

# **Public Goods and Restructuring of the Brazilian Power Sector: Energy Efficiency, R&D and Low Income Programs**

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## **ABSTRACT**

Since the early nineties Brazil has initiated a program of reforms in its electric sector which includes utility de-verticalization, privatization and competition. The main objectives has been to promote a market-oriented energy industry attractive to new private investments. This has led to a re-definition of the public-interest programs formerly undertaken by the state-owned utilities. In particular, of significant concern are the programs for promotion of energy efficiency, renewable energy technologies, electricity services to low income population, rural electrification and environmental protection. In the midst of the privatization effort, the National Agency for Electrical Energy ANEEL was created (end of 1997). One of the tasks of the regulatory agency is to provide funds and incentives to energy conservation and research and development. In this paper we review the funding mechanism currently in place to promote energy efficiency, R&D investments in the context of a market-oriented sector, its limitations and prospects.

## **Introduction**

Brazil, like many other countries, is implementing significant changes in the structure and decision-making of its electricity sector by transferring the ownership of its utilities from the public sector (State and Federal government) to private entrepreneurs, and re-defining the roles of public agencies in charge of energy-related tasks. Privatization is one of the initial phases of the re-structuring process of reforms, that aims to create greater competition within the energy industry. In addition of the privatizing existing utilities, contracts for new electric installations are now to be open to competitive bidding, pending concessions are being canceled and re-tendered for competitive bids, independent power producers are being introduced. Large electricity customers have now access to a competitive market for their power purchases, and progressively more and more consumers will have the opportunity to choose their supplier. As these changes are implemented, we can expect that the public interest tasks undertaken by this industry in the past will also change.

The challenge is whether the new institutional arrangement will address and incorporate important public interest tasks such as energy efficiency, public interest research and development, and secure investments towards options that are environmentally cleaner and more sustainable. Also, there can be an additional adverse impact of privatization on rural communities and low income urban population currently served by subsidized power from previously state-owned utilities. These communities may be subject to a decrease in the quality of the service while unserved communities may wind up even further behind if profit-seeking utilities use a conventional approach to the problem (i.e., grid extension).

An important step was taken in 1998 by ANEEL which obliges privatized utilities to invest 1% of their net annual revenues in Energy Efficiency Programs and Research and Development. Whilst measures like that are significant and signal the importance to

recognize the limitation of competitive markets (or to-be competitive markets) to provide for energy efficiency and R&D, we investigate here some of the limitations that the implementation of this measure can impose on the present market place and suggest possible alternatives.

The objective of this paper is to analyze the recent trends in the re-structuring of the country's electrical sector and the impacts of energy efficiency efforts, R&D and low income programs.

## **Restructuring: Energy Efficiency, Planning and Regulatory Context**

The re-structuring process started in the country without a prior establishment of a clear regulatory framework as centralized planning ended. Electrical planning previously required that ELETROBRÁS, the state national holding electrical utility, organize, plan, finance, build, and operate the entire electrical power system (ELETROBRÁS 1994). More importantly, re-structuring process in Brazil comes at a time when there is no experience with energy regulation and competitive markets, nor is there in telecommunications, nor transportation. Another important point is that energy efficiency is in its infancy and the public debate is non-existent, or poorly informed about the complex issues surrounding energy matters, re-structuring and privatization. Energy-related civil associations are not yet important pressure groups influential in energy decision-making and providing careful oversight of new regulations nor guaranteeing the provision of public benefits associated with the electricity industry.

Since the mid eighties an electricity conservation agency (PROCEL) was established by the Federal government, and also most of its programs and activities have been revised since the implementation of the privatization process. Until 1998 PROCEL had an active leadership, well connected with important actors in the power sector (utilities, ESCOs, ministries), universities, and international agencies. During the period 1986-1998 Total expenditures in energy efficiency initiatives amounted to \$ 260 millions resulting in cumulative savings of 5.3 TWh/year as of 1998, equivalent to 1.8 percent of electricity use in the country (Geller et. al, 1998).

Since the seventies the electrical sector maintained a research center - CEPEL with contributions from public utilities and specially from ELETROBRÁS. Annual investments in R&D channeled through CEPEL varied from US\$ 15 to US\$ 25 millions during the eighties and nineties (Soares, 1997). Since privatization started much of CEPEL's financing has been reduced and several privatized utilities have withdrawn their participation. It has also been suggested that PROCEL and CEPEL should be merged.

