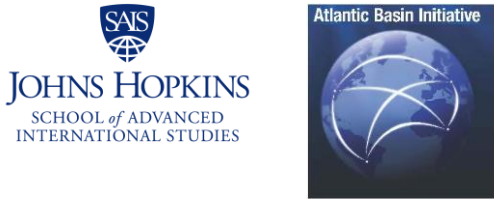

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Atlantic Basin Energy Security and Sustainability: A Brazilian Perspective

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ADVANCE DRAFT FOR THE ATLANTIC ENERGY FORUM

1. Introduction

Energy consumption began to steadily rise after the country's industrial takeoff at the end of the second World War. Today, Brazil has a large industrial capacity but a significant share of its population has limited access to the amenities of modern life. The security of the supply of energy at affordable prices is perceived by the Brazilian government to be a crucial policy, indispensable to the country's socioeconomic development.

Historically, oil imports have place a major constraint on Brazilian economic growth. However, the recent discovery of several giant pre-salt oil reservoirs in the Brazilian offshore has reshaped the Brazilian energy scene. Although Brazil remains a large importer of fossil fuels, the country is now planning to become a large oil exporter in the near future (Bloomberg, 2013). This new scenario has prompted major changes in Brazilian energy policy. Taxes, subsides and energy prices have been used to achieve social, regional and macroeconomic objectives.

The Brazilian government is fiercely committed to the construction of hydroelectric power plants. Financial incentives are offered for hydropower plants in the Amazon region despite the strong opposition of environmentalists that highlight the risks posed by such projects (ie, deforestation, invasion of protected lands, etc). Meanwhile, in the hydrocarbons sector financial problems are forcing Petrobras, the national oil company, to drastically review its investment program, although government remains reluctant to review oil regulations with the aim of making

them more attractive to private investors. Moreover, oil companies are required to buy a minimum share of their equipment and services in Brazil (known as 'domestic content requirements') to foment domestic industrial capacity, but local industry has been unable to competitively meet such demand.

The North Atlantic shaped the foundations of the economic and social progress generated by the industrial revolution (Atxurra, 2015), but the South Atlantic was, to a large extent, left behind in the last quarter of the past century. The Pacific Basin began to drive world economic growth with the start of the Chinese economic boom. There are now signs of an Atlantic Basin renaissance, however (Pelegry and Isbell, 2015). These signs can be perceived particularly in the energy scene where Atlantic Basin hydrocarbon dependency is fading away as a result of both the fracking revolution in the North Atlantic and the discovery of very large pre-salt hydrocarbon resources in the South Atlantic. It is nevertheless important to note that the transition to renewable sources is essential in order to mitigate the risks of global climate change and that the Atlantic Basin is at the helm of the leadership of this transition.

The energy scenario of the Atlantic Basin offers a unique opportunity to accelerate the process of socioeconomic 'catch up' in the South Atlantic. Given its strategic geographic location and its level of economic development, Brazil can play a major role in this development. Indeed, Brazil's geological (eg, offshore), technological and industrial capabilities have already proven valuable for the development of the hydrocarbons resources of the continental platforms on both sides of the South Atlantic. The country's long experience with the renewable energy sources, especially biofuels, is also valuable for the required energy transition. From a geopolitical point of view, Brazil is a troubleshooter, an attribute that facilitates the construction of the economic and political compact needed to enhance energy security in the Atlantic basin.[1]

