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COUNTRY ANALYSIS BRIEFS

Brazil

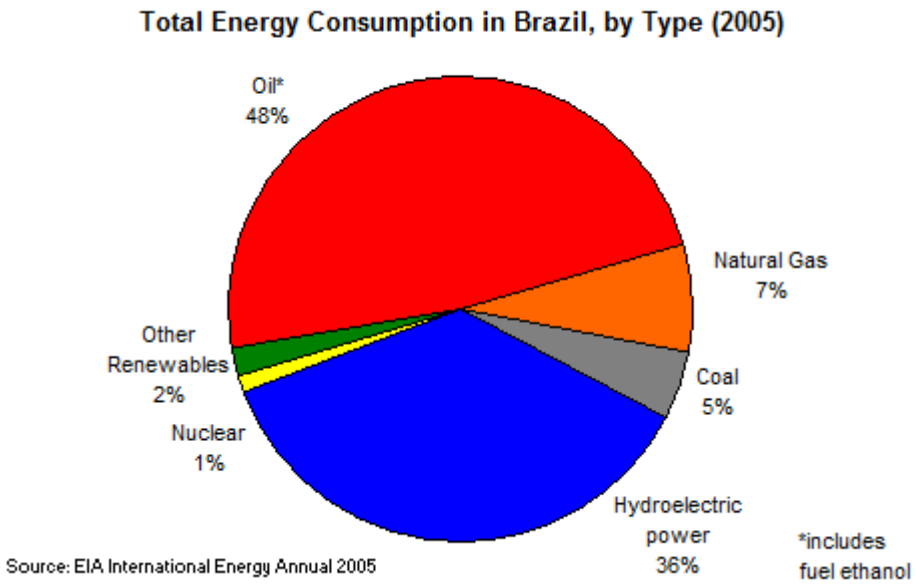
Last Updated: October 2008

Background

Brazil has experienced rapidly expanding oil, natural gas, and electricity consumption in recent years.

Brazil is the 10th largest energy consumer in the world and the third largest in the Western Hemisphere, behind the United States and Canada. Total primary energy consumption in Brazil has increased significantly in recent years. In addition, Brazil has made great strides in increasing its total energy production, particularly oil, over the past decade. Increasing domestic oil production has been a long-term goal of the Brazilian government.

The largest share of Brazil's total energy consumption comes from oil (48 percent, including ethanol), followed by hydroelectricity (35 percent) and natural gas (7 percent). The large share of hydroelectricity in Brazil's energy mix represents the dependence of electricity generation on hydroelectric dams. Natural gas is currently a small share of total energy consumption, but attempts to diversify electricity generation from hydropower to gas-fired power plants should cause natural gas consumption to grow in coming years.

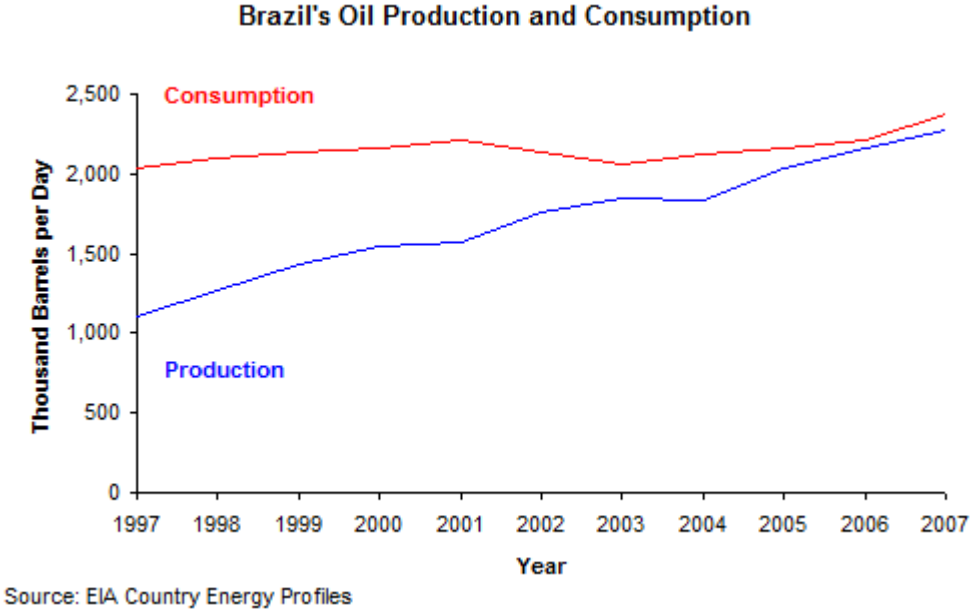


Oil

Brazil has the second-largest crude oil reserves in South America, and is one of the fastest growing oil producers in the world.

