BRAZIL

1. Overview of National Energy Policy

Apart from ethanol, policies for renewable energy sources were absent up to 1998. With the privatization of the electric sector and the establishment of a new Federal Agency to handle electricity, some legislation was introduced.

The biggest RE program in place now, excluding large hydro, is the PROINFA – Programme of Incentives for Alternative Electricity Sources, which is based on Guaranteed Prices and feed in tariffs for 20 years for on-shore wind, biomass and small hydro power.

The PPAs – Power Purchase Agreements are signed between the Brazilian Electric Energy Holding – ELETROBRÁS, a company under the Ministry of Mines and Energy (MME) and the entrepreneurs (both Independent Power Producers and Self (auto) Producers that can commercialize the exceeding energy) having a 3rd Party Finance. Projects under the PROINFA are eligible for tradable green certificates and thus have attracted groups interested in carbon trading.

Brazil is a world leader in renewable energy both in the power and transportation sectors. Several National programs related to energy sector, as seen below, create a minimum framework for biomass, hydro (large, small and to a lesser extent micro), wind and solar energy development and use. In addition to electric power generation, biofuels play a major role in Brazil's energy matrix, especially Ethanol, and most recently the Biodiesel Program (still on a small scale) with a voluntary 2% blend effective in 2004, mandatory for 2008 and set targets for 2012.

Due to the existing large hydropower potential, a cheaper source of energy as compared to other sources of energy, Brazil has developed this sector more than the other renewable energy sources, such as wind, for example. Associated to a clean energy matrix, close to 45% of energy consumption is originated from renewable energy (RE). Since the 80's, Brazil has created energy efficiency (EE) programs that has avoided investment in new generation and has saved thousands of MWh of energy consumption and also reduced energy demand on peak hours.

In the transportation sector Brazil has been a world leader in production of ethanol from sugar cane, with actual production of about 15 billion liters per year either mixed to gasoline or used as pure ethanol. As mentioned, just recently a national Biodiesel program was created with the objective to include, during the first phase, a blending mandate to mix 2% of Biodiesel to all Diesel used for transportation. The mandate starts at 0 % today and will increase up to 5% by 2012.

2. National Programs/Policies and Targets for Renewable Energy

The addition of 3300 MW from wind, small hydro, biomass by 2016 is the current target of the PROINFA and the principal target for RE in Brazil, excluding large hydro. The total expected investment under PROINFA will be around U$ 4.3 billion, with a large share being financed - U$ 3.5 billion. Less than one month after PROINFRA's creation ANEEL defined a fixed Normative Price (R$ 72.35/MWh) for all energy sources.

After program conclusion, revenue of U$ 900 millions / Yr is expected from new RE sources and the expected mission reductions: 2.8 million tons of CO2 / year.

As off March 2007, the program has achieved the following results:

- 139 projects contracted
- 28 Power plants operational (755,08 MW)
- 65 start operation in 2007 (1.168,64 MW)
- 46 start operation in 2008 (1.226,36 MW)
- Total added capacity under PROINFA (~3.150,08 MW)

The table below represents the forecast of renewable energy supply growth, as stated in the national energy plan for 2030 issued by the Ministry of Mines and Energy in 2007. As seen, the major renewable energy contribution will continue to be from hydropower followed by biomass and wind power to a lesser extent.

Biomass, excluding CHP will be the second RE source, losing in installed capacity to hydropower (a breakdown by energy source and percentage of total by energy source can be found at section 7 below.) In the Brazilian interconnected electric system there are no technical barriers regarding cogeneration systems using biomass residues, such as sugarcane bagasse and black-liquor/wood residues.

An expressive share of the full cogeneration potential from biomass can be implemented with technologies that are commercially available. A study from the Brazilian Reference Centre on Biomass (CENBIO) estimates that at least 4,000 MW can be generated using sugarcane bagasse for instance.

