IEEE POWER ENGINEERING SOCIETY
ENERGY DEVELOPMENT AND POWER GENERATION COMMITTEE

PANEL SESSION: LATIN AMERICA--PRICE CAP REGULATION: STIMULATING EFFICIENCY IN ELECTRICITY DISTRIBUTION IN LATIN AMERICA[#].

(Luiz Barroso, Tom Hammons, Ruy Varela and Hugh Rudnick)

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Track 5: Surviving New Markets and New Structures

. LATIN AMERICA--PRICE CAP REGULATION: STIMULATING EFFICIENCY IN ELECTRICITY DISTRIBUTION IN LATIN AMERICA PAPER 07GM 0430.

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INTRODUCTION

Electrical distribution companies, being network industries, transport and distribute electric power from connection points of the transmission system to end consumers for industrial and residential usage at appropriate voltage levels. This activity is organized in public service utilities (Discos) that buy power supply from generators in both the long term and sport markets.

For more than two decades, most of the Latin American countries have made drastic transformations to their electrical power sectors in both the unbundling and privatization processes of the state monopolies. As a consequence of the deregulation process, an important change has occurred in the role of the State. From the owner and operator of electric vertically integrated companies, the State has evolved to become the regulator of activities that are natural monopolies, such as electrical power distribution, owned and or operated by private or public market players. Within this framework, the challenge has been to stimulate an efficient service in distribution, similar to that that would be achieved in a competitive environment.

In order to regulate the electrical power distribution stage, most of these countries have adopted Price Cap regulations, using concepts such as the "model/standard utility" or benchmarking schemes (i.e. efficiency frontiers). The "standard utility model" corresponds to a company whose investments are economically adapted to demand and operates under an optimal plan. In setting distribution tariffs, because of the very monopolistic nature of the activity, both models (standard utility and benchmarking techniques) intend to introduce a virtual competition, trying to make companies more efficient, thus

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minimizing the present value of all their costs (capex, opex, loses and non supply energy). In general, this has meant important distribution tariff reductions, obtained through a regulated periodic process, the so called Tariff Revue.

The panel will evaluate the results of Price Cap regulation in Latin America power distribution and assess what can be learned from that experience and the challenges that may arise in the future.

Panelists and Titles of their presentations are:

1. Ruy Varela (President, SIGLA), and Eduardo Redolfi Technical Director, SIGLA) "Compared Regulations: The Tariff Revue Process in Brazil, Panamá and Perú. Paper 07GM0920 (E-mail: rvarela@sigla.com.ar)
2. Hugh Rudnick (Pontificia Universidad Catolica de Chile) and Sebastian Mocarquer (Systep). Benchmark Regulation and Efficiency of Electricity Distribution: Strengths and Weaknesses. Paper 07GM0943 (E-mail: h.rudnick@ieee.org, smocarquer@systep.cl; smocarquer@systep.cl)
3. Luis Fernando Alvarez (Siglasul). "Brazilian Discos Price Cap Regulation." Paper 07GM1022 (E-mail: falvarez@siglasul.com.br)
4. Sandra Fonseca (Consultora, ex CREG Colombia). "The Impact of WACC Calculation in the Price Cap Regulation Results: Colombian Case". Paper 07GM 1159 (E-mail: sandrastellacol@gmail.com)
5. Víctor C. Urrutia (Autoridad Nacional de los Servicios Públicos de Panamá (ASEP)). Price Cap Regulation, The Panamanian Experience from the Regulator Point of View. Paper 07GM1167 (E-mail: vurrutia@ansp.gob.pa)
6. Invited Discussers.

Each Panelist will speak for approximately 25 minutes. Each presentation will be discussed immediately following the respective presentation. There will be a further opportunity for discussion of the presentations following the final presentation.

The Panel Session has been organized by Luiz Barroso (PSR, Brazil), Tom Hammons (Glasgow University, UK), Hugh Rudnick (PUC, Chile) and Ruy Varela (Sigla, Argentina). Luiz Barroso, Tom Hammons, and Ruy Varela will moderate the Panel Session.

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BIOGRAPHIES

Luiz Augusto Barroso has a BSc degree in Mathematics, and MSc/PhD degrees in Operations Research from the Federal University of Rio de Janeiro, Brazil. He joined PSR in 1999 and has been coordinating several studies and research in the following areas: (i) economic studies; (ii) energy trading, risk management and physical-financial optimization in energy markets; (iii) system planning studies; (iii) electricity-gas integration, (iv) strategic pricing in competitive energy markets and in energy auctions and (v) regulatory assessment to private investors and institutions. Dr. Barroso has been an invited speaker on energy deregulation and power-gas system planning and economics in workshops, courses and talks in Brazil and many countries in Latin America, in USA/Canada, in Europe, and in Oceania.

Thomas James Hammons (Fellow IEEE 1996) received the degree of ACGI from City and Guilds College, London, U.K. and the B.Sc. degree in Engineering (1st Class Honours), and the DIC, and Ph.D. degrees from Imperial College, London University. He is a member of the teaching faculty of the Faculty of Engineering, University of Glasgow, Scotland, U.K. Prior to this he was employed as an Engineer in the Systems Engineering Department of Associated Electrical Industries, Manchester, U. K. He was Professor of Electrical and Computer Engineering at McMaster University, Hamilton, Ontario, Canada in 1978-1979. He was a Visiting Professor at the Silesian Polytechnic University, Poland in 1978, a Visiting Professor at the Czechoslovakian Academy of Sciences, Prague in 1982, 1985 and 1988, and a Visiting Professor at the Polytechnic University of Grenoble, France in 1984. He is the author/co-author of over 350 scientific articles and papers on electrical power engineering. He has lectured extensively in North America, Africa, Asia, and both in Eastern and Western Europe. Dr Hammons is Chair of International Practices for Energy Development and Power Generation of IEEE, and Past Chair of United Kingdom and Republic of Ireland (UKRI) Section IEEE. He received the IEEE Power Engineering Society 2003 Outstanding Large Chapter Award as Chair of the United Kingdom and Republic of Ireland Section Power Engineering Chapter (1994~2003) in 2004; and the IEEE Power Engineering Society Energy Development and Power Generation Award in Recognition of Distinguished Service to the Committee in 1996. He also received two higher honorary Doctorates in Engineering. He is a Founder Member of the International Universities Power Engineering Conference

(UPEC) (Convener 1967). He is currently Permanent Secretary of UPEC. He is a registered European Engineer in the Federation of National Engineering Associations in Europe.

Ruy Varela graduated as Industrial Engineer from the Buenos Aires Institute of Technology (ITBA, 1971) with post-graduate studies in Operations Research from the Catholic University of Argentina (UCA, 1973). He is an expert on energy economics and regulation. His recent background was developed following deregulation and privatization of the power industry in Latin America (1992), where he has managed several restructuring and/or privatization generation, transmission and distribution projects in which SIGLA was involved. His previous background was on energy planning and economics. In later years his activity has been focused on the tariff revue process of distribution in Brazil and other Latin American countries, such as Guatemala, Nicaragua, Panama, Bolivia, Peru, Uruguay and Venezuela. On the academic side he was founder and professor of "Power System Planning in Deregulated Environment" for the postgraduate course on "Power Market Management" at the ITBA (1996-1998). Ruy Varela is a founding partner and current President of both energy consultant firms SIGLA (Argentina, 1977) and SIGLASUL (Brazil, 2002).

Hugh Rudnick, an IEEE Fellow, graduated as an electrical engineer from the University of Chile, Santiago, Chile. He received the M.Sc. and Ph.D. degrees from the Victoria University of Manchester, Manchester, U.K. Currently he is with the Catholic University of Chile, Santiago, Chile and also with Systep Engineering Consultants, which specializes in power-gas system planning and operations issues. His research activities focus on the economic operation, planning, and regulation of electric power systems that specializes in power-gas system planning and operations. He has been a consultant with utilities and regulators in different countries, the United Nations and the World Bank, mainly on the design of deregulation schemes and transmission and distribution open access tariffs.

PAPERS

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1. COMPARED REGULATIONS: THE TARIFF REVIEW PROCESS IN BRAZIL, PANAMA AND PERU (PAPER 07GM0920)

Ruy Varela and Eduardo Redolfi (1)

Abstract— This paper compares the Discos Tariff Review process in Brazil, Panama and Peru, three Latin American countries where "deregulation" and privatization of the power industry and the setting of *incentives regulation* in the distribution branch has being successfully implemented through Price/Revenue Cap schemes, hence stimulating efficiency. The paper discusses how the main components of the tariff are set in the three countries and the implications of the different approaches.

Index Terms— Energy Economics; Power Distribution Regulation.

I. INTRODUCTION

Reforms in the power sector in most of Latin American countries during the 1990s (Chile, Argentina, Peru, Bolivia, Colombia and Brazil in South America, and Panama, El Salvador, Guatemala, Nicaragua and Dominican Republic in Central America) shared basic common elements: the design of a specific

Regulatory Framework; the vertical unbundling of generation, transport and distribution; the creation of a competitive Wholesale Electrical Market managed by an Independent System Operator (ISO) and granting of Transport and Distribution Concessions regulated by an autarchic Body, and the privatization of most the newly created companies independently of the former integrated public utilities.

Distribution Concessions were regulated by a new conceptual paradigm, originally applied in the United Kingdom: the *incentives regulation scheme* (also called *price-cap*, *performance-based* or *indirect regulation*), a paradigm articulated in combination with a Tariff Scheme and a Quality and Penalties Scheme. In other words, the Concession Contract ensures the Disco a monopoly with price caps to render the network service under the obligation to provide such service at service quality standards (accepted outages) and product standards (frequency and voltage levels), and subject to penalties in case of non-compliance. This philosophy implies the Disco freely decides on the resources applied to the management (Capex and Opex) and allows for clear discrimination between the roles and responsibilities of the service *supplier* (Concessionaire) and the *controller* (Regulatory Body), thus avoiding constant resource and tariff negotiations between the governmental controlling agencies (which authorized budgets, investments and tariffs) and the utilities, a confusing process that has been the historical source of politization, insider trading and mismanagement leading most public power utilities in South America to chronic deficit.

The term *incentives regulation* applied to distribution comprises the *Price Cap* and the *Revenue Cap* methods. Although similar, the concepts differ on whether the "cap" is applied to *tariff*s (as in Peru) or to the Disco's total *revenue* (as in Brazil and Panama). However, since the Concessionaire's revenue is allocated to the different customer groups (put together in different Tariff Categories), both methods become equivalent as long as no cross-subsidies are applied; therefore, we will refer to both concepts as Price Cap, as generally found in the literature.

The advantage of the Price Cap over the Cost Plus scheme applied in the USA and most of Latin American countries before the "deregulation" is a question of responsibilities and risks. Whereas in the Cost-Plus scheme the Disco passes through all of its costs to the captive customer with the restrictions imposed by the control authority on an annual-basis process, in the Price Cap scheme -once the revenue is established for the 4 to 5 years tariff period- the Disco is free to manage its costs and an incentive to convert the benefits resulting from the efficiencies obtained, which will be ultimately passed through to the customers in the subsequent tariff period, after the corresponding Tariff Review.

This work is organized as follows: sections II to IV present the Peruvian, Panamanian and Brazilian cases, and section V discusses the main conclusions of the compared regulations.

PERU

The legal framework applicable to Distribution Tariffs in Peru is based on the Chilean model and is ruled by:

- Decree-Law Nº 25844, Law on Concessions of Electricity (LCE),
- Supreme Decree Nº 009-93-EM, which regulates the LCE,
- Decree-Law Nº 27833 on Transparency and Simplification of Tariff Setting Procedures,
- OSINERG Resolution Nº 001-2003-OS/CD: Procedures for Setting Regulated Prices and OSINERG Resolution Nº 181-2005-OS/CD: the Setting of Electricity Distribution Tariffs applicable to the November 2005-October 2009 period.

Tariff periods in Peru extend for four years and three Tariff Reviews have already been performed.

