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Distribution System Planning for a Competitive Market in Brasilia

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During the last 3 years, the Brazilian electricity industry has undertaken a major and deep restructuring process, started with an important privatizing program. The main steps in this process are the introduction of competition in generation, the deverticalization of utilities, permitting open access to the transmission and distribution grid, and the introduction of retail competition.

Moving towards competition, the distribution utilities, usually at government level, must adapt themselves to this new competitive environment. For example, they must unbundle their services, e.g., create a new independent distribution (grid) company. In parallel, utilities must enhance their commercial activities since they no longer have a service monopoly.

In the old model, a utility's energy supply was ensured by means of supply contracts signed with the government energy company supplying the corresponding region of Brazil. Two coordination groups, organized at the federal level, were responsible for the generation planning (GCPS) and for the operation of the system (GCOI). Inside these groups, planning and operational decisions were made with close cooperation among all government companies and utilities.

The new model, however, primes for competition. The regulatory framework is established by ANEEL (The Brazilian National Commission for Electrical Energy) and executed by a system operator (ONS). Likewise, the introduction of competition in generation has led to the creation of an energy market (MAE). In order not to expose the utilities and consumers to the volatility of prices that may occur following such a dramatic change, an 8-year transition period has been established. During this transition period, utilities will gradually be exposed to and must adapt themselves to the new competitive environment.

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Focusing on this 8-year period (1999-2007) of transition from the present cooperative model to the new competitive model, consideration must be given to alternative solutions available to replace the old supply contracts in the energy portfolio of a distribution utility such as CEB, the company with the present distribution monopoly in Brasilia, the capital of Brazil. The effects of the new policy on open access and retail competition must be studied and an economic assessment of all supply alternatives made, showing how the price of energy will be affected by different scenarios.

Cooperative Model

During the past decades, the Brazilian electricity industry developed under a government owned monopoly. At the federal level, the country has been divided into four energy companies charged with the production and transmission of energy. Generally, they sell their production to local utilities. However, depending on the supply voltage (i.e., 230 kV and above), they may directly supply large consumers.

At the distribution level, there are many different utilities whose concession areas coincide with the administrative boundaries of the local government. Usually, they buy the energy they need to meet the market from the government energy companies. However, many of them possess their own hydro generation and, occasionally, thermal power plants.

In this model, the energy market requirements are met cooperatively. All of the energy companies benefit from this monopoly. The energy supply and demand of all companies are treated as one and the goal of dispatch is the overall optimization of the system. Finally, the prices are fixed through a federal order and do not reflect market forces. The values are bundled, i.e., energy production and transmission costs are not viewed separately.

Competitive Model

The state monopoly and cooperative model no longer exist. The Brazilian electricity industry is now moving towards a competitive model. Without describing this new model in detail, some aspects of it are of vital importance in assessing the appropriate actions of a competitive utility in a free market.

Initial Contracts

During the transition period, the energy supply of the distribution utilities is ensured by special contracts (i.e. Initial Contracts). They guarantee adequate supply to the energy market at present contractual conditions until the year 2001. That means that the utility will continue to receive the energy necessary to supply its market (except for its own generation). In 2002, the level of 2001 is guaranteed, therefore requiring the utility to look for a new energy supply to meet its market growth. Starting in 2003 the guaranteed amount will be linearly reduced until 2006. The difference between the contractual amount and the market requirements of the utility must be provided by either new generation plants, new bilateral contracts or short term purchases on the open market.

Open Access and Transmission Pricing

ANEEL Order 459 sets the conditions for open access to the transmission and distribution grids. It also determines the costs to move any amount of power over the entire system as well as the costs of the associated losses.

Competition in Retail Sales (Commercialization)

As a consequence of the introduction of competition in commercialization, some consumers (e.g., above 10 MW) are now free to choose their energy retailer. For economic and administrative reasons and the volume of their energy contracts, large consumers are more likely to consider this option. Utilities are aware of this and will take steps to keep their present customers. Moreover, new contracts must take into account the costs associated with the utilization of the distribution grid (i.e., the wire) of the local distribution company.