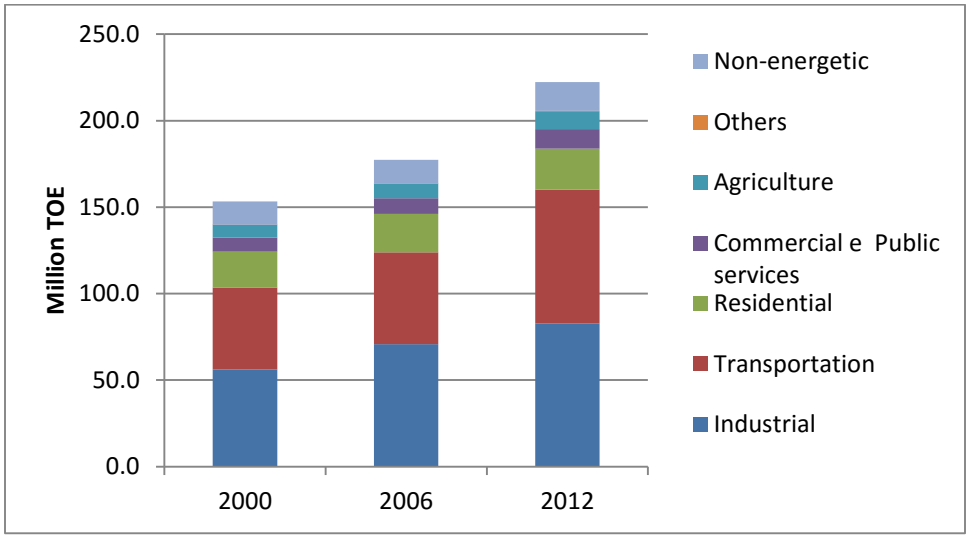
[1] A troubleshooter country can be identified by the way it pursues three objectives whenever it faces a problem with international impact: i) to contain the conflict, preventing it from expanding into new, violent clashes; ii) to circumscribe the conflict, so as to prevent it from spreading to other countries: iii) to reverse the crisis so that the relations between the parties, domestic or otherwise, return to normal.

This paper explores the potential role of Brazil in the energy renaissance of the Atlantic Basin (Isbell, 2015). The first section presents the current Brazilian energy situation, reviews the country's energy markets, regulation and policies, and highlights the main challenges that policymakers must deal with in order to move forward the development of the Brazilian energy system. The second section analyses the transformation of the global energy market that is expected in the coming years, highlighting the role of the hydrocarbons supply of the Atlantic Basin, especially the pre-salt Brazilian oil resources, in contributing to a secure and sustainable global supply of energy. The opportunities created by the transformation of the global energy market for deeper cooperation in the energy sector among the countries of the Atlantic Basin are identified in this section. A few focal points for this cooperation are suggested in the conclusion.

2. The Brazilian Energy System: Current Situation and Policies

Brazilian energy consumption is concentrated in the industrial, residential, and transportation sectors (Figure 1) and is currently being driven by the demand for mobility and electrical appliances (especially air conditioning) from the emerging middle class.

Figure 1 – Primary Energy Consumption by Sector



Source: International Energy Agency (IEA). Note: Million TOE = million tons of oil equivalent (one million barrels a day, or mbd, equals 49.8 million tons of oil, or its equivalent, annually).

To supply the country's energy consumption, the energy sector historically had been organized around state-owned companies. However, a new institutional arrangement was established at the end of last century that aimed at attracting private investors into the energy sector. The monopolistic 'command and control' privilege of the state-owned company was removed to give room to competition among energy companies so as to supply consumersmore efficiently and securely. Nevertheless, the governance of the energy system still remains largely under the control of government (de Oliveira, 2007; de Oliveira, 2012).

2.1. The Power Market

In the power sector, the system operator (Operador Nacional do Sistema Elétrico - ONS) is in charge of the dispatch of power plants but its governing board is selected by the government. On the demand side, only a few large consumers (those using over 3 MW) are free to negotiate their supply with power generators. Most consumers are captives of their local distribution companies and must take their power supply from generators selected by a central government bidding process. An electricity regulator was also created but it must to comply with government directives. Also, a state-owned company (Empresa de Pesquisa Energética - EPE) is responsible for conducting the process of licensing new power plants and transmission lines. Finally, a clearing house (Câmara de Compensação de Energia Elétrica - CCEE) reconciles the actual consumption with the contracted flows of power using spot prices that are calculated by a set of computer models using expected variables estimated by the government.

Organized around hydroelectric power plants[2] and an extensive, interconnected network of transmission lines (Figure 2), the Brazilian power system can move electricity among the four (4) regional markets which comprise Brazil's vast territory.[3] During the dry season, the system operator can use the accumulated water in the hydro-reservoirs, or it can also rely on the dispatch of thermal power plants (which burn coal, gas, fuel oil, etc.), to guarantee the supply of power to consumers.

[2] Hydropower plants represent 80% of the installed capacity (ONS, XXXX). Most of them are controlled by Eletrobras, a state-owned company.