The OSINERG (Supervisory Agency for Private Investment in Energy) is responsible for the regulation and control, and is the equivalent to the Regulatory Body. For the purpose of Tariff Reviews, the Peruvian regulation includes the concept of "Typical Sectors" (TS). TSs represent a set of homogeneous power distribution systems in terms of the geographical load arrangement characterized by the *load density* (i.e. high-density urban sector, medium-density urban sector, low-density urban sector, urban-rural sector, rural sector). OSINERG calculates the standard costs of an *actual distribution system* called "Model Utility" and representative of a TS. This means the Model Utility is made up of a *homogeneous subsystem* of an *actual utility*. Then, OSINERG determine the Distribution-Added Value (DAV) for every Model Utility.

In compliance with the LCE, the DAV comprises:

- the commercial costs (associated to the consumer regardless of its power and energy demand), represented by the fixed charges in tariffs;
- the standard power distribution losses;
- the standard Capex and Opex per kW, which make up the medium and low voltage DAV.

DAVs are then validated by verifying the return of homogenous groups of Discos, calculating the resulting Internal Rate of return (IRR) for the immediate preceding year. If such IRR falls within the range of the Rate of Return established by the Law (12% +/- 2%), DAVs will be final, otherwise, they are proportionally adjusted to reach the limits of such range. For the purpose of presenting DAV calculations and the tariffs resulting from the process described, the OSINERG calls for Public Hearings.

Which is the rationale that distinguishes the Peruvian regulation when it comes to calculating distribution tariffs?

1. Typical Sectors: since the load density is the main driver of distribution costs, modeling homogeneous power systems allows for evaluating costs with increased accuracy. Then, results are generalized for the actual utilities by applying their share of TS.
2. Regulatory Asset Base (RAB): regulations establish the standard New Replacement Value (NRV), i.e., that of the Model Utility economically adapted to the load in the initial year of the new tariff period.
3. Capex: results from the RAB annuity, i.e. the NRV times the Capital Recovery Factor for a standard life of 30 years and an actual discount rate of 12%.
4. Opex: standard operating and maintenance costs of the Model Utility. The regulation does not establish a specific calculation methodology, as it is the case in Brazil, although it applies methods similar to those described in section IV.
5. X-Factor: comprises the Economy of Scale Factors (ESF) which are determined to capture the effect associated to demand growth (number of customers and unit consumption in the area served). DAV of the subsequent years is determined by indexing the values of the initial year (RPI) and adjusting them by the ESF (-X).

II. PANAMA

The legal framework applicable to Distribution Tariffs in Panama is based on the English model and is ruled by:

- Law Nº 26/96 that creates the current National Authority for Public Services (ASEP),
- Law Nº 6/97: Institutional and Regulatory Framework for Power Services as amended by Law Nº 10/98,

- Resolution JD-5863/06: Rules for the Distribution and Commercialization of Power Services that includes the Tariff Scheme.
- Document for Public Consultation by the ASEP: "Maximum Allowed Revenue for Power Distributors for the 2006-2010 Period" [2].

Tariff periods in Panama extend for four years and two Tariff Reviews have already been performed.

As mentioned in section I, Panamanian regulation is based on a Revenue Cap scheme, locally called Maximum Allowed Revenue (MAR). In order to calculate the MAR, the following concepts should be previously defined:

- the Representative Areas, equivalent to the Peruvian Typical Sectors;
- the Comparative Utilities and the Efficiency Equations for the Capex and Opex benchmarking,
- the Rate of Return, and
- the Regulatory Asset Base (RAB).

Unlike for the 1st Tariff Review (and the Peruvian Model) only one Representative Area per Utility was selected for the 2nd Tariff Review.

Comparative Utilities, as for the 1st Tariff Review, were obtained from the FERC's database on account of its good quality. Eighty-one companies were selected.

The Tariff Scheme establishes the drivers of distribution costs are:

- the total number of customers,
- the Disco's total maximum load, and
- the amount of energy sold.

These variables represent the basis for the Benchmarking Efficiency Equations, which account for the different costs concepts:

- Distribution Assets.
- Commercialization Assets.
- Administration Opex,
- Distribution Opex,
- Commercialization Opex, and
- Efficient Losses.

The Rate of Return is calculated on the basis of the WACC model; however, Law Nº 6 establishes that "the rate shall not differ in more than two points from the rate resulting from adding the actual annual interest rate, average of the twelve months preceding the date in which the tariff formulae is set, the 30-year US Treasury Bonds, plus an eight-point premium for the risk inherent to power distribution in the country." The ASEP set the rate for the 2006-2010 period at actual 10.59% before taxes.

The Regulatory Asset Base (RAB) established by Law Nº 6 is determined at book values: "Fixed Assets in operation, as estimated by the Regulatory Body for the effective period of tariff formulae. This estimation shall be based on the Concessionaire's book value, at the original cost, at the beginning of the (tariff) period, under the assumption of economic efficiency of investments by the Concessionaire during the (tariff) period." However, the Tariff Scheme approved in 2006 established the ASEP shall perform an efficiency analysis" on the value of the Concessionaire's investments

registered in the books, an analysis which, in fact, acts as a reducer of the RAB.

On the basis of the elements presented, the MAR is calculated with the formula:

MAR= (ACTSPD)*(DEP%) + (ACTNSPD)*(RRD) + ADMD + OMD + COMD + PERD,
where:

- ACTSPD: present value of efficient Gross Assets at book values plus the investments weighed at efficient costs to cover withdrawals and increase in demand.
- DEP%: lineal depreciation rate in the life of assets (30 years).
- ACTNSPD: present value of efficient Net Assets at book values plus the investments weighed at efficient cost to cover withdrawals and increase in demand.
- RRD: Disco's regulated Rate of Return.
- ADMD: efficient Administration Opex.
- OMD: efficient Distribution Opex.
- ADMD: efficient Commercialization Opex.
- PERD: recognized efficient losses.

Hence, the conceptual aspects that distinguish the Panamanian regulation to calculate distribution tariffs are:

1. Representative Areas: they were actually eliminated from the last Tariff Review, and only one Area was allocated to each Disco.
2. RAB: efficient Fixed Assets at the Concessionaire's book values.
3. Capex: the initial RAB plus the efficient investments to calculate the Gross Assets and Depreciations; the Gross Assets minus the accumulated depreciations to calculate the Net Assets and the Return on them. Investments result from a benchmarking analysis (DEA) with Comparative Utilities from the FERC. Depreciations are lineally calculated for a standard 30-year life.
4. Opex: efficient Opex result from a benchmarking analysis (DEA) with Comparative Utilities from the FERC.
5. Losses: efficient losses result from a benchmarking analysis (DEA) with Comparative Utilities from the FERC.

III. BRAZIL

The legal framework applicable to Distribution Tariffs in Brazil is ruled by:

- Law Nº 8987/95 that approves the Concession Regime,
- Law Nº 9074/95 and Amendment 9648/98 that regulate the granting of Concessions,
- Law Nº 9427/96 that creates the Regulatory Body ANEEL (National Electric Energy Agency) and defines the X Factor.
- ANEEL Resolution 493/02 that approves the Regulatory Asset Base (RAB).

There are 64 Distribution Concessions within the federal jurisdiction in Brazil, with a model contract that:

- establishes the principle of preserving the Concession *economic-financial balance*,
- defines the concept of tariffs regulated by Price Cap,
- sets the obligation to supply under quality conditions and to perform investments at the concessionaire's own risk,

- sets restrictions and penalties on product and service quality (Non Supplied Energy price up to 10 times the energy value),
- forces the concessionaire to enter into supply and transport agreements,
- establishes tariff resetting mechanisms: Annual Adjustment (RPI-X), Ordinary Tariff Reviews every 4 years and Extraordinary Tariff Reviews,
- The distributor's Revenue is made up of two components: A (unmanageable costs: capacity and energy supply; transport and efficient losses in the wholesale market) and B (manageable costs: distribution Opex and Capex).

Ordinary Tariff Reviews adjust Portion B and are divided in two stages to calculate:

1. the "Required Revenue": Opex and Capex;
2. the X-Factor.

Efficient operating, maintenance, administration and commercial costs are calculated by applying the methodology of the Reference Utility, also called Model Utility. This is based on the concept that the costs of performing a certain activity, O&M for instance, can be determined by specifying the main tasks of such activity, allocating the necessary resources (labor and materials) and valuing them at the market price in the Concessionaire's area. Thus the ANEEL aims at establishing a *market reference* adjusted to the actual geographical, climatic and macroeconomic conditions at the Disco's concession area to calculate the corresponding efficient Opex. As put forward by the ANEEL, "*the purpose is to set a reference to which the concessionaire must compete*."

The methodology used to estimate the Return on Assets is the WACC, applied to a RAB assessed as established by Resolution 493/02. The regulator had previously turned down claims by the Brazilian Association of Electric Power Distributors (ABRADEE) to consider the official valuation of the utility at the time of privatization as the RAB. The spirit of Resolution 493/02 is that the RAB shall only reflect prudent investments, i.e., those necessary to render the distribution service at the quality levels established in the concession contract, at market values and adjusted by rates reflecting their utilization. This procedure, implemented by independent consultants pre-qualified by the ANEEL and hired by the Discos, is equivalent to the accounting valuation of assets with an expeditious adaptation reflecting, basically, the degree of utilization of lands and transformers.

Although the ANEEL has announced its intention to adopt the economically adapted NRV as a valuation criterion for the RAB, it has not officially implemented it; however, it has become known that the ANEEL expeditiously calculated such values and contrasted them (and eventually used them as caps) with those resulting from applying Resolution 493/02.

The Depreciations are calculated by applying a linear rate that reflects the average accounting life of immobilized assets in service excluding lands.

For the first tariff review process, the ANEEL set a methodology that integrates three components into the X Factor:

- Xe represents the productivity gains derived from economies of scale resulting from market expansion (increase in the number of customers and consumption/customer),
- Xa represents the gains derived from the increase on economic productivity, and
- Xc represents the level of customer satisfaction (commercial service quality).

Xe is obtained by the discounted cash flow method, where investments are forecasted by an

econometric formula that shows the decreasing marginal cost with increasing demand. Xa is valuated as the difference between wholesale and retail price indexes, and Xe is determined on opinion-poll basis among captive customers and carried out by independent surveyors.

One of the virtues of the Brazilian process is that the ANEEL submits all of its technical notes and resolution bills to public discussion through the Internet “virtual hearings”, as well as through “actual” public hearings, and incorporates many of the proposals put forward through these institutional channels.

In sum, the first tariff review process in Brazil is characterized by:

- Opex: Reference Utility.
- RAB: accounting base plus an accounting valuation at market price and an expeditious adaptation.
- X Factor: productivity gains resulting from economies of scale, increase of economic productivity and commercial quality.
- Losses: a target is established to reach the level of efficient losses as defined by the ANEEL.

The ANEEL has recently announced some methodological changes for the second tariff review [4] which can be summarized as follows:

- Reference Utility: parameters related to central structure and other costs to be determined by benchmarking.
- RAB: the base at the end of the first tariff review shall be shielded and rolled forward by two tariff periods. Improvement of asset utilization criteria. Creation of an ANEEL’s Price Reference Database.
- X Factor: elimination of the Xc sub-factor (commercial quality).

IV. CONCLUSIONS

The following table presents a comparison of relevant aspects of tariff reviews in all three countries:

	Peru	**Panama**	**Brazil**
Number of Discos	20	3	64
Tariff Reviews	3	2	1
Tariff Period	4 years	4 years	4 years
Analysis Period	First year	Tariff Period	First Year
Typical Sectors	Yes	Yes (1st TR) No (2nd TR)	No
RAB	NRV Adapted	"Efficient" Accounting	"Efficient" Accounting
Investments	NRV Adjusted	Benchmarking	Econometric Formulae
Opex	Model utility	Benchmarking	Model utility
X Factor	No	Economies of Scale	Economies of Scale and Economic Productivity
Losses	Regulatory Body criteria	Benchmarking	Regulatory Body criteria

The main differences are found in:

- The Analysis Unit: while some countries take Typical Sectors (Peru and Panama for the 1st TR), others consider the Disco as a whole (Brazil and Panama for the 2nd TR).
- The RAB: Adjusted NRV (Peru and Brazil as reference) vs. efficient Books Value (Panama and Brazil).
- Opex: Model Utility vs. Benchmarking.