Overview

According to *Oil and Gas Journal (OGJ)*, Brazil had 12.2 billion barrels of proven oil reserves in 2008, second-largest in South America after Venezuela. The offshore Campos and Santos Basins, located on the country's southeast coast, contain the vast majority of Brazil's proven reserves. In 2007, Brazil produced 2.28 million barrels per day (bbl/d) of oil, of which 77 percent was crude oil. Brazil's oil production has risen steadily in recent years, with the country's oil production in 2007 about 5 percent (or 110,000 bbl/d) higher than 2006. EIA estimates that Brazil's oil consumption in 2007 averaged 2.37 million bbl/d. Based on its September 2008 *Short Term Energy Outlook*, EIA forecasts Brazilian oil production to reach 2.41 million bbl/d in 2008 and 2.72 million bbl/d in 2009. As a result of this rising oil production, EIA estimates that Brazil will become a net oil exporter by 2009.



Sector Organization

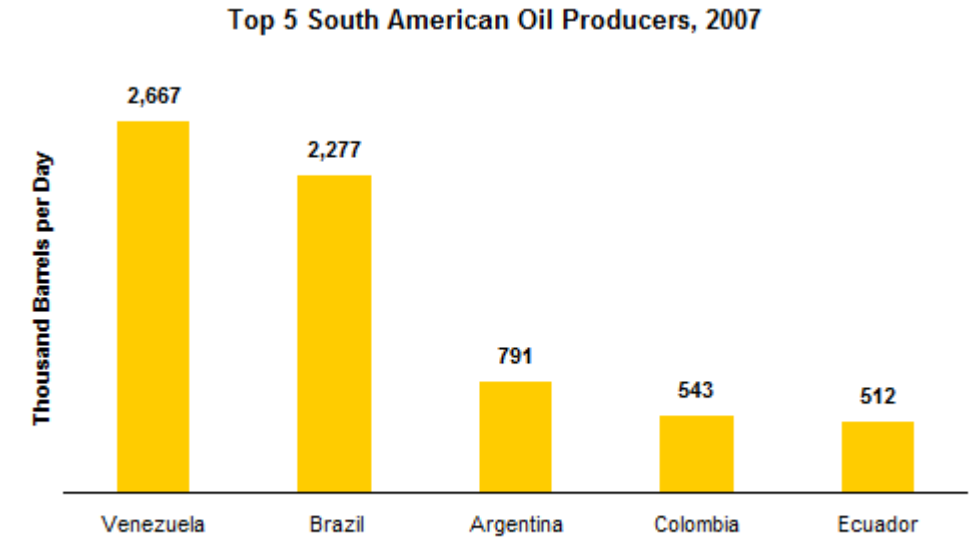
State-controlled Petrobras is the dominant player in Brazil's oil sector, holding important positions in up-, mid-, and downstream activities. The company held a monopoly on oil-related activities in

the country until 1997, when the government opened the sector to competition and freed oil prices from state control. The principal government agency charged with monitoring the oil sector is the National Petroleum Agency (ANP), which is responsible for issuing exploration and production licenses and ensuring compliance with relevant regulations.

Despite the opening of the sector to private actors in the late 1990s, foreign-operated oil projects are rare in Brazil. Royal Dutch Shell was the first foreign operator of crude oil production in the country, operating a single, relatively small field in the Campos Basin. In mid-2007, Devon brought its Polvo field on-stream, representing the first oil project without any Petrobras participation. Private competition in the sector is not just from foreign companies: in 2008, Brazilian oil company OGX raised $4 billion in an IPO, and the company secured interests in 21 blocks in Brazil's ninth licensing round.

Exploration and Production

Petrobras controls over 95 percent of the crude oil production in Brazil. The largest oil-production region of the country is Rio de Janeiro state, which contains about 80 percent of Brazil's total production. Most of Brazil's crude oil production is offshore in very deep water and consists of mostly-heavy grades. One of Brazil's principle marketed crude streams is Marlim, which has an API of 19.6º and a sulfur content of 0.67 percent.



Source: EIA Country Energy Profiles

Petrobras has brought numerous projects onstream in recent years, with many more planned for the near future (see table below). In 2007, the company brought online Piranema (20,000 bbl/d nameplate production capacity), Espadarte (100,000 bbl/d), the second phase of the Golfinho (100,000 bbl/d), and two floating production, storage, and offloading (FPSO) units in the Roncador field (380,000 bbl/d). In September 2008, construction of the P-53 FPSO was completed, and the vessel is scheduled for installation in the Marlin field by the end of the year. In 2009, Petrobras plans to install another FPSO in the Marlim field, P-51, with a nameplate production capacity of 180,000 bbl/d.

