projects such as pre-salt operations, thus, might not be quite competitive for the time being. On top of that, the little interest shown by IOCs in taking part in pre-salt exploration in light of the recently approved PSA legislation is noteworthy. In early 2015, Petrobras stated that, in spite of the fall in oil prices worldwide, duction in the pre-salt layer would remain economically viable e the break-even price for pre-salt production was at US$45/ , including taxes. Since some wells in the southeast have produced easingly more, projects are more economical. In addition to this, decline in oil prices might be accompanied by a fall in prices ther goods and services, which can offset the lower revenue sed by the former (WORLD OIL, 2015). In October 2015, however, robras announced that the break-even price for pre-salt was $55 a barrel (NOGUEIRA et al., 2015).

15 There are certainly other factors to have an impact on gasoline prices in petrol stations, such as federal and state taxes and the exchange rate between the Brazilian real and the US dollar, which means one is unlikely to find symmetry in global and domestic oil price movements in most countries. As of early December 2015, gasoline prices in Brazil were US$0.93 per litre (GLOBAL PETROL PRICES, 2015).

The corruption scandal that has affected Petrobras is another factor that has shaken domestic perceptions of the NOC, bringing about questions concerning the Executive's ability to deal with corruption. This has made way for a heavily politicised debate between pro- and anti-government movements: the former groups are in general supportive of current and past actions by Rousseff's administration to investigate and tackle corruption while the latter tend to not see ongoing investigations as sufficient. In spite of the very serious allegations involving many of its managers, the company's production in Brazil has been on the rise. In 2014 its total oil and natural gas production reached 2.46 million BOE, up 6% from the previous year (ROSAS, 2015). In 2014, however, the company's losses totalled US$5.7 billion (Fig. 30) and continuous lows have been verified throughout 2015. According to the audited 2014 numbers released by the company in April 2015, corruption alone amounted to US$1.65 billion in losses (ALVARENGA et al., 2015).

When considering production alone, the impact of corruption and losses do not seem to heavily affect the company's total performance, but it is still quite early to predict if this will have a strong impact. Overall, two parallel movements seem to be taking place in the past decade: 1) the development of an increasingly more robust oil and gas sector in Brazil (when it comes to production) championed by Petrobras and other IOCs operating in the country; 2) increasing allegations of mismanagement of the country's NOC, which might reflect more wrongdoings in recent times and/or that these have been more thoroughly investigated and publicised.

These factors shed light onto the position Brazil is when it comes to self-reliance and, particularly, global projection. Notwithstanding the progress in E&P operations in the country concerning rising production and a generally safe environment for bidding and competition in the past years, Brazil's main challenges in the oil and gas production are: a) to make sure hydrocarbon demand will be constantly met; b) to have equal and sound development of all E&P sectors to decrease foreign dependence, which, at a fast rate, may not be feasible if current models of contract are not diversified to be more attractive to IOCs; c) to improve management and transparency in the activities of oil and gas companies in Brazil, particularly Petrobras, to make the business environment more accountable and predictable.

Such shortcomings hinder Brazil's ability to be energetically independent and to project itself as a truly global E&P player. In this scenario, one might wonder what international role Brazil might play, not as a "high-ranking" energy player (increasing production, consumption or occasional exports of refined products), but rather as a member of an energy community that provides enough security to itself and the region around it. Building the last remarks from what has been presented in this work, one may now try to answer the three questions made at the beginning of this study: 1) what is hydrocarbon security for Brazil; 2) within the hydrocarbon sector, what is the role of the socio-political environment in Brazil; 3) Is Brazil energetically independent?

Firstly, Brazil sees energy security through a lens that is quite similar to that of other countries, namely, ensuring that its energy needs are met and that there is enough margin to be safe when it comes to future shortages. This means not relying on foreign suppliers whenever possible and, when this is not the case, making sure partners are dependable. In this regard Brazil has not had great problems, particularly when it comes to refined products, as most of its partnerships have been forged in a quite diversified manner, following historic links at times and following new trends more recently. In 2013, the US accounted for 32.3% of Brazilian imports of refined products, whereas India came second at 13.7%. Algeria was next at 8.2%, Venezuela ranked fourth at 8% and Argentina represented 5.3% of the total. The highest-ranking European country in this group was the Netherlands at 4%. The share of imports within the apparent consumption of refined products in 2014 was 21% (ANP/SECEX apud DEPEC/BRADESCO, 2015). The US accounts for a premium share of the Brazilian market of refined products and, in Asia, India has played an important role. It is still noteworthy that there does not seem to be a high interdependence of South American countries when it comes to the trade of both crude oil and refined products. In any case, the improvement of the country's refining capacity, if continued, is bound to decrease its dependence on foreign partners in the future.

As for the second question it has been shown that the renouncing of hydrocarbon management by the state tends to be frowned upon by many sectors of the country's public opinion. Such discussions do not particularly touch the issues of technical and operational reliability, as well as attractive prices, which an ideally competitive market could bring, but rather bring historical reminiscences of the "plundering" of natural resources by foreign actors throughout the country's history with little regard to the economic and social welfare of the land in question. Understanding this rationale is key to addressing the difficulties many local social actors have when it comes to foreign participation in E&P activities. In spite of the easy assumption that this does not mean national companies and/or government agencies will do a "better job" in managing hydrocarbons for the well-being of the populations concerned, the very idea that such operations might overwhelmingly be in the hands of actors who do not share their environment and might not be directly concerned with local social grievances is sometimes difficult to elude.