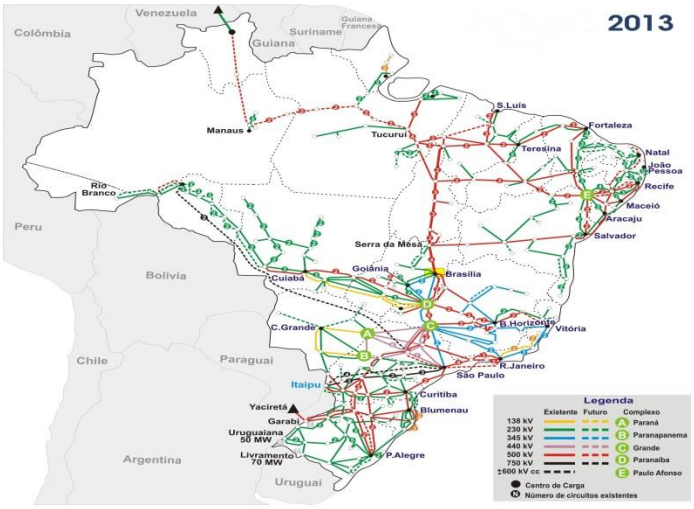
[3] A few small communities in Amazonia are supplied by isolated power plants.

Thermal dispatch increases the operational cost of the system which produces dramatic increases in the spot price, at least eventually.[4] To avoid such prices increase, the system operator can postpone the thermal dispatch, accelerating the depletion of the water accumulated in the hydro-reservoirs. Unfortunately, this second choice has serious and complex economic consequences for the market players. Indeed, whenever the water accumulated in the reservoirs is 'overused,' the power companies demand financial compensation for economic losses produced by the water overuse (Folha de São Paulo, 2015). Moreover, this overuse generates bitter disputes over the water supply among different users (Porto, 2014).

To remediate these problems, several new regulations have been established in the last few years, regrettably, with no success. In fact, their results have very much been the opposite. With the establishment of each new regulation, power companies have been successful in obtaining court injunctions to guarantee that the new regulations do not compromise their financial cash flows. Unable to observe the many, sometimes contradictory, court injunctions, the CCEE ends up postponing the financial clearing of the power flows among market players (Costa, 2015). This situation is pushing the power sector toward the brink of a very serious financial crisis (Freire, 2015).

Figure 2– Brazilian Network of Power Transmission Lines

[4] The spot price is calculated by a set of computer models that have the expected water accumulation in the hydro-reservoirs as its critical variable.



Source: ONS

There is a general feeling among power sector players that the government remains in a position of command over the power market. Indeed, the liberalization of the power market envisaged at the end of last century was interrupted to put the power system under the control of government (de Oliveira, 2015). A fundamental review of the existing industrial organization of the power market is urgently needed to adjust and adapt this framework to the new technological and environmental trends affecting the power system.[5] The central aspect that needs to be reviewed is the pricing regime for the water flow to the hydro-reservoirs. The use of computer models to fix energy spot prices should be abandoned. The price offers of generators for their power supply, along with consumer demand offers, should govern the spot pricing regime.[6]

[55] Including the emerging possibilities and imperatives of the smart grid, wind and solar power, and regional electricity integration.

[6] A bill (1917/2015) is currently debated at the House of representatives that intends to reorganize industrial organization of the power system.

2.2. The Hydrocarbons Market

Oil represents 39.3% and natural gas another 12.8% of the total primary energy offered to Brazilian consumers.[7] A small share of biofuels (ethanol and biodiesel) supplements the hydrocarbons supply of liquid fuels to the economy. Both biofuels markets are largely commanded by private producers but they are highly dependent on government subsides.[8] The supply of hydrocarbons is organized around Petrobras, a state-owned company that exerts a *de facto* monopoly over the hydrocarbons market. An oil regulator (Agência Nacional do Petróleo - ANP) was created to oversee the fuels markets and their operations, and to license oil exploration blocks in the Brazilian sedimentary basins. However, the government (through its Conselho Nacional de Política Energética – CNPE) decides which blocks ANP should offer to oil companies.[9]

Petrobras accounts for more than 90% of the domestic production of hydrocarbons in Brazil, and it is the sole importer of these fuels as well (MME, 2015). Moreover, Petrobras operates all of the oil refineries and the company controls all of the logistics needed to supply hydrocarbons to consumers. Although the Petrobras pricing policy is not regulated, Petrobras ex-refinery prices remain under strict supervision of the Ministry of Finance.