Shell's Bijupira-Salema project in the Campos Basin was the first field in Brazil not operated by Petrobras. The project came on-stream in 2003 and produces about 50,000 bbl/d. Shell is also developing its BC-10 project (100,000 bbl/d), which will utilize an oil tanker currently being converted into an FPSO in Singapore. Devon brought its Polvo project (50,000 bbl/d) online in August 2007, representing the only upstream oil project without any Petrobras participation. Chevron is developing the Frade project (100,000 bbl/d), with first production expected in 2009. Finally, StatoilHydro is developing the Peregrino field in Brazil, with expected production capacity of 100,000 bbl/d.

In large part due to this sizable slate of new projects, EIA expects that Brazil's total oil production

could reach 2.72 million bbl/d in 2009. This forecast takes into account the above-mentioned projects and an estimate for decline rates at Brazil's older, mature fields. This could make Brazil one of the largest sources of new, non-OPEC oil supply growth. However, recent experience has shown that non-OPEC supply growth has been overestimated in recent years, so there is considerable downside risk to this forecast. Such risks include larger decline rates at mature fields and delays to project schedules. In total, industry analysts estimate that spending on investments in oil and natural gas exploration and production in Brazil could amount to $72 billion by 2012.

Subsalt Reserves: Tupi and Beyond

Petrobras announced that it had discovered an estimated 5-8 billion barrels of recoverable reserves (including both oil and natural gas) in the Tupi field, located in the Santos Basin. The reserves occur in a subsalt zone that is an average of 18,000 feet total below the ocean surface. The Tupi find is the largest oil discovery since the supergiant Kashagan field in Kazakhstan. In addition, oil encountered in the subsalt zones appears to be lighter and sweeter than most of Brazil's existing production. Following Tupi, numerous additional subsalt discoveries were announced, including Carioca, Iara, and Guara. Preliminary estimates by industry analysts of the total extent of recoverable oil and natural gas reserves in the entire subsalt reserve have approached 56 billion barrels of oil equivalent.

Tupi and the subsequent subsalt announcements immediately transformed the nature and focus of Brazil's oil sector, and the potential impact of the subsalt discoveries upon world oil markets is vast. However, considerable challenges must still be overcome in order to bring these reserves to fruition. The full scope and nature of development of the subsalt resources is still pending the establishment of the formal contractual framework that will guide exploitation of the reserves. In addition, the difficulty of access to the reserves, considering both the large depths and pressures involved with subsalt oil production, mean that there are many technical hurdles that must be overcome. Finally, the subsalt reserves contain a high concentration of natural gas, along with oil, and proper handling this gas will require additional infrastructure and consideration. As a result, production from small 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.

Pipelines

Transpetro, a wholly owned subsidiary of Petrobras, operates Brazil's crude oil transport network. The system consists of 4,000 miles of crude oil pipelines, coastal import terminals, and inland storage facilities. The overall structure of the network enables the movement of crude oil from coastal production facilities and import terminals to inland refineries and consumption centers.

