Public Benefit Funds are Not Enough to Secure Energy Efficiency and Energy R&D Activities: Lessons from Brazil

Gilberto De Martino Jannuzzi, State University of Campinas and International Energy Initiative

Alan Poole, Independent Consultant

ABSTRACT

Brazil is one of the very few developing countries to have demonstrated continued support for energy efficiency and energy R&D during the re-structuring process of its power sector.

Regulation enacted in the country helped to create significant funds for energy efficiency and energy R&D projects, reverting the initial decline in funding and activities during the initial stages of the re-structuring and privatization process.

About US $ 300 million are collected annually from utilities in Brazil. The allocation of resources has changed very significantly since the initial implementation of the wires charge in 1998. This is due both to successive rulings by National Electricity Regulator (ANEEL), as well as to laws passed in 2000 and 2004. The country created two separate funding schemes from a 1% levy on utilities' annual revenues (wires charges). Part of the resources are administered by the utilities themselves under the supervision of ANEEL and the other part is managed by a board of representatives from government, academia and private sector.

This paper reviews the recent achievements from compulsory investments made by utilities and the National Public Benefit fund.

The Brazilian experience suggests that in spite of the importance of securing funds for energy efficiency and R&D, better governance of these efforts is required both for the regulated utility programs and for the centrally managed public benefit fund. The lack of coordination amongst the main actors -- regulator, utilities, and government -- has become evident. This fragmented approach together with the still fragile institutional setting has precluded a strategic view as to how to maximize the social benefits from EE and R&D investments. Also, the experience in Brazil has demonstrated that it is necessary to clearly establish broad public energy policy goals in order to guide the regulator's and utilities' efforts to apply the resources available more cost-effectively.

Introduction

Developing countries face the enormous task of raisung the material levels of their populations; providing for clean water, sanitation, housing, and health care; and at the same time meeting the challenge of sustainable development. Energy efficiency (EE) and research and development (R&D) in the area of sustainable energy are essential keys to helping in this process (Herzog & Kammen, 2002; Turkenburg, 2002; Williams, 2001). These countries in particular must also find ways to finance these efforts and create the necessary institutional framework and

human capacity in order to be able to compete fairly and participate meaningfully in the global economy.

Public benefits funds (PBFs) are one of the several policy mechanisms that have been used to support and/or enhance activities related to energy efficiency, renewable energy, energy R&D, and assistance to low income customers, among other public purpose objectives. PBFs have become an important alternative especially in countries that have introduced measures to promote more competition and privatization of electric utilities. The rationale for a public role for energy efficiency and energy R&D is particularly strong, and calls for specific actions such as the creation of public benefits funds.

Brazil is one of a small number of developing countries that have implemented a PBF to support energy efficiency and related research initiatives. This paper is based on prior research carried out to evaluate the recent impacts of the introduction of PBF for energy efficiency and energy R&D in Brazil (Jannuzzi, 2005); its particular objective is to analyze and discuss of the limitations encountered, in order to provide recommendations for Brazil and other countries that seek to maximize the economic and social impacts of the PBFs.

The following sections present the evolution of the PBF in Brazil; the results achieved to date; and the lessons learned as Brazil has attemped to maintain the PBF resources and improving the programs funded.

The Brazilian Power Sector and Support to Energy Efficiency and Energy R&D

The Brazilian electricity sector in 2004 had 93.5 GW of installed capacity, of which 76.2% was hydroelectric power. Total electricity sales, using data from electricity consumption and national yearly average tariffs, amounted to approximately US$ 40 billion in that year. The industrial sector was the largest consumer of electricity (48%), followed by the residential (22%) and commercial (14%) sectors. Public sector consumption was 10%, of which public street lighting was estimated to account for approximately 3% of total consumption.