In general, the most controversial conceptual issues have been the power of regulatory bodies to review investments recorded in the accounting books, particularly their unit prices (Panama and Brazil), the relevance of the reference utility methodology to the performance-based regulation (in Brazil, for instance, it has been questioned and regarded as a tool closer to the direct regulation regime), and the criteria used by regulators to established the recognized levels of non-technical losses, mainly in the concessionaire's socially marginal areas.

As for the conflictive aspects of accounting bases, it is worth pointing out that the adjusted NRV does away with the debate, since it is a theoretical regulatory approach which is not in conflict with accounting procedures. Such methodology is improved when applied to homogeneous typical sectors, as it builds up representativity of the sample and the advantages of power system modeling. Modeling, in turn, improves with the development of ever-more powerful software and computerization of databases -as those resulting from GIS, for instance.

The reference utility model has been criticized; yet, the alternative benchmarking methodology is more related to the incentives regulation, as it allows for the establishment of relative efficiencies while not aiming at emulating the Discos' organization and management model, but limited by the need for reliable and homogeneous databases -like those of the FERC, for example.

Determining more objective criteria and methodologies to set levels of non technical efficient losses appears to be the "pending subject" of the process; however, it is to be accepted that even an improved distribution management can't do much in the marginal and poverty-stricken areas without the joint involvement of all governmental powers.

Nevertheless, and without going into the detail of the distribution tariff reviews carried out in the Latin American countries mentioned in section I —of which Brazil, Panama and Peru are but a quite representative sample of countries and regulatory structures, it is possible to verify the effort made by governments, regulators, distributors the electricity market and the society in general to systematize a fair and transparent regulatory process aimed at enhancing distribution efficiency in favor of final users — captive customers and users of the toll networks, while preserving business profitability and sustainability.

As far as this process is sustained and enhanced over time, as it actually has occurred to date, it will continue to set the case for the structural reform of the power industry, which is what our countries are in need of.

V. ACKNOWLEDGEMENTS

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Ruy Varela graduated as Industrial Engineer from the Buenos Aires Institute of Technology (ITBA, 1971) with post-graduate studies in Operations Research from the Catholic University of Argentina (UCA, 1973). He is an expert on energy economics and regulation. His recent background was developed following deregulation and privatization of the power industry in Latin America (1992), where he has managed several restructuring and/or privatization projects on generation, transmission and distribution in which SIGLA was involved. His previous background was on energy planning and economics. In later years his activity has been focused on the tariff revue process of distribution in Brazil and other Latin American countries, such as Guatemala, Nicaragua, Panama, Bolivia, Peru,

Uruguay and Venezuela. On the academic side he was the founding professor of “Power System Planning in Deregulated Environment” for the postgraduate course on “Power Market Management” at the ITBA (1996-1998). Ruy Varela is founding partner and current President of both energy consultant firms SIGLA (Argentina, 1977) and SIGLASUL (Brazil, 2002).

Eduardo Redolfi graduated as Mechanical and Electrical Engineer from the Cordoba National University (UNC, 1967). He is an expert on transmission and distribution system design and construction. His recent background was developed following deregulation and privatization of the power industry in Latin America (1992), where he has managed several restructuring and/or privatization projects on generation, transmission and distribution in which SIGLA was involved. In later years his activity has been focused on the tariff revue process of distribution in Latin American countries, such as Guatemala, Nicaragua, Panama, Bolivia, Peru, Uruguay and Venezuela. Eduardo Redolfi is the Technical Director of SIGLA Energy Consultants of Argentina.

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2. BENCHMARK REGULATION AND EFFICIENCY OF ELECTRICITY DISTRIBUTION: STRENGTHS AND WEAKNESSES (PAPER 07GM0943)

Hugh Rudnick (Pontificia Universidad Catolica de Chile) and Sebastian Mocarquer (Systep).

Abstract- A growing challenge in the restructuring of the electrical sector, where competition is introduced in the generation area, is to achieve equivalent efficiencies in the electrical distribution service, an activity that develops in a monopolistic environment. Chile has had an experience of over 20 years of applying benchmark price regulation to its distribution companies. This summary discusses the strengths and weaknesses of the Chilean benchmark scheme .

I. INTRODUCTION

Electrical distribution companies, being network industries, aim to the transport and distribution of electric power from specific points in high or medium voltage lines to end consumers at appropriate voltage levels for industrial and residential usage. This activity is organized in public service utilities that obtain power supply through contracts with generators.

During the last two decades, many countries and geographical areas of the world have made drastic transformations in their electrical sectors, both in terms of segmentation and privatization of state monopolies. Because of these transformations, a big change in the role of the State has been witnessed. The State has transformed itself from a producer and enterprise-owner agent into an agent that regulates those stages of the electrical sector that become natural monopolies, such as electrical distribution. The challenge is to stimulate an efficient service in distribution, similar to that that would be achieved in a competitive environment [5].
To regulate electrical distribution, most Latin-American countries that have started this transformation have adopted a “benchmark” scheme, using the concept of an efficient company that is a company that is adapted to demand and that operates under an optimal investment and operations plan. Under this scheme, to force companies to be efficient, the regulator fixes prices according to the costs of an efficient company, designed from square one and without considering actual companies. The actual company will get a normal profitability only if it is capable of emulating the efficient company, reducing its operating and investment expenditure, thus minimizing the present value of its costs. In general, this regulation has implied a reduction trend in distribution tariffs.

This paper assesses the 20 year experience of Chile in applying benchmark price regulation to its distribution companies. It discusses the strengths and weaknesses of the Chilean benchmark scheme.

II. THE DISTRIBUTION ACTIVITY

The distribution activity is characterized by the constant investments to be made to render good services and to achieve the various scale economies that can be attained by companies when developing their facilities and their management and operation. Although economies of scale add up efficiency, they also make the revenues generated through a marginal cost tariff not to be enough to cover these companies’ total costs. Likewise, the strong inter-dependence of investments and the long capital-recovery period give origin to a costs function that is clearly under-additive for the relevant demand range. This takes to conclude that it is more socially efficient to have a single company instead of several companies operating in a same geographical area. In this manner, and as it is a matter of

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guaranteeing maximum coverage, with the highest quality and least price possible, single distribution companies are justified and they are allowed to operate as a natural monopoly.

Within this framework, since there is no market competition, the primary goal of any regulatory scheme is to provide the appropriate incentives to companies to force them to be efficient and through an adequate price signal, to make them to be able to transfer, in the long term, part of their benefits to the users given their efficient investment and operating policies [4]. Based on these principles, the regulation of natural monopolies is made through different approaches [1, 2].

Regarding costs associated to the activity that is intended to be remunerated, they are associated to the network exploitation, maintenance and expansion components. They can be grouped into the items indicated in Fig. 1.

III. DISTRIBUTION REGULATION CHALLENGES

The tariff regulation is a very complex and demanding process, considering:

•The need to adequately identify and value the different components
•The need to fairly and transparently weight the influence of factors such as network type – rural or urban – overhead or underground lines, and the type and density of consumption present in the company's activity
•The convenience of emitting signals to encourage the adoption of more efficient behaviors by the companies performing in the concession areas

These challenges have been treated differently in regulations, some using rate of return and price cap methods, or in the case of Chile, and other countries in South and Central America, adopted a "benchmark" scheme, using the concept of comparison with an efficient company. All methods serve the same final objective, but the context in which they were created where different, making them more suitable than others depending on the general environment of the country. In the case of Chile, benchmark methodologies were appropriated twenty years ago when Chile was a fast developing country, and still is, with high needs of investment across all economic sectors, which demanded high investment rates in energy markets. Benchmark methodology provided clear signals of investment and stability for recently privatized utilities, and forced for efficiency.

In Chile, where the next tariff process is due to commence in early 2008, a reform to the distribution regulatory model is currently been discussed, the Government assessing other price cap schemes.

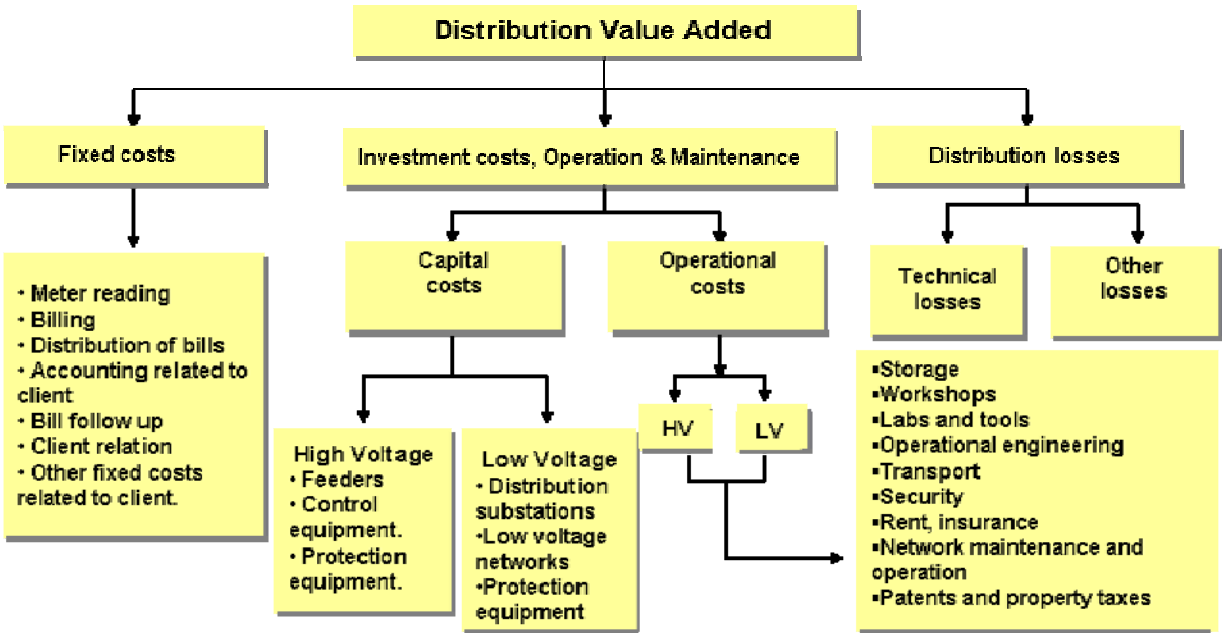

Figure 1.- Cost components of the distribution activity

IV. THE BENCHMARK IN ACTION

There have been 20 years of experience in Chile in applying benchmark price regulation to its distribution companies. As Fig. 2 illustrates for the low voltage segment of the largest Chilean distribution company, the remuneration of the distribution business has followed a downward pattern, with an overall reduction of 44% since 1984.

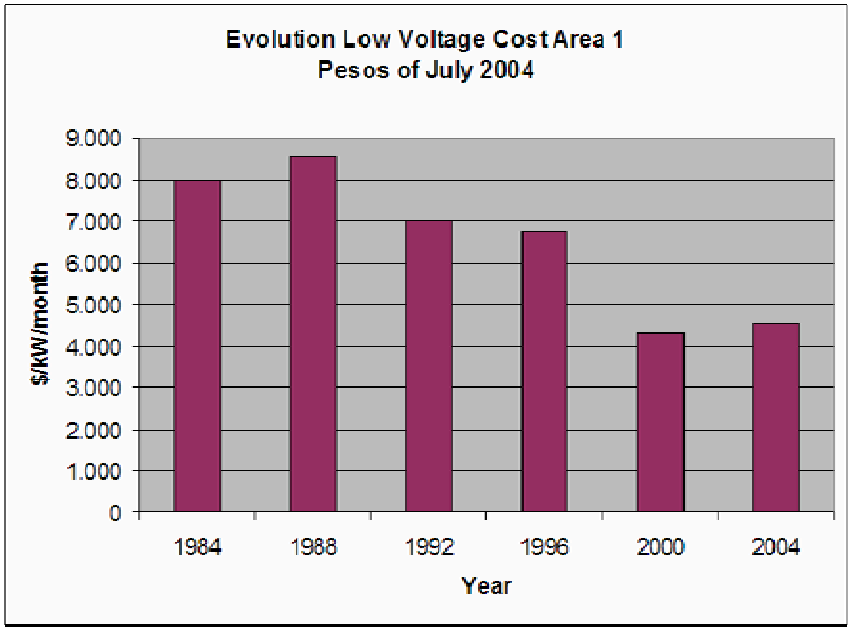

Figure 2.- Costs recognized for low voltage distribution

Nonetheless the cost reductions, returns for the distribution companies have been very favorable concentrating between 10 % and 20%, as can be seen in Figure 3. This solely fact is what leads to question if fairness has been achieved and if there has been or not an adequate transfer of benefits to the final consumers, given the distribution companies efficient investment and operating policies.