Finally, Brazil can take secure steps towards energy independence if it succeeds in varying its energy sources. Overall, renewables account for 39.4% of the country's energy mix, whereas petroleum and refined products account for 39.4%, followed by natural gas at 13.5% (EPE, 2015). The country is not self-sufficient in those, as has been shown in this study, and, therefore, it is not actually independent, although it has not had many problems with finding hydrocarbon suppliers. After bearing in mind the domestic challenges when it comes to solidifying the country's oil and gas sector in what might be a period of transition, one might ask about the "role" Brazil has to play as an energy actor. Here the matter of being a consumer of refined products or, in the future, an occasional supplier might be just as important (both regionally and globally) as being a stable country both socio-politically and energy-wise. An important country in matters of economy, population and, at least regionally, geopolitics, Brazil is still a developing country, which might be obliterated in times of continuous GDP growth or more active foreign relations. Politically and economically relevant as a South American and Latin American state, and also as one of the representatives of the BRICS and the G-20, an energetically sound Brazil helps foster stability in the region and contributes to the continuum of supply-demand that is necessary in the highly interdependent world of hydrocarbon trade. Internationally, thus, the fact that Brazil has not experienced domestic strife for hydrocarbon control and has mostly gotten along with its neighbours concerning oil and natural gas trade can be seen as a positive trait that walks alongside the country's international tradition of promoting stability.

7. Concluding remarks

The much-celebrated Brazilian growth in the past years has been recently put into broader perspective. The country's ability to manage domestic political divisions, secure steadfast and responsible economic growth and deliver a safe environment for investments has had its ebbs and tides. The reconfiguration of hydrocarbon exploration since the 1997 opening of this particular market has changed the dynamics of oil and natural gas activities in the country; it has become more profit-driven due to increased competitiveness. As IOCs took hold of some of the operations, E&P initiatives have become more diversified in spite of the clear advantage Petrobras still has in most operations concerned.

This study has presented relevant facts and figures about oil and natural gas exploration in Brazil in the past decades, followed by a general political, legal and historical discussion, as a way of determining how Brazil officially sees the control of natural resources, particularly hydrocarbons. The strategy of the governments concerned ever since re-democratisation started, whether left- or right-leaning, has not given up the importance of Petrobras's centrality in spite of dealing with it in a different light according to diverging conceptions of economic and energy policies.

Therefore, Brazil's rising production of oil and natural gas in the past years, not to mention the massive discoveries in the pre-salt layer, have given way to deliberations about the country's "new approach" to non-renewables management and its occasional labelling as an energy superpower. Notwithstanding the continuous strengthening of the country's NOC and the sizable reserves yet to be explored with the help of varied IOCs, one cannot be certain about Brazil's capacity to influence the local flow of hydrocarbons, which has become quite clear after the latest drop in oil prices, as well as the depreciation of the Brazilian Real, both having severely impacted the many dollarised transactions of E&P operations in the country. In addition, the disproportionate role Petrobras plays in Brazilian oil and gas activities has not walked in tandem with the company's management capabilities. The investigation of wrongdoings and the subsequent corruption scandal have shed light on the need for higher supervision and accountability within the company. The decrease in market value does not seem to have affected the company's operational capability, however, which sends mixed signals to domestic and foreign investors alike.

Being a considerable "player" has more to do with the position of an actor within certain dynamics, such as the hydrocarbon market. When it comes to hydrocarbons, for a "player" to become a "power/superpower" it is important that it have control over much of that flow, whether because it is a major international supplier and/or because it has the ability to aggregate value to a much wanted resource. Brazil's lack of an aggressive production of refined products coupled with the difficulty of supplying its own domestic market with them makes whatever influence it has on oil and gas flows very limited. Brazil's main challenges when it comes to E&P operations are to secure the domestic market with enough amounts, make sure the institutional and legal environment for oil and gas production follows positive international patterns, such as accountability and socio-economic and environmental responsibility, besides convincing both domestic and foreign interested parties that the area concerned has enough predictability for investment. Considering the vast amounts of oil and natural gas the country holds, it might eventually be successful in this field if it tackles corruption at state and private companies, gradually includes domestic and foreign actors in mutually beneficial plans for the development of the hydrocarbon industry and has a sounder official and public strategy for the growth of its oil and gas operations throughout the years. This way, the old Brazilian symbolism of a "sleeping giant" of natural wealth waiting to suddenly awake may give way to a more comprehensive and thoughtful management of the country's energy resources, which need to be gradually – yet convincingly – developed.

8. References

8.1. Books, journals, dissertations and theses

CERVO, Amado Luiz. *Política exterior e relações internacionais do Brasil: enfoque paradigmático.* Revista Brasileira de Política Internacional [Online]. Brasilia. July/Dec. 2003. [Accessed 21 November 2014].

Available from: **www.scielo.br/scielo.php?script=sci_arttext&pid=S0034-73292003000200001.**

ENCARNAÇÃO, Ana Paula Gama. *Geração de biodiesel pelos processos de transesterificação e hidroesterificação, uma avaliação econômica* (Master's thesis). [Online]. 2008, pgs. 22-25. Federal University of Rio de Janeiro. [Accessed 11 August 2015].

Available from: **www.tpqb.eq.ufrj.br/download/biodiesel-via-trans-e-hidroesterificacao.pdf.**

FURTADO, Celso. *The Economic Growth of Brazil: a survey from colonial to modern times.* University of California Press, 1963.

FONSECA, Pedro Cezar Dutra. *Nem ortodoxia nem populismo: o Segundo Governo Vargas e a economia brasileira.* Tempo [Online]. vol. 14. no. 28. Niterói. June 2010. [Accessed 02 December 2015]

Available from: **www.scielo.br/scielo.php?script=sci_arttext&pid=S1413-77042010000100002&lng=pt&nrm=iso.**

FUSER, Igor. *Conflitos e contratos: A Petrobras, o nacionalismo boliviano e a interdependência do gás natural* (2002-2010) (PhD dissertation) [Online]. São Paulo, 2011. [Accessed 11/02/2015].

