
# BRAZIL'S TECHNOLOGY SECTOR

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## PREFACE

This study provides a general assessment of major science and technology (S&T) developments in Brazil. The report is organized into eight sections: key findings, an introduction to the topic of S&T activities in Brazil, an overview of the Brazilian government, government S&T policy, funding for research and development (R&D), S&T priorities and the domestic and foreign participants in R&D, threats to and opportunities for pursuing S&T development, and a conclusion. Prominent Brazilian research facilities and their respective specialties are listed in an Appendix.

Whenever possible, the researcher used primary documents published by the Brazilian government. Other documents that were used in the research include reports by non-Brazilian government agencies (such as United States government agencies), intergovernmental organizations, and Brazilian and non-Brazilian media. The documents used in this paper were obtained from the collections and databases at the Library of Congress, including the Business Research Suite, Ingenta, Intelink, ISI Emerging Markets, Jane's Information Group, Lexis-Nexis, and the Open Source Center.

For the purposes of this study, the term S&T refers to processes, products, and services that may be created by R&D. In turn, R&D refers to the discovery of knowledge about processes, products, or services and the subsequent application of that knowledge to create new processes, products, or services.

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## KEY FINDINGS

- In 1999 the Brazilian government began to increase funding and other forms of support for research and development (R&D) and in 2003 began to provide unprecedented levels of funding for R&D. Since 2003, the government has supported research into numerous fields of science and technology (S&T), but the government's principal areas of interest appear to be agriculture, energy from biomass, nanotechnology, pharmaceuticals, semiconductors, and software.
- In 2004 the Brazilian government established the Industrial, Technological, and Foreign Trade Policy (PITCE) as its national strategy to support economic and social development. The PITCE listed nanotechnology, pharmaceuticals, semiconductors, and software as "strategic" research subjects that are to be developed and supported by the government.
- Statistics on R&D funding vary, but one 2005 study estimates that R&D spending increased from US$3.7 billion in 1990 to US$23.9 billion in 2004 and is expected to balloon to US$32.6 billion by 2006.
- The Brazilian government has provided the majority of funding for R&D in Brazil and thus has had far greater influence on S&T development than the private sector. However, the government has attempted to increase private-sector involvement in R&D.
- The Ministry of Science and Technology has emerged as the most important government ministry for administering S&T, largely because it administers numerous R&D funding programs that have been created since 1999.
- The government has funding programs for at least 20 specific fields of research, including agriculture, nanotechnology, pharmaceuticals, semiconductors, software, and telecommunications.
- Little information is available about foreign spending in Brazilian R&D. Available evidence suggests that foreign investment in R&D is minimal but increasing, and that an overwhelming amount of foreign R&D investment comes from the United States.
- Brazil maintains relationships with many foreign governments for R&D, including Argentina, France, India, South Africa, and Spain.

- Brazil's space program has formal agreements or has cooperated on specific projects with Argentina, China, France, Russia, Ukraine, and the United States. Brazil has expressed interest in working with Arab countries, particularly Algeria, in space technology.
- Military spending has focused on modernizing and upgrading existing equipment—particularly armored vehicles and artillery—rather than developing new equipment. Plans to improve military equipment have focused on purchases and local production by domestic defense contractors, which have suffered economically since the 1980s.
- From 2000 to 2006, Brazil's key military technology developments have been in missiles developed indigenously or through foreign cooperation. Russia and South Africa have been major partners in missile development.
- The principal foreign suppliers of military equipment to Brazil have been France, the United Kingdom, and the United States. France and South Africa have been the principal foreign partners in production.
- There is much speculation as to whether or not Brazil has abandoned earlier efforts to develop or acquire nuclear weapons capabilities. In 2006 Brazil Nuclear Industries began operating a uranium enrichment plant built with technology developed by Brazil's navy. Reportedly, Brazil is conducting research on the use of thorium for nuclear energy, and it has substantial natural reserves of thorium for such purposes, estimated at 1.2 million tons.

## INTRODUCTION

Large-scale research and development (R&D) of science and technology (S&T) in Brazil is a relatively recent enterprise. The Brazilian government has had agencies for promoting S&T since the early 1950s, but funding and conduct of R&D did not begin to increase substantially until the 1990s. After a brief decline between 2000 and 2002, R&D-related activities accelerated to unprecedented levels beginning in 2003 following the election of a new government led by President Luiz Inácio Lula da Silva. The government has created various programs to support domestically produced technology as a means of promoting economic and social development.

The Brazilian government has provided the majority of financial support for R&D, directing most funding toward universities, which historically have been the major participants in Brazil's S&T research. Domestic and foreign private entities also have increased funding for R&D since the late 1990s, but such funds continue to occupy a minority position in overall R&D financial support.

Government R&D funding has largely proceeded according to the Industrial, Technological, and Foreign Trade Policy (PITCE), which was established in March 2004 as a blueprint for improving Brazil's economic and social development. The PITCE explicitly emphasizes nanotechnology, pharmaceuticals, semiconductors, and software as areas that could help the country meet its development needs.[1] Government funding for these and other technologies has been administered through subject-specific "sector funds" and funding programs for particular research areas, such as the FUNTTEL program for telecommunications. The government has attempted to promote private-sector participation in R&D through financial support of public-private collaboration in R&D, privatization of government entities, strengthening of the patent law, and introduction of R&D tax credits.

These efforts have produced mixed but encouraging signs. By 2004, Brazil had 283 facilities to provide training and other forms of assistance to help businesses become established during their start-up phase (business incubators), which was the highest number in Latin

[1] Rede Nacional de Informações sobre o Investimento, "The Industrial, Technological and Foreign Trade Policy – PITCE" (Brasília: Federative Government of Brazil, 2004). <http://investimentos.desenvolvimento.gov.br/renai_en/arquivos/RENAIlistaalteracoesiteNoticiasrepor53.pdf> (accessed on October 12, 2006).

America.[2] Moreover, foreign governments and private firms increasingly are expressing interest in participating in R&D activities with Brazilian entities, particularly in fields such as aerospace, nuclear and biodiesel energies, and information technology.

On the other hand, there has been little reporting of noteworthy Brazilian S&T developments resulting from recent government-funded projects. This is largely because R&D in Brazil is in its early stages, and a substantial amount of the government R&D funding has been directed toward the creation of R&D infrastructure, such as research facilities. In addition, much R&D funding has not been directed to the creation of products or processes that would gain international recognition or market share. Rather, the common objectives of R&D spending have been to create inexpensive duplicates of existing imported consumer products (such as digital televisions) and to create technologies that are purely intended to support domestic economic, environmental, and social development priorities, such as technologies for sustainable agriculture.

Furthermore, despite substantial government efforts to promote private-sector involvement in R&D, the private sector has shown mixed signs of doing so. According to a 2005 Brazilian government report on private-sector innovation, the number of Brazilian companies that created innovations in products or processes grew from approximately 22,700 in 2001 to nearly 28,000 in 2003, an increase of nearly one-third. However, these companies were a relatively small percentage of the total number of companies in Brazil: in 2003 approximately 31.5 percent of Brazilian companies introduced innovations in processes, and 5.3 percent introduced innovative products. The percentage of companies that engaged in government-funded R&D activities—and that received government support for such—increased from 16.9 percent in 2000 to 18.7 percent in 2003, which amounts to approximately 5,000 companies.[3]

[2] FINEP, "The Brazilian Innovation Agency 2005" (Rio de Janeiro: Federative Government of Brazil, 2005). <http://www.finep.gov.br-FINEP_folder_ingles.pdf> (accessed on October 5, 2006); and Centro Incubador de Empresas Tecnológicas, "Institutional: The Movement in Brazil" (Butantã: 2005). <http://www.cietec.org.br/pages_ing.php?pagina=movibrasiling> (accessed on October 6, 2006).

[3] Instituto Brasileiro de Geografia e Estatística, *Pesquisa Industrial de Inovacao Tecnologica 2003* (Rio de Janeiro: 2005), 46–50. <http://www.ibge.gov.br/home/estatistica/economia/industria/pintec/2003/pintec2003.pdf> (accessed on September 28, 2006); and Jorge Brito, "Cooperação Tecnológica e Esforços Inovativos na Indústria Brasileira: um estudo exploratório a partir da PINTEC," *Anais do XI Encontro Nacional de Economica Politica da SEP* (Uberlândia, BR: Instituto de Economia, Universidade Federal de Uberlândia, June 2004). <http://www.ie.ufu.br> (accessed on September 28, 2006).

## OVERVIEW OF THE BRAZILIAN GOVERNMENT

Brazil is the largest, most populous country in South America and is also the region's most economically and militarily influential country. Formally called the Federative Republic of Brazil, the country consists of 26 states and the federal district of Brasília, which is the nation's capital. Both the federal and state governments consist of executive, legislative, and judicial branches.[4] The president is the chief executive and head of state and is directly elected for a four-year term. The current president, Luiz Inácio Lula da Silva (Lula), with the left-leaning Worker's Party (PT), was first elected in October 2002 and then reelected in October 2006.[5] The national legislature is the bicameral Congress, which consists of the 81-seat Federal Senate (the upper house) and the 513-member Chamber of Deputies. Three senators are elected from each of the 26 states and the federal district of Brasilia and serve eight-year terms; members of the Chamber of Deputies are directly elected based on proportional representation and serve four-year terms.[6]

## OVERVIEW OF BRAZILIAN GOVERNMENT S&T POLICIES

The Brazilian government's involvement in S&T has changed substantially in the last few decades. The Brazilian government had no agency to support R&D of S&T until 1951,when the government created the National Research Council (now called the National Council for Scientific and Technological Development or CPNq). In the 1970s, the government attempted to establish a strong S&T base and invested heavily in steel production, energy, communications, and transportation. In the 1970s and 1980s, technology investments were primarily provided to large-scale government projects conducted by state-owned corporations and the military, while universities developed most scientific capabilities. However, economic stagnation in the 1980s undercut investments in R&D, and S&T developments failed to provide significant economic benefits, although there were impressive developments in space research and aeronautics during this time.

Since the late 1990s, the government has substantially changed its approach to S&T by increasing its funding for R&D to unprecedented levels and also formally prioritizing the support

[4] Rex A. Hudson, ed., *Brazil: A Country Study* (Washington, DC: GPO, 1998).
[5] "Brazil Re-elects President Lula," BBC News (30 October 2006).
<http://news.bbc.co.uk/1/hi/world/americas/6095820.stm> (accessed on October 30, 2006).

and development of certain technologies, namely nanotechnology, pharmaceuticals, semiconductors, and software, particularly since 2004. These efforts have been undertaken to make the country economically self-sufficient and to enable it to better withstand international economic and political pressures. The Ministry of Science and Technology (MCT) has emerged as the most prominent agency in R&D for these and other technologies, largely because it is the main source of government research funding. Other government ministries also finance R&D in specific fields of research. For example, the ministries of agriculture and industry support research into such fields as alternative energies and space. As of 2006, eight government ministries and their subordinate agencies supported R&D, generally through funding specific fields of research (see Table 1).

**Table 1. Brazilian Government Ministries Involved in R&D**

| Ministry | Agency | Focus |
|---|---|---|
| Agriculture | Brazilian Agricultural Research Corporation (EMBRAPA) | Agriculture |
| Communications | Center for Telecommunications Research and Development (CPqD) | Telecommunications |
| Defense | Aeronautic Technology Institute (ITA) | Aeronautics |
| | Aerospace Technology Center (CTA) | Space research |
| | Military Engineering Institute (IME) | Military Ordnance |
| Education | Universities, technical schools | University R&D |
| | Committee for Postgraduate Courses in Higher Education (CAPES) | University R&D |
| Environment | | Environmental protection |
| Health | Oswaldo Cruz Foundation (FioCruz) | Health R&D |
| Industry, Commerce, and Tourism | Brazilian Agency for Industrial Development (ABDI) | Development of private-sector industries, including R&D |
| | National Institute of Metrology, Standardization and Industrial Quality (INMETRO) | Measurement, nanotechnology, and standardization |
| | National Institute of Industrial Property (INPI) | Intellectual property protection |
| Science and Technology | National Council for Scientific and Technological Development (CNPq) | R&D funding agency, via sectorial and other funds |

[6] Hudson, 263–79.

**Table 1. Brazilian Government Ministries Involved in R&D**

| Ministry | Agency | Focus |
|---|---|---|
| | Research and Projects Financing (FINEP) | R&D funding agency, via sectorial and other funds |
| | Center for Management of Strategic Studies (CGEE) | Research assessment |
| | Brazilian National Space Agency (INPE) | Space research |
| | Nuclear Commission | Nuclear research |
| Source: Sergio M. Rezende, "Financing Science, Technology and Innovation in Brazil" (Rio de Janeiro: Agencia da Ciencia e Tecnologia, Ministerio da Cienca e Tecnologia, 2006) <agenciact.mct.gov.br/upd_blob/40861.pdf> (accessed on October 23, 2006). | | |

## FUNDING FOR R&D IN BRAZIL

Statistics on funding for R&D in Brazil vary, but according to one 2005 estimate spending on R&D in Brazil increased from US$3.7 billion in 1990 to US$23.9 billion in 2004 and is expected to increase to US$32.6 billion for 2006.[7] In 2005 the Brazilian government provided 60.2 percent (not including public industries, such as military industries, and universities) of total R&D funding, Brazilian industries provided 38.2 percent, and universities provided 1.6 percent.[8] Despite the high level of funding by the government, government funding for R&D constituted 1.6 percent of Brazil's gross domestic product (GDP) in 2005, which is below the 2.0 to 4.0 percent of GDP invested by Japan, the United States, and many European countries.[9]

### Federal Government Funding for R&D

The Ministry of Science and Technology administers the two main agencies that manage R&D research financing: Research and Projects Financing or FINEP (Financiadora de Estudos e Projetos) and the National Council for Scientific and Technological Development or CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico). There is some overlap in the

[7] Jules Duga, Tim Studt, and Andrew Dearing, "2005 Global R&D Report: The State of Global R&D," *R&D Magazine* (September 2005): G12. Note that figures for funding by the Brazilian government do not include funding by universities, which is counted as a separate funding category, nor by public industries, such as the military, which are included in statistics for funding by industry.
[8] Duga, Studt, and Dearing, G12.
[9] "Brazil Must Invest 2% of GDP in Research and Development to be More Competitive," *NoticiasFinancieras* [Miami] (September 23, 2005): 1; and Duga, Studt, and Dearing, G3.

type of research that FINEP and CNPq fund, but in general CNPq provides only non-reimbursable scholarships and grants to individuals and research groups whereas FINEP only provides grants to nonprofit institutions, such as universities and research centers, as well as loans to private institutions.[10]

FINEP grants and loans for R&D are provided through a number of programs, the most important of which are the "science and technology sectorial funds" and the Inovar project (literally "to innovate"). The sectorial funds are essentially funding instruments for specific research fields (see Table 2), university and business R&D cooperation, and R&D infrastructures at universities and research institutions. Each fund is administered by either FINEP or CNPq, and the program is managed by a committee that includes the Ministry of Science and Technology and the ministries representing the industries covered by the sectorial funds. The total budget for the sectorial funds, which were established in 1999, increased from BRL343 million (US$117.4 million) to BRL800 million (US$328.5 million) from 2002 to 2005. The sectorial funds are derived mostly from taxes on private companies' consumption of natural resources owned by the federal government. Grants from sectorial funds are directed to projects through calls for proposals published by the Ministry of Science and Technology, FINEP, and CNPq. Loans from FINEP are provided through proposals from public and private research entities and are financed through FINEP's own budget.[11]

**Table 2. Brazilian Government S&T Sectorial Funds, 2003 and 2005**

| Sectorial Fund | Managing Agency | 2003 Funding (BRL) | % of 2003 Total | 2005 Funding (BRL) | % of 2005 Total |
|---|---|---|---|---|---|
| Aeronautics | CNPq | 725,925.00 | 0.3% | 13,325,987.06 | 3.1% |
| Agronomy | CNPq | 2,292,856.92 | 1.0% | 13,445,949.15 | 3.1% |
| Amazon | FINEP | 0 | 0.0% | 10,272,844.12 | 2.4% |
| Biotechnology | FINEP | 140,000.00 | 0.1% | 10,123,999.43 | 2.4% |
| Energy | CNPq | 12,656,373.00 | 5.6% | 38,214,782.14 | 8.9% |
| Health | CNPq | 4,192,800.00 | 1.9% | 9,338,233.04 | 2.2% |
| Information | CNPq | 10,187,215.10 | 4.5% | 13,334,600.89 | 3.1% |

[10] Instituto Brasileiro de Geografia e Estatística, *Pesquisa Industrial de Inovacao Tecnologica 2003*, 46–50; FINEP, "The Brazilian Innovation Agency 2005;" and FINEP, "Formas de Atuação" (Rio de Janeiro: n.d.). <http://www.finep.gov.br/o_que_e_a_finep/formas_atuacao.asp?codSessaoOqueeFINEP=3> (accessed on October 13, 2006).

[11] Agencia Brasileira de Desensolvimento Industrial, "Balanço PITCE 2005," 4; and FINEP, "The Brazilian Innovation Agency 2005."

