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Brazil's Pre-salt Oil Potential: The Hype & the Reality

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Brazil's Pre-salt Oil Potential: The Hype & the Reality

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Abstract

There is a great hype about Brazil's pre-salt oil potential and the impact it will eventually have on the global oil market. Some sources say that it could vault Brazil to seventh place in the world rankings in terms of proven oil reserves behind Saudi Arabia, Venezuela, Iran, Iraq, Kuwait and United Arab Emirates. Others claim that Brazil could emerge as a major oil producer and exporter and that will certainly change the balance of oil distribution in the world with very important geopolitical implications for the United States' dependence on Middle East oil. Others, in contrast, see Brazil as an overstated high-risk oil province whose pre-salt oil is extremely challenging and very costly to produce. The reality, as always, is somewhere in between. Even with Brazil's growing oil reserves and accelerating production, the country could never become a major oil exporter as all the incremental oil production will be needed to fuel the country's economic growth. Brazil could only aspire to remain self-sufficient if its current economic growth continues its surge into the future. While Brazil's oil wealth will certainly accelerate the country's ascent into the top ranks of the world's economic powers, it will hardly make a dent in the global oil market and the price of oil.

Key Words: Pre-salt, reserves, hype, Gulf, price, dent.

Introduction

Brazil is the ninth largest energy consumer in the world and the third largest in the Western Hemisphere, behind the United States and Canada. **1** Total primary energy consumption in Brazil has increased by more than a third in the last decade due to sustained economic growth. In addition, Brazil has made great strides in increasing its total energy production, particularly oil and ethanol. Increasing domestic oil production has been a long-term goal of the Brazilian government, and recent discoveries of large offshore, pre-salt oil deposits could transform Brazil into one of the largest oil producers in the world.

In 2011 Brazil emerged as the world's sixth largest economy and the sixth largest consumer of oil. Already the South American continent's powerhouse, Brazil alone accounts for over 40% of the continent's GDP influencing if not determining the direction of development across the continent. At a time when economies around the world are struggling, Brazil's economy is forecasted to continue its remarkable growth driven in part by its oil and gas sector which, if realized, would allow it to emerge as a major oil producer.

After years of trial and error – probing 7,000 meters below the ocean's surface, past the rock and sand seabed, and on through the thick crust of salt on the South American coastal shelf – Brazilian oil engineers found in 2007 staggering quantities of crude oil. Just the proven reserves in three different areas of the so-called pre-salt cache totalled some 9 billion barrels (bb) to 15 bn barrels of oil,

the largest find in the Western Hemisphere in more than three decades. But that may be just the beginning. After drilling scores of test wells, the experts now reckon that the pre-salt reserves sprawl over 149,000 square kilometres and could contain up to 80 bb of recoverable oil reserves. Not the heavy, low-grade crude stuff Brazil currently produces from the sandy layers in its existing offshore wells, but light, sweet crude. **2**

If all the pre-salt discovered reserves are proven and added to Brazil's current 14.2 bb reserves, they could vault Brazil to seventh place in the world rankings in terms of proven oil reserves behind Saudi Arabia, Venezuela, Iran, Iraq, Kuwait and United Arab Emirates. **3** This will certainly change the balance of oil distribution in the world with very important geopolitical implications for the United

States' dependence on Middle East oil.It could also accelerate Brazil's ascent into the top ranks of the world's economic powers.

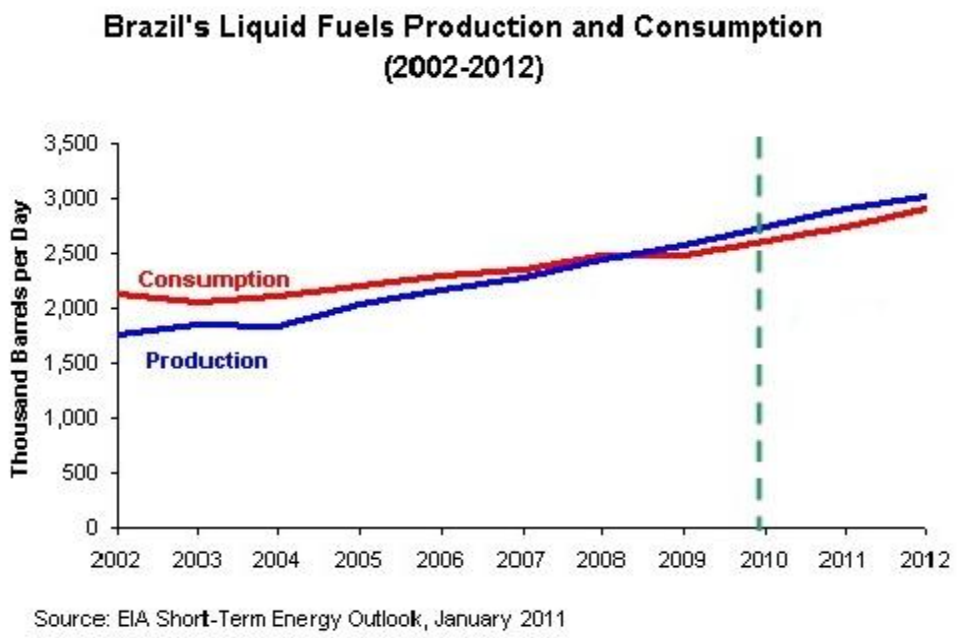
Brazil is already the world leader in renewable energy with 80% of its electricity generated by hydropower plants. Half the national fleet of passenger cars runs on clean-burning ethanol distilled from sugar cane, a world benchmark. **4**

Before "pre-salt" was even part of the working vocabulary, Brazilian geologists, experienced engineers and pioneering investment plans have already turned Brazil's national oil company, Petrobras, into one of the world's most profitable oil companies and the leader in deep-water exploration.