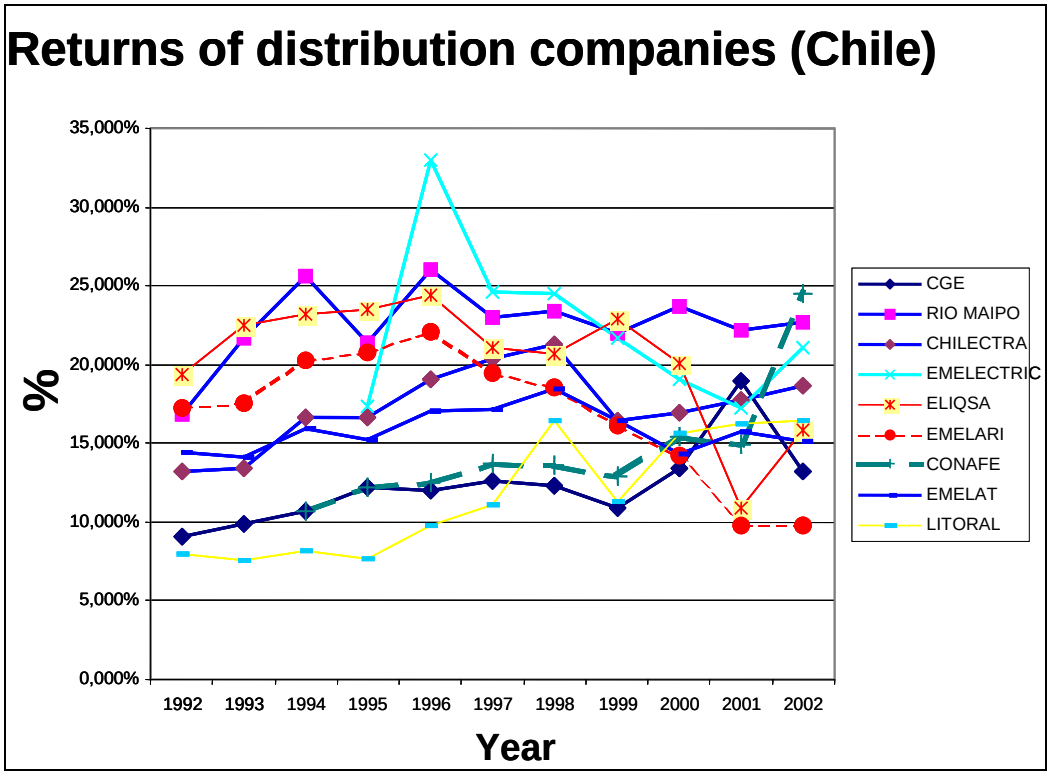

Figure 3.- Return of distribution companies in Chile

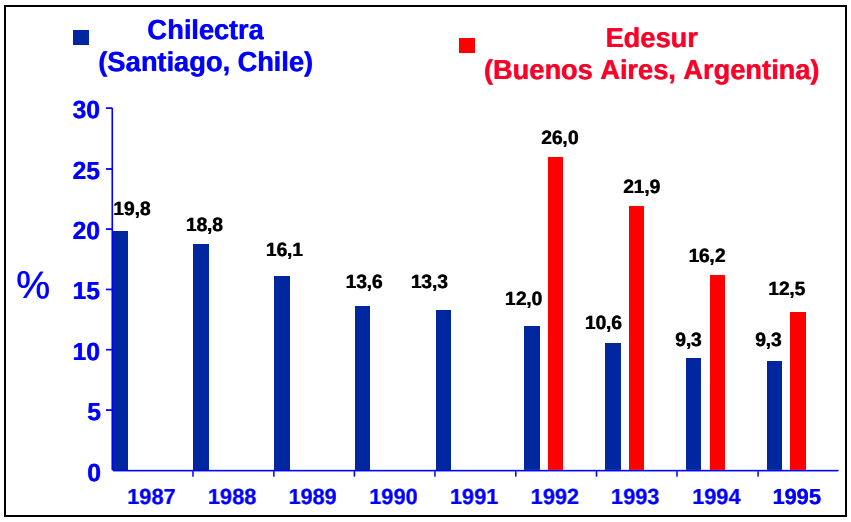

Figure 4.- Loss reductions – technical and non technical

It is clear that distribution companies have been able to gain efficiency through out the time, reflecting the clear incentives of the benchmark methodology. Reductions of technical and non technical losses are shown in Fig. 4. Reduction of losses has been achieved over time, reducing them more than 50 % in less than ten years.

V . THE BENCHMARK CHALLENGES

The benchmark process has faced different difficulties over the years, with conflicts arising over interpretation between the regulator and the companies involved. While the regulator aims at reducing tariffs as much as possible, the companies aim at increasing their revenues. Some of the areas of conflict are described.

a). Technologies

The use of an efficient model company requires designing a distribution company from square one, in which it is possible to evaluate different technological alternatives that not necessarily are in use by the concessionary company, leaving aside the historical practices. In this sense, the evaluation of conductor technologies is a matter of permanent discussion, for example, the use of copper versus aluminum, the determination of distribution voltage, the range for optimal use of the conductors and the compared length of networks of low and high voltage. The studies show that the model company installs practically the same amount of network of low voltage, but with a greater transport capacity, mainly correlated with the street layout, and installs a high voltage network of smaller length, conditioned by the optimization of the secondary transformers.

In relation to secondary transformers, the total installations are evaluated, considering both location and capacity. The studies show that the model company installs a smaller number of transformers of greater capacity and better located, which nevertheless results in a greater total installed capacity with a lower cost than the concessionary company, essentially due to economies of scale.

b). Management

Certainly an area that causes conflict in the building of the model company bears relation to the design of the organization and infrastructure necessary to administer, operate and maintain the distribution network of the company. Aspects such as organization design and the number of workers, level of outsourcing of functions, such as maintenance or commercial areas, are permanently discussed and subject to different views between the regulator and the distribution companies.

c). Economies of scale and prices

With the objective to determine the value of the efficient model company, it is necessary to have studies of market prices of the necessary items for the installation and operation of the distribution network, as well as studies of wages for the employees of the model company. There is a permanent discussion on different issues, such as the concept of market price, given the difficulty to obtain price references of specific equipment, which often forces to use actual information from the company, and the level of wages adapted for the distribution company, which is generally obtained from a survey of prices and benchmark with other companies.

Another subject of discussion the price to consider for commodities at the time of the study, such as steel, copper and aluminum, the discussion arising in relation to the model being valued at a cost that does not correspond to the one historically incurred by the monopoly. Possibly, it can mean a sub valuation of the company, if the commodities at the time of the fixation correspond to historical lower of prices, or viceversa.

d). Municipal rights

Municipal rights have to be paid for the construction of new infrastructure when public roads are used, rights which are related to the ground occupation for the construction. Although these rights have not necessarily been paid historically by the companies, they are costs that any new entrant must assume. For this reason, these costs are recognized in the model company, principle that is consequent with the objective to simulate the competition produced by a new entrant. This is an important difference with other models of tarification, like rate of return or price cap regulations, and has been very controversial in past processes.

In general, the benchmark process needs to follow general guidelines that may also be difficult to achieve.

For example, it is very important to assure regulator independency from monopoly pressure, and avoid regulator capture. This is a key issue in any of the schemes that have been formulated to tariff the distribution segment. The benchmark model exacerbates conflictive interests between regulator and monopoly. On another hand there is always the risk that the regulator could manipulate the model company with other objectives, such as political interests to lower rates.

Also it is very important to consider reliability and quality of supply, especially since the model company has to necessarily comply with current reliability and quality regulations, same as the existing distribution companies. Therefore, there has to be a consistency between the standards of quality and reliability that are required and the level of income set by the resultant tariff.

Currently there are other concerns related with the procedures for the tariff fixation in Chile. For example, the law requires that when the model company is to be calculated, two independent studies must be done, one by the distribution company and a second one done by the National Energy Commission. The results of these two studies must be averaged considering a weight of two thirds for the government and one third for the distribution company. This mechanism obviously has the perverse incentive to raise the values of the study in one hand and in the other to reduce it to minimum, leading to a speculative game. Alternatives mechanisms are currently being revised to replace it.

Certainly another limitation that is present in the process are the asymmetries of information in the knowledge of the consumer needs and the consumer load characteristics. In Chile there has been little done on load characterization and if the distribution companies have anything, there is nothing that forces them to provide it to third parties.

VI. CONCLUSIONS

The Chilean experience with a benchmark scheme to determine distribution rates, using the particular concept of an efficient company that is adapted to demand and that operates under an optimal investment and operations plan, has resulted in a sustained evidence of efficiency, though clear incentives for cost reductions, and attraction to investors, given adequate returns to investment capital.

Nonetheless, greater fairness in efficiency sharing is an objective that although it is partially achieved, should be revised, in order to allow a larger transfer of benefits of the scheme to end users.

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Hugh Rudnick, IEEE Fellow, is a professor of electrical engineering at Pontificia Universidad Catolica de Chile. He graduated from University of Chile, later obtaining his M.Sc. and Ph.D. from Victoria University of Manchester, UK. His research and teaching activities focus on the economic operation, planning and regulation of electric power systems. He has been a consultant with utilities and regulators in Latin America, the United Nations and the World Bank.

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3. BRAZILIAN DISCOS PRICE CAP REGULATION. (PAPER 07GM1022)

Luis Fernando Alvarez (Siglasul)[#].

***Abstract*—**this paper presents an overview of the Distribution regulatory framework in Brazil, describes and analyzes its development over time and the methodologies applied by the Regulator to determine the regulated revenue. Finally, a diagnosis is presented of the results obtained during the first Periodic Tariff Review (PTR) and the trends expected for the second review period.

Index Terms— Distribution system economics, price-cap regulation.

I. INTRODUCCION

The Brazilian electricity Distribution sector has experienced significant changes as from the mid 1990s; it replaced a *cost-plus* for a *price-cap* regulation in order to generate incentives to enhance the utilities' management efficiency, including vertical unbundling and partially transference of public utilities to the private sector.

Transition was not easy and was affected by a number of unfavorable events, namely:

- service subsidized tariffs during the public administration as a result o several governmental plans to combat inflation during the 1980s,
- political difficulties during the implementation of the reform (the first Discos were privatized in 1996),
- a strong currency devaluation at the beginning of 1999,
- the electricity rationing crisis resulting from lack of generation investments (a 20% demand reduction was registered between 2001 and 2002, with the consequential loss of revenue),
- absence of a regulatory framework in the distribution companies Discos' concession contracts to rule the tariff setting systems,

PTR first process implementation was also complex since:

- it occurred in the context of a political transition to the present government (2003),
- it had a social impact resulting from price adjustments,
- it led to a process of regulatory improvement that included the debate and adjustment of methodologies for the second PTR starting in 2007.

This paper presents an overview of the Brazilian distribution sector (section II), describes and analyzes the regulatory framework applied during the first PTR (section III) and the regulatory adjustments for the second PTR (section IV). Conclusions are presented in section V.

II. OVERVIEW OF THE BRAZILIAN DISTRIBUTION SECTOR

A. DESCRIPTION

The Brazilian electricity distribution sector is made up of 64 Distributors (Discos) rendering the service in 26 states and the federal district.

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They supply a total of 58 million customers (185 million inhabitants) in an area of 8.5 million $km^{2.}$

In 2005, Discos distributed a total energy volume of 265 TWh/year, representing an annual revenue of R$68 billion (US$ 32 billion) at current prices.

Both public and private utilities operate in the distribution sector, which is regulated at the federal level by the National Electric Energy Agency (ANEEL).