**Table 2. Brazilian Government S&T Sectorial Funds, 2003 and 2005**

| Sectorial Fund | Managing Agency | 2003 Funding (BRL) | % of 2003 Total | 2005 Funding (BRL) | % of 2005 Total |
|---|---|---|---|---|---|
| Infrastructure | FINEP | 78,086,323.84 | 34.8% | 127,747,977.17 | 29.8% |
| Minerals | CNPq | 407,460.50 | 0.2% | 2,032,579.38 | 0.5% |
| Petroleum | CNPq | 23,595,347.43 | 10.5% | 39,092,109.50 | 9.1% |
| River ways | FINEP | 0 | 0.0% | 1,311,593.77 | 0.3% |
| Space | CNPq | 1,300,000.00 | 0.6% | 1,361,938.82 | 0.3% |
| Transportation | CNPq | 599,524.11 | 0.3% | 37,323.15 | 0.0% |
| Water | CNPq | 4,438,955.37 | 2.0% | 11,524,986.20 | 2.7% |
| Other | FINEP | 17,954,456.29 | 8.0% | 29,942,905.32 | 7.0% |
| Public-Private | FINEP | 68,101,080.15 | 30.3% | 106,367,600.22 | 24.8% |
| **Total** | | 224,678,317.71 | 100% | 428,862,549.36 | 100% |

Source: FINEP, "Liberações Efetuadas [2003]." Rio de Janeiro: n.d. <http://www.finep.gov.br/numeros_finep/fundos_setoriais/liberacoes_2003.asp> FINEP, "Liberações Efetuadas [2005]." Rio de Janeiro: n.d. <http://www.finep.gov.br/numeros_finep/fundos_setoriais/liberacoes.asp?codSessaoFundos=5> Please note that FINEP does not provide funding statistics for the telecommunications sectorial fund (FUNTTEL).

In May 2000, FINEP initiated the Inovar project in order to coordinate venture capital funding by government agencies, professional organizations, and private investors for small- and medium-sized technology-based companies attempting to develop technologies with potential benefits for the economy and social development. Historically, small- and medium-sized companies generally have not obtained financing through traditional credit systems, and venture capital historically has lacked an institutional structure in Brazil. Funding, services, and other forms of support for Inovar also are provided by international financial institutions such as the Inter-American Development Bank, Brazilian government agencies, and Brazilian professional organizations such as the Brazilian Association of Agencies Promoting Advanced Technological Projects (ANPROTEC) and the Society for Promoting the Excellence of Brazilian Software (SOFTEX). Inovar also includes a number of subordinate projects, including the Inovar Fund Incubator, the Brazil Innovation Forum, the Brazil Venture Capital Web site, the Inovar Business Prospecting and Development Network, and programs to train venture capital agents and to support them.[12]

[12] Capital de Risco Brasil, "All About It" (n.p.: 2002).
<http://www.capitalderisco.gov.br/VCN_ING/EN_oquee_PI.asp> (accessed on October 6, 2006).

Since 2001, six venture capital funds have been established through Inovar (CRP Venture VI, GP Technology, Novarum, Rio Bravo Investech II, SPTec, and Stratus VC). These funds' available financial resources range from BRL24 million (US$9.9 million) to BRL130 million (US$53.4 million). In addition, three other approved venture capital funds (Fundotech II, JBVC 1, Stratus VC III) are in their capitalization phase. In December 2005, FINEP launched the Inovar Semente program to provide an anticipated BRL300 million (US$123.2 million) to emerging companies. Private investors are expected to provide 20 percent of the eventual funding for projects financed under this program, state and municipal government agencies are expected to provide 40 percent, and FINEP is to provide the remaining 40 percent.[13]

Other government-supported programs to finance or otherwise support R&D are the CNPq-administered National Program for Human Resource Training in Strategic Areas (RHAE), which provides grants to private and public institutions seeking to employ experts in short-term projects; FINEP's Program of Technological and Export Support (PROGEX), which provides technology support to small companies; and FINEP's National Program of Support to Incubator Companies (PNI). Nearly 1,100 companies use these programs.[14]

Government funding for R&D is also provided through official banks, such as the National Bank for Economic and Social Development (BNDES), the Central Bank of Brazil (BCB), the Federal Savings Bank (CEF), and the Bank of the Northeast. Such funds are generally utilized by companies to finance the purchase of machinery and equipment used for innovation in products and processes.[15]

On June 20, 2006, BNDES started the Technology Fund (FUNTEC) to provide financial subsidies for projects conducted jointly by public or private companies with nonprofit research organizations, such as research institutes and universities. The Ministry of Development, Industry, and Trade (MDIC) administers a funding program called FUNTEC, which supports the objectives stated in the government's 2004 blueprint for industrial development, the Industrial, Technical, and Foreign Commerce Policy (PITCE). FUNTEC was created with BRL153

[13] Capital de Risco Brasil, "Fundos INOVAR Venture Capital" (Rio de Janeiro: n.d.). <http://www.capitalderisco.gov.br/vcn/fundos_venture_PI.asp> (accessed on October 6, 2006); Capital de Risco Brasil, "Dúvidas mais frequentes" (Rio de Janeiro: n.d.). <http://www.capitalderisco.gov.br/vcn/htms/duvidas.htm > (accessed on October 6, 2006); and FINEP, "INOVAR Semente" (Rio de Janeiro: n.d.). <http://www.capitalderisco.gov.br/vcn/inovar_semente_PI.asp> (accessed on October 6, 2006).

[14] Instituto Brasileiro de Geografia e Estatística, *Pesquisa Industrial de Inovacao Tecnologica 2003,* 46–50; and FINEP, "The Brazilian Innovation Agency 2005".

[15] Instituto Brasileiro de Geografia e Estatística, *Pesquisa Industrial de Inovacao Tecnologica 2003,* 46–50.

million[16] (US$69.5 million), but the total value of projects that BNDES has identified for funding totals BRL286 million (US$130 million).[17]

### State Government Funding for R&D

State governments also fund R&D, but in far lower amounts than those provided by the federal government. One such program is the Program for Supporting Research in Enterprises (PAPPE), which is managed by FINEP. PAPPE is a partnership of 18 states' R&D foundations that was started in October 2003 to provide grants to researchers working in or with small high-tech companies to produce innovative projects. In 2004 and 2005, FINEP allocated a total of BRL87 million (US$35.7 million) to PAPPE from the sectorial funds for agronomy, biotechnology, energy, health, and public-private research cooperation. States' R&D foundations are to provide matching or greater funds totaling BRL170 million (US$69.8 million), and institutions are expected to also supply funding. However, there are limits on FINEP funding, which ranges from BRL50,000 (US$20,500) to BRL150,000 (US$61,600) depending on the stage of the research project.[18]

### Foreign Funding for R&D

There is little information about foreign funding for R&D in Brazil, but available information suggests that while foreign direct investment in Brazil has increased since 1995, foreign investment in R&D has been minimal.[19] For example, between 1995 and 2000 the

[16] BRL is the International Organization for Standardization's currency code for Brazil's currency, the real. See International Organization for Standardization, "ISO 4217 Currency Names and Code Elements" (Geneva: 2006). <http://www.iso.org/iso/en/prods-services/popstds/currencycodeslist.html> (accessed on October 2, 2006).

[17] Banco Nacional de Desenvolvimento Econômico e Social, "Technology Fund" (Rio de Janeiro: n.d.). <http://www.bndes.gov.br/english/funtec.asp> (accessed on October 2, 2006); Banco Nacional de Desenvolvimento Econômico e Social, "Innovation" (Rio de Janeiro: n.d.). < http://www.bndes.gov.br/english/innovation.asp> (accessed on October 2, 2006); and Janaina Simões, "Funding: Brazil Development Bank Launches Support Initiative for R&D in Strategic Areas and Encourages Business-Academia Partnership," *Unicamp Innovation* [Campinas, São Paulo, BR], (August 9, 2006). <http://www.inovacao.unicamp.br/english/report/news-technologyfund.shtml> (accessed on October 2, 2006).

[18] FINEP, "The Brazilian Innovation Agency 2005"; and FINEP, "Programa de Apoio à Pesquisa em Empresas" (Rio de Janeiro: n.d.). <http://www.finep.gov.br/programas/pappe.asp> (accessed on October 6, 2006).

[19] Banco Centro do Brasil, *Boletim do Banco Central do Brasil, March 2005 Volume 41 – Number 3* (Brasília: 2005): 157. <http://www.bcb.gov.br/ftp/histbole/bol200203i.pdf> (accessed on October 6, 2006); and Banco Centro do Brasil, *Boletim do Banco Central do Brasil, Abril 2006 Volume 42 – Número 4* (Brasília: 2006): 159. <http://www.bcb.gov.br/ftp/histbole/Bol200604p.pdf> (accessed on October 6, 2006) (Source for 2004 and 2005 data).

earnings from foreign R&D investments in Brazil (i.e. "total capital paid in by non-residents") increased from US$41.7 billion to US$103 billion. However, R&D received only 0.3 percent of those funds in 1995 and 0.7 percent in 2000. In 2000, 99 percent of foreign investment in R&D came from the United States, followed by the Cayman Islands at 0.4 percent, and the Netherlands at 0.1 percent. The remainder of the funding came from Chile, Japan, Panama, the United Kingdom, and other unnamed countries. Foreign R&D expenditures have been in sectors with high technological content, such as the manufacturing of electronics, communications equipment, pharmaceutical products, computing products, and electrical equipment.[20]

Brazil does, however, maintain relationships with numerous foreign entities in R&D activities. For example, FINEP maintains strong relations with Spain's Centro para el Desarrollo Tecnológico Industrial (Center for Industrial Technological Development), OSEO (the French government's S&T organization), and IBEROEKA, an organization that coordinates innovation efforts among Latin American countries and that also counts Portugal as a member.[21] On March 5, 2004, Brazil signed a "trilateral plan of action" with India and South Africa that stipulated cooperation and collaboration in numerous subject areas, including R&D in alternative and renewable energies, astronomy and astrophysics, biotechnology, information technologies, meteorology and climate change, and oceanography, fisheries science, and Antarctic research. Modes of cooperation included collaborative and cooperative R&D, exchange of scientists, information exchanges, specialized training, technology transfers, and trilateral workshops.[22]

[20] Rede Nacional de Informacoes sobre o Investimento, "FDI Inflows in Brazil – Inward Investment – Annual – 1995-2005" (Brasília: Ministério do Desenvolvimento, Indústria e Comércio Exterior, n.d.). <http://investimentos.desenvolvimento.gov.br/renai_en/arquivos/IEDfluxoSITERENAI.pdf> (accessed on October 6, 2006); Banco Centro do Brasil, *Census of Foreign Capitals in Brazil – 1995 Base Year* (Brasília: 1998). <http://www.bcb.gov.br/?CENSUS1995> (accessed on October 6, 2006); Banco Centro do Brasil, *Census of Foreign Capitals in Brazil – 2000 Base Year* (Brasília: n.d.). <http://www.bcb.gov.br/CENSUS2000> (Source for 1995 and 2000 total capital paid in for 1995 and 2000). <http://www.bcb.gov.br/ingles/censo/2000/CENSUS2000SectionIII-FDI_Stock.xls> (accessed on October 6, 2006). (Source for 1995 and 2000 capital paid in by non-residents data); and Jorge Brito, "Cooperação Tecnológica e Esforços Inovativos na Indústria Brasileira: um estudo exploratório a partir da PINTEC."

[21] FINEP, "Liberações Efetuadas, Cooperação Internacional" (Rio de Janeiro: n.d.). <http://www.finep.gov.br/cooperacao_internacional/cooperacao_ini.asp?codSessaoOqueeFINEP=5> (accessed on October 13, 2006).

[22] South Africa, Department of Foreign Affairs, "RSA-Brazil-India Joint Statement on New Delhi 'Agenda for Cooperation'," (Johannesburg: 2004). (Open Source Center document AFP20040305000079).

## THE BRAZILIAN GOVERNMENT'S S&T PRIORITIES

The Brazilian government has, in various ways, supported research into numerous fields of S&T, but the government's principal areas of interest appear to be agriculture, energy from biomass, nanotechnology, pharmaceuticals, semiconductors, and computer software. The emphasis on these fields of research is apparent in various federal government policies and R&D funding instruments that were established from 1999 to 2006.

In 1999 the Brazilian government established "sectorial funds" (see Table 2) to target government R&D financing to specific economic sectors. As mentioned previously, CNPq and FINEP, both of which are under the authority of the Ministry of Science and Technology, manage all of these funds, except one. The one exception is the sectorial fund for telecommunications, which is called FUNTTEL and is administered by the Ministry of Communications. Most sectorial fund financing has been provided to universities. Although the government has attempted to promote private-sector funding for research covered by the sectorial funds, there is little information about private-sector involvement in these fields of research.[23]

All of the sectorial funds are for specific fields of research, with the exception of a fund that supports collaborative research performed by public and private entities. This so-called public-private sectorial fund has received a high percentage of the overall funding for the sectorial funds, and 50 percent of it is financed through a fund called the Contribution on Intervention in the Economic Domain (CIDE), which is financed by taxes on natural resource consumption. According to FINEP, public-private research projects for 2003 and 2004 were for research on building materials, residence construction, and crab and shrimp cultivation (carciniculture).[24]

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[23] FINEP, "O que são os fundos de C&T" (Rio de Janeiro: n.d.). <http://www.finep.gov.br/fundos_setoriais/fundos_setoriais_ini.asp?codSessaoFundos=1> (accessed on October 6, 2006); FINEP, "Liberações Efetuadas [2005]" (Rio de Janeiro: n.d.). <http://www.finep.gov.br/numeros_finep/fundos_setoriais/liberacoes.asp?codSessaoFundos=5> (accessed on October 6, 2006); FINEP, "Liberações Efetuadas [2003]" (Rio de Janeiro: n.d.). <http://www.finep.gov.br/numeros_finep/fundos_setoriais/liberacoes_2003.asp> (accessed on October 6, 2006); and Banco Central do Brasil, "Focus February 18th, 2002" (Brasília: 2002). <http://www4.bcb.gov.br/Pec/Gci/Ingl/Focus/I20020218-Deregulation%20of%20the%20Oil%20Sector.pdf> (accessed on October 6, 2006).

[24] FINEP, "O que é o VERDE-AMARELO?" (Rio de Janeiro: n.d.). <http://www.finep.gov.br/fundos_setoriais/verde_amarelo/verde_amarelo_ini.asp?codFundo=5> (accessed on October 10, 2006); FINEP, "Chamadas Públicas Encerradas/Resultados" (Rio de Janeiro: n.d.).

In addition, all of the sectorial funds provide funding for a program referred to as "transversal actions," which was created in 2004 to support research in subject areas deemed of strategic importance for economic and social development in the government's policy document for industry, technology, and trade (PITCE, see below). These research areas include nanotechnology, pharmaceuticals, semiconductors, and software, but according to documentation of funded research projects, this program has also supported research in agriculture, energy, and water treatment. Furthermore, from 2004 to 2006 the transversal action program has largely financed the development of infrastructure for R&D and has also provided financial support to business incubators and technology parks. It should also be noted that the transversal action program is not a sectorial fund but rather is funded by sectorial funds, and thus financing for transversal actions is spread among sectorial funds. Funding statistics for transversal actions are not available as a category distinct from sectorial funds.[25]

In 2004 the Brazilian government established the PITCE as its national strategy plan to support economic and social development. These objectives are to be attained in part through a three-pronged policy of industrial modernization, export growth, and technological innovation and development. Promotion of the latter is to occur through measures such as tax incentives and funding for R&D relating to S&T, intellectual property protection, and the creation and support of small technology-based companies. The PITCE is not itself a funding instrument, but it does specifically enumerate "strategic" research subjects that are to be developed and supported by the government: nanotechnology, pharmaceuticals, semiconductors, and software. Other fields of research not identified in the PITCE continue to receive financial support from sectorial funds. Some sectorial funds have also been used to finance the aforementioned strategic research subjects along with other dedicated funding programs discussed later in this study.[26]

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<http://www.finep.gov.br/fundos_setoriais/verde_amarelo/verde_amarelo_resultados.asp?codSessao=8&codFundo=5> (accessed on October 10, 2006).
The Contribution on Intervention in the Economic Domain (CIDE), was established on January 1, 2002, and CIDE funds are used to finance environmental projects, transportation infrastructure, subsidies on various fuels, and the sectorial funds.

[25] FINEP, "Ações Transversais" (Rio de Janeiro: n.d.).
<http://www.finep.gov.br/fundos_setoriais/acao_transversal/acao_transversal_resultado.asp?codFundo=17> (accessed on October 10, 2006).

[26] Rede Nacional de Informacoes sobre o Investimento, "The Industrial, Technological, and Foreign Trade Policy—PITCE"; and Banco Nacional de Desenvolvimento Econômico e Social, "Technology Fund."

