A METHOD TO CARRY OUT THE REGULATION OF ELECTRICITY TARIFFS FOR THE MAXIMIZATION OF THE SOCIAL WELFARE – THE ARGENTINE CASE.

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ABSTRACT

This paper presents an innovative integrated approach to the rate structure; rates are the prices that public utilities charge for service. We satisfy the complexity of the rules and regulations governing the rendering of service having on mind harmonic and integrated considerations of essential principles, those are: sustainability, efficiency and distributional equity.

Our approach differs from other studies in the sense that our integrated methodology and/or procedure focuses on effective developments to fulfill such exigencies.

In relation to the investments, the analysis of cases was realized from indices of quality that reflect the different values based on optimal ones required because a delay in the investments. We weigh the magnitude improved with the indicators which measure the network to be planned on the Utility (Distribution service) and the required level of investment. On the other hand a function maximizes the average social welfare, analyzing in particular distributed equity, using the distribution coefficient of Feldstein.

The paper’s study case we choose one Utility, took it from 200,000 users, introducing the aspects of distributed equity, affecting the effective development of strategic policies on macro and micro levels, measuring each surplus on the basis of the marginal utility of the rent.

The investments which define each case with different topologies from distribution networks, allows experiencing different degrees of efficiency for the tariffs, it represents the total amounts sufficient to provide operation and maintenance to the planned investments and the quality of service (reliability) to be watch. In such sense we define the values of the investments forecast for different scenes with different user measured amount by index different index: CAIDI, SAIDI and SAIFI

- CAIDI determine the Relation between index SAIDI and SAIFI, where:
- SAIDI: System Average Interruption Duration Index.
- CAIDI: Customer Average Interruption Duration Index.
- The values adopted on our case for the CAIDI (relation SAIDI/SAIFI) were 1,50; 1,70 and 1.90 to present/display calculation sensitivities, and those values of the table of “Historical Global Indicators of Technical Quality”, were considered references for an Historical Average of Utilities (Distribution), the values we choose are the totals and include urban and rural areas of all the localities.

Disregards on the origin of the goods to invest, all the involved ones are soon considered to determine the magnitude of the prices or electrical tariffs necessary to provide the public service of electricity with distributional equity in acceptable way, considering the principles mentioned before.

Our approach provides practical solutions to contribute to improve the processes of revitalization the economic and social impact that electricity supply has on the life style and progress of the country.

INTRODUCTION

The determination of rates is governed by a set of principles which are rules that require that something be done to the maximum extent possible within the scope of legal and factual possibilities (real) existing consequently those are optimization mandates.

In this contribution the practical application of these principles requires to connect with the same procedures, methodologies, tools (engineering, economics, etc.). Those are added to the social aspects of demand, which will allow the collection of fares best. I.e. show a practical application to the Argentine case

PRINCIPLES OF SUSTAINABILITY, EFFICIENCY AND EQUITY

The methodology developed is presented in this
contribution. It emphasizes the technical analyses, organizational and economic-financial and social that enable sustainable, efficient and equitable solutions. For this purpose it uses a function that Maximize The Social Welfare so weighted, being able to express this function as follows:

\[
\sum_{k=1}^{N} E_k + \pi
\]

Where the weighted sum (weights: W, λ) from the surplus of N users E, and profit producer constitute the objective to maximize, thus introducing redistributive objectives and obtaining a better balance between efficiency and equity, to properly allocate resources so that efficiency is understood as a component of justice (distributive justice). While some authors pose a problem referred to the uncertainty regarding the merit on which the distribution is made, one thing that stands out is that it is difficult to assign merit criteria of justice and it is other very different meaning to say that the idea of merit is inadmissible, it should be noted here the sayings of Stiglitz, when it states: “The critics of the compensation principle point out that if a policy has distributional consequences, they have taken into account explicitly. It should attempt to quantify the magnitude of gains and losses in each group, nevertheless any justification does not exist to assign the same weight to the gains of the winners of the profits and to the losses of the losers.”

It should be noted that in the presence of the utility (Distribution of Electricity), that legal characterization fully justifies the adoption by the regulator of equity criteria in determining fares.

