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Theory and Operation of a Modern National Economy

Some Regulatory Tools to Deal with Competition in the Brazilian Electricity Sector

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"I grew up in the world of planning and marginal cost pricing. I know how to make tariffs and calculate rates of return. I know how to choose the next supply source and how to estimate demand. I can do cost allocations. But in this new world of competition, I seem to need to know about markets and contracts and risk allocation, and how to structure an open transmission system. Most of all, I need to know whether I want the industry that I regulate to be in this new world."

(A utility regulator said)

(In: Hunt – 1996)

SUMMARY

Presentation	1
Introduction	2
1. Key Issues in the restructuring	3
1.1 Industry structure	3
1.2 Competitive segments – Production and Retailing	5
1.3 The Electricity Market	7
1.4 Transition period	9
1.5 Open Access to regulated segments – Transmission and Distribution	11
2. Regulatory Issues	13
2.1 Regulating market and competition	13
2.2 Transmission Services	14
2.3 Distribution Services	15
2.4 Market Power	18
3. Performance Based Regulation	20
4. Conclusion	26
References	29

Fall 1999 Minerva Course
Theory and Operation of a Modern National Economy

Final Paper

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**SOME REGULATORY TOOLS TO DEAL WITH COMPETITION IN THE
BRAZILIAN ELECTRICITY SECTOR**

Presentation

Restructuring the power sector, the Brazilian electricity regulator now faces the challenge of providing an adequate economic regulatory framework in order to incentive efficiency, improve quality of services and energy conservation, attract new investments, avoid monopolistic competition and assure fair prices and tariffs for the customers.

The aim of this paper is to analyze the different economic regulation that can be applied to each segment of the electricity industry, with emphasis in performance-based regulation as a way to achieve better quality in the services and avoid wasting of energy.

Introduction

The Brazilian Power Sector restructuring has been pushed by privatization. At the first moment government decided to privatize its power companies and to promote the privatization of the States companies. After a first and non-effective change introduced by the Concession Law in July 1995 (Law # 9.074/1995) government started privatizing its distribution companies. The two most important distribution companies owned by Federal Government were privatized in 1995. One year later, in 1996, it was hired a comprehensive study to modeling the power sector reform. The regulatory agency was created by the end of 1996 but the most important guidelines in terms of economic regulation of distribution companies were already defined and frozen in the terms of Concession Contracts that were signed with the utilities after privatization in 1995. The main aspects regarding competition, electricity market and coordination of operation were defined in 1998 in order to privatize generation companies.

The first part of this paper describes the main aspects that have already been defined in Brazilian power sector reform. The second part will describe the aspects related with economic regulation in each segment of the power industry and the third part will discuss some fundamentals in terms of regulation with special emphasis in performance-based regulation.

1. Key issues in the restructuring

The reform of the Brazilian power sector started in July 1995. The Concession Act Law 9,074, of July 7 1995, besides defining the main aspects of concessions awards, introduced the first steps toward competition. This Act created the Independent Power Producer, stated the right of choice for large consumers and established the main principles to open access. Others important aspects concerning the sector reform were introduced later. By the end of 1996, the Congress (Law 9,427, of Dec 27th 1996) created the Brazilian Electricity Regulatory Agency – ANEEL that was effectively implemented by the end of 1997. The third important step in terms of legal framework was taken in May 1998 by the Law 9,648, that stated the Wholesale Energy Market – MAE, created the Independent System Operator – ONS, instituted free purchasing of power for the distribution companies, created the retailer¹ and defined the transition period for competition.

To better understand the reform it is worth to analyze some aspects in terms of industry structure, ownership, competition and regulatory framework.

1.1. Industry structure

Traditionally the Brazilian power sector, as in other countries, had vertically integrated companies providing all the services in electricity industry. Most specifically, the production and long distance transmission activities, being capital

¹ Retailer is a new agent that can operate in the electricity industry just buying and selling energy. It doesn't need to own or build any facility such as generation plant, transmission lines or distribution network.

intensive, were more concentrated in four Federal companies² and a few state companies³. These companies had monopoly to build all generation facilities in their area, except in the States where there was a strong electricity company. In this case, the Federal Company was responsible to build the new plant only if it was on the border between two States.