Petrobras's huge offshore oil discoveries in recent years now enable its leaders to contend that it could surpass ExxonMobil as the world's largest publicly-traded oil company. **5** According to the Fernand Braudel Institute of World Economics in Sao Paulo, Petrobras is currently engaged in the biggest industrial undertaking in Brazil's history. Petrobras's annual spending is estimated at more than $45 bn through 2020. By 2020, Brazil could emerge as the fifth-largest oil producer after Russia, Saudi Arabia, the United States and Iraq. **6**

In 2009, Brazil became self-sufficient in oil for the first time in its history when it produced 2.61 million barrels a day (mbd) including 429,000 barrels a day (b/d) of ethanol, and consumed 2.40 mbd (see Figure 1). Now with the discoveries more than doubling proven reserves in just three fields and due to start producing by 2013, experts expect Brazil to become a net exporter of oil, natural gas and refined products. However, if the Brazilian economy continues to grow as fast as is now projected, all the extra 2 mbd of oil expected to be coming from the pre-salt fields by about 2020 will be needed in Brazil.

Figure 1



Brazil's rise as an oil power is part of a broader expansion of the Western Hemisphere's energy output, especially in the United States and Canada. It also offers a vivid example of the reordering of Latin America's energy hierarchy in which long-time energy exporters like Venezuela, Ecuador and Bolivia are being eclipsed by Brazil.

Emerging exploration technologies like those of tapping rock formations by combining horizontal drilling with hydraulic fracturing explain Brazil's growing oil potential. Brazil's oil production could increase from just above 2 mbd to a projected 3.9 mbd by 2020. **7**

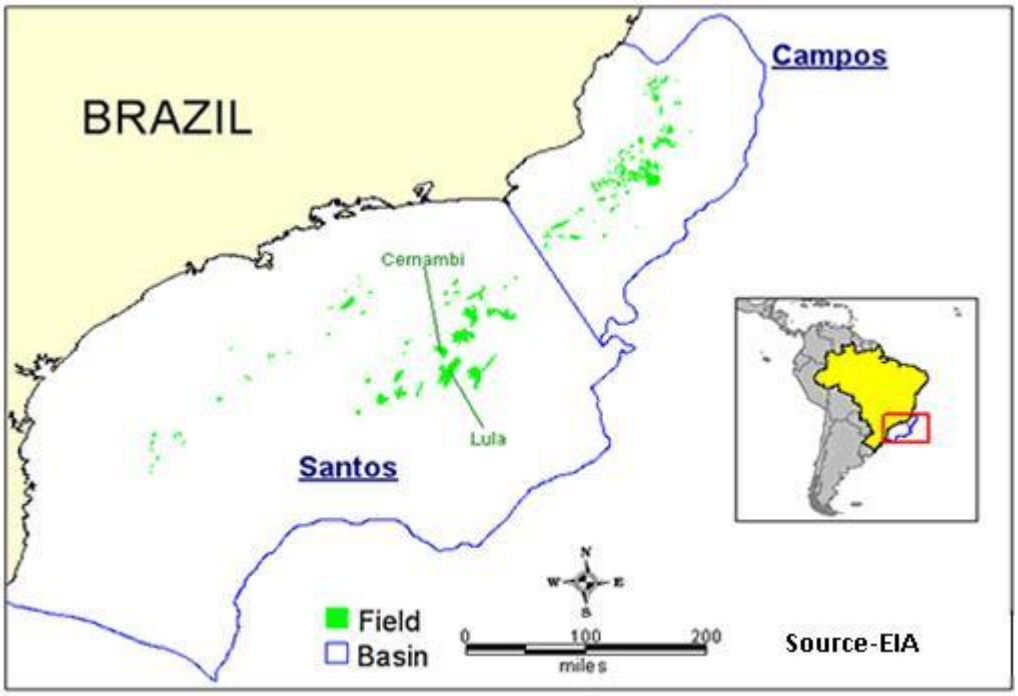
Of course, big challenges still await Brazil's energy industry. The devilish complexity of producing oil from its pre-salt discoveries has some investors questioning whether Petrobras is overextending itself. The oil lies deeper and farther away than any being commercially exploited today. Petrobras may have the know-how, but it needs the cash: some $224 bn over the next five years. **8**

Exploration, Discoveries & Reserves

It is difficult to exaggerate the impact the extremely large reserves of oil and gas will have on the Brazilian economy. In the past few years, oil's share of Brazil's GDP has risen from about 3% to close to 10%. It is expected to rise to 20% during the next few years. **9**

So far eight fields have been found beneath the layer of salt in the Santos basin cluster, as well as some smaller fields to the north of the Campos basin (see Figure 2).

