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**REGULATORS' CHALLENGE IN THE PRICE CEILING - THE  
VALUATION OF REGULATORY ASSETS IN THE BRAZIL'S  
ELECTRICITY RATEMAKING**

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# Regulators' challenge in the price ceiling - The valuation of regulatory assets in the Brazil's Electricity ratemaking

## I – Introduction

Ratemaking processes can become a battlefield since the consumer always wants a lower energy price and private distributors seek maximum profit. In this classical dispute regulation plays an important role, because free competition does not exist in the distribution branch of the electricity sector.

The process of deregulation in the Brazilian Electricity Sector was begun ten years ago by federal law nº 8.987, on February 13, 1995. This law set out guidelines and created concession rules for privatization. Since then, energy distribution became almost totally privatized; today there are only a few state owned companies. On the other end of the “line” most of the generation companies are still federally owned. Even though the Fernando Henrique Cardoso government signalled the willingness to privatize generation companies - according with his state reform proposal – it has become definitely unfeasible since the 2001 rationing arrived.

Indeed, the government had started one of the most basic solutions needed for the Brazilian development. The federal government was prepared to give concessions and the National Agency of Electricity Energy – ANEEL, which was in charge of it, had started its operation in 1998. The legal context was ready to allow new private investments in generation and the responsibility to build new generation plants would not be exclusively a government task. At this time the lack of federal resources in energy infrastructure could be replaced by private investment.

In spite of the institutional and legal arrangement the solution arrived too late to avoid rationing in 2001. First, because hydroelectric power plants needs long period to built. Second, because the commercial rules were not yet defined. The electricity wholesale market was created by federal law within the assumption that it would be self-regulated.

The consequence was an endless disagreement about the settlement rules and delicate governance problems.

The shortage in the generation strongly impacted distributors because the first government action was compulsorily reducing the electricity consumption by twenty percent. For the recently privatized distributors it meant reduce their income. For some of them, without enough hedge contracts it was even worse because they had to pay very high prices for electricity in the precarious wholesale market.

As this rationing situation was not foreseen in the ratemaking process, distributors would not survive without some changes in this process. Therefore, government had to step in and heal distributors' cash-flow in some way. Otherwise Brazilian development would be deeply compromised and foreign investments would not come anymore.

The solution came when Congress approved federal law 10.438 on April 26, 2002 allowing a specific ratemaking process to cover rationing losses. Generally, the distributors would be able to get a loan from the government and pay it over the long run with the new raised rates.

When it came to matters of population acceptance, definitely the result was not positive. First the population had to make a tremendous effort to reduce consumption by twenty percent of the previous year's average consumption; otherwise the distributors could fine or cut off the service. Right after they had their rates raised to absorb distributors' losses.

Besides the rhetoric blaming privatization for rationing in 2001, this entire situation brought an important change in the society's behavior. During the last two years we have seen crowds in public hearings when the issue is ratemaking process. Recently newspapers have published articles about very specific topics related to ratemaking rules and their effects on the consumers' pockets. One of these specific topics is the asset-base used to calculate investor's payment, which seems very technical to be in newspapers. But now, the population seems to care about what's going on in the ratemaking process.

As it is naturally a complex issue, sometimes regulation is misunderstood by the population and most of the time unsatisfactory to investors – as economic theory can demonstrate. This paper intends to clarify the effect of some aspects of the methodology used to value the asset-base in Brazil and its significance on electricity rates.

## **II – Natural Monopoly**

The electricity sector in Brazil was mainly vertical until privatization, when industries were divided in four segments: generation, transmission, distribution and trade. On 27 May, 1998 Congress approved federal law 9.648 which opened a free market for generation and trade by creating the first guidelines. This same law clearly defines transmission and distribution as regulated services.

It means that the ANEEL is in charge of establishing rates for everyone using the distribution system and the transmission system. If Brazil was moving to a private electricity sector and to free competition one may ask why does ANEEL have to fix rates? The answer is in the natural monopoly definition.

Suppose that a new firm wants to enter the field of electricity distribution. This firm would have to build a grid to physically connect homes to generation facilities. Now imagine several distributors building their own networks through underground or overhead lines to connect homes and compete for customers. In this case the unit costs are higher than when one firm provides electricity to all homes, because the cost of duplicating connecting lines obviously implies higher average cost.

In fact, as the firm doing business already has its own grid it would not cost very much to connect a new customer. But, since competition does not exist the monopolist is not a “price taker”. In this case the firm would establish the price per unit that maximizes its profits. Thus, this price probably would settle at a high level – although lower than when several firms have duplicated networks to attend the same consumer.

The monopoly definition implies only one seller that can fix prices in a maximum profit level. But in the electricity distribution it goes further because, one large firm can produce

at a lower per-unit cost than several smaller firms providing the same service. This is clearly an example of economies of scale, when average cost declines per unit of kWh sold. This characteristic defines natural monopoly.

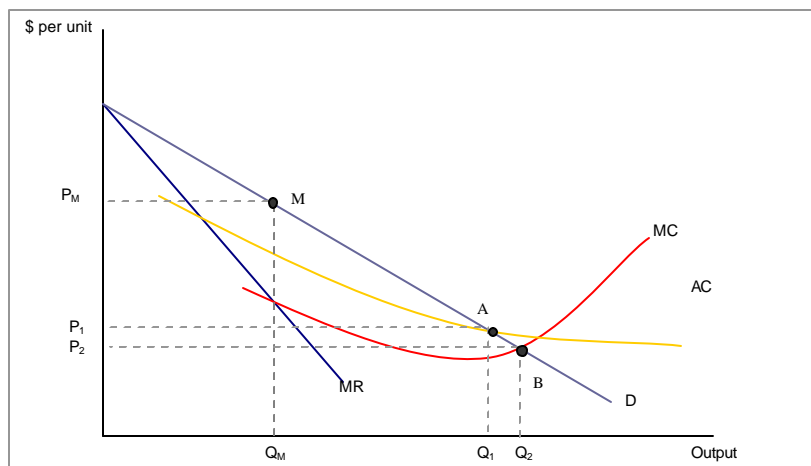
### II.1. Public Policy Dilemma

If in a natural monopoly the monopolist is more efficient than several others providing the same services why should regulation step in?

Economic theory proves that a monopolist without regulation will be tempted to exploit its natural monopoly power to restrict output and raise price. In the electricity distribution it means the monopolist could just refuse a request for a new connection. This new customer could be an electric-intensive industry employing hundreds of people, but from the monopolist's point of view maybe it would not be worth it. Thus, one good reason to carry out regulation on electricity distribution is that government must defend the country's development, assuming this is a public interest.

If the monopolist could fix the electricity price it would be fixed where marginal cost is equal to marginal revenue (Figure 1 -  $P_M$ ). This point defines the maximum profit level, because if the monopolist sells one more kWh the cost to supply this additional unit would be higher than the revenue related to this same unit. Figure 1 depicts Natural Monopoly situation.

Figure 1 – Natural Monopoly



In order to avoid natural monopoly's undesirable consequences - restricted service and higher prices - regulators have to establish prices at a level that promotes incentives to keep the monopolist in business and at the same time come up with a reasonable rate for consumers.

