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# Fighting Electricity Waste in Brazil

## The Role of the Regulatory Agency

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*"Such is Truth! Men dare not look her in the face, except by degrees: they mistake her for a Gorgon, instead of knowing her to be a Minerva".*

Lord Byron  
(1788–1824)

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I. PRESENTATION

The objective of this work is to present the new model of the Brazilian Electrical Sector and the role of the Regulatory Agency in the energy efficiency issue, more properly to promote fighting electricity waste.

In the chapter III a picture of the Brazilian Electrical Sector is presented with general data on the country; composition of the interconnected and isolated systems; characterization of the consuming markets and principal agents.

Soon after, the chapter IV reports the process of restructuring the Brazilian Electrical Sector, started in 1993 and consolidated in 1998. For better understanding the activities developed by the sector are described *ex-ante* and *ex-post* the restructuring process.

The chapter V analyzes the private investor substituting the State in the electrical sector. It also presents a retrospect of the private investment in generation, transmission and distribution of electricity in Brazil.

The chapter VI presents a summary of the actions took until now in fighting the waste of electricity in Brazil, the Federal Government's performance through PROCEL and the performance of the utility companies. It also presents tendencies in energy efficiency vis-à-vis the private investment and the new model of the electrical sector.

Thus, the chapter VII shows the structure, competencies and guidelines of the Brazilian Electricity Regulatory Agency - ANEEL and its role as regulator in combating the waste of electricity.

The chapter VIII places final comments to be taken into consideration. It is about opportunities and challenges that the current moment and the future could bring to the Regulatory Agency and society to improve the energy efficiency in Brazil.

## II. INTRODUCTION

With the publication of the Law 8631 on March 04, 1993, the "*Eliseu Law*", was initiated the restructuring of the Brazilian Electrical Sector. This law extinguished in Brazil the regime of guaranteed remuneration where the state owned utilities debts was credited in the *Conta de Resultados a Compensar - CRC* - and paid by the *Reserva Nacional de Remuneração e Compensação - RENCOR*.

The extinction of this mechanism helped to impel in the companies of the electrical sector the search of total quality, reduction of costs, best use of electricity, focus in the customer, continuous improvement and fixation of the institution viz à viz the consuming market.

Parallel to this effort of the companies, the Federal Government prepared a new scenario for the electrical sector, willing to improve the participation of the private investor in generation, transmission and distribution of electricity and the State as regulatory, supervisor and mediator agent. This process, highlights the following milestones:

- Creation of *SINTREL – Sistema Nacional de Transmissão de Energia Elétrica* (Decree 1009 of December 22, 1993);
- The Concessions Law (Law 8987 of February 13, 1995) and Renewal of Concessions and Permissions Law (Law 9074 of July 7, 1995), disposing on the new concession regimes, permission and installment of the public services of electricity and the rules for these services;
- The DNAEE Resolutions 244 of June 18, 1996 and 459 of November 10, 1997, establishing the basic transmission net and the general conditions of electricity supply;
- The regulation of *I.P.P. - Independent Power Producer* and the *Self-Producer* by the Decree 2003 of September 10, 1996;
- The Brazilian Electricity Regulatory Agency - ANEEL, created by the Law 9427 of December 26, 1996;
- The restructuring of Eletrobrás and the determination of celebration of the *Mercado Atacadista de Energia (MAE)* and *Operador Nacional do Sistema (ONS)* by the Law 9648 of May 27, 1998.

Established this new scenario, the industry of electricity became more attractive to the private investor's eyes. This fact was demonstrated by the success and the surplus price obtained in the sales of the public electricity utilities.

The new owners brought new values to the companies' core, where the reduction of technical and commercial losses and the expansion of the consuming market started to receive special attention.

In this context the programs of energy efficiency, aligned to the government's policies of fighting the waste of electricity, put in direct confrontation reducing the consumption and postponing investments against the paradigm that these programs result in revenue losses for the utilities.

The Federal Government assumes the fundamental task of stimulating, through the regulation, investments to combat the waste of electricity.

Besides the government's regulator role, exercised by ANEEL, it also exists the action of Eletrobrás and of the *National Development Bank - BNDES* supporting, as financial agents, the actions of energy efficiency.

The following chapters will show the actual scenario of the Brazilian Electrical Sector and the actions developed and previewed by the Federal Government, with prominence for the regulation, to combating the waste of electricity.

## III. FEATURES OF THE BRAZILIAN ELECTRICAL SECTOR

### III.1 General Data

Brazil has an area of 8.511.965 km<sup>2</sup> and a demographic density of just 18.8 hab/km<sup>2</sup>; being characterized by wide isolated areas with low demographic concentration in the North, Northeast and Midwest Regions and high concentration in the South and Southeast Regions. Other data from Brazil is presented in the table below.

<b>Brazil's General Data (1997)</b>	
<b>Area (km<sup>2</sup>)</b>	8511965
<b>Demographic Density (inhab/km<sup>2</sup>)</b>	18.5
<b>Urban Population - 1990(%)</b>	73.9
<b>Currency</b>	Real (R\$)
<b>Official Language</b>	Portuguese
Gross Domestic Product - GDP (10 <sup>9</sup> US\$)	800
GDP Growth Rate (%)	3,03
Energy / GPD (koe/ US\$)	303.5

Source: *Balanço Energético Nacional 1998 - MME.*

### III.2 Features of the Electrical System.

The Brazilian Electrical System is segmented in three different systems, to know:

**South / Southeast / Midwest Interconnected System**, with an installed capacity of 42,706 MW (December 1997), considering only 50% of the installed capacity in UHE Itaipú (6,300 MW, owned by Paraguay and Brazil), it has 191 hydroelectric power plants (39,275 MW - 92%) and 24 thermal power plants (3,431 MW - 8%).