**Equity criteria**

An alternative approach to the introduction of equity is to define a social welfare function as a weighted sum of the individual surpluses, considering some criterion of economic capacity. We use the formulation of Feldstein by which corrects the expression of Ramsey (LACK THE LITERATURE REF) through a factor that reduces the regressively associated with that type of pricing, developing a tariff in two parts, which includes redistributive arguments, raising an optimization program in which the objective function surpluses are weighted based on the individual marginal utility of income. So i.e.: greater is the elasticity of the marginal utility, the greater the weighting of the surplus for low-income users. We establish a criterion of merit where the monetary unit, one dollar (U.S. $) has a surplus of marginal utility which is different for a rich user than for a poor one.

In this context, the formulation of Ramsey adopts the following expression:

\[
\frac{p_i - c_i}{\lambda} = \frac{\lambda - d_i}{\lambda \cdot \eta_i}
\]

Where: 
\[
d_i = \sum_{j=1}^{n} \sigma_j \cdot \theta_j :\text{ Distributive characteristic of good } i.
\]

Where: \[
\theta_j = \frac{q_{ij}}{q_i} :\text{ Participation of every consumer in the consumption of the good } i
\]

\[
\sigma_j = \frac{\partial W}{\partial V^*} \cdot x \cdot \frac{\partial V^*}{\partial Y_j} :\text{ Marginal utility of income of the person } j
\]

This factor is the product of the valuation of the social marginal utility of the person \( j \) (\( \frac{\partial W}{\partial V^*} \)) and the marginal utility of income of the income of each person \( (\frac{\partial V^*}{\partial Y_j}) \).

Based on information from surveys covering the Total Monthly Household Income as income quintiles, identifying the social marginal utility of income relative to income quintiles ranks and information on the number of users and ranks for quintiles of consumption, we can build the following table (applies in this case to the residential rate), determining the distributive characteristic: \( d_i \).

<table>
<thead>
<tr>
<th>QUANTILES</th>
<th>CONSUMPTION BLOCS</th>
<th>AVERAGE INCOME</th>
<th>CONSOLIDATE FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 - 300</td>
<td>301 - 740</td>
<td>741 - 1400</td>
</tr>
<tr>
<td>1</td>
<td>35%</td>
<td>25%</td>
<td>15%</td>
</tr>
<tr>
<td>2</td>
<td>20%</td>
<td>15%</td>
<td>10%</td>
</tr>
<tr>
<td>3</td>
<td>15%</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>4</td>
<td>10%</td>
<td>5%</td>
<td>5%</td>
</tr>
</tbody>
</table>

Table 1

If we are assuming, for example the Argentina case, some simplifications (elasticity’s, and marginal costs constant, and so on.) Becomes an expression of type \( p_i = \lambda x \cdot (CMg / d_i) \), which is the ratio between two prices (e.g. \( p_1 \) and \( p_3 \)) is given by the inverse ratio of the distributional characteristics, leaving that \( p_3 / p_1 = d_1 / d_3 \). According to the distributional characteristics obtained, it is a rate structure into three increasing residential blocks, where \( p_1 = 2.29 \cdot p_1 \) and \( p_2 = 1.35 \cdot p_1 \); notes that is a progressive, based on a nondiscretionary criterion of merit.
CRITERIA FOR DECISION-MAKING

Once the blocks to implement tariff to the localities that have or not the electricity service it will seek to identify cost-reduction scenarios and minimize the losses, scheduled rationing and incorporating new users. It will be improved by reducing the consumption of traditional energy and enhance consumer welfare. There shall be established a flow of net benefits must be provided by the regulator in case of social tariffs stipulated for power concession.

The investments which define each case with different topologies from distribution networks, allows experiencing different degrees of efficiency for the tariffs, it represents the total amounts sufficient to provide operation and maintenance to the planned investments and the quality of service (reliability) to be watch. In such sense we define the values of the investments forecast for different scenes with different user measured amount by index different index: CAIDI, SAIDI and SAIF

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<table>
<thead>
<tr>
<th>Inversions MT/ BT</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screening criteria for projects with distributional equity for CAIDI</td>
<td>US$ x 1000</td>
<td>US$ x 1000</td>
<td>US$ x 1000</td>
<td>US$ x 1000</td>
<td>US$ x 1000</td>
<td>US$ x 1000</td>
</tr>
<tr>
<td>1,50</td>
<td>621,68</td>
<td>787,53</td>
<td>818,54</td>
<td>850,79</td>
<td>884,31</td>
<td>3.962,84</td>
</tr>
<tr>
<td>1,60</td>
<td>622,82</td>
<td>647,36</td>
<td>768,41</td>
<td>798,65</td>
<td>830,12</td>
<td>3.667,36</td>
</tr>
<tr>
<td>1,70</td>
<td>545,23</td>
<td>566,71</td>
<td>581,52</td>
<td>600,75</td>
<td>624,42</td>
<td>2.918,62</td>
</tr>
<tr>
<td>1,80</td>
<td>488,27</td>
<td>507,51</td>
<td>581,14</td>
<td>599,18</td>
<td>622,78</td>
<td>2.798,88</td>
</tr>
</tbody>
</table>