The opposite of natural monopoly is free competition where prices are set at a minimum level. This minimum is exactly where marginal cost intersects the demand curve. In this way regulators could set price at  $P_2$ , which provides  $Q_2$  quantity of output (emulating free competition). This is called *marginal-cost-pricing*.

There is, however, an obstacle to *marginal-cost-pricing*: if prices are set at  $P_2$  monopoly will incur a loss because average cost is above marginal cost. It could put a firm out of business and regulators want exactly the opposite. Regulators want the firm providing service as much as it can or, in other words, they want demand met and investments to support development.

Afterwards, the second alternative is to establish price at  $P_1$  where average cost intersects the demand curve. The problem in this point is that consumers will be paying more for additional units than they cost to produce. This situation is not simple for regulators to explain to society. It is even harder when this society had in the past electricity distribution running under public administration with considerable subsidies.

The choice has to be taken. *Marginal-cost-pricing* is not enough to keep a firm in business in the long run. *Average-cost-pricing* seems to be a better option because it keeps the firm in business and despite its higher price it is still lower than monopolist pricing and promotes higher output as well.

## ***II.2. Average-cost-pricing in Electricity Distribution***

Since the *average-cost-pricing* is the best option, we should understand its application to electricity rates. The first step is to identify what is the variable cost and the fixed cost in electricity distribution. Taking a very simplified view, distributors need the following to run their business: (i) the grid, (ii) employees and materials in the maintenance and administration (O&M); and (iii) energy to sell. In the short run there is no need to expand the grid to meet demand, and then as grid costs are not increasing with each kWh sold, we can define costs related to the grid as fixed cost.

The same is true for Operational and Maintenance costs because we can assume the distributor will not hire more employees or rent a new building to meet an increase in demand in the short run. If the grid is the same, maintenance costs will probably not increase. It is known that there is a relationship between employees in the administration and the number of consumers, but this ratio is not big enough to include O&M costs in variable costs.

When we analyze costs related to the grid we reach some inferences very particular to the energy distribution sector. The investor in a distribution company will expect his payment because he had invested in an acquisition of some assets. This payment will be a percentage of the value of the assets used to provide the service. As the asset and the percentage are fixed then the investor's payment is a fixed cost as well. Thus, in the ratemaking process the investor's payment is considered as any other fixed cost, such as employees' payment.

Additionally, as assets are being used they loss value and the investor expects that his capital used up over time will be maintained by apportioning an appropriate fraction of the cost of the asset used (Macdonald, 1974). Then, this is also considered a fixed cost, which goes to the investor and has to be included in the electricity rate as well.



The energy purchased for distributors is clearly a variable cost, because each kWh sold will equal exactly one kWh to be acquired<sup>1</sup>. Then, energy purchase fits exactly in the variable cost definition, which is ‘*cost incurred by the firm that depends on how much output is produced*’ (Browning & Zupan, 2005).

The average cost is the summation of total variable costs and fixed costs divided by the total output. Bringing this definition to the electricity distribution sector, the average cost is the total cost divided by total energy consumption. Table 1 illustrates how fixed and variable costs are allocated in a set of Brazilian and American distributors in the 2004 ratemaking process.

Table 1 – Fixed and Variable Costs in the Electricity Distribution

	Brazilian Southeast Firms			USA - Florida Firms		
	A	B	C	D	E	F
Variable cost (\$)	58,17%	66,52%	55,96%	53,92%	44,53%	60,53%
Fixed Cost (\$)	41,83%	33,48%	44,04%	46,08%	55,47%	39,47%
Total Cost (\$)	100%	100%	100%	100%	100%	100%

### III – Regulation of Natural Monopoly

Assuming that every firm aims for the maximum profit, it is important to understand what economic theory explains the relationship between regulation by *average-cost-pricing* and distributors’ behavior.

When regulators set a price ceiling based on the firm’s costs, it will become an incentive for the monopolist to increase its costs or, in some way make regulators believe in high costs. This tendency happens because higher costs mean higher rates, so profits will increase in the same direction. Then, regulators will be creating an incentive for inefficiency while considering all costs to set the electricity price. In this situation unnecessary costs will not reduce profits. Additionally, the electricity demand, in general, is not elastic enough to break this tendency.

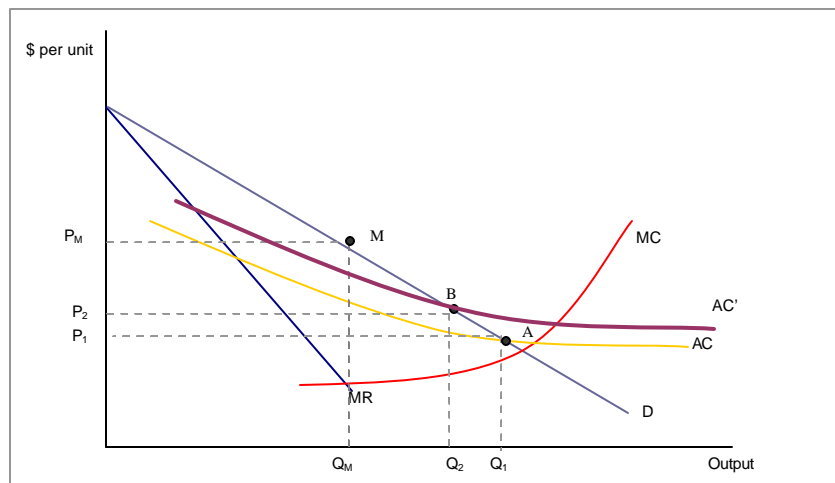
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<sup>1</sup> Not considering transmission losses.

Figure 2 illustrates the consequences of this perverse incentive. The curve AC is still showing minimum unit production cost, but the direct relationship between profits and costs makes distributors try to move AC curve to AC'. With this new average-cost curve (AC') price  $P_1$  will no longer be satisfactory, since this price is below the unit production cost. The consequence is that prices will be set at  $P_2$ .

This problem is recognized by ANEEL which had established rules to approve, under regulated criterion, costs related to O&M, energy purchase and those related to investor's payment such as cost of capital invested, capital structure and asset-base value.

Figure 2 – Perverse incentive in average-cost-pricing



Monitoring distributors' costs is always a difficult task for regulators. The asymmetric information might lead regulator's criterion toward the monopolist interest, making AC curve drift upward to some degree. Also, this form of regulation can suppress or slow down the introduction of invention. This kind of reaction in the industry is a natural response to a price ceiling (Browning & Zupan, 2005).

### ***III.1. Criticism of Regulation***

For these reasons, some economists have become increasingly critical of the regulation of natural monopolies. Sometimes it is suggested that regulation does not have real effect in curbing rates (Stigler & Friedland, 1962).

This critical position has helped to launch the “Capture” Theory which has two main bases. First, the general public is rationally ignorant of most of the agency’s activities. The public is “rationally” ignorant because concerning electricity rates, an increase of a few cents in the rate has a small significance for the consumer. For one consumer it would take a disproportional effort and knowledge to influence the ratemaking process in order to get just a few cents. Second, from the distributors’ side it is exactly the opposite; some extra cents included in rates will probably represent a significantly higher profit. This is a sufficient reason to hire well trained specialists and spend as much effort as possible to influence regulators.