The distribution activity was concentrated in state owned utilities in each State of Federation, with a few private owned utilities. These utilities provided the distribution services as well as the purchasing and retailing of energy and, in some cases, they built generation and transmission facilities.

One of the main pillars to introduce competition is the separation of activities⁴ in order to give more transparency to the market, avoid market power and information asymmetries, and to regulate the monopolistic activities while deregulating the competitive ones.

The electricity industry is being divided in four segments. Generation and Retailing are being deregulated and becoming competitive activities. Transmission and Distribution, considered as natural monopolies, remain as regulated activities.

The Federal companies, as well as some state companies, are being separated in transmission utilities and generation companies before privatization. Not only the vertical separation is in course, the generation plants are also being restructured in smaller companies in order to avoid too much market power in one company and promote more competition.

² Eletrobras is the Federal holding company and had four regional subsidiaries: Eletrosul, Furnas, Chesf and Eletronorte. All of them own generation and major transmission facilities in their regions.

³ More notably Cesp, Copel and Cemig

⁴ Also called unbundling

1.2. Competitive segments – Production and Retailing

The creation of the Independent Power Producer – IPP, in July 1995, by the Law 9,074, was the first step to deregulate the generation activity.

The independent power producer is considered to be the legal entity, or group of companies joined in a consortium, which receive authorization from the regulator to produce electric power destined to commercialization of the energy produced, on its own account and risk. The independent power producer is subject to specific operational and commercial rules, with compliance with the provisions of the law or the authorizing act.

The tendency now is that all new generation plants will be considered as IPP, which means that they can sell energy to anyone in conditions freely negotiated, without any kind of interference of the regulator. In addition, the Law 9,648, of May 1998, gave permission to the regulator to change all generation facilities that are being privatized to IPP regime. This means that almost all generation will be completely deregulated by the end of privatization process. It could be expected that total deregulation of generation will be permitted in the near future. However, this total deregulation depends on a new Law that gives permission to regulator to change the regime of the existing power plants that are not being privatized.

The activity of buying and selling energy, known as retailing, traditionally performed by distribution utilities, is now considered an independent segment. Several new firms have already been authorized by the regulator to operate as

retailers to compete with existing distribution companies and Independent Power Producers. The main roles of this new segment will be to aggregate producers or consumers and to manage some risks that others agents are not willing to take.

Despite they are not being obligated to divest its generation, transmission or retailing activities, distribution companies have to separate their accounts in a standardized way defined by the regulator and must provide distribution services to all consumers in a non-discriminatory basis.

The competitive market is composed by large consumers, called free consumers, that have the right to choose their suppliers: a producer (IPP), a retailer or even another distribution company that operates as retailer in another region. The existing consumers with demand of 10 MW and up connected at 69 kV and above, as well as new consumers above 3 MW, are currently considered free consumers. These limits are temporary and will be reduced to 3 MW for the existing consumers in July 2000. The regulator can define further threshold reductions after July 2003. In fact, the regulator has already announced that the tendency is to promote total competition in all levels of consumption. This means that the distribution companies will loose the monopoly to sell energy for the non-competitive segment of market - the small consumers, called captive consumers. On the other hand, they will remain with the exclusive right over the distribution activity.

As counterpart for the monopoly of delivering electricity for all consumers in a given region, the Distribution Company is considered as the supplier of last resort. This means that it has to act as retailer, buying energy in order to guarantee

that all consumers in its region will be served even if they are in the competitive segment of the market.

1.3. The Electricity Market

After reform, the electricity market in Brazil will be predominantly free and competitive. Large consumers, retailers and distribution companies can already choose their suppliers, no matter where they are located. Purchasing of energy will be made at least in two manners: bilaterally contracting or in the Spot Market.

- **Bilateral Contracts**

Bilateral Contracts between producer and retailer or consumer, or between retailer and consumer, will be agreed by parties concerning terms, price, duration, point of delivery, guarantees and other conditions, in a private environment. These contracts don't need to be approved or even registered by the regulator and will serve as a financial instrument to hedge both parts against fluctuations of spot price. In case of rationing, these contracts do not give any kind of preference on energy for the buyer. All the consumers in the region under rationing will be affected and will pay a higher spot price. Those consumers or retailers who have contracts to buy energy will be hedged against the spot price. In this case it is the producer that will lose the opportunity to sell energy for a higher price.