Figure 2
Map of the Campos and Santos Basin



Source: US Energy Information Administration (EIA)

The Campos Basin oilfields are already producing or set to come on-stream soon. The Santos Basin has even larger reserves. The major oilfields located at Tupi, Iara and Guara should reach full scale production after 2020.Some estimate that the oilfields, located off Brazil's southeast Atlantic coast, contain an estimated 80 bb of high-quality recoverable oil.

Production from the newly discovered reserves is eventually expected to offset production decline in Venezuela and Mexico. And while Mexico's exports to the United States are declining, imports from Brazil could play a vital role in shaping the demand and supply balance in the region.

To ensure the security of its oil, Brazil is strengthening the country's defence and naval capabilities. Brazil's navy is expanding as it moves to protect the nation's deep water oil and gas reserves. The country has already commenced its nuclear submarine program with technology transfer from France and it is expected that by 2016 Brazil will boast the continent's largest Navy. The addition of a nuclear submarine would make it an undisputed power in the region. **10**

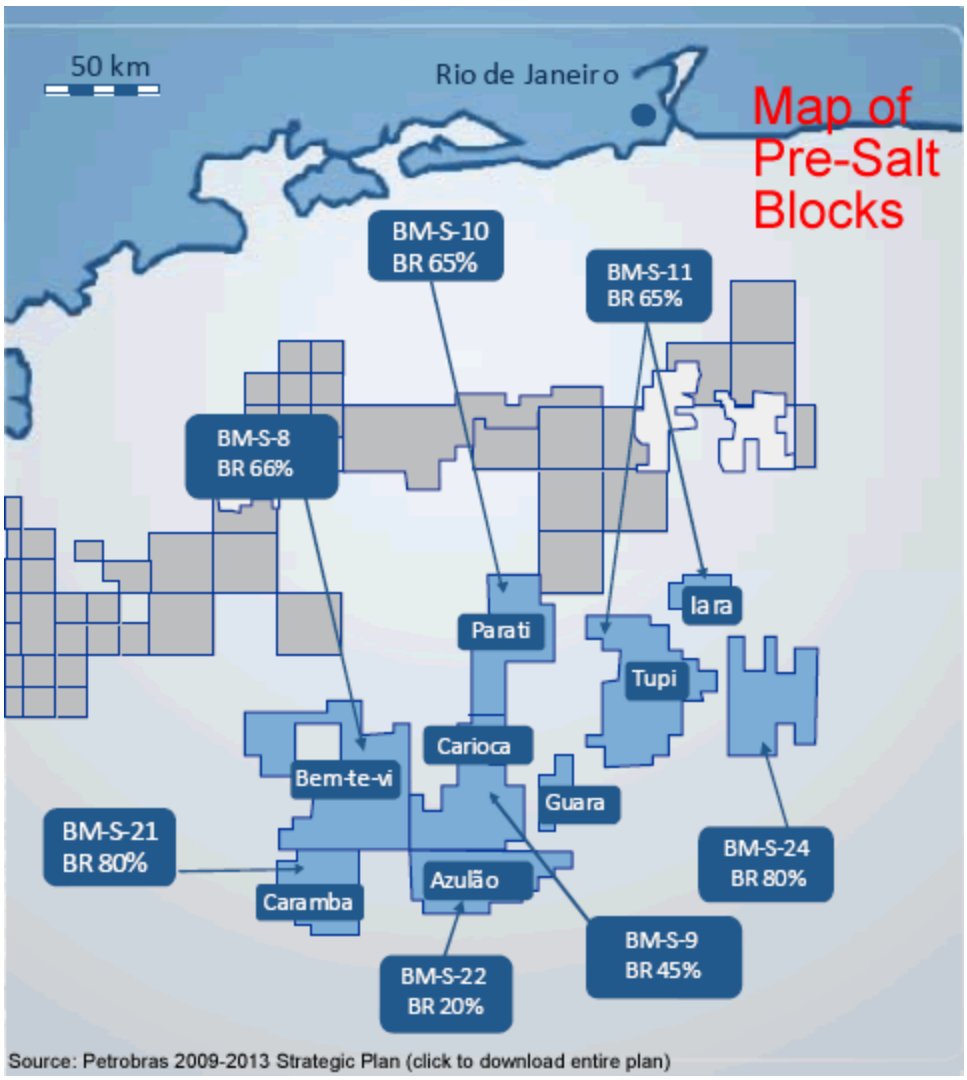
As new oil is discovered the Brazilian government is looking for investment capital from foreign oil majors. All the global energy giants Shell, Chevron, Exxon-Mobil, Repsol and Indian and Chinese nationalized oil companies already have major stakes in the country's oil and gas markets and are expected to

continue and consolidate their investments and in turn their interests in the future. Chinese government-backed oil companies have a major advantage at present. The Chinese government offers loans for E&P (Exploration & Production) activities and in return is guaranteed shipments of oil on continual basis. Such loans give China an edge over competitors and have proved to be a decisive winning factor in many major oil contracts. A case in point is the $10 bn loan given by China to Petrobras in return for 200,000 b/d of oil for the next decade. The three Chinese oil majors CNPC (China National Petroleum Corporation), Sinopec and CNOOC (China national Offshore Oil Corporation) are going all out to secure supplies.

