



Energy Industry

DIVERSIFICATION AND SUSTAINABLE DIFFERENCE MATRIX ELECTRIC BRAZILIAN

INDUSTRY MEETING FOR SUSTAINABILITY

FÓRUM DE
MEIO AMBIENTE
DO SETOR ELÉTRICO

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CNI

National Federation of Industries

Headquarters

Setor Bancário Norte
Quadra 1 – Bloco C
Edifício Roberto Simonsen
70040-903 – Brasília – DF
Phone: (61) 3317-9000
Fax: (61) 3317-9994
www.cni.org.br

FMASE

Environment Forum of the Energy Sector

SCN, Quadra 4
Ed. Centro Empresarial Varig, Sala 102
70714-900 – Brasília – DF
Phone: (61) 3327-6042
Fax: (61) 3326-2940
www.fmase.com.br



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CNI PRESENTATION

The diversity of the national industry and the significant availability of natural resources reveal excellent opportunities for the sustainable development of Brazil, combining economic growth, social inclusion and environmental conservation. The materialization of concerns related to sustainability in the strategic agenda of enterprises and governments is a reality. Apart from isolated cases of success, the consequences of this attitude are felt in entire sectors of the economy. Further advances are still needed, but the path has already been identified and going back is impossible.

After coordinating an unprecedented critical thinking process on sustainability with 16 industry associations, the National Industry Confederation (CNI) delivers to the Brazilian society a wide range of information on progress, challenges and opportunities yet to come. The results presented here may not portray the significance of the discussion process experienced by the industry in preparing these documents. Developments on the process will be beyond the Rio +20 Conference, and are definitely incorporated on the daily lives of companies.

The subject of sustainability is inserted differently in each of the industrial sectors. However, some elements are common to all. The continuous pursuit for efficiency in use of resources and the need to increase industrial competitiveness are on the agenda of all the sectors. Encouraging innovation and scientific and technological development is strategic on the transition to more sustainable patterns of production.

Strategies to intensify actions coordinated internally in the industrial sectors and with governments and civil society organizations are no less important. The dissemination of sustainable practices by means of the supply chain and incentives for companies to undertake the role of integrated management of the territories are powerful tools.

The sectorial volumes developed by industry associations are valuable contributions to addressing subjects such as sustainability and competitiveness of domestic industry. One of the most representative results of this process will certainly be the strengthening of structured programs of action with a focus on promoting sustainability in the

production. These initiatives will act as raw materials so that the industries involved and CNI are able to systematically publish documents presenting the national industry's developments towards the goals of sustainable production.

The documents presented here are intended to be a valuable contribution to enhance the debate on sustainability. Each of the sectorial associations is to be congratulated for their efforts.

Robson Braga de Andrade

President of the National Confederation of Industry – Brazil



SECTORIAL PRESENTATION

This booklet, prepared by the Working Group of the Rio +20 Environment Forum of the Electricity Sector – FMASE, has the important task of portraying the positioning of the Brazilian electric sector (SEB) on the topics that we consider most relevant to our segment, be debated at the UN Conference on Sustainable Development – Rio +20.

With this specification, the FMASE – recognized as the main interlocutor of the SEB in proposing solutions together for sustainable development – aims to:

- Strengthen the role of SEB's premises, which are: (i) to provide energy security, and (ii) to provide sustainability and universal access to energy.
- Highlight the contribution of SEB in promoting the "new economy", since electricity is a key input for the stimulus to production and to social inclusion as well as the design and implementation of policies and socio-environmental programs in Brazil's recent history .
- Addressing the challenges and opportunities that are already part of the reality of SEB in building a sustainable reality.
- Strengthen the position of SEB as a global benchmark in setting up a renewable energy matrix and, above all, sustainable, based on best practices in social and environmental management.
- Remember that the Brazilian electric matrix is 7.5 times cleaner than the world, and that the challenge is to maintain this characteristic.

The supply chain of electricity is one of the themes of visibility in any environment in which it discusses sustainability. And should be treated with technical parameters and off ideological issues. It is this spirit that we hope to find in the Rio +20.

Marcelo Moraes

Coordinator

Environment Forum of the Electricity Sector



1 INTRODUCTION

The **Forum for the Environment of the Electricity Sector – “FMASE”** brings together 19 sector organizations of the Electric Power industry seeking the improvement of environmental issues relating to the segment. It is recognized as the main interlocutor of the electricity sector in proposing joint solutions for sustainable and environment-related issues.

In early 2005 it took up the initiative of creating the Forum, so that industry associations could act before the government and civil society in a joint and organized manner. Since then the *FMASE* has been expanding its operations and consolidating the role of interlocutor of the electricity sector, and from 2010 became part of the Environmental Council of the CNI (“Coema”). Today it is formed by the following entities:

1. Brazilian Aluminum Association – ABAL
2. Brazilian Association of Electric Power Companies – ABCE
3. Brazilian Coal Association – ABCM
4. Brazilian Association of Wind Energy – ABEEólica
5. Brazilian Association of Renewable Energy – Abeer
6. Brazilian Association of Investors Self-Energy – Abiape
7. Brazilian Association of Large Industrial Energy Consumers and Free Consumers – Embrace
8. Brazilian Association of Electricity Traders – Abraceel
9. Brazilian Association of Electricity Distributors – Abradee
10. Brazilian Association of Generating Electricity – ABRAGE
11. Brazilian Association of Flexible Generation – Abragef
12. Brazilian Association for Clean Energy Generation – Abragel

13. Brazilian Association of Thermoelectric Generators – Abraget
14. Brazilian Association of Large Companies Electricity Transmission – Abrate
15. Brazilian Association of Independent Power Producers – Alpine
16. National Association of Energy Consumers – Anace
17. Foundation Corporate Management Committee – Funcoge
18. Subcommittee on Environment of Business Eletrobras - SCMA
19. National Reference Center for Small Hydropower – Cerpch

It is complex to size the representation of the FMASE because, as can be seen in the relationship of the components, the Forum brings together organizations of all types of agents: generation, transmission, distribution, sale and consumption. You could say they represent almost the entire supply and consumption chain of electrical energy that circulates in the National Interconnected System – SIN.

With this specification, the FMASE wants:

- In line with the Document of Brazilian Contribution to the Rio +20 Conference, to reiterate the assumptions of the performance of the electricity sector, which are: (i) to provide energy security, and (ii) to provide sustainability and universal access to energy in Brazilian public support for programs of social inclusion and combating poverty.
- Present the progress in implementing the initiatives proposed for the electricity sector in the summits on sustainable development, particularly covering the period from the Rio Conference 92 and the present.
- Highlight the contribution of the Brazilian electric sector in promoting the “new economy”, since the energy input is critical to the stimulus for production and for social inclusion, in this case, including through direct action to combat poverty.
- Highlight the contribution of industry to design and implement policies and pioneering social and environmental programs in the recent history of Brazil, showing the commitment of the electricity sector with the continuity of these actions.
- Address, as players, challenges and opportunities that are already part of reality in the electricity sector in building a sustainable reality.
- Strengthen the position of the Brazilian electric sector as a global benchmark in setting up a renewable energy matrix and, above all, sustainable, supported by good practice in social management of the enterprises in the sector.
- Noted that the Brazilian electric matrix is 7.5 times cleaner than the world, and that the challenge is to maintain this characteristic.



2 ECONOMIC AND SOCIO-ENVIRONMENTAL CHARACTERIZATION OF THE SECTOR

Importantly, the electricity sector was designed and constructed in accordance with the environmental characteristics of Brazil, marked by great diversity of landscapes and biomes, and very peculiar climatic conditions along its 8.5 thousand km² extension. The electricity sector thus equates and reflects the environmental complexity of the country in search of hydroelectric energy use consistent its characteristics.

FIGURE 1. ITAIPU HYDROELECTRIC POWER PLANT, FOZ DO IGUAÇU, PARANÁ



Source: Collection Itaipu Binacional.

2.1 Economic characterization

There is no denying that the energy sector is one of the main drivers of development. In more recent history, electric power began to play, for technical, environmental and economic reason, a more important role in the energy matrix. It seems that the irreversible trend is the migration from a predominantly fossil fuels matrix to one of more balanced electrical power matrix, with a predominance of clean and renewable sources.

Making a brief retrospective in 70 years, the Brazilian electric sector was boosted by a developmental leap promoted and sustained by the government. In the 80s the Brazilian environmental legislation was reformulated in its entirety through the National Environmental Act (Law No. 6.983/1981), the resolutions of the National Environment Council – CONAMA and the promulgation of the new Constitution of the Federative Republic of Brazil (1988), which established mandatory licensing for all new developments that could cause significant environmental impact.

In the 90s began a period of profound change with a view to privatization and the gradual inclusion of features of the free market sector. In 1995, The Ministry of Mines and Energy implemented the Brazilian Electrical Sector's structuring Project (RE-SEB), leading to the deverticalization of each production chain: generation, transmission, distribution and sale of electricity became then independent business areas. The generation and sale were progressively deregulated to encourage competition; transmission and distribution, which are natural monopolies, continued to be treated as regulated utilities.

Faced with this new configuration, the federal government created the National Electric Power Agency – ANEEL, whose function is to regulate and supervise the activities of the sector, as discussed below. Other changes were implemented with the objective of organizing the market and the structure of the Brazilian energy matrix, with emphasis on the creation of the National Water Resources Management in 1997, the Wholesale Energy Market – MAE and the National System Operator – ONS, 1998.

With the start of the 2000s, backed by a mainly hydroelectric generation model and without the necessary expansion, Brazil found itself in an emergency when passing through a period of low rainfall that led to considerably reduced reservoir levels for power plants. In May 2001 the government was forced to take emergency measures to prevent a collapse in energy supply.

The crisis drew attention to the need for new generation sources in the national energy matrix. Thermoelectric plants that operate on fuels such as natural gas and bagasse (biomass) gained the highlights. The government also adopted measures that supported the development of small hydroelectric plants (SHP), non-conventional sources and energy conservation.

This trend culminated in the Incentive Program for Alternative Sources of Energy (Proinfa), established by Decree No. 5.025/2004 in order to increase the share of electricity produced by hydropower designed based on wind power, biomass and small hydroelectric power plants, and how to develop the productive chain of these sources. Proinfa consisted in the hiring of energy from these sources at a premium rate, or feed-in tariff, such as the policy adopted in Germany. This rate, equivalent to 90% of the final tariff paid by consumers, enabled reducing the risks associated with investing in sources not yet widespread com-

mercially. Therefore, it was established that the amount paid for the electricity purchased would be divided among all classes of consumers, with the exception of consumer of low income residential subclass (consumption equal to or less than 80 kWh / month).

**FIGURE 2. IMPLEMENTATION OF WIND PARK MORRO DOS VENTOS
– JOÃO CÂMARA, RIO GRANDE DO NORTE**



Source: Collection Abeeólica

The program hired 144 plants, totaling 3299.4 MW of installed capacity, and 1191.24 from 63 from hydroelectric power plants, 1422.92 MW from 54 wind farms and 685.24 MW from biomass based power plants, scattered throughout the national territory. All that energy is warranted hiring for 20 years by the government company Centrais Elétricas Brasileiras S.A. – Eletrobrás. The table below has a size of the program and its scope.

TABLE 1. PROINFA – PROJETS				
	In Operation	Under construction	Construction not yet commenced	Total contracted
Biomass	21 plants	–	6 plants	27 plants
	530.2 MW	–	155.0 MW	685.2 MW
PCH	60 plants	2 plants	1 plant	63 plants
	1,159.2 MW	22.0 MW	10.0 MW	1,191.2 MW
Wind	52 plants	1 plant	1 plant	54 plants
	1,187.1 MW	100.8 MW	135.0 MW	1,422.9 MW
TOTAL	133 plants	3 plants	7 plants	144 plants
	2,876.5 MW	122.8 MW	282.0 MW	3,299.4 MW

Source: Abeeólica – 2011.