Available from: **www.teses.usp.br/teses/disponiveis/8/8131/tde-03062013-125451/publico/2011_IgorFuser_VCorr.pdf.**

MIRANDA, Maria Augusta de Toledo Tibiriçá. *O petróleo é nosso: a luta contra o "entreguismo," pelo monopólio estatal--1947-1953, 1953-1981*. Ed. Vozes, Rio de Janeiro,1983.

MORAIS, José Mauro de. *Petrobras: uma história das explorações de petróleo em águas profundas e no pré-sal* [Online]. Campus- Grupo Elsevier, 2014. [Accessed 26 May 2015].

Available from: **https://books.google.co.uk/books?id=ZGDjBwAAQBAJ&**

MORAIS, José Mauro de. *Petróleo em águas profundas: uma história tecnológica da Petrobras na exploração e produção offshore.* Brasília :Ipea: Petrobras, 2013.

MOREIRA, Vânia Maria Losada. *Nacionalismos e reforma agrária nos anos 50.* Revista Brasileira de História [Online]. 1998. Scielo. [Accessed 14 December 2014]

Available from: **www.scielo.br/scielo.php?script=sci_arttext&pid=S0102-01881998000100015**

OLIVEIRA, Gesner; TUROLLA, Frederico. *Política econômica do segundo governo FHC: mudança em condições adversas.* Tempo Social [Online]. vol. 15 no. 2. São Paulo. November 2003. [Accessed 05 November 2015]

Available from: **www.scielo.br/scielo.php?pid=S0103-20702003000200008&script=sci_arttext.**

SÁ, Eliane Garcindo de. *Petróleo e nacionalismo na América Latina: a tese Horta Barbosa.* Anais Eletrônicos do V Encontro da ANPHLAC [Online]. Belo Horizonte, 2000 [Accessed 06 July 2015].

Available from: **anphlac.fflch.usp.br/sites/anphlac.fflch.usp.br/files/eliane_garcindo.pdf.**

SANTOS, Luis Cláudio Villafane G. *O Brasil entre a América e a Europa: o império e o interamericanismo (do congresso do Panamá à conferência de Washington).* Editora UNESP, 2004.

SOUZA, Angelita Matos. *Governos Geisel e Dilma: o poder das finanças.* Cuadernos de Economía [Online]. vol. 34 no. spe. 66. Bogota, December 2015 [Accessed 06 December 2015].

Available from: **www.scielo.org.co/scielo.php?pid=S0121-47722015000300004&script=sci_arttext&tlng=pt.**

8.2. Brazilian and international official bodies

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *PORTARIA ANP Nº 249, DE 1º.11.2000* [Online]. 2000. [Accessed 23 April, 2015]

Available from: **nxt.anp.gov.br/NXT/gateway.dll/leg/folder_portarias_anp/portarias_anp_tec/2000/novembro/panp%20249%20-%202000.xml?f=templates$fn=document-frame.htm$3.0$q=$x=$nc=1843.**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *LEI Nº 11.097, DE 13.1.2005* [Online]. 2005. [Accessed 10 January 2015].

Available from: **nxt.anp.gov.br/NXT/gateway.dll/leg/leis/2005/lei%2011.097%20-%202005.xml?f=templates$fn=default.htm&sync=1&vid=anp:10.1048/enu.**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Anuário Estatístico Brasileiro do Petróleo, Gás Natural e Biocombustíveis 2012* [Online]. 2013a. [Accessed 08 June 2015

Available from: **www.anp.gov.br/?dw=68644.**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Produtor de Biodiesel* [Online]. 2013b. [Accessed 15 February 2015]

Available from: **www.anp.gov.br/?id=2808**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Anuário Estatístico Brasileiro do Petróleo, Gás Natural e Biocombustíveis 2013* [Online]. 2014a. [Accessed 08 June 2015]

Available from: **www.anp.gov.br/?dw=73191**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Boletim do Etanol no 01/2014* [Online]. 2014b. [Accessed 29 June 2015]

Available from: **www.siamig.com.br/cache/Documentos/anp.pdf.**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Biodiesel – Introdução* [Online]. 2014c. [Accessed 02 May 2015]

Available from: **www.anp.gov.br/?pg=73292&m=&t1=&t2=&t3=&t4=&ar=&ps=&1435680308027.**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *RESOLUÇÃO ANP Nº 25, DE 24.4.2014* [Online]. 2014d. [Accessed 24 June, 2015]

Available from: **nxt.anp.gov.br/NXT/gateway.dll/leg/resolucoes_anp/2011/fevereiro/ranp%2013%20-%202011.xml?fn=document-frameset.htm$f=templates$3.0.**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Boletim da Produção de Petróleo e Gás Natural:* abril de 2015 [Online]. 2015a. [Accessed 03 July 2015]

Available from: **www.anp.gov.br/?dw=75892**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Anuário Estatístico Brasileiro do Petróleo, Gás Natural e Biocombustíveis 2014* [Online]. 2015b. [Accessed 11 August 2015]

Available from: **www.anp.gov.br/?pg=76798**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Importações e exportações* (barris equivalentes de petróleo) [Online]. 2015c. [Accessed 13 May 2015]

Available from: **www.anp.gov.br/?dw=8475**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Biocombustíveis* [Online]. 2015d. [Accessed 29 June 2015]

Available from: **/anp.gov.br/?id=470**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Blocos concedidos em 06/08/1998-Exploration concessions as of August 6th, 1998* [Online]. 2015e. [Accessed 01 April 2015].

Available from: **www.brasil-rounds.gov.br/Resultado_Rodadas/RESUMO_round0.asp.**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Empresas vencedoras da Primeira Rodada de Licitações* (Round 1 winning companies) [Online]. 2015f. [Accessed 19 May 2015].

Available from: **www.brasil-rounds.gov.br/Resultado_Rodadas/RESUMO_round1_vencedoras.asp.**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Empresas vencedoras da Segunda Rodada de Licitações* (Companies winning the Second Round of Public Tender) [Online]. 2015g [Accessed 19 May 2015].