Traditionally energy efficiency programs and energy research and development in Brazil have relied strongly on governmental support. The state-owned electricity holding company (Eletrobrás) was responsible for the activities of the National Electricity Conservation Program (PROCEL)[1] and the main power sector research facility (CEPEL). During the 1990s, when the first moves towards power sector re-structuring took place, there was much uncertainty about the future of PROCEL and CEPEL, and both are still re-defining their roles and activities within the reformed power sector. PROCEL has had successful programs, such as voluntary labeling, and at times PROCEL has provided active leadership in energy efficiency (Geller *et. al.*, 2000). During 1994-2003 the average annual expenditure on energy-efficiency programs by PROCEL was about US$ 14 million.

CEPEL was created in the early 1970s and has been heavily dependent on Eletrobrás and state-owned utilities for its core funding. Up until the early 1990s, almost 90% of its annual budget was met with services to the publicly owned electricity system. As privatization started, CEPEL had to seek funding from other sources, competing with the existing university and research laboratories (Jannuzzi, 2003).

[1] PROCEL still operates under Eletrobrás management.

The Brazilian Electricity Public Benefits Fund

A public benefit "wires charge" was created as part of the reform of the power sector initiated by the Brazilian government in 1995. The objective was to assure that certain public policy objectives were maintained in the new context of privatized utilities and liberalized markets.

Clauses mandating energy-efficiency investments were included in the privatization documents for all distribution utilities, and such clauses were also included in the concession contracts for publicly-owned utilities when these were renewed. Starting in 1998, the requirement for EE investments was formalized through resolutions of the Electricity Regulatory Agency, ANEEL, in the form of a wires charge of 1% of net utility revenues.

The allocation of resources is subject to regulations by ANEEL, which also approves the project proposals of the utilities and oversees compliance with norms, etc. However, with the exception of some blocks of resources, utilities are responsible for designing and executing all the programs and projects.

The allocation of resources has changed very significantly since the initial implementation of the wires charge in 1998. This is due both to successive rulings by ANEEL, as well as to laws passed in 2000 and 2004, which created new allocations for these funds.

Table 1 presents the evolution of the acts that regulated the allocation of the 1% wires charge since 1998. The resulting structure is complex and Figure 1 illustrates the current distribution and flow of resources to EE and R&D according to the type of utility. Only Distributing utilities are obliged to implement EE programs, utilities that only generate or transmit electricity invent only in R&D programs. Generators using renewable resources (solar, wind, small hydro-plants and biomass) are exempted from these requirements.

Table 1: Legal annual requirements in energy efficiency and energy R&D by eletric utilities in Brazil (as % of their annual net sales revenues)

	Year	Legal instrument	Energy Efficiency (Regulated programs)	Energy R&D		
				Total (%)	Regulated programs (Utilities) (%)	CTEnerg (%)
Generation and Transmission	2000-04	Law 9.991/00	-	≥ 1.00	≥ 0.50	≥ 0.50
	2004 onwards	Law 10.848/04	-	0.80	≥ 0.40	0.40
Distribution	1998-99	ANEEL Regulation (n. 242/98, n°261/99 e n°271/00)	≥ 0.25 end-use, ≥ 0.65 supply-side	≥ 0.10	≥ 0.10	-
	2000-05	Law 9.991/00	≥ 0.50 (end-use)	0.50	0.25	0.25
	2006 onwards	Law 9.991/00	≥ 0.25 (end-use)	0.60	≥ 0.30	0.30
	2004-05	Law 10.848/04†	≥ 0.50	0.40	≥ 0.20	0.20

Notes: Since year 2000 only end-use energy efficiency projects can be financed (Law 9.991/2000). Generators using renewable resources (solar, wind, small hydro-plants and biomass) are exempted from these requirements. † Since year 2004, 0.10% is destined to support the activities of the EPE, Energy Planning Company, owned by the Ministry of Mines and Energy, after 2006 EPE will get 0.15% of annual revenues from distributing utilities, as the percentage to EE falls; (for T&D utilities the % allocated to EPE will not change from the current 20%). Sources: ANEEL (1998, 1999 and 2000), and MME (2005).