**The National Electricity Regulatory Agency - ANEEL.** In late December 1996 the Brazilian Congress passed a law creating the Agência Nacional de Energia Elétrica (ANEEL). Until then all the utilities being privatized were regulated only by the terms of the contract at the time of the sale of assets by the public utility. This new agency has been entrusted with regulatory oversight of the restructured Brazilian electric industry. Initially ANEEL relied on the structure of the previous DNAEE, or National Department of Electric Energy, a now-extinct Ministry of Mines and Energy department, and started to function only in December 1997. ANEEL is establishing the regulatory regime necessary to provide the

right signals to the market and other measures in accordance to the national energy policies that will be promulgated by National Energy Policy Council<sup>1</sup>.

ANEEL regulates the power sector, sets guidelines for tariffs and rate-making, approves tariffs, and has the authority to grant concessions to service providers. Such an authority resembles a licensing or authorization power to grant a private agent the right to use a public resources to generate, transmit, or distribute power. ANEEL is also charged with establishing competition among the actors, as well as reliability and cost effectiveness of service, including to rural areas. ANEEL has decentralized its activities, transferring regulation oversight to some State Public Utility Commissions that are better positioned to monitor the performance of distribution utilities. Several Brazilian states (Pará, Ceará, Rio Grande do Sul, Rio de Janeiro, São Paulo and Bahia) are establishing state regulatory agencies.

ANEEL is still being structured, hiring, training personnel, and defining its activities without policy guidelines from the National government. At the same time it has to provide clear rules so that investors can be interested in the Brazilian energy market, and also has to ensure that customers are being well served.

Nevertheless, it is fair to say that a great deal of effort is being invested by the newly created regulatory agency in order to guarantee conditions to attract new investments, create competition on the generation side and find ways to ensure that future energy prices will drop. This preoccupation has dominated most of the activities undertaken by ANEEL so far.

## **The One-percent Charge for Energy Efficiency and R&D**

Since 1998 the regulatory agency ANEEL enforces the application of at least 1% of the previous year utilities' revenues in energy efficiency measures and research and development. These funds are allocated to end-use efficiency measures (0.25% of total net operational revenues), research and development (0.1%); the rest goes to the improvement of supply efficiency (see Table 1). During 1995-98 provisions for energy efficiency and R&D were appended as clauses to the concessions contracts. However, they were very general and hard to be verified. In some cases it was possible to insert more specific requirements for energy efficiency and R&D in concession contracts, as it happened in the State of São Paulo, but only after some pressure from advocacy groups<sup>2</sup>.

ANEEL is responsible for the definition of broad investment priorities, and final approval of the annual plans submitted by the energy companies. PROCEL and State Energy Commissions are giving technical support to analyze utilities' R&D and Energy Efficiency proposals. ANEEL is also in charge of evaluating the implementation of R&D and efficiency programs of each utility.

Instead of collecting utilities 1% revenues and administer a general fund, ANEEL preferred to let each utility specify its own annual investment plans for energy efficiency and R&D. It is their understanding that utilities have a better knowledge of customers behavior

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<sup>1</sup> The National Energy Policy Council is designed to be the most important body to determine overall energy policies that can shape the future development of the sector and its commitments towards sustainability. The committee includes a wide range of ministries representatives and chaired by the Ministry of Mines and Energy. However, as of May/2000 it has not been made operational nor had any meetings.

<sup>2</sup> The State government feared that specific requirements for investments in energy efficiency and R&D would devalue the companies assets during the bidding process by private entrepreneurs.

and more capable to design programs and what is best to achieve in their respective markets. Very little debate, so far, has been promoted to decide on important issues of governance, administration and broader public policy strategies associated with the use of such funds. However, there has been a growing awareness inside ANEEL that the present system needs revision.