The “Capture” Theory says that as the general public is rationally uninformed about the process, regulators thus have little incentive to act in the public interest but have a large incentive to act in the interest of those who interact with the regulator on a regular basis (Holcombe, 1988).

However, a gradual change in the population’s behavior has been happening in Brazil. After 2001 rationing the society is effectively participating in public hearings about ratemaking process. Regulators have had demonstrations of how consumers are worried about increasing electricity rates. Public prosecutors have been demanding from ANEEL detailed information about costs and methodologies considered in the process. The media has been highlighting results of the ratemaking process very often. These recent facts seem to weaken the base of Capture Theory about the rational ignorance of the public.

In fact, the suggestion that regulation has none of the intended effects deserves reconsideration. The debate over the effect of regulation is a matter of public interest

(Etzioni, 1986)<sup>2</sup>. So, what can be better for public interest in natural monopoly than regulation? The alternatives, such unregulated monopoly and government ownership probably will not come up with better results for society than regulation (Browning & Zupan, 2005).

Maybe there is no completely satisfactory solution to the natural monopoly problem. However, a regulation that combines efficiency incentives and methodologies to monitor costs seems to be a reasonable goal for regulators.

### ***III.2. Objectives of price Regulation***

In general terms, it is possible to affirm that regulation's objective is to maximize society's benefits considering limited resources. In other words regulation aims for economic efficiency, which can be expressed in terms of: (i) efficient pricing, (ii) efficient investment and (iii) efficient production.

From consumers' point of view, efficient pricing means the lowest price available for one good or service. Accordingly, regulation has to be concern about distributors' market power and also has to come up with rules to minimize the distributors' tendency for increase costs.

On the investor's side, efficient investment has a strongly connection with sufficient returns, which means that costs will be recovered, including opportunity costs of the funds tied up in the regulated business. The valuation of opportunity cost has to be adjusted for the risk of the investment what can represent a tricky task for regulators.

Finally, when regulators search for a condition of efficient production it can be simply defined by: service provided at a lowest cost. To meet the three conditions regulated prices have to be set in a way that investor will recover all costs, including implicit costs.

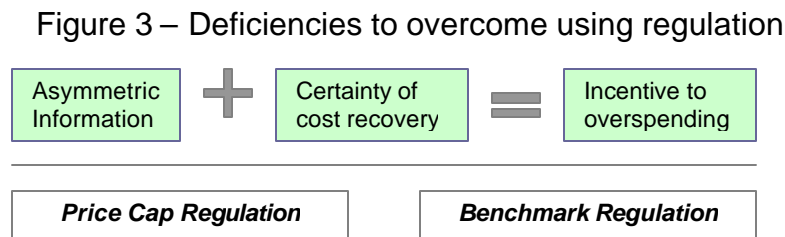
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<sup>2</sup> Amitai Etzioni reassessed the original data of Stigler and Friedland's influential 1962 article on the effects of regulation, which studied U.S. electricity rates in the early 1900's. Whereas Stigler and Friedland contended the economic effects of regulation serve those regulated regardless of the statutory characteristics of the regulations, but a critical look at their data suggests the regulations studied did have their intended effect.

On the other hand, to meet consumer’s objectives these costs have to be as low as possible – obviously considering a certain level of quality and liability. Therefore, regulation can become sophisticated since it has to support conflicted interests.

#### IV – Price Cap Regulation and External Benchmark Regulation

When distributors have a high degree of certainty of cost recovery it becomes a poor incentive to minimize cost<sup>3</sup>, which confront the consumers’ objectives. Additionally, regulators tend to be at a disadvantage when arguing with distributors about its costs. The distributors’ knowledge of its own costs is naturally higher than regulators’, what is called asymmetric information. Therefore, alternative forms of regulation have been developed to overcome these deficiencies. The two alternative forms of regulation relevant for this paper are: price cap regulation and benchmark regulation (Figure 3).



##### IV.1. Price Cap Regulation

Price Cap regulation is designed to protect consumers by providing a maximum price that can be charged. This cap is established independently of the firm’s real costs, which can prevent asymmetric information effects. Thus, if a firm can provide services, on the regulated level of liability, with costs below the cap, its profits will be higher.

<sup>3</sup> The first incentive to maximize cost is the price ceiling based on average-cost-pricing. Investor’s payment is recognized as a cost in the ratemaking process, then monopolist will have an incentive to inform higher cost to regulator. Additionally, the objective “*efficient investment*” in price regulation leads to a high level of certainty of capital recovery. This becomes again a poor incentive to reduce cost.

The price cap regulation may not assure that costs are in the minimum level of cost (*efficient production objective*), but it can “persuade” utilities’ behavior in this direction in order to obtain better profits. The price cap regulation is a form of incentive regulation, since it prompts a firm to operate at an efficient level of cost in exchange of having a higher profit.

Additionally, regulators can observe the firm’s behavior toward lower cost – or efficiency. Then, by analyzing the consequences of the firm’s operation at a lower level of costs, regulators can improve the price cap in the next period. At the same time, the strength of incentive costs reduction has to be controlled in order to avoid undesirable effects, such as unacceptable level of profit or underinvestment, which can compromise the quality of the service.

#### ***IV.2. Benchmark Regulation***

By definition benchmark is a measurement or standard that serves as a point of reference by which process performance is measured. Accordingly, benchmark regulation will establish this standard by identifying the best practices from industry and comparing and adapting them to the regulated utility.

The results expected by using such an approach are standards that reflect efficient operation – or efficient costs. When these standards are applied in rates calculation, regulators suggest that consumers are paying fair costs in their rates. On the other hand, the regulated utility operating below the standards will be motivated to aim for process improvement.

In the electricity sector this approach uses costs information from a large number of regulated utilities to predict standards of efficiency. However, each network needs some adjustments in order to recognize their differences.

## V – Price Cap and Benchmark in Brazilian Regulation

There are different methodologies in the Brazilian ratemaking process. Each one is connected to a different type of cost, but all of them aim for the three objectives of price regulation: (i) efficient pricing, (ii) efficient investment and (iii) efficient production.

### V.1. Reference Value for Electricity Supply Cost

Electric energy supply is very significant in a distributor's total cost (Table 2). In some Brazilian utilities it can represent more than fifty percent of the total cost. To avoid unnecessary high costs regulators establish a “normative value” that is a maximum cost recognize for electricity purchase in rates calculation. This rule has a graduation; the lower the price of the electricity purchased, the more distributors can pass through rates. This is the incentive regulation, when benefits of a good operation are shared between investor and customers. This rule is an example of price cap regulation.

Table 2 – Electricity Supply Cost Worth

Southeast Brazilian Distributors

	A	B	C
EC / TC	48,76%	61,28%	44,57%
EC/ TC*	42,07%	51,28%	38,84%

EC not including transmission costs

\* Total cost including federal tax and subsidies

The normative value rule begun in 1999 and suffered some changes right after the 2001 rationing. Unfortunately, this rule did not reach the best results for distributors. The normative value became a reference value and instead of buying low price electricity, some firms created significant profits for their corporations, by buying electricity at the price cap from a related generator.

Recently, in the federal law 10.848/2004, the Brazilian government changed rules by which distributors buy electric energy. Now distributors are not allowed to buy from whoever they want to. The only way to buy long term electricity contracts is by participating

in electricity auctions promoted by the government. Therefore, the price (R\$/MWh) for each kind of contract is equal for every distributor. In the same way the “pass through” rule will change to reflect auction’s prices – called “reference value”, which will be assumed as an *efficient cost*.