B. DISTRIBUTION RESTRUCTURING

State and federal distribution utilities historically rendered the service at tariffs set by Law, along with a complex system of subsidies and compensations that evened out the tariffs to be applied at a national level homogenize.

In 1993, Discos were authorized by law to determine their own tariffs, subject to approval by the Licensing Authorities.

This measure aimed at adjusting tariffs according to the actual costs of service rendering by each concessionaire (cost plus) in the light of future privatizations included in the National Privatization Program (NPP) enacted in 1990.

The system was modified in 1995 with the Real Plan which reversed indexation of the economy.

Deregulation of the distribution sector began in 1995 with the enactment of the Law on Concessions and the first privatizations of Discos in 1996.

ANEEL was created at the end of 1996 with purpose to regulate and monitor electricity distribution concessions in Brazil.

The Agency is in charge of regulating and carrying out all the Discos' PTR processes.

In 1998, the new general structure of the electric power sector, The Model ("O Modelo") was established by Law.

The first PTR period occurred between 2003 and 2006.

As a consequence of the rationing crisis in 2001-2002 and in order to prevent future supply crises, the new government (2005) restructured the model to ensure supply expansion.

The new model ("Novo Modelo") modified the rules under which distributors can contract generation: Discos serving the captive market are obliged to contract exclusively in the pool and new agencies are created to favor the conditions for generation expansion.

In 2006, at the end of the first PTR, the regulation methodology was subject to debate in the sector and ANEEL approved regulatory adjustments for the second PTR starting in 2007.

III. THE DISTRIBUTION REGULATORY FRAMEWORK

A. CONSTRUCTING THE REGULATORY FRAMEWORK

Both the Law on Concessions enacted in 1995 and the Discos' Concession Contracts (entered into after the deregulation of the distribution sector) establish that:

- tariffs are price-caps, and
- shall be annually adjusted by the wholesale price index (IPGM) corrected by the X Factor.

The X Factor partially captures the productivity gains inherent to the increase in business scale during the tariff period (three to five years depending on the concession contract).

Concession Contracts also established that PTRs be carried out at the end of every tariff period in order to:

- reestablish the financial-economic balance of concessionaires operating under efficiency conditions, i.e., determine the Regulated Revenue that allows the efficient concessionaire to obtain a fair return, and

- determine the X Factor to be applied in the following period.

The first tariff review started by mid 1998 (ESCELSA, the Disco at the Espiritu Santo State) and ANEEL submitted a first draft to discuss the basic criteria to be implemented; yet, no contributions from the sector were received.

At the end of 2000 ANEEL called a public hearing and submitted the basic guidelines of the regulatory methodology for ESCELSA's second PTR, and indicated such criteria could be subject to amendments for the future reviews.

This time, the agents and specialists in the sector made significant contributions.

In 2002, the different Technical Notes, hearings, sectoral debates, and Resolutions consolidated the regulatory methodology to be massively applied to the remainder 63 Discos during the 2003-2006 period.

Undoubtedly, the most controversial issue was the determination of the Regulatory Asset Base (RAB) which gave rise to a number of conflicts and administrative and judicial claims by the Discos, which delayed the definite implementation of most of the processes.

B. THE FIRST PTR

In order to reestablish the Concession Contract financial-economic balance, ANEEL determined the Regulated Revenue, which is composed of manageable and unmanageable costs.

The calculation is based on the forecast market for the first year of the new tariff period (Test year).

Unmanageable Costs comprise:

- power purchases (sells + losses),
- costs for the use of the transmission system,
- taxes and rates.

These costs are, *a priori*, beyond the concessionaire's control and are totally passed through to consumers.

Manageable Costs are those effectively under the concessionaire's control and encompass:

- operating costs,
- return on capital, and
- depreciation,

and thus, the efficient concessionaire can obtain a fair return on capital.

Operating Costs involve the management, commercial, and operating and maintenance costs in which an efficient operator should incur to supply the market.

The *Return on Capital* results from multiplying:

- the Net Regulatory Asset Base (NRAB), or efficient capital stock (net of depreciations), to provide the service by
- the Opportunity Cost to develop the distribution activity in Brazil.

The *Regulatory Depreciation* is the value to be annually recovered to replace the assets at the end of their life, and is obtained by multiplying:

- the Gross Regulatory Asset Base, or gross efficient capital stock, to provide the service by

- the Annual Depreciation Rate of assets.

Losses constitute a special case of unmanageable costs.
Distribution systems suffer both:

- technical losses, associated to power transport (joule effect, losses at the transformers, etc.), and
- non-technical losses resulting from power thefts[1], measurement errors, etc.

The concessionaire has partial control over these losses; therefore, the Regulator should include the efficient loss level in the Regulated Revenue.

Finally, ANEEL calculated the X Factor, an annual tariff reducer that partially captures productivity gains at every regulatory period.

The following paragraphs deal with the methodologies applied by ANEEL for the calculation of these components during the first PTR.

Operating Costs

ANEEL adopted the Reference Utility methodology, a virtual company that efficiently serves the Disco's assets and market, which is used to determine the efficient costs (operating and maintenance, commercial management and business management).

The method was furthered developed taking into consideration suggestions by the agents and the cases accumulated during the first PTR.

No debate was held with the sector on the better practices and their associated costs. In the first PTR, ANEEL did not provide the Discos with the "open" model for them to make contributions.

Net Regulatory Asset Base (NRAB)

Before the deregulation, assets were assessed at their book value.

ANEEL applied this criterion at the first PTR (ESCELA, 1998), and the resulting NRAB amounted to R$ 685 million.

ESCELSA questioned this figure on the grounds that the book value had not been corrected for inflation since 1995 (Law 8248). ANEEL accepted the claim, adjusted the book value for inflation and determined NRAB for R$ 988 million, indicating that the criterion would be subject to revision for future PTR processes.

In 2002, after an intense debate with the sector over ANEEL's Technical Note 148/02 enacted by Resolution 493/02, the regulator adopted a DORC (Depreciated Optimized Replacement Cost) methodology.

The method consists in revaluing assets at depreciated replacement cost, with minor adjustments associated to land occupancy factors and the level of HV/MV transformers use.

The accumulated depreciation is calculated by applying the accounting criteria.

The Brazilian Association of Electric Power Distributors (ABRADEE) claimed for the adjournment of the resolution and filed a judicial remedy because it considered the RAB should be calculated on the minimum sale value.

This minimum sale value had been calculated by each State government at the time of privatization and established the minimum sale value of concessions.

It is worth pointing out that the value actually paid by the new concessionaires was an average 40% higher than the minimum sale value (with variations ranging between 0% and 100% depending on the

[1] In some Brazilian concessionaires, the percentage of non-technical losses is alarmingly high (more than 20% of energy purchase) and they represent a severe social problem that cannot be totally controlled by Discos.

It is essential to define correctly the regulatory losses in the PTR (losses which can be passed through to tariffs) in order to gradually induce a reduction without affecting the financial-economic balance of Discos operating efficiently.

case) and generated expectations that were not confirmed by later events.

The Real devaluation at the beginning of 1999 of 1/3 of the value at the time of privatization, and the rationing crisis in 2001-2002 strongly affected the expected return on investments.

The methods applied by ANEEL resulted in NRAB values significantly lower than both book values corrected by inflation and the minimum sale value of Discos.

Processes were highly contentious and of difficult implementation, thus resulting in passing of ANEEL's Technical Note 178/03.

The most conflictive aspect was the definition of assets market price.

Another contentious issue is the unclear nature of criteria to adjust the NRAB in future tariff periods (addition of debt new investments).

Capital Cost

This is the return on capital for the development of distribution in Brazil.

The cost of capital adopted by the ANEEL is the same for all Discos.

The methodology to estimate the cost of capital is by the weighted average cost of capital (WACC), which in turn considers the remuneration of equity and debt, including the tax benefit of debt, weighted by the average leverage structure for the sector (debt/equity ratio).

The portion that remunerates equity is estimated through the capital asset pricing model (CAPM), widely applied all over the world, which includes partially the country risk, the foreign exchange risk and regulatory risk with specific methodologies for every case.

The portion that remunerates debt comes from estimating the Discos' credit risk plus the foreign exchange risk and part of the country risk.

Gross Regulatory Asset Base (GRAB)

It is the NRAB without considering the accumulated asset depreciation.

Additionally, the GRAB includes the third-party assets to be replaced by the Disco at the end of their life [1].

Annual Regulatory Depreciation Rate

It considers the annual depreciation rates applied in accounting.

Regulatory Losses

ANEEL requested Discos to submit a characterization of their losses in their concession areas and an outline of combat plans and objectives.

ANEEL, in general, recognized the average loss over the past three years as the regulatory value of losses.

This is one of the main subjects to be dealt with in the second PTR.

X Factor

ANEEL determines the X Factor as the addition of three components: Xe; Xa and Xc.

The Xe component captures the technical productivity gains associated to the increase in business scale during the tariff period. It is obtained by the discounted cash flow method, determining the annual revenue reducer that equals the internal rate of return "IRR" to the regulatory WACC.

The discounted cash flow comprises:

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[1] Since it is forced to replace these assets at the end of their life, the Disco receives an annual depreciation every year to constitute the replacement fund.

The Disco will never be remunerated for this capital as it still belongs to third-parties, i.e. these assets shall only be considered in the GRAB and will never be incorporated to the RAB.

This method has been modified for the second tariff process and is living rise to intense debate with the regulator..

- the annual revenue: it is the Regulated Revenue annually reduced by the Xe component,
- the annual costs: they are the Reference Utility costs, annually adjusted according to the forecast market growth.
- the expanding annual investments: based on a simplified econometric formula that associates investments with the forecast market growth rate[1],
- investment replacement: based on a simplified formula that considers the average life of assets.
- taxes and charges

The Xa component captures the economic productivity associated to the relative variation of labor prices with respect the wholesale price index (contractual index).

The Xc component captures the consumers' perception on service quality, which is evaluated on opinion polls basis (may vary between 1% and -1%).

This last component has been strongly challenged by the sector since:

- it generates a double penalty system (the Disco's penalty system involves commercial and technical quality objectives), and
- it would induce a quality perception sub-evaluation because it is widely known by users its value impacts on the service price.

Tariffs

ANEEL calculates the new tariffs according to their share in the cost components of the Required Revenue.

Residential tariffs historically subsidized industrial tariffs; therefore, ANEEL implemented measures for the gradual elimination of the subsidy in order to determine the economic tariffs adequate for every category.

IV. REGULATORY ADJUSTMENTS

By mid 2005, at the end of the first PTR, the sector engaged in an analysis of the first tariff process in order to suggest regulatory adjustments to enhance the quality of the second period starting in 2007.

There was a consensus as to not to introduce dramatic changes in the regulation applied so as not to affect the business regulatory stability.

In August 2006, ANEEL called Public Hearing 08/2006 and received the contributions by the sector. ABRADEE submitted an extensive document with the process diagnosis and regulatory adjustments proposals.

The most controversial issues were the determination of the RAB (Gross and Net) and of the regulatory losses.

By mid October 2006, ANEEL passed Technical Note 262/06 that includes an analysis of the contributions received at the Public Hearing and by the end of the month approved Resolution 234

[1] This issue became significantly controversial when the Executive Power established objectives for the universalization of the electric power service, granting a subsidy which, in many cases, was not consistent with the level of investments and costs required to meet the objectives.

Discos were forced to meet the objectives without receiving a higher tariff associated to the diseconomies of scale generated by these investments.

These diseconomies of scale could be captured within the X Factor.

The subject is currently under consideration by ANEEL.

establishing the methodologies for the 2007-2010 period.

The following paragraphs summarize the main regulatory amendments.

Operating Costs

The Reference Utility approach is maintained.

ANEEL will adjust the model's inputs to reflect efficient practices (average salaries, standard central structure, productivities, etc.) based on information periodically requested of the Discos. The model will then be made available to ensure its reproducibility and transparency.

There is a clear trend by ANEEL to gradually introduce benchmarking practices, which are very appropriate for the Brazilian market, considering its extension and heterogeneity and the large number of Discos operating under the same regulatory framework.

