INTERNATIONAL TRADE ADMINISTRATION

2016 Top Markets Report Civil Nuclear Country Case Study

Brazil

Market Type: Newly Emerging

Brazil has a promising civil nuclear energy market. The country's two nuclear reactors supply 3 percent of Brazil's energy, and there are plans for eight new reactors in operation in the 2020s, with one additional reactor currently under construction. Brazil is dependent on hydro for its electricity, and recent droughts illustrate the need for energy diversification. The Brazilian government and the general public have favorable opinions of nuclear power, but recent scandals involving industry leaders and broader political uncertainty will slow Brazil's ambitions to grow its nuclear fleet in the near future.

New Builds	12
Existing Reactors	15
Decommissioning	N/A
Overall Rank	12

U.S. Ambassador to Brazil: Liliana Ayalde
Senior Commercial Officer in Brasilia: Rick Ortiz

Approximately 3 percent of Brazil's energy is supplied by two pressurized water reactors (PWRs) at the Angra dos Reis NPP near Rio de Janeiro. Angra 1&2 have 626 MWe and 1270 MWe generating capacity, respectively. A third 1270 MWe reactor, Angra 3, is under construction and expected to come online in 2018. In May 2015, Brazil's Energy Minister stated that Angra 3 would be the last state-sponsored NPP and that Brazil would seek private investment for future NPPs.

The Government of Brazil (GOB) is very supportive of nuclear power. The Angra 3 project, which started construction in the 1970s and was suspended in 1986 due to budgetary issues, was resumed in 2010 after France's Areva signed a deal with Brazil's state-owned utility Eletronuclear to take over the project. Eletronuclear, a subsidiary of Eletrobras, is responsible for building and operating NPPs in Brazil

Recent droughts have demonstrated the need to reduce Brazil's dependence on hydropower, which accounts for a large proportion of the country's energy. In April 2015, the Ministry of Mines and Energy updated its 10-year energy plan, confirming that Brazil will continue to invest in nuclear energy and that it was evaluating sites for the development of eight new units to be built in the future. This plan, however, only contemplated the conclusion of Angra 3, which is currently under construction. Brazil's Long-Term Energy Plan (PNE 2050) has not yet been concluded, and although new nuclear plants are expected to be included in this plan, the role that nuclear power will play in Brazil's long-term energy mix is currently unclear. Pernambuco in the northeast and Minas Gerais in the southeast have been selected as potential sites. A July 2015 bribery charge against Eletronuclear's CEO has raised doubts about the completion of Angra 3 and the commencement of any new projects.

Public opinion in Brazil regarding nuclear power is positive. After the Fukushima disaster, Globescan, a public opinion research company, found that 60

This case study is part of a larger Top Markets Report. For additional content, please visit www.trade.gov/topmarkets.
U.S. Department of Commerce | International Trade Administration | **Industry & Analysis**

percent of those surveyed wanted to keep operating NPPs or build new NPPs, with 35 percent wanting to shut down existing plants. Public opinion is generally in favor of balancing the energy mix to include nuclear with renewables, including wind and biomass. Local populations near uranium mines, however, have expressed concerns about the feasibility of emergency plans and other nuclear-related contingencies in the event of an accident.

Planned Nuclear Energy Projects

Angra Nuclear Power Plant Expansion
Owner: State
Reactor Type: Pressurized Water Reactor
Capacity: 1405 MWe (1270 MWe net)
Value of Project: N/A
Construction Period: 2010-2017
Operation: 2018
Angra NPP: Angra 3 was originally envisioned in 1984 as a twin of unit 2. The project was suspended until the mid-2000s, and the first concrete was not laid until June 2010. Following the 2015 corruption probe, several contracts for Angra 3 were again suspended. Construction of the plant is approximately half finished.

New Northeast Nuclear Power Plant
Owner: State
Reactor Type: PWR (TBC)
Capacity: 6000-6600 MWe (four PWR units)
Value of Project: N/A
Construction Period: N/A
Operation: TBD
New Northeast NPP: Electronuclear wants to construct two additional NPPs in Brazil: one in the northeast, and a second near Angra in the southeast. In 2013, Pernambuco-Bahia was chosen for the northeast site. All eight units will need approval by the Brazilian Congress.

New Southeast Nuclear Power Plant
Owner: State
Reactor Type: PWR (TBC)
Capacity: 6000-6600 MWe (four PWR units)
Value of Project: N/A
Construction Period: N/A
Operation: TBD
New Southeast NPP: In 2013, Minas Gerais was chosen for the southeast site.

Commercial Opportunities

Services (front-and back-end): Currently, no opportunities for decommissioning exist, as both Angra 1 and Angra 2 are expected to be granted life extensions to 2024 and 2041, respectively.

Legal and Consulting Services: There is limited potential, but opportunities exist for lifetime extension and plans for new construction.

Licensing Support: Opportunities exist to support Brazil's nuclear regulator, the National Nuclear Energy Commission (CNEN). CNEN's Directorate of Radiation Protection and Safety is responsible for licensing and supervising all nuclear facilities.

Design, Construction, and Operation: Opportunities exist for new construction of eight reactors.

Components: Moderate opportunities to supply existing plants, one of which was built by Westinghouse, with engineering support, fuel components and related materials.