**Table 1. Regulated Investments in Energy Efficiency and Research & Development (Minimum levels of total annual revenues, according do Resolution ANEEL 261/99)**

% of total annual revenues		Areas of expenditures	Details of suggested limits and investment priorities
(a)	$\geq 1.00\%$	End-use efficiency, R&D, Supply-side efficiency	Listed below
(b)	$\geq 0.25\%$	End-use efficiency	Up to a maximum of 0.125% to be invested in public lighting, marketing Minimum of 0.025% to be invested in the industrial sector Minimum of 0.025% to be invested in the residential sector Minimum of 0.025% to be invested in the public sector
(c)	$\geq 0.1\%$	Research and Development	Suggested areas: energy planning, alternative energy sources, improvement of the quality of service, co-generation
(d)	(a)-(b)-(c)	Supply-side efficiency	Load factor improvements (minimum of 30% to be invested in regions S, SE and CW, minimum of 10% in regions N and NE). Energy losses (technical and commercial)
Note: (b) generating companies that do not own distribution networks have a minimum of 0.25% to be invested in R&D. Sources: ANEEL 1999a and 1999b.			

### **Investments in Efficiency Programs during 1998/99**

Table 2 shows ANEEL's approved projects considering the 1999 investment plan. A total of US\$ 113 millions were invested in energy-efficiency programs, which represented 16% more than the enforced minimal requirements. About 68% of this amount were invested in supply-side efficiency and load management programs. It is important to observe the broad definition adopted when analyzing supply-side efficiency programs which includes: a) improvements in distribution systems (reinforcement, new construction) aiming to reduce technical losses; b) installation of meters in unmetered consumers (a total of US\$ 20 millions

of the 1999 budget is spent under this category)<sup>3</sup>; c) projects to reduce reactive losses in distribution systems and d) improvement of the operation of secondary circuits. Investments in programs aimed at reducing utility losses alone (technical and commercial) totaled 0.54% of the utilities annual revenues.

All utilities have complied with the minimum investment requirements in end-use sectors, as stated in Table 1. In fact, they saw opportunities to invest more than the required levels, specially in public lighting, industrial and residential programs. However, a more careful analysis of end-use programs shows that some of them were efficiency programs in their own buildings, these programs should be at least considered supply-side energy efficiency programs, since by minimizing the utility's own consumption they would have more energy available to sell to customers. Public lighting programs also represented attractive opportunities to many utilities because some of them could share part of the investments with local municipalities gain financial benefits. These examples illustrate the difficulties of the current mechanism to ensure that benefits acquired through regulated funds are fairly distributed in the society.

Another challenge for ANEEL is to be able to evaluate the progress and implementation of these programs. The procedure in place is based on an expenditure mechanism, and so far ANEEL has not been able to make explicit data requirement in order to perform ex-ante, ex-post analysis. ANEEL in the best case will be able to assess only utilities' expenses on efficiency programs, but it will be a very difficult task to evaluate the amount of savings achieved with such programs. Program evaluation is a very recent activity in which PROCEL only in the last few years dedicated some attention. Now ANEEL needs to rapidly develop strategies to evaluate the implementation of such programs in the field.—specially those related to end-use efficiency measures. Otherwise this measure will have little effect, specially if these programs affect utilities revenues.

### **Investments in Research and Development Programs during 1998/99**

Investments in R&D totaled about US\$ 6.9 millions, which is below the historical values invested in the research center CEPEL, as mentioned. A closer analysis on the types of R&D utility projects approved by ANEEL, show that the great majority are projects destined to improve the short-term economic performance of utilities (92% of R&D investments), reducing technical losses of electrical systems and improving remote metering of electricity use. Only 5% of the investments were in energy-efficiency R&D related projects, and 3% of the funds were invested in projects with explicit environmental objectives. The majority energy-efficiency R&D projects, were short-term projects destined to improve supply-side efficiency (ANEEL, 1999c). There were no projects on renewable energy.

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<sup>3</sup> Since 1999 ANEEL demanded that an additional effort had to be implemented by utilities implementing these projects, which were information campaigns and other initiatives to help reduce energy consumption in these households.