The installed hydro capacity in this system represents 66% of the national total in operation, disposing, still, a potential in the order of 39 GW, already inventoried.

In terms of thermal generation, in the South Region are located coal power plants with 1,387 MW installed and oil power plants (fuel oil and diesel) with 96 MW. In the Southeast and Midwest Regions exist fuel oil power plants (1,291 MW) and the thermonuclear plant Angra I (657 MW), the only one in the whole country.

The current transfer capacity of the transmission system that links the South and Southeast / Midwest Regions is of 3,600 medium MW, in the South / Southeast sense, and 3,900 medium MW in the inverse sense. This link allows an exchange of energy remarkably seasonal, with flows in the Southeast / Midwest direction during the period of May to November (dry period in the Southeast / Midwest System) and in the South direction, during the period of December to April (rainy period in the Southeast / Midwest System).

**North / Northeast Interconnected System**, that corresponds to the markets of low Tocantins, Belém, area under influence of Tucuruí Hydro Power Plant and the whole Northeast Region. With an installed capacity of 14,686 MW, it has 17 hydroelectric power plants (14,387 MW - 98%) and 3 thermal power plants (299 MW - 2%).

The hydro capacity installed represents 24.2% of the national total in operation, disposing, still, a potential of about 58 GW, already inventoried, considering, in the case of the North Region, the basins of Tocantins / Araguaia, Xingu and Tapajós rivers.

The current transfer capacity between the two areas is in the order of 600 medium MW in the sense North / Northeast and 700 medium MW in the reverse direction. That link also allows an exchange of energy remarkably seasonal, with flows of energy in the Northeast direction in the first semester of the year, when abundance of water exists in the basin of the Tocantins river (Tucuruí Hydro Power Plant) and in the reverse

sense in the second semester of the year, when the flows of the Tocantins river are reduced and the reservoir of Tucuruí shows accentuated volume reduction.

**Isolated systems**, corresponding more than 300 places electrically isolated one to another, most of them located in the North Region. Among them are included the attendance of the five state capitals: Boa Vista, Macapá, Manaus, Porto Velho and Rio Branco.

The states of Maranhão, Pernambuco, Bahia, Tocantins, Paraná, Mato Grosso, Mato Grosso do Sul, Rio Grande do Sul e Paraná also have isolated systems, even so of small load size.

The total installed capacity in the isolated systems is of 1,932 MW (December 1997), where 1,367 MW are provided by thermal power plants and 565 MW by hydroelectric power plants. About 85% of the isolated systems are in the North Region, including the states of Amazonas, Roraima, Rondônia, Amapá and Acre. Have a generating park of 1,652 MW (86% of the country's isolated systems), where 1,383 MW are installed on state capitals (877 MW in thermal power plants and 560 MW in hydroelectric power plants) and 269 MW in the interior, of the which 10 MW in small hydroelectric power plants (PCH) and 259 MW in thermal power plants.

The 15% remaining installed capacity are distributed by the states of Pará, Maranhão, Tocantins, Pernambuco, Bahia, Mato Grosso, Mato Grosso do Sul, Paraná e Rio Grande do Sul, that, in spite of being assisted by the Interconnected Systems, possess Isolated Systems of small load, totaling 280 MW, of the which 231 MW in thermal power plants and 49 MW in hydroelectric power plants.

The hydro participation in Brazil's installed power capacity developed from 84% (8.7 GW), in 1970, to 88% (27 GW), in 1980, 91% (44.9 GW), in 1990, and 91% (54.2 GW), in 1997.

In the electric energy production, the hydro participation reaches about 97% and the thermal production is destined to the Isolated System and complementation in the attendance of the Interconnected Systems market in unfavorable hydro periods or for located attendance, when transmission restrictions occurs.

The hydroelectric prevailing distinguishes the Brazilian generating system in world terms. The following table compares the participation of different primary sources in electricity generation in world ambit (prevailing of the coal, followed by the hydroelectric and nuclear) and in Brazil, evidencing a very different context for the Brazilian situation.

<b>Power Source</b>	<b>World (%)</b>	<b>Brazil(%)</b>
Coal	40	1.2
Hydro	19	96.8
Nuclear	17	0.7
Oil Derivatives	11	1.3
Natural Gas	13	-

*Source: Relatório Anual da Eletrobrás 1998*

Hydraulic generation, with regulation reservoirs and belonging to different companies, results in the need of integrated actions, seeking for the best use of the system, the increase of efficiency and the minimum cost in electric energy supply.

There are in Brazil a group of 123 power plants with installed capacity of 10 MW and above, where 19 have installed capacity over 1,000 MW. The hydroelectric power plants sites, usually far from the main load centers, demanded the development of a complex system of wire transmission with long lines and in high transmission voltages (230 kV and above). This net of transmission links North / Northeast Systems and the South / Southeast

/ Midwest Systems. The linkage of these two macro systems should be made possible in the second semester of 1999 by the conclusion of the transmission line in 500 kV between the cities of Imperatriz, in the state of Maranhão, and Brasília, in Distrito Federal, with 1,000 km of extension and capacity of transmission of 1,000 MW.

Energy importation is made almost exclusively from Paraguay through Itaipú Hydroelectric Power Plant, however is predicted for 1999 imports of 250 to 500 MW through a link with Uruguay, 2,000 MW from Argentina by the south of Brazil and of 200 MW from Venezuela by a line to the state of Roraima in the north end of the country.

### III.3 Consuming Market

The consuming market of electricity in Brazil is more intensive in the South and Southeast regions, due to the largest concentration of the industrial segment, in contrast with the North, Northeast and Midwest regions where the demographic concentration is smaller and the economic activity reduced.