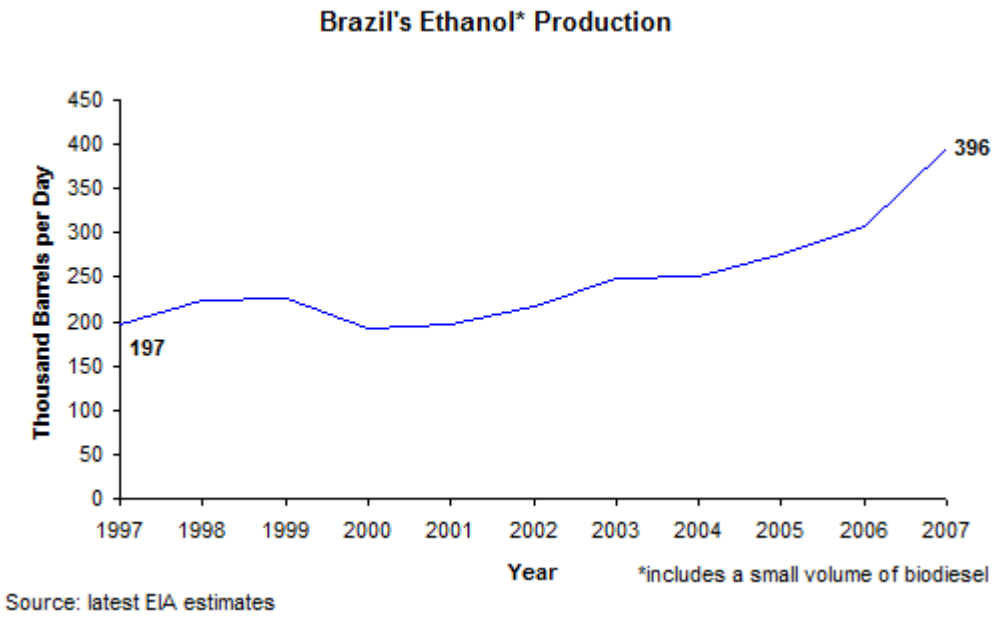
Downstream

According to *OGJ*, Brazil has 1.9 million bbl/d of crude oil refining capacity spread amongst 13 refineries. Petrobras operates 11 facilities, the largest being the 360,000-bbl/d Paulinia refinery in Sao Paulo. Petrobras also controls a dominant stake in the retail products market. According to the International Energy Agency (IEA), regular unleaded gasoline prices averaged $1.17 per liter in 2006 ($4.43 per gallon), versus $2.58 per gallon in the United States.

In February 2005, Petrobras signed an agreement with Venezuela's state-owned Petroleos de Venezuela S.A. (PdVSA) to build a new, 200,000-bbl/d refinery in the northeastern Brazil at a cost of $5 billion. The companies expect to complete the facility, dubbed Abreu e Lima, by 2010, with each country providing half of the crude oil processed there. The facility has reportedly suffered delays due to disagreements between the two countries, but media accounts indicate that Petrobras broke ground on the facility in late 2007. Petrobras announced in 2008 that it plans to spend $40 billion over the next 5-10 years to increase Brazil's refining capacity by 1.3 million bbl/d.

Ethanol

Brazil is one of the largest producers of ethanol in the world and is the largest exporter of the fuel. In 2007, Brazil produced 390,000 bbl/d of ethanol, up from 306,000 in 2006. Based on the September 2008 *Short Term Energy Outlook*, EIA forecasts that Brazil's ethanol production will reach 440,000 bbl/d in 2008 and 530,000 bbl/d in 2009. Over half of all cars in the country are of the flex-fuel variety, meaning that they can run on 100 percent ethanol or an ethanol-gasoline mixture. Eight in ten new cars sold in Brazil are flex-fuel vehicles. All gasoline in Brazil contains ethanol, with blending levels varying from 20-25 percent. Ethanol in Brazil comes from sugar cane, which prospers in the country's tropical climate.



Source: latest EIA estimates

In 2008, BP announced that it was taking a stake in an ethanol project in Edia, Goias state that would produce 115 million gallons per year (7,500 bbl/d), making it one of the largest ethanol plants in Brazil. Petrobras has also launched numerous ethanol pipeline projects, including one linking Goias with Sao Paulo.

In recent years, Brazil has sought to increase ethanol exports, especially to the United States. Media reports indicated that Brazilian ethanol exports could total 5 billion liters in 2008 (86,000 bbl/d). In 2007, Brazil exported 12,600 bbl/d of ethanol to the United States, down from 30,000 bbl/d in 2006 but well above levels seen prior to 2005. The increase in exports to the U.S. has been driven by the phase-out of methyl tertiary butyl ether (MTBE) in the United State, which effectively replaced MTBE with ethanol as an additive to gasoline. However, surging domestic demand and high domestic prices may limit export growth. In addition, Brazil's ethanol exports face high tariffs in some markets, such as the 54 cent per gallon tariff in the United States. Besides the United States, Brazil exports ethanol to Europe, and it began exports to industrial customers in Japan in 2008.

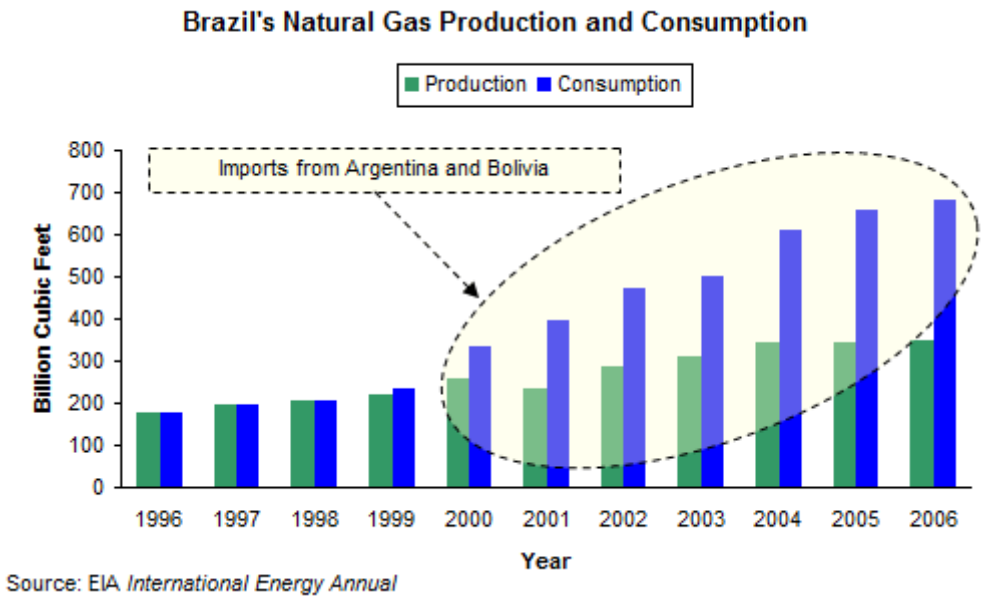
Brazil is also reportedly looking towards growing production of biodiesel. In 2008, Petrobras announced that it planned to build three biodiesel plants in the country, with at least one plant oriented towards the export market. ANP announced a 3 percent blending requirement for domestic diesel sales in July 2008, with plans to reportedly increase this to 5 percent by 2013.