Power Purchase Agreement – PPA is a kind of long-term bilateral contract that is essential to make possible new investments in generation as a way to reduce market risks to investors. The remaining question is whether the distribution companies or retailers will bear the market risk. However, considering that

distribution utilities are the suppliers of last resource and that they have a portfolio of contracts, this risk can be considered as bearable. After all, they can argue to the regulator that the cost related with these contracts results from their role as last resource suppliers and get compensation in regulated tariffs.

A general rule defined by the regulator is that every retailer, including distribution companies and producers, must have at least 85% of its energy sales covered by bilateral contracts purchasing energy with duration beyond two years. This measure aims to avoid overexposure to spot price and protect the consumers. At the same time, it pushes distributors into signing long term contracts, giving better conditions for the development of new generation projects.

The only bilateral contracts that will be under supervision of the regulator are those agreed between distribution companies and their suppliers. In other words, the distributor is free to choose its supplier and define the price and conditions of energy purchased but it has to follow some rules to pass these prices on to captive customer.

- **The Spot Market**

Producers, retailers and free consumers will need to buy or sell non-contracted energy resulting of differences between the energy contracted and that actually produced or needed. These differences will be cleared in a spot market in a multilateral trade mechanism that will define the spot price of energy in a half-hourly basis.

All the energy produced by generators and all the demand for energy by the consumers will be considered to define the spot price rather than just the

differences cited above. So the spot price will reflect the short run marginal cost to produce energy at each time and will represent the match between supply curve and demand curve.

If all agents, producers, retailers and large consumers could present their willingness to produce or to buy energy in a bidding process, this mechanism would operate as a perfect market where the price would be set at the point where supply curve and demand curve meet.

The Brazilian Electricity Market will be operated by the Wholesale Energy Market Agent – ASMAE. Taking into consideration the strong predominance of hydro plants, several of which in the same river or cascade, the power pool has to be cost-based. This means that the hydro producers will not be given freedom to bid their prices and willingness to produce. All hydro plants will be coordinated by the Independent System Operator – ONS who will follow an optimization model that simulates the entire interconnected system behavior in the next 5 years. In this model of power pool, the economic dispatch is determined based on models run centrally by a dispatch center which receives information about costs and operation conditions of all agents participating in the pool. The marginal cost of producing energy by a hydro plant reflects the cost of future rationing of energy.

1.4. Transition period

- **Initial contracts**

To avoid turmoil introducing competition in electricity, a phase-in period was defined. For this period the regulator defined both prices and volumes, for the contracts that were to be signed between generators and distributors, called Initial

Contracts. These contracts will lie in force until the end of 2005, but the amount of energy contracted for the years 2003, 2004 and 2005 will be based on the 2002 amount reduced by 25% each year. The figure 1 below illustrates the volumes of energy under Initial Contracts and contracted in the market.