**Table 2. Expenditure of Funds in Energy Efficiency Projects : Approved Investments during the Cycle 1998/99**

	<i>Project expenditures as % of total revenues</i>		
		Minimum requirements	Actual values
End-use efficiency projects	Public Lighting	0.158%	0.172%
	Industrial	0.025%	0.041%
	Marketing	No requirement	0.034%
	Residential	0.025%	0.034%
	Public Buildings	0.025%	0.029%
	<i>Total</i>	<i>0.25%</i>	<i>0.346%</i>
Supply-side efficiency projects	Commercial and technical losses (total)		0.541%
	Examples:		
	a) New constructions, retrofitting of electrical grid		0.196%
	b) Installation of meters and legalizing customers, reduction of commercial losses		0.192%
	c) Reactive compensation		0.063%
	d) Improvement of transformers and secondary circuits		0.056%
	Improvement of load factor		0.183%
	<i>Total</i>	<i>0.724%</i>	
<b><i>TOTAL</i></b>	<b><i>US\$ 112.7 millions</i></b>		
Source: ANEEL (1999d). Note: Minimum expenditure requirements for Public Lighting started with Resolution 261 in 1999.			

**Table 3. R&D Investments 1998/99: Main Indicators**

Total investments: US\$ 6.9 millions ( 0.066% of net annual revenues)
Expenses as % of total investments:
<ul style="list-style-type: none"> <li>• Salaries of utilities' staff working in R&amp;D related projects: 24%</li> <li>• Contracted services with research centers and universities: 76% (CEPEL 17%)</li> <li>• Expenditure on energy-efficiency related R&amp;D projects: 5% (end-use projects: 0.6%)</li> <li>• Expenditure on environment related R&amp;D: 3%</li> <li>• Expenditure on R&amp;D with short-term direct benefits to utilities: 92%</li> </ul>
Source: ANEEL (1999e).

## Low Income Programs

Although the regulation in place does not specify any obligation to invest in projects targeting low income groups, ANEEL introduced more recently a criteria to approve utility

projects (proposed under the one-percent charge) that have the objective to install meters and proper connections to the grid of low income consumers. The utility is requested to also present a program to improve energy use of low-income households.

As utilities became privatized they revised the classification of their low income customers, which previously was dealt with much more flexibility by the public utilities. The result has been a steady decline in the numbers of households receiving a special tariff, as can be seen from Table 4. These households are faced now with an increased energy bill, and at the same time they lack information, have poor electrical installation and obsolete equipments. Some of these issues are now being addressed by utilities as a result of ANEEL's enforcement to counterbalance the expenditure on commercial loss related programs.

The introduction of competition also poses the problem of a new funding mechanism to replace the current use of cross-subsidies. ANEEL and governmental institutions seem to be concerned about this issue but so far an alternative has not been proposed.

**Table 4. The Participation of Low-income Customers in Country Regions (March/99)**

Region	% of total residential customers	Variation of number of low income customers (Dec. 97/ Mar. 99)
Center-West	11,80%	-19,52%
North	31,93%	-17,90%
Northeast	19,58%	-26,44%
South	6,61%	-40,75%
Southeast	42,34%	-9,47%
Brazil	29,10%	-14,47%
Source: ANEEL, 1999		

## Conclusions

The introduction of fair competition in the Brazilian market will take time to be effectively in place and will dominate the agenda of the regulatory body if the current trends are maintained. The transition from a public monopoly, hydro-based electrical system to a competitive industry is no trivial task.

The lack of a national energy policy setting broad guidelines and defining which are the public interests is largely responsible for the omission and/or incomplete formulation of regulatory measures.

The important step taken by ANEEL to create funds for energy efficiency and R&D does not go far enough. The formulation of energy efficiency and R&D plans by the interested utilities limits severely, in our view, the scope and the opportunities to invest in programs that have the potential to yield greater societal benefits. It is very likely that only those alternatives that present favorable cost-benefit ratios from the utility point of view will be proposed and implemented by the utilities, unless ANEEL has a clearer and more objective prescription of allocation of resources that consider prominently the public perspective of energy investments. The lack of reference studies to assess the potential of

energy efficiency and expertise in program evaluation limits severely an assessment of the utilities programs by a public regulatory agency.

In the case of low income households, the utilities' initial priority was to get them properly connected to the grid and metered, end-use efficiency came later, when ANEEL conditioned the use of the One-percent regulated investment for these purposes to the implementation of efficiency programs for low income groups. Other issues, however, remain undefined as reforms seek to introduce more competition in the electricity sector: the connection of new low income households and their ability to afford electricity prices. Funding mechanisms will have to be proposed in order to provide for these services.