Table1. Renewable energy supply growth

Unit: MW cumulative	2015	2020	2025	2030
Hydro	99,000	116,100	137,400	156,300
of which: Pumped Storage	N/A	N/A	N/A	N/A
Small hydro	2,330	3,330	5,330	8,330
Wind	1,382	2,282	3,482	4,682
Solar PV	N/A	N/A	N/A	N/A
Solar Thermal	N/A	N/A	N/A	N/A
Geothermal	N/A	N/A	N/A	N/A
Biomass excl. CHP	1,821	2,971	4,521	6,571
Biomass (solid residues)		200	650	1300
Tide, Wave, Ocean	N/A	N/A	N/A	N/A

Source: Brazilian Ministry of Mines and Energy, 2007

Biodiesel (2005) is a program to produce Biodiesel to be blended to fossil Diesel with a minimum blend percentage target of 2% by 2008, increased to 5% by 2016. These targets can be reviewed by the National Council for Energy Development and targets changed if conditions, such as biodiesel availability, including installed industry capacity, etc are in place. It is important to mention that Biodiesel should be preferably produced by Small Farmers – Family Agriculture, as noted in the current law.

Ministry of Mines and Energy forecast for Biodiesel production up to 2030 is as follows:

- 2010 – 3,000,000 m3
- 2020 – 4,800,000 m3
- 2030 – 11,750,000 m3

As off August 2007, Biodiesel production was 261,000 m3, nearly 30% of the projected result by the government for this year. This volume is insufficient to fulfill the target of adding 2% of biodiesel to all mineral diesel produced by 2008. For that to happen, Brazil production needs to be at least 800,000 m3 per year. In 2007 the production should be around 400,000 m3.

In addition to the low production results for 2006/2007 harvest season, and this is not an industrial capacity constraint since there is an installed capacity for production of 2,000,000 m3 annually. Also, the government planed that biodiesel should be produced by small farmers but nearly 85% of the raw material comes from large soy beans producers.

A quick overview about the ethanol program in Brazil demonstrates the importance of government regulation to market expansion. Brazil is a world leader in ethanol production from sugarcane, a result of a program that started due to the international oil crises in the 1970's - the PROALCOOL Programme. After the programme start up a series of regulation favored ethanol production.

In 1997 a complete price deregulation was applied for anhydrous ethanol and tests were authorized for use of blended ethanol in diesel oil (3% and 10% latter on). In 1998, due to the large surplus of ethanol, it was authorized to increase ethanol share in gasoline to 24%, from the earlier value of 22%. Yet in 1998 hydrated ethanol price was deregulated and in the same year the Federal Government required that all new cars acquired for its own use should use neat ethanol, provided the model is available in the market.

Fortunately, the important policies set years ago regarding the compulsory blending of ethanol in gasoline and the compulsory availability of hydrated alcohol in all service stations are still in effect and that boosted the ethanol market in Brazil.

A. Progress/Barriers

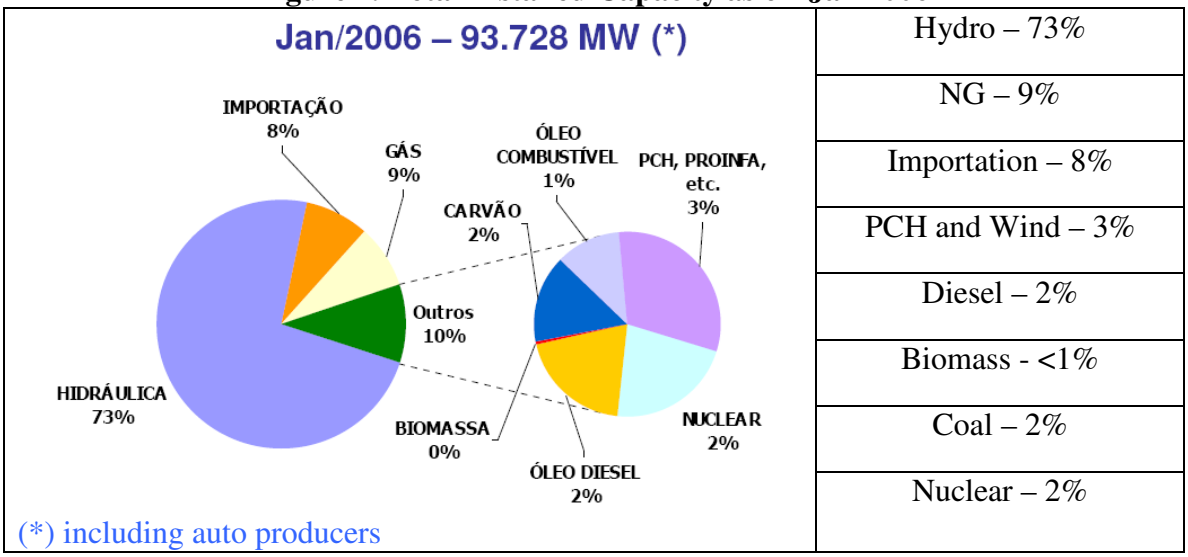
From 2004 to 2006, total RE growth in Brazil was around 2%, with major participation of hydropower and biomass. As seen in the table below.