If all goes according to plan, an extra 2 mbd of oil with an API of 27-31 will be produced from just three fields in the Santos cluster by 2017. Large volumes of gas will also be produced. **11**

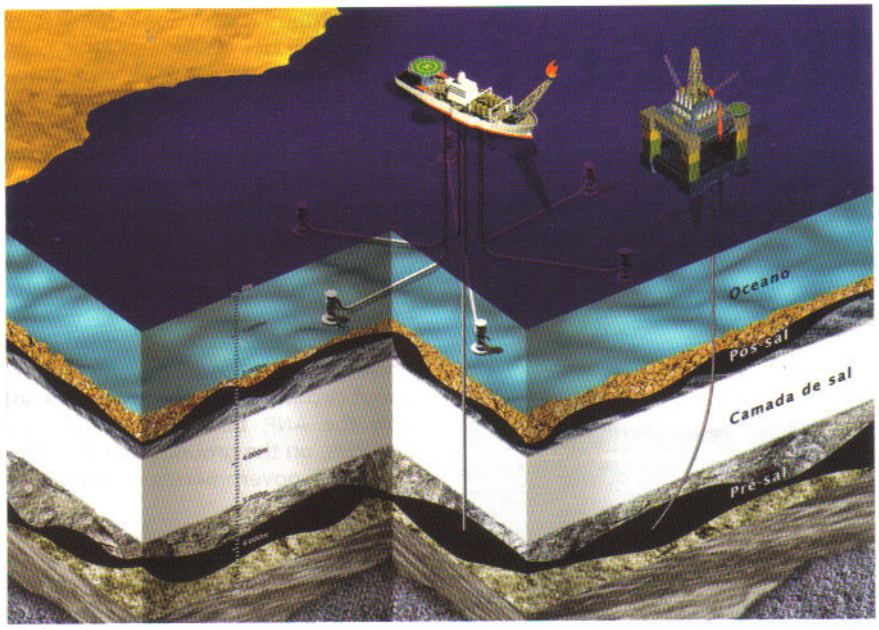
So far Petrobras has only published very conservative initial estimates for two of the fields located in the Santos cluster – between 5 bb and 8 bb for Tupi; and between 3 bb and 4 bb for Lara. However, many analysts suggest that the eight fields (Tupi, Lara, Guara, Parati, Bem-Te-Vi, Caramba, Carioca and Jupiter) could contain at least 50 bb between them (see Figure 3).

Figure 3
Map of Pre-Salt Blocks



Since the first well was drilled in Tupi, 13 more wells have been drilled through the salt layer and commercial quantities have been found in all these wells (see Figure 4).

Figure 4



Pre-salt exploration offshore Brazil Source: Agência Petrobas de Notícias

However, considerable challenges must still be overcome in order to bring these reserves to fruition. The difficulty of accessing the reserves, considering both the large depths and pressures involved with subsalt oil production, means that there are many technical hurdles that must be overcome. Production from additional pilot projects is possible in the next several years, but large-scale development of the subsalt reserves will likely not occur until well into the next decade.

Brazil's Pre-Salt Technical Challenges

Due to the formation of the rock and the way the pores are formed, neither vertical, nor horizontal drilling is appropriate, and directional wells seem best. Corrosion will be a serious problem, as the oil contains an average of 12% Carbon dioxide (CO_2). When this comes into contact with water, as it inevitably will during the lifetime of wells, it becomes an extremely corrosive acid. **12**

As the crude oil contains such a high proportion of CO_2, the CO_2 has to be separated out on the platforms and pumped back into wells, together with water and gas.

As well as corrosion, ensuring that water crystals contained in the hot crude oil don't freeze and interrupt the flow of oil when it encounters very cold conditions on the sea bed up to 2,500 meters below the surface, various insulation materials are being tested to prevent problems there should this occur. The fact that the pre-salt crude contains an above average proportion of paraffin may also prove a problem. **13**

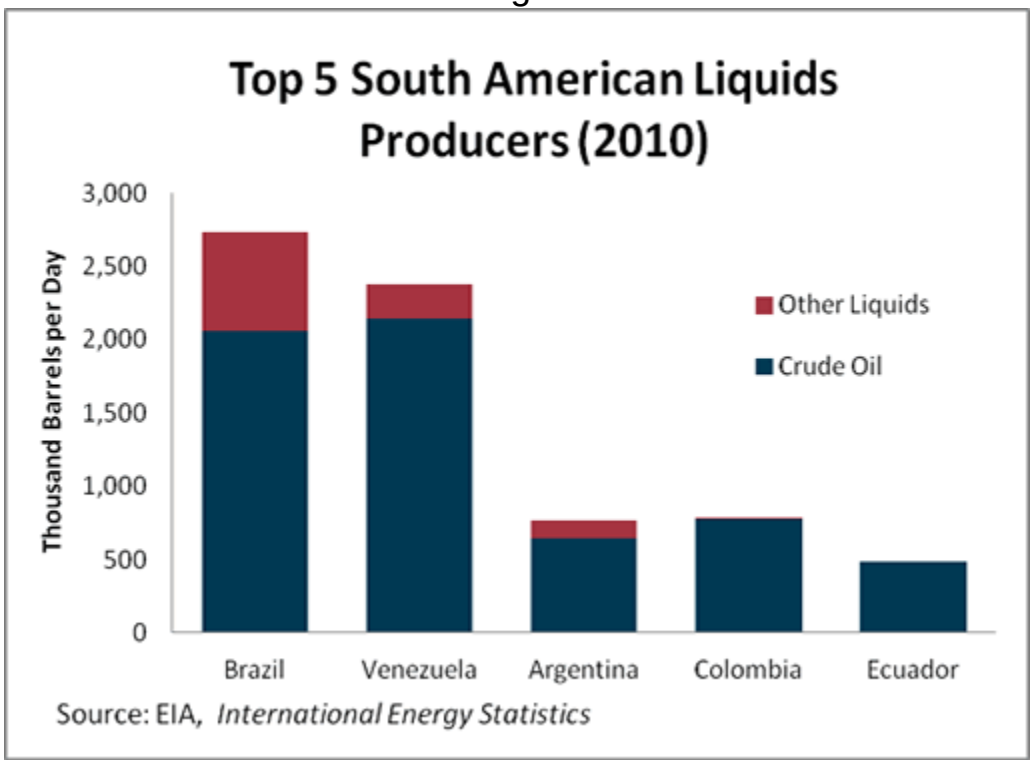
While crude oil will be collected and taken ashore or to other destinations by shuttle tankers, too much gas will be produced for it to be vented at platforms. Work will soon begin on laying a gas pipeline to carry some 10 million cubic metres per day (cm/d) from the first production platform at Tupi to the large production and processing facilities now being installed 220 km away.