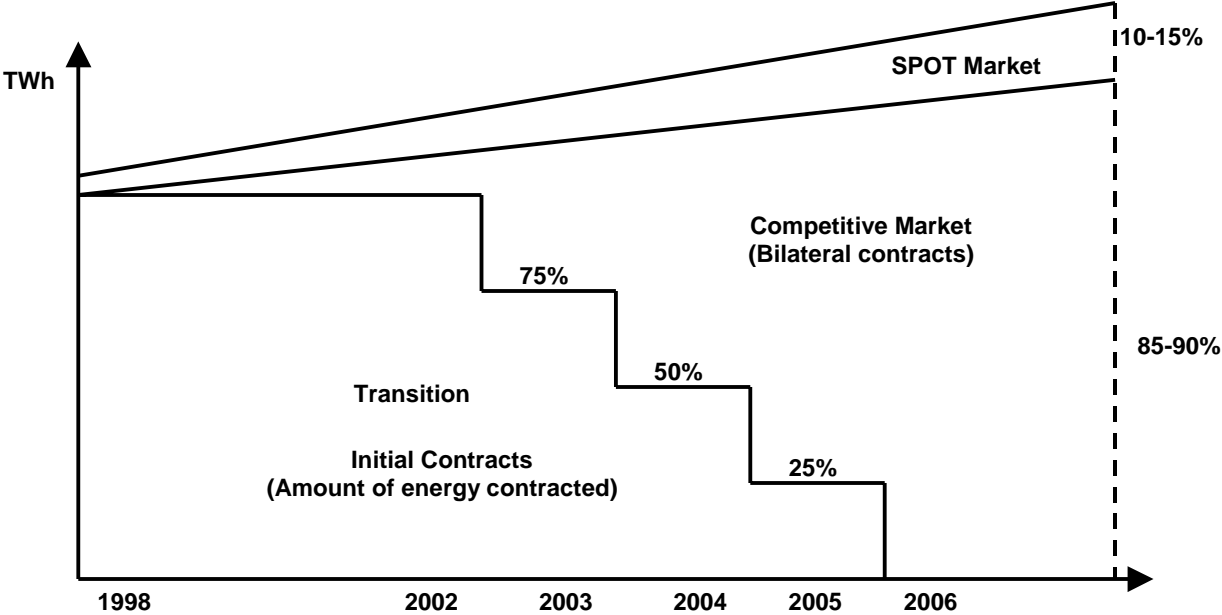


Fig.1: Phase-in period before total competition

- **Prices or Tariffs**

The prices of the Initial Contracts were set by the regulator in order to avoid sudden rise in electricity prices for the final consumers. This means that the initial prices for generation could be less than a fair price or the marginal cost for a new power plant. However, considering that this price (or tariff) does not apply to new projects, it is expected that the market will not be distorted and the consumers will pay more for the additional need of energy.

1.5. Open Access to regulated segments – Transmission and Distribution

- **Main principles**

To effectively promote competition in electricity it is essential that the monopoly segments, transmission and distribution, could be used by all participants in the market, without restriction or discrimination. This is the fundamental issue in a competitive environment.

In the Brazilian system, the transmission facilities are owned by several companies that are being restructured to be exclusively transmission companies. To coordinate the transmission system the solution was the creation of an Independent System Operator – ISO (Operador Nacional do Sistema - ONS) that will provide transmission services on behalf of transmission companies. All the users (generators, distributors, retailers, and large consumers) will contract with ONS the conditions to use the grid in accordance with the provisions of the regulator.

The main principles in the regulation of open access to transmission and distribution are:

- assure non-discriminatory access for all users;
- guarantee for transmission and distribution companies and their shareholders a fair return on investments;
- encourage new transmission projects;
- promote rational use of the systems;
- reduce costs and tariffs to use the systems.

As the distribution companies remain operating in competitive segment (retail), both the access tariffs and the energy prices to captive consumers must be regulated; otherwise there will be an asymmetry between competitors. The distribution company could overprice the access in order to reduce competitors margins. Whether it distorts competition depends very much upon the regulation of access terms.

- **New entrants**

To promote new transmission projects, what is basic for ensure system reliability, without any restriction for new entrants, it was conceived a mechanism where the new transmission company will receive a guaranteed revenue disregarding the flow of energy that passes through the new transmission line. The concession to build and operate the new transmission project will be awarded to the company that asks the minimum revenue to do it. The users of the transmission system as a whole will pay the tariffs established by regulator. All the payments made by all the users must be sufficient to pay all the transmission companies and the ISO costs. If any difference results at the end of exercise, it will be compensated in the next exercise.

2. Regulatory Issues

2.1. Regulating market and competition

- **Market Rules**

Production and retail of energy are competitive and deregulated segments of electricity industry. The rules that must be followed by agents in the Wholesale Energy Market are being discussed and established by the agents, without interference of regulator. These rules have to be approved by the regulator that will verify if they are fair to consumers and all the agents.

- **ANEEL's Role**

The regulator has to define some basic aspects in order to harmonize the competition environment. These are related with the initial right and compulsory participation in the wholesale energy market, the transition period before competition, funding of the software development and implementation of market, among others.