Table 2. Average Growth in Renewables in Brazil

RE Average Growth	**1.82%**
Hydro	4.17%
Biomass (traditional wood)	-0.76%
Biomass (sugarcane)	2.96%

Other technologies have not been so representatives in terms of total installed capacity. On the other hand, wind technology has grown from 22 MW to 650 MW that is an increment of almost 3,000%. Again, in terms of installed capacity this figure represents less than 1% of the energy matrix, as seen in the graph below.

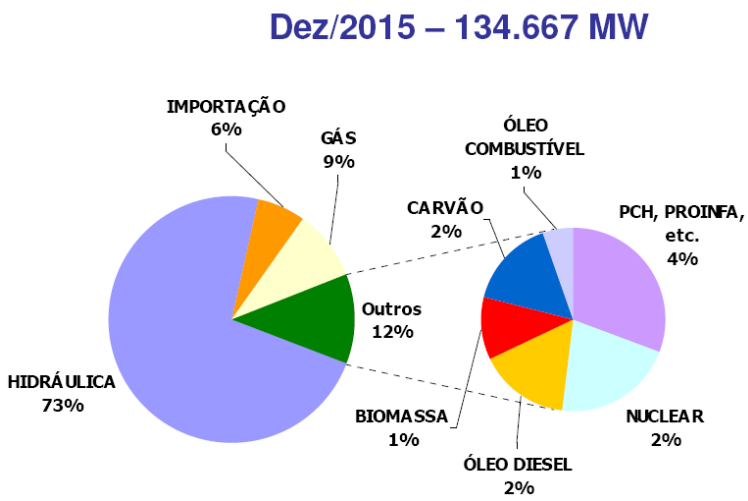
Figure 1. Total Installed Capacity as off Jan 2006



Source: MME, 2006

The forecast of RE growth in the next 10 years is shown in the graph below. As noted, the RE energy sources that will experience growth and replace imported energy will be wind power, Small Hydro Power and biomass, mainly due to the PROINFA Program targets to add 3,300 MW from Wind, Biomass and SHP (expected to be 1,100 MW from each source).

Figure 2. Total Installed Capacity forecast for Dec 2015



Hydro – 73%
NG – 9%
Importation – 6%
PCH and Wind – 4%
Diesel – 2%
Biomass 1%
Coal – 2%
Nuclear – 2%

Source: MME, 2006

Considering the PROINFA and PROCEL programs as the two main efforts in the area of RE ad EE respectively, these programs have achieved the following results toward meeting their original targets.

- PROINFA – Addition of 755.08 MW (24% of target)
- PROCEL – Reduction of 42.50 TWh (33% of target)

The latest PROCEL results, as off November 2006, was that with an investment of US$ US$ 428 millions between 1986 and 2005, the reduction achieved was of 22,095 GWh/yr, which represents avoiding the construction of a 5,206 MW hydroelectric power plant, considering a capacity factor of 56% and distribution and transmission loss of 15%. This represents an avoided investment of nearly US$ 8 Billion in new generation capacity. On the public lighting sector only, the savings were of 625,400 MWh/yr, which represented a reduction of 144 MW of demand on peak period.