Another challenge is the cost of producing pre-salt oil. The future of the pre-salt oil production will depend crucially on oil prices and on the investment policies of the major oil producers of the Gulf region itself. Given the complexity of producing oil from the pre-salt reserves and the huge depth at which the oil lies, nominal fixed and variable costs per barrel could range from $20-$30/b in comparison with $12-$15/b in the Caspian Sea and $2.0-$2.5 in the Gulf. **14**

Production & Consumption

In 2010, Brazil was the largest oil producer in South America (see Figure 5).

Figure 5



Before that in 2009 Brazil became self-sufficient in oil for the first time in its history (see Table 1). Brazil's oil production (including ethanol) has risen steadily in recent years from 2.61 mbd in 2009 to an estimated 2.82 mbd in 2012 and is projected to reach 3.00 mbd by 2013 rising to 3.90 mbd by 2020. This could make Brazil one of the largest sources of new, non-OPEC oil supply growth.

Table 1
Brazil: Current & Projected Oil Production, 2009-2020
(mbd)

	2009	2010	2011	2012	2013	2017	2020
Production	2.61	2.81	2.72	2.82	3.00	3.80	3.90
Of which:							
Crude oil	2.18	2.36	2.36	2.42	2.60	3.35	3.45
Ethanol	0.43	0.45	0.36	0.40	0.40	0.45	0.45
Consumption	2.40	2.60	2.72	2.85	2.96	3.46	3.90
Imports / exports	+ 0.21	+0.21	-	- 0.03	+ 0.04	+ 0.34	-

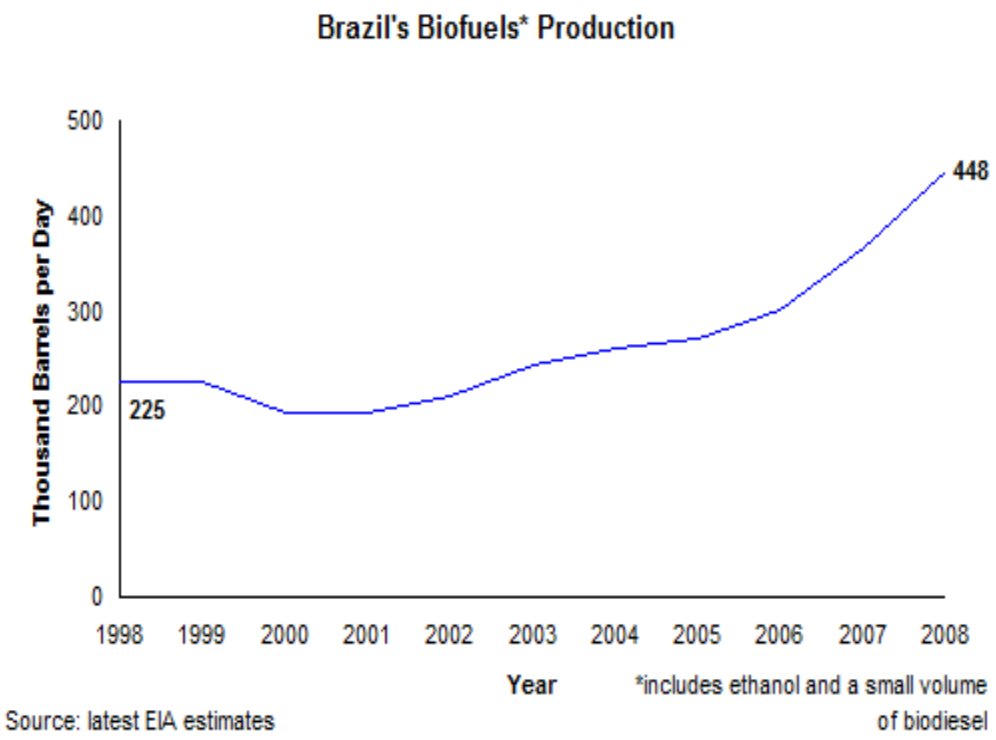
Source: US Energy Information Administration (EIA), January 2012 Short-term Energy Outlook / BP Statistical Review of World Energy, June 2011/ author's projections.