While captive consumers exist, unable to choose their suppliers, the regulator will also set the criteria to consider how much of the price of energy that is freely purchased by the distribution companies will go into the tariffs. To do this it was used a kind of regulation for incentives defining reference prices that determine what level of purchased power prices the distributors can incorporate in their tariffs to regulated customers.

The terms of the regulation allow distributors to sign contracts with prices different from the reference price, but with an incentive/penalty structure. If a distributor signs a contract at a price higher than reference price, it can only pass

through part of the difference in their tariffs; the other part reduces the distributor's earnings. Conversely, if a distributor signs a contract at a price lower than reference price, it has to consider just part of the difference to customers, the other part increases the distributor's earnings. Thus, distributors are motivated to sign contracts below the reference price. As a distributor is unlikely to sign a contract above reference price, the reference prices will heavily influence the market price. However, the incentive/penalty only becomes meaningful when the variance (plus or minus) is more than 5%.

2.2. Transmission Services

- **Allowed revenue**

As the structure of costs of a transmission company shows that most of them are fixed costs, non-related with the power flows, it was defined an economic regulation based on total revenues. The annual allowed revenue is defined based on actual costs, including a fair return on assets, and on expected performance.

Allowed revenue will be contracted between the transmission company and the ISO (ONS) and can be reduced by a variable part related with the performance. If the facilities achieve the expected level of reliability the company will deserve more revenues and will make more profits. By the other hand, if quality deteriorates the revenues will automatically be reduced and the company can face losses.

- **Transmission pricing**

Once defined the allowed revenues for all transmission companies, the challenge for the regulator is to set the tariffs for open access that provide the right

economic signals for generators and consumers to use the system efficiently. In the Brazilian system it is defined a set of different tariffs for each node of the system to be applied to generators. These tariffs are defined based on the long run incremental costs and are proportional to the cost of expansion of the system caused by the increase of generation in each node. For the demand side it is defined an average tariff to be applied to all consumers in each state of federation.

2.3. Distribution Services

- **Concession Agreements and Economic Regulation**

Distribution companies in Brazil are regulated as natural monopoly and are submitted to economic regulation of prices (tariffs) in a Price-Cap regime. Tariff structure was initially fixed in the Concession Agreement, however the utility can propose to the regulator changes in this structure. There is a formula in the Concession Agreement that establishes the annual readjustment of all tariffs. This formula is applied by the regulator after analyzing utility data.

The formula has two parts as is shown hereafter:

$$IRT = \frac{VPA_1 + VPB_0 \cdot x(IGPM - X)}{RA_0}$$

Where RA_0 is the total revenues earned by utility in the past twelve months. VPA_0 is the total exogenous cost evaluated in conditions existing at the previous annual readjustment. VPA_1 is this cost evaluated in current conditions. VPB_0 is the difference between RA_0 and VPA_0 . $IGPM$ is the inflation index and X is the factor that will be introduced to consider productivity and performance-based regulation.

The formula can be understood as a weighted average of two indices: the actual variation of the exogenous costs (VPA) and the inflation index (VPB). Exogenous costs are considered energy purchase, payments to access transmission system and intra-sector charges.

After an initial period of 4 or 5 years, the regulator will revise the tariffs and structure, defining the X factor for the next period. Each period of application of the readjustment formula is called the period of regulatory lag. This kind of regulation intends to give the right incentives to reduce costs: as tariffs will be readjusted without considering the actual costs, the company can get profits by being more efficient.

The revision process will take into account the utility costs, a fair return on assets considering an ideal structure of capital and a fair return on equity, to set new tariffs trying to share with the consumers part of the gains in efficiency achieved in the precedent period. This revision process will define also the parameters of a performance-based regulation to be applied in the next period. This can be done by defining the X-factor as a function of these parameters. In this way, the X-factor can have several components like:

- An expected minimum productivity gain;
- A quality of service goal-related component;
- A universal service goal-related component and
- An energy efficiency promotion component.

In part 3 of this paper, we will discuss more about these components.