## **V.2. Reference Firm for O&M costs**

When regulators collect data from distributors to calculate average cost it is a real challenge to criticize if the Operation & Maintenance – O&M costs are reasonable or not. To compare O&M costs for distributors set in different areas is almost impossible considering Brazil's diverse geography (Table 3). In some areas, cities are close and one regional administration office is sufficient to attend three or four cities. For some distributors close to the coast, maintenance costs can be higher because the firm has to spend more to manage salinity and oxidation over wire that transmits electricity.

Since the Agency has to consider distributors’ operational costs to calculate their rates, there is necessity to use some parameters to avoid distributors’ tendency for inflating costs. Thereby, ANEEL established a methodology to estimate what would be the efficient operational cost for each concession area.

Basically, data like concession area size, population, number of cities, historical consumption and rate of demand growth are processed to create a virtual firm. The virtual firm includes number of offices, deposits, kilometers of wire in the network and number of employees. Then, some standards<sup>4</sup> are used to calculate the final operational cost. These standards are, for instance, cost per km<sup>2</sup> rented, office material cost per employee, salaries, etc. Having this methodology ANEEL has no need to use distributors’ information.

The parameters in the reference firm methodology are established based on information of several distributors. Thus, this methodology is an example of benchmark regulation.

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<sup>4</sup> Standards are established by benchmark.



Table 3 – O&M worth in some distributors' total cost

	A	B	C
O&M / TC	14,00%	21,93%	32,26%
O&M/ TC*	12,08%	18,35%	28,11%

\* Total cost including federal tax and subsidies

Brazilian experience of using the reference firm methodology shows that asymmetric information can not be a hundred percent eliminated, because some distribution areas can have too many technical particularities that the Agency has to make adjustments in the results of the methodology based on the distributor's information.

Although subjected to some asymmetric information, the reference firm methodology can be considered successful from regulators' point of view<sup>5</sup>. In some processes the Agency had identified a considerable inefficiency in utilities and some of them are state owned distributors. One relevant case of state owned utility had shown double O&M costs in the application for the ratemaking process than the reference firm methodology came up with. Certainly, the Agency board had a delicate situation facing union's complains and state government criticism.

The reference firm methodology to define O&M costs in ratemaking process had experienced only one ratemaking period, which is not enough time to measure its effects on distributors' cost efficiency. But, until now it seems to attend the price regulation objective since it provides standards of efficient production.

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<sup>5</sup> The reference firm provides at least a starting point to negotiate O&M costs since it gives regulators specific knowledge about the concession area and better conditions to criticize distributors' arguments to increase cost.

### **V.3. Regulation for Asset Valuation**

The asset valuation methodology was subjected to public hearing in June 2002. The theme was really relevant because ANEEL was about to start the first cycle<sup>6</sup> of ratemaking after privatization and the decision to be taken would be apply to all distributors' rates.

Generally, distributors wanted the value of their assets equal the price they paid for them in the privatization action. The main argument was that this price in the auction represents exactly what the assets were worth for investors and for the government when the distribution concession was given. This request is supported by *economic value* theory.

*“Economic value is the future net cash flows discounted back to the present”* (Macdonald, 1974). Therefore, the action price should represent how much the company is worth to investors when they decide to get the concession. In fact, if the new regulation could incorporate the same criterion investors used to value the firm in the privatization auction, they would certainly be able to maintain the value of their capital.

However, the economic value - represented as the firm's price in the privatization auction – was established for the original controllers of the firms, which were state and federal owned. These controllers had their particular premises to value the assets focus on what would be returned to public funds.

ANEEL understood that asset valuation methodology had to achieve price regulation objectives. Thus, the firm's price in the auction could not be a good reference, since it was calculated under different objectives.

Accordingly, ANEEL's final proposal was to value assets based on their *current value*. Despite some different definitions for current value, basically it is *“the amount of money a*

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<sup>6</sup> The ratemaking process is launch, in average, each four years. In this process ANEEL rebuilt all distributors' costs. During the following three years rates are actualized in a simpler process. In Brazil most of distributor had their first rates set in 1999, right after the privatization. Thus the first ratemaking process took place in 2003, for seventeen distributors.

*property would realize if sold at arm's length by a willing seller to a willing buyer*<sup>7</sup>. When adapting this definition to electricity distribution assets, the current value would be how much these assets would value in a second hand market.

Although, some definitions say the current value is the actual value of an asset, as opposed to its historical price<sup>8</sup>, it can also be compared to its new replacement cost. In this way, the methodology Optimized Depreciation Replacement Cost (ODRC) estimates a maximum price that a person would be willing to pay for an existing asset given the alternative of constructing a new asset (ACG, 2003).

This methodology was chosen by ANEEL as the most consistent with price regulation objectives. First, the asset value would reflect the market experience instead of firms' own perspective<sup>9</sup>. Second, the ODRC is supposed to provide an efficient asset value, since the methodology takes the buyer point of view – and the buyer would pay the lowest price.

While the asset-base is needed to calculate investor's payment, which is a cost, the ODRC methodology will give the lowest cost (*efficient production*). On the other hand, the ODRC represents how much someone would pay for an asset assuming the actual return over capital. It implies that the price given in this “second hand market” reflects the buyer acceptance about the actual return over capital – Then, sufficient returns meet the price regulation objective of *efficient investment*.

The ODRC Methodology can also be considered benchmark regulation once it will take an external point of view over assets' value. Table 4 shows the significance of investors' payment and asset depreciation in some Brazilian distributors' total cost.

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<sup>7</sup> This definition is in the web page of Ministry of Municipal Affairs and Housing at Ontario – Canada (<http://www.mah.gov.on.ca>).

<sup>8</sup> <http://www.asset-analysis.com>

<sup>9</sup> The valuation methodology can also attenuate asymmetric information effects

Table 4 – Investor’s payment worth in distributors’ cost

	A	B	C
Investor's payment	16,69%	6,48%	5,75%
Asset depreciation	7,32%	3,19%	4,52%
Investor Total	24,01%	9,67%	10,27%

Total cost including tax and subsidies

## VI – Brazilian experience of asset valuation

The result of the public hearing about asset valuation methodology was the Resolution 493 on September 9, 2002. The Agency faced distributors’ argument against ODRC Methodology. In fact distributors were better defending the firm’s price in the privatization auction than pointing out ODRC disadvantages. Distributors had expectations to make the regulatory agency accept the privatization price as assets value. In this way, they would be cementing - with high certainty - their bets in the privatization auction<sup>10</sup>.

Therefore, ANEEL was not convinced by distributors during the public hearing and the Resolution 493/2002 confirms de ODRC Methodology. Also, the new regulation establishes that all procedures to be followed in order to reach the asset valuation in time of the date of the establishment of the rate. However, distributors were reluctant and they went to court to try to change ANEEL’s Resolution. The result was a very tricky ratemaking process because for regulators it would be a new experience using the ODRC methodology. On the other side, distributors were not willing to facilitate the process.

### VI.1. General Procedures

The Resolution 493/2002 establishes the guidelines that follow: (i) what can enter asset-base, (ii) ODRC Methodology range and (iii) credential requirements for firms to elaborate assets valuation report.