Proinfa was essential for the development of wind energy in Brazil. In addition to access to financing of 80% of projects by the National Economic and Social Development Bank (“BNDES”), it was also established the requirement of a minimum 60% local content in projects contracted by the program, which allowed the emergence of a chain supply of equipment and services that today are extremely important in reducing the price of wind energy observed in recent years.

FIGURE 3. PCH BURITI, IN MATO GROSSO DO SUL



Source: Collection Atiaia Energia.

Concurrently, between 2003 and 2004, the government took a few more important steps to make the electricity sector become less vulnerable. The Energy Research Company – “EPE”, which included the planning of the sector in the long run, the Monitoring Committee of the Electric Sector (“CMSE”), responsible for continuously evaluating the security of electricity supply in the country, and the Chamber of Commerce Energy – “CCEE”, which replaced the EAC, with the assignment of organizing the activities of energy trading in the country.

According to the Ten Year Plan for Energy Expansion – PDE 2011/2020, prepared by the EPE and detailed later in 2010, the recovery of the domestic industry was achieved, confirmed both by production back to pre-crisis levels, investment, and movements in new projects, which had been suspended. Additionally, the economic scenario considered as the reference includes strong domestic demand for basic industrial inputs such as steel and aluminum, the improvement in the income of the population and especially the need to equip the country with a modern and efficient infrastructure. This demand for basic materials tends to exhibit significant expansion not only in Brazil but also in other developing countries such as China and India.

Still based on the PDE 2011/2020, we can say that in addition to population growth occurred in Brazil, the increase in energy consumption is also associated with growth in income levels and the consequent reflection in the consumption of goods and services. Over 10 million Brazilians left the poorest class in the last ten years and with that

the government is faced with new challenges, as it needs to ensure compliance with the demands of new consumers. It needs to keep expanding the supply of consumer goods, housing, sanitation, education, health services, and leisure and, as a condition for economic growth, energy supply, especially electricity. These 10 million are part of a much larger contingent of people with access to the latest durable goods market and the comforts of the middle class.

One consequence of the incorporation of a new group of consumers to the market was the rapid growth of electricity consumption. Per capita consumption of electricity increased by 11.3% between 2006 and 2010, almost double the population growth in the period. Between 2006 and 2010, total consumption of electricity increased by 16.8%. In the same period, industrial consumption grew 11%, while residential expanded 26.4%. This corresponds to an average annual rate of about 6%.

In 2010, Brazilians consumed an average of 2,246 kilowatt / hour / person. Still, it remained below the world average of 2009 of about 2730 kWh / inhabitant. In the same year, Argentines consumed an average of 2744 kWh / inhabitant; Chileans, 3288, the Chinese, 2631, and South Africans, 4532, to name just a few examples. In the UK, consumption reached 5693 kWh / inhabitant, and 12,884 in the United States.

To get a sense of industry growth, it is important to analyze the increase in demand. See the tables below with the evolution of the number of consumers and increased residential consumption in recent years:

TABLE 2. TOTAL NUMBER OF CONSUMERS BY GEOGRAPHIC REGION						
	2006	2007	2008	2009	2010	Part. % (2010)
Brazil	58.979.698	61.072.066	63.367.452	65.528.441	67.906.964	100.0
North	3.116.534	3.318.080	3.461.508	3.665.313	3.868.873	5.7
Northeast	14.437.696	15.111.861	15.929.425	16.748.559	17.614.793	25.9
Southeast	27.915.466	28.720.595	29.619.534	30.308.025	31.063.194	45.7
South	9.200.591	9.448.603	9.672.495	9.911.542	10.267.916	15.1
Midwest	4.309.411	4.472.927	4.684.490	4.895.002	5.092.188	7.5

Note: In December of each year. Source: EPE.

TABLE 3. AVERAGE RESIDENTIAL USE BY GEOGRAPHIC REGION (KWH / MONTH)					
	2006	2007	2008	2009	2010
Total / Brazil	142.1	143.9	145.8	150.1	154.0
North	140.2	140.6	145.4	146.2	156.5
Northeast	93.9	94.1	95.9	99.5	105.7
Southeast	160.0	162.3	165.0	170.3	173.0
South	159.9	165.5	166.2	171.9	174.0
Midwest	151.4	152.4	152.6	157.8	164.8

Source: EPE, 2011.

To complement, we present consumption divided by geographic region and by type of consumer:

TABLE 4. CONSUMPTION BY GEOGRAPHIC REGION (GWH)						
	2006	2007	2008	2009	2010	Part. % (2010)
Brazil	356,129	377,030	388,472	384,306	415,277	100.0
North	21,552	22,850	23,873	24,083	26,237	6.3
Northeast	59,060	62,367	65,103	65,244	71,190	17.1
Southeast	195,131	206,785	209,944	204,555	221,976	53.5
South	59,694	62,996	65,900	65,528	69,563	16.8
Midwest	20,692	22,031	23,652	24,896	26,310	6.3

Note: freer captive consumption.

Source: EPE.

TABLE 5. CONSUMPTION BY CLASS – (GWH)						
	2006	2007	2008	2009	2010	Part. % (2010)
Brazil	356,129	377,030	388,472	384,306	415,277	100.0
Residential	85,784	89,885	94,746	100,776	107,215	25.8
Industrial	163,180	174,369	175,834	161,799	179,478	43.2
Commercial	55,369	58,647	61,813	65,255	69,170	16.7
Rural	16,022	17,269	17,941	17,304	18,500	4.5
Government	10,648	11,178	11,585	12,176	12,817	3.1
Lighting	10,975	11,083	11,429	11,782	12,051	2.9
Public service	12,164	12,441	12,853	12,898	13,589	3.3
Own	1,987	2,158	2,270	2,319	2,456	0.6

Note: freer captive consumption.

Source: EPE.

GERAÇÃO

The Brazilian model of electric power generation is mainly hydroelectric. About 70% of national production capacity consists of hydroelectric power plants of large and medium-size and small hydroelectric power plants. The choice of this model is justified by the existence of large upland rivers, fed by abundant tropical rains that constitute one of the largest reserves of freshwater in the world. Additionally, hydro power demand, in general, lower costs in the operational aspect. Today, however, the hydroelectric plants for large and medium-sized plants are located more distant from large centers, with significant impacts on transmission costs. Therefore, the importance of the interconnection of transmission systems and the diversification of the eletroenergetic matrix.

The following table presents the current situation of the Brazilian eletroenergetic matrix (including imports).

TABLE 6. PROJECTS IN OPERATION							
Type		Installed capacity		%	Total		%
		No. of plants	(kW)		No. of plants	(kW)	
Hydro	Hydroelectric Power Plants	180	78,277,779	62.56	966	82,318,681	65.79
	Small Hydroelectric Power Plants	418	3,829,007	3.06			
	CGHs	368	211,895	0.17			
Gas	Natural	102	11,424,053	9.13	140	13,213,236	10.56
	Process	38	1,789,183	1.43			
Oil	Diesel oil	890	3,895,920	3.11	917	7,028,127	5.62
	Residual oil	32	3,132,207	2.50			
Biomass	Sugarcane bagasse	346	7,259,243	5.80	419	8,986,128	7.18
	Black liquor	14	1,245,198	1.00			
	Wood	44	378,177	0.30			
	Biogas	16	70,902	0.06			
	Rice husk	8	32,608	0.03			
Nuclear		2	2,007,000	1.60	2	2,007,000	1.60
Mineral coal	Mineral coal	10	1,944,054	1.55	10	1,944,054	1.55
Wind		72	1,450,792	1.16	72	1,450,792	1.16
Paraguay	Paraguay		5,650,000	4.52		8,170,000	6.53
	Argentina		2,250,000	1.80			
	Venezuela		200,000	0.16			
	Uruguay		70,000	0.06			
Total		2,540	125,118,018	100	2,540	125,118,018	100

Source: BIG – Aneel's Information Database on Generation – January/2012.

In 2009, Brazil produced 2% of all electricity in the world, a list where the United States accounted for more than 20% of production. The renewable feature of our matrix places us as one of the leaders in the production of energy from non-fossil sources, a unique situation, which places Brazil in a position of global model of clean energy matrix.

If we only consider hydroelectricity, the most important renewable source, Brazil occupies second place (12%) among the producing countries in the world. China ranks first with 15%. The amazing thing is that only six countries (China, Brazil, Canada, United States, Russia and Norway) hold almost 60% of this production. Even among the six major producers of hydroelectricity, there are other features that differentiate Brazil, such as the ability to store water in significant quantities in relation to consumption. Canada has tanks capable of storing nearly 700 km³ and Brazil ranks second, with 500 km³. It turns out that Canada does not have a fully interconnected system. Brazil, with its interconnected system saves five months in its storage tanks.

The new frontier of hydropower generation in Brazil is in the Amazon, with emphasis on three large dams that are already under construction in the region, encouraged by the Growth Acceleration Program ("PAC") of the Federal Government. Two of them, Santo Antônio (3,150 MW) and Jirau (3,750 MW), on the Madeira River in Rondônia. The third, Belo Monte (11,233 MW), Rio Xingu, Pará Brazil has a strict environmental protection legislation, which imposes on new hydroelectric projects detailed requirements to minimize the negative effects on the nature and impacted communities, as well as provide compensatory and mitigating measures that, combined with advanced socio environmental management practices of the Brazilian electric sector, provide sustainable development of the regions where they operate, enabling it to implement these projects.

TRANSMISSION

The Brazilian transmission system comprises a network of lines and substations that operate at voltages above 230 kV, defined as "Basic Network". It spreads throughout the national territory with the purpose of transporting electricity from generating sources to distribution companies and large consumers connected directly to the transmission. With great distances to be traveled between the plants and the consumer centers (mainly due to large hydroelectric projects are located far from load centers), Brazil achieved in 2011, a total of 99,649 kilometers of transmission lines.

The electrical-energy optimization is the motivating factor for such interconnection, since this system the energy exchange, different regions with each other, taking advantage of the hydrological diversity of a country that has continental dimensions. A region that is in the dry season, when energy shortages due to falling volumes of its hydroelectric reservoirs, receives power from other regions.

In general, the interconnections seek to ensure, at the lowest cost, system reliability, quality and quantity of energy required by the market.

FIGURE 4. SUBSTATION AND TRANSMISSION LINE OF COPEL, PARANÁ



Source: Collection Copel.

DISTRIBUTION

The distribution system consists of 64 Brazilian utilities companies, responsible for the delivery of low voltage energy to final consumers.

The distribution companies serve approximately 63 million consumer units, of which 85.38% are residential. 99% of Brazilian municipalities are served by distribution networks. There are programs still in progress towards universal access to energy in the country, among which stands out the Light for All program (detailed below).

The distributors are utilities, state or private companies. Many were part of the National Privatization Program in the 90s and today are controlled by groups comprised of large Brazilian, American, Spanish and Portuguese companies, among others.

ANEEL is responsible, among other activities, to determine standards and technical procedures relating to the regulation and supervision of the generation, transmission, distribution and sale of electric energy, and discipline the expansion and operation of distribution networks, always aiming at improving indicators of performance while preserving the safety, efficiency and reliability of electrical systems. It is responsible for economic regulation, in that it defines rates being applied to the end consumer, by means of periodic rate review process.

Distributors, as agents of the sector, are crucial for development, feasibility and implementation of public programs and social inclusion, recovery of citizenship and combating poverty, as discussed below.

LIGHT FOR ALL – The Brazilian government launched in November 2003 the challenge of ending the electricity exclusion in the country. The Light for All program was created with the goal of taking electricity to more than 10 million rural people. It is coordinated by the Ministry of Mines and Energy, operated by Eletrobrás and implemented by electric utilities and rural electrification cooperatives throughout the country.

The map of the electricity exclusion in the country reveals that households without access to energy are mostly in smaller towns of lower Human Development Index (HDI) and in low-income families. The government's objective with the program is to use energy as a vector of social and economic development of these communities, helping to reduce poverty, and increase family income. The arrival of electricity has facilitated the integration of social programs from the federal government, and access to health services, education, water supply and sanitation.