NRAB & GRAB

At the beginning of the second PTR (and at every subsequent even PTR) the RAB will be rolled forward through the addition of the net new investments valued at market prices.

Additionally, the RAB will be evaluated at every odd year on the basis of the same methodology applied for the PTR[1].

A price manual will be defined as a reference for subsequent RAB adjustments.

ANEEL changes the approach of third-party assets remuneration. It will no longer remunerate asset depreciation until replaced by the Disco. At that moment, both the capital and the depreciation will be remunerated, thus characterizing a process of ownership transference to the concessionaire.

This measure transfers present revenues to the future.

This is probably the most controversial measure implemented by ANEEL as it raises strong discontinuation of short-term revenue for those Discos with a significant share of third-party assets.

Capital Cost

The criteria applied for the first tariff period are maintained. Model inputs are adjusted.

Regulatory Losses

In order to determine the regulatory technical losses ANEEL will apply mathematical network models.

Regulatory non-technical losses will be determined on a case-by-case basis considering the information submitted by the concessionaires and based on the general criteria set forth in the Resolution[2].

ANEEL will simultaneously create a working group to analyze the feasibility of a hybrid mathematical and benchmarking model that allows for the calculation of regulatory non-technical losses for the third PTR.

Regulatory non-technical losses are those where the efficient cost to combat losses equals the recovered marginal revenue.

Efficient combat costs and investments will be determined by a clusters study at the Discos' concession areas, identifying the best market practices by means of benchmarking econometric practices.

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[1] In the author's opinion, the period between re-evaluations should be larger than two tariff periods since once the investment is made, the concessionaire cannot manage the future variations of market prices until the asset is replaced at the end of its life (30 years or more after the investment).

This effect may have an impact on the consumer, for instance, a hypothetical circumstantial increase in the price of aluminum may cause an arbitrary tariff increment with no correlation with the investment already made.

[2] This is probably the most conflictive issues since there are no clear guidelines on the criteria to be adopted by ANEEL.

X Factor

In order to determine the Xe component, ANEEL improves the rules to define the market and forecast investments.

Particularly, forecast investments in the distribution network will be defined by a mathematical network model that will allow the association of investment with the quality requirements demanded by the regulator.

Determination of the Xa component is adapted by considering labor costs are adjusted by the consumer price index (IPCA).

The Xc component is eliminated since it generates a double penalty on quality and leads to sub-evaluation of quality levels due to its impact on the service price.

V. CONCLUSIONS

The first PTR period was a founding process in the definition of the Discos' tariff regulation.

ANEEL was characterized by a great transparency and openness to debate (Technical Notes, Open Public Consultations on the Internet, Public Hearings, etc.).

The first review period permitted a gradual recovery of the sector profitability, which was seriously affected by the rationing crisis and revenues that for many years did no reflect the efficient cost of service.

On average, the sector's adjustment indices were higher than inflation, correcting the distortions of pre-existing prices.

RAB determination has been the most controversial subject.

Many lessons were drawn from the first PTR. Determination of the RAB and the regulatory losses will be the central issues of the second PTR.

New regulatory issues shall be developed and improved, namely:

- the regulatory losses approach,
- the improvement of regulatory methodology to determine quality objectives,
- the determination of a penalty regime associated to the economic cost of non-supplied energy, and
- the debate of a new tariff structure.
-

The implementation of benchmarking methodologies will increasingly gain ground in the regulatory development of the distribution sector.

A serious problem to cope with is the asymmetry between the economic cost of service rendering and the society payment capacity.

Taxes and charges currently represent 38% of the consumer's bill, one of the highest rates in the world.

Manageable costs, the object of PTRs, represent on average 27% of the total tariff.

VI. ACKNOWLEDGEMENTS

The author gratefully acknowledges Ruy Varela for encouraging the preparation of this manuscript, Sebatián Butto for the contributions resulting from his untiring commitment to daily work, and Danilo Dias for the sharp and enlightening debates that made understanding of the Brazilian regulation system easier.

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VII. BIOGRAPHY

Luis Fernando Alvarez graduated as an electrical engineer from the Buenos Aires University (UBA) and has master degrees in electric market administration and business administration. He has specialized in economic regulation of energy and planning. Over the past 15 years, his professional career was focused on the Latin American market, leading important consulting projects in the region. In Brazil, he was in charge of over 15 consulting processes on tariff review and was consultant of ABRADEE (Brazilian Association of Electric Power Distributors) during the debate over the regulatory methodology in the sector. He is a founding partner and CEO of SIGLASUL consulting company.

4. THE IMPACT OF WACC CALCULATION IN PRICE CAP REGULATION RESULTS: COLOMBIAN CASE" (PAPER 07GM1159),

Sandra S. Fonseca, Consultora, ex CREG Colombia, Carrera 6 # 57-11 A-901,
Bogota,- Colombia

Abstract: The risk of applying price cap regulation on distribution systems where the institutional and industrial structure is still weak is discussed. It has been found that there is a huge impact on end user's tariffs for a tariff-setting period after increases from 9% to 16.04% on discount rates used to calculate the rate base on Colombian Discos are introduced.[1]

Index Terms:CREG: Comisión de Regulación de Energía y Gas en Colombia.

I. INTRODUCTION.

Colombia, as with other countries in Latin America, has followed the path of electricity sector reform, implementing policies according to this, which in the last decade appeared to be essential to survive. In 1994 an Electricity Law and a Utilities Law were enacted on the same day. An unbundled system was born and a Regulatory Commission was put in place.

II. PRICE-CAP REGULATION RESULTS

A market place was designed with a power pool in a wholesale market, and the retail market was launched, where in theory; users were able to choose their provider. A privatization process began and transmission and distribution services were regulated as monopolies.

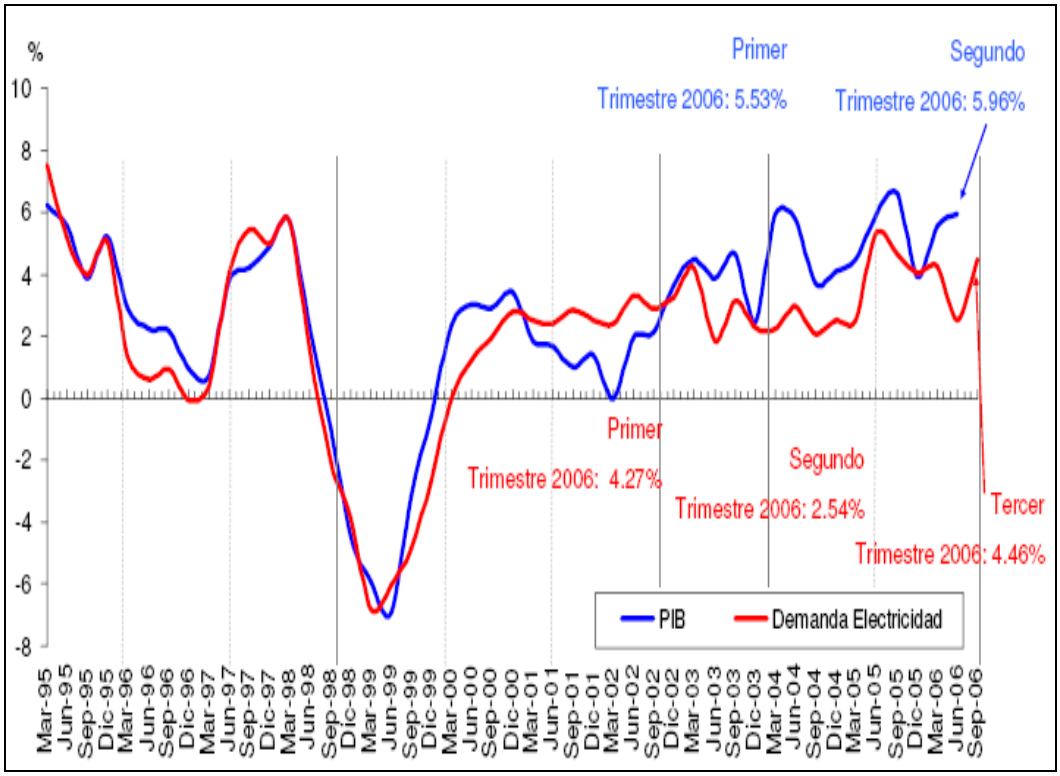
From 1995 to 1997, the regulation system was in transition; after that, two tariff periods have passed, five years each. In distribution services, the tariffs were settled by price cap regulation, using as a Rate Base a value given by the installed infrastructure.

The assets rate base, and its value, was calculated with standard price units on a replacement market price. The annual value, to be included in the tariffs, was deducted from assets market value, asset life-time and a discount rate. An X-factor was calculated from economic studies on Colombian productivity.

After 10 years of market reform and with a regulatory framework in place, Colombia's market was effectively in place; industrial customers were freely negotiating their prices. On the other hand, participant agents in the market place are now half state-owned and half privately-owned. The power pool seems fairly competitive and users were facing reduced tariffs because efficiency issues were included as requirements on their income calculations.

However, Colombia suffered an economic crisis in 1999. Electricity demand as well as the country's GDP decreased from 3-4% to minus 3% per year as is shown in Figure 1. In other words the electricity demand fell 7 percentage points in a year, causing an internal sector crisis.

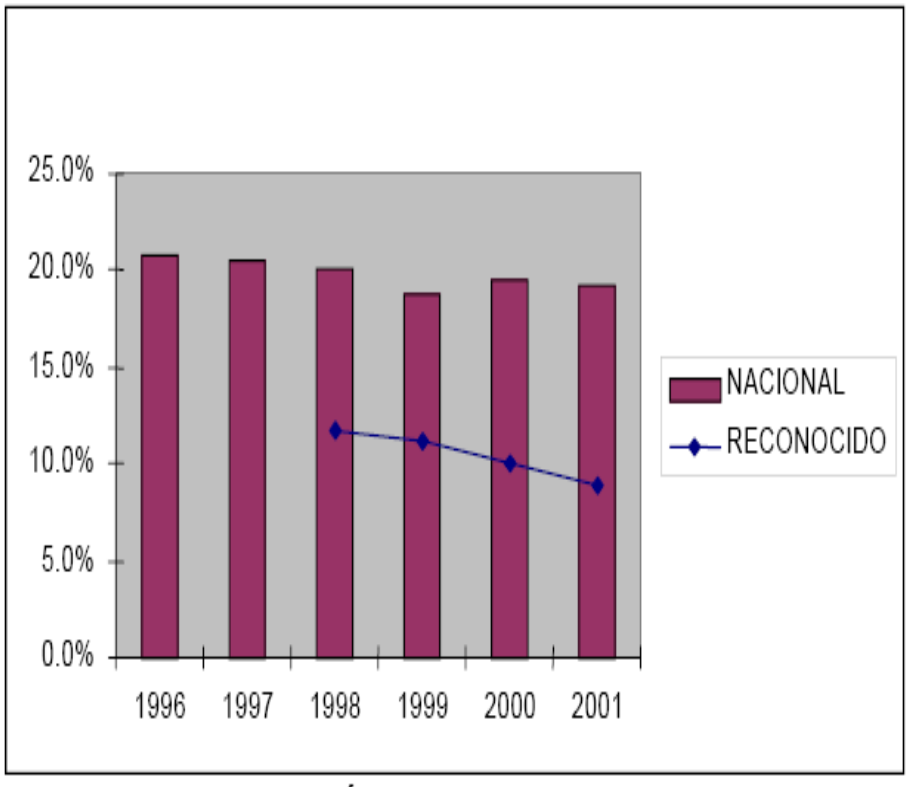
[1] Sandra Fonseca is an Electrical Engineer who has a Masters Degree in Energy Studies, who was a former Regulator and CREG´s Chief Executive Director. Now works as Regulatory and Energy Sector Consultant.



Source: UPME, Nov. 2006

Figure. 1. Electricity Demand and GDP Index Evolution.

So as the new tariff period arrives, the utilities were having financial losses and even thought that market risk was part of their business, the companies started a strong and continuously movement in order to get from the Government tariff-rise approval. This aimed at recovering their weak financial position. According to this, a high loss situation was also in place with a country average rate of 20%, see Figure 2.

