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Brazil



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[full report](#)

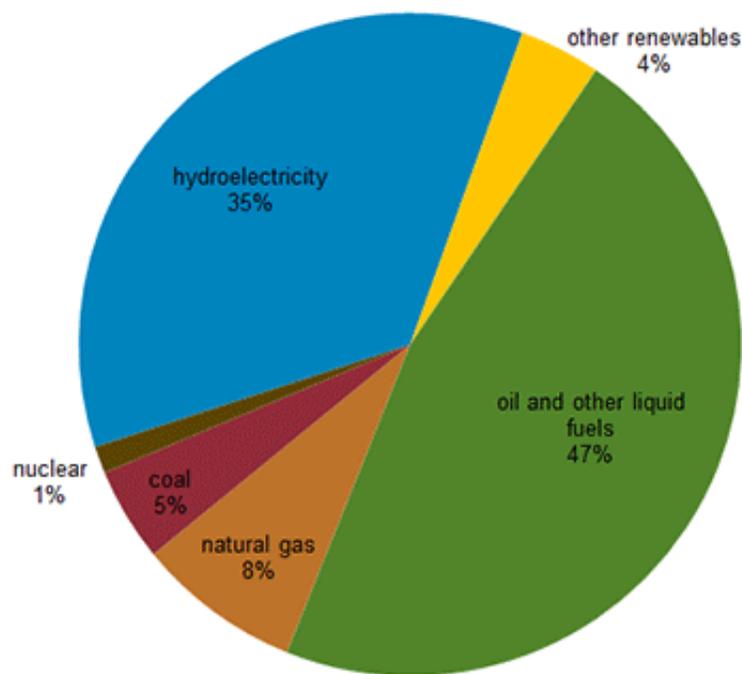
Overview

Brazil is the 8th largest total energy consumer and 10th largest producer in the world.

The latest complete EIA statistics for all countries (2010) indicate Brazil is the 8th largest energy consumer in the world and the third largest in the Americas, behind the United States and [Canada](#). Total primary energy consumption in Brazil has increased by more than one third in the past decade because of sustained economic growth. EIA 2010 statistics show Brazil is the 10th largest energy producer in the world. 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.

Total Brazilian energy consumption grew to 11.7 quadrillion British thermal units (Btu) in 2011. The largest share of Brazil's total energy consumption comes from oil and other liquid fuels (47%), followed by hydroelectricity (35%) and natural gas (8%). Additionally, Brazil is consuming increasing amounts of biomass in both the residential and industrial sectors.

Total primary energy consumption in Brazil by fuel type, 2011



Source: U.S. Energy Information Administration



Source: Central Intelligence Agency, *The World Factbook*

Oil and other liquid fuels

Brazil was the largest producer of liquid fuels in South America in 2012.

Overview

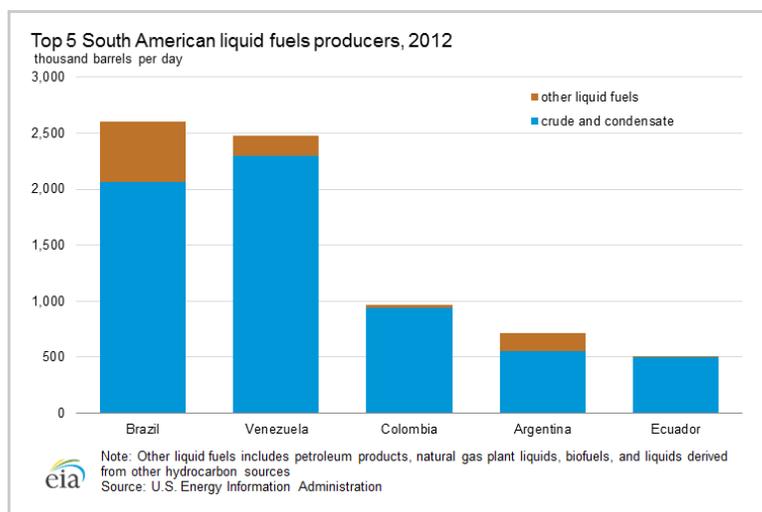
According to the *Oil and Gas Journal* (OGJ), Brazil had 13 billion barrels of proven oil reserves as of January 2013, the second-largest in South America after [Venezuela](#). The offshore Campos and Santos Basins, located off the country's southeast coast, hold the vast majority of Brazil's proved reserves. In 2012, Brazil produced 2.7 million barrels per day (bbl/d) of liquid fuels, of which 78% was crude oil. Liquid fuels production in Brazil declined slightly in 2012.