Challenges and Barriers to Exports

GOB support for nuclear energy is strong. Earlier this year, the Minister of Energy and Mines confirmed that future energy plans will include new reactors. Brazil's interest in building new reactors has attracted a high level of interest from U.S. reactor vendors, as well as Areva and Rosatom. Brazil's goals remain ambitious, particularly amid a history of delays and regards to the units at Angra. cancellations in

The unfolding scandal surrounding Eletronuclear poses a challenge to civil nuclear exports. The investigation prompted the suspension of two contracts with Brazilian consortiums that were to work on the construction of Angra 3, potentially further delaying the project. The effects of this scandal on public opinion are unclear. Additionally, the proposed reactors may not be built without the approval of the National Congress, which is not guaranteed.

Financial obstacles exist for U.S. civil nuclear exports to Brazil. As the GOB no longer plans to sponsor any new NPPs, funding will have to come from the private sector. Doing business in Brazil requires a strong understanding of the local environment, as well as the direct and indirect costs of doing business, such as

This case study is part of a larger Top Markets Report. For additional content, please visit www.trade.gov/topmarkets.

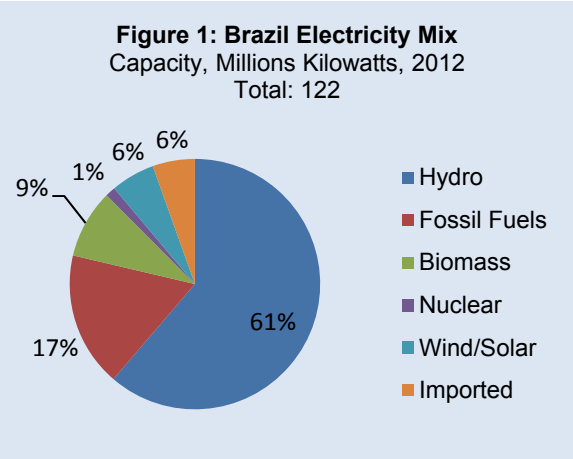
government procedures, local content requirements, environmental laws, insufficient infrastructure and a complex tax system.

Nuclear Infrastructure

Research reactors: Brazil has four operational nuclear research reactors. In Sao Paulo, there are two research reactors (including a 5 MWe pool type reactor) and a cyclotron with radioisotope production.

Fuel: Brazil has 278,000 tons of known uranium. It is mined and used domestically, after conversion and enrichment abroad. Conversion is done by Areva in France. Most enrichment is conducted by Urenco in the United States or Europe. Efforts are underway to begin enriching uranium domestically. Currently, the Brazilian navy leases the uranium enrichment technology to Brazilian Nuclear Industries and produces centrifuges for it.

Waste Management: Nuclear waste is disposed of in four temporary repositories. A long-term solution is still being considered. CNEN is responsible for management and disposal of radioactive wastes.



U.S. Government Collaboration

123 Agreement: Brazil has had a 123 Agreement with the United States since 1999.

Strategic Energy Dialogue (SED): SED is one of the four high-level presidential dialogues between the United States and Brazil. One of the priority areas of intergovernmental cooperation in SED is nuclear energy.

International Engagement

The first nuclear contract was awarded to Westinghouse. In 1975, Brazil was to develop two reactors with West Germany, but construction was interrupted due to economic issues. The construction of Angra 2 was eventually resumed thanks to funding from German banks and newly formed Brazilian state owned companies, Furmas and Eletrobras. Brazil signed agreements with Germany in the 1970s to transfer nuclear technology and jointly develop experimental technology to enrich uranium. The completion of the third reactor, Angra 3, was awarded to Areva in 2008, which is also being considered for supplying additional reactors.

After Eletronuclear's proposed plan to build four more reactors, Areva, Westinghouse and Rosatom expressed interest in the projects. In June 2015, Westinghouse signed an agreement with Nuclebras Equipamentos Pesados for collaboration on fabrication of reactor components in Brazil. Rosatom offered a Build-own-operate project, which could solve the financing issue that other bidders face.

Figure 2: Additional Agreements	
Non-Proliferation Treaty	✓
IAEA Comprehensive Safeguards Agreement & Additional Protocol	
Joint Convention on Safety of Spent Fuel Management	✓
Convention on Nuclear Safety	✓
Convention on Early Notification of a Nuclear Accident	✓
Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency	✓
Paris Convention on Third Party Liability in the Field of Nuclear Energy	
Vienna Convention on Civil Liability for Nuclear Damage	✓
Joint Protocol Relating to the Application of the Vienna Convention and Paris Convention	
Convention on Supplementary Compensation for Nuclear Damage	
Organization Membership	
IAEA	✓
Nuclear Suppliers Group	✓
OECD/NEA	
IFNEC	
GenIV International Forum (GIF)	✓

This case study is part of a larger Top Markets Report. For additional content, please visit www.trade.gov/topmarkets.

Resources

For more information on the commercial opportunities in Brazil, contact: Brian Brisson (Minister Counselor for Commercial Affairs, Brian.Brisson@trade.gov); Regina Cunha (Senior Commercial Specialist , Regina.cunha@trade,gov).

For more information on the civil nuclear industry in Brazil, contact: CNEN website (http://www.cnen.gov.br/)

Sources

CIA Factbook, United Nations, World Nuclear Association, and our contacts at the US Embassy in Brasilia.