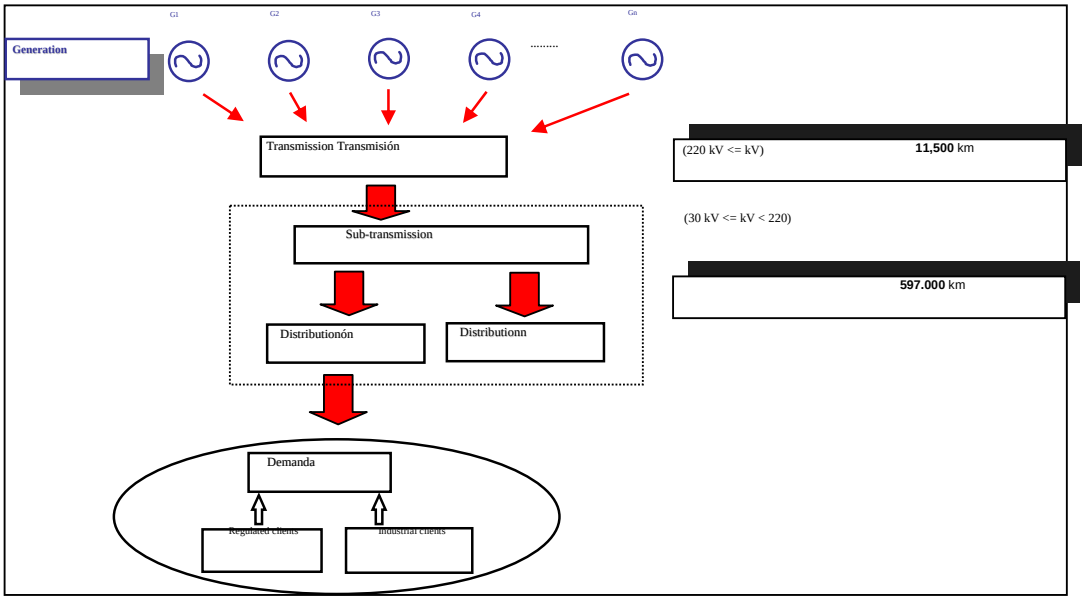


Source: CREG

Figure. 2. National Average Losses vs. Tariff Losses.

The industrial structure used in the Colombian electricity system divides the network into transmission, sub-transmission, and distribution, depending on voltage levels.

In order to set transmission and sub-transmission tariffs, the revenue caps method is applied; and in distribution, price cap is used, as indicated in Figure 3.



Source: CREG

Figure. 3.

In this scenario, the regulatory commission was under pressure to give what they want. As autonomy of the Regulatory Commission was guaranteed, as in the fixed period the commissioners were appointed, the arguments centered on “technical issues”. So the price cap regulation method continues in application, the arguments fall in some specific point between the methodology concepts. The variables analysis was focused on the discount rate to annualize the investment value.

In the first tariff period the discount rate had not suffered from any kind of discussion and it was set at 9% in real terms per year. However in the second tariff period, the discount rate became the way utilities achieve more remuneration, keeping the argument inside the regulatory framework.

The regulatory body, CREG, chose a transparent and known methodology to calculate this value. It was understood that a replicable, open methodology was the best protection against political manipulation. Then, it was applied a Weighted Average Cost of Capital and a CAPM, (capital asset pricing model), another method used to determine cost of equity.

The WACC formula and develop is shown in box 1.

Box 1.

ACC: A calculation of a firm's cost of capital in which each category of capital is proportionately eighted. All capital sources are included in a WACC calculation.

ACC is calculated by multiplying the cost of each capital component by its proportional weight d then summing:

$$WACC = \frac{E}{V} * Re + \frac{D}{V} * Rd * (1 - Tc)$$

ıere:

= cost of equity
l = cost of debt
= market value of the firm's equity
= market value of the firm's debt
= E + D
V = percentage of financing that is equity
V = percentage of financing that is debt
= corporate tax rate

company's assets are financed by either debt or equity. WACC is the average of the costs of these urces of financing, each of which is weighted by its respective use in the given situation.

firm's WACC is the overall required return on the firm as a whole and, as such, is often used ernally by company directors to determine economic feasibility of expansionary opportunities d mergers. It is the appropriate discount rate to use for cash flows with risk that is similar to that the overall firm.

In Colombia the corporate tax rate, Tc, is 35%, and after hard discussion about the nominal vs. the real value of this variable to be included in the price cap method, the WACC ended at 16.06%, applied as a discount rate to set the rate base in each utility.

The end result of this decision was a significant increment on end users tariffs but more than that, a huge increase in utilities' income by year, due to demand increase. As an example, utility comparative examples are shown in Chart 1:

Chart 1. Rate Impact on Utilities' Income Simulation. Example Utilities

ELECTRICARIBE

MES	INGRESOS DISTRIBUIDOR (millones de $ corrientes)										Aumento
	Nivel 1		Nivel 2		Nivel 3		Nivel 4		Total		
	099/97	082/02	099/97	082/02	099/97	082/02	099/97	082/02	099/97	082/02	
ENERO	9,867	8,637	2,163	1,796	267	294	135	5,327	12,433	16,054	
FEBRERO	10,044	8,792	2,202	1,828	272	300	138	5,422	12,656	16,342	
MARZO	10,222	8,949	2,241	1,861	277	305	140	5,519	12,881	16,633	
ABRIL	10,320	9,034	2,263	1,878	280	308	142	5,571	13,004	16,792	
MAYO	10,468	9,164	2,295	1,905	284	312	144	5,651	13,190	17,033	
JUNIO	10,554	9,239	2,314	1,921	286	315	145	5,698	13,299	17,173	
JULIO	10,528	9,217	2,308	1,916	285	314	145	5,684	13,266	17,131	**29.13%**
AGOSTO	10,536	9,223	2,310	1,918	285	314	145	5,688	13,276	17,143	
SEPTIEMBRE	10,567	9,251	2,317	1,923	286	315	145	5,705	13,315	17,194	
OCTUBRE	10,577	9,259	2,319	1,925	287	316	145	5,710	13,328	17,210	
NOVIEMBRE	10,533	9,221	2,309	1,917	285	314	145	5,686	13,273	17,139	
DICIEMBRE	10,521	9,210	2,307	1,915	285	314	144	5,680	13,257	17,119	
TOTAL ANO	124,736	109,197	27,348	22,705	3,380	3,721	1,712	68,350	157,177	202,963	

Accumulative increase index 2003 to 2004.

ELECTROCOSTA

MES	INGRESOS DISTRIBUIDOR (millones de $ corrientes)										Aumento
	Nivel 1		Nivel 2		Nivel 3		Nivel 4		Total		
	099/97	082/02	099/97	082/02	099/97	082/02	099/97	082/02	099/97	082/02	
ENERO	6,007	7,729	1,595	2,099	178	220	698	4,744	8,478	14,792	
FEBRERO	6,115	7,803	1,623	2,119	181	222	710	4,829	8,629	14,973	
MARZO	6,224	7,915	1,652	2,150	184	225	723	4,915	8,782	15,204	
ABRIL	6,284	7,980	1,667	2,168	186	227	730	4,962	8,867	15,336	
MAYO	6,374	7,960	1,691	2,162	188	226	741	5,033	8,995	15,382	
JUNIO	6,426	7,966	1,705	2,164	190	227	746	5,074	9,067	15,430	
JULIO	6,411	7,990	1,701	2,170	190	227	744	5,062	9,045	15,449	**64.96%**
AGOSTO	6,416	7,997	1,702	2,172	190	227	745	5,065	9,053	15,462	
SEPTIEMBRE	6,434	7,964	1,708	2,163	190	226	747	5,080	9,079	15,434	
OCTUBRE	7,540	7,955	1,869	2,161	207	226	891	5,085	10,507	15,427	
NOVIEMBRE	7,509	7,977	1,861	2,167	206	227	887	5,064	10,463	15,435	
DICIEMBRE	7,500	8,011	1,859	2,176	206	228	886	5,058	10,451	15,474	
TOTAL AÑO	79,241	95,245	20,633	25,872	2,294	2,709	9,248	60,870	111,416	183,796	

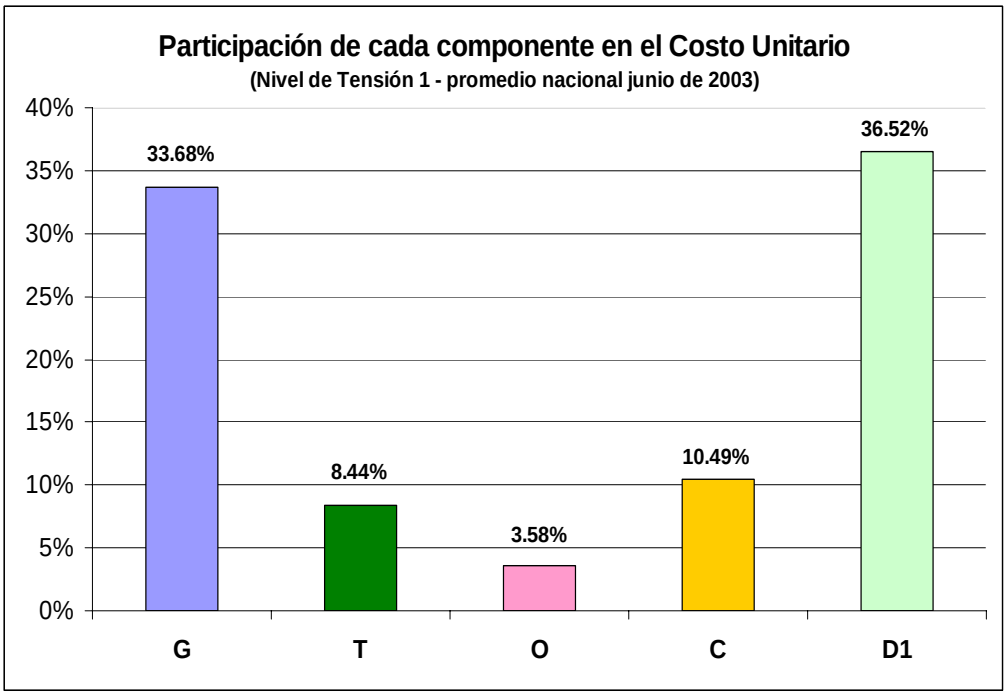
Source: CREG

Right now, after three years of tariff application, the utilities have today a surplus on their cash flows even though the level of their losses has not reduced. The utilities are flamboyant and the users are being highly stressed.

The end user's tariff is set by the next formula, which includes generation, transmission, distribution, commercialization and other costs:

$$CU_{h,m,t} = \frac{G_{m,t} + T_{m,t,z}}{(1 - PR_{n,t})} + D_{h,m} + O_{m,t} + C_{m,t}$$

And the specific weight contribution on average is shown in the Figure 4.



Source: CREG

Figure 4. Costs Participation in Final Regulated Tariff

The application of a precise methodology and a consequent price cap regulation was dangerous for the system, society, and finally for the final demand: users. This is not because there are any wrong calculations or interpretation, but because an incentive regulation has to be applied in a context where institutions are strongly respected and heard; and where external intervention can be controlled.

As a consequence, congress is discussing a Law Act to enforce tariffs control to protect users from price cap regulation application. So as consequence of a technical decision that was manipulated by political interests, the entire regulatory system is at risk.

III. CONCLUSIONS:

Regulatory decisions are not independent of other institutional and sector arrangements. Even a strictly and serious application of a price cap regulation can produce as a result negative or unexpected results.

IV. BIOGRAPHY

Sandra S. Fonseca: Address--Carrera 6 # 57-11 Apt 901, Bogotá Colombia, Tel: 0571-2117173/0573166923393. South America. E-mail: sandrastellacol@gmail.com

Personal Profile: Expert on Energy and utilities´ regulation. Multi-skilled manager experienced on Strategic Planning, Administration, Project Management and Technical and Financial Advising. Energy and infrastructure sector Expert, focused on economic and regulatory matters.

Skills Profile: Responsibility, initiative and leadership. Handling multi-task assignments and team working. Languages: Spanish (native), English as a foreign language.