In March 2013, Brazil launched a 10-year energy plan that aims to expand oil production to over 5 million bbl/d by 2021, a decrease from its previous plan of over 6 million bbl/d by 2020. The plan sets targets for oil exports of over 2.25 million bbl/d by 2021.

Sector organization

State-controlled Petrobras is the dominant participant in Brazil's oil sector, holding important positions in upstream, midstream, 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. Royal Dutch Shell was the first foreign crude oil producer in the country, and it has now been joined by Chevron, Repsol, BP, Anadarko, El Paso, Galp Energia, Statoil, BG Group, Sinopec, ONGC, and TNK-BP. Competition in the sector is not just from foreign companies: Brazilian oil company OGX, which is staffed largely with former Petrobras employees, started to produce oil in the Campos Basin in 2011.

The principal government agency charged with regulating and monitoring the oil sector is the Agência Nacional do Petróleo (ANP), which is responsible for issuing exploration and production licenses and ensuring compliance with relevant regulations. Recent legislation concerning pre-salt exploration and production has changed the operating environment somewhat. A full discussion of this situation can be found in the "[Pre-salt oil](#)" section.



Exploration and production

More than 90% of Brazil's oil production is offshore in very deep water and consists of mostly heavy grades.

Most Brazilian oil is currently produced in the southeastern region of the country in Rio de Janeiro and Espírito Santo states. More than 90% of Brazil's oil production is offshore in very

deep water and consists of mostly heavy grades. Six fields in the Campos Basin (Marlim, Marlim Sul, Marlim Leste, Roncador, Jubarte, and Barracuda) account for more than half of Brazil's crude oil production. These Petrobras-operated fields each produce between 100,000 bbl/d and 350,000 bbl/d.

International oil companies also play a role in Brazilian production. The Shell-operated Parque de Conchas project and the Chevron-operated Frade projects produce 75,000 bbl/d and 85,000 bbl/d, respectively. In November 2011, Chevron reported an oil spill of about 2,400 barrels at the Frade facility. And in March 2012, Chevron detected another seep in a different location in the Frade field. Although Chevron took full responsibility for the accident and has paid more than \$27 million in fines, the spill has caused many Brazilian legislators to question Chevron's presence in their country.

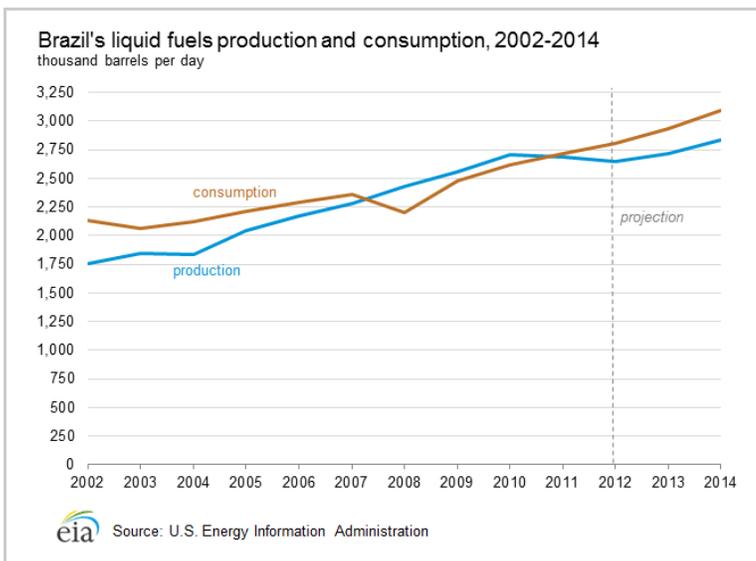
Recent offshore exploration efforts in Brazil have yielded massive discoveries of pre-salt oil fields, which are oil fields situated under layers of rock and thick layers of salt.