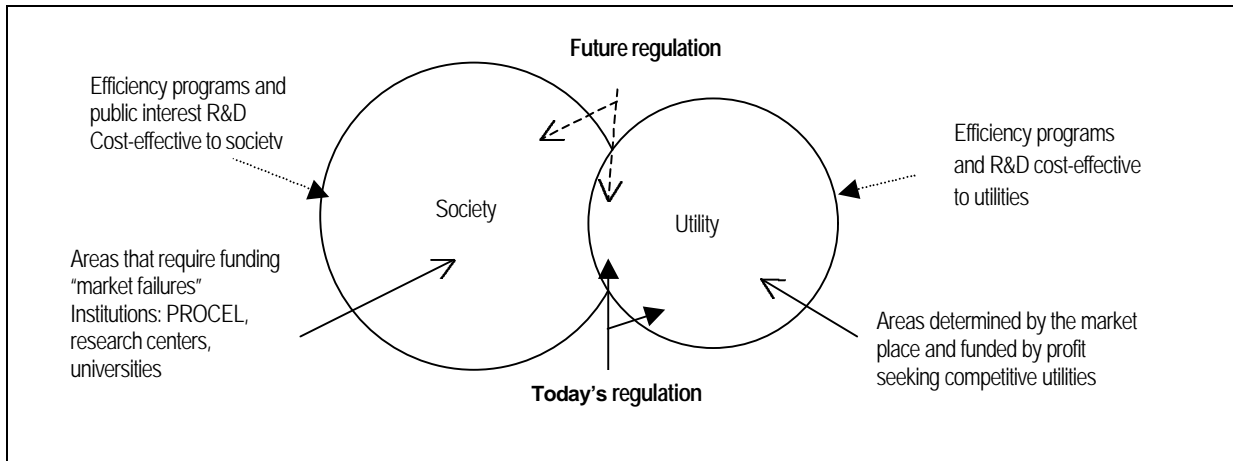
The present regulation to finance utility-led activities in energy efficiency and R&D has the following main impacts:

- It will limit R&D to short-term and proprietary research, precluding investments in public interest research, which remain unfunded and undefined.
- It will aggravate regional disparities. The larger and more profitable utilities are concentrated in the Southeastern portion of the country, which also present higher per capita incomes. End-use efficiency programs tend to be more costly to operate in other areas of the country, but could have greater societal benefits. These regions (specially North and Northeast) also present characteristics that are less investigated by research and development programs and would therefore require more funds than in the more developed South and Southeast regions.
- Some of the priorities stated by ANEEL will be done anyway by profit-seeking utilities and would not require this kind of mechanism, as can be depicted from many of the projects being currently implemented. Resources collected through this mechanism should be directed to the investments that would not be done otherwise via market forces.
- Current ANEEL guidelines for program proposals do not facilitate the evaluation of energy savings achieved. They basically allow for verification of utility expenditures on programs and not their performance.

It is true that current ANEEL's regulation provides a window of opportunities for investments in energy efficiency and energy R&D, but present distortions in our view that reveal an apparent misunderstanding of the role of public interest policies and the operation of energy markets. Profit seeking utilities would not require any legislation to direct investments to reduce commercial losses which currently may have a privileged portion of the one percent charge, for example. Although ANEEL must ultimately approve the utilities' plans, the posing of alternatives that may yield greater societal benefits but offer lower financial benefits to the utilities will have lower priority or will not even be considered under the present system. This will likely prevail for public interest research and development which may present relatively long pay-back periods.

Figure 1 illustrates the present situation in which programs that present benefits to utilities are funded. Alternative mechanism need to be put in place to finance other types of programs that satisfy public interest. PROCEL could be a candidate to manage efficiency programs outside utilities promoting, with the help of other governmental agencies, consumer associations and manufacturers, energy standards, market transformation, fuel substitution programs. Existing research centers located at universities and CEPTEL could assume the leadership in conducting energy related public interest R&D.





**Figure 1. Funding of Public Interest Efficiency and R&D Programs**

The creation of the One-percent regulation is an important step forward to fund public goods, specially if it can also be emulated by other developing countries in the process of restructuring its energy industry. However, it is even more important that the newly created public regulatory agencies have the conditions to operate and be guided by adequate policies that do not harm the progress and effectively promote the access of energy services, contributing to solve severe social problems in a manner that is energy efficient and sustainable.

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