In the initial phase, from 1998 to 2000, only electricity distribution companies were obliged to invest in EE and R&D. During this period 90% of the resources (the 1% wires charge) went to energy efficiency and 10% to regulated R&D programs. Legislation in 2000 (Law 9991) increased the share of R&D to 50% and foresaw a further increase to 75% from 2006 on. Under this legislation, half the resources for R&D are managed by the utilities in regulated programs; and half go to a national fund called CTEnerg. CTEnerg has the mandate to invest in energy R&D and also in public-interest energy efficiency, in order to complement the utilities' programs.

In 2004, new legislation (Law 10848) created a third use for funds collected from the wires charge: support for a new planning agency created by the government, the EPE (Energy Planning Company). This agency initially received a 10% share of the wires charges, a ratio increasing to 15% starting in 2006. These values are subtracted from the allocation for R&D.

Table **2** summarizes the changes in allocations within the Distribution utilities and shows the gradually diminishing share allocated for EE investments. (Note that the share allocated to EE funding steadily decreased, as the share for energy R&D correspondingly increases.). Values are in terms of % utility receipts, with the total always = 100%. Congress is currently debating a law which would postpone to 2010 the reduction of the EE allocation to 0.25%, half of which would be for EE measures targeted at low-income households.

Table 2: Allocation of Wires Charge Fees from 1998-2006 (Distributing Utilities)

Year	Energy Efficiency	R&D*	EPE**
1998-1999	0.90%	0.10%	----
2000-2003	0.50%	0.50%	----
2004-2005	0.50%	0.40%	0.10%
From 2006	0.25%	0.60%	0.15%

*R&D: Starting in 2000, half the resources for R&D are managed by the utilities in regulated programs and half go to a national fund called CTEnerg

In the initial phase, distribution utilities could allocate up to 0.65% of the 0.90% for EE to "supply side" measures, i.e. reducing their technical and commercial losses. The legislation in 2000 restricted applications to end use measures only. This change was more consistent with the objectives of the wires charge, since in the newly liberalized environment utilities already had strong incentives to reduce their losses.