## Nanotechnology

Nanotechnology is one of the Brazilian government's most emphasized fields of S&T research. However, funding for nanotechnology research has fluctuated tremendously. Nanotechnology funding declined from BRL25.5 million (US$10.8 million) in 2001 to BRL17.5 million (US$6 million) in 2004, increased to BRL80.1 million in 2005 (US$33 million), and was BRL5.2 million (US$2.4 million) for the first quarter of 2006.[27]

In 2001 the Brazilian government launched a nanotechnology initiative to coordinate the research of nanotechnology research groups based in universities and national research centers. From 2001 to 2003, nanotechnology research was funded through programs that created nanotechnology research facilities and through sectorial funds for energy and petroleum. In 2004 the federal government released a four-year development spending plan (the "Pluriannual Plan 2004–2007" or "PPA 2004–2007") that stipulated the financing of specific issues by government agencies, including nanotechnology research funding by the Ministry of Science and Technology.[28] In 2004 nanotechnology began to be funded principally through sectorial funds for energy and through specific programs ("editals" or proclamations) for research infrastructure and cooperative research. The other funding source has been FINEP's transversal action program, which supports cross-disciplinary research projects such as nanotechnology.[29]

In August 2005, the government initiated the National Nanotechnology Program (PNN), which in 2005 and 2006 has provided funding of BRL71 million (US$29.2 million) for research on nanotechnology and nanobiotechnology. This funding supplemented nanotechnology R&D funding from other sources, including FINEP's transversal action program. The Ministry of Science and Technology administers the PNN, and the ministry's General Coordination of Micro and Nanotechnologies (CGNT) is responsible for coordinating nanotechnology research among various research entities. Of the BRL80.1 million (US$32.9 million) spent on nanotechnology R&D in 2005, BRL58.6 million (US$24.1 million) was directly provided to laboratories, and

[27] Ministério da Ciência e Tecnologia, "Relatório Nanotecnologia Investimentos, Resultados e Demandas" (Brasília: 2006), 12. <http://www.mct.gov.br/upd_blob/8075.pdf> (accessed on October 20, 2006).
[28] Ministério da Ciência e Tecnologia, "Relatório Nanotecnologia Investimentos, Resultados e Demandas."
[29] Ministério da Ciência e Tecnologia, "Relatório Nanotecnologia Investimentos, Resultados e Demandas."

BRL21.5 million (US$8.8 million) was used to finance microelectronics research projects and the creation of research institutions.[30]

Brazilian nanotechnology research has focused on biodegradable nanoparticles for drug delivery, magnetic nanocrystals, nanobiotechnology, nanomaterials, and nanotechnology for optoelectronics, biosensors, and tissue bioengineering. Brazilian researchers also have developed polymer-coated superparamagnetic nanoparticles that can be used to neutralize pollutants and then be recovered with a magnetic pump. Another development has been the creation of magnetic nanoparticles, which, when combined with citric acid, are used to remove heavy metals from soil and water.[31] In addition, the State University of Campinas and Padtec, a Brazilian company that produces optical communication systems, have received funding from FINEP to create nano-optical devices for semiconductors.[32] The medical field is also benefiting from Brazilian nanotechnology research. In 2006 the Laboratory of Solid State Chemistry and the Laboratory of Biological Chemistry worked jointly to transform silver ions into nanoparticles of metallic silver to treat lesions and on the use of nanoparticles of gold and violacein (the active principle of the bacteria Chromobacterium violaceum) to combat carcinogenic cells. The Physics Institute of the State University of Campinas reportedly has been involved in computer-simulated tests of carbon nanotubes, metallic nanowires, and nanotubes made of nanotubes.[33]

Brazilian research institutes conducting nanotechnology research include the Brazilian Center of Research Physics (CBPF), the National Institute for Measurement (INMETRO, the government agency for measurement and standardization), the Embrapa Instrumentation and Strategic Technology Center (CETENE), the National Laboratory of Synchroton Light (LNLS),

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[30] Ministério da Ciência e Tecnologia, "Programa Nacional de Nanotecnologia" (Brasília: n.d.). <http://www.mct.gov.br/index.php/content/view/27137.html> (accessed on October 10, 2006); Peter A. Singer, Fabio Salamanca-Buentello, and Abdallah S. Daar, "Harnessing Nanotechnology to Improve Global Equity: The Less Industrialized Countries are Eager to Play an Early Role in Developing this Technology; the Global Community Should Help Them," *Issues in Science and Technology*, 21, no. 4 (June 22, 2005): 57–58 (accessed via Lexis-Nexis).

[31] Singer, Salamanca-Buentello, and Daar, 57–58.

[32] FINEP, "Chamada Pública MCT/FINEP – Ação Transversal – Nanotecnologia – 03/2005 Propostas Aprovadas" (Rio de Janeiro: 2005). <http://www.finep.gov.br//fundos_setoriais/acao_transversal/resultados/resultado_aprovadas_Acao_Transversal_NANOTECNOLOGIA_03_2005.PDF> (accessed on October 19, 2006).

[33] Agençia Brasileira de Desensolvimento Industrial, "Balanço PITCE 2005" (Brasília: 2006), 18; Rachel Bueno, "Nanotechnology: Unicamp's Chemistry Institute Develops Process for Silver Nanoparticles; Gold Particles Can Be Used for Drug Delivery," *Unicamp Innovation* [São Paulo], June 5, 2006). <http://www.inovacao.unicamp.br/english/report/news-nanotechnology060522.shtml> (accessed on October 3, 2006); and "Nanoscientist Douglas Galvão," *Unicamp Innovation* [São Paulo], June 5, 2006). <http://www.inovacao.unicamp.br/english/report/interview-douglasgalvao.shtml> (accessed on October 4, 2006).

the Physics Institute of Campinas State University (Unicamp), the Laboratory of Solid State Chemistry at Campinas State University, and the Laboratory of Biological Chemistry at Campinas State University.[34] There is also a plan to create a national nanotechnology center at INMETRO.[35]

Foreign entities also have been involved in Brazilian nanotechnology research. France has supported five nanotechnology projects in Brazil, and Argentina and Brazil have jointly maintained the Brazilian-Argentine Nanotechnology Center (CBAN) since 2004. The Brazilian government also has conducted exploratory missions for nanotechnology research cooperation with Australia, Japan, South Africa, Switzerland, and the United Kingdom.[36]

### Pharmaceuticals

The pharmaceuticals produced in Brazil are generally for the Brazilian consumer market and include analgesics, anti-inflammatories, and many other pharmaceuticals for common health problems. Based on publicly available information, the pharmaceuticals field appears to be one with high private-sector participation. The Brazilian Association of Pharmochemical Industries (ABIQUIF) lists 29 members, including subsidiaries of foreign companies.[37] One prominent R&D program for pharmaceuticals is the Support Program for Brazil's Development of the Pharmaceutical Productive Chain (PROFARMA), which is funded by Brazil's Development Bank. Created in 2004, the program was established to support existing investments made by Brazilian industries in the production and R&D of various health products, including chemical intermediary products, vegetable extracts, pharmaceuticals, and medicines. PROFARMA fund recipients include Libbs and Nortec, both based in Brazil.[38]

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[34] Agençia Brasileira de Desensolvimento Industrial, "Balanço PITCE 2005," 18; Rachel Bueno, "Nanotechnology"; and "Nanoscientist Douglas Galvão."

[35] "Nanotecnologia no Brasil," *Inovação Unicamp* [São Paulo], (July 14, 2005). <http://www.inovacao.unicamp.br/report/news-nanotec20050715.shtml> (accessed on October 12, 2006).

[36] Agençia Brasileira de Desensolvimento Industrial, "Balanço PITCE 2005" (Brasília: 2006), 18; Ministério da Ciência e Tecnologia, "Relatório Nanotecnologia Investimentos, Resultados e Demandas"; and Ministério da Ciência e Tecnologia, "Cooperação Internacional" (Brasília: n.d.). <http://www.mct.gov.br/index.php/content/view/17255.html> (accessed on October 10, 2006).

[37] Associação Brasileira da Indústria Farmoquímica, "Index 2006" (Rio de Janeiro: 2006), 17–93. <http://www.abiquif.org.br/in/index.htm> (accessed on October 19, 2006).

[38] Nacional de Desenvolvimento Econômico e Social, "Support Program for the Development of the Pharmaceutical Productive Chain – PROFORMA" (Rio de Janeiro: n.d.). <http://www.bndes.gov.br/english/profarma_in.asp> (accessed on October 2, 2006); Banco Nacional de Desenvolvimento Econômico e Social, "News 03.14.05" (Rio de Janeiro: 2005). <http://www.bndes.gov.br/english/news/not052_05.asp> (accessed on October 18, 2006); and Banco

## Semiconductors

In July 2001, the government established the FINEP-funded National Microelectronics Program (Programa Nacional de Microelectrônica—PNM) to establish incentives for microelectronics development in Brazil; however, Brazil does not yet have commercial-scale semiconductor manufacturing capability. This situation may change, as the Center of Excellence in Advanced Electronics Technology (CEITEC) is expected to begin producing integrated circuits in Porto Alegre in early 2007 with equipment provided by Motorola.[39] CEITEC is one of a few public and private research centers involved in producing semiconductors or supporting such production under the National Microelectronics Program. Other research centers include the CPqD Foundation (in Campinas, São Paulo), the Recife Advanced Studies and Systems Center (Cesar), and the Genius Institute (Manaus).[40]

Electronic component production in Brazil has generally been limited to passive components, such as capacitors and resistors, rather than semiconductors. Brazilian companies that manufacture computer chips (AVX, Itaucom, and Murata) use imported components, such as silicon wafers and memory chips. One prominent foreign semiconductor producer in Brazil is Netherlands-based Philips, which has a semiconductor-manufacturing unit in Manaus that produces semiconductors and other parts for cellular telephones. Semiconductors are also used in auto parts manufacturing by numerous Brazilian and foreign companies, including Robert Bosch, Visteon Sistemas Automotivos, Magneti Marelli, Kostal Electromecânica, Siemens, and Indústria Marília de Autopeças.[41]

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Nacional de Desenvolvimento Econômico e Social, "BNDES contrata com a Libbs o primeiro financiamento do Profarma, 16.11.04" (Rio de Janeiro: 2004). <http://www.bndes.gov.br/noticias/2004/not922.asp> (accessed on October 18, 2006).

[39] "Ceitec," *Porto Alegre Tecnópole* (Porto Alegre: n.d.) <http://www.tecnopole.palegre.com.br/Default.asp?proj=88&secao=217&m1=19220> (accessed on October 10, 2006).

[40] Centro de Pesquisa e Desenvolvimento em Telecomunicações, "Foco na Modernização" (Campinas: 2004). <http://www.cpqd.com.br/site/ContentView.php?cd=867> (accessed on October 10, 2006).

[41] Rede Nacional de Informacoes sobre o Investimento, "Industrial Policy" (Brasília: Ministério do Desenvolvimento, Indústria e Comércio Exterior, n.d.). <http://investimentos.desenvolvimento.gov.br/renai_en/index.asp> (accessed on October 10, 2006); Rede Nacional de Informacoes sobre o Investimento, "Brazil Electronic Component Market Report, March/2004" (Brasília: Ministério do Desenvolvimento, Indústria e Comércio Exterior, 2004). <http://investimentos.desenvolvimento.gov.br/renai_en/arquivos/compEletrIng.pdf> (accessed on October 10, 2006); Centro de Excelência em Technologia Eletrônica Avançada, "Objectivos Especificos" (Porto Alegre: Secretaria da Ciência e Tecnologia, n.d.). <http://www.sct.rs.gov.br/programas/ceitec/objetivos/objetivos_01.htm>

## Information Technology

Historically, Brazilian information technology (IT) producers have focused on services and hardware production more than software production. Brazilian software companies have generally developed their own technologies through reinvestment of their own capital. Their main product area has been systems integration, which has a far greater market share and fewer R&D requirements than electronic business software or software for document and content management.[42]

Since the late 1990s, domestic and foreign investment in the Brazilian IT industry, including government funding and private risk capital, has increased substantially. The primary government funding program for software development is the Development of the National Software and Related Services Industry (PROSOFT), which is financed through the Development Bank. In addition, FINEP administers a dedicated fund for computer science goods and information (CT–Info). From 2003 to 2005, the funds for CT–Info increased from BRL10.2 million (US$3.3 million) to BRL13.3 million (US$5.5 million).[43]

Since 2002, FINEP has funded dozens of software R&D projects. Based on the directives outlined in the PITCE, software R&D funds are supposed to be directed toward projects of interest to Brazilian companies, including automated banking, telecommunications, health, security, the Internet, and digital entertainment. According to FINEP, the most recent funding for software S&T development was granted to Brazilian universities for research on audible reply,

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(accessed on October 10, 2006); Centro de Excelência em Technologia Eletrônica Avançada, "Programa Nacional de Microelectrônica" (Porto Alegre: Secretaria da Ciência e Tecnologia, n.d.). <http://www.sct.rs.gov.br/programas/ceitec/pnme/pnme_01_eng.htm> (accessed on October 10, 2006); and Claudia Izique, "Once Again, in the Front Line," *Revisita Pesquisa FAPESP* [São Paulo ], no. 99 (May 2004). <http://www.revistapesquisa.fapesp.br/?art=1192&bd=1&pg=1&lg=en> (accessed on October 10, 2006).

[42] Massachusetts Institute of Technology and the SOFTEX Society, *The Software Industry in Brazil – 2002: Strengthening the Economy of Knowledge* (Campinas, BR: 2002). <http://www.softex.br/cgi/cgilua.exe/sys/start.htm?sid=108> (accessed on October 2, 2006); and Carlos H.C. Duarte, "Brazil: Cooperative Development of a Software Industry," *IEEE Software* (May/June 2002): 84–85. <http://ieeexplore.ieee.org/iel5/52/21654/01003461.pdf?arnumber=1003461> (accessed on September 29, 2006).

[43] Massachusetts Institute of Technology and the SOFTEX Society; Duarte, 84–85; FINEP, "Pagamentos Efetuadas 01/01/2003 até 31/12/2003" (Rio de Janeiro: n.d.). <http://www.finep.gov.br/numeros_finep/fundos_setoriais/liberacoes_2003.asp> (accessed on October 6, 2006); FINEP, "Pagamentos Efetuadas 01/01/2005 até 31/12/2005" (Rio de Janeiro: n.d.) <http://www.finep.gov.br/numeros_finep/fundos_setoriais/ptf2005/estado/total_estado.asp> (accessed on October 6, 2006); and Banco Nacional de Desenvolvimento Econômico e Social, "Program for the Development of the National Software and Related Services Industry – PROSOFT" (Rio de Janeiro: n.d.). <http://www.bndes.gov.br/english/progsoft_in.asp> (accessed on October 2, 2006).

cryptography, data mining, education, games, integrated project management systems, Internet-based geospatial services, multimedia applications, portable microcomputers, public roads, and sustainable water management.[44]

Brazil also partners with other countries on software and IT research projects. An example of such a partnership is Brazil's 2004 agreement to cooperate with India and South Africa on augmenting Internet infrastructure through grid and cluster (blade and middle range) computing, high-performance computing, and broadband communications networks.[45] Another example of such a partnership is the Brazilian state Paraná's April 2006 agreement with the Venezuelan government to collaborate on both open-access, free software applications and on a digital environment for collaborative software development. The agreement also provides the Venezuelan government with existing free software, including a system that provides common applications (such as e-mail), a free software development platform, the Linux/Debian operating system, and administrative system software (e-CAR). Furthermore, in May 2006, IBM announced that it would invest US$2.2 million in a joint project with the State University of Campinas in São Paulo for a Linux Technology Center.[46]

### Aerospace

Brazil is widely regarded as possessing Latin America's most advanced airplane manufacturing and space program, including launch vehicles, launch sites, and satellite manufacturing. Space program activities have been focused in four main programs: the China–Brazil Earth Resources Satellite (CBERS); the Applications Satellite program, which includes the Multi-Mission Platform and remote sensing payloads; the Program for Scientific Satellites for low-cost micro-satellites and frequent flight opportunities for research from space; and the

[44] FINEP, "Chamada Pública MCT/FINEP/CT-INFO-Software – 01/2003 Software Livre" (Rio de Janeiro: 2003). <http://www.finep.gov.br//fundos_setoriais/ct_info/resultados/resultado_chamada_publicaMCT_Finep_ct_info_01_2003.pdf> (accessed on October 19, 2006); FINEP, "Chamada Pública MCT/FINEP/CT-INFO-Software – 01/2004 Projetos Aprovados" (Rio de Janeiro: 2004). <http://www.finep.gov.br//fundos_setoriais/ct_info/resultados/resultado_CT_INFO_Grade_01_2004..PDF> (accessed on October 19, 2006); and FINEP, "Chamada Pública MCT/FINEP/CT-INFO-Software – 01/2005 Divulgação de Resultados" (Rio de Janeiro: 2005). <http://www.finep.gov.br//fundos_setoriais/ct_info/resultados/Resultado_CT_INFO_SOFTWARE_01_2005.PDF> (accessed on October 19, 2006).

[45] South Africa, Department of Foreign Affairs, "RSA-Brazil-India Joint Statement on New Delhi 'Agenda for Cooperation'."