Available from: **www.brasil-rounds.gov.br/Resultado_Rodadas/RESUMO_round2_vencedoras.asp.**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Empresas vencedoras da Terceira Rodada de Licitações* (Companies winning the Third Round of Public Tender). [Online] 2015h [Accessed 19 May 2015].

Available from: **www.brasil-rounds.gov.br/Resultado_Rodadas/RESUMO_round3_vencedoras.asp.**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Empresas vencedoras da Quarta Rodada de Licitações* (Companies winning the Fourth Round of Public Tender. [Online] 2015i. [Accessed 19 May 2015].

Available from: **www.brasil-rounds.gov.br/Resultado_Rodadas/RESUMO_round4_vencedoras.asp**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Empresas vencedoras da Quarta Rodada de Licitações* (Companies winners of the Fifth Round of Public Tender) [Online] 2015j. [Accessed 19 May 2015]

Available from: **www.brasil-rounds.gov.br/Resultado_Rodadas/RESUMO_round5_vencedoras.asp**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Empresas vencedoras da Sétima Rodada de Licitações - Parte A* (Companies winning the Seventh Round of Public Tender) [Online]. 2015k. [Accessed 19 May 2015]

Available from: **www.brasil-rounds.gov.br/Resultado_Rodadas/RESUMO_round7_vencedoras.asp.**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Empresas vencedoras da Oitava Rodada de Licitações* (Companies winning the Eighth Round of Public Tender) [Online]. 2015l. [Accessed 19 May 2015]

Available from: **www.brasil-rounds.gov.br/Resultado_Rodadas/RESUMO_round8_vencedoras.asp.**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Empresas vencedoras da Nona Rodada de Licitações* (Companies winning the Ninth Round of Public Tender) [Online]. 2015m. [Accessed 19 May 2015.]

Available from: **www.brasil-rounds.gov.br/Resultado_Rodadas/RESUMO_round9_vencedoras.asp.**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Empresas vencedoras da Décima Rodada de Licitações* (Companies winning the Tenth Round of Public Tender) [Online]. 2015n. [Accessed 19 May 2015]

Available from: **www.brasil-rounds.gov.br/Resultado_Rodadas/RESUMO_round10_vencedoras.asp.**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Empresas vencedoras da 11ª Rodada de Licitações* (Companies winning the 11th Bidding Round) [Online]. 2015o. [Accessed 19 May 2015].

Available from: **www.brasil-rounds.gov.br/Resultado_Rodadas/RESUMO_round11_vencedoras.asp.**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Relatórios das rodadas de licitações: empresas vencedoras* [Online]. 2015p. [Accessed 19 May 2015]

Available from: **www.brasil-rounds-data.anp.gov.br/relatoriosbid/Empresa/VencedorasDesktop.**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]. *Superintendency of Licensing Rounds Promotion* – SPL [Online]. 2015q. [Accessed 06 June 2015

Available from: **www.brasil-rounds.gov.br/round_TGas1/ingles_TGas1/apresentacao.asp.**

ANP [Agência Nacional do Petróleo, Gás, Natural e Biocombustíveis]/ SECEX [Secretaria de Comércio Exterior] apud DEPEC [Departamento de Pesquisas e Estudos Econômicos] - Bradesco. *Petróleo e Derivados.* [Online] June 2015. [Accessed 17 August 2015]

Available from: **www.economiaemdia.com.br/EconomiaEmDia/pdf/infset_petroleo_e_derivados.pdf.**

BRASIL ROUNDS. *Resultado das rodadas de licitações de blocos por rodada* [Online]. 2015a. [Accessed 15 May 2015]

Available from: **www.brasil-rounds.gov.br/portugues/RESUMO_geral_blocos.asp.**

BRASIL ROUNDS. *Brasil 13th Round* [Online]. 2015b. [Accessed 04 December, 2015]

Available from: **www.brasil-rounds.gov.br/round_13/ingles_R13/resultado_r13.asp.**

CHAMBER OF DEPUTIES. *Legislação*: DECRETO-LEI Nº 737, DE 23 DE SETEMBRO DE 1938 [Online]. 1938. [Accessed 10 March 2015]

Available from: **www2.camara.leg.br/legin/fed/declei/1930-1939/decreto-lei-737-23-setembro-1938-350748-publicacaooriginal-1-pe.html.**

EPE. *Balanço Energético Nacional 2015* [Online]. 2015. [Accessed 05 December 2015]

Available from: **https://ben.epe.gov.br/downloads/Síntese do Relatório Final_2015_Web.pdf.**

MINISTRY OF MINES AND ENERGY. *Produção de petróleo bate recorde histórico em 2014* [Online]. 2015a. [Accessed 24 March 2015

Available from: **www.mme.gov.br/web/guest/pagina-inicial/manchete/-/asset_publisher/neRB8QmDsbU0/content/producao-de-petroleo-bate-recorde-historico-em-2014;jsessionid=D15DFD51E480E63EA1A426E4A3A7AD91.srv155.**

MINISTRY OF MINES AND ENERGY. *PPSA* [Online]. 2015b. [Accessed 8 June 2015]

Available from: **www.mme.gov.br/web/guest/entidades-vinculadas-e-afins/ppsa.**

MINISTRY OF MINES AND ENERGY. N3E. *Resenha Energética Brasileira: exercício de 2014* [Online]. 2015a. [Accessed 11 August 2015

Available from: **www.mme.gov.br/documents/1138787/1732840/Resenha+Energética+-+Brasil+2015.pdf/4e6b9a34-6b2e-48fa-9ef8-dc7008470bf2.**

MINISTRY OF MINES AND ENERGY. *Resolução no 237, de 19 de dezembro de 1997* [Online]. 1997. [Accessed 24 June 2015]

Available from: **www.mma.gov.br/port/conama/res/res97/res23797.html.**

OPEC. *Oil and Gas Data* [Online]. *2014. [Accessed 14 August 2015]*

Available from: **www.opec.org/library/Annual Statistical Bulletin/interactive/current/FileZ/Main-Dateien/Section3.html.**

OPEC. *Annual Statistical Bulletin* [Online]. 2015.