As far as barriers, Brazil faces the challenge to increase wind technology from a total installed capacity of 22MW to 1100 MW (5000% increase in 12 years). At the same time the wind industry world wide has had a high demand for products and services, impacting the availability of such products and services in Brazil. In addition, according to PROINFA laws, at least 60% of all hardware has to be from National Industry, and thus, industry needs to grow at faster pace nationally to meet these targets.

One other constraint is the financial mechanism put in place for PROINFA that requires large amounts for equity funds and big players. Again, the international players have funded projects with better regulatory and financial framework elsewhere in the world, which delayed results here.

Finally, PROINFA program has run into a range of administrative, contractual and financing delays that are now being addressed. As far as PROCEL, energy efficiency has not being as disseminated as expected according to government. This resulted in a slow start for this sector.

Financing Renewable Energy projects use to be more complex than conventional, because of the risk perception and lack of experiences, in special for Wind Power.

Other barriers identified by the government are:

- Technology
  - Energy efficient equipment are more expensive
  - National industry is behind international development
- Cultural
  - Unawareness about energy efficiency techniques
  - Decision based on lower initial cost
  - Energy waste cultural trend
- Economical
  - Energy price
  - Elevated capital cost
  - Uncertainty about energy cost scenarios
- Financial
  - Performance contracts are not well received by banks yet
- Institutional
  - Lack of structured market for energy efficiency
  - Stakeholders divergent points of view and interest (for example, constructor x user)

3. National Programs/Policies and Targets for Energy Efficiency

Several programs have been created focusing on promoting energy efficiency and reduction of non-renewable energy sources. See the most important ones below.

- PBE (1984) – National Labeling Program - establishes performance standards of energy efficiency for domestic appliances, electric motors and even solar water heating collectors.

- PROCEL (1985) - Promoting of energy efficiency both on the production and consumption side, eliminating looses and reducing cost and investments.

Table below present the results of PROCEL program from 1996 to 2003.

Table 3. Results of PROCEL

Year	1996	1997	1998	1999	2000	2001	2002	2003
U$ Millions Invested	10	20	24	19	12	14	14	14
Energy Saved (GWh)	1,970	1,758	1,909	1,852	2,300	2,500	1,270	1,300

- CONPET (1991) - To encourage the efficient use of non-renewable energies in transportation, home, commerce, farming and stock breading, and industry in general by promoting technical cooperation agreements with governmental and private entities and rationalization in the use of fossil fuel products.

  CONPET was established by a federal decree in 1991, as the National Program for the Rational Use of Oil Derivatives. Its main objective is to promote the efficient use of these sources of non-renewable energy in transportation, in households, in commerce, in industry and in the agricultural and livestock industries. For its deployment, it followed the same guidelines as for PROCEL - the National Program for Power Conservation and, likewise, it is conducted by the Ministry of Mines and Energy.

  Table below presents the results of COMPET program since its creation in 1991.

Table 4. Results of COMPET

Energy Source	Economy
Diesel	63,5 million liters
Oil	743,7 x 1000 liters
NG	641 million m3
LPG	8,4 tons
Electricity	281,7 GWh
Diesel – TrasportAR Program	20,5 million liters / yr

Another important program is regulated by the Federal Law - 9,991 (2001), which determinates that 1% of the annual net income revenue of all energy distribution utilities shall be applied in EE and R&D projects. The investments are made by the utilities with the National Electricity Agency (ANEEL) approval.

Table below shows results of EE and R&D measures in terms of investments made, annual energy reduction and peak demand displaced since 1998 by National utilities.

Table 5. Results of EE and R&D

Period	# Utilities	Peak Demand Reduction (MW)	Annual Energy Economy (GWh/Yr)	Investment (U$ millions)
1998/1999	17	250	755	93
1999/2000	42	370	1.020	110

2000/2001	64	251	894	73
2001/2002	64	85	348	68
2002/2003	64	54	222	73
2003/2004	64	110	489	149
2004/2005	64	275	925	83
TOTAL	-	1.395	4.653	649

There are several legal instruments that regulate the energy sector and provide major instructions related to electricity and other energy sources. Below is a list of the main laws related to EE and RE in Brazil.