[46] "Brazil: Paraná, Venezuela to Form Information Technology Partnership" *Paraná State News Agency* (April 19, 2006) (Open Source Center document LAP20060419357002).

Brazil–Ukraine agreement to design and market the Cyclone–4 rocket for commercial Geostationary Earth Orbit (GEO) missions. In 2004 the space program's objectives were reoriented toward meteorology, remote sensing, and telecommunications. FINEP's sectorial fund for space research has financed 17 projects emphasizing agriculture, communications, meteorology, oceanography, and remote sensing.[47]

Brazil has partnered with numerous countries on aerospace, particularly China, Russia, and Ukraine. Since its inception in 1994, the Brazilian Space Agency (AEB) has signed agreements with Argentina, China, France, Germany, Russia, Ukraine, the United States, and the European Space Agency.[48] In January 2005, for example, Brazil and China began working on prototypes of earth resource satellites. Brazil also is cooperating with the European Union (EU) and Chile on the Galileo satellite positioning system. In addition, Brazil has publicly expressed interest in working with numerous other countries on space technology, including cooperation with Arab countries, namely Algeria, through student and researcher exchanges.[49] Brazil also has observer status in the Asia Pacific Space Cooperation Organisation (APSCO), an organization formed in October 2005 by China and Pakistan "to join forces with nations on their respective experience, expertise and resources in developing space technology." Other members of the organization include Bangladesh, Indonesia, Iran, Mongolia, Peru, and Thailand. At its inception, Indonesia, Malaysia, the Philippines, Argentina, Turkey, and Ukraine also expressed interest in

[47] Instituto Nacional de Pesquisas Espacials, "Histórico: O Brasil no Espaço" (São José dos Campos: 2006). <http://www.inpe.br/scd1/site_scd/historico.htm> (accessed on October 6, 2006); Hudson, 452–53; H. Carvalho, J. Kono, M.M. Quintino, and L.F. Perondi, *Space Activities in Brazil* (Lindau: Copernicus Online Service and Information System, n.d.) <http://www.cosis.net/abstracts/COSPAR04/02819/COSPAR04-A-02819.pdf> (accessed on October 6, 2006); FINEP, "Pagamentos Efetuadas 01/01/2003 até 31/12/2003"; FINEP, "Pagamentos Efetuadas 01/01/2005 até 31/12/2005"; FINEP, "O que é o CT-Aero?" (Rio de Janeiro: n.d.) <http://www.finep.gov.br/fundos_setoriais/ct_aero/ct_aero_ini.asp?codFundo=12> (accessed on October 6, 2006); FINEP, "CT-Espacial – Fundo Setorial Espacial: O que é o CT-ESPACIAL?" (Rio de Janeiro: n.d.). <http://www.finep.gov.br/fundos_setoriais/ct_espacial/ct_espacial_ini.asp?codFundo=13> (accessed on October 19, 2006); "Brazil: Seeking Prestige and Exploring Space," *Stratfor Weekly* (November 30, 2004). <http://stratfor.com/products_pre_prev.php> (accessed on October 6, 2006); Ministério da Ciência e Tecnologia, "Programa Nacional de Atividades Espacias" (Brasília: 2006). <http://www.mct.gov.br/index.php/content/view/35257.html> (accessed on October 10, 2006); and Howard Wen, "IBM Ups Linux Ante in Brazil; Big Blue Will Invest $2.2 Million on a Linux R&D Center in Brazil," *Information Week* (May 24, 2006) (accessed via Business Research Suite database).

[48] Agéncia Espacial Brasileira, "Cooperação Internacional" (Brasília: 2005). <http://www.aeb.gov.br/conteudo.php?ida=4&idc=29> (accessed on October 31, 2006).

[49] Randa Achmawi, "Interview with Science and Technology Minister Sergio Rezende," *Brazil-Arab News Agency* (December 6, 2005) (Open Source Center document LAP20051206357003).

joining APSCO.[50] By contrast, the Brazilian government is believed to be reluctant to participate in the United States' Vision for Space Exploration, largely because of the Vision's perceived restrictiveness with technology transfers.[51]

The Brazilian government also has promoted R&D in aeronautics, including aeronautical and electronic engineering and mechanics. From 2003 to 2005, funding for the aeronautic sectorial fund increased from BRL725,925 (US$240,000) to BRL13.3 million (US$5.5 million), and funding for the space sectorial fund increased from BRL1.3 million (US$420,000) in 2003 to BRL1.4 million (US$575,000) in 2005.[52] One promising aeronautical development has been in non-conventional air-breathing propulsion engines (scramjets).[53] In addition, Brazilian researchers at the National Institute of Space Research and the Aerospace Technical Center have developed a supersonic combustion engine capable of flying at six times the speed of sound.[54]

Brazilian aircraft manufacturer Embraer has enjoyed substantial domestic and foreign commercial success. Many of Embraer's aircraft have been developed for civilian markets, but the company also has developed military aircraft for surveillance (EMB–145), light attack (EMB–314 Super Tucano), and training (EMB–312 Tucano). Buyers of these products have included Lockheed Martin and the air forces of Brazil, Colombia, and the United Kingdom. Venezuela also has emerged as a possible customer for Embraer.[55] The EMB–314 Super Tucano

[50] "Pakistan, China Ink Space Agreement," *The News* [Islamabad] (October 29, 2005) (Open Source Center document SAP20051029033012); and James Lowe, "APSCO Set to Be Born," *NASASpaceflight.com* (October 24, 2005). <http://www.nasaspaceflight.com/content/?cid=3938> (accessed on October 24, 2006).
[51] Virginia Silveira, "Brazil to Participate in Galileo Program for Positioning Satellites; Brazil Will Participate in Galileo," *Gazeta Mercantil* [São Paulo] (December 16, 2005) (accessed via Lexis-Nexis); Instituto Nacional de Pesquisas Espacials, "Histórico: O Brasil no Espaço;" Hudson, 452–53; Carvalho, Kono, Quintino, and Perondi, *Space Activities in Brazil*; FINEP, "Pagamentos Efetuadas 01/01/2003 até 31/12/2003;" FINEP, "Pagamentos Efetuadas 01/01/2005 até 31/12/2005;" FINEP, "O que é o CT-Aero?;" and "Brazil: Seeking Prestige and Exploring Space," *Stratfor Weekly*.
[52] Instituto Nacional de Pesquisas Espacials, "Histórico: O Brasil no Espaço;" Hudson, 452–53; Carvalho, Kono, Quintino, and Perondi, *Space Activities in Brazil*; FINEP, "Pagamentos Efetuadas 01/01/2003 até 31/12/2003;" FINEP, "Pagamentos Efetuadas 01/01/2005 até 31/12/2005;" FINEP, "O que é o CT-Aero?;" and "Brazil: Seeking Prestige and Exploring Space," *Stratfor Weekly*.
[53] Virginia Silveira, "Brazil Develops Hypersonic Engine."
[54] Virginia Silveira, "Brazil Develops Hypersonic Engine."
[55] Bill Sweetman, "ISTAR Platform Battles Loom in Transition to New Security Era," *Jane's International Defence Review* (March 1, 2006) (accessed via Intelink) (posted on February 7, 2006); "Spreadsheet: Aircraft Production Tables (Rest of World)," *Jane's All the World's Aircraft* (n.d.) (accessed via Intelink) (posted on November 18, 2004).

purchased by the Colombian air force in 2006 can be fitted with FLIR's Star SAFIRE III multisensor thermal-imaging system or BRITE Star laser target-designation system.[56]

Embraer has a number of connections to private foreign defense manufacturers, including Dassault Aviation (France), EADS (a multinational European company based in the Netherlands), Snecma (France), and Thales (France), which are all shareholders in Embraer. Embraer also has subsidiary operations in Australia, China, France, Singapore, and the United States.[57] On August 30, 2006, Embraer, the Brazilian Institute of Aeronautics Technology (ITA), and the State of São Paulo Institute of Technology Research (IPT) announced that they would jointly develop the Center for the Development of Aeronautics Technology (CDTA) as an aeronautics R&D center.[58]

## Agriculture

The Brazilian Agricultural Research Corporation, commonly known as Embrapa, is the government organization in charge of administering research in agriculture. The organization is also involved in coordinating research on biotechnology, nanotechnology, and agriculturally derived renewable energies. Embrapa maintains 37 research centers in Brazil and two laboratories outside the country, one in France and the other in the United States.[59] Embrapa also receives substantial foreign funding, and most notably from the US$120-million Project for Development of Agricultural Technology in Brazil, which began in 1997 and is funded by the World Bank.[60] In 2001 the Inter-American Development Bank and the Brazilian government each provided half of the funding for the US$3.2-million Project to Develop Agriculturally Based Technology Enterprises. The project funds companies that focus on R&D for agriculture,

[56] "Columbian Air Force Purchase Super Tucano Light Attack Aircraft," *Jane's International Defence Review* (February 1, 2006) (accessed via Intelink) (posted on January 17, 2006).
[57] "Contractors, Brazil" *Jane's Aircraft Upgrades* (Croydon, UK: 2006) (accessed via Intelink) (posted on September 8, 2006).
[58] Janaína Simões, "São Paulo Science Parks," *Unicamp Innovation* (São Paulo: State University of Campinas, September 12, 2006). <http://www.inovacao.unicamp.br/english/report/news-spscienceparks.shtml> (accessed on October 3, 2006).
[59] EMBRAPA, "Embrapa's Virtual Laboratories Abroad" (Brasília: 2006). <http://www.embrapa.gov.br/English/a_embrapa/laboratorios_no_exterior/index_html/mostra_documento> (accessed on October 16, 2006); and EMBRAPA, "Research Centers" (Brasília: n.d.). <http://www.embrapa.gov.br/English/a_embrapa/unidades_de_pesquisa/index_htm> (accessed on October 16, 2006).
[60] EMBRAPA, "Embrapa's International Cooperation" (Brasília: n.d.). <http://www22.sede.embrapa.br/sci/unit.htm> (accessed on October 16, 2006).

agroindustry, and forestry.[61] The government also has a sectorial fund for agriculture, and from 2003 to 2005 financing for this sectorial fund increased from BRL2.3 million (US$750,000) to BRL13.4 million (US$5.5 million). The research funded by Embrapa and the agricultural sectorial fund generally involves biotechnology, horticulture, soil science, and veterinary medicine.[62]

**Biotechnology**

The Brazilian government considers biotechnology research to be a strategic research area and promotes R&D in this field through funding and coordinating research between private and public entities. Universities have performed most biotechnology research in Brazil, but there are indications that private companies will become more involved in such research. In 2004 the Ministry of Development, Industry, and Foreign Trade (MDIC) established the Forum for Competitiveness in Biotechnology to promote discussions among academic and business organizations, with the objective of defining priorities for biotechnology research policy. The forum led to the enactment of the National Biotechnology Strategy–Bio-Industry Development Policy on July 4, 2006, which defined the priority subjects of biotechnology research as agriculture and livestock, human health, and industry.[63]

The National Biotechnology Strategy is to be implemented by the National Committee of Biotechnology, which reportedly will be composed of representatives from academia, business, civil society, and government. Initial investments for the Strategy are reportedly BRL7 billion (US$3.2 billion), through the principal funding agents—BNDES and FINEP.[64] The National Biotechnology Strategy included BRL382 million (US$156.8 million) for public and private R&D infrastructure and BRL64 million (US$26.2 million) for human resource development. The private sector also is expected to provide BRL2 million (US$830,000) in matching funds for human resource development. The National Biotechnology Strategy includes a staged funding

[61] FINEP, "CT-Agronegócio – Fundo para o Setor de Agronegócios" (Rio de Janeiro: n.d.). <http://www.finep.gov.br/fundos_setoriais/ct_agro/ct_agro_ini.asp?codFundo=11> (accessed on October 6, 2006).
[62] FINEP, "Pagamentos Efetuadas 01/01/2003 até 31/12/2003"; FINEP, "Pagamentos Efetuadas 01/01/2005 até 31/12/2005"; FINEP, "O que é o CT-Aero?"; FINEP, "CT-Agronegócio – Fundo para o Setor de Agronegócios"; and EMBRAPA, "Diretrizes para Transferência de Tecnologia: Modelo de Incubação de Empresas" (Brasília: 2005). <http://www22.sede.embrapa.br/snt/html/proeta/incub2.pdf> (accessed on October 24, 2006).
[63] Janaína Simões, "Biotechnology: National Biotechnology Strategy Lays Down Proposed Actions and Policies and Foresees the Need for at Least R$7 Billion," *Unicamp Innovation* [São Paulo] (August 9, 2006). <http://www.inovacao.unicamp.br/english/report/news-biotechnology.shtml> (accessed on October 4, 2006).

strategy for biotechnology companies both to create companies and to fund S&T research for already existing companies. The Strategy estimates that BRL60 million (US$27.2 million) will be required to finance the creation of an estimated 300 biotechnology companies. In addition, the Strategy estimates that BRL200 million (US$90.9 million) will be required to fund start-ups that have the possibility of developing a technology that can reach the market.[65]

An additional funding mechanism is FINEP's biotechnology sectorial fund, which increased from BRL140,000 (US$45,528) in 2003 to BRL10.1 million (US$4.1 million) in 2005.[66] In 2003, this sectorial fund financed 17 research projects on various antibodies for humans and animals.[67] Information about projects funded since 2003 is not publicly available from FINEP.

Among the announced biotechnology research projects is one on neuroscience, specifically brain mapping with a focus on epilepsy. This US$10 million project is scheduled to commence in 2007 as part of the Inter-Institutional Cooperation for the Support of Research on the Brain. The project will be funded by the São Paulo Research Foundation and involves the State University of Campinas, the University of São Paulo, the Federal University of São Paulo, and São Paulo's Albert Einstein Hospital.[68]

### Energy

Brazilian government entities have supported R&D in energy, principally petroleum, natural gas, nuclear energy, and various renewable energies (aeolian, biomass, biodiesel, hydrogen, solar). From 2003 to 2005, funding for the energy sectorial fund increased from BRL12.7 million (US$4.1 million) to BRL38.2 million (US$15.7 million), and funding for the petroleum sectorial fund increased from BRL23.6 million (US$7.7 million) to BRL39.1 million

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[64] Janaína Simões, "Biotechnology: National Biotechnology Strategy."
[65] Ministério do Desenvolviment, Indústria e Comércio Exterior, *National Biotechnology Strategy – Bio-Industry Development Policy* (Brasília: July 2006). <http://www.mct.gov.br/upd_blob/7449.pdf> (accessed on October 4, 2006); and Janaína Simões, "Biotechnology: National Biotechnology Strategy."
[66] FINEP, "Pagamentos Efetuadas 01/01/2003 até 31/12/2003"; and FINEP, "Pagamentos Efetuadas 01/01/2005 até 31/12/2005".
[67] FINEP, "Edital MCT/FINEP/CT-BIOTEC 01/2003 Projetos Aprovados" (Rio de Janeiro: 2003). <http://www.finep.gov.br//fundos_setoriais/ct_bio/resultados/resultado_chamadaMCT_Finep_ct_biotec_03_2003.pdf> (accessed on October 19, 2006).
[68] Álvaro Kassab, "Cooperation in São Paulo: Unicamp Scientists Help Conceive and Carry Out Brazil's Most Ambitious Brain Research Project Ever; Focus Will Be on Epilepsy," *Unicamp Innovation* [São Paulo] (August 9, 2006). <http://www.inovacao.unicamp.br/english/report/news-epilepsy.shtml> (accessed on October 4, 2006).

(US$16.1 million).[69] Moreover, the Ministry of Science and Technology allocated BRL13.9 million (US$5.7 million) in 2004–5 for research on biodiesel and industrial processes, and in October 2006 FINEP announced BRL6 million (US$2.8 million) in available funding for biodiesel projects to be financed from the agronomy and energy sectorial funds.[70] In addition to these funds, many government agencies contribute to the Program of Science, Technology, and Innovation for the Economy of Hydrogen (ProH2), the Program of Hydrogen Fuel Cell Systems (Procac), the National Program of Production and Use of Biodiesel (PNPB), and the Brazilian Biodiesel Technology Network (RBTB). The government also is interested in R&D for mineral exploration, which also has a dedicated sectorial fund.[71]

In May 2006, Embrapa established Embrapa Energy, a center for research on improving the production of biodiesel from castor seed and oil palm. Biodiesel is the main research focus for Embrapa Energy, and the agency is also investigating agro-industrial residue, ethanol, and energy from wood. In April 2006, the Ministry of Agriculture, Livestock, and Supply announced that it would invest BRL10 million (US$4.6 million) in Embrapa Energy in 2006 and the same amount in 2007. Embrapa Energy is part of the National Agro-energy Project that is designed to substitute 2 percent of the diesel oil used in Brazil with biodiesel by 2011. This project also involves the ministries of Science and Technology, Mines and Energy, and Development, Industry, and Foreign Trade.[72]

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[69] FINEP, "Pagamentos Efetuadas 01/01/2003 até 31/12/2003"; and FINEP, "Pagamentos Efetuadas 01/01/2005 até 31/12/2005."