To develop the domestic supply of hydrocarbons, ANP can use three sort of licensing agreements with oil companies. The *concession regime*, introduced after the decision to liberalize the Brazilian energy market in the 1990s, is the regular, standard regime. The *production sharing regime* was introduced for the licensing of pre-salt offshore blocks at the Campos, Santos and Espírito Santo sedimentary basins, after the government was informed of the existence of several gigantic oil reservoirs in these basins.[10] The *discretionary concession regime* is exceptionally used

[7] Coal is not relevant as a competitor to hydrocarbons. Coal is used in the power sector and the steel industry only.
[8] The Brazilian regulations demand that biodiesel (7%) must be added to the diesel produced at the refineries and that anhydrous ethanol (26.5%) must be added to the gasoline as well. Nevertheless, there is a large fleet of cars that can either use the blended gasoline or hydrous ethanol.
[9] ANP is in charge of the local (or domestic) content policy as well.
[10] It is important to note that several blocks had been licensed in these basins under the concession regime when the production share regime was introduced. The concession regime still holds for these blocks.

to grant the concession to Petrobras of specific blocks, considered strategic by government.[11] So far, only one block has been licensed under a production sharing agreement to a consortium of oil companies that has Petrobras as the block operator, and another block has been licensed under the discretionary regime to Petrobras as well.

In the concession regime, oil companies have to bid in an auction process conducted by ANP. The signature bonus and the local content share for their acquisitions of equipment and services offered by the companies are the criteria used to decide the winner.[12] When a reservoir is identified, the oil company must present its reservoir development program to ANP for approval. When the actual hydrocarbons production starts, the oil company has to pay royalties and a participation fee (only if the reservoir proves very profitable) to government. However, they are free to commercialize their hydrocarbons output.

In contrast, at the production sharing auctions oil companies have to bid a share of the hydrocarbons eventually produced to the government. Although the oil companies were not initially supposed to pay a signature bonus, this upfront cost was introduced in the bidding process for the Libra reservoir.[13] The oil companies do have to pay royalties for the oil produced but there is no participation fee on their profits. The production sharing regime supposes that any eventual large profitability will be reduced by the share of the oil received by the government.

There are three major distinctions between these two regimes. First, in contrast to the concession regime, oil companies are not proprietary owners of their hydrocarbons output in the production sharing regime. The oil companies are paid back for their investment and operational costs (including royalties and bonus) but the hydrocarbons eventually produced goes to the Brazilian government which decides the particulars of its commercialization (to whom and its prices). Second, the production sharing regime requires that Petrobras maintain at least 30%

[11] Typically they are expected to hold an extremely large volume of hydrocarbons.
[12] Oil companies have to use certificates from ANP accredited institutes to prove that their activities comply with the share of domestic supply offered in the bidding process.
[13] This rather surprising new arrangement was introduced to provide fresh financial flow to the Treasury.

participation in the consortium winning bid and retain responsibility for the operation activities at the block as well. This means that the role of other companies in any production sharing consortia will be essentially financial. Third, a new fully state-owned company (Empresa Brasileira de Administração de Petróleo e Gás Natural – PPSA) will have the final say in any decision made concerning the development of the oil reservoir. This rule is intended to guarantee control for the government of the local content policy in the pre-salt.

The local content policy is a critical feature in the current upstream Brazilian hydrocarbons regulation. This policy aims to take advantage of the large economies of scale generated by the expansion of Brazilian oil operations to foster the development of a world class set of domestic companies that would be able to supply equipment and services to the oil industry worldwide (de Oliveira, 2010). The exploration of the very large Brazilian offshore hydrocarbons resources is considered a large laboratory of technological innovation. This situation has induced the relevant suppliers of equipment and services to the oil industry to establish a branch of their research activities in Brazil (de Oliveira and Hermes de Araujo, 2015).