Natural Gas

Natural gas constitutes only a small portion of Brazil's total energy consumption.

OGJ reported that Brazil had 12.3 trillion cubic feet (Tcf) of proven natural gas reserves in 2008. The Campos and Santos Basins hold the majority of reserves, but there are also sizable reserves in the interior stretches of the country. Despite Brazil's sizable natural gas reserves, natural gas production has grown slowly in recent years, mainly due to a lack of domestic transportation capacity and low domestic prices. In 2006, Brazil produced 349 billion cubic feet (Bcf) of natural gas, up slightly from 2005.

Natural gas consumption is a small part of the country's overall energy mix, constituting only 7 percent of total energy consumption in 2005. However, natural gas demand is rising: in 2006, Brazil consumed 683 Bcf of natural gas, up from 657 Bcf in 2005. High oil prices have helped spur natural gas demand in Brazil: natural gas is mostly used as a substitute for fuel oil in industrial and power-generating applications, and domestic prices for natural gas are much lower than international fuel oil prices. Further, the introduction of natural gas imports has lead to growth in domestic consumption.



Source: EIA *International Energy Annual*

Sector Organization

Petrobras is the largest producer of natural gas in Brazil. The company reportedly controls over 90 percent of Brazil's natural gas reserves. Other important participants in the sector include Sulgas and Britain's BG. ANP has sought to attract international investment to the sector, with recent exploration licensing rounds including many gas-prone areas. Petrobras is also the largest wholesale supplier of natural gas. The industrial sector is the largest consumer of natural gas in Brazil, representing about 80 percent of total domestic consumption. However, the two fastest growing sectors are thermal electricity generation and vehicular compressed natural gas (CNG).

Exploration and Production

The largest share of Brazil's natural gas production occurs from offshore fields in the Campos Basin in Rio de Janeiro state. Most onshore production occurs in Amazonas and Bahia states and is mostly for local consumption due to the lack of transportation infrastructure.

In order to meet rising demand, Petrobas plans to bring several new natural gas projects online over the coming years. The largest is the Mexilhao project, which contains estimated total reserves of 14 Tcf. Current plans call for production to come online in 2009 at 100 Bcf per year, eventually rising to 180 Bcf per year.

As discussed in the Oil section of this report, recent announcements about discoveries in Brazil's offshore subsalt have generated considerable excitement. Along with their potential to significantly increase oil production in the country, the subsalt areas are estimated to contain sizable natural gas reserves as well. According to Petrobras, Tupi alone could contain 5-7 Tcf of recoverable natural gas, which if proven, could increase Brazil's total natural gas reserves by 50 percent.

Pipelines

Petrobras operates Brazil's domestic natural gas transport system. The network has over 1,550 miles of natural gas pipelines, mostly in the southeast and northeast parts of the country. The network consists of main systems in the southeast, northeast, and the state of Espirito Santo; these systems are not currently interconnected, which has hindered development of domestic production and consumption. In June 2006, China's Sinopec began construction on the 730-mile Gasene pipeline linking the northeast and southeast networks. According to media reports, construction of the third and final stage of the Gasene system began in 2008, with completion fo the project expected by the end of 2009. In 2005, construction began on the Gas Unificacao, or Gasun; the 1,400-mile Gasun will link Mato Grosso dul Sul, in southwest Brazil, to Maranhao, in the northeast.

A lack of natural gas transportation infrastructure in the interior regions of the country has

hindered exploration and production. In particular, Amazonas state contains considerable reserves that remain unexploited, especially the Urucu field, which contains Brazil's largest onshore natural gas reserves. In 2005, Petrobras began construction of the Urucu pipeline that will link Urucu to Manaus, the capital of Amazonas state. The project includes construction of a 240-mile pipeline from Manaus to Coari, where it will interface with an existing liquefied petroleum gas (LPG) pipeline that Petrobras will convert to transport natural gas. The Urucu pipeline will parallel an existing oil pipeline and carry natural gas that is currently re-injected or flared during oil production.