Exports and imports

The United States imported 187,000 bbl/d of Brazilian crude oil in 2012 and has been Brazil's largest crude oil export destination for the past decade.

According to the ANP, Brazil exported nearly 550,000 bbl/d of crude oil in 2012. The United States imported 187,000 bbl/d in 2012 and has been Brazil's largest crude oil export destination for the past decade. According to customs data, [China](#) was the second largest customer, at over 121,000 bbl/d, followed by [India](#) at over 91,000 bbl/d in 2012.

In 2011, Brazil's liquid fuels consumption surpassed its liquid fuels production for the first time since 2007. Brazil's economy grew rapidly in 2011, driving up fuel demand. At the same time, reduced ethanol production and rising ethanol prices caused Brazil to import additional supplies of refined products from the United States. EIA projects that consumption will continue to be greater than production up through 2014. According to the ANP, Brazil imported nearly 470,000 bbl/d of refined product in 2012 of which 166,000 bbl/d came from the United States. Brazil's imports of product from the United States rose 6% from the previous year and increased 219% compared with the level five years earlier. According to customs data, [Argentina](#) was the number one exporter of products to Brazil in 2012, followed by the United States and [Algeria](#).



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. The refining in Brazil is relatively simple, so the country must export some of its heavy crude oil production and import light crude oil. With domestic demand growing, Brazil's refineries are currently operating at full capacity.

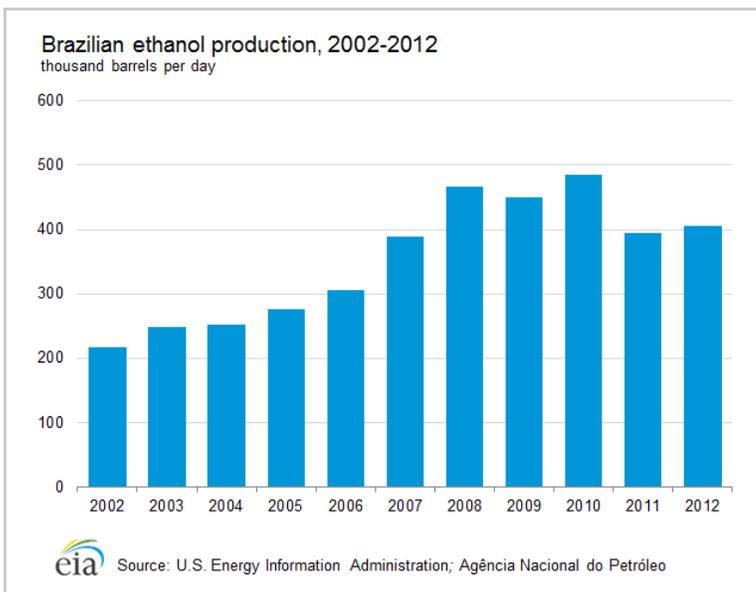
Petrobras plans to increase its Brazilian refining capacity to more than 3.2 million bbl/d by 2020 to meet burgeoning domestic demand. Under the company's 2013-2017 business plan, Petrobras will build five additional refineries to meet this goal. Notable among these facilities is the Abreu e Lima refinery, a 230,000-bbl/d joint-venture with Petroleos de Venezuela (PdVSA) due to come online in 2014 pending PdVSA's ability to meet their component of the financing arrangement. The facility will be designed to process heavy Venezuelan and Brazilian crude oil.

Ethanol

In an effort to address the country's dependence on oil imports and surplus of sugar cane, the government implemented policies to encourage ethanol production and consumption beginning in the 1970s.

Today, Brazil is the second largest producer and consumer of ethanol in the world after the United States. According to the ANP, in 2012, Brazil produced 405,000 bbl/d of ethanol, matching the declined 2011 levels. A combination of high world sugar prices, a poor sugar cane harvest, and underinvestment resulted in a precipitous decline in ethanol production in 2011. This shortage forced Brazil to import corn ethanol from the United States.