The consumption of electricity grew 6.4%, in 1997, impelled by the performance of the commercial segment (9.8%) and residential (7.3%), very superior to the industrial (4.6%). Auspiciously with smaller strength, the residential consumption continues being impelled by the new connections and the incorporation of durable goods consumption, mainly for the less favored classes, that had its purchase power increased with the reduction in the inflation rates. In the commerce, the consumption of electricity continues reflecting the expansion and modernization of the services and the most intense use of air conditioning, besides the opening of malls and shopping centers.

In the residential segment, even though having had an increment of 1.4 million new consuming units in 1997, the medium consumption per bill presented a growth of 2.9% (about 175 kWh / month), still expressive, but less than in the previous years (4.7% in 1996 and 8.8% in 1995). In 1997, 93.6% of the residences were assisted by electricity, verifying an increment of 0.6% in comparison with 1996.

In the industrial segment (not including the energy industry), it is important to mention that, in 1997, some industrial activities, intensive in energy, presented rates of production growth below GDP, as Iron (-12.9%) and Aluminum (-0.8%) and others presented rates above GDP, as Cement (10.1%) and Chemistry (7.5%). The industries most intensive in electricity was the ones that had lower rates of growth that explains the smaller growth in the industrial consumption. In that context, the electricity consumption of the industrial segment presented a growth of 4.6% in relation to 1996.

The total consumption of electricity in Brazil was of 296 TWh in 1997, indicating a growth rate of 6.4% in relation to 1996, while GDP grew 3.03% in the same period. This tendency of energy consumption rates superior to the economic growth is being verified in the last 10 years. The consumption of electricity per segment in 1997 was of 136 TWh for the industrial, 74 TWh for the residential and 38 TWh for the commercial.

### III.4 Institutional Composition

In the institutional plan the Brazilian Electrical Sector has the following agents:

**Distribution Utilities:** 63 companies under concession of public service of electricity, assisting the 26 states of the Federation and Distrito Federal.

**Regional Utilities of Generation and Transmission Owned by Eletrobrás:** Furnas Centrais Elétricas, responsible for the Southeast and Midwest Regions; ELETRONUCLEAR - Eletrobrás Termonuclear S/A, responsible for the Angra I, II and III Nuclear Complex; CHESF - Centrais Elétricas do São Francisco S/A, responsible for the Northeast System; ELETRONORTE - Centrais Elétricas do Norte do Brasil S/A, assisting the Isolated Systems of the North Region, the Interconnected System North/Northeast and the Midwest Region; ELETROSUL - Centrais Elétricas do Sul do Brasil S/A, responsible for the transmission system of the South Region.

**GERASUL - Centrais Geradoras do Sul do Brasil S/A:** Originally part of ELETROSUL is responsible for the generating park of the South System, was privatized in October of 1998.

**Itaipú Binacional:** Company of binacional participation (Brazil and Paraguay) is a hydroelectric power plant that provides 25% of the national demand and 100% of Paraguay's demand.

**ELETROBRÁS - Centrais Elétricas do Brasil S/A:** Holding company of the electrical sector and financial agent works as an extension of the Federal Government.

**ONS – Operador Nacional do Sistema:** Private agent, is responsible for the coordination and control of the operation of the Interconnected Systems South/Southeast/Midwest and North/Northeast.

**MAE – Mercado Atacadista de Energia:** Organized and ruled environment in which the purchase and sale of electric energy are processed among its participants, through long term contracts or by the short term market, limited to the Interconnected Systems.

**Federal Government:** The Ministry of the Mines and Energy (MME) and the Secretary of Energy (SEN), act as agent of the Federal Government, responsible for the electrical sector policy formulation.

**ANEEL – Agência Nacional de Energia Elétrica:** Quasi-governmental organization established under a special regime that is responsible for the regulation, fiscalization and mediation among the agents of the electrical sector.

**Other Entities:** Rural Coops, Independent Power Producers (IPP), Autoproducers and Energy Sales Agents (brokers).

#### IV Restructuring the Brazilian Electrical Sector

In this Chapter will be presented a brief description of the Model of the Brazilian Electrical Sector in the situations before and after the restructuring process.

As it was already mentioned in the Introduction, the restructuring of the Brazilian Electrical Sector began indeed in 1993 with the extinction, through the " Lei Eliseu ", of the Guaranteed Remuneration Regime. The extinction of this mechanism introduced the rate discretization in electric utilities, once *CRC* or *RENCOR* would no longer compensate those eventual debts.

It has become necessary to set a new model for the electrical sector that could introduce the competitiveness, allow a most effective performance of the private investor and place the State in its role of regulator and supervisor.

##### IV.1 Former Model of the Brazilian Electrical Sector

This model took effect up to 1997, before restructuring the Brazilian Electrical Sector. The main characteristic was the vertical concept of the electricity utilities, where were identified three basic physical structures:

- a. Companies with generation, distribution and consumers assisted in low voltage (less than 13.8 kV). Small companies with attendance to areas located at the state interiors or isolated systems. When power plants owners, had small hydroelectric power plants (PCH) and thermal parks with diesel motors. When not, they acquired energy from companies of larger size.
- b. Companies with generation, transmission, distribution and consumers in low voltage (less than 13.8 kV) and high voltage (above 13,8 kV). Here were fitted most of the States owned utilities of the Interconnected South/Southeast/Midwest System. These companies had energy generation mostly of hydraulic origin or bought in high tension at transmission level from larger size companies.
- c. Companies with generation transmission, sub-transmission and distribution with consumers in the transmission levels (above 69 kV), sub-transmission (between 69 and 13.8 kV) and distribution (13.8 kV). Here still are the Regional Utilities (FURNAS, CHESF, ELETROSUL and ELETRONORTE). The

customers in the transmission, sub-transmission and distribution levels are the companies mentioned in the items "a" and "b" above and intensive electricity consumption industries.