<sup>10</sup> During the privatization auction investors had made their bets based on the future cash flow, which commonly implies a considerable level of uncertainty. This cash flow basically depends on: regulated rates, consumption growth and operational costs.

Distributors were in charge of hire a firm with credentials to valuate their assets following the procedures established on Resolution 493/2002. The firm hired had to qualify before in order to get ANEEL credentials because without this, the final report would not be accepted. Accordingly, since a firm has the ANEEL acceptance, this firm is subject to enforcement.

Also, Resolution 493/2002 ordered distributors to make the accounting data compatible with the new asset value – based on ODRC Methodology – before turning in the valuation report to ANEEL.

In addition, ANEEL was concerned with the assets eligible to enter the asset-base. Thus, the firm hired to make the valuation has to identify each asset and then separate it in two groups: eligible and non eligible. The first group should be only those assets used to provide service in the concession area. Non eligible assets (those used in other services, than energy distribution in the concession area) also have to be reported to ANEEL considering the exact use of each asset and reasons why it is non eligible

Once ANEEL has the asset valuation report, the next step is the inspection. Needless to say that ANEEL can not inspect everything; therefore the inspection is made in some asset groups selected by sampling.

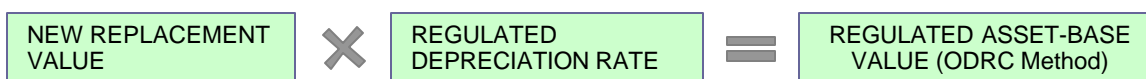
When ANEEL's inspections are finished the asset valuation can be approved if ANEEL do not find significant inconsistencies. As well, the Agency can make some adjustments on the final value, or excludes asset from the base if they are not matching with regulation requirements. If the inspections show big differences, then ANEEL can not approve the asset-base value proposed. In this case, the distributor has to fix problems pointed out by the inspection and remake the final report.

## **VI.2. First results of ODRC Methodology in Brazil**

On September 2003, ANEEL inspected six distribution utilities, in order to approve the asset valuation report. During these inspections ANEEL realized that firms with credentials were not properly using the rules to evaluate assets. Also distributors were not filling ANEEL expectations while following Resolution 493/2002.

Thereby, the Agency issues a detailed paper to clarify general understanding about the ODRC Methodology and its application<sup>11</sup>. Some basic concepts were highlighted including that new replacement value should be the first step to calculate the optimum depreciated replacement value (Figure 4).

Figure 4 – ODRC by using new replacement value



To calculate the unit replacement cost of each asset, firms should consider information such as quotation of prices with producers and suppliers of the specific asset. Then, the purchase and logistic system of the distributor has also to be considered to calculate how much it would cost to buy a new asset under these circumstances. Also, it is needed to take in to account the distributor's power of purchase in the market, comparing prices and always using the lower price because the idea is to consider the efficient cost.

Even after detailed explanations, in 2003 there was no asset-base validated by ANEEL. Seventeen distributors were in ratemaking process in 2003 and none of them could get ANEEL's approval on asset-base value. In fact, some distributors did not turn in the assets valuation report.

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<sup>11</sup> On July 30, 2003 ANEEL issued the Technical Note 178/2003-SFF/SRE/ANEEL with forty seven pages of detailed information about the asset valuation by using the ODRC Methodology.

What has caused these results? Some might say distributors' expectations of changing ANEEL decision in court<sup>12</sup> (about ODRC Methodology) influenced results, but it does not seem the only reason for a hundred percent of fail in the asset-base valuation process.

In fact, the process could not wait and ANEEL had to find an alternative to ODRC because rates can not be calculated without asset values. Thus, in this situation, the historical-cost appears as a possible solution, since the majority of accounting practice is based on historical-cost principle.

Accordingly, the ratemaking process was taken by giving temporary rates as results, because the asset-base value was provisory<sup>13</sup>. Afterwards, in 2004, ANEEL made a commitment to adjust the final rates in order to consider the definitive asset-base value. Although, in the second trial in 2004, the level of approval was again very low as Table 5 shows.

Table 5 - Temporary asset-base value in 2003 and their situation in 2004.

Ratemaking 2003	Distributor	Temporary Value in 2003	Definitive Value in 2004	Range
01	CEMAT	725.657.630	690.590.854	-5,08%
02	CEMIG	4.837.778.135	-	0,00%
03	CPFL	2.605.204.107	-	0,00%
04	ENERSUL	751.891.829	-	0,00%
05	AES-SUL	764.578.921	670.834.256	-13,97%
06	RGE	889.677.534	833.011.757	-6,80%
07	COELBA	2.098.484.358	*	0,00%
08	COELCE	998.118.437	-	0,00%
09	COSERN	457.804.445	-	0,00%
10	ENERGIPE	275.979.753	-	0,00%
11	ELETROPAULO	5.242.509.448	-	0,00%
12	CELPA	1.232.827.919	829.520.167	-48,62%
13	ELEKTRO	1.709.110.086	1.601.659.165	-6,71%
14	BANDEIRANTE	1.676.200.965	*	0,00%
15	PIRATININGA	1.395.178.072	*	0,00%
16	LIGHT	4.982.059.766	*	0,00%
17	CERJ	1.708.540.800	-	0,00%

\* Temporary value adjusted in 2004 but final asset-base value is still unapproved

<sup>12</sup> In court ANEEL won twice in different instances.

<sup>13</sup> For instance, the asset-base value for Distributor A in table 4 worth 24% of the distributor's total cost, which is very relevant. Then, as much as the asset-base value is worth in the distributor's total cost, there is a higher chance that temporary will be rates strongly divergent from definitive rate.

The temporary asset-value for most of the distributors was not exactly the historical-cost but a percentage of its value. For the majority of distributors, ANEEL established the temporary asset-base value in eighty percent of historical-cost. But there were different percentages as well, which can be analyzed in order to better understand results.

There is one distributor that received a temporary asset value which was sixty five percent of its historical-cost. This low percentage of historical cost could be assumed as harmful for the distributor's profit. However, in practice this temporary criterion does not seem to worry the distributor because its final report was not approved either in the following year.

Another interesting case to analyze refers to one distributor that had its electricity rate calculated considering seventy percent of the historical-cost as its asset-base value – which primarily could be considered a low value. However, in 2004 this distributor received the definitive value approved and despite the assumed low value, 70% of historical-cost, the final asset-base was even lower by applying the ODRC Methodology.

In contrast others three temporary asset-bases, which were established on the full historical-cost, were not approved even one year late.

Based on ANEEL's sensitivity of distributors' accounting data, ANEEL defined how much of the historical-cost could represent the asset-base value. This value has to be as close as possible to the efficient investments value. However all situations, full historical-cost and low percentage of it, suggest that accounting data related to assets are higher than efficient investments would be.

In the first case, even seventy percent of historical-cost was higher than the final asset-base value established by ODRC Methodology. In the second case, the full historical-cost as the asset-base value was not an incentive to distributors make efforts to apply the ODRC Methodology. So in 2004 the majority of distributors were still with an unapproved final report. Therefore, ANEEL decided to reduce the temporary asset-base since the historical-cost will probably turn out higher than the ODRC value would.