The Brazilian government has taken measures to prevent future ethanol supply shortages and increase government involvement in the sector. In May 2013, the government raised the blend requirement in gasoline back to 25%. Most of Brazil's cars are capable of running on pure ethanol or gasoline that is blended with 20% to 25% ethanol by volume. It also brought regulation of the ethanol sector under the jurisdiction of the ANP and announced plans to expand Petrobras' presence in the ethanol market. In the medium term, Brazil plans to export ethanol to the United States, which recently removed tariffs on Brazilian sugar cane ethanol.



Pre-salt oil

The world's largest oil discoveries in recent years have come from Brazil's offshore, pre-salt basins.

Pre-salt oil is generally characterized as oil reserves situated exceptionally deep under thick layers of rock and salt and requiring substantial investment to extract. A consortium of Petrobras, BG Group, and Petrogal discovered the Tupi field in 2007, which contains substantial reserves in a pre-salt zone 18,000 feet below the ocean surface under a thick layer of salt. Following Tupi, many pre-salt finds were announced in the Santos Basin, such as Iracema, Carioca, Iara, Libra, Franco and Guara. Additional pre-salt discoveries were also announced in the Campos and Espírito Santo Basins. Estimates for the total pre-salt resources vary. Some analysts place total extent of pre-salt recoverable oil and natural gas reserves at more than 50 billion barrels of oil equivalent (boe).

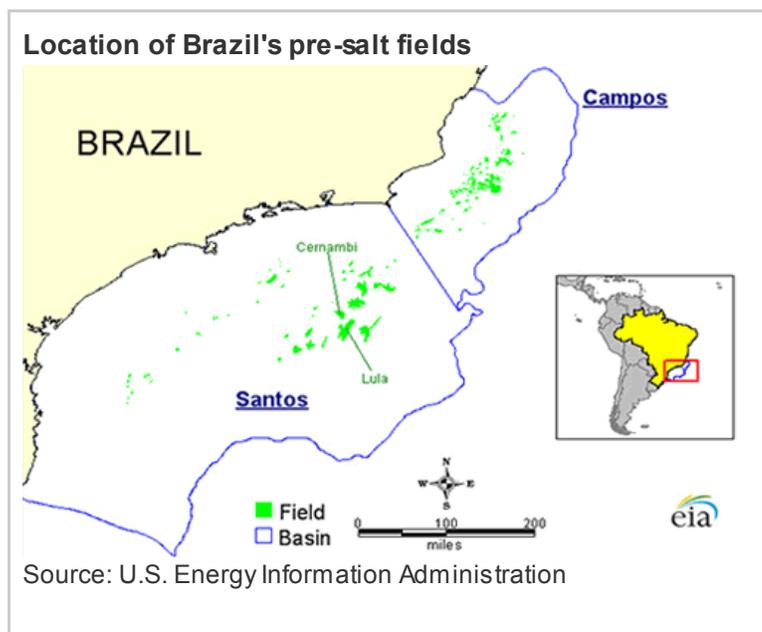
In December, 2010 Petrobras submitted a declaration of commerciality to the ANP for the Tupi and Iracema fields, which renamed the fields Lula and Cernambi, respectively. The total recoverable reserve estimate for these fields is 8.3 billion boe (6.5 billion boe for Lula and 1.8 billion for Cernambi). In January, 2011, Petrobras declared the Sapinhoa (formerly Guara) field to be commercial, with a recoverable reserve estimate of 1.1 billion boe.

Petrobras plans to develop its major pre-salt assets in three discrete phases: 1) extended well tests; 2) pilot projects; 3) large-scale production through multiple, duplicate floating production, storage, and offloading (FPSO) facilities. Pilot projects in the Lula and Sapinhoa fields began production in 2010 and 2011, respectively. According to Petrobras, Brazil currently produces more than 100,000 bbl/d of oil from its pre-salt fields.

In its 2013-2017 business plan, Petrobras laid out plans to invest \$147.5 billion in exploration and production, \$73 billion of which will be in pre-salt exploration and production activities. This investment constitutes a major increase from the \$53 billion targeted at pre-salt activities in the previous year's plan. The company is shifting its focus away from downstream and international expansion to the domestic upstream sector. Although Petrobras will finance most of this work through operating cash flow, the company's 2010 initial public offering (\$67 billion) and 2011 and 2012 corporate debt offerings (\$6 billion

and \$7 billion, respectively) all set records.