CEB Case Study

During the transition period, the amounts of energy ensured by the initial contracts with the distribution utilities will be gradually reduced. As a consequence, they must replace them with other sources of energy. Considering all the alternatives is a complex matter that depends not only on the available energy sources (present and future), but also on the strategy adopted by the utility to supply its energy market.

As part of its new strategy for the competitive model, CEB became a partial owner of two new hydro plants under construction. It owns 35 percent of the Queimado Plant and 20 percent of the Lajeado Plant (Figure 1).

Presently, CEB receives most of its energy from Furnas and Itaipu. It owns a diesel thermal plant and a hydro plant. The two hydro plants now under construction should come into service in 2002. Also, there is the option of constructing a gas pipeline and a gas thermal plant by 2005.

The Market Division of CEB forecasts a market growth of about 5 percent a year for the period 1999-2007 (Figure 2).

With the open access policy, the cost of moving energy from one point of the system to another is unbundled from the cost of energy production. These costs will increase the price of the energy delivered to the utility system and will obviously affect any energy contract. For example, Order 459 sets the transmission cost from FURNAS to

CEB at \$0.79/kW (i.e., \$1.69/MWh assuming a 65 percent load factor). Now suppose that the Serra da Mesa Hydro Plant (Figure 1) owner is willing to sell energy to CEB, Assuming the same load factor, the transmission cost from this plant to CEB would be \$6.43/MWh. Since CEB now pays about \$36.00/MWh for the energy it buys from FURNAS, the new producer must offer its product at least 19 percent cheaper to become competitive.

The total load of a category of CEB's consumers (i.e., supplied at 88 to 138 kV) is 16.7 MW and 57.1 MW during peak and off-peak hours, respectively. If this load profile repeats every day, its monthly energy consumption will be 37,5 GWh. It is worth noting that this value corresponds to an average power consumption of 52 MW, which represents about 11 percent of the total average load of CEB (Figure 2). Based on the tariffs being used by CEB, these consumers' invoices total \$1.67 million per month. If the market price of energy is \$40/MWh, it would cost CEB \$1.50 million to acquire the energy to supply these consumers. In the concession area of CEB, Order 459 fixes the cost of distribution as \$2.41/kW per month. Thus, the profit margin for these consumers is \$170,000, of which \$137,000 corresponds to the grid remuneration and \$33,000 to commercialization.