The program notes, whenever possible, the following priorities:

- rural electrification projects stalled for lack of resources that meet communities and rural villages;
- municipalities with Households Served Index below 85%;
- municipalities with an HDI below the state average;
- communities affected by dams or hydroelectric power system works;
- public schools, health clinics and water supply wells;
- settlements and agricultural development projects for subsistence farming or family handicraft production;
- serve small and medium size farmers;
- the surrounding population of Preserves, and
- populations in areas of specific use of special communities, such as racial minorities, quilombola (slave descendant communities) and extractive communities.

The *Light for All* is of singular importance for social inclusion and the eradication of poverty. By September 2011, 14.2 million people had benefited from the program. According to the PDE 2011-2020, in 2011 the Brazilian population reached 191.6 million people. This means that from 2004 to 2011, the program reached about 7.4% of Brazil's population.

In the table below, there is the development of the program since its implementation based on the number of units involved.

TABLE 7. LIGHT FOR ALL PROGRAM: NUMBER OF CONNECTIONS								
	2004	2005	2006	2007	2008	2009	2010	Total
Brazil	69,999	378,046	590,013	397,877	441,427	357,970	291,431	2,526,763
North	8,265	41,009	90,067	77,220	99,547	86,205	65,086	467,399
Northeast	27,157	200,853	271,529	201,141	235,381	180,790	147,247	1,264,098
Southeast	24,229	67,342	151,457	59,817	39,413	38,593	44,801	425,652
South	4,218	36,913	42,896	33,743	33,563	28,410	15,499	195,242
Midwest	6,130	31,929	34,064	25,956	33,523	23,972	18,798	174,372

Source: Ministry of Mines and Energy (MME) Preparation: EPE.

MARKETING

Under the new configuration of the business model of the electricity sector, from 2004, the relationship of buying and selling in the energy market is done basically in two contract environments: free market contract ("ACL"), the regulated environment contract ("ACR").

The agency responsible for managing commercial relations in the wholesale electricity market is the Energy Trade Chamber – CCEE, regulated by Decree No. 5.177/2004 as a civil association integrated by agents of generation, distribution and marketing. The institution plays a strategic role to facilitate the buying and selling of electricity, registering and administering contracts between agents.

The CCEE takes accounts and records of the aggregate net amount of energy measured, generated and / or consumed. The differences are settled in the Short-Term and integrated into the calculation of the Settlement Price Differences – PLD, which is formed weekly.

These traders promote the rational apportionment of surpluses and deficits of energy through the incorporation of the laws of supply and demand, take the risk of price, quantity and time and increase market liquidity and free-market settlement of differences.

DECENNIAL ENERGY EXPANSION PLAN ("PDE")

The PDE incorporates an integrated view of the expansion of demand and supply in the country of several energies within ten years. The EPE is prepared by relying on the guidelines of the Department of Planning and Development and the Department of Energy and Petroleum, Natural Gas and Renewable Fuels of the Ministry of Mines and Energy. Each cycle of the plan, once established, goes through a public hearing process before being formalized.

The latest cycle of PDE (2011/2020) presents a Brazilian energy matrix with a significant increase in the share of renewables in the next decade. The so-called new renewable or non-conventional renewable sources (wind, biomass and small hydro) will double their stake in the electricity sector by 2020. The presence of these features in the auctions of energy (installed capacity), which totaled 44.8% in 2010 will reach 46.3% in 2020.

With regard specifically to the conservation, PDE believes that the electricity saved over the next 10 years in Brazil will be equivalent to the production of a hydroelectric plant of 7,000 MW.

The following tables present a summary of the planned expansion for the Brazilian energy sector, in data:

TABLE 8. EVOLUTION OF INSTALLED GENERATION CAPACITY IN BRAZIL (MW)										
2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
109,578	115,467	123,192	132,763	135,182	140,853	148,441	155,430	161,887	165,779	171,138

TABLE 9. SIN: ESTIMATION OF THE EVOLUTION OF THE TRANSMISSION SYSTEM – TRANSMISSION LINES (KM)							
Tension	750 kV	±600 kV	500 kV	440 kV	345 kV	230 kV	Total
Existing in 2010	2.698	1.612	34.190	6.809	9.991	44.349	99.649
Period 2011-2015	-	7.050	15.474	9	252	9.512	32.297
Period 2016-2020	-	3.750	6.176	-	-	330	10.256
Total 2011-2020	-	10.800	21.650	9	252	9.842	42.553
Estimated for 2020	2.698	12.412	55.840	6.818	10.243	54.191	142.202

TABLE 10. SIN: ESTIMATION OF THE EVOLUTION OF THE TRANSMISSION SYSTEM – TRANSFORMATION (MVA)						
Tension	750 kV	500 kV	440 kV	345 kV	230 kV	Total
Existing in 2010						222,119
2011-2015 Period	1500	24,830	3,733	9,072	18,295	57,430
2016-2020 Period	0	9,497	0	100	2,224	11,821
Total 2011-2020	1,500	34,327	3,733	9,172	20,519	69,251
Estimated for 2020						291,370

Sources: PDE 2011/2020 (EPE).

And in investment compared to other energy sources:

TABLE 11. FORECAST OF INVESTMENT COMPARED TO OTHER ENERGY		
	R\$ billion Period 2010-2020	%
Supply of electricity	236	23
Generation	190	18
Transmission	46	5
Oil and natural gas	686	67
Exploration and production of oil and natural gas	510	50
Oil supply	167	16
Natural gas supply	9	1
Liquid biofuels supply	97	10
Ethanol – production plants	90	9
Ethanol – ports and pipeline/roads infrastructure	7	0.9
Biodiesel – production plants	0.2	0.1
Total	1,019	100

Source: PDE 2011/2020 (EPE).

NATIONAL ENERGY PLAN (PNE 2030)

Developed in 2007, it is a pioneer study in Brazil integrated with the planning of energy resources conducted within the Brazilian Government. In it all forms and sources of energy have been contemplated, especially hydropower, oil and its derivatives, natural gas and products derived from sugarcane, in addition to energy efficiency and technological innovation. They considered the expanding of electricity supply with the following sources: potential hydroelectrical, nuclear, coal, natural gas, sugarcane bagasse, wind, solar, solid urban waste and other renewable sources. The document provides information for the formulation of a strategy to expand the energy supply and sustainable economic, given the evolution of demand and based on a long term perspective.

2.2 Socioenvironmental characterization

The treatment of environmental issues has always been part of the proceedings of electricity companies, especially when it came to physical components of biotic systems, an approach that could be characterized as a correction of problems caused by the implementation of specific projects. The expansion of the sector to meet the energy needs of the country, and especially large enterprises deployed in the 70s and 80s, made the entrepreneurs deal with environmental issues on a higher scale and with a higher degree of complexity in a context of a society undergoing profound changes.

Following a worldwide trend of institutionalization of public policies for the management of environmental issues and impacts on quality of life for people in the last 30 years the socioenvironmental issue for the Brazilian electric sector has been regarded with special importance. In Brazil, the process had two important milestones: the Federal Law No. 6.938/1981, which established the National Environment Policy, and Resolution CONAMA 001/1986 and 006/1987, regulating the compulsory licensing of activities that cause environmental impact on the environment, the latter being specific to the developments in the electricity sector. Environmental legislation reflects on the one hand, the increasing and widespread attention to the proper use of natural resources to be spent for the Brazilian society. On the other, it expresses a new political and institutional framework that is consolidated with the enactment of the Federal Constitution in 1988, which devotes a chapter to the environment. The Constitution protects and enshrines the principles of mitigation and compensation for damage caused to the environment and social groups and, in general, to review the role and decision making in the public sector, which begin to demand an open discussion of the characteristics and justification of major infrastructure projects.

Several legal instruments have been promulgated in recent years, resulting in a complex and comprehensive legal framework regulating the relations between society and the environment. In this context, and within an evolutionary process, today the cycle of studies and development projects of enterprises in the electricity sector fully incorporate environmental studies into all its stages, integrated into engineering studies. In addition to support decisions on the economic feasibility of projects, environmental studies must also meet the requirements of its environmental licensing processes.

The country adopts an environmental licensing phase, covering the “Preliminary”, “Installation” and “Operation” licenses, which in turn keep correspondence with the steps of “viability”, “basic design” and “executive design” of the cycle of projects practiced by the sector, duly approved by environmental agencies.

Given that the most relevant environmental aspects to be addressed by industry relate to the generation of electricity, the following themes bring a bias of this type of venture. Importantly, social and environmental studies are not only a stage of decision-making process, but must be present at all stages of development, becoming more detailed as the project develops. The studies are not only a premise of the authorization and implementation of the project, as well as the feasibility of the necessary funding resources.

RELOCATION OF POPULATION GROUPS

Until the 80 the actions in the sector were ruled by the predominant objective of releasing at the lowest possible cost and on schedule of works, the lands necessary for reservoir formation and deployment of infrastructure to support the venture. The acquisition of these areas, either by negotiation or by way of judicial compensation in general was based on unilateral evaluation criteria in whose drafting the owners did not participate. The attendance to the strict letter of the law forbade non-owners, even those who held possession of the land and exploited it for their livelihood, any compensation for their loss, counting only the value of the improvements implemented in it. They did not recognize the rural workers as being entitled to any compensation for the loss of jobs resulting from the flooding of land, exempting utilities to any formal responsibility in this regard.

FIGURE 5. RESETTLEMENT OF THE SALTO CAXIAS HYDROELECTRIC POWER PLANT, PARANÁ



Source: Antônio Fonseca dos Santos.

From the 80s, with the advent of new institutional order provided by the 1988 Constitution and reinforced by the requirement for preparation of Environmental Impact Assessments and Environmental Impact Report (EIA / RIMA) in projects over 10 MW, there was a change in the posture of the industry in driving the processes of relocation of populations, based on the recognition of rights and obligations and supported by complex processes of dialog and negotiation. One of the milestones of this process is the introduction by CONAMA Resolution 009/1987, of public hearings to discuss the environmental programs of compensation and mitigation for damage caused by enterprises.

Another important milestone in the evolution of treatment of this subject is the recent establishment of the Register of Socioeconomic populations affected by hydropower generation of electricity (Decree 7.342/2010). Registration is the instrument of identification, qualification and public record of the population affected and lets you define the recipients of the relocation programs that may be formulated and approved during the licensing process of new developments. Besides the inclusion criteria, is set the expiration time and expertise relating to its management. On the one hand seeks to ensure that those affected and registered the right to an analysis and definition of benefits, on the other, defined beneficiaries, entrepreneurs provide legal certainty and reliability in predicting the costs.

INDIGENOUS PEOPLES

The electricity sector recognizes that these populations are ethnically distinct and peculiar. It believes that aspects of their cultural adaptation to habitat and world view are elements that require specific studies, often time-consuming. On the other hand, there

is also the aspects of relationships with government agencies involved with indigenous issues that require institutional arrangements. The National Indian Foundation (Funai) is the agency responsible for protection of indigenous peoples and the administration of their reserve. It regulates the interference of enterprises on indigenous territories through 6.001/1973 Law, which provides for the Indian Statute.

In cases of interference from new developments in indigenous communities, in addition to meeting all the requirements of the licensing process, specific studies are developed and formulated programs containing mitigation and compensation of impacts that go through processes of negotiation and approval to the communities concerned and Funai.

BIOTIC ASPECTS AND WATER QUALITY

Among the environmental impacts caused by hydroelectric projects, stand out those related to flora, fauna and water quality. Since the 80s to today, we have gone through a stage of evolution of the process that seeks to expand knowledge especially on the specific environments in which the projects operate. As a result, studies of flora, fauna and aquatic environment become more detailed and diverse. These studies clearly gain quantitative trends and incorporating the prediction of impacts, to help pass the revision of the usual activities and the search for new proposals as per mitigation and compensation of impacts.