In this model the consumers were captive to the utility that assisted their physical area, that is to say, an industry installed in the state of Minas Gerais could only hire supply with CEMIG. In the same way, the state utility were captive of its Regional Utility, for example, the state utility of Pará (CELPA) was a captive customer of ELETRONORTE. The lack of competition was evident.

In the North / Northeast and South / Southeast / Midwest Interconnected Systems, there was energy exchange among the companies in the transmission level and the pro rata participation in the costs of energy generated by Itaipú Binacional.

The Isolated Systems, mostly thermal, deserved the benefit of " CCC – Fossil Fuel Consumption Compensation Account" where the difference between the costs with the generation and the price of energy sales was compensated.

#### IV.2 THE New Model for the Brazilian Electrical Sector.

The new model was conceived considering two principal issues: Competition, where it is possible and regulation where it is necessary.

This way, the model introduces specific agents for generation, transmission, distribution and consumers; an strong regulatory agency (ANEEL); the presence of an independent organism for operation and coordination of the interconnected electrical systems and the Federal Government performing the indicative planning function.

The Law 9648/98 established the restructuring of Eletrobrás, split the Regional Utilities into generation, transmission and distribution companies and also introduced new agents:

- The ONS and MAE;
- The free consumer that can acquire energy from any utility of the Interconnected System. In the beginning only the consumers with demand above 10 MW and assisted in 69 kV or that were connected after July 95 with demand above 3 MW are considered free consumers. After July 2002, the consumers connected before July 95 will also be considered as free;
- The Energy Broker that, authorized by ANEEL, may buy and sell energy in the wholesale market without being part of any generating company or dealer and
- The Independent Power Producer (IPP) that produces and negotiates energy in the MAE environment for its own effort and risk.

The above mentioned agents were regulated by Resolutions issued by ANEEL during 1998.

#### V. The Private Investor

The end of restrictions to the foreign capital investments in Brazil, set through amendment to the Federal Constitution (Amendment 6/95 of August, 15 1995), was fundamental for the private investment in the Brazilian Electrical Sector.

Until then the state participation in the electrical sector was predominant: Of the 62 existent utilities, 37 were under the stock control of Union or of the States, and were responsible for 98% of electrical energy generation and distribution in the country. By that time, the others 25 private utilities held 1.7% of participation in the market.

In July 1995, with the auction of *ESCELSA – Espírito Santo Centrais Elétricas*, has began the process of transferring for the private sector the utilities companies inserted in the *PND - Programa Nacional de Desestatização*.



To pass on the stock control of the utilities companies to the private sector is part of the process of introduction of the new model of the Brazilian Electrical Sector, but it is also can be translated as revenues for the Treasure vault and review of public debts.

From July 1995 to November 1998 the Brazilian Government collected R\$ 22,177 billion with the sale of 18 companies of the electrical sector and transferred, only in 1998, R\$ 4,0 billion in public debts to the private initiative.

<b>Utility</b>	<b>Auction</b>	<b>US\$ million</b>	<b>Buyer</b>
Escelsa	07/12/95	357.9	Consortium leaded by Iven S/A
Light	05/21/96	2,217.0	EFD, Houston, AES Corp., Eletrobrás and others.
Cerj	11/21/96	605.3	Chilectra, EDP and Endesa
Coelba	07/31/97	1,730.0	Banco do Brasil, Iberdrola and others
Cachoeira Dourada	09/05/97	779.7	Endesa, Edgel and Investing Funds
RGE	10/21/97	1,635.0	VBC, Previ and Community Alternative
AES-Sul	10/21/97	1,510.0	AES
CPFL	11/05/97	3,015.0	VBC, Previ, Bonaire and others
Enersul	11/19/97	625.5	Magistra (leader: Escelsa)
Cemat	11/27/97	391.5	Rede/Inepar
Energipe	12/03/97	577.0	Cataguazes Leopoldina
Cosern	12/12/97	676.4	Coelba/Iberdrola
Coelce	04/02/98	987.0	Cerj
Metropolitana	04/15/98	2,026.0	Light
Celipa	07/09/98	599.0	Rede/Inepar
Elektro	07/16/98	2,024.0	Enron
Gerasul	09/15/98	952.0	Tractbel
Bandeirantes	09/17/98	1,469.0	EDP

Source: BNDES

Besides the reduction of the public debt, the privatization process also has the following objectives:

- guide the focus of actions and resources of the Federal Government for the social areas;
- help the Government to perform a fiscal adjustment;
- retake investments in the privatized companies through its new owners resources;
- strength the stock market through a greater capital pulverization;
- foster the competitiveness in the market and consequent improvement in the quality of the services and offered goods;
- end the financial aid of the Federal Government to the States owned or federalized companies chronically in debt and inefficient.