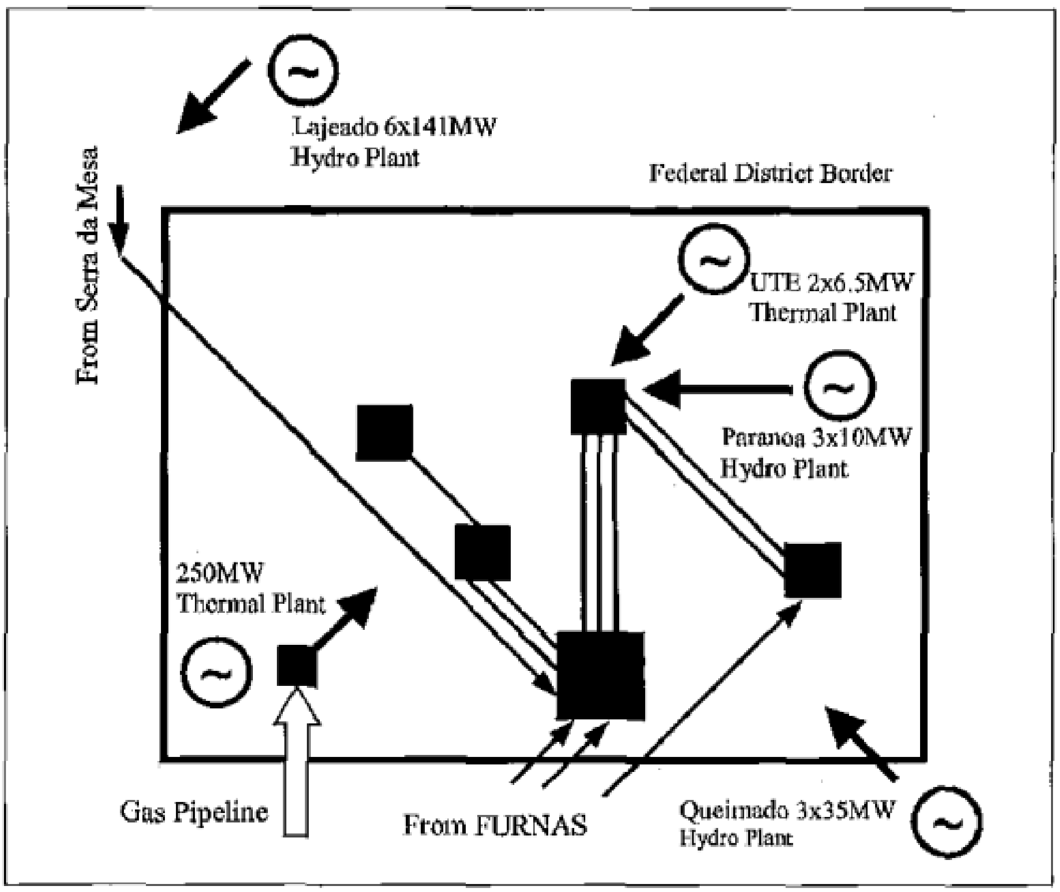

Figura 1 - Main grid of the present Brasilia system and future supply alternatives considered in the study

Now consider these consumers being supplied by a new retailer. Based on the energy price and the distribution cost, the new retailer would spend $ 1.5 million for energy and $ 137,000 for the grid utilization. Considering that its tariffs might at most equal those of CEB, the new retailer has only a narrow margin of 2 percent ($33,000) to make an attractive proposal to the consumers.

From this analysis, it is hard to believe that a consumer or group of consumers will change suppliers for such a narrow margin. On the other hand, the market price of the energy is the major component of consumer cost. If the new supplier has access to a cheaper source of energy, it can expand its margin and would be able to propose more attractive prices to the consumers. So the price of energy in the developing free market is a key issue in this matter and must be given due attention.

CEB's energy supply alternatives are as follows:

• **Initial Contract (IC).** As the amounts of energy ensured by the initial contracts reduce to zero, CEB may replace them with energy contracted from FURNAS through bilateral contracts. This alternative is quite attractive, since both FURNAS and CEB will be interested in selling and buying quantities that differ from the initial contract.

• **Itaipu Binational (ITA).** The contract with Itaipu will not be affected by the restructuring process, since Itaipu is a Brazil-Paraguay joint project. The study considers the values as they are presently established in the international contract.