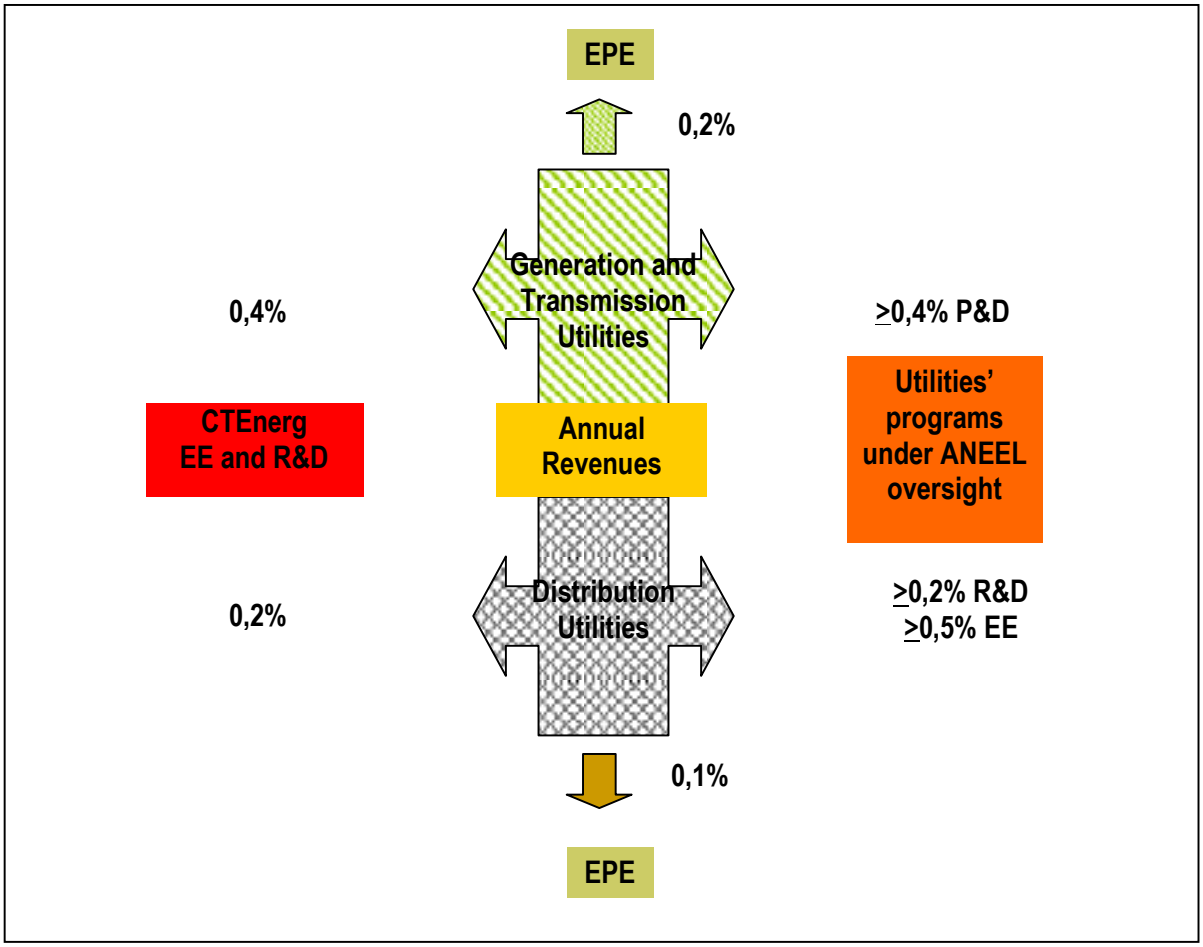
Besides being able to spend most of its resources on supply side activities, which they would want to do anyway, utilities in the initial phase had considerable freedom in choosing their projects and could allocate resources to marketing. There was little concern about measuring costs and benefits.

Over time, successive rounds of rulemaking by ANEEL gradually restricted utilities' options and came to require minimum benefit-cost ratios (0.85 for most projects, 1.00 for public lighting). Marketing was eliminated, and minimum allocations for different economic sectors were required. These allocations and norms were the same for all utilities, regardless of the large

differences in the size and market characteristics of different utilities. At the same time, the duration of projects was no longer limited to just one year.

While initially all projects were implemented on a grant basis, in later cycles utilities were allowed to recuperate their EE expenditures under part of the wires charge program (currently 50%) using performance contracts with the beneficiaries, unless they are in the education, municipal or residential sectors. Part of the returned funds would be used for new EE projects, part to reduce electricity rates for consumers.

Figure 1: Illustration of the structure of the Brazilian PBF, allocation of the 1% wires charge to the CTEnerg Fund and Utilities' programs



Notes: All percentages are related to the utilities' annual revenues. The legislation sets the minimum level of investment for the utility annual EE and R&D program.

Therefore, currently the resources collected from utilities are destined to EE, R&D and also to support the activities of a planning agency owned by the Ministry of Energy.

PBF Administration

The literature on PBFs shows a wide variety of ways of structuring and implementing Public Benefits Funds, and apparently no single or best arrangement has emerged from the international experience that has proved to be clearly superior (Wiser et al 2003, Blumstein et. al. 2005, Hamilton et. al. 2005). Internationally there are three general options for PBF programs administration:

- Utility administration
- Government administration through regional or central agencies
- Use of independent non-governmental organization

Electricity utilities have been the main EE program administrators in the US, but in many cases regulatory commissions and state legislatures have established advisory committees or collaborative processes that permit the participation of customer groups and market actors to provide inputs on program direction and budgets, independently from the regulatory process. In many places, there has been a trend of shifting some (or all) of the administrative responsibility of PBFs to entities other than utilities. Some countries using government agencies to administer PBFs include Norway, Thailand, and Belgium.[2] Other countries created non-governmental non-utility agencies to manage their EE programs Mexico, UK and Australia.