Meanwhile, the local content policy continues to be criticized by the oil companies. Their main reproach is the inability of the domestic suppliers to comply with their obligation of delivering their supply competitively (on time, meeting quality standards and at prices similar to imports). The oil companies point to the domestic suppliers´ failure to observe these conditions as a major barrier to the further development of the Brazilian oil industry. From their point of view, the local content policy needs to be reviewed in order to attract foreign investors to the Brazilian oil industry.[14]

Although Brazil is now a net exporter of crude oil, the country remains an importer of oil derivatives[15] and, in particular, of natural gas. Petrobras had an ambitious expansion program that

[14] A bill is currently debated in the Senate that would give the choice to Petrobras of being or not the block operator to Petrobras. The Minister of Mines and Energy stated that a working group is elaborating a strategy to give flexibility to this regulation (Lima, 2015)
[15] Gasoline, diesel, LPG and nafta.

is expects will eliminate this import dependence by the end of this decade. This program was drastically reviewed, however, after the identification of serious corruption problems in the top management of the company, and ongoing controversy that has coincided with the collapse of the oil price. The last 10-year energy plan released by EPE indicates that Brazil will become a large importer of oil derivatives during the coming years (EPE, 2015).

Roughly 35% of the natural gas available for consumers is imported (BEN, 2014). A long pipeline is used for imports from Bolivia (up to 33 million m^3 a day) and three LNG terminals are strategically located to supply natural gas to the country's thermal power plants (Figure 3).[16] Natural gas imports, especially LNG, are crucial for guaranteeing the reliability of the power supply, given that they are used in thermal power plants to fill the gap in hydropower capacity to supply electricity during the dry seasons.

In order to redress its deteriorated financial situation, Petrobras is being forced to reduce its five year (2015 to 2019) investment program by 37% (Tecnoil online, 2015). Moreover, Petrobras decided to sell off several assets to both domestic and international investors. Nevertheless, Petrobras is planning to increase its domestic oil and gas production steadily in the coming years.

[16] There is a connection to the Argentinian market that is used to supply a thermal power plant placed on the Brazil-Argentina border on rare occasions to avoid power shortages in the South of Brazil.

Figure 3

Source: EPE, 2015

3. Energy Security and Sustainability in the Atlantic Basin

The 21st century has ushered in fundamental changes in the global energy market. On the demand side, the NOECD countries are replacing the OECD countries as the main drivers of the global energy consumption (Finley, 2012).[17] On the supply side, the transition from fossil fuels to renewable energy sources must be accelerated in order to avoid the risks pointed out by International Panel on Climate Change (IPCC). Nevertheless, the transportation sector will largely remain dependent of the supply of oil products and the power sector will increase its dependence on the supply of natural gas in the foreseeable future. Although the oil share in the global energy matrix will be reduced, the supply of hydrocarbons will likely remain strategic in the foreseeable future (BP, 2015).

In the 1970s, the Middle East became the critical supplier for the balancing of global oil demand. New sources of oil and natural gas were developed in the following years but the strategic position of the Middle East was not substantially altered. Uncertainties concerning the reliable supply of oil eventually became a source of energy prices volatility (Lipsky, 2009; Ait Laoussine and Gault, 2012). And this volatility is a major hurdle to the urgently needed transition from fossil fuels to renewable energy sources.[18]

The fracking revolution and the discovery of gigantic offshore oil reservoirs in the Atlantic Basin are promising to radically change this situation, reducing Atlantic energy dependence on politically troubled parts of the world. Cooperation among the South and the North Atlantic can rapidly turn this promise into reality. Brazil is a central piece in this geopolitical process.

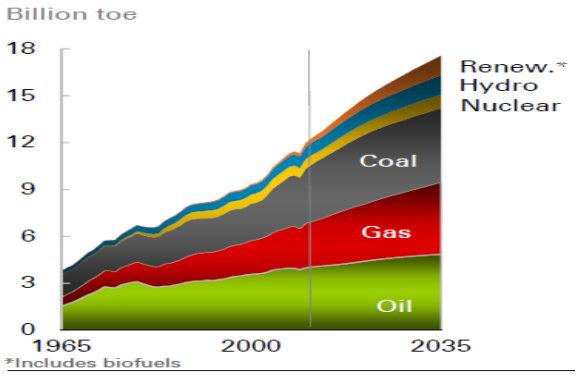
[17] The BP outlook expects that roughly 5 billion toe will be added to world energy consumption by 2035.