The private investor's answer to the objectives above described can be seen in the increase of the productivity of the steel sector, privatized in the first phase of PND and in the results verified from the utilities companies already privatized. As an example, the net profit and the efficiency increase verified in ESCELSA in 1997, reflected an average reduction of 3.0% on its energy rates, reaching 5.0% for the residential segment

Country	PND		State-Owned		Telecommunications		Total	
	US\$ <b>x1000</b>	%	US\$ <b>x1000</b>	%	US\$ <b>x1000</b>	%	US\$ <b>x1000</b>	%
USA	1603.2	8.9	4,311.0	19.4	3,636.9	13.7	9,578.1	14.7
Spain	1.2	<0.1	3,045.9	13.7	5,042.0	19.0	8,089.1	11.9
Chile			1,006.1	4.5			1,006.1	1.5
Italy					1,220.3	4.6	1,220.3	1.8
France	479.1	2.6	90.0	0.4			569.1	0.8
Argentina			148.2	0.7			148.2	0.2
Portugal	0.5	<0.1	658.0	3.0	4,224.4	15.9	4,882.9	7.2
Uruguay	0.1	<0.1					0.1	<0.01
Korea					265.4	1.0	265.4	0.4
Sweden					599.3	2.3	599.3	0.9
Japan	8.1	<0.1			256.0	0.9	264.1	0.4
Germany	75.4	0.4					75.4	0.1
Holland	5.1	<0.1					5.1	0.01
England	2.4	<0.1					2.4	<0.01
Canada	21.0	0.1			640.6	2.4	661.6	1.0
Belgium	800.4	4.1					800.4	1.2
Other	156.6	0.9	350.0	1.6			506.6	0.7
Foreign Participation.	3,180.1	16.5	9,609.2	43.3	15,884.9	60.0	28,674.1	42.1
<b>Total</b>	19,290.4	100.0	22,299.7	100.0	26,506.0	100.0	68,096.1	100.0

Source: BNDES.

An increasing foreign capital participation in the privatization auctions is being observed in the current phase of PND. In the electrical sector this participation has been quite significant: The privatization of Light, occurred in May 1996 had about 61% of foreign capital participation and in the Gerasul's auction, occurred in September 1998, the foreign capital reached 100% of the sale price.

#### VI. Fighting Electricity Waste in Brazil – An Overview

In December, 30 1985 through the Conjunct Act 1877 (Ministry of The Mines and Energy and Ministry of the Interior) was created the National Program of Energy Conservation - PROCEL, with the purpose of integrate and articulate measures to maximize the results from Federal Government resources application in the rational use and conservation of electricity.

This was the first Federal Government effort in the search of a combating the waste of energy policy. The actions developed from 1986 up to 1991 were shown not very effective and proportional to the modest investments accomplished by the government. The country lived on the effects of an inflationary spiral that didn't let to reveal the real participation of electricity costs in the consumer's monthly budget, turning not very attractive investing in energy conservation: It was very difficult to propose reductions of 10% in the electricity bill in an atmosphere of 100% inflation rate per month.

In 1991 PROCEL had been risen to the status of Federal Government Program and received the new denomination of Program to Combat the Waste of Electricity (the idea of "energy conservation", in agreement with the marketing professionals, was not so clear in the consumers' mind). Up to 1994 the investments were, almost in its totality, originating from of the Federal Government through PROCEL and with resources from the RGR account. The executed actions focused on consumers' regularization through the installation of electricity consumption meters; substitution of bulbs in the public illumination systems; audits to establish the potential of energy conservation in industries and public buildings and education through "PROCEL at Schools" in public elementary and high schools.

With the beginning of the Brazil's economy stabilization in 1994 and the consequent increase of the energy consuming market, the possibility of an energy collapse started to worry the Federal Government. It has initiated, then, a process of hard investments to increase the offer of energy as well to fight the waste of electricity, resulting in the following main actions:

- linkage of the North/Northeast System with the South/Southeast/Midwest System;
- energy importation from Venezuela, Argentina and Uruguay;
- improve the use of Rio Urucú's natural gas reserves in Amazonas and construction of the gas pipeline Brazil/Bolivia;
- reinforcements in the power generation of the isolated systems at the North of Brazil;
- establishment of a four year goal for the period of 1995 / 1998 to reduce the waste of electricity in 7.3 TWh / year and a long-term goal to reduce 130 TWh until the year 2015.

To reach these last cited goals PROCEL had engaged in projects with a wide range of agencies and companies acting close to production and consumption of electricity for better use of the resources, competing with the improvement of the products and services quality and the reduction in the impacts to the environment.

#### VI.1 Results from PROCEL's and Other Actions

Playing the role of motivator and producer, PROCEL has been developing the following activities:

- training, professional preparation to perform projects focusing the combat of electricity waste on the demand and supply side;
- technological development support, elaboration of technical standards and base case studies;
- implementation of the program "PROCEL at Schools", including all levels of education : public and private schools, as well as professional schools, such as *SENAI* and *SENAC*;
- raise and allocate funds from Eletrobrás or other financing for the project implementation;
- agreements with manufactures for the increase of electric equipment efficiency and incentives for the commercialization of efficient equipment;
- stimulate the ESCOs development and consolidation;
- project implementations in the public sector: public lightning, water and sewage utilities and public buildings;
- pilot projects implementation to improve the use of electric energy in industries, commercial establishments and residences;
- marketing the concept of combating the waste of electricity at national level;
- PROCEL Annual Prize addressed to the combat of electricity waste, granted to companies or manufactures that have implemented major actions in this area;
- technical Support for the regulatory agency (ANEEL).

The following table summarizes the results obtained and the investments accomplished by PROCEL from 1986 to 1997.

	<b>86/94</b>	<b>95</b>	<b>96</b>	<b>97</b>
<b>Investments (US\$ million)</b>	31.5	15.8	19.6	40.6
<b>Saved Energy (GWh/year)</b>	1274	572	1970	1758

Saved Energy (GWh/year)				
<b>Power Plant Equivalent (MW)</b>	300	135	430	415
<b>Peak Load Reduction (MW)</b>	219	103	293	976
<b>Avoided Investment (US\$ million)</b>	600	270	860	830

Source: PROCEL / Eletrobrás 1998 Annual Report

In the accomplished investments are included incoming from RGR resource, that were US\$ 20 million in 1995, US\$ 40 million in 1996 and US\$ 90 million in 1997.