Education & Qualifications:

1998 to 2000--MBA in Industrial Management at Sheffield Hallam University

1997 to 1999--MA in Energy Studies at the University of Sheffield

Dissertation: Regulating Public and Private Utilities in the 21st century: What is the future of regulation in the energy sector.

1994 to 1996--Master in Economics at the Javeriana University ("Pontificia Universidad Javeriana de Colombia".) (Candidate.)

1984 to 1990--First Degree in Electrical Engineering at the Colombian Engineering School ("Escuela Colombiana de Ingenieria".)

Career History

Company: *INDEPENDENT CONSULTANT*

2005-2006 *Position:* Energy and Regulation Consultant.

Projects:

- Advisor on energy investments for Taborda Velez Group.
- Ecuador's Energy Market regulatory framework analysis. (PROMEC-BIRF 7082-EC. (In progress).
- Cogeneration regulatory framework training for ASOCANA (Sugar Industry Committee).
- Cogeneration Project of Mayaguez Company: regulatory evaluation.
- Electricity Regulatory Framework: Escuela Colombiana de Ingenieria (Private University), Training Program.

Company: *SERPRE S.A. Servicios Prepago.*

2005 to 2006 *Position:* Manager.

Responsibilities:

- Innovative project on measurement system application management.

- Prepayment electricity services implementation.
- Answering to board members on all aspects of the company.

***Company*:** *CREG (Energy and Gas Regulatory Commission)*
2001 to 2005 *Position:* Commissioner and Executive Director.

Duties: Commission appointed member for 4 years period. Power sector, Natural Gas and GLP regulation decision taking duties. Lead in the regulatory framework development in the energy industry.

Responsibilities: Electricity and Natural gas regulation decisions. Tariffs, rates and markets design regulation. Regional electricity markets development. Develop market oversight mechanisms in the Colombian electricity sector. Undertaking tasks on competency and monopoly regulation. Electricity Interconnection systems project manager. Energy integration in the Andean Community applied, among others.

GTOR and CANREL committees' member (CAN's energy integration groups).

Company: *DNP (National Planning Department – Colombian Government.)*
1999 to 2001 *Position:* Infrastructure and Energy Unit Advisor. (PNUD Program)

Responsibilities: Regulatory policy amendment, formulation and support. Develop on utilities and infrastructure policy. Duties on Infrastructure projects structure analysis. Evaluation on project's financial issues Project. Lead coordination between public entities. Participate on the Energy sector institutional reform development. Taking part in different working Teams. Duties on Multilateral project management.

1996 to 1997 *Position:* Energy and Mining Division Chief.

Responsibilities: Energy policy formulation, public projects review, financial evaluation, investment budget allocation, and regulatory support. Part on Privatization and liberalization programs implementation.

1995 to 1996 *Position:* Adviser of the Energy and Mining Division.

Responsibilities: Support in the above mentioned activities.

Company: *Empresa de Energía de Bogotá (Energy Utility of Bogotá City.)*
1994 to 1995 *Position*: Urban Supervising Section Chief.
Responsibilities: Inspection of the technical and financial specifications fulfillment in public projects, electrical installations approval, and team supervising
1993 to 1994 *Position*: Rural Engineering Projects Section Chief.
Responsibilities: Electrical distribution projects contracting. Technical issues commitments.
1993 to 1993 *Position:* Generation and Transmission Planning Engineer

Responsibilities:
Electrical grid design and development.

***Company*:** *Distral S.A. (Engineering Company.)*
1992 to 1993 *Position:* Electrical and Control Design Engineer.
Company: Eléctricos Importados Ltda. (Electric Equipment Supplier Company.)
1991 to 1992 *Position:* Automation and Control Engineer.

Participation on the following International conferences.

2005 Soterramiento de Redes, CHILECTRA, Santiago, Chile. Junio.
2004 "Integración Regional Energética", CIER, Brasil, Diciembre.
2004 II Simposio: Integración Energética, ARPEL, PE, Uruguay, Nov.
2004 El Sector eléctrico en el ámbito Euro-Latinoamericano, "Integración Regional de Mercados", UNESA, Madrid, Mayo.
2004 Eficiencia Energética, Regulación en Generación Distribuida, Cogeneración. Bogotá. ANDI.
2003 I Curso de Regulación de ARIAE. Noviembre. Guatemala.
2003 V Jornadas de funcionamiento del Mercado Eléctrico Mayorista en Ecuador. CENACE. Manta, Octubre.
2003 Integración y Viabilidad de mercados, un desafió a la creatividad", Seminario Concejo Nacional de Operación, Cartagena, Octubre.
2003 I Encuentro de Energía, "Hacia la Integración de Mercados", Quito.
2003 I Reunión de Consejo de Ministros de Energía y Minas de la Comunidad Andina, en Representación del CANREL. Bogotá, Junio.
2003 VII Reunión de la Asociación Iberoamericana de Entidades Reguladoras de Energía –ARIAE-. Oaxaca, México, Mayo

Seminars
2005 "Como negociar con China?" Seminario Legis y GC, Bogotá.
2005 "Alta Gerencia: Liderazgo y Gestión Humana", Uniandes, Bogotá.
2004 "Relaciones Públicas y Lobby Político", Idelco, Bogotá.
2004 "Manejo de Medios de comunicación", Azucena Lievano y Cia, Bogotá.
2004 "Fundamentals of Energy Trading & Hedging", and "Fundamentals of Energy Options & Option Hedging", Paradigm Strategy Group, USA.
2003 Curso de Tecnologías, medición, transporte y distribución de Gas Natural. CREG. (Natural Gas Regulation)
2000 Seminario en Gerencia de Créditos bajo el Programa "Official Development Assistance". –JBIC-. Japan

5. PRICE CAP REGULATION, THE PANAMANIAN EXPERIENCE FROM THE REGULATOR POINT OF VIEW. (PAPER 07GM1167)

Víctor C. Urrutia (Autoridad Nacional de los Servicios Públicos de Panamá (ASEP)).

***Abstract*—**The electrical sector in the Republic of Panama was privatized in 1997. Distribution services are regulated using a "Price Cap" scheme. We present the Panamanian experience with Price Cap Regulation in the last 9 years.

I. INTRODUCTION

The Panamanian Power Sector was restructured in 1997. The vertically integrated state owned utility was replaced by a vertically and horizontally segregated system with multiple agents and strong private sector participation.

Early in 1999 the transition was completed, there were four generating companies, three distribution companies and a transmission company. The latter in accordance with the law was fully state owned.

At the present time the state participation in the distribution companies remains unchanged. The distribution companies are 51% owned and controlled by the private sector partners.

The electricity sector Law provides some fundamental principles on the development of the distribution activity:

- The participation of distribution companies on the power generation activity is limited to 15% of the demand served on their concession area.
- Power and energy purchases by the distributors will be mainly thru contracts awarded in open biding processes. Shortfall in contract purchases will be acquired in the spot market. The cost of all purchases will be "passed thru" to the final customer bill.
- The transmission activity is regulated and the transmission charges paid out by the distributors are also passed thru to the final customer bill.

That is to say that the distribution companies will be reimbursed for all valid expenses incurred in the procurement of power and energy for their customers.

As a consequence of the above, distribution companies should focus their efforts to the distribution a commercialization of electricity.

Panama has been divided in three geographical areas and each one has been assigned to a distribution company where they have exclusive rights for the distribution activities. End users that meet the "Large Customer" criteria have the option to negotiate directly with a generating company for their supply. Free Access is the norm for all activities.

SISTEMA ELÉCTRICO NACIONAL

II. REGULATORY SCHEME

The regulatory scheme for distribution and commercialization is based on regulating the maximum price/tariff and the minimum quality of service level required.
The price regulation is thru a scheme that contains both price cap and cost of service elements.

Every four years a revenue cap, the "Maximum Allowed Income" for the next four years is calculated for each distribution company. After this cap is established the distribution company is requested to propose a tariff that will produce the allowed income in the next four year period.

Up to now there have bee tree rate making periods.

To establish the "Maximum Allowed Income" the following procedure is used:

A. OPERATIONS, MAINTENANCE AND ADMINISTRATION COSTS.

- Econometric equations are developed based in the statistical analysis of the performance data of international competitive "representative" companies. Up to now we have used the U.S. Federal Electricity Regulatory Commission (FERC) Data Base, with suitable adaptations for the Panamanian market.
- The objective is to allow the distribution companies to recover the "efficient cost". To that end, using the same methodology, in each of the rate making periods there have been refinements introduced. In the first period there were five companies used (one for each of the "Service Areas" (AR)). For the second period one hundred companies with equivalent data distributed in three "Service Areas". For the third period, from July 2006 to June 2010, we used data from the one hundred and twenty companies with equivalent data, seventy nine with a relative efficiency index of 0.8 or higher were chosen and only one AR was used.

B. DISTRIBUTION LOSSES.

- Using a similar analysis as the previous paragraph, a standard losses percentage to be allowed for each distribution company is determined. This percentage remains fixed for the whole period. However, the allowed losses are valued at the real cost of energy during the period.
- The standard losses recognized in the last two periods are 8%

C. CAPITAL COSTS.

- The first step is to review the cost of all new assets entered into the books in the previous period. These costs are compared against costs of similar construction units obtained in the international market to verify its efficiency or reasonability. When costs higher than expected are found they are adjusted accordingly.
- The rate of return to apply to the rate base is established in the sector Law. It is eight points above the current rate of the 30 year U.S. Treasury bond plus a discretionary margin of plus or minus two percent. To help in developing the discretionary margin a study is made of current market rates for equivalent activities. The rate of return is not guarantied for the period.
- The revenues to be recognized for the depreciation are based on the life expectancy of the assets.

Next we show some results for the rate making.

"Benchmarking" O&M –Adm.-Distribution			
Details	Jul98-Jun02	Jul02-jun06	Jul06-jun10
AR	5	3	1
Companies	5	100	79

"Cost of Capital" Distribution			
Details	Jul98-jun02	Jul02-jun06	Jul06-jun10
Depreciation %	3.3	3.3	3.5
Rate of Return %	14.45	13.2	10.73

"Maximum Allowed Income"			
	Jul98-jun02	Jul02-jun06	Jul06-jun10
DVA (no losses) Millions US$ (NPV)	384.4	508.3	572.0
DVA (no losses) $/kWh	3.23	3.83	3.30

The reduction of the average cost of the Distribution Value Added (DVA) is due to the use of higher efficiencies in the comparison parameters and to the reduction of the market capital cost.

III. EVOLUTION

We feel that the regulatory scheme for the distribution and commercialization activities in Panama has worked reasonably well in spite of very strong information asymmetries and the economic and legal resources available to the companies.

Its is important to note that in the period considered, from 1999 to 2005, the capital investment by the distribution companies is in the order of US$345 millions for expansion and improvements in the

distribution network. These have resulted in improved efficiency and service levels, as can be seen in the following tables.

Details	1998	2005	% change
Demand (MW)	726.4	946.3	13.0
Sales (GWh)	3,392.8	4,696.3	38.4
Clients	451,442	666,030	47.5
Generation Cost ($/MWh)	59.80	85.66	43.2
Cents/kWh - Total	11.12	13.81	24.2

Details	1998	2005	% change
Lines (Km)	17879.9	24,402.58	36.5
Dist. losses %	17.6	11.4	-35.2

Quality of service has also improved, due to physical improvement to the network and better management. The following tables show the actual values of interruptions per year.

COMPANY	1999	2004
EDEMET		
Frequency (int/year)	14.38	3.49
Duration (hrs/year)	27.39	5.73
ELEKTRA		
Frequency (int/year)	14.39	4.67
Duration (hrs/year)	49.42	8.14
EDECHI		
Frequency (int/year)	11.85	2.58
Duration (hrs/year)	20.39	4.71

The efficiency improvements shown here have been overshadowed by the increases in generation cost.

At present we have just fixed the tariff for the period ending in June 2010 with a reduction of the Distribution Value Added (No Losses) in the order of 13%.

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V. BIOGRAPHY

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He was involved in the restructuring of the power sector in Panama. He was with IRHE, the now defunct public electric utility in Panama, from 1974 to 1985 where he was involved with power system operations and eventually, in management. Since 1990, he has been associated with the Electronics and Communications Department in the University of Panama.