As a national policy, Brazil blends sugarcane-derived alcohol with gasoline rendering an ethanol fuel blend of between 20% -25% [ethanol] based on the country's sugarcane harvest. Though having less energy per unit volume than gasoline, the cost economics of ethanol, combined with its high octane rating and environmental advantages, make ethanol an important element in Brazil's energy matrix. Eighty percent of the cars today in Brazil can run on blended fuel making the country the world's second largest producer of ethanol while concurrently reducing its consumption of traditional fuels to a great extent.

Ethanol Production

Brazil is the second largest producer of ethanol in the world and largest exporter of the fuel. In 2008, Brazil produced 448,000 b/d of ethanol, up from 365,000 in 2007 (see Figure 6).

Figure 6



Ethanol production in Brazil has grown continuously from 260,000 b/d in 2004 to 452,000 b/d in 2010 but it declined to 364,000 b/d in 2011 because of poor sugar cane crop in that year. It is projected to reach 400,000 b/d in 2012 (see Table 2).

Table 2
Ethanol Production in Brazil, 2004-2012
(000' b/d)

2004	2005	2006	2007	2008	2009	2010	2011	2012
260	276	293	365	422	429	452	364	400

Sources: Industry Statistics: 2012 Ethanol Industry Outlook.

The importance of ethanol in Brazil's domestic transportation fuels market will only increase in the future. According to Petrobras, ethanol accounts for more than 50 percent of current light vehicle fuel demand, and the company expects this to increase to over 80 percent by 2020. Nearly 90 percent of all new cars sold in Brazil are flex-fuel vehicles, which will slowly remove gasoline-only cars from the fleet.

Impact on the Global Oil Market & the Oil Price

With estimated ultimate reserves of 50 bb-80bb, Brazil does not pose a major challenge to the supremacy of the Arab Gulf as a pivotal supplier of oil to world markets. Apart from the limited size of the reserves, Brazil's pre-salt oil is very

costly to produce. It is estimated that the cost of pre-salt oil production could range from $20-$30/barrel in comparison with $12-$15/b in the Caspian Sea and $2.0-$2.5/b in the Gulf.

Incremental production from the pre-salt reserves can at the margin contribute to a slight weakening of oil price levels. But it is unlikely to be a major threat to the market share and market power of the Gulf producers. Therefore, the pre-salt potential alone does not justify Gulf producers implementing production policies that would drive down the price of oil simply to discourage pre-salt oil development. It is estimated that without the extra oil production from Brazil, oil prices could be as much as $5-$6/b higher by 2020. But with Brazilian oil production, oil prices could be $2-$5/b lower by 2020.

Moreover, oil demand in Brazil has been growing at an average rate of 5% per annum during the period of 2005-2010. It is projected to continue growing at a similar rate well into 2020s while production is projected to grow at 4% per annum during the same period. This means that by 2017 Brazil will be able to save only 340,000 b/d for export (including ethanol exports) and by 2020 it will revert to being self-sufficient only.

Even with Brazil's growing oil reserves and accelerating production, the country will never become a major oil exporter and could only aspire to remain self-sufficient as its economy continues its surge into the future.

Deepwater Drilling & Global Oil Production

Deepwater drilling has grown from less than 50, mostly exploratory wells drilled each year at the beginning of the 1990s to nearly 600, mostly development wells being drilled each year today. **15** And numbers are rising. Such expanding drilling levels have been responsible for increasing oil and gas production (see Figure 7).

Figure 7

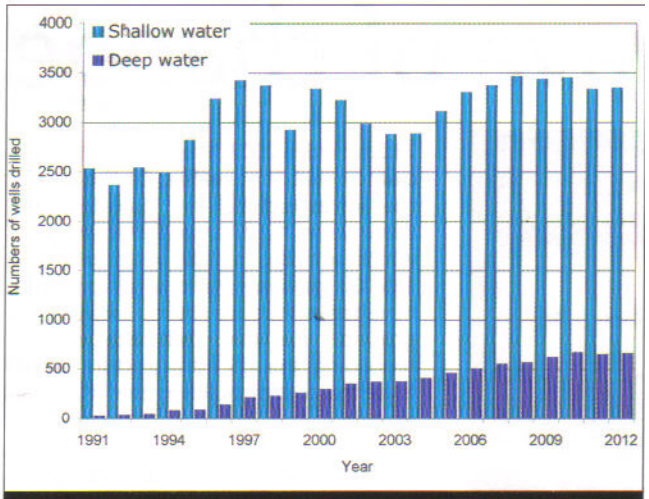


Figure 1: Offshore shallow versus deepwater drilling forecast to 2012 *Source: Energyfiles*

Offshore drilling now attracts over 50% of all capital expenditure that has grown from $34 bn in 2003 to a projected total of $80 bn by 2012. Along with more complex development wells, deepwater represents the real physical growth area within this part of the service sector.

However, it was in Brazil and the Gulf of Mexico where deepwater drilling really took off. **16** Wells off Brazil and Angola are now regularly drilled in water depths greater than 2,000 metres. Figure 8 shows how oil production in particular has expanded since 1990. The graph shows projected growth in oil production to 2015, when deepwater will perhaps be producing nearly 10 mbd, amounting to 10% of global output.