In 2004 there were twenty four distributors scheduled for the ratemaking and only four had the asset-base evaluation report approved. Three of them belong to the group of small distributors that sells less than 500 GWh per year, which implies that the asset valuation would be less difficult in the sense that fewer assets would be evaluated. Table 6 depicts the results of asset-base valuation in 2003 and 2004.

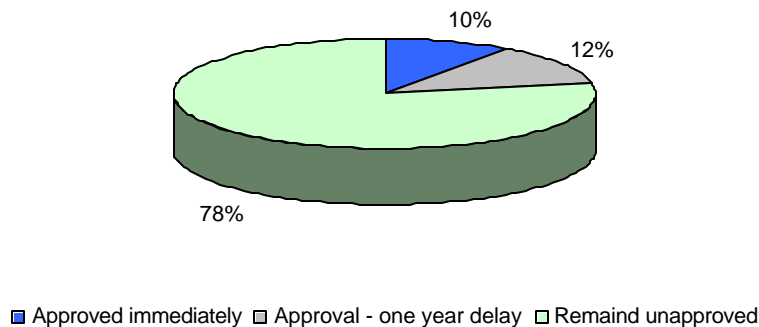
Table 6 – Asset-base valuation during 2003 and 2004 ratemaking process

Asset-base by ODRC	Ratemaking process in 2003		Ratemaking process in 2004	
	17 Distributors		24 Distributors	
Approved immediately	0	0,00%	4	16,67%
Approval - one year delay	5	29,41%	N/A	
Remains unapproved*	12	70,59%	20	83,33%

\* Until December 2004

Generally, results of ODRC Methodology in asset-base valuation indicate there might be some problems while following Resolution 493/2002 procedures. When the first two years are analyzed together it results in seventy eight percent of unapproved asset-base.

Figure 5 – Results of the asset-base valuation in the Brazilian ratemaking



### VI.3. Temporary Rate Consequences

As long as asset-base values are temporary, the regulated rates calculated are temporary as well. By definition, consumers are probably paying more when asset-base is overestimated, or paying less if the temporary value are lower than the definitive asset-base value.

The ratemaking process happens in average every four years when all distributors' costs are taken by ANEEL in order to apply average-cost-pricing. Also, each year regulated rates are readjusted to absorb costs that can not be managed by distributors such as subsidies, transportation costs and energy supply<sup>14</sup>. Doubtlessly, fixed costs (here taken as investors' payment derived from the asset-base value) are placed in the manageable costs group which are calculated only when the ratemaking process happens.

However, the temporary rates set in the previous period had to be fixed. Then, during the yearly rate-readjustment process ANEEL had to substitute the temporary asset-base value for a definitive one, or in some cases, for a proxy of the final value<sup>15</sup>. Indeed, until December 2004 ANEEL fixed twelve percent of distributors' temporary rates in the readjustment rate process. All of the distributors had the definitive asset-base value lower than what was previously taken by ANEEL.

When ANEEL first decided to use a temporary value all distributors were warned about the rules to adjust the definitive rate. Basically, the difference between incomes collected<sup>16</sup> while using the temporary rates and the supposed income using the final rates would be calculated to be absorbed in the following period. In fact, to correct the temporary rate ANEEL had to step back in time and recalculate rates as if were the previous year. Then, the current rate-readjustment process will start from the definitive value of the current period. Figure 6 illustrates this mechanism.

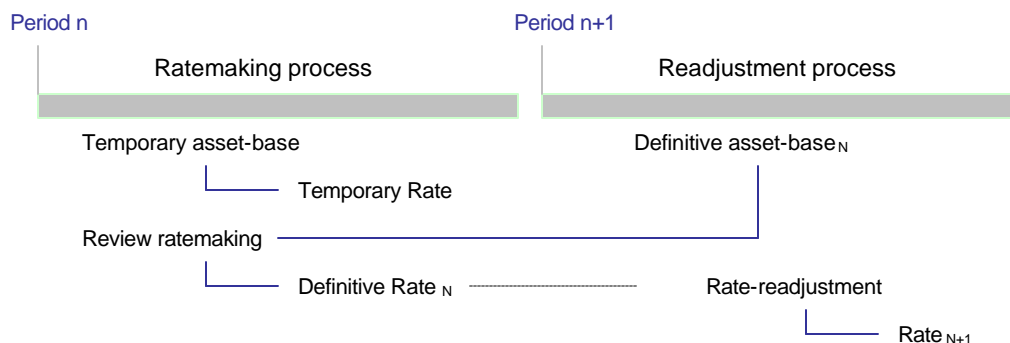
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<sup>14</sup> Energy supply prices were totally regulated at the beginning of the Brazilian deregulation process. Its transition was scheduled to decline 25% of regulated supplies per year, starting in 2003 while distributors could buy their own need in an open electricity market. ANEEL uses a Normative Value as a price cap for energy supply cost.

<sup>15</sup> ANEEL decided to use a proxy even though when the final asset-base value was not ready, because during the asset valuation process it was observed that the temporary asset values were higher than the result of ODRC Methodology.

<sup>16</sup> It is not the realized income, but the assumed income considering a regulatory consumption forecast times regulated rates.

Figure 6 – Mechanism to adjust temporary rates



Considering that the temporary asset-base value was higher than the definitive value, the consumers would have their rates diminished. But, in the following period rates will absorb changes in the manageable cost, which in some cases can be higher than the effect of the diminished asset-base value.

How were all these mechanisms received by the population? Newspapers published that ANEEL let private distributors wrongly overcharge consumers. This information would suggest that rates for the next period would be lower<sup>17</sup>. However, for some distributors the rate-adjustment process captured the annual increase in manageable costs, which was higher than the effect of the difference between temporary and definitive asset-base value. Therefore, consumers received the information that ANEEL made mistakes in the previous process and simultaneously they got the announcement of an increase in the new rates.

As previously said when we describe the “Capture” Theory the general public is rationally uninformed about rates calculation. Even though consumers are lately becoming more involved, they are still away to understand all nuances about natural monopoly regulation and asset-base valuation methodologies. ANEEL makes efforts to publicly clarify that the previous rate was not wrong, but the best temporary value under all circumstances at that time. However ANEEL’s reputation as a competent regulatory agency was already damaged.

<sup>17</sup> The inflation effects are not being considered here in order to emphasize the consumers’ expectations about the review in the ratemaking process.

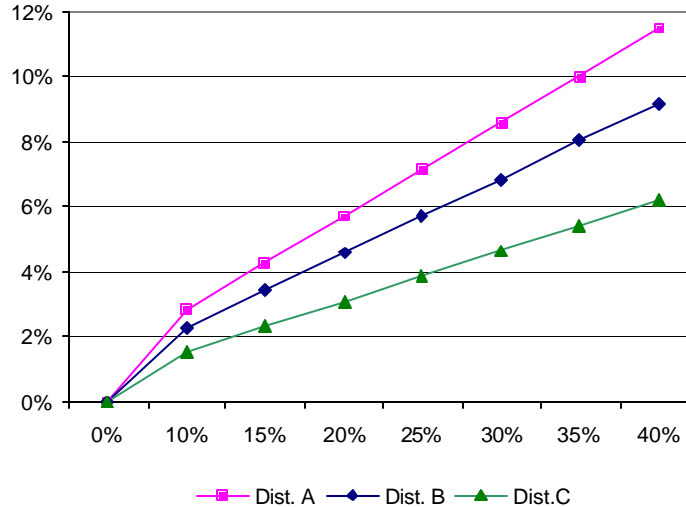
## VII – Change in rates by changing asset-base value

If we take only numbers to understand the impact of changing asset-base value in the rate calculation it is possible to identify that it depends on the total cost arrangement. As more representative investors' payments are in the total cost, the impact of the asset-base value in rates will be higher.