A complete list of resolutions, decrees and law of the energy sector is found at the National Electricity Regulatory Agency website: www.aneel.gov.br and www.anp.gov.br.

Table 6. Relevant Decrees, Regulations, Policies, and laws Affecting the Brazilian Energy Sector

Law	Date enacted	Purpose
Federal Law # 9074	07/07/1995	Establishes norms for grant and extensions of the concessions and permissions of public services and gives other instructions.
Federal Law # 9427	12/26/1996	Institutes the National Agency of Electric Energy - ANEEL, it disciplines the regiment of the concessions of Public Services of Electric Energy, and gives instructions.
Federal Law # 9.478	08/06/1997	Regulates the National Energy Politics, the relative activities to the monopoly of the oil, institutes the National Council of Energy Politics and the National Agency of the Oil and gives other instructions.
Federal Law # 9,991	07/24/2000	Federal regulation determining that 1% of the net income of companies shall be applied in EE and R&D projects (this percentage varies along time).
Federal Law # 10.295	10/17/2001	Regulates the National Politics of Conservation and Rational Use of Energy, aiming at the efficient allocation of energy resources and environmental preservation, and gives other instructions
Federal Law # 10.285	2001	Establishment of maximum levels of consumption, or minimums of energy efficiency, of machines and manufactured or commercialized consuming devices of

		energy in the Country, as well as in the buildings. To elaborate a program of targets for each product, aiming at a progressive evolution of the EE rates
Federal Law # 10,438	04/26/2002	Regulates the expansion and offer of emergency electric energy and creates the Program of Incentive to the Alternative Sources of Electric Energy (Proinfa), creates the Energy Development Account to fund RE and NG projects and programs, among other subjects related to rural electrification. PROINFA law, created opportunity for 3,300 MW of RE sources (1,100 for each of the following: wind, biomass and SHP)

Law	Date enacted	Purpose
Federal Law # 10.847	2004	Authorizes creation of the EPE (Energy Research Company - ERC[1]) and defined ability to it stops: art. 4º (…) XV - to promote studies and to produce information to subsidize plans and programs of development energy ambiently sustainable, also, of energy efficiency; XVI - to promote plans of goals directed toward rational use and conservation of energy, being able to establish partnerships of cooperation for this end;
Federal Law # 10,848		Regulates the commercialization of electric energy, introducing new chances for distributed generation and cogeneration (commercialization with the concessionaires)
Federal Law # 11097	01/13/2005	Regulates the introduction of Biodiesel in the Brazilian energy matrix and gives other instructions

[1] ERC in Portuguese is called EPE – Empresa de Pesquisa em Energia

A summary of all pertinent legislation (laws, decrees, resolutions, etc) related to energy sector with links to the most up to date versions is available at www.aneel.gov.br/biblioteca/legisbasica.cfm#texto .