Figure 8

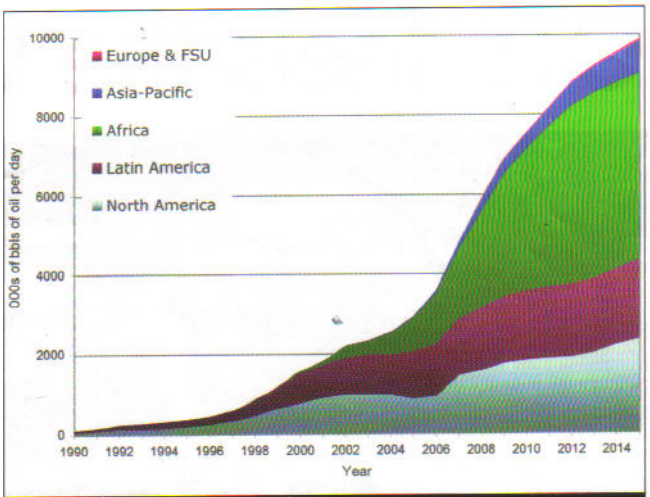


Figure 2: Deepwater oil production forecast to 2015
Source: The World Offshore Oil and Gas Production and Spend Forecast 2008–2012

And despite the Gulf of Mexico's disaster, the quest for oil and gas in the most difficult places on the planet is just getting underway. Prospecting proceeds apace in deepwater reserves off the coasts of Brazil, Ghana, and Nigeria and also in the depths of the Black Sea. Brazil's Petrobras, which already controls a quarter of global deepwater operations, is just starting to plumb its 9 bb to 15 bb of proven oil reserves below the Atlantic.

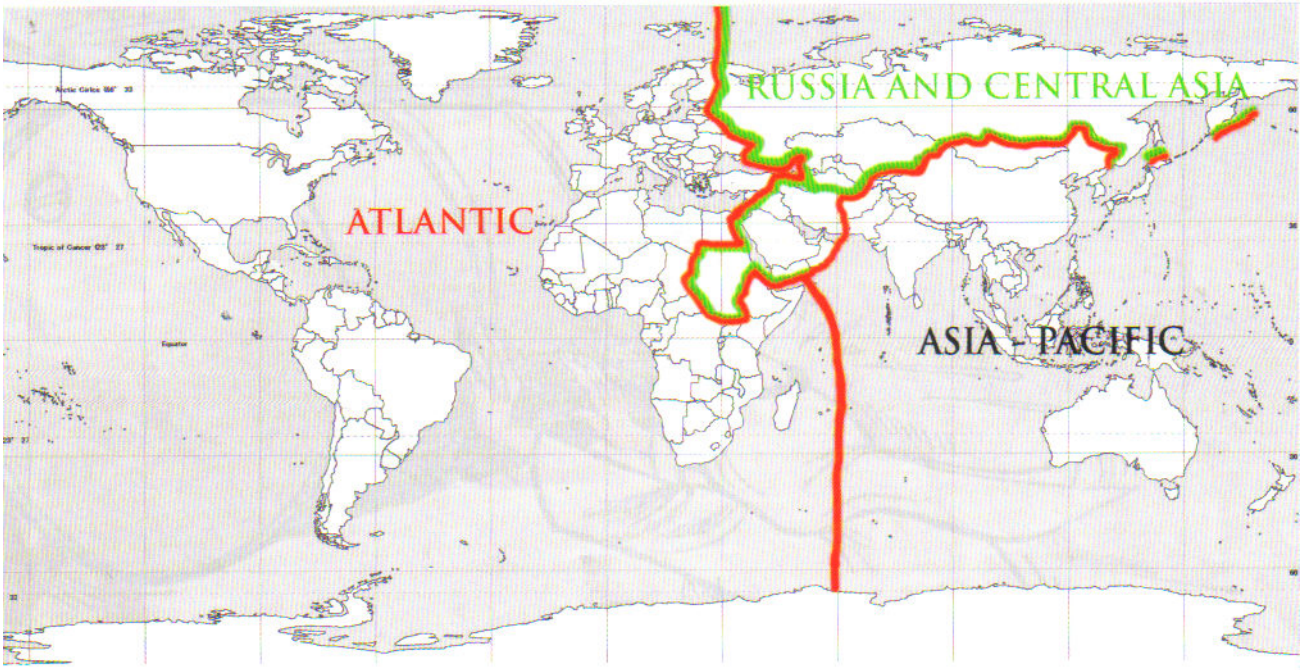
The reason for this is simple. Blistering growth in emerging nations has turned the power grid upside down. India and China are projected to account for 28% of global energy consumption by 2030, triple their consumption in 1990 and China has overtaken the United States in primary energy consumption in 2010. **17**

And now that the global recession is easing, the global reserves of conventional oil will be depleting even faster. The International Energy Agency (IEA) reckons the world will need to find 65 million additional barrels a day by 2030. Daily output from offshore oilfields around the world is estimated at 25 mbd and accounting for 31% of current global oil production. Moreover, 90% of non-OPEC oil production growth is projected to come from offshore drilling over the next decade in the four leading basins: the Gulf of Mexico, the North Sea, Brazil and Africa. **18**

Geopolitical Implications of Brazil's Expanding Oil Wealth

In the current transparent and increasingly globalized oil markets, oil commerce has come to be shaped by transport costs rather than political relationships. As a result of the huge oil discoveries off Brazil and Angola, new oil balances are developing which will shape the oil market and change its geopolitics. Thus a two-forked global oil market is emerging: oil supplies from the Middle East gravitating to the Asia-Pacific region, while supplies to the Atlantic region projected to come mainly from Brazil, Russia and Central Asia (see Map 1).