Brazil's pre-salt announcements immediately transformed the nature and focus of Brazil's oil sector. The potential impact of the discoveries upon world oil markets is vast. However, considerable challenges still must be overcome to produce these reserves. Considering both the large depths and pressures involved with pre-salt oil production, there are significant technical hurdles that must be overcome. Further, the scale of the proposed expansion in production will also stretch Petrobras' exploration and production resources and Brazil's infrastructure, as will strict local content requirements.



Regulatory reforms

In contrast to the earlier concession-based framework, Petrobras will be the sole operator of each production sharing agreement and will hold a minimum 30% stake in all pre-salt projects.

The Brazilian government passed legislation instituting a new regulatory framework for the pre-salt reserves in 2010 that includes four notable attributes: First, the legislation creates a new agency, Pré-Sal Petróleo SA, to administer new pre-salt production and trading contracts in oil and gas industry. The second component allowed the government to capitalize Petrobras by granting the company 5 billion barrels of unlicensed pre-salt oil reserves in exchange for larger ownership share. The other two components establish a new development fund to manage government revenues from pre-salt oil and lay out a new production sharing agreement (PSA) system for pre-salt reserves. In contrast to the concession-based framework for non pre-salt oil projects, where companies are largely uninhibited by the state in exploring and producing, Petrobras will be the sole operator of each PSA and will hold a minimum 30% stake in all pre-salt projects. However, to incentivize companies, the PSA will also include a signing bonus of U.S. \$6.6 billion and a low-cost recovery cap. Brazilian officials intend to hold the pre-salt licensing round in October 2013.

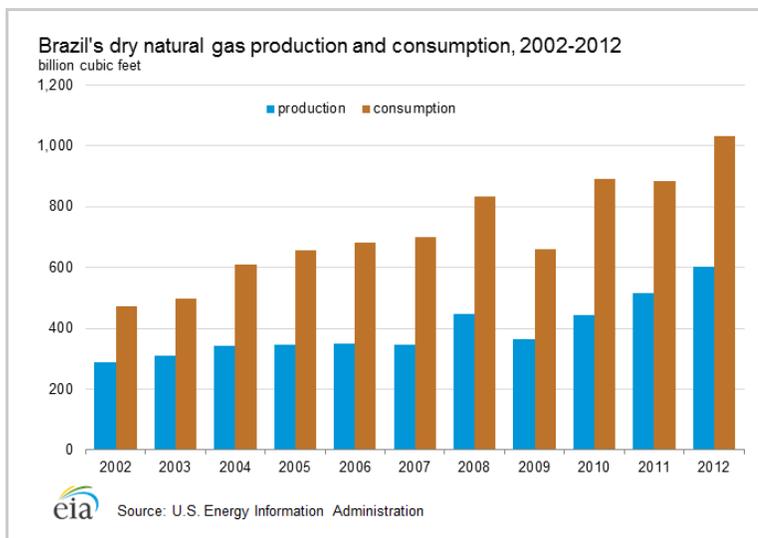
For these reforms to be implemented, Brazilian legislators must first agree on a system for distributing royalties from the pre-salt oil. Currently, most oil production revenue accrues to the state and municipal governments of oil-producing states Rio de Janeiro, Sao Paulo,

and Espírito Santo. Other Brazilian states are fighting for a greater share of the royalties from the pre-salt oil. Demonstrators, who took to the streets to oppose bus fare hikes, have expressed their long-held dissatisfaction with government services and alleged corruption. After weeks of protests, the lower chamber of Brazil's Congress approved a bill, which has stalled in the Congress, to allocate petroleum revenues to education and health throughout the country. As of August 2013, the bill awaits the President's signature.

Natural gas

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

OGJ reported that Brazil had 14 trillion cubic feet (Tcf) of proved natural gas reserves as of January 2013. The Campos, Espírito Santo, and Santos Basins hold the majority of reserves, but sizable reserves also exist in the interior of the country. In 2012, Brazil produced 601 billion cubic feet (Bcf) of dry natural gas, the majority of this production was associated with oil. Despite a 16% increase in natural gas consumption in 2011 to over 1 Tcf, natural gas consumption is a small part of the country's overall energy mix, constituting less than 10% of total energy consumption in recent years.