- **Unbundling and Distribution pricing**

One of the most difficult current issues in regulation in Brazil is to define the tariffs for open access to distribution systems considering the Concession Agreements already signed and the bundled tariffs to captive consumers that are already set.

As well as transmission services, the best way to regulate distribution services is regulating the total revenues and dividing this for all users in a fair way. This because the most part of costs is fixed, unrelated with demand of energy. Merely losses could be considered as variable costs.

The challenge is that the Concession Agreements comprehend both, the distribution services themselves and the retail activity of distribution companies, and regulate them by a price-cap applied on bundled tariffs.

If distribution companies are free to define which part of their total revenue corresponds to distribution services (the monopoly); they will consider most part of cost in the regulated activity to avoid competition in retail (the non-regulated activity).

The solution put in practice in Brazil by the regulator was to consider a initial percentage of total revenue as related to distribution services and to allow distribution companies six months to accept or contest the tariffs for the use of the distribution system. In this way, the distribution companies can propose and justify new tariffs that have to be analyzed and approved by the regulator.

2.4. Market Power

The presence of market power in electricity market without any regulation of prices or profits can cause harmful economical results. The demand for electricity is almost inelastic and even without strong barriers against new entrants it is necessary a long time (more than two years) to build a new production facility.

In these markets with market power, the price is larger and the offered amount is smaller than would prevail if the market was competitive. The basic objective of the regulation, in these cases, is to prevent that anti-competitive practices are adopted.

Many regulated industries are regulated precisely because they suffer from problems of monopoly power caused in part by elements of *increasing returns of scale*, and for such industries marginal cost pricing offers no simple solution to the regulatory problem.

- **Concentration limits**

To avoid market power, the Brazilian regulator has already established some limits to be observed by generation and distribution companies. Each generation company or a group of generation companies with common significant shareholders cannot control more than 20% of total installed capacity of generation in the country. There are also some regional limits, but as the two big electrical systems in the country are now interconnected, the relevant market for electricity can be considered as the national market. One generator located in the northern part of the country can compete, at least theoretically, to sell energy to a consumer

sited on the southern part. The cost of transmission is not directly proportional to distance but to the state of congestion of the system.

Similarly, limits were defined for concentration in distribution business. The attempt of the regulator is to ensure a large enough number of competitors to avoid market power.

3. Performance Based Regulation

Regulation is necessary when markets fail to operate in the interests of firms and society, reducing costs, increasing the quality of services, innovating in order to satisfy the consumers, increasing the overall welfare. These market failures can be understood in three classes: externalities, market power and asymmetric information.

When one firm's behavior affects other firms or people in either a positive or negative way, it is necessary the action of the regulator to impose on the firm the costs it produces, to limit the negative effects of externalities or to give some compensation to the firm when there are positive externalities.

By far, the most important and concerning market failure in energy market is the excess of market power in one firm. At the extreme the market is supplied by a single firm, protected by barriers to entry, that faces no competition on the prices it could charge. In a market such as electricity, where demand elasticity is very low, if the prices were not regulated the result would be an inefficient allocation of resources. Another problem resulting from market power is low incentives to firms to cut their costs where possible and to introduce new products or technologies. The regulator has to impose some limits in market concentration and cross-ownership, as stated in 2.5 above.

The product electricity is standardized. Consumers know exactly the product they are buying, though the seller's integrity is unknown. To avoid this kind of asymmetric information, the regulator must supervise all the agents acting in the electricity market to protect consumers against misbehavior.

Another sort of asymmetric information can be found between regulator and firm. The information available to the regulator is always inferior to that known by the firm. The regulated firm typically is better informed than the regulator about:

- Its costs, consumer demand and behavior, and other conditions in the industry – problems of hidden information (adverse selection);
- Its actions and possibilities for cost reduction – problems of hidden action (moral hazard).

Particular cases of hidden action in the context of utilities include the regulator being unable to accurately judge the effort electricity suppliers make to ensure that their power is obtained at minimum cost. For this reason it could be better to establish some performance-based regulation (PBR) awarding firms that achieve buying energy below a reference price and penalizing ones that couldn't get it. The most important problem of hidden action in the regulatory context, however, is the unobservability of the firm's cost-reduction effort and the consequent risk of managerial slack (in this case, regulators and shareholders are in the same position).