In order to exploit the gas potential of the offshore subsalt reserves, Brazil will need to construct additional pipeline infrastructure in the area. In 2008, Petrobras announced that it would construct a 150-mile natural gas pipeline linking the Tupi field to its Mexilhao development. From there, a pipeline would link Mexilhao to shore, allowing any gas production from Tupi to flow to the domestic market.

Import Pipelines

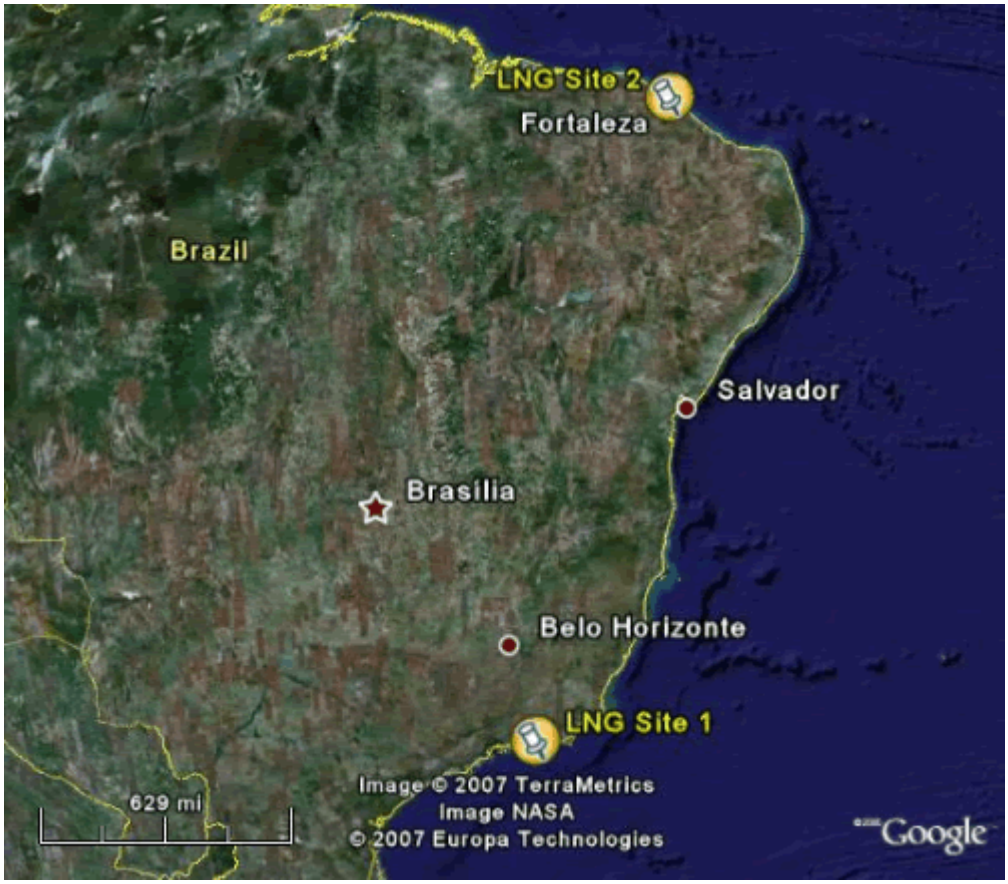
Brazil imports natural gas from Bolivia via the Gasbol pipeline linking Santa Cruz, Bolivia to Porto Alegre, Brazil, via Sao Paulo. The 2,000-mile Gasbol has a maximum capacity of 1 Bcf per day (Bcf/d). Gasbol also has a 170-mile, extension that connects to a natural gas-fired power plant in Cuibana, supplying 100 million cubic feet per day (MMcf/d). According to ANP, Brazil imported about 360 Bcf of natural gas from Bolivia in 2007

Brazil also receives natural gas from Argentina via the Parana-Uruguayana pipeline. The 275-mile, 100-MMcf/d pipeline connects to a gas-fired power plant operated by AES. According to ANP, Brazil imported 5.9 Bcf of natural gas from Argentina in 2007.

Liquefied Natural Gas

The construction of liquefied natural gas (LNG) terminals in Brazil could allow for larger natural gas imports and a reduced dependency upon existing import sources. In early 2007, Petrobras contracted with Golar LNG for two floating regasification and storage units (FRSU), for delivery in 2008 and 2009. The two vessels will provide for a combined 670 MMcf/d of gas sendout capacity, with the first moored in the southeast (Rio de Janeiro state, 450 MMcf/d) and the second in the northeast (Ceara state, 220 MMcf/d). In July 2008, the FRSU arrived at the Ceara site, and the Rio de Janeiro FRSU was expected to arrive in late 2008/early 2009.