During 1998-2000 the the administration of the Brazilian PBF was managed only by utilities under the regulator's supervision. However, since 2000 the PBF has been managed by the utilities (with the oversight of ANEEL) and by CTEnerg's Board in a quite independent manner. It is therefore a mix of utility administration with the regulator's oversight and a non-governmental decision maker (the CTEnerg Board).

The CTEnerg is managed by a board of 9 members representing the Ministry of Science and Technology and its funding agencies (3 members); the Ministry of Mines and Energy; the Regulator (ANEEL); 2 representatives from the academic community; and 2 from the private sector. The Board has the mandate to define the annual budget allocation, investment portfolios in energy efficiency and R&D and multiyear programs. The representative from the Ministry of Science and Technology is the chairman of the Fund, while two of its agencies, the National Science and Research Council (CNPq) and the Brazilian Innovation Agency (FINEP) are the implementing agencies. Usually, all the training and academic components (scholarships, grants, conferences) are handled by CNPq, and direct financing of applied projects is managed by FINEP, in particular projects involving industries. This type of governing body combining representatives from government, the research community, and private sector is a novelty in the management of public funds in Brazil, especially in the R&D area, which has traditionally been dominated by the academic and/or the government sectors.

In 2001 the Ministry of Science and Technology contracted a non-governmental organization to be in charge of the technical and administrative management of the various R&D

[2] In Thailand, the government manages a broad-based set of energy-efficiency progtrams from the Energy Conservation Promotion Fund, which has annual inflows of approximately US$ 40 million from a levy on petroleum products. At the same time, the national electric utility manages a much smaller budget for DSM programs that focus primarily on appliance and equipment efficiency (Vongsoasup et al. 2002).

funds. This organization was the Centre of Strategic Studies and Management in Science, Technology and Innovation (CGEE, www.cgee.org.br). The executive secretariat of CTEnerg was located at the CGEE (2001-2003), and had as its main tasks the preparation of prospective studies in energy technology and the evaluation of programs financed by the Fund. As the executive-secretariat of the various funds was hosted at CGEE, the idea was also to conceive and promote programs that could be supported by several funds. An example of this effort was the National Fuel Cell Program (proposed by the CTEnerg Executive Secretariat) which combined funds and interests from the Oil and Gas Fund (CTPetro), the Transportation fund, and others.

Since 2003, with the change of government, the CGEE has not had any role in managing the R&D Funds[3].

Investment Impacts in EE and R&D (1998-2006)

The Utilities' Investments

The regulatory requirements introduced since 1998 have had a positive impact on the overall national level of funding for energy efficiency. They have increased by several times the amount of investment in energy efficiency that has been traditionally made by PROCEL. While PROCEL invested an annual average of US$ 14 million during 1994-2003, utilities' investments averaged US$ 57 million per year during 1998-2004.

Table **3** below summarizes the investments in end-use programs in the annual cycles since 1998, as well as the estimated energy savings and avoided demand. The annual cycles do not follow the calendar year. The investment values since 2002 are estimates, since official figures had not been divulged at the time the study was made. The estimates of avoided demand and energy savings are even patchier. A major criticism of this program is that while there is substantial *ex-ante* evaluation of projects by the regulator, there is little if any systematic verification of the results.