Available from: **www.opec.org/opec_web/static_files_project/media/downloads/publications/ASB2015.pdf.**

PETROBRAS. *Pré-Sal:* perguntas e respostas [Online]. 2009 [Accessed 03 July 2015]

Available from: **www.sites.petrobras.com.br/minisite/presal/perguntas-respostas/index.asp.**

PETROBRAS. *Memória Petrobras:* 1995. 2013. [Accessed 14 August 2015]

Available from: **www.memoria.petrobras.com.br/depoentes/cesar-tavares-pereira/descoberto-o-campo-de-roncador#.VZggNPlWfz8.**

PETROBRAS. *Fatos e Dados:* iniciamos operação do terceiro terminal de regaseificação de GNL [Online]. [Accessed 18 May 2015]

Available from: **www.fatosedados.blogspetrobras.com.br/2014/01/24/iniciamos-operacao-do-terceiro-terminal-de-regaseificacao-de-gnl/.**

PETROBRAS. *Nossa História* [Online]. 2015a. [Accessed 06 June 2015]

Available from: **www.petrobras.com/pt/quem-somos/nossa-historia/.**

PETROBRAS. *Terminal de Regaseificação de Pecém (GLN)* [Online]. 2015b. [Accessed 18 May, 2015]

Available from: **www.petrobras.com.br/pt/nossas-atividades/principais-operacoes/terminais-e-oleodutos/terminal-de-regaseificacao-de-pecem-gln.htm**

PETROBRAS. *Terminal de Regaseificação da Baía de Guanabara (GLN).* 2015c. [Accessed 18 May, 2015]

Available from: **www.petrobras.com.br/pt/nossas-atividades/principais-operacoes/terminais-e-oleodutos/terminal-de-regaseificacao-da-baia-de-guanabara-gnl.htm.**

PETROBRAS. *Investor Relations:* Financial Results [Online]. 2015d. [Accessed 05 December 2015]

Available from: **www.investidorpetrobras.com.br/en/financial-results#topo.**

PETROBRAS. *Fatos e Dados:* A descoberta de um campo de petróleo e gás natural em 5 passos [Online]. 2015e. [Accessed 08 June 2015]

Available from: **www.petrobras.com.br/fatos-e-dados/a-descoberta-de-um-campo-de-petroleo-e-gas-natural-em-5-passos.htm.**

PETROBRAS. *Pré-Sal* [Online]. 2015f. [Accessed 8 June 2015]

Available from: **www.petrobras.com.br/pt/nossas-atividades/areas-de-atuacao/exploracao-e-producao-de-petroleo-e-gas/pre-sal/.**

PORTAL BRASIL. *Mapa do Pré-Sal no Brasil:* área do território brasileiro com potencial de exploração de pré-sal [Online]. 2014. [Accessed 08 June 2015]

Available from: **www.brasil.gov.br/infraestrutura/2014/07/brasilpresal.jpg/view.**

PORTAL BRASIL. *Economia e Emprego:* Governo estabelece adição de 27% de etanol na gasolina [Online]. 2015. [Accessed 29 June 2015]

Available from: **www.brasil.gov.br/economia-e-emprego/2015/03/adicao-de-27-de-etanol-na-gasolina-e-estabelecida-pelo-governo.**

PRESIDENCY OF THE REPUBLIC Civil Staff – Deputy Directorate of Legal Matters). *LEI Nº 2.004, DE 3 DE OUTUBRO DE 1953* [Online]. 1953. [Accessed 22 March 2015]

Available from: **www.planalto.gov.br/CCivil_03/LEIS/L2004.htm.**

PRESIDENCY OF THE REPUBLIC Civil Staff – Deputy Directorate of Legal Matters). *Decreto nº 53.337, de 23 de Dezembro de 1963* [Online]. 1963. [Accessed 01 May 2015]

Available from: **www2.camara.leg.br/legin/fed/decret/1960-1969/decreto-53337-23-dezembro-1963-393305-publicacaooriginal-1-pe.html.**

PRESIDENCY OF THE REPUBLIC (Civil Staff – Deputy Directorate of Legal Matters). *LEI Nº 9.478, DE 6 DE AGOSTO DE 1997* [Online]. 1997. [Accessed 10 January 2015]

Available from: **www.planalto.gov.br/ccivil_03/leis/L9478.htm.**

PRESIDENCY OF THE REPUBLIC Civil Staff – Deputy Directorate of Legal Matters). *LEI Nº 9.966, DE 28 DE ABRIL DE 2000* [Online]. 2000. [Accessed 24 June 2015]

Available from: **www.planalto.gov.br/ccivil_03/leis/L9966.htm.**

PRESIDENCY OF THE REPUBLIC Civil Staff – Deputy Directorate of Legal Matters). *LEI Nº 12.351, DE 22 DE DEZEMBRO DE 2010* [Online]. 2010. [Accessed 8 June 2015]

Available from: **www.planalto.gov.br/ccivil_03/_Ato2007-2010/2010/Lei/L12351.htm.**

PRESIDENCY OF THE REPUBLIC *Blog do Planalto.* O Petróleo no Brasil [Online]. 2009. [Accessed 30 March 2015].

Available from: **http://blog.planalto.gov.br/o-petroleo-no-brasil/.**

8.3. Research centres and databases

ALICEWEB. *Biodiesel exports* (1997-2015) [Online]. 2015. [Accessed 11 August 2015].