Sector organization

Petrobras plays a dominant role in Brazil's entire natural gas supply chain. In addition to controlling the vast majority of the country's natural gas reserves, the company is responsible for most domestic Brazilian gas production and for gas imports from Bolivia (see below). Further, Petrobras controls the national transmission network, and it has a stake in 21 of Brazil's 27 state-owned natural gas distribution companies. However, Brazil passed a new Gas Law in 2009 that created a separate regulatory framework for natural gas. This law is expected to facilitate private investment in the sector.

Exploration and production

Along with the potential to significantly increase oil production in the country, the pre-salt areas are estimated to contain sizable natural gas reserves as well.

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

In order to meet rising demand and decrease reliance on imports, Petrobras has planned to increase existing production in the southeast and bring several new natural gas projects online over the coming years. The largest is the Mexilhao project, which contains estimated total reserves of 8 Tcf. Production began in March 2011 and is expected to rise to 120 Bcf in 2012.

As discussed in the oil section of this report, recent announcements about discoveries in Brazil's offshore pre-salt layer have generated excitement about new gas production. Along with the potential to significantly increase oil production in the country, the pre-salt 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%.

Pipelines

Petrobras operates Brazil's domestic natural gas transport system through its subsidiary Transpetro. The network has over 5,110 miles of natural gas pipelines, mostly in the southeast and northeast parts of the country. For years these systems were not interconnected, which has hindered the development of domestic production and consumption. However, in March 2010 the Southeast Northeast Integration Gas Pipeline (GASENE) linked these two markets for the first time. This 860-mile pipeline, which runs from Rio de Janeiro to Bahia, is the longest ever built in Brazil. GASENE should offset supply shortfalls caused by declining local production in the northeast with offshore supply from the southeast.

The other major natural gas market in Brazil is the Amazon region. In 2009, Petrobras completed construction of the Urucu pipeline linking Urucu to Manaus, the capital of Amazonas state. This project is expected to facilitate development of the Amazon's considerable natural gas reserves.

Imports

Brazil imported 470 Bcf of dry natural gas in 2012, a 27% increase from 2011. Bolivia accounted for over 75% of Brazilian gas imports.

Brazil imported 470 Bcf of dry natural gas in 2012, a 27% increase from 2011, stemming from a large increase in domestic gas demand. The country currently receives imports by pipeline from Bolivia and liquefied natural gas (LNG) imports primarily from Qatar, Trinidad and Tobago, and the United States. Total imports decreased 17% in 2011, much of the drop from dramatically reduced liquefied natural gas (LNG) imports, according to the ANP.

According to the ANP, Bolivia accounted for over 75% of total Brazilian gas imports and 100% of its pipeline imports in 2012. Brazil imports natural gas from Bolivia via the Gasbol pipeline, which links Santa Cruz, Bolivia to Porto Alegre, Brazil, via Sao Paulo. The 2,000-mile pipeline has a maximum capacity of 1.1 Bcf per day (Bcf/d). Despite efforts to reduce

dependence, Brazilian imports of Bolivian gas increased by 3% in 2012.