[70] Ministério de Minas e Energia, "Biodiesel: The New Fuel from Brazil" (Brasília: n.d.). <http://www.biodiesel.gov.br/docs/cartilha_ingles.pdf> (accessed on October 5, 2006); and FINEP, "Chamada Pública MCT/FINEP Ação Transversal – Biodiesel – 10/2006" (Rio de Janeiro: 2006). <http://www.biodiesel.gov.br/rede.html> (accessed on October 20, 2006).
Currency conversion is based on exchange rate for September 2006. See Federal Reserve Bank, "G.5 Foreign Exchange Rates (Monthly)" (Washington: October 2, 2006). <http://www.federalreserve.gov/releases/g5/current/> (accessed on October 20, 2006).

[71] FINEP, "Chamadas Públicas" (Rio de Janeiro: n.d.). <http://www.finep.gov.br/como_obter_financiamento/editais_financiamento_ini.asp> (accessed on October 6, 2006); FINEP, "CHAMADA PÚBLICA MCT/FINEP/CT-PETRO - TEMAS ESTRATÉGICOS 01/2006," (Rio de Janeiro: 2006). <http://www.finep.gov.br//fundos_setoriais/ct_petro/resultados/Resultados_CHAMADA_PUBLICA_MCT_FINEP_CT_PETRO_TEMAS_ESTRATEGICOS_01_2006.pdf> (accessed on October 6, 2006); Ministério da Ciência e Tecnologia, "Energia e Recursos Minerais: Introdução" (Brasília: 2006). <http://www.mct.gov.br/index.php/content/view/5066.html> (accessed on October 10, 2006); and Ministério da Ciência e Tecnologia, "Energia e Recursos Minerais: Programa de Hidrogênio" (Brasília: 2006). <http://www.mct.gov.br/index.php/content/view/5118.html> (accessed on October 10, 2006).

[72] Debora Rubin, "Brazil Invests in the Energy of the Future," *Brazil-Arab News Agency* (May 11, 2006) (Open Source Center document LAP20060511357001).

## Telecommunications

The Brazilian government has sought to promote technological innovations in telecommunications in order to increase the country's international competitiveness in this field. The principal program for financing telecommunications innovation is the Fund for the Technological Development of Telecommunications (FUNTTEL), which is funded through the BNDES. The FUNTTEL provides financial support for 50 to 80 percent of a project's value depending on the size of the company involved and whether resources are refundable. Most of the funded projects for which FINEP provides public information are related to digital television and research into coding and decoding of MPEG files.[73] One of Brazil's principal telecommunications research centers is the Center for Research and Development in Telecommunications, located in Campinas, São Paulo. In 2003 CPqD worked on the FINEP-funded Giga Project, which involved the development of optical networks with 1 gigabytes-per-second transmission rates, protocols, network services, experimental telecommunications services, and various scientific services and applications.[74]

There are few reports of foreign investment in telecommunications R&D in Brazil. Foreign participation in Brazilian telecommunications has generally involved foreign private companies, some of which are telecommunications service providers. Among the foreign private entities operating in Brazil is Huawei Technologies, a Chinese telecommunications equipment manufacturer. In August 2006, this company was awarded a contract to build Latin America's largest global system for mobile communications (GSM) in Brazilian coastal states. The contract was awarded by a foreign company, the Spanish multinational telecommunications operator

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Currency conversion is based on exchange rate for July 2006. See Federal Reserve Bank, "G.5 Foreign Exchange Rates (Monthly)".

[73] FINEP, "FUNTTEL – Fundo para o Desenv. Tecnol. Das Telecomunicações: Chamadas Públicas Encerradas/Resultados" (Rio de Janeiro: n.d.). <http://www.finep.gov.br/fundos_setoriais/funttel/funttel_resultado.asp?codSessao=8&codFundo=7> (accessed on October 19, 2006).

[74] Banco Nacional de Desenvolvimento Econômico e Social, "Fund for the Technological Development of Telecommunications – FUNTTEL" (Rio de Janeiro: n.d.). <http://www.bndes.gov.br/english/funttel_in.asp> (accessed on October 2, 2006); and Rede Nacional de Ensino e Pesquisa, "RNP and CPqD Start Giga Project in 2003" (Rio de Janeiro: 2003). <http://www.rnp.br/en/news/2003/not-030114.html> (accessed on October 10, 2006).

Telefnica, which is a major telecommunications services provider in Brazil and which also will operate the GSM network with Portugal Telecom under a joint venture called VIVO.[75]

As concerns foreign involvement in telecommunications R&D, the United States companies Lucent Technologies and Motorola are the only two that have received publicity. Lucent has been involved in the INOVAR Fund Incubator administered by FINEP, and since 1997 Motorola has invested more than US$175 million to fund research into telecommunications networks. In March 2005, Motorola announced US$5 million in funds for two research initiatives, one for mobile and fixed telephone carriers and the other for research into the company's SoftSwitch technology, which would be conducted at the company's Jaguariuna Industrial and Technological Campus in São Paulo.[76]

Brazil also has a presence in foreign telecommunications. The Brazilian telecommunications company CPqD has sold telecommunications technology, primarily software, in Brazil and in Africa, Europe, Latin America, Oceania, and the United States. CPqD also has publicly announced its interest in operating in the Middle East.[77]

### Military Technologies

Brazil has the largest military in South America, but national economic problems and political limits on military spending since 1985 have pushed military R&D to focus on modernizing and upgrading existing equipment—particularly armored vehicles and artillery—rather than developing new equipment. The resumption of civilian rule in 1985 and subsequent national economic problems led to a steady decline in the military budget. In addition, Brazil's improved relations with historic military rival Argentina and the civilian government's reluctance to allow the military any role beyond public and domestic security have shifted defense priorities toward countering the drug trade and domestic and foreign counterinsurgency operations, although the Brazilian military reportedly has been reluctant to pursue these

[75] Li Weitao, "Huawei Secures Major Brazilian Deal," *Beijing China Daily* (August 22, 2006) (Open Source Center document CPP20060822062030).
[76] Capital de Risco Brasil, "Inovar Project: Achievements" (n.p.: 2002) <http://www.capitalderisco.gov.br/VCN_ING/en_resultados_PI.asp> (accessed on October 6, 2006); and "Motorola's Brazilian Subsidiary Announces Two Research Initiatives," *Wireless News* (March 3, 2005) (accessed via Business Research Suite).
[77] Isaura Daniel, "Paulo Xavier: Entry in the Arab Market is the CPqD Target for 2006," *Brazil-Arab News Agency* (July 31, 2006) (Open Source Center document LAP20060801357005).

objectives.[78] Thus, the country's military equipment is copious but outdated, and military procurement has been driven by domestic security concerns and regional strike-force parity rather than an interest in becoming an internationally dominant or influential military power.[79]

Many domestic military goods producers have had financial problems since the end of military rule in 1985, and thus their financial capacity to engage in R&D is doubtful. Brazil's largest ground defense company, ENGESA, ceased operations in 1993, and the army-managed arms manufacturer Imbel (Indústria de Material Bélico do Brasil) has experienced declining revenues that have affected operations.[80] The government of President Luiz Inácio Lula da Silva has been favorable to increasing domestic weapons production but has also focused on reducing military procurement funds.[81] Thus, there is little indication of improvement in the finances of many domestic military goods manufacturing in the foreseeable future. In January 2005, the government authorized Imbel to operate outside of defense production so that the company can be re-capitalized and renew its emphasis on defense production.[82] Imbel's products largely have been communications systems, firearms, and various types of ammunition (artillery, ground-based weapons, and mortars).[83] Among the firearms developed by Imbel are 5.56-millimeter assault rifles that can be fitted with a laser, image-intensifier, or other optical sights.[84]

Domestic military S&T developments have been largely in aircraft, ammunition, firearms, transportation vehicles, and, particularly, missiles developed indigenously or through foreign cooperation. The Brazilian company Avibras has been the main domestic developer of missiles. For example, Avibras has developed the 300-millimeter, 595-kilogram SS–80 long-range artillery rocket that has a maximum range of 90 kilometers.[85] Avibras also has developed the 90-kilogram MAA–1 air-to-air missile that has a high-explosive fragmentation warhead

[78] "Executive Summary, Brazil," *Jane's Sentinel Security Assessment – South America* (Croydon, UK: 2006). (accessed via Intelink); and "Procurement, Brazil," *Jane's Sentinel Security Assessment – South America* (Croydon, UK: 2006) (accessed via Intelink) (posted on April 5, 2006).
[79] "Executive Summary, Brazil," *Jane's Sentinel Security Assessment – South America*.
[80] "Procurement, Brazil," *Jane's Sentinel Security Assessment – South America*; and "Defence Production and R&D, Brazil," *Jane's Sentinel Security Assessment – South America* (Croydon, UK: 2005) (accessed via Intelink) (posted on May 23, 2005).
[81] "Executive Summary, Brazil," *Jane's Sentinel Security Assessment – South America*; and "Procurement, Brazil," *Jane's Sentinel Security Assessment – South America*.
[82] "Defence Production and R&D, Brazil," *Jane's Sentinel Security Assessment – South America*.
[83] "Contractors, Brazil," *Jane's Infantry Weapons* (Croydon, UK: 2006) (accessed via Intelink) (posted on May 10, 2006); and Indústria de Material Bélico do Brasil, Web site (Piquete, SP: n.d.). <http://www.imbel.gov.br/index.php?centro=home&lang=en> (accessed on October 18, 2006).
[84] "Procurement, Brazil," *Jane's Sentinel Security Assessment – South America*.

activated by an active laser proximity fuse and detectors placed on the forward part of the missile.[86] In addition, Jane's Information Group has stated that several countries reportedly have purchased the Brazilian-made 70-millimeter AV–SF–70 Skyfire, which can have either multipurpose or high-explosive warheads and can be launched from trailer-mounted 36-tube multiple launchers or from 7- or 19-tube pods on helicopters and fixed-wing aircraft. However, the source does not have information about which countries have purchased the Skyfire.[87]

The Brazilian company Mectron also has been active in missile production. In 2005 the Brazilian army awarded a US$4.2 million contract to Mectron to further develop 40 MSS–1.2 laser-guided antitank missiles, 10 of which are to be fitted with high-explosive antitank warheads and the remainder with telemetry. Mectron also has assumed production of simulators and training equipment for 3,000-meter-range MAF laser-guided missiles and firing posts that were supplied by Italy's OTO Melara in the late 1980s. In addition, Mectron has supplied the Brazilian army with the Aérospatiale 600-meter-range Eryx system and the Euromissile 2,000-meter-range Milan 3 antitank guided missile.[88] In 2006 Mectron confirmed that it would be working on an upgrade of the Brazilian-made Piranha, called Piranha 2 or MAA–1B. The MAA–1B is intended to have improved range and engagement capabilities, including a new two-color seeker using a fixed-array IR detector and a dual-pulse rocker motor. The seeker is intended to have an off-boresight look angle of up to 80 or 90 degrees and twice the MAA–1's acquisition range.[89]

The principal foreign suppliers of military equipment to Brazil have been France, the United Kingdom, and the United States, and the principal foreign partners in production have been France and South Africa. In 2003 Brazil and South Africa signed a defense cooperation agreement that included defense R&D.[90] In February 2006, Brazil's Aeronautical Command finalized a US$100 million agreement with South Africa's Denel Aerospace to develop the air-to-air A–Darter missile. The agreement also included Brazilian company Mectron Engenharia.

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[85] "Artillery Rockets, Brazil: Avibras Astros II Rockets," *Jane's Ammunition Handbook* (Croydon, UK: 2006) (accessed via Intelink) (posted on July 26, 2006).
[86] "Defense Production and R&D, Brazil," *Jane's Sentinel Security Assessment – South America* (Croydon, UK: 2005) (accessed via Intelink) (posted on May 23, 2005).
[87] "Air-Launched Rockets, Brazil: AV–SF–70 Skyfire Rocket System," *Jane's Air-Launched Weapons* (Croydon, UK: 2006) (accessed via Intelink) (posted on June 6, 2006).
[88] "Defense Production and R&D, Brazil," *Jane's Sentinel Security Assessment – South America*.
[89] "Air-to-Air Missiles – Within Visual Range, Brazil," *Jane's Air-Launched Weapons* (Croydon, UK: 2006) (accessed via Intelink) (posted on October 11, 2006).
[90] "Procurement, Brazil," *Jane's Sentinel Security Assessment – South America*.

The A–Darter is intended to be a compact short-range interceptor missile (2.93 meter x 0.49 meter) that can be directed by radar aboard the launching plane or by a digital visor on the pilot's helmet.[91] In addition, Brazil's Aerospace Technology Center (CTA), Denel, and Mectron jointly produced the Piranha MAA–1 air-to-air missile, which, after various delays, was approved by the CTA in June 2003. Denel supplied the missile's seeker technology, and Mectron has purchased detector chips from South Africa. The missile's remaining seeker development and manufacture are performed in Brazil.[92]

In 2004 Russia's Makeev Space Center Design Bureau began cooperating with Brazilian space companies to produce the Orion carrier rocket.[93] Brazilian aerospace and defense company Target and the CTA have jointly developed the air-launched BLG–120 and BLG–252 cluster bombs.[94] Brazil has also sold its Astros II SS–60 rocket abroad to Iraq, Libya, Malaysia, and Saudi Arabia.[95]

### Nuclear Technology

Observers believe that Brazil has abandoned earlier efforts to develop or otherwise acquire biological, chemical, and nuclear weapons capabilities, although the status of the latter is subject to much speculation. In 2003 the minister for science and technology, Roberto Amaral, publicly stated that Brazil should research nuclear weapons production, but other government officials quickly claimed that Brazil's nuclear research is entirely peaceful in intention. However, in early 2004 the government refused to allow International Atomic Energy Agency (IAEA) officials to inspect a newly developed uranium enrichment plant at Resende, which is run by Brazil Nuclear Industries and built with technology developed by the Brazilian navy. By November 2004, Brazil had agreed to allow IAEA inspections, and the plant's first unit was opened on May 5, 2006. The plant's centrifuges are reportedly four times more economical than those used in Europe or the United States, but it is also believed that Resende will not be

[91] Roberto Godoy, "FAB Invests $100 Million in Missiles," *O Estado de São Paulo* [São Paulo] (February 12, 2006) (Open Source Center document LAP20060212045005).
[92] "Air-to-Air Missiles – Within Visual Range, Brazil," *Jane's Air-Launched Weapons.*
[93] *Agentstvo Voyennykh Novostey* [Moscow] (October 11, 2004) (Open Source Center document CEP20041011000189).
[94] "Bombs – Cluster and Dispenser Munitions, Brazil," *Jane's Air-Launched Weapons* (Croydon, UK: 2006) (accessed through Intelink) (posted on January 16, 2006).
[95] "Artillery Rockets, Brazil," *Jane's Ammunition Handbook* (Croydon, UK: 2006) (accessed via Intelink) (posted on July 26, 2006).

commercially viable without foreign sales of enriched uranium or completion of a new proposed power reactor, Angra 3.[96]

Uranium-fueled reactors are not the only technology of interest to Brazil. Reportedly, Brazil is conducting research on the use of thorium for nuclear energy, and the country has substantial natural reserves of thorium for such purposes, estimated at 1.2 million tons.[97] Brazilian universities and the Brazilian Nuclear Energy Commission are also conducting nuclear energy research, while the Brazilian navy is engaged in research on nuclear propulsion. In the past, Brazil has engaged in cooperative nuclear efforts with France, Germany, and the United States. In addition, Brazil is currently participating in international nuclear energy research programs, such as "Generation IV" nuclear energy systems (which are intended to enhance safety, minimize waste, and resist proliferation) and the International Project on Innovative Nuclear Reactors and Fuel (INPRO).[98]

The Brazilian Navy's Technological Center in São Paulo has completed the pressure vessel and internal components of the nuclear reactor at the Laboratory of Energy Generation (LABGENE). The reactor has been constructed at the navy's ARAMAR Experimental Center for electricity generation and naval applications.[99]

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[96] "Executive Summary, Brazil," *Jane's Sentinel Security Assessment – South America*; "Brazil Attains Advanced Nuclear Power Capability," *Jane's Intelligence Digest* (September 29, 2006) (accessed via Intelink) (posted on September 27, 2006); and "NBC Capabilities, Brazil," *Jane's Nuclear, Biological, and Chemical Defence.*

[97] José Rubens Maiorino and Thiago Carluccio, "A Review of Thorium Utilization as an option for Advanced Fuel Cycle-Potential Option for Brazil in the Future," paper presented at Americas Nuclear Energy Symposium, Miami Beach, FL, October 3–6, 2004 (São Paulo: Instituto de Pesquisas Energéticas e Nucleares, 2004). <http://www.osti.gov/bridge/servlets/purl/839368-n26hHx/native/839368.pdf> (accessed on September 29, 2006).