Looking to characterize the evolution in the treatment of these issues, it is possible to identify some main lines of action:

Protection of fish fauna – the conservation of river wildlife began to be promoted from the first Fishing Country Code, Decree-Law 794/1938. The deployment of hatchery stations, in the 60s, can be considered as starting point of systematic work with the fishes in the electricity sector – basically sought to harness the potential of producing reservoirs.

In the 70s it was officially established the practice of building stairs for free climbing of fish in water reservoirs – structures associated with dams in order to transpose rheophiles. In the same period, due to the installed stations and new buildings, there was increased stocking of reservoirs and the promotion of fish farming, initially through the use of exotic species and those whose breeding techniques were already dominated.

In the 80s, with the emergence of reservoir size, gradually some companies started to invest in the reproduction of native species, and in the 90s, with the maturity of the centers of ichthyology associated with reproductive and research projects, the practice of stocking exclusively with native species has been institutionalized.

Rescue of wildlife – To restrict the expulsion or extinction of animals, by drowning or starvation during filling operations of the reservoirs, they started to pull them through fauna “rescue” programs. In principle, it emphasized mainly the capture of mammals for release in the margins or the eventual transport to zoos, and of snakes to extract venom in specialized institutions. Currently we try to cover the largest possible quantities of species, with release in areas previously selected for having the right conditions to receive the rescued animals.

Water quality – In the late 80s, the electricity sector faced some problems in its reservoirs, especially in new developments in river basins where land use has compromised the quality of water in tropical regions where the flooding of forests and ecosystems dynamics determine the occurrence of phenomena that compromised both the plant's facilities and the environment. These facts led the industry to adopt new approaches to addressing these issues.

The attention to characterization studies of the conditions prevailing before the implementation of the project and its subsequent follow-up was made possible by the fact that in addition to the initiatives of the electricity sector, the state environmental agencies have intensified during this period, the surveys of the conditions of water bodies. These data allowed us to check the water quality standards, as reasonably amended by its use and land cover in watersheds.

Reforestation – From the 80s, forest gardens began to be deployed, associated with dams, on the recommendation of the EIA / Rima, with increasing emphasis on the reproduction of native species to be used in the reforestation of the margins of reservoirs and reclamation around it, starting to underpin the development and maintenance of native fauna, protection of banks and also for water purification.

STORAGE UNITS

Law No. 9.985/2000, which instituted the National System of Conservation of Nature – SNUC establishes criteria and standards for creation, deployment and management of protected areas. With this objective the preservation, maintenance, sustainable utilization, restoration and recovery of the natural environment, so that we can produce the greatest benefit on a sustainable basis, the current generations and future generations, and ensuring the survival of living beings in general .

After the institution of environmental licenses, two practices were noted in the compensatory actions of the electric sector in the implementation of projects: the implementation of new preservation units or technical and financial support to already existing units. The type of action was defined in each case and resulted from negotiations between the Environmental Protection Agency and the entrepreneur in the licensing process.

It should be noted also that in 2009 it was regulated by Decree No. 6848 the percentage and the criteria for collection of fees payable by companies for compensation for environmental damage. This rate is calculated based on the information contained in the EIA / Rima when licensing the project, and was set at 0.5% of the amount of investment.

FINANCIAL COMPENSATION

Established by Law No. 7.990/1989, regulated by Decree No. 3.739/2001 and ANEEL Resolution No. 67/2001, the Compensation for Use of Water Resources (CFURH) is paid monthly to states and municipalities that have wetlands or were affected by hydroelectric reservoirs. The dealers and authorized for the production of hydropower collect monthly 6.75% of the energy produced by their dams.

The values of the Financial Compensation ultimately have a positive impact on the budgets of the municipalities affected, targeting investments to areas such as education, health, safety and urban infrastructure. It can not be used to offset debt, unless the creditor is the federal government, or for the payment of staff. That is, a direct influence on improving the social conditions of the population when properly applied.

In 2010, 663 municipalities in 21 states and the Federal District received R\$ 1.21 billion by way of CFURH, while the transfer of Itaipu Binational royalties in the amount of R\$ 337.47 million reached 341 municipalities in five states and the Federal District. The total received (compensation and royalties) was R\$ 1.515 billion.

The sum of CFURH and royalties for the Union was R\$ 340.5 million, of which R\$ 37.5 million were in royalties and R\$ 303 million were for financial compensation. These resources are distributed to the National Water Agency (ANA), the National Fund for Scientific and Technological Development (FNDCT) and ministries of Environment and Energy. The collection and distribution of compensation and royalties are the responsibility of ANEEL.

ARCHAEOLOGICAL RESCUE

Law No. 3924/1961 provides that every area to be affected by implementation works of enterprises should be subject to archaeological studies, which determine the actions relevant to each case in order to contribute to the knowledge of the archaeological heritage and historic country's cultural

Archaeological studies are part of the Environmental Impact Assessment (EIA) and are run by specialists, linked to academic institutions that are in the custody of the material collected according to law.

In some cases it is recommended to the rescue, which includes the removal and cataloging of the lithic material, ceramic, animal bones, campfires, complete skeletons and sediments in the sites identified. This material passes through and is transferred to cataloging the collection of museums and academic institutions, and in some cases, the actual EIA / Rima recommended the construction of museums for specific projects such as the Museum of Xingó (Sergipe) and the Regional Museum of Iguaçu (Paraná), and several others are maintained by the companies responsible for the projects.



3 ECONOMIC, SOCIAL AND ENVIRONMENTAL REGULATIONS AFFECTING THE INDUSTRY

Among the challenges for companies (public and private) operating in the planning, implementation and operation of electrical projects, is adapting its actions and activities of political and economic conditions, the report highlights the concern for the environment and socioeconomic aspects.

Note that currently the electricity sector in environmental management goes beyond mere compliance with laws, since in recent years is based proactive and comprehensive manner the principles of sustainability.

The compliance with environmental legislation has been a constant concern of the companies comprising the Brazilian electric sector. With the restructuring of the sector and the consequent inclusion of new partners, increased demand for information that they would clarify the rules to be observed in relation to environmental protection, and to offer appropriate legal certainty.

The information presented below adds topics of specific interest to the sector, chosen for its relevance in the activities undertaken by companies and institutions thereof.

3.1 Institutional roles in the electricity sector

It is important to highlight that in the Brazilian institutional legislation there are, besides the federal, two other levels of power: state and municipal with competence to set their own laws as long as subordinated and not conflicting with the federal laws.

The table below lists the main bodies or institutional entities that influence the performance of the Brazilian electric sector, grouped by theme:

TABLE 12. MAIN ENTITIES THAT INFLUENCE THE BRAZILIAN ELECTRIC SECTOR	
Policies and guidelines	Environmental regulation
<ul style="list-style-type: none"> • National Congress (Committee on Mines and Energy – CME) • National Energy Policy Council – CNPE • Monitoring Committee of the Power Sector – CMSE • Infrastructure Policies Committee of the Governing Council • Ministry of Mines and Energy – MME • Interministerial Council on Climate Change – CIM • State regulatory agencies or state departments of energy and the environment 	<ul style="list-style-type: none"> • Ministry of Environment, Water Resources and Legal Amazon – MMA • Brazilian Institute of Environment and Renewable Natural Resources – IBAMA • National Environmental Council – CONAMA • Federal Prosecutor's Office • State and local environmental agencies • Committee on Environment and Sustainable Development – CMADS, of the National Congress
Regulatory agency and granting power delegate	Planning and research
<ul style="list-style-type: none"> • National Electric Power Agency – ANEEL 	<ul style="list-style-type: none"> • Energy Research Company – EPE, subordinated to the Energy and Mines Ministry
Monitoring, control and operation of electric system	Accounting and settlement of electricity market
<ul style="list-style-type: none"> • National Electricity System Operator – ONS 	<ul style="list-style-type: none"> • Energy Commercialization Chamber – CCEE
Regulation of activities related to the energy sector	
<ul style="list-style-type: none"> • National Petroleum Agency – ANP • National Agency for Mining – ANM • Regional Councils engineering, architecture and agronomy (Creas) 	<ul style="list-style-type: none"> • National Water Agency – ANA • National Water Resources Council – CNRH • State agencies, municipal and watershed committees

Source: FMASE.

Among the objects of regulation, recent topics include:

- The promulgation, after more than ten years in Congress, of the National Policy on Solid Waste (Law No. 12.305/2010) and its regulatory decree (Decree No. 7.404/10);
- The establishment of the register to identify socioeconomic, qualification and public record of the population affected by developments of hydroelectric power generation;
- The establishment of the National Dam Security Policy (Law No. 12.334/2010) destined for accumulation of water for all purposes, including hydropower generation;

- The systematization of the performance of federal agencies in authorizing and conducting studies of potential hydroelectric power within protected areas and in authorizing the installation of transmission systems and distribution of electricity in conservation units for sustainable use;
- The institutionalization of the climate change issue, by means of Law No. 12.187/2009 and regulatory Decree No. 7.390/2010;
- The establishment by the National Environmental Council – CONAMA, of guidelines for campaigns, actions, and environmental education projects (Law No. 9.795/1999);
- The National Policy on Water Resources and the National Water Resources Management, established by Law No. 9433/1997;
- The publication of Ecological-Economic Macrozonning of the Legal Amazon (Decree 7.378/10), among others.

NATIONAL ENVIRONMENTAL POLICY

The basic rule of the country's environmental law is 6.938/1981, and aims at "the preservation, improvement and restoration of environmental quality conducive to life, to ensure, in the country, conditions and social development economic interests of safety and protection of the dignity of human life.

Among the effective or potentially polluting or degrading activities of the environment are included the ventures of the electrical sector whose construction, installation, expansion and functioning remain consequently subject to licensing by the competent environmental body.

The licensing of the effective or potentially polluting activities is part of the roll of instruments of the National Environmental Policy established in Law 6.938/1981 (art. 9), which was changed by Law 7.804/1989 (art.10) and by Decree 99.274/1990 (art. 19). CONAMA Resolution 001/1986 establishes the requirements for impact assessment and licensing of activities that modify the environment, such as engineering works of the mining, transport, energy and other sectors. In some cases – among which include electricity generation plants, whatever the source of primary energy, systems above 10 MW and transmission lines above 230 kV require the following documents:

- The Environmental Impact Study ("EIA"): an analysis of technical, detailed and broad character.
- the Environmental Impact Report ("RIMA"), which reflects the findings of the EIA, in order to provide a basis for discussion with government or private agencies, with the potentially affected population and society in general about the project objectives, characteristics and impacts, and mitigation measures envisioned.

**FIGURE 6. PUBLIC HEARING – THERMAL POWER PLANT
SÃO JOÃO DE ITABAPOANA, RIO DE JANEIRO**



Source: Noel Júnior.

CONAMA Resolution 006/1987, in turn, contextualizes the licensing process to the context of the electricity sector.

The environmental licensing is, in short, an administrative procedure through which the government, federal, state or municipal, in the performance of administrative police power, requires those interested in developing potentially of effectively polluting activities prepare environmental impact studies. However, the licensing agencies must understand that the work will not cause substantial ecological imbalances in order to grant environmental permits to the applicant.

3.2 Detail of the main points of legislation that affect the brazilian electric sector

3.2.1 Storage units and protected areas

- **Federal Law No. 9.985/2000** – This Act establishes the National System of Conservation of Nature – SNUC, establishing criteria for the creation, deployment and management of protected areas. The National System of Conservation of Nature – SNUC is made up of all federal, state and municipal conservation units. Protected areas of SNUC, created by act of government, are divided into two distinct groups with specific characteristics: Units of Integral Protection and Sustainable Use Units. The Biosphere Reserve is a model, adopted internationally, of integrated, participatory and sustainable natural resources management, with the basic objectives of preserving biodiversity, development of research activities, monitoring and environmental education, sustainable development and improvement of quality of life of populations. It establishes the recovery of 0.5% of the amount of planned investment in the projects subject to licensing by way of environmental compensation. The charge was regulated by Decree No. 6.848/2009.