The dollar value of: US$ = 1dolar $ 3.4 pesos

Of the possible alternatives will determine the Economic Social Net Present Value VANS and define the conditions to make it VANS> 0 will give a feasible alternative. The benchmark interest rate in social projects is 11% in the Rca. Argentina (Dec 2008)

It is able to use the average fare idea of social computing the required average annual cost per unit of equivalent socio-economic and energy supplied, by calculating the average annual cost equivalent per unit of economic power, for the three steps of consumption indicated in the previous point (about 0.0150 USD/kwh for 300 kWh - 0.2025 USD/kwh for 450kWH -0.3450 USD/kWh for <450 kWh for 600 kWh respectively).

It is further define an index measuring the economic equivalent annual cost per user and the annual cost per unit of economic equivalent distance lines from BT.

Those values can be compared with a traditional utility with a discount rate of market of approximately 16% to 24% in the Rca Argentina.

Must be found to be feasible and finally the value of the social rate of discount with eventual agreement with the government and the private sector to facilitate the study of the scene determined.

We prepare a sensitivity analysis of the variables that may strengthen the project. Studies of different alternatives will always allow an improvement (although sometimes it is not significant) of the errors of inclusion and exclusion.

CONCLUSIONS

1. The determination of rates, means acting in a multiobjective context, bounded by a series of principles (sustainability, efficiency, equity, solidarity, etc.) Who must observe the same, for verification of the principle of justice and reason

2. The public service of electricity is an activity designed to achieve essential tasks such as the general welfare and social progress.
3. It has submitted a contribution to the calculation of the characteristics of the residential tariff structure from the distributional characteristics of the blocks of electricity consumption, observing the rules and being fulfilled of the regulator and with a methodology to define the investments required to obtain an adequate quality of service.

4. Our approach provides practical solutions to contribute to improve the processes of revitalization the economic and social impact that electricity supply has on the life style and progress of the country.

5. We are indicating the social dimension of the distribution of electricity, through principle of fairness, like thus also the dimensions socio-economic which allows to diagramed the design of right, equitable and sustainable Tariffs.

6. Finally after that basic technical and legal highlights some legal principles, guidelines are some technical and some are spelled considerations, whose observance helps to access and permanence of the lower income sectors of the population, in the public service distribution of electricity.

7. The economic justification for the loss of efficiency for the purpose of verifying the principle of sustainability should not be seen as exclusive of the loss of efficiency that can generate by the introduction of fairness considerations.

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Biography of authors
Mr. Carlos Horacio SALZMAN has over 35 years of experience in power system planning and studies with Utilities, Industrial Mills and Leading teams in international contractors and consultant offices. He is one of the most qualified professors in Electrical Engineer in the University of Bergamo and University of Buenos Aires in the issue of power system analysis. Recently he has developed valuable power system studies and computer analysis skills to carry out investments projects and wholesale electric market analysis and rate analysis. The target for that analysis was studies for generation and T&D utilities, strategic planning and public utilities rates design and analysis. On the research side he has been responsible for the long range planning involving interconnection with neighbors of Argentina. He is perfectly familiar with the knowledge of EHV-HV-MV and LV networks and has additionally been involved in international projects.

Mr. Julio Cesar Molina is a Civil Engineer. He was graduated from National University of Cordoba, Master in Law, Economics and Management of Public Services. From Universidad del Salvador, Carlos III de Madrid, Paris X France. He made a number of postgraduates on Regulation of Public Service in the Country and Abroad. He published: Two books covering: 1) Institutions and Organizations of the Argentine energy sector and 2) Principles on tariff of the distribution of electricity and various articles on utilities in specialized publications Professor in the Course on Regulatory Skills. He is currently teaching at the UB and is founding member of GEIISE (Group Integrated Education & Research Electricity Systems). He was Director (Vocal) Ente National Electricity Regulator Argentine. He has performed various conferences and consulting in the field of the public agencies in different provinces.