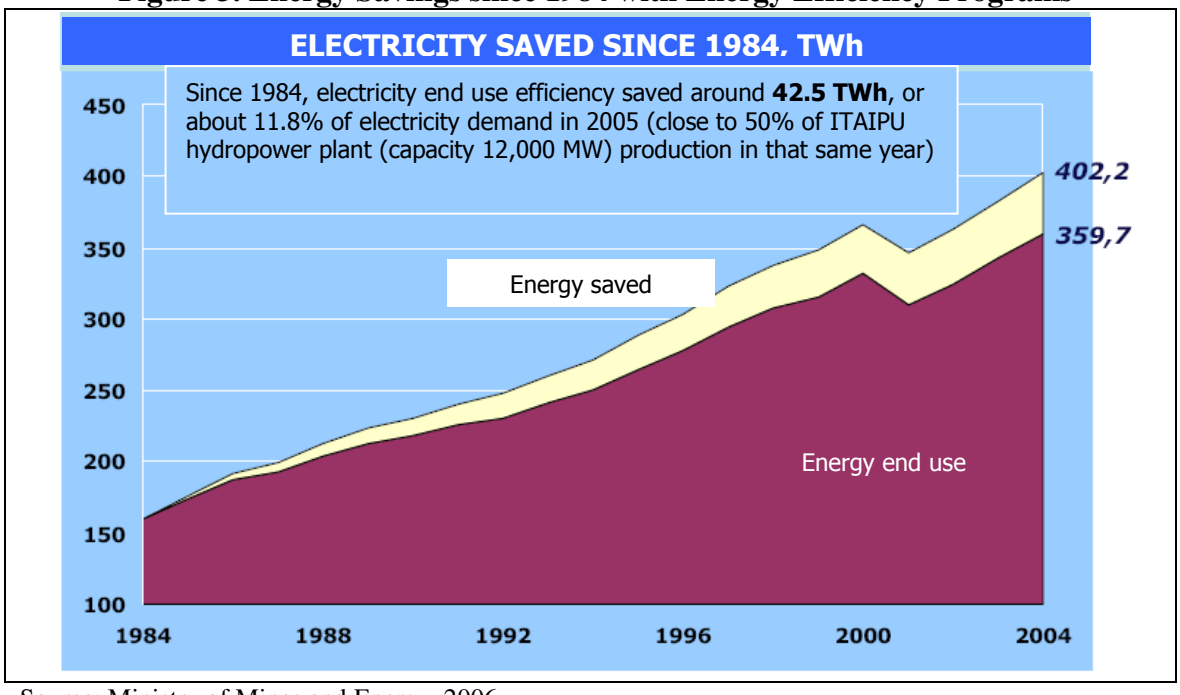
Brazil has three major Programs focused on Energy Efficiency.

- PBE (1984) – National Labeling Program for Energy Efficient Equipments
- PROCEL (1985) – National Program for Conservation of Electrical Energy and Energy Efficiency
- CONPET (1991) – National Program for the rationalization of the use of oil and natural gas derivates

Brazil aims at reducing, under the PROCEL program, up to 130 million MWh by 2015. This represents avoiding the construction of about 25,000 MW in power generation, which represents an estimate economy of US$ 14.7 billion. These results will be achieved through various actions and governmental promotions.

The following graph represents the energy savings of close to 43 TWh since 1984 with energy efficiency programs and projects in Brazil.

Figure 3. Energy Savings since 1984 with Energy Efficiency Programs



Source: Ministry of Mines and Energy, 2006

A study from the Ministry of Mines and Energy pointed out the following results as the potential energy saving from various sources taking in consideration the actions of the above mentioned programs.

Table 7. Potential Electricity Savings with Energy Efficiency Programs

Sector	TWh	US$ (millions) *
Industrial	9.2	596.50
Sanitation	1.5	95.50
Commercial	5.6	366.50
Residential (10%)	7.5	487.50
Public	1.6	102.50
Public lighting	1.3	86.00
Others (10%)	3.0	195.00
TOTAL	**29.7**	**1,843.50**

* considering US$ 65/MWh

Table 8. Potential Oil and NG Savings with Energy Efficiency Programs

Sector	TEP (x 1,000)	US$ (millions) *
Industrial, Oil and NG	862.00	408,00
Transportation – Diesel	2,497.00	1.181,50
Commercial – LPG	27.20	13,00
Residential – LPG	571.00	270,00
Public – LPG	39.10	18,50
Agribusiness - Diesel	483.00	228,50
Others (10%)	1,021.00	483,00
TOTAL	**5,500.00**	**2,602.50**

* considering US$ 65/barrel

According to the Ministry of Mines and Energy, the potential reduction of CO2 emissions considering the results of the energy efficiency programs, such as the PROCEL, CONPET and PROINFA is as follows:

Table 9. Potential Reduction of CO2 emissions with Policies

Activity	Reduction Potential (millions tCO2/year)	Revenue (US$ millions/year)*
Law #10,295	0.38	3.9 **
PROCEL + CONPET	6.50 – 12.20	66.2 – 122.40
PROINFA	2.90	29.00
TOTAL	6.70 – 12.40	67.80 – 124.00

*US$ 10.1 / tCO2 ** Electric motors and compact fluorescent lights
Source: Ministry of Mines and Energy, 2006.

Based on the figures above an also the large penetration of RE sources in Brazil energy matrix there are several on-going carbon sequestration project in Brazil related to Clean Energy generation.