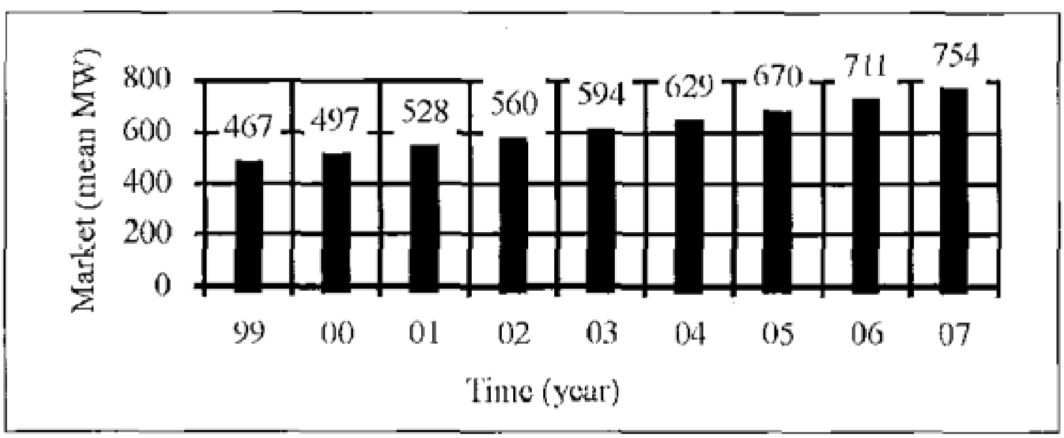

Figura 2 - Market forecast for the period under study

• **Paranoa Hydro Plant (UPA).** This hydro plant has an installed capacity of 30 MW (i.e., 3x10 MW) and a firm energy of 13 mean MW. Since it was constructed over 30 years ago, most of its cost has been recovered. Therefore, it produces energy at a low cost (i.e., $10/MWh).

• **Diesel Thermal Plant (UTE).** This diesel thermal plant has an installed capacity of 13 MW (i.e., 2 x 6,5 MW) and a firm energy of 8 mean MW. In this study, its energy production was considered at $10/MWh, which does not really correspond to its production cost. In fact, this plant is considered as a technical reserve for the Brazilian Inter-connected System, and it only generates during emergency situations. As compensation for maintaining it available as a reserve, CEB receives the same amount of energy (i.e., 8 mean MW) from other hydro plants in the interconnected system.

• **Queimado Hydro Plant (QUE).** CEB is an owner (i.e., 35 percent) of this hydro plant, planned to have an installed capacity of 105 MW (i.e., 3 x 35 MW) and a firm energy of 61 mean MW. Presently under construction, its generators will come into service during 2002. In this study, its energy price is considered to be $40/MWh, including the trans-mission price.

• **Lajeado Hydro Plant (LAJ).** CEB is an owner (i.e., 20 percent) of this hydro plant, planned to have an installed capacity of 850 MW (i.e., 6 x 141.7 MW) and a firm energy of 539.3 mean MW. Presently under construction, its generators will come into service during 2002. In this study, its energy price is considered to be $40/MWh, including the transmission price.

Table 1. Balance of the supply alternatives (mean MW)

				Self-Production					
Year	Market	IC	ITA	UTE	UPA	QUE	LAJ	GAS	TBC
1999	467	340	106	8	13	-	-	-	-
2000	497	371	105	8	13	-	-	-	-
2001	528	403	104	8	13	-	-	-	-
2002	560	403	93	8	13	6	65	-	-38
2003	594	302	91	-	13	21	102	-	65
2004	629	202	92	-	13	21	102	-	199
2005	670	101	90	-	13	21	102	75	268
2006	711	0	88	-	13	21	102	150	337
2007	754	0	88	-	13	21	102	150	380