- **CONAMA Resolution # 302/2002** – It aims to set the parameters, definitions and limits for the Permanent Preservation Areas (PPAs) of artificial reservoirs and the institution of compulsory drafting of an environmental conservation and use of surroundings. APP (PPA) is the area with minimum width, in horizontal projection in the vicinity of artificial reservoirs, measured from the normal maximum of 30 meters for artificial reservoirs located in consolidated urban areas and 100 meters for rural areas. The entrepreneur, in the environmental licensing procedure, shall prepare the Environmental Conservation and Artificial Surrounding Reservoir Use Plan (Pacuera) in accordance with the terms of reference issued by the competent environmental agency for artificial reservoirs for the generation of energy and water supplies.
- **Decree No. 7.154/2010** – aims to systematize and regulate the activities of federal agencies, establishing procedures to be followed to authorize and conduct studies of potential hydroelectric power hydraulic, transmission systems and power distribution within protected areas and installation of associated systems in conservation units for sustainable use. The authorization to carry out technical studies will be issued by the Chico Mendes Institute for Biodiversity Conservation through administrative proceedings, the applicant must demonstrate that it holds the active registry with Aneel.

FOREST CODE

The Brazilian Forest Code was first formalized by Decree No. 23.793/1934. In 2009 it resumed discussions on the basis of Decree No. 6.514/2008, which provided for the period until December 2009, registration for legal reserves.

Importantly, the actions stipulated by the new Brazilian Forest Code with regard to environmental conservation have been developed or practiced by the electricity industry.

3.2.2 Solid waste

- **Law 12.305/2010 and Decree 7.404/2010** – The National Policy on Solid Waste (PNRS) is recent and austere, but the electricity sector is prepared to meet the points that the law contemplates. Law No. 12.305/2010 instituted the policy and was regulated by Decree No. 7.404/2010. These legal provisions are aimed at regulating the main principles, objectives and instruments, as well as guidelines for the management and integrated management of solid waste, including hazardous, the responsibilities of generators and the public and to apply economic instruments. In principle all companies, public authorities (federal, state and municipal) and citizens are obliged to observe the provisions of these rules.

Among the main tools for realization of PNRS is worth emphasizing the selective collection, the reverse logistics system, encouraging the creation and legalization of cooperatives or associations of collectors of recyclable materials.

Importantly, the concept establishing this legislation, the shared responsibility for the life cycle of products, defining it as “the responsibility to be implemented individually and unchained, including manufacturers, importers, distributors and retailers, consumers and titular holders of public urban sanitation and solid waste management.

The rules also establish, besides the civil obligation to repair any damage to the environment resulting from non compliance with the provisions in its text, administrative and criminal sanctions to those responsible for solid waste management.

- **CONAMA Resolution #428/2010** – Regulates the licensing procedures for projects with significant environmental impact that would affect the specific protected areas or their buffer zones. Determines that the licensing of ventures that may affect the Conservation Unit (CU) specifically or its Buffer Zone (ZA) – so considered by the environmental licensing, based on EIA / Rima – can only be granted after approval of the agency responsible for administering the UC or in the case of Private Reserves of Natural Patrimony (PRNP), the body responsible for its creation.

3.2.3 Socioeconomic register

- **Decree No. 7.342/2010** – Institutionalizes the socioeconomic registration as a means of identification, qualification and public record of the population affected by developments of hydroelectric power generation. It lists the roster of members that must be included in the record, considering not only those who will lose possession or ownership of property, but also all those who otherwise may have their income, livelihood or way of life affected. Creates the Interministerial Committee for Socio-Economic Registry, whose function is to provide, during the environmental licensing the requirements for the preparation of the registry and monitor it.

3.2.4 Environmental education

- **CONAMA Resolution # 422/2010** – Whereas the establishment of the National Environmental Education – PNEA by Law No. 9.795/1999, this resolution is to establish guidelines for content and procedures in actions, projects, campaigns and programs of information, communication and environmental education within the formal and non-formal, held by public, private and civil society.

Set as guidelines for the use appropriate language and also the context of environmental issues in historical dimensions, economic, cultural, political and ecological public involved.

Believes that environmental education campaigns are tools of empowerment of society and should support the processes of transformation of values, habits, attitudes and behaviors to improve the quality of life in relation to the environment.

3.2.5 Security of dams

- **Law No. 12.334/2010** – Establishes the National Dam Safety Policy, including those concerned for the accumulation of water for all purposes, temporary or final disposal of waste and the accumulation of industrial waste, and creates the National System of information on Safety of Dams. Defines the safety of dams so as to maintain structural integrity and operational and the preservation of life, health, property and the environment in order to reduce the possibility of accidents and their consequences.

3.2.6 Ecological-economic macrozoning of Legal Amazon

- **Decree No. 7.378/2010** – Approves Ecological-Economic Macrozoning of the Legal Amazon in order to ensure the sustainability of regional development, indicating productive strategies and environmental management and land in accordance with the ecological, economic, cultural and social diversity of the Amazon.

The macro-zoning was elaborated through a broad process of discussion in the areas of the Coordinating Committee of Ecological-Economic Zoning of the national territory, composed of 13 ministries and the Secretariat for Strategic Affairs of the Presidency, and the Working Group for the Elaboration of Ecological-Economic Macrozoning of the Legal Amazon, comprised of representatives from nine states in the region and the institutions of the ZEE Brazil Consortium. During its preparation, meetings were held with representatives of various segments of civil society, especially the sectors of agriculture, industry, NGOs and social movements.

3.2.7 Climate change

- **Law No. 12.187/2009** – Instituted a National Policy on Climate Change – PNMC.
- **Decree No. 7.343/2010** – Decree regulating Law 12.114/2009, which created the National Fund on Climate Change (FNMC), which aims to secure resources to support projects and studies and also to finance projects that tend to mitigate climate change and adaptation to climate change and its effects. The application of FNMC resources may be allocated to education, training, certification and mobilization in the area of climate change. The financial agent in relation to recoverable resources is *Banco Nacional de Desenvolvimento Economico e Social* – BNDES.
- **IBAMA Normative Instruction No. 12/2010** – Revokes Normative Instruction 7/2009 and provides that the Ibama's Licensing Board evaluate in the process of licensing the activities capable of emitting greenhouse gases, the measures proposed by the contractor in order mitigate these environmental impacts, in compliance with commitments made by Brazil in the United Nations Framework Convention on Climate Change. Determines that the terms of reference prepared by IBAMA contemplate measures to mitigate or offset these impacts in line with the PNMC.

- **Decree No. 7.390/2010** – The main scope of the decree is the integration of PNMC by action plans for prevention and control of deforestation in the biomes and the sectoral plans for mitigation and adaptation to climate change. The regulation considers the following sectoral plans of action to mitigate and adapt to climate change: Prevention and Control of Deforestation in the Amazon – PPCDAm; Prevention and Control of Fires and Deforestation in the *Cerrado* – PPCerrado; Ten Year Plan for Energy Expansion – EDP; Plan for the Consolidation of Economy Low Carbon Agriculture; and Steel Mill Emission Reduction Plan. For the determination of this Decree there are sectoral plans drawn up for mitigation and adaptation to climate change in order to consolidate a low-carbon in urban public transport systems and modes of interstate transportation of cargo and passengers, in manufacturing and durable consumer goods, and fine chemical industries based on pulp and paper industry, in mining, construction industry, health services and agriculture, in order to meet gradual reduction targets for anthropogenic emissions measurable and verifiable, considering the specificities of each sector, including through the Clean Development Mechanism – CDM and Namas – Nationally Appropriate Mitigation Actions.



4 BUSINESS PRACTICES FOR SUSTAINABLE DEVELOPMENT

The concepts of sustainability, social responsibility and corporate governance are already well established in the companies that comprise the Brazilian electric sector. Aspects and environmental and social impacts are identified and analyzed through formal established areas or interdisciplinary work groups composed of representatives from the areas of environment, land, legal, internal audit and operational.

From these diagnostics are implemented actions to maintain quality of the physical, biological and socioeconomic areas directly and indirectly affected by the companies, enterprises and the business itself.

4.1 Practices for treatment of social and environmental impacts

For each business sector, there are different and consolidated practices. Everything that is the result of licensing is available on the Internet pages of the environmental agencies for consultation by any interested citizen.

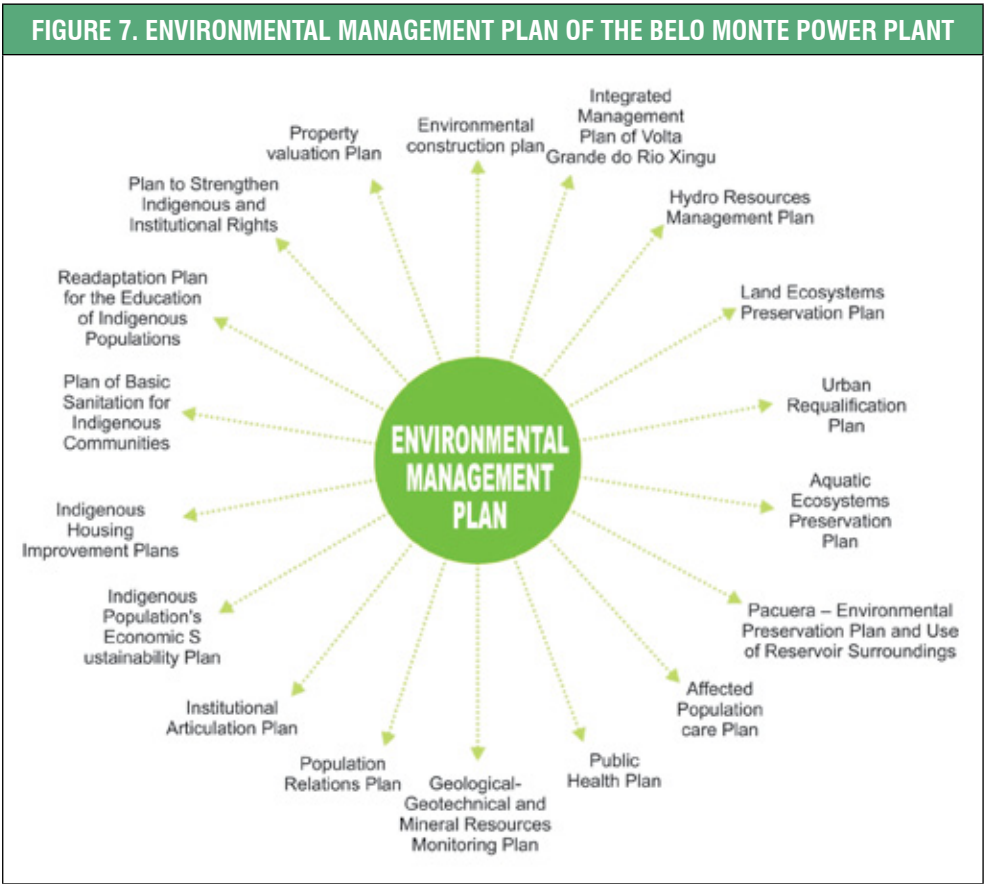
The sector manages the environmental impacts from what is specified in the licensing process, to negotiate with the parties involved and always taking into account the principles of mitigation, compensation and environmental responsibility.

A more complex situation occurs in the implementation of large hydropower utilization, where it is natural to have the biggest discussions and interactions with the various stakeholders. This dialog starts already in the feasibility phase, which develops the EIS / EIR (RIMA), an essential tool to support technical discussions about the social and environmental viability of hydroelectric utilization. The EIA makes a diagnosis of interference in the physical, biotic, and socioeconomic status, makes a prediction of what may occur in the media with the implementation of the project and proposes a set of actions to minimize and compensate for these interferences, and seek to improve

local socioeconomic conditions and regional, enhancing the positive actions. They are the plans, programs and environmental projects that should be put into practice in the stages of research and design, construction, reservoir filling and operation.