The new inflow of financial resources has created an important source of income for some ESCOs and engineering consulting firms. A recent survey conducted by ABESCO concluded that ESCOs have rated the regulated EE programs as one of their main funding sources (ABESCO, 2005). Some of the largest utilities in the country are increasingly outsourcing the design of EE projects to ESCOs. These utilities decide the types of projects they have interest in and ESCOs compete for designing and implementing the projects. For example during the year 2002, 117 contracts were signed with ESCOs, which represented about 20% of the investments of the EE utilities' regulated programs in that year. It is important to observe that in most cases, performance contracts are signed between utilities and their clients directly, and not by the ESCO and the client. At the same time, there is no evidence that the utilities' resources have been leveraged by ESCOs or other agents by taking loans from financial institutions.

[3] One of the main rationales for locating the management of R&D funds outside the Ministry's premises was to minimize possible political interference and provide a more stable administration. However, the strategy did not succeed; in March 2003 the administration of R&D funds was transferred from CGEE and placed directly under the Ministry of Science and Technology, with the new government at that time.

Table 3: Total Investment in Regulated Utility Energy-Efficiency Programs (1998-2004)

Cycle	Investments (US$ millions)	Average Cost-Benefit ratio of programs	% Supply-side programs	% End-use programs	Energy Savings (GWh)	Avoided Demand (MW)
1998/1999	68.3	n.a.	68%	32%	754	250
1999/2000	75.9	n.a.	60%	40%	994	369
2000/2001	35.4	0.31	6% (a)	94%	892	251
2001/2002	57.2	0.53	1% (a)	99%	351	84
2002/2003(*)	39.8	0.52	-	100%	234	56
2003/2004 (**)	118.1	0.56	-	100%	499	110

Source: updated from Jannuzzi (2005) and Vidinich (2005). Notes: (a) After 2000 (Law 9.991/00) only supply-side programs that had been previously been approved by ANEEL were allowed to be continued. (*) estimated by the author based on data from the major 28 utilities. (**) ANEEL

Most of the investments in energy efficiency (about 55% during 1998-2003) have gone towards improving public street lighting, although it represents only 3% of total electricity consumption. The predominance of public lighting becomes even more pronounced when we consider the governmental program RELUZ administered by PROCEL and Eletrobrás. This program started in 2000 with the target to improve the efficiency of 77% of the lighting points and to help expand public lighting systems up to the year 2010. RELUZ can finance 75% of the capital costs of new lighting systems to utilities at very subsidized rates of interest.[4] This partial grant helps explain the overwhelming preference for this type of measure by the utilities. Other reasons are the relatively low price paid by public lighting, despite its impact on peak load demand, and the poor payment history of many municipalities. From the utilities perspective this was a way to minimize losses from their sales to municipalities.

[4] The interest rate and payment conditions are very favorable considering existing market conditions in Brazil (5% interest/ year, while the National Development Bank – BNDES, has an average rate of 15% per year) and market rates are much higher.