Available from: **https://www.dropbox.com/s/0l8xlqyptsh2ctt/aliceweb20150811050539485.xls?dl=0.**

DADOS.GOV.BR. *Organizações:* Agência Nacional de Petróleo, Gás Natural e Biocombustíveis. Biodiesel – Produção [Online]. 2015. [Accessed 10 July 2015]

Available from: **dados.gov.br/dataset/biodiesel-producao.**

EIA. [US Energy Information Administration]. *Analysis – Brazil (2013/2014)* [Online]. 2014a. [Accessed 5 May, 2015]

Available from: **www.eia.gov/beta/international/analysis.cfm?iso=BRA**

EIA. [US Energy Information Administration]. *Analysis – Venezuela* [Online]. 2014b. [Accessed 5 May, 2015

Available from: **www.eia.gov/countries/cab.cfm?fips=ve.**

EIA. [US Energy Information Administration]. *International Energy Statistics* – Brazil (Total oil supply: 1990-2014) [Online]. 2015a. [Accessed April 23 2015]

Available from: **www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=53&aid=1&cid=BR,&syid=1990&eyid=2014&unit=TBPD.**

EIA. [US Energy Information Administration]. *International Energy Statistics* – Brazil (Total petroleum consumption: 1990-2013). [Online] 2015b. [Accessed April 23, 2015]

Available from: **www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=5&aid=2&cid=BR,&syid=1990&eyid=2013&unit=TBPD.**

EIA. [US Energy Information Administration]. *International Energy Statistics – Brazil* (Refinery processing gain: 1990-2014) [Online]. 2015c. [Accessed April 23, 2015]

Available from: **www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=56&aid=1&cid=BR,&syid=1990&eyid=2014&unit=TBPD.**

EIA. [US Energy Information Administration]. *International Energy Statistics* – Brazil (Consumption – Motor gasoline: 1990-2013). [Online] 2015d. [Accessed April 23, 2015]

Available from: **www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=62&aid=2&cid=BR,&syid=1990&eyid=2013&unit=TBPD.**

EIA. [US Energy Information Administration]. *International Energy Statistics* – Brazil (Consumption – Jet fuel: 1990-2013) [Online]. 2015e. [Accessed April 23, 2015]

Available from: **www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=63&aid=2&cid=BR,&syid=1990&eyid=2013&unit=TBPD.**

EIA. [US Energy Information Administration]. *International Energy Statistics* – Brazil (Production – Crude oil, NGPL, and other liquids: 1990-2014) [Online]. 2015f. [Accessed April 23, 2015]

Available from: **www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=55&aid=1&cid=BR,&syid=1990&eyid=2014&unit=TBPD.**

EIA. [US Energy Information Administration]. *Petroleum and other liquids:* Definitions, Sources and Explanatory Notes [Online]. 2015g. [Accessed 03 July 2015]

Available from: **www.eia.gov/dnav/pet/tbldefs/pet_pri_wco_tbldef2.asp.**

EIA. [US Energy Information Administration]. *International Energy Statistics* – Brazil (Consumption – Distillate fuel oil: 1990-2013) [Online]. 2015h. [Accessed April 23, 2015

Available from: **www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=65&aid=2&cid=BR,&syid=1990&eyid=2013&unit=TBPD.**

EIA. [US Energy Information Administration]. *International Energy Statistics* – Brazil (Consumption – Residual fuel oil: 1990-2013) [Online]. 2015i. [Accessed April 23, 2015]

Available from: **www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=66&aid=2&cid=BR,&syid=1990&eyid=2013&unit=TBPD.**

EIA. [US Energy Information Administration]. *International Energy Statistics* – Brazil (Consumption – Liquefied petroleum gases: 1990-2013) [Online]. 2015j. [Accessed April 23, 2015]

Available from: **www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=67&aid=2&cid=BR,&syid=1990&eyid=2013&unit=TBPD.**

EIA. [US Energy Information Administration]. *International Energy Statistics* – Brazil (Consumption – Other products: 1990-2013) [Online]. 2015k. [Accessed April 23, 2015]

Available from: **www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=68&aid=2&cid=BR,&syid=1990&eyid=2013&unit=TBPD**

EIA. [US Energy Information Administration]. *Analysis – Brazil (2014/2015)* [Online]. 2015l. [Accessed 05 December, 2015]

Available from: **www.eia.gov/beta/international/analysis.cfm?iso=BRA.**

EIA. [US Energy Information Administration]. *International Energy Statistics* – Brazil (Production – Natural gas: 1990-2013) [Online]. 2015m. [Accessed April 23, 2015]

Available from: **www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=3&pid=26&aid=1&cid=BR,&syid=1990&eyid=2013&unit=BCF.**

EIA. [US Energy Information Administration]. *International Energy Statistics* – Brazil (Consumption – Natural gas: 1990-2013) [Online]. 2015n. [Accessed April 23, 2015]

Available from: **www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=3&pid=26&aid=2&cid=BR,&syid=1990&eyid=2013&unit=BCF.**

EIA. [US Energy Information Administration]. *Today in Energy:* Pre-salt oil and natural gas provide an increasing share of Brazil's production [Online]. 2015o. [Accessed 09 June 2015]

Available from: **www.eia.gov/todayinenergy/detail.cfm?id=19511.**

GLOBAL PETROL PRICES. *Gasoline prices, liter* [Online]. 2015. [Accessed 15 August 2015]

Available from: **www.globalpetrolprices.com/gasoline_prices/.**

IBP. (Instituto Brasileiro de Petróleo, Gás e Biocombustíveis). *A Bacia de Campos* [Online]. 2009. [Accessed 05 June 2015]

Available from: **www.ibp.org.br/main.asp?View={58784FF7-BB06-46B8-8200-A72A1FA66ABD}&.**

BP. (Instituto Brasileiro de Petróleo, Gás e Biocombustíveis). *Origem das importações* [Online]. 2014. [Accessed on 30 April 2015]