The power plant equivalent is obtained through the saved energy, considering a typical capacity factor of 56% for hydro power plants and including 15% of average losses in the transmission and distribution for the portion of energy saved.

#### VI.2 Barriers and Advantages

In the last years, during the process of analyzing results, implantation and execution of combating the waste of electricity related actions, were identified barriers whose conversions are critical factors of success and advantages that must be better explored and disseminated to society.

Barriers:

- investment pay back based on the saved energy comes only in the long-term;
- lack of knowledge, on the part of consumer, about electricity saver equipment;
- existence of a "waste culture" in several social levels of the population. As higher the social level, higher the waste;
- old architectural concepts still in use are not compatible with the energy efficiency concept;
- lack of a building code tuned with the energy efficiency techniques;
- utilities still think that fighting waste of electricity related action results only in loss of revenue due the reduction on the consuming level.

Advantages:

- reduction in the electricity consumption;
- creation of jobs and global market opportunities;
- spreading of the non waste conscience among the other society supply segments: food, building construction and fuels;
- postpone of investments in the offer of electricity;
- growth of productivity and competitiveness of Brazilian products and services vis-à-vis the world market;
- improvement of efficiency in productive processes and equipment;
- reduction in the environmental impact due to the postponement of new power plants;
- reduction in the emission of greenhouse gases resulting from fossil fuels burning in power plants, mostly in the North Region, contributing to reduce global warming.

#### VI.3 Tendencies

The New scenario of the electrical sector, with a new structure and with the private investor's larger participation, indicates tendencies for the combating the waste of energy:

- Wide scale projects implementation once considerable amount of pilot projects and energy audits have already been executed, demonstrating the viability, attractiveness and conservation potential in several segments of the consuming market.

- Reduction of PROCEL and Eletrobrás participation as a financial agent providing resources from RGR, which, according to Law 9648/98, extinction is foreseen for the end of the year 2002.
- Increasing participation of private financial agents.
- Significant utility diversification into combat to the waste of electricity related services by creating unregulated subsidiaries to provide these services outside their own territories. The trend will be for the utilities to become more sophisticated in providing services and much more service oriented.
- Use of service orientation in combat to the waste of electricity actions and other projects like cogeneration to negotiate contracts with new consumers that are passing from the status of "captive" to "free consumer". Some utilities from the South/Southeast System have already announced their intention to act in this way.
- Increase in the participation of ESCOs in performing energy efficiency projects. The ESCO can be contracted by the utility or by the consumer. In a typical arrangement, the ESCO is responsible for finding a consumer, if contracted by the utility, and achieving the electricity consumption reduction or demand reduction goal.
- Gain in popularity of "Performance Contracts" or "Shared Savings Contracts" as alternative methods of financing energy efficiency improvements. Under these alternatives the contracted part, that could be the utility or an ESCO, pay all the up-front costs and, in exchange, the contractor receives a share of the cost savings resulting from the improvements until the contract period expires.
- Participation of the Federal Government through regulation, fiscal incentives and other mechanisms to attract the private utilities investments in combat the waste of electricity related actions, seeking reach the established goals of saved energy and avoided demand.

#### VII. The Regulatory Agency Role

Perform a regulator role in a changing market like the Electrical Sector in Brazil is not an easy task. We all agree that none regulation is a utopia and that some regulation is necessary to avoid market's failure. The pressing issue is determining how much regulation can regulators afford?

When dealing with regulation, the State Agencies must be aware of some important premises:

- The public view of Regulatory Agencies has considerable hope that government regulations would serve to correct failures of the market mechanism and thereby promote economic efficiency.
- It is very common and easy to public judge the Agencies regulation actions as promotion not to the public interest but to the private interests of the companies being regulated.
- Government regulation shapes market in a variety of ways, many of them unintended. As regulators we must have additional attention to the impact of regulation on the firm itself as well on the market and do not ignore the unintended consequences.
- Regulation must works with market forces and technological progress and not against them.
- Regulators should focus more on ends than on means and do not become gridlocked by process.
- Regulation is not static. It must respond to technological innovations or changes in the macroeconomics.

Taking into consideration the premises above, the ideal regulator would try to anticipate the broader impacts of his or hers decisions. Would design policies to manipulate and guide the market forces, rather than reverse them. Would have to guard against policies that protected competitors or specific groups and would make whatever revisions were necessary to avoid regulatory lag.

#### VII.1 The Electricity Regulatory Agency

Articles 29 and 30 of Law 8987/95 describe the responsibilities of the State as "Conceding Power" in the structure of the Brazilian Electrical Sector.

To assist the execution of these responsibilities, it was instituted, through the Law 9427 of December 26, 1996, the Brazilian Electricity Regulatory Agency - ANEEL, an autarchy of the Federal Government under a special regime of operation, linked to the Ministry of The Mines and Energy, with the following competencies:

- Regulating and inspecting the production, transmission, distribution and trade of electric energy;

- mediating between industry players and electric energy consumers;
- granting, permitting and authorizing electric energy installations and services.

Executing the duties bellow:

- Guarantee just rates.
- Care for the commercial services and attendance to the consumer quality.
- Mediate the relationship of electric energy industry players among themselves and with society.
- Stimulate and ensure fair competition in the electric energy industry as well as free access to electric systems.
- Regulate and inspect aimed at furthering free competition, meeting consumer needs and providing full access to electricity services.
- Ensure electric energy supply to low income urban and rural populations as well as those living in areas of low demographic or economic density.
- Educate and inform industry players and society about energy policies, guidelines and regulation.

ANEEL has financial autonomy provided by the annual collection of the Fiscalization Tax from the utilities, and administrative autonomy where the Board of Directors deliberates under collegiate rules of procedure.