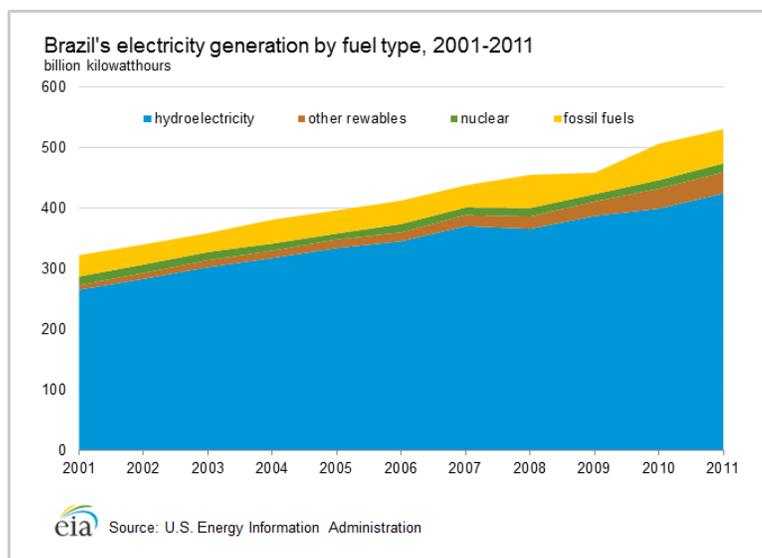
Liquefied natural gas

Brazil has two liquefied natural gas (LNG) regasification terminals, both installed in the past three years: the Pecem terminal in the northeast, and the Guanabara Bay terminal in the southeast. Both facilities are floating regasification and storage units (FRSU), with a combined sendout capacity of 740 million cubic feet per day (MMcf/d). The Pecem received its first LNG cargo from Trinidad and Tobago in July 2008, while the Guanabara Bay terminal came online in May 2009. Petrobras plans to bring two additional terminals online in the states of Bahia and Rio Grande do Sul in late 2013. Petrobras, Repsol-YPF, BG Group and Galp Energia have teamed together to build an LNG vessel that would develop pre-salt natural gas that would be sent to be processed at existing terminals in Brazil by 2015.

Electricity

Brazil has the third-largest electricity sector in the Americas, behind the United States and Canada.

Brazil had 114 gigawatts of installed generating capacity in 2010, with the single largest share being hydroelectric capacity. In 2011, the country generated 531 billion kilowatt-hours (kWh) of electric power. Hydropower accounted for 80% of this generation, with smaller amounts coming from fossil fuels, nuclear, other renewables, and other fuel sources.



Sector organization

The government plays a substantial role in the Brazilian electricity sector. Until the 1990s, the state controlled the electricity sector almost completely. Brazil initiated an electricity sector privatization process in 1996 that led to the establishment of the National Electric Energy Agency (Aneel). However, when drier-than-average weather led to severe energy shortages in 2000 and 2001, the process stalled. Although the electricity sector was privatized in the early 2000s, the bulk of Brazil's major generation assets remain under

government control. Eletrobras, a state-owned holding company, constitutes the dominant player in the electricity market. The government also owns almost the entire electricity transmission network.

In 2004, the Brazilian government implemented a new model for the electricity sector. This hybrid approach to state involvement splits the sector into regulated and unregulated markets for different producers and consumers. This approach allows for both public and private investment in new generation and distribution projects. Under the plan, however, Eletrobras was formally excluded from privatization efforts.

Hydroelectricity

Brazil is planning new hydroelectric power projects, notable is the Belo Monte plant, which upon completion will be the third largest hydroelectric power plant in the world.

Brazil generated 424 billion kWh of hydroelectric power in 2011. 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 largest hydroelectric generation asset is the Itaipu hydroelectric dam on the Parana River, which Brazil maintains with Paraguay. According to Itaipu Binacional, the facility generated 92.2 Bkwh of electricity in 2011. Although Brazil plans to move away from hydropower to mitigate the risk of supply shortages brought about by dry weather, new hydro projects continue to move forward. Most notable among these projects is the Belo Monte plant in the Amazon basin, which upon completion will be the third largest hydroelectric plant in the world behind China's Three Gorges Dam and the Itaipu dam.

Fossil fuel generation

Fossil fuel generating sources provided only a small part of Brazil's electricity supply, contributing about 17% in 2011. The largest source of generation from fossil fuels in Brazil is natural gas. EIA projects that natural gas use in the electricity sector will increase as Brazil expands and diversifies its natural gas supplies.

Nuclear power

Brazil has two nuclear power plants, the 657-megawatt (MW) ANGRA 1 and the 1,350-MW ANGRA 2. State-owned Eletronuclear, a subsidiary of Eletrobras, operates both plants. The ANGRA 1 nuclear power plant began commercial operations in December 1984, and the ANGRA 2 began commercial operations in December 2000. Construction of a third plant, the 1,350-MW ANGRA 3, started in 1984, but it was never finished. In 2008, construction began again, with completion slated for 2016. According to industry sources, Eletronuclear plans to build at least four new nuclear power plants (in addition to ANGRA 3) by 2030, began to meet expected growth in Brazilian electricity demand.

Notes

- Data presented in the text are the most recent available as of October 1, 2013.
 - Data are EIA estimates unless otherwise noted.
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