If information asymmetries are present, if the regulator does not accurately know costs, then marginal cost pricing becomes more problematic. If the firm's effort level is unobservable by the regulator, then the firm cannot simply be instructed to undertake a desirable level of effort, and the firm must be given an incentive to reduce its costs.

Information has assumed a central importance in the economics of regulation. If the firm does not possess better information about industry conditions than the regulator, and if there are no other regulatory failures, then the monopoly

problem can be solved simply by instructing the firm to carry out whatever is calculated to be the socially optimal plan. In this case, the regulator could simply run the firm. In reality the firm is much better informed about many aspects of the running of the firm than the regulator, and so the problem is to design regulatory regimes that motivate the firm to use its superior information for general benefit rather than to increase its own monopoly rents.

Regulatory schemes that encourage the firm to reveal private information about its cost and demand conditions at the same time as encouraging it to undertake desirable cost reducing activity have been proven superior to the form of regulation where the firm is simply instructed to offer a fixed price or tariff.⁵

The regulator must set some type of economic regulation to the segments of the electricity industry that will remain as natural monopolies: transmission, distribution and retailing for captive customers (while the freedom is not extended to all consumers).

If competition is not feasible, there are several policy issues related to the regulation of a monopoly activity. First, there is a question on what to regulate, the prices charged by the utility or its total remuneration or profits. Regulation of prices focus the attention on regulating both the level and the structure of tariffs, while regulation of remuneration focus on the average tariff, leaving decisions on the structure to public utilities, subject to general clauses about cost reflective pricing.⁶

Regulation of profits (Rate of Return Regulation – ROR) has been traditionally used for several years in US and in most countries but its major

⁵ Armstrong, pp 27-28, 36-37

⁶ Dussan, p.23

drawbacks are that it is costly to operate, reduces the incentive to efficiency and innovation, and distorts the pattern of investment. Despite that, after each period of regulatory lag, where the price cap (or RPI – X formula) is applied, the regulator has a tendency to use ROR regulation in the revision process to set a new tariff level, to define the X factor and the parameters of performance-based regulation and to start a new period of regulatory lag.

The use of Price cap (or Revenue cap when the utility has a single product like transmission companies) combined with performance-based regulation has the advantage that allowed revenues, average prices or even the complete tariff structure needs to be determined less frequently than has been the norm under ROR regulation.

Performance benchmarks should be set at the most recent average performance. It is not easy to evaluate benchmarks every year or more frequently. The utility may need more time to obtain results of investments or actions to improve performance. Such benchmarks should be established for a limited number of broad measures that could be easily tracked and are important to customers

With introduction of competition in electricity and the use of Price Cap regulation, the utilities have strong incentives to cut costs and be more efficient and profitable. However, to insure that the utilities do not allow service quality to deteriorate to unacceptable levels, or even to push them to improve quality of services, PBR programs generally include specific quality standards and penalties for not achieving them. Some benchmarks related with quality are:

- Customers complaints

- Outages (duration, frequency, number of customers affected and kilowatts of demand)
- Outage frequency (five minutes or longer)
- Voltage fluctuations (frequency and size)
- Billing errors
- Storm outage response time
- Hours lost due to accidents (employee safety)

One success of the current regulatory system has been the near-universal connection of customers to the grid, often supported by targeted protections for particularly vulnerable customers such as the elderly and the poor. By the other hand, it has been hard to supply customers located far from the existing grid like rural properties. As utilities seek to cut costs under restructuring and PBR mechanisms, it will be important to establish targeted incentives to maintain universal service standards and affordability that is closely related with universality.