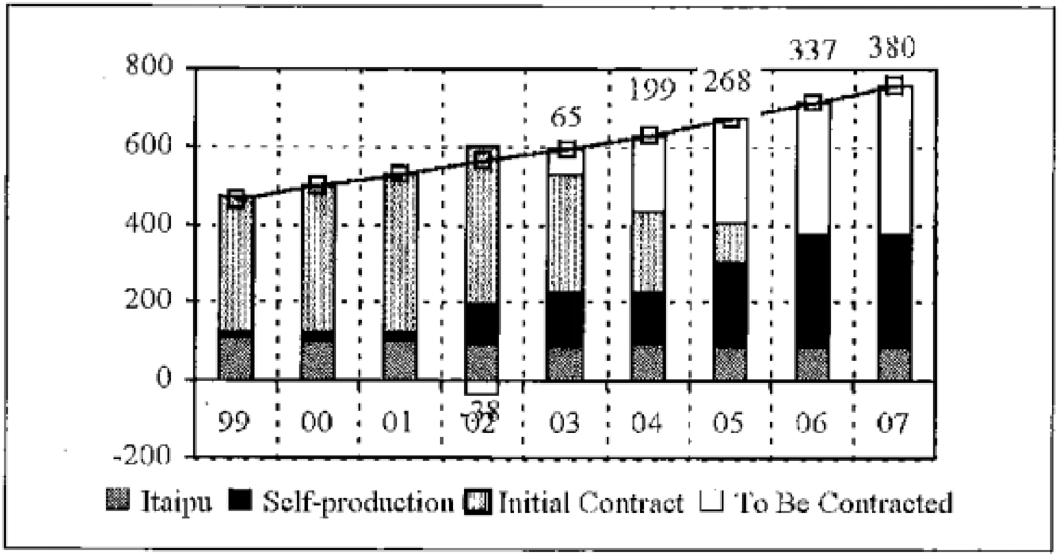

Figura 3 - Market and balance of energy with the gas supply alternative

Table 2. Energy prices for each supply alternative						
	Energy Supplier					
	IC	ITA	UTE	UPA	QUE	LAJ
$/MWh	36	38	10	10	40	40

• **Natural Gas Thermal Plant (GAS).** The study considers the construction of a gas pipeline from Campinas (SP) to Brasilia and the installation of a thermal plant with an in¬stal led capacity of 250 MW and a firm energy of 150 mean MW.

If we consider all the alternatives to supplying the market, it is possible to determine the amounts of energy to be contracted (TBC) by CEB either through bilateral contracts or in the short term market (Table I and Figure 3).

Figure 3 shows the relative amounts of each supply alternative. It is interesting to note that CEB has a surplus of energy only in 2002. From 2003 until 2007, CEB has to contract increasing amounts of energy to supply its market.

Economic Assessment

In order to determine the value of the energy to CEB, simulations have been carried out based on the energy prices of the portfolio composed of the energy suppliers considered above (Table 2).

At present, it is difficult to make a precise estimate of the price at which CEB will buy the energy necessary to cover the deficit expected in the coming years. Therefore, the study was carried out considering three different prices for this energy: $35, $40, and $45 per MWh.

Without the Gas Supplier

Since the gas alternative still has many uncertainties associated with it (e.g., construction of the gas pipeline and the gas plant), in the first part of the study the prices of the energy in the portfolio have been determined without considering this supplier available. Table 3 shows the energy cost for CEB for each year.

It is dear that the three scenarios have essentially the same price until 2003. This is quite evident, since until this year, CEB maintains about the same contractual conditions. From 2004 to 2007, the prices increase accordingly to the price of the new contracted energy. The greater this price, the greater the price of CEB's energy portfolio.

Table 3. Energy price for CEB without the gas alternative

Year	Energy Price ($/MWh)		
	35	40	45
1999	35.27	35.27	35.27
2000	35.30	35.30	35.30
2001	35.33	35.33	35.33
2002	36.01	35.60	35.19
2003	36.52	36.92	37.32
2004	36.30	37.71	39.12
2005	35.70	37.47	39.24
2006	35.16	37.25	39.34
2007	35.16	37.38	39.60