They all fall on the entrepreneur. For many of them, the developer should be responsible for making contacts and partnerships with various institutions such as universities, NGOs, and especially municipal governments and even the state government and the Federal Government. Some must be maintained throughout the life of the project.

For example, the figure below shows a summary of the aspects covered by the Environmental Management Plan of the Belo Monte Power Plant:



Source: Hydroelectric performance Belo Monte: environmental impact report – Eletrobrás.

4.2 Major technological changes and management incorporated by the sector

- **Networks Risk Regularization Program** – Performs switching and grounding of rural fences and grounding of transformers to avoid accidents on rural distribution networks.
- **Power Accident prevention program for the population** – Lectures given by volunteer employees with a focus on accident prevention and safe and efficient use of energy, according to annual schedule, with priority given to elementary school students, construction workers and third party vendors.

Potential accidents and hazardous situations are part of the macro-environmental process, which established controls and mitigation measures for negative impacts. These controls are audited with a view to assessing their effectiveness and subject to control measures to prevent or mitigate potential environmental impacts.

- **Low Income Social Rate** – Created by Aneel, provides discounts of up to 65% in the invoice amount of energy to consumers who meet cumulatively the requirements, as consumption of up to 220 kW / month, single-phase service and be enrolled in any of the Federal Government's social programs.
- **Social tariff for charities** – Extends the benefits of low-income residential tariff for non-profit charities, such as daycare centers, nursing homes, shelters, hostels, orphanages, etc..
- **Legal Connection** – Redemption of citizenship for the regularization of illegal connections in critical areas (invasions, shanty towns and villages on the fringes of urban areas), preventing poor and unsafe installations.
- **Fraternal Light** – Discharge of bill of needy families with consumption of up to 100 kWh / month, registered in the Federal Government's social programs or social registers.
- **Night Irrigation Program** – Rate reduced from 60 to 70% in the period from 9:30 PM to 6 AM, to encourage agricultural production and activation of irrigation systems. Increase income and quality of life for farmers squarely in the National Program for Strengthening Family Agriculture – Pronaf.
- **Night Poultry Program** – to encourage the poultry industry through 60% discount on the period from 9:30 PM to 6 PM. Minimizes costs and increases the production and export of poultry products.
- **Energy Efficiency Program (EEP)** – A set of measures and practices to increase energy efficiency in benefit entities (municipal facilities, schools and charities and research) in order to avoid or postpone the environmental impacts associated with construction and maintenance of new plants, substations, transmission lines and distribution networks.

- **Procel** – The Procel Seal, established in 1993, was developed and awarded by the National Program for Energy Conservation (PROCEL), coordinated by the Ministry of Mines and Energy. It provides guidance to the consumer in the act of purchase, indicating products with the best levels of efficiency within each category, thus providing savings in their electric bill. It also stimulates the production and marketing of more efficient products, contributing to technological development and environmental preservation. To be awarded the Procel seal, the product should be tested in a specific and renowned laboratory indicated by Procel. Adhesion to the Procel seal by companies is voluntary.
- **Corporate Waste Management Programs** – In addition to providing the management and proper waste management in the industry, it is aimed at enabling actions to minimize resource consumption through recycling and reuse of waste, optimizing its use in production processes and by replacing the use of non-renewable resources with renewable.
- **Regeneration of IMO** – Recovery and reuse of insulating mineral oil, reducing its consumption.
- **Studies for use of vegetable oil insulation** – Replacement in the distribution system transformers of mineral oil (non-renewable raw material) with insulating oil of plant origin (renewable raw material).

4.3 Practices related to the use of renewable energy

- **Solar Energy** – Study of solar energy for electrification of houses by photovoltaic cells and electric power generation in solar thermal plants. Due to the high volume of investments in research and development, solar technologies for electricity generation comes with its low cost, and it is likely that in the coming years this power gain greater representation and global competitiveness. In turn, the use of solar energy for water heating (seeking the replacement of electric showers) has a technology that is economically viable and widely used.
- **Fuel Cells** – Conversion of hydrogen and oxygen into electricity, heat and water, without loading and continuously. This technology is still nascent, investments are needed for its development for commercial use. The best operation of the fuel cell is pure hydrogen. However, there are still high costs for production, storage and transport of this gas, with the possible use of other fuels such as natural gas and ethanol.
- **Distributed Generation with Environmental Sanitation** – Generation of electricity in digesters, using biogas from organic waste originating from swine. In addition to providing a sustainable society that promotes the establishment of farmers in the field, expanding job opportunities and income, this action promotes environmental sanitation to avoid such waste from being released into the environment.

4.4 Practices for treatment of social and environmental impacts from procedures and facilities

- **Underground network and sheltered substation** – They combine high reliability and low socio-environmental impact.
- **Ecological Networks** – In densely wooded areas the naked networks are replaced by compact and isolated systems.
- **Management of Urban Tree Planting** – aims to maximize the benefits of trees and minimize the impacts of urban aerial grids.
- **Good practices in construction** – Social actions with local communities near the power generation projects during the construction period, such as vaccination campaigns, environmental education, and reform of squares and public places, in addition to promoting the settlement of properties.

4.5 Vendor development practices

- **Dialog with suppliers** – Discussion meetings (ethics and sustainability) on the AA1000 standards and participation of suppliers in events and activities related to corporate sustainability.
- **Social and environmental clauses** – clauses protecting the environment, prevention of slave and child labor and non-discrimination in the workplace in contracts and procurement, encouraging good practices of suppliers.
- **Lectures on pruning and mowing** – Lecture prior to the commencement of the work of mowing and pruning on safety at work, specified in contracts (safety, environment and community relations).

4.6 Initiatives of certification and self-regulation adopted by sector

In addition to the practices and procedures related to the electricity companies adjust their practices so as to be aligned to the requirements of certification bodies and focused on quality, governance and sustainability, for example:

- **Global Reporting Initiative (GRI)** – Dutch organization pioneer in sustainability, and which developed the most widely used sustainability report worldwide. The aim of the GRI includes the integration of disclosure of environmental, social and governance institutions. GRI reports have been produced since 1999 and each year more companies adhere to the use of the report presents the monitoring of indicators and initiatives towards a more egalitarian and environmentally responsible economy.

- **AA1000** – This is a standard of accountability, focusing on ensuring the quality of accounting, auditing and reporting social and ethical. It consists of a set of principles and standards process, involving the definition and integration of values of the organization with the development of performance goals and evaluation and reporting of organizational performance. Through this process, the organization focused on engagement with stakeholders, AA1000 social and ethical issues linked to strategic management and operations of the organization.
- **Global Compact / Millennium Challenges** – The Global Compact is an initiative proposed by the United Nations to encourage companies to adopt policies of corporate social responsibility and sustainability. It aims to promote dialog between companies, UN organizations, unions, nongovernmental organizations and other partners, to develop a global market that would more inclusive and sustainable. The idea is to give a social dimension to globalization.
- **Bovespa ISE** – Created in 2005 by the Stock Exchange (Bovespa) in partnership with professional organizations related to capital markets, and the Getulio Vargas, Instituto Ethos and Environment Ministry, the index aims to provide investors with an option portfolio composed of shares of companies that have a recognized commitment to social responsibility and corporate sustainability. The premise is that the country's economic development is closely related to the welfare of Brazilian society and the global trend of investors seeking socially responsible, sustainable and profitable companies to invest their resources. The new portfolio of the Corporate Sustainability Index for 2012 has 11 companies in the Brazilian electric sector.
- **Dow Jones Sustainability Index World (DJSI)** – was launched in 1999 as the first indicator of financial performance of leading sustainability globally. The companies listed in the DJSI, indexed to the New York Stock Exchange, are rated as the most capable of creating value for shareholders over the long term, by managing the risks associated with economic, environmental and social. The Brazilian electric sector has had a company listed in the index for the past 10 years.
- **National Quality Award (PNQ)** – The National Quality Foundation (FNQ) is the entity that sets the parameters, assesses and recognizes organizations that practice the Excellence in Management in Brazil. Among the eight dimensions assessed, there are practices related to sustainability in virtually all of them, but the emphasis is on the dimensions "Leadership" and "Society." As evidence of the importance and influence of PNQ in the electricity sector, it is noteworthy that the four companies honored with the National Quality Award in 2011 belong to the electricity sector: Coelce, CPFL Paulista, CPH Eletrobrás Eletronorte Tucuruí and Rio Grande Energia (RGE).
- **ISO 14001** – The standard is applicable to any organization (government or private) that aims to establish, implement, maintain and improve an environmental management system and seek its approval by a competent external organization, in addition to checking the environmental policy implemented for compliance with the reality of the enterprise and also serve as input to an intra or outside analysis of compliance with this standard and a self-declaration of an enterprise. The electricity companies use ISO 14001 to certify the processes more influenced by environmental requirements.



5 CHALLENGES AND OPPORTUNITIES FOR THE SECTOR ON THE PATH TO SUSTAINABILITY

Before presenting the challenges and opportunities inherent in the Brazilian electric sector, it is important to highlight some assumptions:

- a)** There is no generation of electric energy without interference socioenvironmental and therefore environmental costs associated with it. The important thing is to set up a sustainable way to implement a specific project, be it a large hydroelectric plant, a coal-fired thermal power plant or several wind farms. The environmental hydroelectric and economically viable potential should be exhausted in 2030.
- b)** Brazil has significant reserves of gas and coal that can be used to generate electricity by increasing the security of the system, mitigating the effects of unfavorable hydrological cycles, using clean-burning technologies (Clean Coal Technologies), and use of biomass with co-firing;
- c)** Brazil has significant reserves, approximately 309 thousand tons, and technological knowledge related to the enrichment of uranium for use in power generation.
- d)** Each type of energy source has its application and place in the energy matrix. The choice should consider the specific local socio-environmental and opportunity cost. No source can be neglected, since the diversification of the energy matrix increases the security of energy supply by removing the dependency on weather conditions or the provision of international fuel prices. What to look for is the mitigation of emissions, with investment in technological research to increase efficiency and reduce energy penalties, and the study of resource use from carbon credits.
- e)** The availability and price of energy are key factors in Brazil's industrial competitiveness in a globalized world.
- f)** Hydroelectric plants also represent the lowest opportunity cost when compared with the social and environmental alternatives for expanding the supply of electricity in Brazil.

- g)** With the growing participation of renewable wind and solar future, the Brazilian energy matrix, characterized by being less flexible and not dispatchable, the flexible thermoelectric and hydroelectric plants are the essential means to ensure the reliability of the SIN;
- h)** Although there is in the SE Planning an expansion of unconventional renewable energy sources such as wind and solar, it is essential to the maintenance of said conventional sources to support the uses considered as electro-intensive (steel, basic industries, subway etc..).
- i)** In the concept of sustainability, the most eco-efficient energy is the one we do not consume. Therefore the need for importance of structured programs of energy conservation and education.
- j)** As shown earlier, the EDP considers that the electricity to be saved over the next 10 years in Brazil will be equivalent to the production of a hydroelectric plant of 7,000 MW. It is crucial to put into practice and expand programs designed for this purpose.
- k)** It should be identified for potential improvement in energy efficiency, using the demand-based management, in the industrial as well as commercial and residential sectors. As it becomes economically viable, smart grids could be installed.
- l)** For three decades Brazil had been among the 10 lowest cost electrical energy producers in the world. Today it is among the 10 most expensive. The current price of the electricity industry in Brazil is higher than that practiced in the United States, France, India, Russia and China.
- m)** The last and main premise to contextualize the challenges and opportunities of the Brazilian electric sector in the Rio +20 debate is to find that:
- Emissions per capita in Brazil correspond to half the world average,
 - The Brazilian energy matrix is three times cleaner than the world, and
 - The Brazilian energy matrix is 7.5 times cleaner than the world.