Clean Development Mechanism: Brazil is the third country in number of projects under the clean development mechanism (CDM), with some 226 in the various stages of processing. In terms of emissions reductions projected, Brazil also is also third, with a reduction of 195 million tons of CO2, or about 6% of the world total in a period between seven and ten years.

This market represented in 2006 investments around U$ 6 billions and it is growing. On the other hand, lack of proper regulation within the country has slowed down several projects.

The largest number of projects developed in Brazil is in the area of energy and cogeneration with biomass (CHP), methane capture from both Swine culture and landfill gas (44% of total).

Landfill sites and activities that release nitrous oxide (N2O) - gas from burning solid fuels, liquid and gaseous, among other processes - should be responsible for the reduction of 113 million tons of CO2 alone, representing 60% of the emissions reduction certificates in Brazil.

Other projects accounted are in the areas of pulp and paper planted forests. Nevertheless, 70% of Brazil's green house gas emissions are related to deforestation and fire set to native forests.

4. National Programs/Policies and Targets for Other Clean Energy Technologies

Nuclear: The Eletrobrás thermonuclear Inc. was established in 1997 and is a subsidiary of Eletrobrás (Electric power holding) and responds with approximately 3.3% (performance, 2006) of the electricity consumed in Brazil.

The nuclear power electricity comes to major consumer centers in the country through the interconnected grid and represents more than 50% of the electricity consumed in the state of Rio de Janeiro. Today there are 2 nuclear power plants in Brazil: Angra 1, with an installed capacity of 657 MW and Angra 2, with capacity of 1,350 MW. Angra 3, which will be virtually a replica of Angra 2 (incorporating technological advances), is also expected to generate 1,350 MW.

The growth in demand for electricity estimated by MME up to 2015 implies in a need for expansion of generation capacity of about 3,000 MW on average per year. It is being drafted the National Action Plan for Energy 2030 (NAP - 2030), a long-term planning of the energy sector in the country. The preliminary studies suggest the construction of four new nuclear power plants by 2030 in addition to Angra 3, which had already been

included in the 10 year Plan (2006-2015). Two of the new nuclear units with capacity of 1,000 MW each, should be built in the Northeast Region and the other two in the Southeast (also with 1000 MW each).

According to the study, in 2015 the nuclear power capacity would be 3,300 MW with the entry of Angra 3. With the four other plants the ability to generate nuclear power, in 2030, will reach 7,300 MW. To do the calculations, the study is considering an increase in the Gross Domestic Product (GDP) of 4.1% per year and a growth of demand for energy of 3.5% annually by 2030. The considered investment in Nuclear generation ranges from 1,800 to 2,200 US$/kW.

Natural Gas: The regulatory framework for the natural gas industry in Brazil is approved by the Commission of Economic Affairs (CAE) of the Federal Senate - Law Project 226, in 2005. This law is under revision and the new one proposes new increments to the use of natural gas through the expansion of production and infrastructure for transport and storage of this product in the country.

The National Petroleum Regulatory Agency - ANP itself acknowledges that the natural gas receives, based on the law # 9478 / 1997, treatment of a petroleum-derived and not as a primary source of energy, as it should be.

Brazil consumes around 45 million cubic meters of natural gas per day, of which about 25 million cubic meters are imported from Bolivia. The current contract with Bolivia is to import 30 million cubic meters but due to the current political instability created by the Bolivian Government, Brazil canceled the import expansion plan and started the development of an increase of production plan. Called Plangás 2008, already approved by Petrobras and with the approval of the National Council for Energy Policy (CNPE), the NG plan aims for the increase in the supply of the current 17 million cubic meters per day to 40 million cubic meters at the end of 2008. That is, an increase of 23 million cubic meters per day with an estimate investment of 7.1 billions.

Brazil will continue importing NG from Bolivia but through the production capacity increase the country is looking for supply stability for industry, residences and vehicular use, the three major markets for the NG.

References

A summary of all pertinent legislation (laws, decrees, resolutions, etc) related to energy sector available at http://www.aneel.gov.br/biblioteca/legisbasica.cfm#texto

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