Universal service indicators should be established for (a) low-income efficiency program and discount rate saturation, (b) disconnection of low-income discount rate customers, and (c) the effectiveness of the utility in providing affordable bills to low-income customers. In addition, universal service indicators should be computed separately for the worst circuits on the distribution system, in order to monitor for geographic concentrations of poor service. Some universal services indicators could be;

- Ratio of homes connected
- Ratio of termination for nonpayment

- Ratio of low-income consumers
- Participation in low-income energy efficiency programs.
- Frequency of bills above 5 percent of household income.
- Ratio of rural properties connected

Price Cap approach creates a strong incentive against energy efficiency programs. Profits are affected by the costs for efficiency programs as well as by the decrease in sales that results from well-implemented DSM programs (Demand Side Management). Implementation of PBR related to efficiency targets can help to solve this failures. Another way is unbundling the activities and applying Revenue Cap instead of Price Cap regime to distribution services activities. The part of the firm that could suffer with decrease in sales would be the retail that is now competitive. The distribution activity has almost no interest in sales volume. It can be more profitable if the electricity is used in a more rational way. Some benchmarks that can be used in a PBR program for energy efficiency are:

- Percentage of total revenues invested in efficiency programs
- Percentage of total revenues invested in DSM
- Some other indicator of output in efficiency achieved, for instance, the average load factor of typical consumers.

In setting the targets to be achieved in a PBR program and the penalties that will result otherwise it is important to remember that quality of services, universalization or DSM programs are not costless. Consumers are not willing to pay high prices for extremely reliable services if an occasional outage does not impose so much hardship. On the other hand, the utility will make investments

below the value of penalty and will choose to bear the penalty if the investments to achieve the targets exceed value of the penalty.

4. Conclusion

This paper briefly presented the changes that are in course in Brazilian electricity sector structure and regulatory framework. It discussed some fundamentals in regulation matter and showed some characteristics and advantages of Performance-Based Regulation.

A number of general lessons that can be obtained from the experience with PBR are cited by Biewald in their report to NARUC:

- Before adopting a PBR mechanism, regulators should first consider what their primary objectives are in a restructured electricity industry, and whether PBR mechanisms are likely to be more effective at achieving those objectives than traditional cost-of-service regulation.
- Most forms of PBR will require significant regulatory input and oversight.
- Incentives should be carefully designed to avoid unintended consequences.
- A regular and comprehensive reporting process should be set up to provide sufficient data for PBR evaluation.
- There should be ample opportunity in the regulatory review process to monitor the rate, cost and distributional effects of the PBR incentives, and to modify the PBR or terminate it if necessary. However, some

PBR measures require a sufficient number of years to provide balanced incentives over the long term. In addition, if utility managers become convinced that PBR mechanisms can be modified frequently, the PBR incentives may be weakened considerably.

- Incentives based on inter-utility comparisons should rely on data that will be available in a timely fashion.
- When including targeted incentives in a PBR mechanism, the penalties and rewards should be commensurate with (a) the savings to the utility of reducing costs and (b) the costs to the utility of improving performance.
- Mandatory cost pass-through and profit-sharing between ratepayer and shareholder should be calculated based on actual utility expenditures, not on budgeted amounts
- When different costs are treated differently in the PBR mechanism, cost categorization should be an important consideration. Differential treatment can lead to inefficient management decisions and unjustified and unanticipated windfall gains from reclassification of costs.

As conclusion, the chart below summarizes our point of view regarding a regulatory framework and use of PBR for each segment of electricity industry.

Segment of industry	Regulatory approach
Generation	<ul style="list-style-type: none"> - No regulation on prices, revenues or tariffs - Penalties for misbehavior or quality deterioration
Retailing to free consumers	<ul style="list-style-type: none"> - No regulation on prices, revenues or tariffs - Penalties for anti-competitive behavior
Retailing to captive consumers	<ul style="list-style-type: none"> - Price Cap (as agreed in the Concession Contracts) with disclosure in the energy bills of the structure of costs: <ul style="list-style-type: none"> - Purchase of energy (including cost of own generation) and Retailing costs (competitive) - Cost of access to transmission system (regulated) - Cost of distribution services (regulated) - Charges and taxes - Regulation to limit the price of energy purchased considered in tariffs. - PBR to promote universal services (low-income consumers)
Transmission	<ul style="list-style-type: none"> - Revenue Cap - PBR to improve quality of services
Distribution services	<ul style="list-style-type: none"> - Revenue Cap - PBR to improve quality of services - PBR to promote universal services (rural consumers) - PBR to encourage energy efficiency (DSM programs)

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