Map 1



Source: Courtesy of the Royal Institute of International Affairs, London.

Since1995, the Asia-Pacific oil deficit has exceeded that of the Atlantic region. By 2030 the Asia-Pacific region's oil deficit will be seven times that of the Atlantic region, where demand will grow more slowly, even without climate change targets. **19** And also by 2030 the Asia-Pacific deficit will be around 83% of consumption, compared to 10% in the Atlantic (Table 3).

Table 3
Projected Oil Deficit in the Asia-Pacific Region
& the Atlantic Region, 2030
(bb)

	Atlantic Region	**Asia-Pacific Region**
Projected oil production	43.38	7.10
Projected demand	48.18	41.30
Projected Imports (deficit)	4.80	34.20
% deficit to consumption	10%	83%

Source: BP Statistical Review of World Energy, June 2011 / Author's projections.

In 2011 the Atlantic region imported 54% of its needs from other countries in the region, 22.5% from Russia and Central Asia and 20% from the Middle East. This compares with 29.5%, 5% and 59.50% respectively for the Asia-Pacific region (see Table 3).

Table 3
Origins of Oil Imports in 2011: The Atlantic Region
Versus the Asia-Pacific Region

(bb)

Oil Imports 2011	**% of Imports Into**	
	Asia-Pacific Region	**Atlantic Region**
From other countries in the region	29.50	54.00
From other importing countries (cross trade)	6.00	3.50
From Russia & Central Asia	5.00	22.50
From the Middle East	59.50	20.00

Source: BP Statistical Review of World Energy, June 2011 / US Department of Energy data / Author's calculations.

There were striking contrasts between the oil dependence of the two regions in 2011. As Table 3 shows clearly, the Atlantic region is far more self-sufficient than the Asia-Pacific region. More than half of the Atlantic region's imports are from other countries in the region, which includes North and West Africa. On the other hand, the Asia-Pacific region's oil supply depends far more on the Middle East than the Atlantic region does.

In 2011, 70% of Middle East oil was actually exported to the Asia-Pacific, while only 30% came to the Atlantic. By around 2015, there will be an entirely new situation – a tipping point – because the oil deficit of the Asia-Pacific will outgrow the surplus of the Middle East. **20** By 2030 a quarter of the Asia-Pacific deficit will be met from outside the Middle East – essentially from West Africa – with some supplies from Russia and Central Asia.

However, the Atlantic oil deficit will no longer depend on Middle East surpluses but on the surpluses of Brazil, Russia and Central Asia. This shift will have strategic geopolitical and commercial consequences that could be reflected in the lessening of potential tensions between the biggest oil importers in the world: the United States and China.

At the start of the 21st century it looked as if growing dependence on Middle East oil by both the United States and the Asia-Pacific region coupled with tight global oil supplies, could increase tension between the US and China and could at some point in the future lead to conflict.

However, as the Atlantic region's (primarily the United States') dependence on the Middle East declines, the fear of a major physical disruption of supplies also declines and with it the possibility, though remote, of the oil weapon ever being used against western countries implicated in the politics of the Middle East.

Those involved in Middle East politics need to review their options. The Middle East's Asian customers need not worry: their governments have no history of involvement in the complex origins of Middle East conflicts, and no immediate role in their resolutions.

Though Middle East oil will always be pivotal to the global oil trade, it will have to share the limelight with Brazil, Russia, and Central Asia. Therefore, Atlantic importers need to focus on the interests of Brazil, Russia and Central Asia, where global oil markets and oil security will balance in future.

Conclusions

There is a great hype about Brazil's oil potential and the impact it will have on the global oil market in the aftermath of its huge pre-salt oil discoveries.

Apart from the limited size of the reserves, Brazil's pre-salt oil is very costly to produce with cost of production projected to be twice that of the Caspian and 10-15 times that of the Gulf.

Incremental production from the pre-salt reserves can at the margin contribute to a slight weakening of oil price levels. But it is unlikely to be a major threat to the market share and market power of the Gulf producers. Therefore, the pre-salt potential alone does not justify Gulf producers implementing production policies that would drive down the price of oil simply to discourage pre-salt oil development. It is estimated that without the extra oil production from Brazil, oil prices could be as much as $5.0-$6.0/b higher by 2020. But with Brazilian oil production, oil prices could be $2.0-$5.0/b lower by 2020.

Moreover, oil demand in Brazil has been growing at an average rate of 5% per annum during the period of 2005-2010. It is projected to continue growing at a similar rate well into 2020s while production is projected to grow at 4% per annum during the same period. This means that by 2017 Brazil will be able to save only 340,000 b/d for export (including ethanol exports) and by 2020 it will revert to being self-sufficient only.

Even with Brazil's growing oil reserves and accelerating production, the country will never become a major oil exporter as all the incremental oil production will be consumed in the country. Brazil could only hope to remain self-sufficient if its economic growth continues its surge into the future.

However, the emergence of Brazil as a major oil producer will certainly change the balance of oil distribution in the world. It could also accelerate Brazil's ascent into the top ranks of the world's economic powers.

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