[18] Consumers can hardly decide to move forward the substitution of their fossil fuels consumption to renewable energy or increase the efficiency of their energy use while the oil price that governs their energy choices remains unclear.

3.1. The Atlantic Energy Scene

Although the consumption of renewable energy is likely experience fast growth, fossil fuels will still dominate the world energy matrix by 2035 (BP, 2015). The share of natural gas (used mainly to generate electricity) is projected to increase substantially among both OECD and non-OECD countries. Oil is expected to continue the trajectory, initiated in the 1970s, of lowering its share of the global supply of energy. However, world oil consumption is projected to increase 0.7% a year, despite the many policies aiming to reduce energy consumption (Figure 4). The increasing consumption of coal to generate power among developing countries is likely to offset the reduced coal consumption in the OECD countries.

Figure 4 – Consumption by fuel



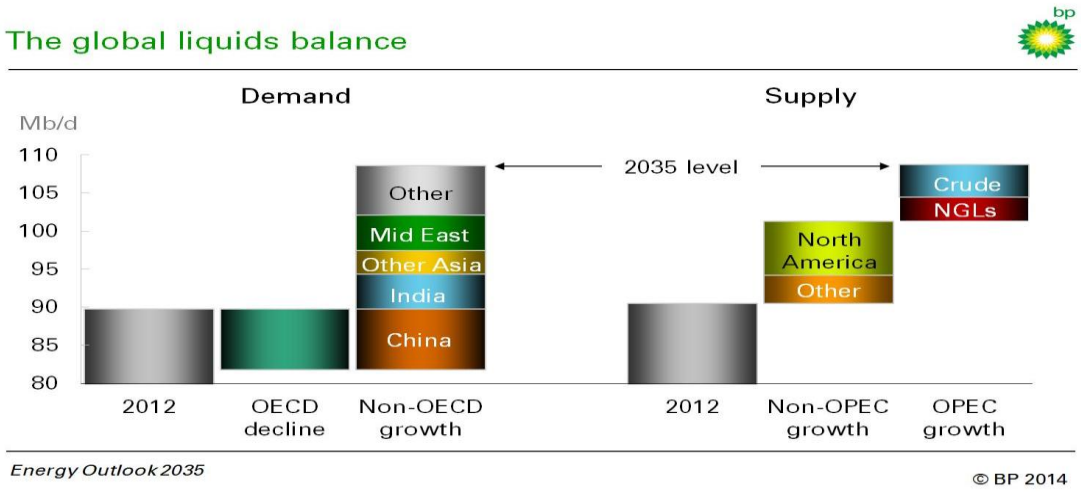
Source: BP, 2014

The OECD countries will reduce their oil consumption by 2030 but the non-OECD countries, especially the emerging economies, are expected to increase their oil consumption steadily. China alone is expected to add 8 million barrels a day (mbd) to world oil demand, offsetting the reduction in oil consumption among the OECD countries (BP, 2014). The main reason for these contrasting trends is found in the demand for mobility. The global vehicle fleet is expected to grow 60% in the next 20 years; more than three quarters of this growth will occur in the non-OECD countries (BP, 2014).

To supply global oil demand, world oil production is expected to increase 17% (roughly

14 mbd) between 2012 and 2035. Two thirds of this increase is projected to occur in the Atlantic Basin as result of both the *fracking* revolution in North America[19] (Wright, 2012) and the development of the pre-salt oil resources in the South Atlantic (Figure 5). Around 34% of the global oil trade will continue to originate in the Middle East (BP, 2014) but this region's currently dominant position in the security of the supply of hydrocarbons to the world economy will be radically changed over the coming decades (Isbell, 2015).