### VII.1. Measuring the impact of asset-base value in electricity rates

It is also possible to measure this impact in terms of elasticity in order to identify how much rates will change in percentage by changing a percentage of the asset-base value<sup>18</sup>. For this proposal we will call it rate elasticity of asset-base value<sup>19</sup>. Chart 1 depicts this situation for the three Brazilian distributors whose costs arrangement is described in previous tables 1 to 4.

Chart 1 – Change in rates by changing asset-base value



<sup>18</sup> Elasticities measure the magnitude of the responsiveness of any variable to a change in particular determinants (Browning & Zupan, 2005).

<sup>19</sup> The idea of rate elasticity of asset-base value is equivalent to price elasticity of demand

Generally distributors want to raise rates as much as possible<sup>20</sup>, since they seek maximum profit. Therefore, the higher the elasticity is, the more likely the distributor is to strive for an increase in asset base value.

$$\epsilon = \frac{\Delta V_{ab} / V_{ab}}{\Delta R / R}$$

Where:

$\epsilon$  = rate elasticity of asset-base value

$V_{ab}$  = Asset-base value

R = electricity rate

The three distributors in the example had elasticity lower than 1. Even when the investor's payment is significant in the distributor total cost – such as distributor A – the elasticity is  $\epsilon = 0,287$ . This value will lead us to infer that rate elasticity of asset-base value is inelastic<sup>21</sup>.

## ***VII.2. ODRC Weakness and Distributors' Expectations***

In the example, by changing ten percent of the asset-base value, rates will increase between 1.5% and 3.0%, which primarily does not seem to have a big impact. However, some distributors had expectations of having asset-base value much higher than ANEEL approved – Table 6 shows some significant adjustments in temporary rates, although the ODRC results are not yet approved.

In some cases, ANEEL cut off the asset-base value by more than forty percent of the temporary value<sup>22</sup>. If distributors have expectations to succeed in overvaluing asset-base in the ratemaking process, then they will be hopeful to reach a significantly higher rate and profits as well.

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<sup>20</sup> There were some small distributors that have shown concern about high rates. The main reason is that in some areas a relevant part of population is in poverty, thus distributors with high rates will be more exposed to losses since the poorest will have difficulty to afford electricity rates.

<sup>21</sup> Here we assume as references values of price elasticity of demand to construct a parallel, although it is known that the elasticity equaling 1 only can be reached by taking all cost components of electricity rate.

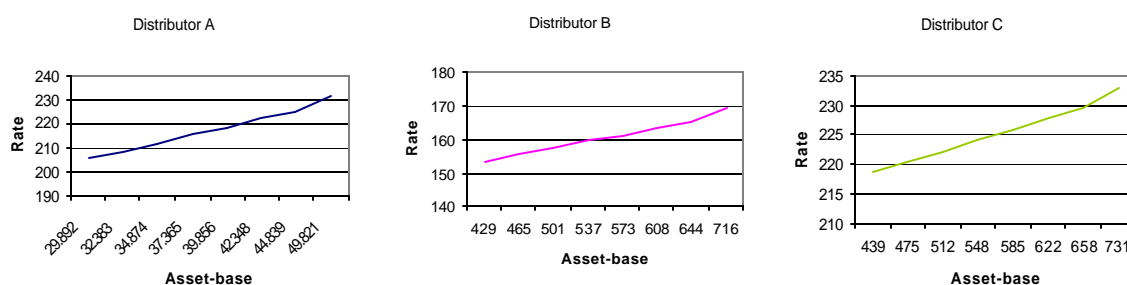
<sup>22</sup> In the table 5, CELPA had a difference of 48% between the temporary and the definitive value.

Table 6 – Adjustments in temporary asset-base values

Distributor	1st Temporary Value	2nd Temporary Value	Difference
Light	4.982.059.766,00	3.515.065.201,90	29,45%
Bandeirante	1.676.200.965,13	1.091.926.090,18	34,86%
Piratininga	1.395.178.072,13	708.000.000,00	49,25%

Indeed, the chance of having asset-base values forty or fifty percent higher means that profits can be around nine percent higher (depending on the costs structure). Then, in this situation it seems that distributors can take advantage of problems in the ODRC Methodology and its implementation procedures. Chart 2 illustrates how rates would be for different asset-base values.

Chart 2 – Effect of asset-base value in electricity rate for three Brazilian distributors



ODRC Methodology has problems while in practice and it makes the regulatory process more fragile. Therefore, if the process shows a weakness, distributors can criticize it in order to come up with a higher asset-base value. Additionally, if the distributor anticipates that the difference between temporary value and definitive value will be large, the distributor will try hard to influence the regulator to keep the highest value.

It is also possible to infer that if ODRC Methodology was not so controversial in terms of feasibility, the distributor's expectation of having an asset-base value of forty or fifty percent higher would not exist. Thus, ANEEL would not be facing the consequences of temporary rates, such as its own loss of credibility.

## VIII – Feasibility of the ODRC Methodology

The concept behind the ODRC Methodology appeals to regulators, since in theory it can meet the objectives of price regulation. Yet, the Brazilian experience by applying this methodology had become a difficult process with undesirable consequences for regulators and for society.

The ODRC values are probably more accurate than historical cost, which has evidence of being particularly far from price regulation objectives. However, the feasibility of the ODRC methodology has some weaknesses that may also compromise its results.

The first criticism is about the assumption of a second hand market, which in practice does not exist. Also, the valuation for one specific asset sometimes can not capture how much it would value in the grid as a whole.

*“The presence of substantial sunk costs and economies of scale and scope implies such a market does not exist – indeed, if a liquid second hand market for regulated assets did exist, then there would be no rationale for regulation” (ACG, 2003).*

The second criticism refers to the definition of “optimal” asset upon time. Basically the methodology starts by setting a price for a new asset and then, by comparing, the worth of the actual asset in a second hand market. The reference for the new asset is focused on service, which means that there is no need to use exactly the same asset as reference. But if a different, more efficient asset, providing the same service, is available in the market then this one shall be the reference.

Therefore, this concept captures the value of the service provided by an asset in a given level of demand. Additionally, the new asset has also to reflect a value that includes a forward-looking service potential. In the same way, the costs of the existing asset have to

consider what would be its forward-looking service potential then it will be possible to compare the existing asset to the new one<sup>23</sup>.

In some circumstances, regulators can characterize some assets as an excess of capacity for a given level of demand. Thus, this excess can not integrate the regulatory asset-base since it is not considered an efficient investment<sup>24</sup>. However, to meet a future growth of demand this excess service potential can be less expensive than replacing it for a new asset; because the actual “optimal” asset may request big changes when demand increases.