[98] United States, Department of Energy, Office of Nuclear Energy, "What is Generation IV?" (Washington, DC: 2006). <http://gen-iv.ne.doe.gov/> (accessed on October 3, 2006); International Atomic Energy Agency, "Development of Innovative Nuclear Technology: Report by the Director General" (Vienna: 2004). <http://www.iaea.org/About/Policy/GC/GC48/Documents/gc48-14.pdf> (accessed on October 3, 2006); "Studies for Two Plants Completed," *Latin American Power Watch* 21, no. 11 (June 7, 2005): 5 (accessed via Business Research Suite); and FINEP, "Chamadas Públicas." As of 2003, INPRO member countries included Argentina, Brazil, Bulgaria, Canada, China, Germany, India, Indonesia, the Netherlands, Pakistan, Russia, South Korea, Spain, Switzerland, Turkey, and the European Commission. See International Atomic Energy Commission, "International Project on Innovative Nuclear Reactors and Fuel Cycles" (Vienna: 2003). <http://www.iaea.org/worldatom/Programmes/Nuclear_Energy/NENP/NPTDS/Projects/inpro_scm.html> (accessed on October 17, 2006). Countries working on Generation IV nuclear technology include France, Japan, South Africa, South Korea, the United Kingdom, the United States, and dozens of other countries. See United States, Department of Energy, "International Collaboration" (Washington, DC: 2006). <http://nuclear.energy.gov/genIV/neGenIV3.html> (accessed on October 20, 2006).

[99] Leonam dos Santos Guimarães, "Completion of Fabrication and Assembly of the Internal and Pressure Vessel of the LABGENE Reactor," *Economia & Energia* (January 1, 2006) (Open Source Center document LAP20060125357001).

## THREATS AND OPPORTUNITIES IN BRAZIL'S PURSUIT OF LEADING-EDGE TECHNOLOGY

There have been numerous obstacles to Brazil's development of leading-edge technologies. One of the greatest impediments has been the failure of the government and private industry to fund R&D. Historically the lack of R&D funds has stemmed from the small number of companies on the Brazilian stock market, the small number of venture capital investors, and insufficient government funding support.[100]

Related to the dearth of R&D funding has been a lack of demand for such funds from Brazilian industry. Research on innovation and R&D in Brazil often has found that Brazilian companies tend not to regard R&D as an integral input into their operations. They usually obtain their information about innovation not from R&D but from commercial relations, expositions, conferences, and the Internet.[101] A 2005 Brazilian government report challenged this view, however, finding that an increasing percentage of Brazilian companies do believe that R&D is important. However, the report also found that the percentage of companies devoting funds to R&D declined from 2000 to 2003.[102] Analysts have noted that small- and medium-size companies cannot afford expenses such as technological innovation prior to making actual sales, especially given the competitive, even hostile, business relations between companies. By contrast, companies with more than 500 employees have been found to engage in more cooperative R&D efforts and have had much greater rates for innovations in products and processes than their small- and medium-sized counterparts. This is primarily because larger companies can better afford R&D expenditures.[103]

Another reason for the low demand for R&D funding by the private sector has been a lack of incentives to seek such support. Historically, Brazil's government has protected domestic industries in various ways, such as imposing restrictions on foreign-made goods that are similar to those produced by domestic industries.[104] Some analysts believe that the resulting reduction in competition from foreign producers has reduced incentives for domestic producers to invest in R&D. Likewise, interest rates in Brazil historically have been high and thus have discouraged

[100] Simões, "Biotechnology: National Biotechnology Strategy."
[101] Duga, Studt, and Dearing, G12; Instituto Brasileiro de Geografia e Estatística, *Pesquisa Industrial de Inovacao Tecnologica 2003*, 46.
[102] Instituto Brasileiro de Geografia e Estatística, *Pesquisa Industrial de Inovacao Tecnologica 2003*, 37–2.
[103] Instituto Brasileiro de Geografia e Estatística, *Pesquisa Industrial de Inovacao Tecnologica 2003*.
[104] Hudson, 452–53.

borrowing to finance R&D. The high value of the Brazilian currency relative to the American dollar has made Brazilian products costly and uncompetitive in international markets and has thus discouraged attempts by Brazilian domestic producers to innovate in order to compete internationally.[105]

The government, however, is working on ways for public and private entities to become more involved in R&D. As noted above, an unprecedented amount of R&D funding is available to public and private institutions from government programs, venture capital, and foreign investors. Moreover, the government has passed legislation that reduces private entities' costs for engaging in R&D and thus provides incentives for them to do so. For example, legislation passed in 2004 provides total exemption from the Industrialized Products Tax (IPI) for IT companies that invest 5 percent of their net revenues in IT R&D and that also operate in the Manaus Free Trade Zone (ZFM). IT manufacturers that operate outside the ZFM and make the requisite 5 percent R&D investment are eligible for an 80 percent exemption from the IPI. The exemption declines by 5 percent annually until 2006 and then remains at 70 percent until 2009.[106] Similarly, the 2004 Innovation Law created subsidies for small businesses involved in S&T research that fit under the priorities of the PITCE, including biotechnology, energy from biomass, and nanotechnology research.

The government also has removed previously existing legal barriers to private-public R&D collaboration. The 2004 Technological Innovation Law legalized public and private R&D collaboration, including the sharing of facilities, funding, and staff. Prior to the law's passage, public-sector researchers (usually those at universities) had to obtain government permission to participate in privately funded research projects and could not accept pay for such research. Other laws have allowed private entities to be involved in certain economic activities that were previously nationalized. For example, Constitutional Amendment Number 8, passed in 1995,

[105] Duarte, 84; and Massachusetts Institute of Technology and the SOFTEX Society.

[106] According to the 2003 Informatics Law (under which the 2004 tax exemptions and deductions were established), 1.8 percent of companies' net revenues must be invested in accredited research institutions (there were 146 such institutions in 2004), and 0.5 percent must be invested in the National Science & Technology Informatics Fund (CT–Info or FNDCT), which is used to invest in government priority research programs. The remaining 2.7 percent can be invested in numerous R&D outlets, including within the company itself, third parties, education institutions, research centers, the IT Business Incubator, or companies linked to the Incubator.
See National Investment Information Network, "Brazil Electronic Component Market Report March/2004" (Brasília: Ministry of Development, Industry and Foreign Trade, 2004): 25–28.
<http://investimentos.desenvolvimento.gov.br/renai_en/arquivos/compEletrIng.pdf> (accessed on August 9, 2006).

eliminated state monopolies on telecommunications services, and Law 9,491 of 1997 eliminated limits on foreign capital in private corporations.[107]

In addition, various nongovernment entities have engaged in efforts that promote R&D directly or indirectly. The nonprofit Society of Software Entrepreneurs, SOFTEX, has supported a project called Softstart that trains lecturers to teach entrepreneurship courses in university computing departments.[108] The Brazilian Support Service for Small and Micro Companies (SEBRAE), a nonprofit private institution, supports R&D by small businesses through various forms of credit and capitalization support, training, and other forms of assistance in order to promote economic and social development. Tourism and agribusiness have received special attention from SEBRAE.[109]

Such efforts appear to have provided remarkable results in entrepreneurship but not in innovation. A 2006 report by the Global Entrepreneurship Monitor (GEM) ranked Brazil as the world's seventh most entrepreneurial country but also stated that Brazilian entrepreneurs are, on the whole, "barely innovative." The report, which was based on a survey of Brazilian companies, found that fewer than 6 percent of surveyed companies claimed to offer innovative products or services to their customers. The survey also found that most early-stage entrepreneurs (97.4 percent) and established business owners (98.6 percent) claimed to be using technologies that were available one year before.[110]

## CONCLUSION

Since 2003, the government of Brazil has provided unprecedented levels of funding for domestic R&D and established incentives to increase private-sector involvement in R&D, such as strengthening intellectual property laws and tax incentives for R&D. The government has also

[107] Fernanda Veneu, "Brazil Adopts Innovation Law," *SciDevNet* [Science and Development Network} (December 20, 2004) <http://www.scidev.net> (accessed on August 9, 2006); and Banco Central do Brasil, *Census of Foreign Capitals in Brazil – 2000 Base Year*.

[108] Duarte, 86.

[109] Capital de Risco Brasil, "INOVAR Project: Partners" (n.p.: 2002). <http://www.capitalderisco.gov.br/VCN_ING/en_parceiros_PI.asp> (accessed on October 6, 2006); Serviço Brasileiro de Apoio às Micro e Pequenas Empresas, "Sebrae – Brazilian Micro and Small Business Support Service" (Brasília: n.d.). <http://www.sebrae.com.br/br/osebrae/sebraeinenglish.asp> (accessed on October 6, 2006); and Serviço Brasileiro de Apoio às Micro e Pequenas Empresas, "Sebrae's Major Acting Areas" (Brasília: n.d.). <http://www.sebrae.com.br/br/osebrae/sebraeinenglish1.asp> (accessed on October 6, 2006).

[110] Marcos Mueller Schlemm et al., "2005 Empreendedorismo no Brasil: Relatório Executivo" (Curitiba, BR: Global Entrepreneurship Monitor, 2006): 9–10. <http://www.gemconsortium.org/download/1159891315437/GEM%20BRASIL%202005%20-%20Relat%F3rio%20Executivo.pdf> (accessed on October 3, 2006).

prioritized support and development of certain sectors, specifically nanotechnology, pharmaceuticals, semiconductors, and software. Other fields that have received significant government support are agriculture, alternative energies, and space research. Military S&T has suffered from nearly two decades of funding neglect, but Brazilian entities have produced impressive aircraft, artillery, and missiles. In all of these fields, private-sector and foreign participation are low relative to that of public research entities, particularly universities, but various signs suggest this is changing.

These developments are relatively new but rapidly progressing, and their significance is therefore subject to some conjecture. However, Brazil R&D appears to have substantial potential to significantly improve the country's domestic economic and social development and to increase Brazil's international economic influence, particularly in Latin America where the country is already the region's biggest economy. However, as optimistic as these developments may be, they are more in the realm of potential than proven results, and the pervasive lack of innovation by private entities, isolation from international markets, and other indicators suggest Brazil's increased R&D efforts may not have any significant economic or political effects outside the country's borders in the foreseeable future.

## APPENDIX: PROMINENT BRAZILIAN RESEARCH FACILITIES

Brazil has numerous facilities involved in research and development, both public and private. Historically, universities have conducted most R&D, but since 2003 federal and state governments have created other research facilities, such as technology parks. An exhaustive list of all Brazilian research facilities would be voluminous and quickly outdated given the rapidly increasing number of R&D entities in Brazil. The following list includes only prominent research facilities as of the writing of this report and their respective research foci.

| Organization | Focus | Location | Web site |
|---|---|---|---|
| Canela Tecnópole | Bio-industry, environmental technology, energy, engineering, electronics, IT, and telecoms | Canela, RS | http://www.canela.com.br/tecnopole |
| Centro de Tecnologia em Saneamento e Meio Ambiente (CETSAM) | Environmental protection services to industries | Curitiba, PR | none |
| Centro Integrado de Manufatura e Tecnologia | Professional education and technology consulting for industries | Salvador, BA | http://www.senai.fieb.org.br/apres_cimatec.shtm |
| Centro Nacional de Referência em Biomassa (CENBIO) | Biomass conversion and use | São Paulo, SP | http://www.cenbio.org.br/in/index.html |
| Escola Superior de Agricultura Luiz de Queiroz (ESALQ) | Agriculture, biology, environmental science, food science, and forestry | Piracicaba, SP | http://www.esalq.usp.br/english/esalqtoday.html |
| Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) | São Paulo state's R&D funding institution | São Paulo, SP | http://watson.fapesp.br/fapesp/instit.htm |
| Fundação Centros de Referência em Tecnologias Inovadoras (CERTI) | Industrial automation, information technology, measuring automation, mechanoptoelectronics, and metrology | Florianopólis, SC | http://www.certi.org.br/english/quem/historico.htm |
| Instituto Agronômico de Campinas (IAC) | Agricultural engineering (including the use of renewable energies), biological sciences, climate studies, floriculture, horticulture, phytotechnology, and soil science | São Paulo, SP | http://www.iac.sp.gov.br/ |
| Instituto Agronômico do Paraná (IAPAR) | Agricultural-related R&D, such as seed development, meteorological research, and soil analysis | Paraná, PR | http://www.iapar.br/noticias/produto-servico.html |
| Instituto Alberto Luiz Coimbra de Pós-Graduação e Pesquisa de Engenharia (COPPE) | Atmospheric sciences, composite materials, environmental engineering, high-performance computing, telecommunications, and technology for exploitation of marine resources and petroleum reserves | Rio de Janeiro, RJ | http://www.coppe.ufrj.br/coppe/catalogo-english.htm |

| Organization | Focus | Location | Web site |
|---|---|---|---|
| Instituto Nacional de Metrologia, Normalização e Qualidade Industrial (INMETRO) | Measurement standards, nanotechnology, and accreditation for products, processes, and services | Rio de Janeiro, RJ | none |
| Instituto Nacional de Pesquisas da Amazônia (INPA) | Conservation and sustainable development | Manaus, AM | http://www.inpa.gov.br/quem_somos/historico.php |
| Instituto Nacional de Pesquisas Espaciais (INPE) | Space engineering, science, and technology | São José dos Campos, SP | http://www.inpe.br/ |
| Instituto Nacional de Tecnologia (INT) | Chemistry, energy, environment, industrial design, and production management | Rio de Janeiro, RJ | http://www.int.gov.br/Novo/INT/Apresentacao/Ingl%EAs/int_ingles_apresentacao.html |
| Instituto de Pesquisas Energéticas e Nucleares (IPEN) | Nuclear physics, radiochemistry, materials research (including laser applications) | São Paulo, SP | http://www.ipen.br/sitio/?idm=152 |
| Instituto de Pesquisas Tecnológias do Estado de São Paulo (IPT) | Chemistry, civil engineering, electrical engineering, forestry, geology, mechanical engineering, metallurgy, naval and oceanic engineering | São Paulo, SP | http://www.ipt.br/institucional/organizacao/historico/ |
| Instituto de Tecnologia para o Desenvolvimento (LACTEC) | Applied chemistry, artificial intelligence, ceramics, civil engineering, electromagnetics, and environmental science | Curitiba, PR | http://www.lactec.org.br/ |
| Laboratório Nacional de Luz Síncrotron (LNLS) | Nanotechnology, synchrotron light, high-resolution electron microscopes, scanning probe microscopes, and nuclear resonance spectrometers | Campinas, SP | http://www.lnls.br/ |
| Londrina Tecnópole | Bio-industry, energy, electronics, IT, and telecommunications | Londrina, PR | http://www.londrinatecnopolis.org.br/ |
| Rio Grande Tecnópole | Bio-industry, environmental technology, energy, engineering, electronics, IT, and telecommunications | Rio Grande, RS | http://www.info.rs.gov.br/tecnopoles/riogrande |
| Petrópolis Tecnópolis | Bio-industry, environmental technology, energy, engineering, electronics, IT, and telecommunications | Petrópolis, RS | http://www.petropolis-tecnopolis.com.br/ |
| Parque Tecnológico do Rio | Bio-industry, energy, engineering, electronics, IT, and telecommunications | Rio de Janeiro, RJ | http://www.parquedorio.ufrj.br |
| Parque Tecnológico do Pólo de Informática | Engineering, electronics, IT, and telecommunications | São Leopoldo, RS | http://www.polodeinformatica.com.br/ |
| Parque Tecnológico da PUCRS | Bio-industry, environmental technology, energy, engineering, electronics, IT, and telecommunications | Porto Alegre, RS | http://www.pucrs.br/tecnopuc |
| Parque Tecnológico do Vale do Sinos | Not specified | Campo Bom, RS | http://www.valetec.org.br/ |
| Pólo de Informática de Caxias | Engineering, electronics, IT, and telecommunications | Caxias do Sul, RS | http://www.polocaxias.com.br/ |
| Blusoft | Engineering, electronics, IT, and telecommunications | Blumenau, SC | http://www.blusoft.org.br/ |

| Organization | Focus | Location | Web site |
|---|---|---|---|
| Parque Tecnológico do Alto Vale do Itajaí - TECNOPARK | Bio-industry, energy, engineering, electronics, and IT | Porto Alegre, RS | http://www.tecnopark.org.br/ |
| Parque Tecnológico Agroindustrial do Oeste | Bio-industry, environmental technology, energy, engineering, electronics, IT, and telecommunications | Cascavel, PR | http://www.fundetec.org.br/?pagina=parque |
| Parque Tecnológico da Fundação Bio-Rio | Not specified | Rio de Janeiro, RJ | http://www.biorio.org.br/ |
| Parque de Alta Tecnologia do Norte Fluminense | Bio-industry, environmental technology, electronics, IT, and telecommunications | Rio de Janeiro, RJ | http://www.tecnorte.rj.gov.br/ |
| Parque Tecnológico de Xerém | Bio-industry, environmental technology, energy, engineering, electronics, IT, and telecommunications | Duque de Caixas, RJ | http://www.inmetro.gov.br/metcientifica/ptx.asp |
| Parque Tecnológico de Eletro-Eletrônica | Energy, engineering, electronics, and IT | Recife, PE | http://www.pop-pe.rnp.br/parqtel |
| Parque Tecnológico do NUTEC | Bio-industry, environmental technology, electronics, IT, and telecommunications | Fortaleza, CA | http://www.partecnet.hpg.com.br/ |
| Parque de Desenvolvimento Tecnológico - PADETEC | Bio-industry and environmental technology | Fortaleza, CA | http://www.padetec.ufc.br/ |
| Associação de Desenvolvimento Tecnológico do Vale - VALETEC | Not specified | Campo Bom, RS | http://www.valetec.org.br |
| Parque Tecnologico UNIVAP | Energy, engineering, electronics, and IT | São José dos Campos, SP | http://www.parquetecnologico.univap.br |
| The Technology Park of Sao Paulo | Biomedicine, biotechnology, IT, advanced materials, environment, and chemicals | São Paulo, SP | http://www.cietec.org.br |
| NÚCLEO DE INCUBAÇÃO DE EMPRESAS DE XINGÓ | Biomedicine, biotechnology, and environment | Piranhas, AL | www.niex.al.org.br/ |
| Centro Regional de Inovação e Transferência de Tecnologia | Agro-industry, biomedicine, biotechnology, and environment | Juiz de Fora, MG | www.critt.ufjf.br/ |
| CENTRO DE ESTUDOS E SISTEMAS AVANÇADOS DO RECIFE | Agro-industry, biomedicine, biotechnology, IT, advanced materials, environment, and chemicals | Recife, PE | www.cesar.org.br/ |
| FUNDAÇÃO EDUCERE DE CAMPO MOURÃO | Agro-industry and biomedicine | Campo Mourão, PR | http://www.educere.org.br/ |

Source: Open Source Center, "Oxford Analytica Catalog of Science Parks in Selected Countries" (03/24/2005) (Open Source Center document FBS20050324777072).