The agency started its activities on December 2, 1997, following the enactment of Decree 2,335/97, which sanctioned its structural regime.

Through the Act 296 of September 11, 1998, the Agency began a process of decentralization of its activities, celebrating agreements with statewide regulatory agencies. Until December of 1998 ANEEL had signed agreements with the Agencies of São Paulo, Bahia, Ceará, Pará and Rio Grande do Sul.

ANEEL's structure is horizontal with just two hierarchical levels working under a process management procedure.

The Agency has 20 superintendencies responsible for process and organization management; finance; social communication; concession and authorization (generation, transmission and distribution); economic studies of market; hydrological studies; fiscalization (electricity services, generation and economic); administration of the hydro potentials, computer science, administration planning, human resources, regulation (economic, generation, transmission, distribution and commercialization of the electricity), mediation and institutional relationships.

#### VII.2 Regulation and Energy Efficiency

In the last 10 years, a large number of actions of the Federal Government accomplished by PROCEL closed to the electrical sector resulted in significant values of saved energy. These actions always counted with federal resources and modest investments on the part of the utilities. The state prevailingness in the electrical sector favored this one way path between Federal Government and utilities, where the first part used to plan, indicate and finance and the second part to execute.

The Brazil's former economic situation had experienced high monthly inflation rates up to 1994. That made difficult to keep accounts of the gains resulting from the energy efficiency related actions and it didn't helped to convince the utilities and consumers investing, once the pay back rates of the projects were ridiculous if compared to the investment rates offered by the finance market.

Nowadays, the country is in a relatively more comfortable economic situation if compared with the previous situation. The country is spending efforts to stabilize the economy, trying to control inflation rates, experiencing larger private performance in sectors that before configured state monopolies and, particularly in the electrical sector, consolidating a new structure and organizational work procedure.

In this context, the ANEEL's Superintendency of Electricity Commercialization Regulation - SRC received the mission of regulating the commercialization activities, of attendance to the consumer and of the efficient use of electricity, looking for the balance among the industry players and to the benefit of the society. The larger

challenge is to transform the words of this mission in regulatory actions capable to promote feasible results of saved energy and avoided demand. Until the creation of ANEEL, the legislation that regulated the utilities performance in energy efficiency was the same that gave institutional support to PROCEL.

ANEEL's first regulatory action towards energy efficiency was the inclusion, in the new utilities contracts of concession, of specific clause that obligates a minimum annual investment of 1.0% of the operational liquid revenue in actions to combat the waste of electricity.

After this initial step, other challenge appeared: Which actions are these and, once defined, how to follow up the execution and the appropriation of its results? The answer came on July 23, 1998 with the celebration of agreement between ANEEL and PROCEL and the emission of ANEEL Resolution 242/98.

The Resolution has been issued to regulate, for the cycle 1998/1999, the foreseen investment of 1.0% of the liquid revenue, instituting the Utilities' Annual Program of Combating the Waste of Electricity. According to the Resolution, a minimum of 25% of the invested amount should be applied in actions on the demand side, which are actions close to the consuming market. The Resolution also determines a minimum investment in projects to improve the daily system load curve and a maximum amount for projects of public lightning retrofits. The determination of these maximum and minimum limits was elaborated looking forward the attendance of Federal Government's goals and to involve the final consumer with the popularization of a non-waste culture.

The agreement signed with PROCEL, aims to use the technical team and the knowledge acquired by PROCEL as technical support to ANEEL in the orientation, analysis and accompaniment of the annual programs proposed by the utilities.

The investments foreseen for application in 1999 reach the amount of R\$ 200,000.00. Of this total, 90% are originating from of private owned utilities.

For the 1998/1999 cycle ANEEL will approve to execution projects proposed by the utilities which benefit/cost relations are favorable under the society's point of view, that is to say that the resulting financial benefits of the saved energy, at least, covers totally the accomplished investment.

By September of 1998, SRC has started to analyze the projects proposed by the utilities and has set, with PROCEL, procedures to follow up the execution of the approved projects and the evaluation of their results.

#### VIII Final Comments – Opportunities and Challenges

As we could see through the former chapters, the Electrical Sector has experienced a deep transformation in its structure and working procedures. The private investor and the promises of better services and quality filled the market with expectations. Shifting our perspective to combating the waste of electricity, this new scenario will bring challenges and opportunities for the sector's agents.

##### VIII.1 Low Income Consumers

The former Electricity Regulatory Agency, DNAEE, defined low-income consumers for each one of the electricity utilities of Brazil by the Act 437/95. The definition was based on criteria informed by the utilities that differed from each other.

Low-income consumers are benefited with lower energy rates and, in some utilities, the municipalities pay their energy bills as a social help program. So, in most cases, the criteria used by the utilities to define low-income consumers were based more in political than technical terms.

After the privatization process, the utilities concentrated efforts for its consumers' regularization through the installation of electricity consumption meters, combating fraud and electricity deviation. The regularization actions differ among the utilities; having been verified different strategies. Some, as alternative to the conventional meter, use new technologies that hinder the combating swindles while other, through the common meter, accomplishes an intensive regularization work seeking the reduction in the number of consumers not

regularized vis-à-vis the quickly growth of residential market. As an immediate benefit the utilities look for the recovery of its revenue and the remuneration of its investment. It is also verified other benefits as the reduction in energy losses. Studies already accomplished indicate a reduction in the consumption of energy of about 40 kWh per month for each regularized consumer, therefore when these consumers start to pay the energy bill they reduce its consumption for a level below what were habituated to consume. Of the consumer's point of view, with the regularization he has to pay not only the investment accomplished by the utility, as well as a more expensive energy bill (in the cases of energy deviation, pay for a bill that never figured in his or hers budget before). Such situation carries to a permanent risk of growing debt, once the larger number of consumers in irregular situation is of low income.