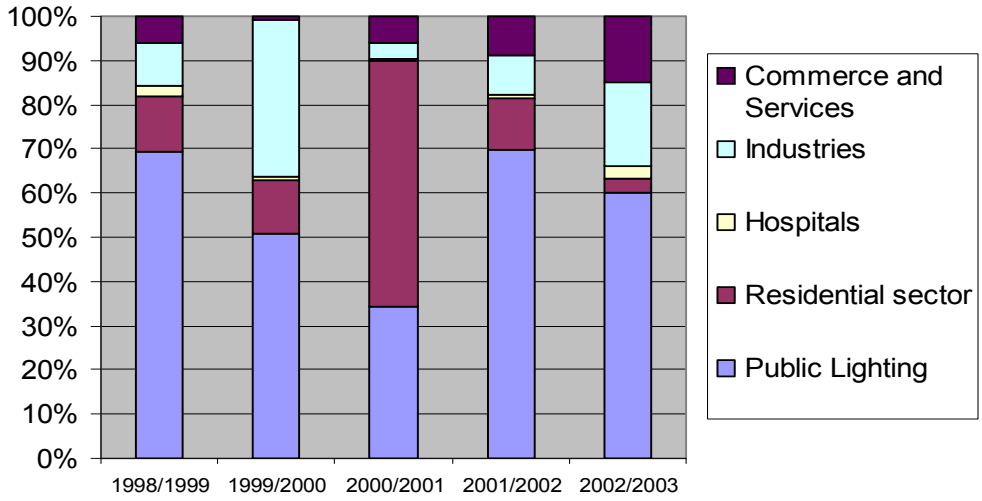


Figure 1: Breakdown of utilities' investments in EE (%) by period (1998-2003)
Source: ABRADEE (2005)

In spite of the new level of funding, it is important to observe that the evaluation of the savings incurred has not evolved so as to accurately monitor the progress being achieved. The regulator in fact has limited capacity in the area of energy efficiency monitoring and evaluation (this is not its primary role); and it has not delegated the task to a more specialized agency. There is an *ex-ante* evaluation based on engineering estimates of the benefit-cost ratios, but the *ex-post* evaluation is very limited and does not rely on established protocols for monitoring and evaluation.

EE projects in sectors like buildings, services and industries have been much smaller than public lighting projects. The current model, with management of EE projects done by each utility, does not take advantage of possible impacts of "scale" by combining several projects of several utilities. Most utility programs are still small and fragmented, and there is no apparent coordination or common strategy among utilities. As a result, some systemic benefits may not be captured adequately, such as better use of transmission lines and the transformation of end-use markets.

There are difficulties in measuring the progress to date with EE utility programs. ANEEL has not been able to introduce indicators to monitor progress in transforming energy markets, nor performance-based criteria to evaluate programs.

Utilities also have started to invest in R&D programs, contracting projects with universities and local research institutions. During 1998-2004 a total of US$ 356.3 million was invested -- a figure that is significant by any international standard, and especially for a developing country. A comprehensive evaluation of the research programs conducted by utilities is not available at the time.

Table 3: Total Investments in Regulated Utilities' R&D Programs (1998-2003)

Cycle	Total invested (US$ millions) *
1998/1999	4.4
1999/2000	10.2
2000/2001	39.1
2001/2002	53.9
2002/2003	69.0
2003/2004	179.7†
Total	356.3

Source: ANEEL 2003, Pompermayer & Melo Jr (2005) and authors' estimates.
Note: Current R$ were converted into US$ using exchange rate as of 31/Dec. †: The oscillation in funding levels varies annually depending on the different time schedules utilities must present their annual plans and dates regulating their concessionary contracts, also there are issues related to non-approved programs that are re-scheduled or postponed.

The CTEnerg Fund

CTEnerg is intended to provide funds for R&D and EE in areas considered socially desirable and that are consistent with national development plans and goals. The resources collected by CTEnerg can be transferred from year to year, when not used in the current fiscal year, and they offer the possibility to invest in long-term projects with a higher degree of risk. This way, CTEnerg offers a more stable source of public support to energy R&D and EE for projects that do not attract interest from private investors but are also considered important for society. If operated in a manner complementary to the utilities' regulated programs and other private investments, it has the potential to provide greater stability to the final commercialization of R&D results in the future. CTEnerg projects are in general larger and have longer realization periods compared to those implemented by utilities.

In 2001 CTEnerg invested US$ 17.3 million in electricity-related programs and in 2002 US$ 37.3 million. This was much less than the amount invested by utilities and less than the estimated amount accruing from the fund's share of the "1% obligation" resources. According to the Law 9.991/00 the residual is being accumulated for future use, but there has not been any sign of this happening. In fact, provisions in the legislation and formal procedures used to plan the national budget (annual expenditures under the CTEnerg Fund need to be approved by the National Congress) have hampered the management of the resources and the fulfillment of its original objectives to provide a stable source for long term programs. As the data in Table 4 show, the funds allocated for public interest EE and R&D have been consistently under-spent. There has been a deliberate government policy to restrict the use of these funds, helping the Planning Ministry to claim these unspent resources as part of the annual targets for the public sector budget surplus. Although this procedure clearly contradicts the legislation that created CTEnerg, the practice has been maintained, compromising long-term research and public interest EE programs.