## BIBLIOGRAPHY

Achmawi, Randa. "Interview with Science and Technology Minister Sergio Rezende." *Brazil-Arab News Agency*, December 6, 2005 (Open Source Center document LAP20051206357003).

*Agentstvo Voyennykh Novostey* [Moscow], October 11, 2004 (Open Source Center document CEP20041011000189).

"Air-Launched Rockets, Brazil: AV–SF–70 Skyfire Rocket System." *Jane's Air-Launched Weapons*. Croydon, UK: 2006 (accessed via Intelink; posted June 6, 2006).

"Air-to-Air Missiles – Within Visual Range, Brazil." *Jane's Air-Launched Weapons*. Croydon, UK: 2006 (accessed via Intelink; posted October 11, 2006).

"Artillery Rockets, Brazil." *Jane's Ammunition Handbook*. Croydon, UK: 2006 (accessed via Intelink; posted July 26, 2006).

"Artillery Rockets, Brazil: Avibras Astros II Rockets." *Jane's Ammunition Handbook*. Croydon, UK: 2006 (accessed via Intelink; posted July 26, 2006).

Associação Brasileira da Indústria Farmoquímica. "Index 2006." Rio de Janeiro: 2006, 17–93. <http://www.abiquif.org.br/in/index.htm>

"Bio-Refinery: Oxiteno Plans to Develop Technology to Produce Cheap Ethanol not for Energy, But as Raw Material for Chemical Products." *Unicamp Innovation* [São Paulo], August 9, 2006. <http://www.inovacao.unicamp.br/english/report/news-oxiteno060809.shtml>

"Bombs – Cluster and Dispenser Munitions, Brazil." *Jane's Air-Launched Weapons*. Croydon, UK: 2006 (accessed via Intelink; posted January 16, 2006).

Borges, Andre. "President Lula Will Regulate the Technological Innovation Law." *NoticiasFinancieras* [Miami], September 2005, 1.

Brazil. Agencia Brasileira de Desensolvimento Industrial. *Balanço PITCE 2005*. Brasília: 2006. <http://www.mdic.gov.br/arquivo/ascom/imprensa/20060404balancoPITCE.pdf>

Brazil. Banco Centro do Brasil. *Boletim do Banco Central do Brasil, Abril 2006 Volume 42 – Número 4*. Brasília: 2006. <http://www.bcb.gov.br/ftp/histbole/Bol200604p.pdf>

Brazil. Banco Centro do Brasil. *Boletim do Banco Central do Brasil, March 2005 Volume 41 – Number 3*. Brasília: 2005. <http://www.bcb.gov.br/ftp/histbole/bol200203i.pdf>

Brazil. Banco Centro do Brasil. *Census of Foreign Capitals in Brazil – 1995 Base Year*. Brasília: 1998. <http://www.bcb.gov.br/?CENSUS1995>

Brazil. Banco Centro do Brasil. *Census of Foreign Capitals in Brazil – 2000 Base Year*. Brasília: n.d. <http://www.bcb.gov.br/?CENSUS2000>

Brazil. Banco Centro do Brasil. "Focus February 18th, 2002." Brasília: 2002. <http://www4.bcb.gov.br/Pec/Gci/Ingl/Focus/I20020218-Deregulation%20of%20the%20Oil%20Sector.pdf>

Brazil. Banco Nacional de Desenvolvimento Econômico e Social. "BNDES contrata com a Libbs o primeiro financiamento do Profarma, 16.11.04." Rio de Janeiro: 2004. <http://www.bndes.gov.br/noticias/2004/not922.asp>

Brazil. Banco Nacional de Desenvolvimento Econômico e Social. "Fund for the Technological Development of Telecommunications – FUNTTEL." Rio de Janeiro: n.d. <http://www.bndes.gov.br/english/funttel_in.asp>

Brazil. Banco Nacional de Desenvolvimento Econômico e Social. "Innovation." Rio de Janeiro: n.d. <http://www.bndes.gov.br/english/innovation.asp>

Brazil. Banco Nacional de Desenvolvimento Econômico e Social. "News 03.14.05." Rio de Janeiro: 2005. <http://www.bndes.gov.br/english/news/not052_05.asp>

Brazil. Banco Nacional de Desenvolvimento Econômico e Social. "Program for the Development of the National Software and Related Services Industry – PROSOFT." Rio de Janeiro: n.d. <http://www.bndes.gov.br/english/progsoft_in.asp>

Brazil. Banco Nacional de Desenvolvimento Econômico e Social. "Programs." Rio de Janeiro: n.d. <http://www.bndes.gov.br/english/programs.asp#agro>

Brazil. Banco Nacional de Desenvolvimento Econômico e Social. "Support Program for the Development of the Pharmaceutical Productive Chain – PROFORMA." Rio de Janeiro: n.d. <http://www.bndes.gov.br/english/profarma_in.asp>

Brazil. Banco Nacional de Desenvolvimento Econômico e Social. "Technology Fund." Rio de Janeiro: n.d. <http://www.bndes.gov.br/english/funtec.asp>

Brazil. Capital de Risco Brasil. "All About It." n.p.: 2002. <http://www.capitalderisco.gov.br/VCN_ING/EN_oquee_PI.asp>

Brazil. Capital de Risco Brasil. "Dúvidas mais frequentes." Rio de Janeiro: n.d. <http://www.capitalderisco.gov.br/vcn/htms/duvidas.htm >

Brazil. Capital de Risco Brasil. "Fundos INOVAR Venture Capital." Rio de Janeiro: n.d. <http://www.capitalderisco.gov.br/vcn/fundos_venture_PI.asp>

Brazil. Capital de Risco Brasil. "Inovar Project: Achievements." n.p.: 2002. <http://www.capitalderisco.gov.br/VCN_ING/en_resultados_PI.asp>

Brazil. Capital de Risco Brasil. "INOVAR Project: Partners." n.p.: 2002. <http://www.capitalderisco.gov.br/VCN_ING/en_parceiros_PI.asp>

Brazil. Indústria de Material Bélico do Brasil. Web site. Piquete, SP: n.d. <http://www.imbel.gov.br/index.php?centro=home&lang=en>

Brazil. Instituto Brasileiro de Geografia e Estatística. *Pesquisa Industrial de Inovacao Tecnologica 2003*. Rio de Janeiro: 2005. <http://www.ibge.gov.br/home/estatistica/economia/industria/pintec/2003/pintec2003.pdf>

Brazil. Instituto de Pesquisas Energéticas e Nucleares. "O IPEN: Áreas de Atuação." São Paulo: 2006. <http://www.ipen.br/sitio/?idm=152>

Brazil. Instituto Nacional de Meteorologia. Web site. Brasília: n.d. <http://www.inmet.gov.br/>

Brazil. Instituto Nacional de Pesquisas da Amazônia. "Histórico," 2002–6. <http://www.inpa.gov.br/quem_somos/historico.php>

Brazil. Instituto Nacional de Pesquisas Espacials. "Cooperacão Internacional." São José dos Campos: 2006. <http://www.inpe.br/>

Brazil. Instituto Nacional de Pesquisas Espacials. "Cooperacão Nacional." São José dos Campos: 2006. <http://www.inpe.br/>

Brazil. Instituto Nacional de Pesquisas Espacials. "Histórico: O Brasil no Espaço." São José dos Campos: 2006. <http://www.inpe.br/scd1/site_scd/historico.htm>

Brazil. Instituto Nacional de Pesquisas Espacials. "Missão." São José dos Campos: 2006. <http://www.inpe.br/>

Brazil. Instituto Nacional de Tecnologia. "Technology Towards Development." Rio de Janeiro: n.d. <http://www.int.gov.br/Novo/INT/Apresentacao/Ingl%EAs/int_ingles_apresentacao.html>

Brazil. Ministério da Agricultura, Pecuária e Abastecimento. EMBRAPA. "Embrapa's International Cooperation." Brasília: n.d. <http://www22.sede.embrapa.br/sci/unit.htm>

Brazil. Ministério da Agricultura, Pecuária e Abastecimento. EMBRAPA. "Embrapa's Virtual Laboratories Abroad." Brasília: 2006. <http://www.embrapa.gov.br/English/a_embrapa/laboratorios_no_exterior/index_html/mostra_documento>

Brazil. Ministério da Agricultura, Pecuária e Abastecimento. EMBRAPA. "Research Centers." Brasília: n.d. <http://www.embrapa.gov.br/English/a_embrapa/unidades_de_pesquisa/index_htm>

Brazil. Ministério da Ciência e Tecnologia. "Cooperação Internacional." Brasília: 2006. <http://www.mct.gov.br/index.php/content/view/17255.html>

Brazil. Ministério da Ciência e Tecnologia. "Definições Básicas." Brasília: 2006. <http://www.mct.gov.br/index.php/content/view/19260.html>

Brazil. Ministério da Ciência e Tecnologia. "Energia e Recursos Minerais: Introdução." Brasília: 2005-2006. <http://www.mct.gov.br/index.php/content/view/5066.html>

Brazil. Ministério da Ciência e Tecnologia. "Energia e Recursos Minerais: Programa de Hidrogênio." Brasília: 2006. <http://www.mct.gov.br/index.php/content/view/5118.html>

Brazil. Ministério da Ciência e Tecnologia. "Meteorologia, Climatologia e Hidrologia: Histórico." Brasília: 2006. <http://www.mct.gov.br/index.php/content/view/10508.html>

Brazil. Ministério da Ciência e Tecnologia. "Programa Nacional de Atividades Espacias." Brasília: 2006. <http://www.mct.gov.br/index.php/content/view/35257.html>

Brazil. Ministério da Ciência e Tecnologia. "Programa Nacional de Nanotecnologia." Brasília: 2006. <http://www.mct.gov.br/index.php/content/view/27137.html>

Brazil. Ministério da Ciência e Tecnologia. "Relatório Nanotecnologia Investimentos, Resultados e Demandas." Brasília: 2006, 12. <http://www.mct.gov.br/upd_blob/8075.pdf>

Brazil. Ministério da Ciência e Tecnologia. Brazilian Synchrotron Light Laboratory. "Open Facilities." Campinas, BR: n.d. <http://www.lnls.br/>

Brazil. Ministério da Ciência e Tecnologia. Brazilian Synchrotron Light Laboratory. Web site Homepage. Campinas, BR: n.d. <http://www.lnls.br/>

Brazil. Ministério da Ciência e Tecnologia. FINEP. "Ações Transversais." Rio de Janeiro: n.d. <http://www.finep.gov.br/fundos_setoriais/acao_transversal/acao_transversal_resultado.asp?codFundo=17>

Brazil. Ministério da Ciência e Tecnologia. FINEP. "The Brazilian Innovation Agency 2005." Rio de Janeiro: 2005. <www.finep.gov.br-FINEP_folder_ingles.pdf>

Brazil. Ministério da Ciência e Tecnologia. FINEP. "Chamada Pública MCT/FINEP/CT-INFO-Software – 01/2005 Divulgação de Resultados." Rio de Janeiro: 2005. <http://www.finep.gov.br//fundos_setoriais/ct_info/resultados/Resultado_CT_INFO_SOFTWARE_01_2005.PDF>

Brazil. Ministério da Ciência e Tecnologia. FINEP. "CHAMADA PÚBLICA MCT/FINEP/CT-PETRO - TEMAS ESTRATÉGICOS 01/2006." Rio de Janeiro: 2006.

<http://www.finep.gov.br//fundos_setoriais/ct_petro/resultados/Resultados_CHAMADA_PUBLICA_MCT_FINEP_CT_PETRO_TEMAS_ESTRATEGICOS_01_2006.pdf>

Brazil. Ministério da Ciência e Tecnologia. FINEP. "Chamadas Públicas." Rio de Janeiro: n.d. <http://www.finep.gov.br/como_obter_financiamento/editais_financiamento_ini.asp>

Brazil. Ministério da Ciência e Tecnologia. FINEP. "Chamadas Públicas Encerradas/Resultados." Rio de Janeiro: n.d. <http://www.finep.gov.br/fundos_setoriais/verde_amarelo/verde_amarelo_resultados.asp?codSessao=8&codFundo=5>

Brazil. Ministério da Ciência e Tecnologia. FINEP. "CT-Agronegócio – Fundo para o Setor de Agronegócios." Rio de Janeiro: n.d. <http://www.finep.gov.br/fundos_setoriais/ct_agro/ct_agro_ini.asp?codFundo=11>

Brazil. Ministério da Ciência e Tecnologia. FINEP. "Formas de Atuação." Rio de Janeiro: n.d. <http://www.finep.gov.br/o_que_e_a_finep/formas_atuacao.asp?codSessaoOqueeFINEP=3>

Brazil. Ministério da Ciência e Tecnologia. FINEP. "FUNTTEL – Fundo para o Desenv. Tecnol. Das Telecomunicações: Chamadas Públicas Encerradas/Resultados." Rio de Janeiro: n.d. <http://www.finep.gov.br/fundos_setoriais/funttel/funttel_resultado.asp?codSessao=8&codFundo=7>

Brazil. Ministério da Ciência e Tecnologia. FINEP. "INOVAR Semente." Rio de Janeiro: n.d. <http://www.capitalderisco.gov.br/vcn/inovar_semente_PI.asp>

Brazil. Ministério da Ciência e Tecnologia. FINEP. "Liberações Efetuadas [2003]." Rio de Janeiro: n.d. <http://www.finep.gov.br/numeros_finep/fundos_setoriais/liberacoes_2003.asp>

Brazil. Ministério da Ciência e Tecnologia. FINEP. "Liberações Efetuadas [2005]." Rio de Janeiro: n.d. <http://www.finep.gov.br/numeros_finep/fundos_setoriais/liberacoes.asp?codSessaoFundos=5>

Brazil. Ministério da Ciência e Tecnologia. FINEP. "O que é o CT-Aero?" Rio de Janeiro: n.d. <http://www.finep.gov.br/fundos_setoriais/ct_aero/ct_aero_ini.asp?codFundo=12>

Brazil. Ministério da Ciência e Tecnologia. FINEP. "O que são os fundos de C&T." Rio de Janeiro: n.d. <http://www.finep.gov.br/fundos_setoriais/fundos_setoriais_ini.asp?codSessaoFundos=1>

Brazil. Ministério da Ciência e Tecnologia. FINEP. "O que é o VERDE-AMARELO?" Rio de Janeiro: n.d. <http://www.finep.gov.br/fundos_setoriais/verde_amarelo/verde_amarelo_ini.asp?codFundo=5>

Brazil. Ministério da Ciência e Tecnologia. FINEP. "Pagamentos Efetuadas 01/01/2003 até 31/12/2003." Rio de Janeiro: n.d. <http://www.finep.gov.br/numeros_finep/fundos_setoriais/liberacoes_2003.asp>

Brazil. Ministério da Ciência e Tecnologia. FINEP. "Pagamentos Efetuadas 01/01/2005 até 31/12/2005." Rio de Janeiro: n.d. <http://www.finep.gov.br/numeros_finep/fundos_setoriais/ptf2005/estado/total_estado.asp>

Brazil. Ministério da Ciência e Tecnologia. FINEP. "Programa de Apoio à Pesquisa em Empresas." Rio de Janeiro: n.d. <http://www.finep.gov.br/programas/pappe.asp>

Brazil. Ministério de Minas e Energia. "Biodiesel: The New Fuel from Brazil." Brasília: n.d. <http://www.biodiesel.gov.br/docs/cartilha_ingles.pdf>