Available from: **http://200.189.102.61/SIEE/dashboard/OrigemDasImportacoes.**

LUCCHESI, Celso Fernando. Estudos Avançados: *Dossiê Recursos Naturais:* Petróleo. 1998 [Online]. [Accessed 30 October 2014]

Available from: **www.scielo.br/scielo.php?pid=S0103-40141998000200003&script=sci_arttext.**

UNICA [Brazilian Sugarcane Industry Association]. *Sugarcane production* - 1980/1981 to 2013/2014 [Online]. 2015a. [Accessed 29 June 2015]

Available from: **www.unicadata.com.br/historico-de-producao-e-moagem.php?idMn=31&tipoHistorico=2&acao=visualizar&idTabela=1611&produto=cana&safraIni=1980%2F1981&safraFim=2013%2F2014&estado=RS%2CSC%2CPR%2CSP%2CRJ%2CMG%2CES%2CM. S%2CMT%2CGO%2CDF%2CBA%2CSE%2CAL%2CPE%2CPB%2CRN%2CCE%2CPI%2CMA%2CTO%2CPA%2CAP%2CRO%2CAM%2CAC%2CRR.**

UNICA [Brazilian Sugarcane Industry Association]. *Ethanol production* - 1980/1981 to 2013/2014 [Online]. 2015b. [Accessed 29 June 2015]

Available from: **www.unicadata.com.br/historico-de-producao-e-moagem.php?idMn=31&tipoHistorico=2&acao=visualizar&idTabela=1611&produto=etanol_total&safraIni=1980%2F1981&safraFim=2013%2F2014&estado=RS%2CSC%2CPR%2CSP%2CRJ%2CMG%2CES%2CMS%2CMT%2CGO%2CDF%2CBA%2CSE%2CAL%2CPE%2CPB%2CRN%2CCE%2CPI%2CMA%2CTO%2CPA%2CAP%2CRO%2CAM%2CAC%2CRR.**

UNICA [Brazilian Sugarcane Industry Association]. *Ethanol exports* – 2000-2014 [Online]. 2015c. [Accessed 29 June 2015]

Available from: **www.unicadata.com.br/listagem.php?idMn=65.**

UNICA [Brazilian Sugarcane Industry Association]. *Ethanol exports to the US* – 2010 to 2014 [Online]. 2015d. [Accessed 29 June 2015]

Available from: **www.unicadata.com.br/historico-de-exportacao.php?idMn=22&tipoHistorico=9&acao=visualizar&idTabela=1592&produto=Etanol&agregacao=3&destino=Estados%2BUnidos&periodicidade=civil&ano=2014.**

UNICA [Brazilian Sugarcane Industry Association]. *Ethanol exports to the US* – 2010 to 2014 [Online]. 2015d. [Accessed 29 June 2015]

Available from: **www.unicadata.com.br/historico-de-exportacao.php?idMn=22&tipoHistorico=9&acao=visualizar&idTabela=1592&produto=Etanol&agregacao=3&destino=Estados%2BUnidos&periodicidade=civil&ano=2014.**

UNICA [Brazilian Sugarcane Industry Association]. *Ethanol exports to the US* – 2005 to 2009 [Online]. 2015e. [Accessed 29 June 2015]

Available from: **www.unicadata.com.br/historico-de-exportacao.php?idMn=22&tipoHistorico=9&acao=visualizar&idTabela=1592&produto=Etanol&agregacao=3&destino=Estados%2BUnidos&periodicidade=civil&ano=2009.**

8.4. News outlets and miscellaneous

AGÊNCIA BRASIL. *Petrobras anuncia descoberta de poço na área de Franco. Exame: Negócios [Online]. 2013. [Accessed 09 June 2015]*

Available from: **http://exame.abril.com.br/negocios/noticias/petrobras-anuncia-descoberta-de-poco-na-area-de-franco.**

ALVARENGA, Darlan; *Preço da gasolina no Brasil está quase 70% acima do internacional.* G1: Economia [Online]. 2015. [Accessed 10 August 2015]

Available from: **http://g1.globo.com/economia/noticia/2015/01/preco-da-gasolina-no-brasil-esta-quase-70-acima-do-internacional.html.**

ALVARENGA, Darlan; CAOLI, Cristiane; LAPORTA, Tais.: Negócios. *Petrobras tem 1o prejuízo desde 1991; perda com corrupção é de R$6.2 bi.* G1: Economia [Online]. 2015. [Accessed 12 August 2015]

Available from: **http://g1.globo.com/economia/negocios/noticia/2015/04/petrobras-divulga-balanco-auditado-com-prejuizo-de-r-216-bi-em-2014.html.**

AMATO, Fábio; MELLO, Káthia; THUM, Tássia: *Consórcio formado por Petrobras e mais 4 empresas vence leilão de Libra.* G1: Economia [Online]. 2013 [Accessed 07 June 2015]

Available from: **http://g1.globo.com/economia/noticia/2013/10/consorcio-formado-por-petrobras-e-mais-4-empresas-vence-leilao-de-libra.html.**

BARBOSA, D.; GUIMARÃES, S. P.; JULIBONI, M. *Veja as 4 sócias estrangeiras da Petrobras no Campo de Libra.* Exame: Negócios [Online] 2013. [Accessed 8 June 2015]

Available from: **http:// exame.abril.com.br/negocios/noticias/veja-as-4-socias-estrangeiras-da-petrobras-no-campo-de-libra.**

BONATO, Gustavo; LORENZI, Sabrina. *Brasil importa mais de US$40 bi em petróleo e derivados em 2013.* Estadão [Online]. 2014. [Accessed 05/06/2015]

Available from: **http://www.estadao.com.br/noticias/geral,brasil-importa-mais-de-us40-bi-em-petroleo-e-derivados-em-2013,1114449.**

BUSTAMANTE, L. A. C. *A Frustração com a Partilha de Produção: o leilão do campo de Libra.* Brasília: Núcleo de Estudos e Pesquisas/CONLEG/Senado (Texto para Discussão nº 168) [Online]. 2015. [Accessed 01 August 2015]