5.1 Challenges and opportunities of the Brazilian energy sector in the context of Rio+20

5.1.1 Climate change

Overall, the energy sector is of paramount importance to the issue of climate change, since the production and energy use accounted for 64.4% of total emissions of greenhouse gases (GHG) from the planet in 2005 (gases considered: CO₂, CH₄, N₂O, PFCs, HFCs and SF₆)¹. From this percentage, electricity and heating are responsible for 28%.

In 2005, Brazil accounted for just 6.5% of global GHG emissions, with deforestation accounting for about 64.1% of national emissions. In turn, the national electric power generation accounts for only 2.1% of emissions of greenhouse gases produced in the country. This index reflects the high level of renewables in our energy matrix. That is the challenge of the Brazilian electric sector on this issue is to maintain a balanced array, aligning electroenergetic security and low tariffs in a low carbon economy, based on the following points of consideration:

1. The power industry supports the adoption of voluntary actions without abandoning the principle of common but differentiated between developed and developing countries. The counterpart would be the mitigation mechanisms (Namas, CDM, REDD) and other mechanisms that can be created. There is a need for different mechanisms for developed countries that have mandatory targets, and developing countries, who may accept quantifiable voluntary commitments.
2. Brazil should have recognized its efforts in having developed and maintained an energy matrix based on 89% renewable sources while the world average is 18%. The country therefore has an “environmental credit history” in contrast to the “historical responsibilities” of developed countries on large past emissions. Negotiations should exploit these comparative advantages of Brazil. In this sense, it is proposed the creation of a **Renewable Electricity Seal** (on the production side) and a **Seal of Electricity Development** (on the consumption side), internationally recognized, which specify the content of energy sources used in the production of Brazilian products. The seal shall certify renewable energy domestic products produced with a significant percentage of renewable sources. The seal of sustainable energy certifies products produced with fossil energy generated from carbon sequestration. Thus it is contributing to the competitiveness of Brazilian industry and at the same time, disclosing our condition as a predominantly renewable matrix.
3. Climate change could adversely affect the planet's agriculture, livestock and public services, especially those associated with operating the electric distribution system, transmission and generation. The facilities in general, can be compro-

¹ Source: Climate Analysis Indicators Tool – Washington, DC: World Resources Institute, 2010.

misled by the impacts of extreme weather events, which, coupled with the possible significant variations of water flow and wind speed, are deep concerns about energy security of the country. Thus, there is the need for the MME, with involvement of the electricity sector, to formalize an instance of treating this subject, to deepen the study of climatic effects on the electricity sector and to propose appropriate actions.

- 4.** To maintain the high share of renewable sources in the Brazilian energy matrix, in accordance with the National Plan on Climate Change, we consider it necessary that the Government implement the following measures:

Within the electricity sector:

- a)** Expand, support and maintain effective networks for monitoring hydrological variables, weather and climate to enable further prospective studies considering these variables in a systematic manner, including vulnerability studies of the electrical grid.
- b)** To promote the revision of the Ten-Year Energy Plan to incorporate the expansion of the energy matrix involving gas thermal power plants, coal and nuclear;
- c)** To promote better understanding and communication to society about the benefits of hydroelectric plants, which currently represent the basis of the Brazilian Electric Sector and other renewable sources such as wind and biomass, causing the country to be recognized by the natural vocation that has to generate energy from these sources.
- d)** Promote the understanding of the potential of coal in the country and new technologies for clean burning existing and deployed in several countries, notably in new power plants.
- e)** Likewise, promote clarification from the company on the thermonuclear power that, in spite of the radioactive waste produced and non-renewable, does not emit greenhouse gases.
- f)** Review the current priority of deployment of river power plants, recognizing that storage reservoirs play a fundamental role: (i) the electroenergetic balance and security of the sector, (ii) the enhancement of participation of plants from renewable sources, especially wind and biomass, as leverage and optimize the complementarity between these sources, (iii) reduction of potential impacts of climate change on water behavior, through the control of floods and droughts, which can further global warming.
- g)** To promote the sustainable use of water potential untapped (more than 100 GW) concentrated in the Amazon, as well as harnessing the great potential still untapped unconventional renewable sources like wind and biomass at sites where such sources are viable .
- h)** Bring to the legal regulations that meet domestic legal loopholes on topics related to climate change, such as governance, administrative and legislative powers, voluntary and mandatory targets and economic instruments.

Outside the electricity sector:

- a)** Uphold expediting the implementation of mitigation mechanisms like Namas, that allow emission reduction targets proposed by the state as one of the counterparts have effective access to resources that will be available for the implementation of all renewable and non- emitters of greenhouse gases.
 - b)** Promote the development of technology for mitigation of emissions, to increase efficiency and reduce energy penalties, with the establishment of cooperation programs with international organizations and companies. The resources for the development of these programs must be provided in the discussions of the Nationally Appropriate Mitigation Actions (NAMAs) and the National Fund on Climate Change.
 - c)** Deal with the thermal power plants and their emissions in the context of their additional condition in the Brazilian energy matrix and indispensable to the energy security of the system, considering incentives for clean technology transfer, rather than penalties, within the concept of "Environmental Credit History," since the planning of the sector already includes minimizing the periods of operation of the thermal power plants.
 - d)** Any negotiation should avoid the establishment of commitments that result in rising electricity rates to Brazilian consumers. These should benefit from the fact that the country has made an enormous effort to invest in renewable sources and, therefore, have a clean matrix. Access to electricity service must be guaranteed for everyone and affordable, since it guarantees social inclusion and competitiveness of products produced in the country
 - e)** It is of interest to the electricity sector to simplify, improve and continue the Further Implementation Mechanisms, especially the Clean Development Mechanism (CDM).
- 5.** The Brazilian electric sector, aware of its role in the expansion of the infrastructure needed for sustainable development of the country, has the following actions to be implemented with reference to climate change:
- a)** Preparation and dissemination of periodic emission inventories, if possible, including a comprehensive approach to value chain.
 - b)** Expansion of conservation programs and energy efficiency.
 - c)** Promotion of scientific research and education by public and private agencies.
 - d)** Prospective studies of the potential storage reservoirs in mitigating or adapting to the effects of climate change and the integration of intermittent sources of energy such as wind farms.
 - e)** Development of studies on GHG anthropic emission from hydro electrical reservoirs: evaluation of gross and net emissions of greenhouse gases such reservoirs in order to reduce the uncertainties in the GHG balance in hydroelectric reservoirs.
 - f)** Investments in R&D related to CO₂ sequestration, energy efficiency and impact and adaptation to climate change.

5.1.2 Expansion of generation

In any scenario that is projected for Brazil, there is unanimity in all sectors of Brazilian society and economy on the need for expanding the supply of electricity. We understand that the strategy of expanding production of electricity to Brazil should be considered a fundamental instrument of social and economic development and based on three axes:

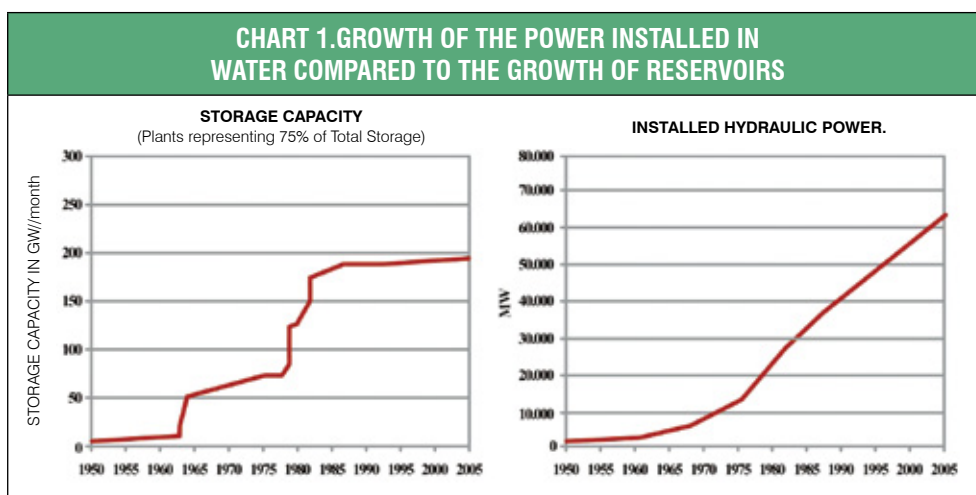
1. CONVENTIONAL HYDROPOWER

The circumstances surrounding the approval of hydroelectric projects has led to the adoption of mostly plants with no reservoir. Thus, in recent years there has been a gradual loss of sensitive regulation of the reservoirs. The average area/power ratio of new plants is 0.06 km² / MW, while in 2007 the average was 0.51 km² / MW.

The hydroelectric reservoirs are fundamental to other energy sources as a complement and provide assurance to seasonal or intermittent sources such as biomass and wind. On the other hand, they act in synergy with thermal plants, resulting in reduced fuel costs.

To that extent, we also provide complementary regional expansion projects, which have the following emphases:

- North: hydro electricity;
- Northeast and South – wind;
- Southeast – biomass and small hydroelectric plants;
- Midwest – biomass.



Source: Source: Energy Research Company – EPE.

Note that there was no growth in Brazil proportional to the capacity of storage, indicating the need for expansion by heat source generating in the base. When no water is stored, the security for the increased demand is the thermal generation.

2. ALTERNATIVE ENERGY SOURCES

FIGURE 8. WIND FARM MUCURIPE – FORTALEZA



Source: Collection Abeeólica.

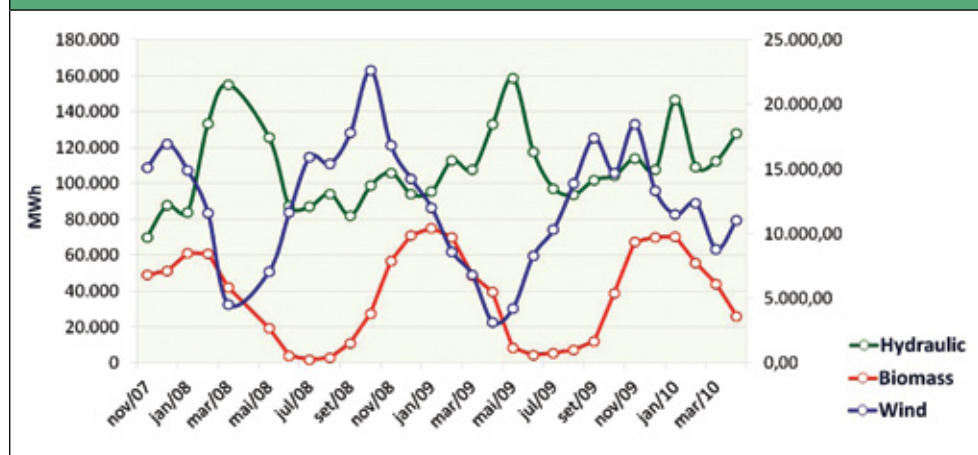
**FIGURE 9. IMPLEMENTATION OF WIND PARK MORRO DOS VENTOS
– JOÃO CÂMARA, RIO GRANDE DO NORTE**



Source: Collection Abeeólica.

Alternative sources of energy, particularly wind, biomass, small hydroelectric plants and, soon, the sun, should play a key role in maintaining the share of renewables in the Brazilian energy matrix. To this end, there is complementarity both regionally and seasonally from these sources with hydroelectric power, generating more energy during the dry season and therefore lower reservoir levels.

CHART 2. COMPLEMENTARITY OF REGIONAL AND SEASONAL RENEWABLE RESOURCES WITH HYDROPOWER



Source: Abeeólica.

The Brazilian wind potential was inventoried in 143,000 MW with towers 50 meters tall in 2001. With current technology of wind turbines, this potential may be greater than 300,000 MW, almost three times the current installed capacity of the Brazilian electrical system.

Similarly, only the replacement of boilers and connection to the network, could be installed 13,570 MW of additional power plants crushed sugarcane, based on the production of 2009.