Brazil. Ministério do Desenvolviment, Indústria e Comércio Exterior. *National Biotechnology Strategy – Bio-Industry Development Policy*. Brasília: July 2006. <http://www.mct.gov.br/upd_blob/7449.pdf>

Brazil. Ministério do Desenvolviment, Indústria e Comércio Exterior. National Investment Information Network. "Brazil Electronic Component Market Report March/2004." Brasília: 2004: 25-28. <http://investimentos.desenvolvimento.gov.br/renai_en/arquivos/compEletrIng.pdf>

Brazil. Ministério do Desenvolvimento, Indústria e Comércio Exterior. Rede Nacional de Informacoes sobre o Investimento. "Brazil Electronic Component Market Report, March/2004." Brasília: 2004. <http://investimentos.desenvolvimento.gov.br/renai_en/arquivos/compEletrIng.pdf>

Brazil. Ministério do Desenvolvimento, Indústria e Comércio Exterior. Rede Nacional de Informacoes sobre o Investimento. "FDI Inflows in Brazil – Inward Investment – Annual – 1995–2005." Brasília: n.d. <http://investimentos.desenvolvimento.gov.br/renai_en/arquivos/IEDfluxoSITERENAI.pdf>

Brazil. Ministério do Desenvolvimento, Indústria e Comércio Exterior. Rede Nacional de Informacoes sobre o Investimento. "Industrial Policy." Brasília: n.d. <http://investimentos.desenvolvimento.gov.br/renai_en/index.asp>

Brazil. Ministério do Desenvolvimento, Indústria e Comércio Exterior. Rede Nacional de Informacoes sobre o Investimento. "The Industrial, Technological and Foreign Trade Policy—PITCE." Brasília: 2004. <http://investimentos.desenvolvimento.gov.br/renai_en/arquivos/RENAIlistaalteracoesiteNoticiasrepor53.pdf>

Brazil. Ministério do Desenvolvimento, Indústria e Comércio Exterior. Rede Nacional de Informacoes sobre o Investimento. "RNP and CPqD start Giga Project in 2003." Rio de Janeior: 2003. <http://www.rnp.br/en/news/2003/not-030114.html>

Brazil. Secretaria da Ciência e Tecnologia. Centro de Excelência em Technologia Eletrônica Avançada. "Objectivos Especificos." Porto Alegre: n.d. <http://www.sct.rs.gov.br/programas/ceitec/objetivos/objetivos_01.htm>

Brazil. Secretaria da Ciência e Tecnologia. Centro de Excelência em Technologia Eletrônica Avançada. "Programa Nacional de Microelectrônica." Porto Alegre: n.d. <http://www.sct.rs.gov.br/programas/ceitec/pnme/pnme_01_eng.htm>

"Brazil Attains Advanced Nuclear Power Capability." *Jane's Intelligence Digest*, September 29, 2006 (accessed via Intelink; posted September 27, 2006).

"Brazil Destines US$367 Million for Research and Innovation." *NoticiasFinancieras* [Miami], February 20, 2006, 1.

"Brazil Must Invest 2% of GDP in Research and Development to be More Competitive." *NoticiasFinancieras* [Miami], September 23, 2005, 1.

"Brazil: Seeking Prestige and Exploring Space." *Stratfor Weekly*, November 30, 2004. <http://stratfor.com/products_pre_prev.php>

Brito, Jorge. "Cooperação Tecnológica e Esforços Inovativos na Indústria Brasileira: Um estudo exploratório a partir da PINTEC**,**" in *Anais do XI Encontro Nacional de Economica Politica da SEP*. Uberlândia, BR: Instituto de Economia, Universidade Federal de Uberlândia, June 2004. <http://www.ie.ufu.br>

Bueno, Rachel. "Nanotechnology: Unicamp's Chemistry Institute Develops Process for Silver Nanoparticles; Gold Particles Can Be Used for Drug Delivery." *Unicamp Innovation* [São Paulo], June 5, 2006. <http://www.inovacao.unicamp.br/english/report/news-nanotechnology060522.shtml>

Carvalho, H., J. Kono, M.M. Quintino, and L.F. Perondi. *Space Activities in Brazil*. Lindau: Copernicus Online Service and Information System, n.d. <http://www.cosis.net/abstracts/COSPAR04/02819/COSPAR04-A-02819.pdf>

Centro de Pesquisa e Desenvolvimento em Telecomunicações. "Foco na Modernização." Campinas: 2004. <http://www.cpqd.com.br/site/ContentView.php?cd=867>

Centro de Previsão de Tempo e Estudos Climáticos. Web site. Cachoeira Paulista, BR: 2006.

Centro Incubador de Empresas Tecnológicas. "Institutional: The Movement in Brazil." Butantã: 2005. <http://www.cietec.org.br/pages_ing.php?pagina=movibrasiling>

Centro Nacional de Referência em Biomassa. "Who we are." São Paulo: n.d. <http://www.cenbio.org.br/in/index.html>

"Colombian Air Force Purchases Super Tucano Light Attack Aircraft." *Jane's International Defence Review*, February 1, 2006 (accessed via Intelink; posted January 17, 2006).

"Contractors, Brazil." *Jane's Aircraft Upgrades*. Croydon, UK: 2006 (accessed via Intelink; posted September 8, 2006).

Daniel, Isaura. "Paulo Xavier: Entry in the Arab Market is the CPqD Target for 2006." *Brazil-Arab News Agency*, July 31, 2006 (Open Source Center document LAP20060801357005).

"Defence Production and R&D, Brazil." *Jane's Sentinel Security Assessment – South America.* Croydon, UK: 2005 (accessed via Intelink; posted May 23, 2005).

Duarte, Carlos H.C. "Brazil: Cooperative Development of a Software Industry." *IEEE Software*, May/June 2002, 84–85. <http://www.ieeexplore.ieee.org/iel5/52/21654/01003461.pdf?arnumber=1003461>

Duga, Jules, Tim Studt, and Andrew Dearing. "2005 Global R&D Report: The State of Global R&D." *R&D Magazine*, September 2005.

"Executive Summary, Brazil." *Jane's Sentinel Security Assessment – South America*. Croydon, UK: 2006 (accessed via Intelink; no posting date).

Federal Reserve Bank. "G.5 Foreign Exchange Rates (Monthly)." Washington, DC: October 2, 2006. <http://www.federalreserve.gov/releases/g5/current/>

Federal Reserve Bank. "G.5A Foreign Exchange Rates (Annual)." Washington, DC: 2006. <http://www.federalreserve.gov/releases/g5a/current/>

Federal University of Rio de Janeiro. Instituto Alberto Luiz Coimbra de Pós-Graduação e Pesquisa de Engenharia. "Introduction." Rio de Janeiro: 1998. <http://www.coppe.ufrj.br/coppe/catalogo-english.htm>

Ferra, Ana Flávia, Maria Beatriz Bonacelli, and Ana Lúcia Assad. "Biodiversity: Scientists and Industry Complain that Red Tape Puts Research on Brazil's Rich Biodiversity and Access to It on the Edge of Illegality." *Unicamp Innovation* [São Paulo], September 12, 2006. <http://www.inovacao.unicamp.br/english/report/news-biodiversity.shtml>

Fundação CERTI. "Who We Are." Florianópolis: n.d. <http://www.certi.org.br/english/quem/historico.htm>

Global Entrepreneurship Monitor. "2005 Empreendedorismo no Brasil: Relatório Executivo." Curitiba, BR: 2006, 9–10. <http://www.gemconsortium.org/download/1159891315437/GEM%20BRASIL%202005%20-%20Relat%F3rio%20Executivo.pdf>

Godoy, Roberto. "FAB Invests $100 Million in Missiles." *O Estado de São Paulo* [São Paulo], February 12, 2006 (Open Source Center document LAP20060212045005).

Guimarães, Leonam dos Santos. "Completion of Fabrication and Assembly of the Internal and Pressure Vessel of the LABGENE Reactor." *Economia & Energia*, January 1, 2006 (Open Source Center document LAP20060125357001).

Hessel, Rosana. "Brazil Loses Six Positions in Information and Communication Technology Ranking." *NoticiasFinancieras* [Miami], March 29, 2006, 1.

Hill, Derek. *Latin America: R&D Spending Jumps in Brazil, Mexico, and Costa Rica*. Washington: National Science Foundation, March 2000.

Hudson, Rex A., ed. *Brazil: A Country Study*. Washington, DC: GPO, 1998.

Instituto de Tecnologia para o Desenvolvimento. "Linhas de Pesquisa." Curitiba: 2006. <http://www.lactec.org.br/>

International Atomic Energy Agency. "Development of Innovative Nuclear Technology: Report by the Director General." Vienna: 2004. <http://www.iaea.org/About/Policy/GC/GC48/Documents/gc48-14.pdf>

International Atomic Energy Agency. "International Project on Innovative Nuclear Reactors and Fuel Cycles." Vienna: 2003. <http://www.iaea.org/worldatom/Programmes/Nuclear_Energy/NENP/NPTDS/Projects/inpro_scm.html>

International Organization for Standardization. "ISO 4217 Currency Names and Code Elements." Geneva: 2006. <http://www.iso.org/iso/en/prods-services/popstds/currency codeslist. html>

"Interview with Embrapa's Silvio Crestana." *Unicamp Innovation* [São Paulo], September 12, 2006. <http://www.inovacao.unicamp.br/english/report/interview-silviocrestana.shtml>

Izique, Claudia. "Once Again, in the Front Line." *Revisita Pesquisa FAPESP* [São Paulo], no. 99 (May 2004). <http://www.revistapesquisa.fapesp.br/?art=1192&bd=1&pg=1&lg=en>

Kassab, Álvaro. "Cooperation in São Paulo: Unicamp Scientists Help Conceive and Carry Out Brazil's Most Ambitious Brain Research Project Ever; Focus Will Be on Epilepsy." *Unicamp Innovation* [São Paulo], August 9, 2006. <http://www.inovacao.unicamp.br/english/report/news-epilepsy.shtml>

Lave, Lester B., and W. Michael Griffin. "Import Ethanol, Not Oil." *Issues in Science and Technology* 22, no. 3 (Spring 2006): 40–42.

Magneti Morelli. "The SFS technology." Milan: 2006. <http://www.magnetimarelli.com/flex/pages/sfs_eng.html>

Maiorino, José Rubens, and Thiago Carluccio. "A Review of Thorium Utilization as an Option for Advanced Fuel Cycle-Potential Option for Brazil in the Future." Paper presented at Americas Nuclear Energy Symposium, Miami Beach, October 3–6, 2004. São Paulo: Instituto de Pesquisas Energéticas e Nucleares, 2004. <http://www.osti.gov/bridge/servlets/purl/839368-n26hHx/native/839368.pdf>

Massachusetts Institute of Technology, and the SOFTEX Society. *The Software Industry in Brazil – 2002: Strengthening the Economy of Knowledge*. Campinas, BR: 2002. <http://www.softex.br/cgi/cgilua.exe/sys/start.htm?sid=108>

"Motorola's Brazilian Subsidiary Announces Two Research Initiatives." *Wireless News*, March 3, 2005. <http://www.tmcnet.com/usubmit/2005/Mar/1121699.htm>

"Nanoscientist Douglas Galvão." *Unicamp Innovation* [São Paulo], June 5, 2006. <http://www.inovacao.unicamp.br/english/report/interview-douglasgalvao.shtml>

"NBC Capabilities, Brazil." *Jane's Nuclear, Biological, and Chemical Defence*. Croydon, UK: 2006 (accessed via Intelink; posted August 11, 2006).

Ottoboni, Julio. "Brazil, South Africa to Develop Air-to-Air Missile." *Gazeta Mercantil* [São Paulo], February 14, 2006 (Open Source Center document LAP20060214055001).

"Pakistan, China Ink Space Agreement." *The News* [Islamabad], October 29, 2005 (Open Source Center document SAP20051029033012).

Paraná. *Paraná State News Agency*. "Brazil: Paraná, Venezuela to Form Information Technology Partnership," April 19, 2006 (Open Source Center document LAP20060419357002).

*Porto Alegre Tecnópole* [Porto Alegre, Brazil]. "Ceitec." n.d. <http://www.tecnopole.palegre.com.br/Default.asp?proj=88&secao=217&m1=19220>

"Procurement, Brazil." *Jane's Sentinel Security Assessment – South America*. Croydon, UK: 2006 (accessed via Intelink; posted April 5, 2006).

Rezende, Sergio M. "Financing Science, Technology, and Innovation in Brazil." Rio de Janeiro: Agencia da Ciencia e Tecnologia, Ministerio da Cienca e Tecnologia, 2006. <agenciact.mct.gov.br/upd_blob/40861.pdf>

Rubin, Debora. "Brazil Invests in the Energy of the Future." *Brazil-Arab News Agency*, May 11, 2006 (Open Source Center document LAP20060511357001).

Schlemm, Marcos Mueller, et al. "2005 Empreendedorismo no Brasil: Relatório Executivo." Curitiba, BR: Global Entrepreneurship Monitor, 2006: 9–10. <http://www.gemconsortium.org/download/1159891315437/GEM%20BRASIL%202005%20-%20Relat%F3rio%20Executivo.pdf>

*Science and Development Network*. "Brazil's Innovation Law: Lessons for Latin America," August 3, 2006. <http://www.scidev.net/content/editorials/brazils-innovation-law-lessons-for-latin-america.cfm>

Serviço Brasileiro de Apoio às Micro e Pequenas Empresas. "Sebrae – Brazilian Micro and Small Business Support Service." Brasília: n.d. <http://www.sebrae.com.br/br/osebrae/sebraeinenglish.asp>

Serviço Brasileiro de Apoio às Micro e Pequenas Empresas. "Sebrae's Major Acting Areas." Brasília: n.d. <http://www.sebrae.com.br/br/osebrae/sebraeinenglish1.asp>

Serviço Nacional de Aprendizagem Industrial. "Apresentação: SENAI CIMATEC." Salvador: 2003. <http://www.senai.fieb.org.br/apres_cimatec.shtm>

Silveira, Virgínia. "Brazil to Participate in Galileo Program for Positioning Satellites; Brazil Will Participate in Galileo." *Gazeta Mercantil* [São Paulo], December 16, 2005.

Simões, Janaina. "Biotechnology: National Biotechnology Strategy Lays Down Proposed Actions and Policies and Foresees the Need for At Least R$ 7 Billion." *Unicamp Innovation* [São Paulo], August 9, 2006. <http://www.inovacao.unicamp.br/english/report/news-biotechnology.shtml>

Simões, Janaina. "Funding: Brazil Development Bank Launches Support Initiative for R&D in Strategic Areas and Encourages Business-Academia Partnership." *Unicamp Innovation* [São Paulo], August 9, 2006. <http://www.inovacao.unicamp.br/english/report/news-technologyfund.shtml>

Simões, Janaina. "São Paulo Science Parks." *Unicamp Innovation* [São Paulo], September 12, 2006. <http://www.inovacao.unicamp.br/english/report/news-spscienceparks.shtml>

Singer, Peter A., Fabio Salamanca-Buentello, and Abdallah S. Daar. "Harnessing Nanotechnology to Improve Global Equity: The Less Industrialized Countries Are Eager to Play an Early Role in Developing This Technology; The Global Community Should Help Them." *Issues in Science and Technology* 21, no. 4 (June 22, 2005): 57–58.

South Africa. Department of Foreign Affairs. "RSA-Brazil-India Joint Statement on New Delhi 'Agenda for Cooperation.'" Johannesburg: 2004 (Open Source Center document AFP20040305000079).

"Spreadsheet: Aircraft Production Tables (Rest of World). " *Jane's All The World's Aircraft*, n.d. (accessed via Intelink; posted November 18, 2004).

"Studies for Two Plants Completed." *Latin American Power Watch* 21, no. 11 (June 7, 2005): 5.

Top500.org. "Current List: June 2006." Knoxville, TN, and Mannheim, DE: Innovative Computing Laboratory, University of Tennessee and University of Mannheim, 2006. <http://top500.org/lists/2006/06>

United States. Department of Energy. "International Collaboration." Washington, DC: 2006. <http://nuclear.energy.gov/genIV/neGenIV3.html>

United States. Department of Energy. Office of Nuclear Energy. "What is Generation IV?" Washington, DC: 2006. <http://gen-iv.ne.doe.gov/>

Veneu, Fernanda. "Brazil Adopts Innovation Law." *SciDevNet*, December 20, 2004. <http://www.scidev.net>

Weitao, Li. "Huawei Secures Major Brazilian Deal." *Beijing China Daily*, August 22, 2006 (Open Source Center document CPP20060822062030).

Wen, Howard. "IBM Ups Linux Ante in Brazil; Big Blue Will Invest $2.2 Million on a Linux R&D Center in Brazil." *Information Week*, May 24, 2006.

Wheatley, Jonathan. "Brazilian Biotech Startup Genoa Has Overcome Lack of Outside Support to Develop a Groundbreaking Cancer Vaccine." *Financial Times* [London], September 21, 2005, 11.