Available from: **www12.senado.gov.br/publicacoes/estudos-legislativos/tipos-de-estudos/textos-para-discussao/td168.**

CARTA CAPITAL. *Graça Foster renuncia à presidência da Petrobras.* Carta Capital. Parlatório: Política [Online]. 2015. [Accessed 28 November 2015]

Available from: **www.cartacapital.com.br/blogs/parlatorio/graca-foster-renuncia-a-presidencia-da-petrobras-3243.html.**

CORTEZ, Luís Augusto Barbosa; LEITE, Rogério Cerqueira. *O etanol combustível no Brasil [Online]. 2015.[Accessed 29 June 2015]*

Available from: **www.agencia.cnptia.embrapa.br/Repositorio/etanol3_000g7gq2cz702wx5ok0wtedt3xdrmftk.pdf.**

CORTEZ, Luís Augusto Barbosa; LEITE, Rogério Cerqueira. *Escândalo na Petrobras. Entenda as suspeitas de irregularidades em torno da estatal.* Folha de São Paulo: Poder [Online]. 2014. [Accessed 20 February 2015].

Available from: **www1.folha.uol.com.br/infograficos/2014/09/114361-escandalo-na-petrobras.shtml#2.**

LEMOS, Luiz Antonio Maia Espinola; MENEZES, Luis Antonio; MONTONI, Alexandre; TRANJAN, Eduardo. *Oil and Gas Regulation in Brazil: overview* [Online]. 2013.

Available from: **http://uk.practicallaw.com/2-524 2451?q=*&qp=&qo=&qe=#.**

LIRA NASCIMENTO, Flávio Augusto. *Image, capitalisation and production: the delicate scenario of post-scandal Petrobras.* EUCERS Newsletter [Online]. Issue 43. April 2015. [Accessed 10 July 2015]

Available from: **www.kcl.ac.uk/sspp/departments/warstudies/research/groups/eucers/newsletter43.pdf.**

MACIEL, Marcelo Sobreiro. *Nota Técnica:* Tributos incidentes sobre os combustíveis [Online]. Biblioteca Digital da Câmara dos Deputados.2011. [Accessed 24 June, 2015]

Available from: **http://bd.camara.leg.br/bd/bitstream/handle/bdcamara/8426/tributos_incidentes_maciel.pdf?sequence=1..**

MIRANDA, Maria Augusta de Toledo Tibiriçá. *Memória Petrobrás. 1952: Campanha "O Petróleo é Nosso"* [Online]. 2015. [Accessed 12 June 2015].

Available from: **http://memoria.petrobras.com.br/depoentes/maria-augusta-de-toledo-tibiria-miranda/campanha-o-petroleo-e-nosso#.Vcs7EPlWfz8.**

NOGUEIRA, Marta; SAMORA, Roberto; BLOUNT, Jeb; TEIXEIRA, Marcelo. *UPDATE 3-Brazil's subsalt oil profitable at $55, official says.* Reuters – Commodities [Online]. 2015. [Accessed 04 December 2015]

Available from: **http://in.reuters.com/article/brazil-oil-libra-idINL1N12K24820151020.**

NUNES, Fernanda. *Com investimentos da Petrobrás, petróleo avança para 13% do PIB brasileiro.* Estadão: E&N Mercados [Online]. 2014[Accessed 16 June 2015]

Available from: **http://economia.estadao.com.br/noticias/mercados,com-investimentos-da-petrobras-petroleo-avanca-para-13-do-pib-brasileiro,1513541.**

O TEMPO. *Entenda o leilão de Libra, o maior campo de petróleo do Brasil.* [Accessed 20/12/2014]. 2013

Available from: **www.otempo.com.br/capa/brasil/entenda-o-leilão-de-libra-o-maior-campo-de-petróleo-do-brasil-1.734163**

RAVAL, Anjili. *Oil price plunge means survival of fittest.* Financial Times: markets: commodities: The Commodities Note [Online]. 2014. [Accessed 10 February 2015]

Available from: **http://www.ft.com/cms/s/0/51cc00ba-7f85-11e4-86ee-00144feabdc0.html#axzz3iuL7a4p1.**

REUTERS BRASIL. *Exportação de etanol do Brasil deve recuar 35% em 14/15.* Exame [Online]. 2014a. [Accessed 02/11/2014]

Available from: **www.exame.abril.com.br/economia/noticias/exportacao-de-etanol-do-brasil-deve-recuar-35-em-14-15-preve-trading-sca.**

REUTERS BRASIL. *Petrobras declara comercialidade de áreas no pré-sal da Bacia de Santos.* Reuters: Negócios [Online]. 2014b. [Accessed 09 June 2015]

Available from: **http://br.reuters.com/article/businessNews/idBRKBN0K800520141230.**

REUTERS BRASIL. *Produção de petróleo da Petrobras cresce 5,3% em 2014 e bate recorde.* Valor Econômico [Online]. 2015. [Accessed 15/07/2015]

Available from: **www.valor.com.br/empresas/3856406/producao-de-petroleo-da-petrobras-cresce-53-em-2014-e-bate-recorde.**

WAISBERG, Idel. *Brazil's pre-salt layer* [Online]. 2011. [Accessed 01 December 2015]

Available from: **http://large.stanford.edu/courses/2011/ph240/waisberg1/.**

WORLD OIL. *Pre-salt is still economically viable, Petrobras says.* World Oil [Online] 2015. [Accessed 03 March 2015]

Available from: **www.worldoil.com/news/2015/1/9/pre-salt-is-still-economically-viable-petrobras-says.**

The European Centre for Energy and Resource Security (EUCERS)

Department of War Studies
King's College London
Strand
London WC2R 2LS

Email info@eucers.eu
Telephone 020 7848 1912
www.eucers.eu