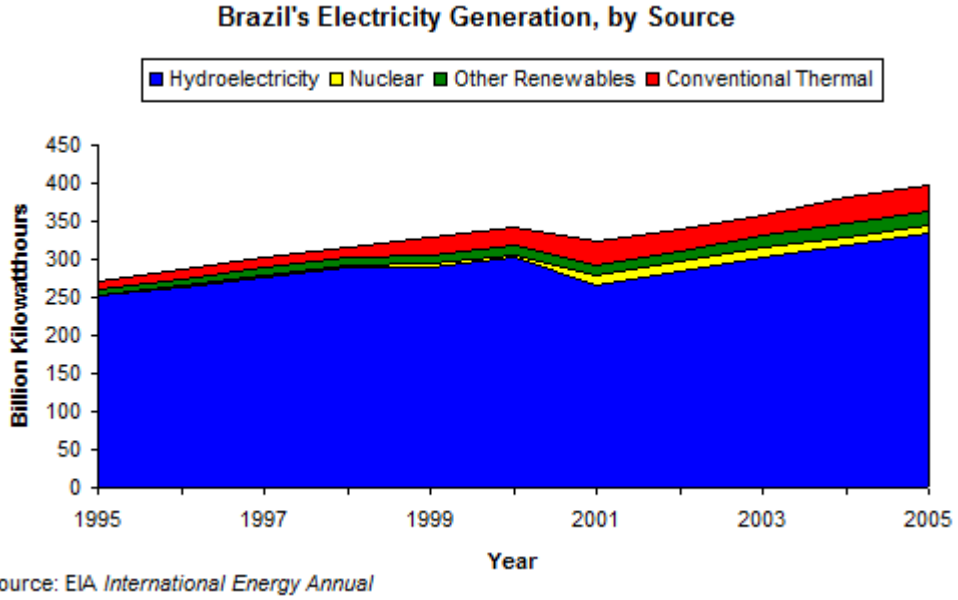
Sites for LNG Regasification Terminals in Brazil



Electricity

Brazil has the third-largest electricity sector in the Western Hemisphere.

Brazil had 90.7 gigawatts of installed generating capacity in 2005, with the single largest share being hydroelectricity. In 2005, the country generated 396.4 billion kilowatthours (Bkwh) of electric power, while consuming 368.5 Bkwh. The largest source of electricity generation is hydropower (84 percent), with smaller amounts from conventional thermal, nuclear, and other renewable sources.



Source: EIA *International Energy Annual*

Hydroelectricity

Brazil generated 334.1 Bkwh of hydroelectric power in 2005, accounting for 84 percent of its total electricity generation. Together with Paraguay, Brazil maintains the world's largest operational hydroelectric generating complex, the Itaipu facility on the Parana River, which generated 87.97 Bkwh of electricity in 2005. Many of Brazil's hydropower generating facilities are located far away from the main demand centers, resulting in high transmission and distribution losses. Brazil's heavy reliance on hydroelectricity has caused some issues in the past, especially during years of below-average rainfall. In 2008, the government announced plans to build two new hydroelectric plants along Brazil's borders with Argentina and Bolivia, representing 12,000 MW of new generation capacity. In addition, Suez Energy won a tender to build a 3,300-MW hydro station near Brasilia.

Conventional Thermal

Conventional thermal generating sources provided only a small part of Brazil's electricity supply. According to Brazil's Ministry of Energy and Mines, about 4 percent of Brazil's electricity generation in 2006 came from power plants fired by natural gas. Roughly a similar amount came from other thermal sources like coal, diesel, and fuel oil. Petrobras estimates that natural-gas fired generating capacity in Brazil could increase to 13,000 MW by 2017. Natural gas offers an alternative to the variability of hydropower but is largely dependent upon the availability of domestic and imported sources of the fuel. Brazil also has about 1,300 MW of installed coal generation capacity.

Nuclear Power

Brazil has two nuclear power plants, the 630-megawatt (MW) Angra-1 and the 1,350-MW Angra-2. State-owned Eletronuclear, a subsidiary of Electrobras, operates both plants. A third, 1,350-MW plant, Angra-3, remains partially constructed. In 2007, Electronuclear received permission from the Brazilian government to resume construction of Angra-3, and the company also began the process of applying for permission from Ibama (Brazil's environmental regulatory agency) to begin operations at the plant. Construction on Angra-3 began again in 2008. Electronuclear announced in August 2007 that it had begun the process of selecting a site for a fourth nuclear power plant in Brazil. According to the government, both of these new plants will use fuel produced in Brazil, rather than imported from Europe.