Figure 5



Source: BP, 2014

There are substantial regional differences as far as the security and sustainability of energy supply in the Atlantic basin. In the North Atlantic, North America is in a relatively comfortable situation. The region, currently an importing region, should become a net exporter of hydrocarbons in the coming years (Helman, 2012). The large availability of cheap gas supply is producing the rapid substitution of coal for natural gas in the power sector, reducing CO_2 emissions. The use of renewable energy sources instead of fossil fuels, including in the transportation sector, is also on the rise. The recent initiative that the every state of the American Union must adopt measures to

[19] Outside North America, the production of unconventional hydrocarbons is in its infancy but it is likely to gain momentum in Asia (especially in China) and in South America in the next decade.

reduce their emissions should accelerate this process (USA, 2013). This scenario is inducing the US to abandon its previous reluctance to play an active role in the global effort to mitigate the risks of extreme climatic events in the next IPCC conference in Paris (Victor, 2013).

Europe, on the other hand, is in a radically different situation. North Sea hydrocarbons production is declining and most of Europe's imports are currently sourced from and through politically troubled regions (Middle East and the former URSS). Although the European countries share the view that they should implement a joint effort to reduce their CO_2 emissions, they have been unable to achieve a common strategy so far. France has chosen to continue to follow its nuclear power strategy while Germany is phasing out its nuclear power plants to concentrate its strategy on renewable energy sources. Energy imports from the Atlantic, North and South, offer many opportunities to improve both European energy security and sustainability.

South America has been a net provider of energy to the Atlantic Basin, a situation largely credited to the oil exports of Venezuela, an Atlantic country that holds a large share of the world oil reserves. This scenario could radically change in the coming years as result of the identification of several large oil reservoirs in the pre-salt layer of the Brazilian deep offshore and the availability of large amounts of unconventional resources in Argentina. As the development of these hydrocarbons resources unfolds, the region will be transformed into a substantial, politically-secure exporter of hydrocarbons from the South Atlantic. From the climate change point of view, the region is an intensive user of hydropower plants to supply its electricity demand and biofuels are used intensively consumed as well.

Africa is a net exporter of hydrocarbons and the development of its West Coast offshore resources should increase substantially its supply to the Atlantic Basin and beyond in the coming years.

3.2. Brazil: a Strategic Partner in the South Atlantic

Until the 1970s, Brazil was perceived as poor hydrocarbons resources country. Oil

exploration efforts were confined to onshore sedimentary basins, where only small reservoirs were found. Brazil was a large importer of oil but the international oil companies (IOCs) had no access to Brazilian oil resources. The national oil company (Petrobras) was the only company allowed to develop domestic oil resources.

The oil industry movement to the offshore opened a new era for the Brazilian oil industry (de Oliveira, 2012). Significant offshore hydrocarbons reservoirs were identified by Petrobras but the access to the Brazilian oil resources remained restricted to Petrobras until the 1990s when the IOC´s were offered fair access to the Brazilian oil resources. Attracted to a reliable source of oil supply, several IOCs opted to operate in partnership with Petrobras to take advantage of the company´s extensive knowledge of the Brazilian sedimentary basins. Brazilian oil reserves jumped from 4.8 to 15.1 billion barrels, and oil production rose from 643 thousand bd to 2.2 mbd between 1991 and 2011.

In 2007, the identification of several gigantic oil reservoirs in the pre-salt area of the Campos and Santos basins opened a new scenario for the Brazilian oil industry. The oil reserves of these fields are estimated at 20 billion barrels and the geophysics data indicates that several other large reservoirs are likely to be found in the same area. It is expected that new reservoirs can add another 50 or 70 billion barrels to the Brazilian oil reserves.[20] This optimistic perception is based on the fact that 50% of the new world oil reserves in the last 5 years were found in the deep offshore and that 63% of these discoveries were made in Brazil at a cost of U$ 1.56 per barrel (Petrobras, 2012).[21]

Brazilian oil production is expected to reach 4 mbd in 2020 and 4.8 mbd in 2024. Gas production is project to rise to 124.1 million m^3/d in 2020, and 171.6 million m^3/d in 2020 (EPE, 2015). This substantial increase in Brazilian hydrocarbons production opens a large window of opportunities for cooperation among the Brazilian oil industry and the oil industries of the Atlantic

[20] The pre-salt area of these two basins has the same size of the sedimentary basin of the Mexican Gulf.
[21] The Campos and Santos basin are a fraction of the Brazilian sedimentary basins, most of it underexplored so far.