To minimize this problem the utility could associate programs of energy efficiency with the consumers regularization related actions. Before regularization, the utility could perform an audit in the consumer residence and apply conservation measures for free that would help to reduce consumption and, consequently, energy bill to values compatible with his or hers social level.

#### VIII.2 Public Fund.

Up to 2002 Eletrobrás will still have the resources of RGR to provide leverage for the projects of energy efficiency. After this a fund formation could be a solution. The resources of the fund could make possible actions of energy efficiency, projects addressed to renewed sources, environmental administration, incentives to the agents and consumers and support energy efficiency programs with low income consumers. Particularly, in this last program type, becomes fundamental an action from the Regulatory Agency in order to determine a low-income consumer definition, based in the consumption, social position and regional location.

A percentage from the transmission fee could be taken to form the monetary basis of the fund. This resource would be administrate by a committee, with participation of the Federal Government and the utilities, which be responsible to set an action plan to distribute the resources, always looking to reach the goals of energy conservation and avoided demand established by the Federal Government.

#### VIII.3 Incentives to the Utilities and Consumers

The private owned utilities must find energy efficiency programs profitable to decide invest and perform them. In other words the necessary criterion for profitability is that the average costs to execute the program is equal or less than the marginal costs of expansion. In other words, to conserve a kWh must be more profitable than to expand the electrical system to supply this kWh.

This condition implies that few programs would pass this test in practice, even considering the benefits that the program could bring to the utility's public image.

This fact seems to justify government intervention by providing additional incentives to the utility in order to perform energy conservation programs. According to survey realize in the United States three types of incentives were identified:

- **Shared Savings:** The utility is allowed to retain a share of the amount that the consumers save, due to the program, when paying his or hers electricity bills. This is the most common incentive and depends only of an agreement between the utility and the consumers.
- **Mark-Ups:** The utility is allowed to include a fraction of the investments associated with energy conservation in the rate base. Not the entire costs are allowed to enter the rate and the fraction is function of each technology used in the program. Its is a very delicate issue, considering that the rate basis is regulated. The action took by the utility must cover a well determinate area or consumer class, otherwise the costs may relay on non-participant consumers. A regulatory action is always necessary.
- **Bonus:** This kind of incentive rewards the utility for each portion of energy saved and may be performed in three different ways: by government financial aid to reduce the programs' average costs and reach a favorable situation such as described above; with fiscal incentives and taxes reduction to the utility or by conceding awards to the utility to enhance its public image.



On the other hand, energy efficiency can be used by the utility to gain new markets and maintain good relationship with the consumers in a competitive environment.

In this situation improve the consumer's decision is fundamental and a way to this is by the utility providing incentives:

- **Audits:** Provide on site energy audits with detailed reports, reduces the cost for the consumer of monitoring electricity costs.
- **Information:** Given by brochures, home energy rating, hot lines, videos, courses, etc. Reduces the investment costs considering that the consumer will skip the cost of acquiring necessary information.
- **Appliance Rebates:** Paid for the utility for efficient refrigerators, freezers, air conditioning, motors, lightning, etc. Subsidizes investments in efficiency and lets the efficient appliance's prize on he same level of standard ones.
- **Payments for kWh Saved:** Pay for energy saved, often rely on ESCOs or particular segments, like commerce and industry, and may be offered tied to a certain minimum standard of efficiency.
- **Rate Reductions:** Lower electricity tariffs to comply with particular efficiency standards.
- **Installation:** Installing the conservation measures for free by the utility represents a gift to the consumer that improves efficiency.

#### VIII.4 ESCOs – Energy Service Companies.

An emerging market for ESCOs in Brazil can be foreseen. The ESCO should perform the role of connection agent between the new private utility owners and consumers. As described in chapter V some utilities can contract their Energy Conservation Program to ESCOs that, in a typical arrangement, is responsible for finding customers within the utility's service territory and achieving the energy conservation goal. The utility pays the ESCO on the basis of performance and avoids costs keeping a reduced own team just to accompany and check the results obtained by the ESCO.

Other model is the third-party bidding. In this arrangement the utility solicits in an auction proposals for projects to achieve specified amounts of saved energy and avoided demand. Eligible bidders will develop projects with utility customers on an energy performance contracting or shared savings basis.

Municipalities may find in the ESCOs a good partner to help reducing its energy costs. Also in a basis of performance or shared savings, the Municipality contracts the ESCO to develop audits in public buildings, public lighting, water and sewer and apply the resulting actions to reduce energy consumption. The ESCO can also provide technical advisory to obtain resources close to banks and the financial market

As can be seen the new scenario for energy conservation in Brazil keeps good opportunities to ESCOs, but must be considered that the private and foreign investor is more concerned with profits and results than the state owned utilities used to. To achieve and consolidate its position in the market, ESCOs must invest in well-trained personnel, state of art equipments and technics and divulge the results to rise its name and became well known.

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The opportunities and challenges above described and many other that could appear in the new scenario of the Brazilian Electrical Sector will demand actions from the Regulatory Agency and participation of society. More than the "invisible hand of the State", regulators are society servers and must be aware that his or hers actions can affect the market structure and behavior of firms and that it is a very delicate issue. Further more, Brazil is passing through a period of concerning about economic stability and this may drives attention to other issues than energy efficiency.

Energy efficiency actions may produce substantial benefits for the Nation – now and in the future – in terms of economic growth and a clear environment, but also demands investments by the private sector and by the Government to achieve solid results. Regulators must be aware of all those issues and let the market acts knowing the right time to intervene in order to guide the energy efficiency in Brazil through a right and fair path.

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