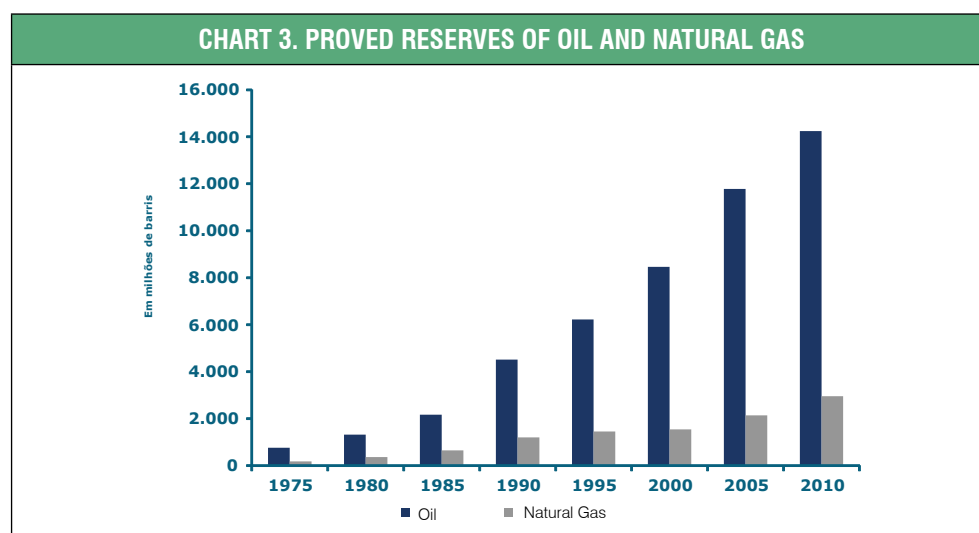
Besides the immense potential for expansion of alternative sources, such plants have the advantage of requiring less construction time, an important factor due to uncertainty in demand growth.

Alternative sources of energy, however, show characteristics of seasonality and intermittency, i.e., generate only when the weather permits. Thus, the present condition of complementary sources, optimizing the use of tanks and reducing the risks associated with dry periods. The dams, the main source of electricity in the country, create the base, with the other sources operating to changes in demand. The reservoirs of hydroelectric plants and transmission network are used to modulate the production of biomass energy and wind power, backups are not required as in other countries, which are usually based on thermal sources that operate with low efficiency due to the need of frequent activation and deactivation.

The optimization of the use of electric energy produced by alternative sources will be obtained with the implementation of distributed generation system, which allows small generators inject into the grid when there is excess power consumption, helping to facilitate generation in the household level by photovoltaic panels, among alternatives.

3. POWER PLANTS (NATURAL GAS, COAL AND NUCLEAR)

The Brazilian reserves of oil and natural gas have increased significantly since the 1980s, when it started operating in the Campos Basin, in Rio de Janeiro. The estimated volume of proven reserves of oil and natural gas are shown in the chart below.



Note: Proved reserves of the pre-salt layer have not been counted in the ANP statistics.

Source: ANP, 2011.

With the start of exploration and production of pre-salt layer, it is estimated that domestic oil production will increase 219%, from 2.1 million barrels per day (bpd) in 2010 to 6.7 million bpd in 2019. The natural gas production will increase 279%, 62 million cubic meters per day (mcd) in 2010 to 238 million in 2019 mcd.

Brazil has coal reserves of around 30 billion tons, of which over 99% of these reserves are located in the South, especially in the State of Rio Grande do Sul, which holds more than 90% of the national reserves. While positioning itself as the 10th country in the world reserves, these reserves represent only 1% of total world reserves. Unlike petroleum, world reserves are more geographically dispersed, with no country having more than 30%, and in regions where there is a low risk of geopolitical tension.

The development of technologies for removal of impurities and efficient combustion provide higher rates of utilization of this resource to generate electricity. The thermal coal technology has evolved to substantially reduce the emission of contaminants in the atmosphere, such as sulfur, nitrogen and particulate matter. Recent years have seen a great evolution of new clean coal technologies, which in addition to increasing the efficiency of these units, reduce the emission of these contaminants. The new plants under construction in Brazil already meet all the stringent international standards established for the mitigation of undesirable emissions.

One of the main questions that still remains is on the issue of greenhouse gases. In this sense, technological development has enabled new options for burning cycles ever more efficient, reducing GHG emissions. Additionally, the burning coal with different kinds of biomass (co-firing) is a process that can be used to further reduce the coal consumption, thereby reducing the balance of CO₂.

Associated with the process of absorption of CO₂, several techniques are being used for the recovery of waste, such as ash and other waste from burning coal in the manufacture of products for construction, paving, zeolites used in various processes of purification of water and others.

Another great potential in Brazil's reserves of uranium ore used as fuel in nuclear power plants. According to the Nuclear Industries of Brazil ("INB"), the country ranks sixth in the world ranking of uranium reserves of approximately 309 000 tonnes. These large reserves are able to guarantee the supply of nuclear fuel to power plants in Brazil, which may expand in the coming years according to the plans of the federal government.

The optimal expansion of a system of power generation is a mix of hydroelectric and thermal sources because they are complementary. On the one hand they may contribute to the thermal power plants operating safely in unfavorable hydrologies, on the other hand they enable hydroelectric plants to reduce operating costs of favorable hydrologies (in the case of Brazil, most of the time).

The thermoelectric power plants are fired every time unexpected events occur. These same activations could not be made by renewable sources (wind and hydro power-of-river), as these sources are not dispatchable – that is, when operating conditions are favorable.

5.1.3 Clean electric matrix

To maintain the national clean energy matrix we need:

- Incentives with tax relief (special tax regimes) for an economy with cleaner energy and climate policies that create competitive advantages in a low carbon economy, including manufacturers of power generation equipment and service providers related to implementation of the facilities – reduction or exemption of taxes such as PIS / Cofins, IPI, ICMS and ISS. Thus, it creates a platform for production of clean low-carbon technologies, combining economy, job creation and green environment, with safe and stable regulatory frameworks, without risk of disruption for macroeconomic reasons, regardless of fiscal space or the need of the result tax or highest goal of primary surplus accounts of the public sector in the short term.
- Prevent increased costs and taxes (including taxes "in natura"). Clear rules are needed for long term application that will give confidence to the public and private investors to do their part with respect to clean energy, climate change and protection of Brazil and the planet.
- Implement integration procedures between environmental planning and management: economic-ecological zoning, watershed plans, strategic environmental assessment, regional and sectoral, national and regional plans of regional planning and economic development and social status of cities, integrated environmental assessment of watersheds (unregulated) and their relationship to decision making in the licensing process.
- Enable the use of resources from the National Climate Change Fund in the development of CO₂ capture technologies in order to promote their use in power generation projects.

5.1.4 Environmental licensing

Important challenges regarding licensing processes:

- Ensure transparency and good quality at all stages of the licensing process, including strengthening of the environmental agencies.
- Mix the procedures, better defining the requirements that involve the cycle of environmental permits – with time and cost predictability bound.
- Eliminate the conflict of jurisdiction regulating Article 23 of the Federal Constitution – common competence between the Union, states and municipalities to protect the environment.
- Provide environmental license to the existence of conditions of legality to proceed with the project.
- Change the rules of environmental crimes to enable the public official who deals with environmental authorizations or permissions to only be punished in case of fraud.
- Improve other environmental management tools (economic instruments, environmental quality targets) as a contribution to the efficiency of licensing.
- Change the paradigm in dealing with environmental disputes, which tend to accumulate and derail the construction of hydroelectric plants, from a reactive posture to a more distinctly proactive and consolidation of a multi-sectoral and structural plan for sustainable development, balancing social and environmental liabilities before -existing example of the “Citizenship Territories Program,” in areas that will receive new investments for the production, transmission and distribution, solving deficits not attributable to public investment projects.

5.1.5 Regulatory framework

The regulatory framework for the electricity sector demand constant improvements in order to meet the parties involved, among which:

- Create, by law, the Strategic Reserve of Hydraulic Energy Potentials, which aims to ensure that areas with potential for hydro generation in the country are effectively used for the production of electricity, and ensure the land necessary for the associated transmission. With this, Brazil enforces the strategic advantage of its large hydro potential.
- Regulating Article 231 of the Federal Constitution on the use of water resources, including hydroelectric potential on Indian lands as well as prospecting and exploitation of mineral wealth.
- Develop specific regulatory milestones for compensation and mitigation measures.

5.1.6 Energy efficiency

As important as increasing the supply of renewable energy is to increase the efficiency of energy consumption generated from renewable sources or not. Initiatives underway in Brazil will avoid an increase of 8.3% expansion in 2030, equivalent to 109 TWh, according to the NAP 2030. The table below shows the projections for consumption of electricity, including self-production and the amount of energy conserved.

TABLE 13. ELECTRIC POWER CONSUMPTION AND EFFICIENCY (GWH)			
Consumption ⁽¹⁾	2011	2015	2020
Consumption potential without storage	480,759	595,768	754,965
Conserved power	2,709	15,208	33,611
Conserved power (%)	0.6	2.5	4.5
Final consumption, considering conservation	478,050	580,560	721,354
Energy conserved per sector			
Industry ⁽²⁾	0.6	7,347	16,211
Transport sector	1.0	124	335
Commercial sector	0.7	2,975	6,665
Residential sector ⁽³⁾	0.4	2,895	6,790
Other sectors ⁽⁴⁾	1.1	1,688	3,610

(1) Includes self-production. (2) Includes electricity sector. (3) Includes urban and rural households. (4) Agricultural and public. Source: EPE.

The cost of additional energy obtained through energy efficiency – energy saved – must be competitive and lower than the marginal cost of expansion (which represents only 20% of value paid by the consumer). The main barrier that inhibits the behavior of private agents to delay investments in energy conservation is the fact that these initiatives provide rates of return below those of other initiatives that compete for the same resource internally (expansion in production, introducing new technologies that increase competitiveness of the product etc.). This makes it essential to create new policies and clear strategies aimed at promoting energy efficiency. It is especially necessary to optimize the benefits, minimize costs, avoid misalignments and use more efficient mechanisms.

FIGURE 10. RURAL ELECTRIFICATION PROGRAM, PARANÁ



Source: Collection Copel.



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CNI – NATIONAL FEDERATION OF INDUSTRIES

DIRECTORY OF INSTITUTIONAL RELATIONS

Mônica Messenberg Guimarães
Director of Institutional Relations

ENVIRONMENT AND SUSTAINABILITY UNIT

Shelley de Souza Carneiro
Executive Manager - Environment and Sustainability Unit

Technical Support
Mário Augusto de Campos Cardoso (Environment and Sustainability Unit – CNI)
Alexandre Vianna (Fundação Dom Cabral)

Editorial Support
Priscila Maria Wanderley Pereira (Environment and Sustainability Unit – CNI)

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Executive Manager

Armando Uema
Editorial Production

Work Group Rio+20 of FMASE

Ivonice Campos – Abeer Consultant
Coordinator

Components

Marcelo Moraes – FMASE Coordinator and Director of Institutional Relations Abiape

Luiz Fernando Leone Vianna – Deputy Coordinator FMASE and President of the Board of Directors of Alpine

Adriana Coli Pedreira – Technical and Legal Assistant FMASE

Antonio Fonseca dos Santos – FMASE Counselor and Director of Environment and Sustainability at Brookfield Energia Renovável

Elbia Melo – Executive President Director of ABEEólica

Ernie Fonseca – Technical Assistant FMASE and Superintendent of Environmental Management for Generation and Transmission Cemig

Moana Simas – Department of Research and Data Collection ABEEólica

Rogério Neves Mundim – Manager of Environmental Department of Eletrobrás

Rosana Santos – Director of Environment ABEEólica

Pilar Álvares da Silva Campos Miranda – Executive Secretary of FMASE

External collaborators

Alexandre Vianna – Coordinator at Fundação Dom Cabral

Mário Augusto de Campos Cardoso – Executive Manager of Environment and Sustainability CNI

Gustavo Martins and Luiz Fernando Calmon – Editors

Aline Santos Jacob – Standardization

Grifo Design – Editorial Project