Basin.[22] Indeed, Brazil is short of the industrial, the technological and the financial capabilities to sustain the program needed to develop its vast hydrocarbons resources (de Oliveira, 2008).

Many suppliers of equipment and services for the oil industry are taking advantage of the scale of the Brazilian oil development to establish local activities. The technological learning acquired and the industrial capacity developed in Brazil will be used in their activities elsewhere, especially off the African West Coast where the continental platform is a mirror of the Brazilian one (Augé, 2015).

Brazil is in a privileged geopolitical position to take a leading, constructive role on both South Atlantic issues: the increased secure supply of hydrocarbons and the transition to renewable energy sources. The country´s energy system is largely organized around renewable energy sources and it can use its large hydropower reservoirs to support the spread of renewable energy sources in its neighboring countries (de Oliveira, 2006). Moreover, Brazil can offer a secure supply of hydrocarbons to the global energy market, reducing the oil price volatility. Deforestation, a major problem in the past, has been drastically reduced, and the increasing productivity of the domestic agribusiness has led Brazil to the position of a large supplier of food to the global market.

South America, nuclear weapons-free region, poses no relevant threat to international security agenda. The spread of populist, nationalist regimes in some countries generated some political concern but the Brazil is a troubleshooter country historically. Brazil can play a decisive role in the process of removing the existing restrictions for the IOCs access to the regional oil resources.

[22] Petrobras recently announced a substantial reduction in its investment program to deal with its currently difficult financial situation. The increase in the production indicated by EPE will most likely be postponed but it will come to the market place eventually.

4. CONCLUSION

The industrial revolution has been at the core of the socioeconomic development of the Atlantic Basin (Mumford, 1950). Fossil fuels replaced renewable energy enabling the development of economic activities where renewable energy sources were scarce. Since then, the GDP growth became connected to the consumption of fossil fuels (Darmstadter, 1971). In the 20 century, although coal remained an important source of primary energy for the power sector, the automobile industry put oil at the center stage of the world energy market (Blair, 1976). The oil supplied at low prices by international oil companies (IOCs) became a major driver of the world economy until the OPEC countries introduced barriers for accessing their oil resources (Nore and Turner, 1980).

At the end of last century, the perception that oil scarcity (Meadows et al, 1972) was a major constraint to economic growth induced many countries to search for oil in the offshore (Grenon, 1975). Eventually, the perception of oil scarcity vanished as many reservoirs were discovered outside the OPEC countries. A sort of unstable equilibrium in the oil market emerged (de Oliveira, forthcoming). The oil price has recently retreated to historical figures and its volatility has been reduced. Nevertheless, oil supply and its price remain at the center stage of the energy scene.

While the problem of oil scarcity has faded away, the climate change issue has gained momentum (Stern, 2007). The increase of carbon emissions provoked by the consumption of fossil fuels is pointed out by the scientific community as the major long term threat for mankind (IPCC, 2014). The replacement of fossil fuel by renewable energy sources is needed to avoid climate change but the transition to renewable energy sources is a complex process. The outlook for the oil supply (its security and its price) is a critical piece of this transition, especially in the transportation sector.

The oil revolution in the Atlantic opens a window of opportunity for the economic renaissance of the Atlantic Basin. A *strategic energy partnership agreement* among the Atlantic

countries will create the condition to explore it. However, that agreement must not be limited to myopic view of energy trade. The security of the energy supply must be fundamental piece of this agreement. It will mitigate the regional oil price volatility that obscures the opportunity costs of renewable energy sources, a situation that induces energy companies to postpone their projects.

The Brazilian offshore is a large laboratory of innovation where the technological and the industrial capacities to supply the deep offshore worldwide will be developed. These capacities will be of use in the West Africa offshore and the Mexican Gulf as well. Europe and North America have extensive innovation capabilities in renewable energy and modern urban mobility. The Atlantic Basin strategic energy agreement must be perceived as an energy bridge between the South and the North Atlantic Basins that: (i) secures their supply of energy; (ii) mitigates their oil price volatility and (iii) speeds up their transition to renewable energy sources as well. The agreement must go beyond the energy trade issue to encompass innovation, industrial capacity and technological capabilities that are essential for the sustainability of the Atlantic Basin socioeconomic development.

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