International Trade

In recent years, Brazil has run an overall power surplus, allowing exports to its neighbors. In 2007, Brazil began exporting electricity to Uruguay. In 2008, it exported power to Argentina during the winter in exchange for receiving electricity back from Argentina during the summer.

Profile

Energy Overview

Proven Oil Reserves (January 1, 2008E)	12.2 billion barrels
Oil Production (2007E)	2,277 thousand barrels per day.
Oil Consumption (2007E)	2,372 thousand barrels per day
Crude Oil Distillation Capacity (2008E)	1,908 thousand barrels per day
Proven Natural Gas Reserves (January 1, 2008E)	12.3 trillion cubic feet
Natural Gas Production (2006E)	349 billion cubic feet
Natural Gas Consumption (2006E)	683 billion cubic feet
Recoverable Coal Reserves (2004E)	11,148 million short tons
Coal Production (2006E)	7.0 million short tons
Coal Consumption (2006E)	23.8 million short tons
Electricity Installed Capacity (2005E)	90.7 gigawatts
Electricity Production	396.3 billion kilowatt hours

(2005E)	
Electricity Consumption (2005E)	368.5 billion kilowatt hours
Total Energy Consumption (2005E)	9.3 quadrillion Btus*
Total Per Capita Energy Consumption (2005E)	50.1 million Btus
Energy Intensity (2005E)	6,312 Btu per $2000-PPP**

Environmental Overview

Energy-Related Carbon Dioxide Emissions (2005E)	360.6 million metric tons
Per-Capita, Energy-Related Carbon Dioxide Emissions (2003E)	1.94 metric tons
Carbon Dioxide Intensity (2004E)	0.24 metric tons per thousand $2000-PPP**

Oil and Gas Industry

Organization	Petrobras: national oil and gas company with partial government ownership, Royal Dutch Shell, Devon
Major Oil/Gas Ports	Sao Sebastiao, Paranagua, Salvador, Tramandai, Sao Francisco do Sul, Aracaju, Maceio, Recidfe, Natal, Fortaleza, Belem
Major Oil and Natural Gas Basins	Campos Basin, Santos Basin
Major Refineries (capacity, bbl/d)	Paulinia-Sao Paulo (350,000), Mataripe-Bahia (293,700), Duque de Caxias-Rio de Janeiro (232,2000), Sao Jose dos Campos-Sao Paulo (241,500), Canoas-Rio Grande do Sul (180,900), Araucaria-Parana (180,900), Cubatao-Sao Paulo (162,900), Betim Minas Gerais (144,800)

* The total energy consumption statistic includes petroleum, dry natural gas, coal, net hydro, nuclear, geothermal, solar, wind, wood and waste electric power. The renewable energy consumption statistic is based on International Energy Agency (IEA) data and includes hydropower, solar, wind, tide, geothermal, solid biomass and animal products, biomass gas and liquids, industrial and municipal wastes. Sectoral shares of energy consumption and carbon emissions are also based on IEA data.
**GDP figures from OECD estimates based on purchasing power parity (PPP) exchange rates.

Links

EIA Links

EIA - Historical Energy Data on Brazil

U.S. Government

CIA World Factbook - Brazil
U.S Embassy in Brazil
U.S. State Department's Consular Information Sheet - Brazil
U.S. State Department's Background Notes on Brazil

Foreign Government Agencies

Agência Nacional de Energia Elétrica
Agência Nacional do Petróleo (ANP) (National Petroleum Agency)
Ministério de Minas e Energia (MME) (Ministry of Mines and Energy)

Sources

Agência Nacional do Petróleo
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Americas Oil and Gas Insights
Argus Latin American Energy and Latin American Power Watch
Associated Press
Business Daily Update
Business News Americas

Chemical News and Intelligence
ChevronTexaco
CIA World Factbook
Coal Americas
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Daily Oil Bulletin
Dow Jones
Economist
Economist Intelligence Unit
Economist Intelligence Unit ViewsWire
Edmonton Journal
Eletrobrás
Electricity Journal
Emerging Markets Online
Energy Day
Ethanol and Biodiesel News
Financial Times
Gazeta Mercantil
Global Insight
Global Power Report
Houston Chronicle
Infopetro Bulletin
International Energy Agency
International Herald Tribune
International Oil Daily
International Petroleum Finance
InvestNews (Brazil)
James Baker Institute-Energy Forum
Latin America Monitor
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World Gas Intelligence
Worldwide Projects
Wood MacKenzie Ltd.
World Gas Intelligence
World Markets Analysis

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