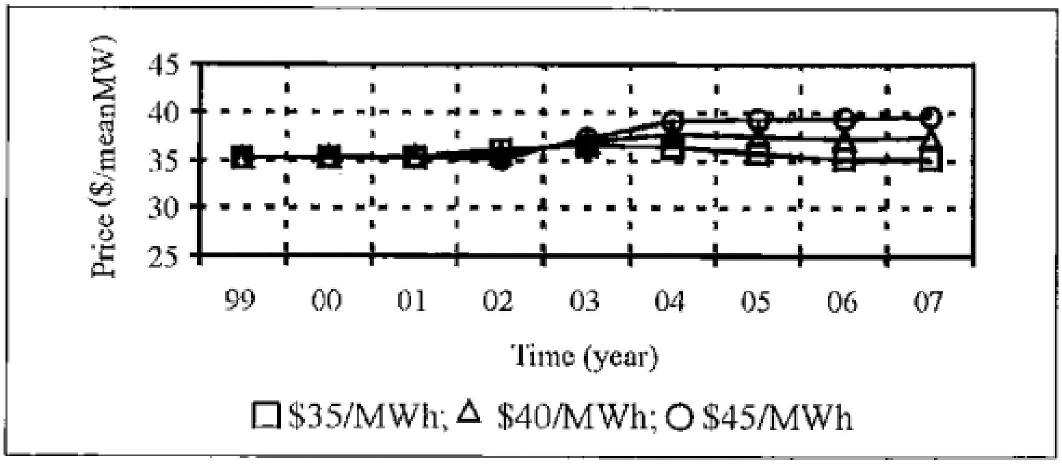

Figura 4 - Energy price without gas supply

Table 4. Energy price for CEB with the gas alternative			
Year	Energy Price ($/MWh)		
	35	40	45
2005	31.79	33.56	35.33
2006	27.70	29.79	31.88
2007	28.03	30.25	32.47

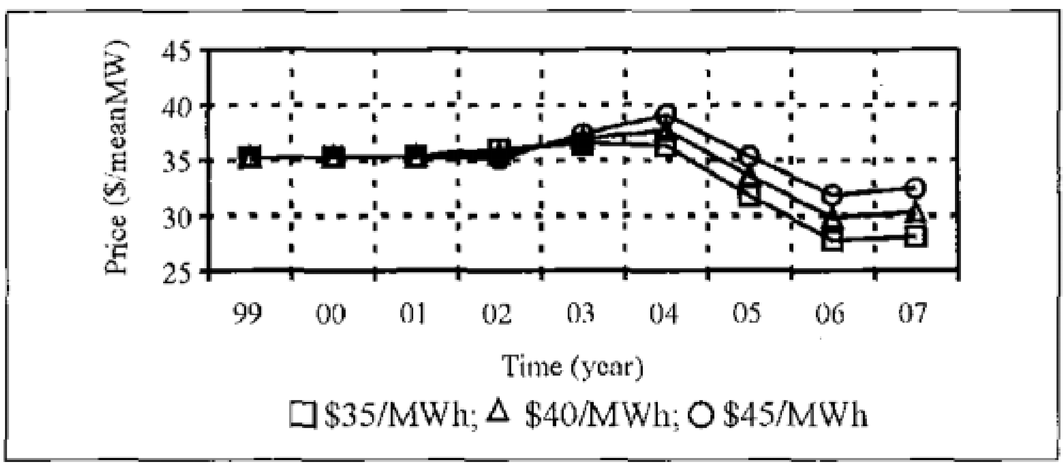

Figura 5 - Energy price with gas supply

From an analysis of Figure 4, one can see that the strategy of CEB in becoming a party of new hydro plant projects limits the variations in price of the CEB energy portfolio to a narrow range, even considering a large variation in the prices of energy in the future contracts.

With the Gas Supplier

In order to determine the influence of the gas supplier alternative, the second part of the study considered the cost of this new supplier in the energy portfolio. Considering the construction of the gas pipeline and the gas plant, the latter will start commercial operation during 2005 (i.e., 75 mean MW) and will reach full operation in 2006 (i.e., 150 mean MW). Preliminary studies estimated that the price of the energy produced by the gas plant will be around $32/MWh and this was the value adopted in the study.

Comparing Table 4 with the corresponding values of Table 3, one verifies that the values considering the gas supplier are lower. This is quite evident, since part of the energy to be contracted has been supplied by a cheaper energy source. It is worth noting that the gas alternative is even cheaper than the lower price assumed to buy the energy (Figures 4 and 5).

Conclusions

The Brazilian electricity industry restructuring process has many important consequences for the energy market and utilities. Utilities must make a major effort to adapt themselves to this new competitive environment. Retail competition is a key issue in this process. If utilities do not become competitive rapidly, they risk losing part of their market to other agents acting in this environment.

Although prices still contain a large degree of uncertainty, strategic decisions must be made right now for the utilities to compose their energy portfolio and to ensure hedging to its prices. In this context, natural gas seems to be an attractive solution, especially if the utility has access to a nearby gas source.

In the case of CEB, simulations of price considering the strategic decisions already made showed that the prices of energy are limited into a narrow range.

Acknowledgments

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For Further Reading

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