The ODRC Methodology assumes the existence of a second hand market, which implies that the future benefits for the excess service capacity will be captured by adding more value to the existent asset<sup>25</sup>. Consequently, the new replacement value will probably be higher, since usually there is a relationship between a used asset and a new one. However, the “optimal” replacement asset might not deliver more benefits than the existing asset in the future.

In order to avoid this inconsistency it is necessary to estimate the costs and services (or benefits) for the “optimal” replacement asset and for the existing asset. Then, to reach the right ODRC value the differences between the existing asset and the new one, in the forward-looking analyze, have to be compared and discounted to a present value as follow (ACG, 2003):

$$ODRC_0 = ORC_0 + \sum_{t=1}^{\infty} \frac{Serv_{new,t} - Serv_{existing,t}}{(1+r)^t} - \sum_{t=1}^{\infty} \frac{Cost_{existing,t} - Cost_{new,t}}{(1+r)^t}$$

Where  $ORC_0$  is the optimal replacement cost of the existing asset;  $Serv$  is the value of the service potential of the asset;  $Cost$  is the forward-looking cost associated with the asset;

<sup>23</sup> All discounted to a present value

<sup>24</sup> This happens because from a regulatory point of view consumers can not pay for something that is not providing them any service.

<sup>25</sup> The buyer of the existing asset will consider that the excess of capacity represents savings in the future, when the demand grows. This benefit is capture in the present while valuating the existing asset, making it more valuable.



and  $r$  is the discount rate. Also, implicit in this formulation, there is the *depreciation* that adjusts services and costs of the asset used up over time.

Accordingly, all the information described above will be required in order to have the ODRC Methodology properly implemented. So, it will depend on forecasts of too many variables. The consequence is that, in practice, the application of this methodology will certainly require highly simplifying assumptions. Indeed, in the Brazilian experience the Resolution 493/2002 explicitly allows simplifications for some kinds of assets. From this point on the perfectiveness of ODRC begins to be questionable.

In Australia, for instance, The Allen Consulting Group in its report to Australia Competition and Consumer Commission in 2003 said: *“In practice, the application of the ODRC methodology in Australia has fallen well short of theoretical ideal, and has also involved a number of highly simplifying assumptions...”*

The third problem pointed out is about the incentive to meet demand growth. Considering that distributions networks run upon economies of scale, usually systems are overbuilt in some level. However, if investors' payments are based in an “optimal” asset-base there will be a low incentive for new investments in order to meet a higher level of demand<sup>26</sup>.

In fact, when the ODRC Methodology is in to the practical field its first appeals turns in to a hard implementation with several imperfections. Until now there is no official association between the Brazilian results by applying ODRC and its feasibility problems. However, it seems to be a good factor to explains ANEEL difficulty in approving asset-base valuation reports.

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<sup>26</sup> The Allen Consulting Group in the Report to Australia Competition and Consumer Commission said that the incremental cost of expanding the actual system always exceed the change in the cost of the optimally configured system. The implication of re-setting the regulatory asset base by ODRC value is that the investor would always suffer a financial shortfall from meeting growth in demand.

## **IX – Conclusion**

The electricity distribution business has a very accurate demand forecast and a high certainty of costs recovery. Considering the risk taken by the investor as a starting point in the calculation of investors' payment, we could say that there is no risk in this business. However, the certainty of capital recovery is not sufficient; the return over the capital invested has to be "competitive" enough in order to make the investor renounce investing his money in another business or in another country.

Basically, the investor's payment is the capital invested multiplied by a certain rate of return. In electricity distribution the methodology to calculate the rate of return does not vary significantly all over the world. Commonly, it is used the Weight Average Cost of Capital – WACC Methodology combined with Capital Asset Pricing Model – CAPM. In Brazil, the result of these methodologies was a rate of return of 11.256%. In California, for instance, the rate of return varies from 8.15% to 9% depending on the utility.

Since Brazil is considered more risky than U.S it is natural to come up with a higher rate of return even though this risk is not exactly related to the electricity distribution business but to the calculation of the opportunity cost. Moreover, WACC and CAPM are well consolidated methodologies to calculate rate of return and, in Brazil, there is no relevant discussions about it.

Arguably, capital invested multiplied by a rate of return should be easy to calculate since the rate of return is well defined. Nevertheless, in the electricity distribution sector the capital invested is not trivial to identify, because regulation objectives must be incorporated. In this sense, in the electricity distribution, the return is calculated over the regulatory asset-base.

When ANEEL lunched the ODRC Methodology to value the regulatory asset-base, it was considered, in theory, the best alternative to match economic efficiency. In practice, the ODRC resulted in a long process, which has forced ANEEL to adopt temporary solutions to conclude ratemaking process in time.

Although ANEEL has allowed a large number of simplifications in the ODRC implementation, some problems are inherent to the methodology. In summary, there are three methodological problems: (i) the second hand market for electricity distribution assets does not exist; (ii) the correct new replacement asset is hard to define, and (iii) in a long term it will probably not come to an optimal asset. As a consequence, the perfect ODRC will not incentive distributors to meet demand growth.

Until now, there is no official information that links the delay in the results and the feasibility problems in the methodology in the Brazilian ratemaking process. However, we may not ignore that these problems certainly made the asset valuation process more difficult for distributors and regulators.

Indeed, ANEEL is highly concerned in eliminating inefficient electricity rates costs. For these reason ANEEL has been creating a sophisticated regulation in order to establish a “fair” *average-cost-pricing*. But, sophisticated regulation implies complexes implementation and sometimes it can become a trap for regulators. Particularly in the ODRC Methodology case, the temporary solution (historical cost) brought to the general public a feeling that ANEEL is against consumers and in favor of distributors.

The complexity of electricity ratemaking using ODRC, resulted in a temporary higher rate. Having the general public not involved in the process to capture the details, it became a problem for ANEEL credibility. In this situation misunderstanding is natural to happen.

Moreover, the ODRC methodology and its benchmark assumptions are not being applied in the way it is proposed in theory giving the simplifications assumed. Then, it is not possible to ensure that ODRC results are perfectly matching regulation objectives. A consequence of have chosen this complex methodology was higher temporary rates, which made whole ratemaking process less comprehensible for the society. Thus, ANEEL appears as a non transparency agency.

Despite all the criticism about ODRC implementation, it is not recommended to change the regulation before the first ratemaking cycle ends up in Brazil. Keeping the same methodology for all distributors is highly recommended in order to create stability in the

regulation. Nonetheless, in the next cycle it could be considered to switch to a simpler way to update the asset-base value.

The international experience has shown that regulators prefer to use price cap regulation instead of benchmark when updating regulated asset-bases. Generally speaking, regulators use an opening value for the regulated asset-base; the capital expenditure and the depreciation are considered in order to obtain the final asset-base value. Diverging in some points, specifically the opening value, regulatory agencies of the United States, United Kingdom and Australia (New South Wales, Victoria, Queensland, Tasmania and South Australia) had opted for price cap regulation in the asset valuation process.

The situation in Brazil indicates that if regulators decide for simpler methodologies then the implementation would be easier and the ratemaking more comprehensible for the general public. Additionally, the results of using a simpler methodology would probably be suboptimal, but would avoid divergences between temporary asset-base values and the ODRC values. Simpler regulation brings more credibility for regulators and more confidence for investors, consequently implies more benefits for the society.

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