Table 4: Estimated and actual budget/expenditures by the CTEnerg Fund (2001-2004) in US$ millions

Year	Total budget (US$ millions)	% actually spent
2001	34.5	62%
2002	20.1	34%
2003	64.8	35%
2004	54.1	9%
2005	39.4	63%
2006	52.0	-

Source: Updated from Jannuzzi (2005), MCT (2006). Note: Exchange rates used (R$/US$): 2.32 (2001), 3.53 (2002), 2.88 (2003), 2.65 (2004), 2.55 (2005) and 2.12 (2006).

Lessons learned

Energy Efficiency

The rise in funding levels for energy efficiency is clear and would not have occurred without the specific legislation creating the PBF during the power sector privatization and re-structuring process. Since 1998, the amount of resources available for energy efficiency investments, in the range of US$ 40-60 million/year, has been significantly higher the historical average of US$ 10 million/year spent by PROCEL. Not only has more funding been allocated to EE programs; but also a significant new funding stream for energy R&D has been developed and implemented. The new funding mechanism has also made it possible for EE investments to be spread out across the country through the local distribution companies.

Unfortunately, it seems that the "leveraging effect" of these resources has been very small. Potentially the RELUZ program could represent an additional source to EE investments, but the indications were that most utilities used the RELUZ funds to finance their EE investments in public lighting as part of their compulsory EE investments (as reported before up to 75% of the investments in these projects could be financed by RELUZ). Some utilities have already replaced all public lighting equipment within their concession areas and all expansion is done with the more efficient technologies.

EE programs in sectors like buildings, services and industries have been much smaller than those in public lighting projects. The current management of EE projects done by each utility does not take advantage of creating "scale" combining several projects of several utilities. Most utility programs are still small and fragmented, and there is no apparent coordination or common strategy across the utilities. As a result, some systemic benefits are not being adequately captured, such as better use of transmission lines and the transformation of end-use markets.

Additionally, there are difficulties in measuring the progress to date with EE utility programs. ANEEL has not been able to introduce either indicators to monitor progress in transforming energy markets, or performance-based criteria to evaluate programs.

Research and Development

Analyzing the country's experience since 1998, an important learning process can be observed, both with the regulator and among the utilities. Some utilities now clearly value the

strategic importance of pursuing activities in R&D, such as technical improvements in their own staff. Some small companies are appearing as a result of some of the more successful projects, and a better relationship between research centers and universities is being developed (ABRADEE, 2003). This is a significant change in the relationship between utilities and research establishments in the country. It also helped to promote interesting spill-over effects, inducing the creation of new businesses represented by small consulting firms and ESCOs. Data available for the São Paulo State utilities have shown an increasing participation of engineering firms in R&D projects (Jannuzzi, 2005).

The experience with CTEnerg, is more recent when compared with the regulated R&D programs. It is illustrative that it has invested much less than the amounts invested under the regulated utilities' EE and R&D programs. The model for managing this fund is quite innovative, as it includes representatives from government, academia and the private sector,. However, the model, still needs to be consolidated, and CTEnerg has to demonstrate a higher degree of consistency and predictability in disbursements over time. In practice, the federal government has limited annual spending in order to comply with macro-economic targets for public spending, and CTEnerg has been affected by these interventions.[5] Interestingly enough, legislation gives conditions for a more stable operation, but indigenous institutions have not been able to implement these conditions and political interference seems to dominate the final decisions of the CTEnerg fund.

Nevertheless, investments were made in upgrading laboratories that could serve as testing and certification sites for energy-using equipment. These investments were made during the first two years of CTEnerg, with the purpose of contributing to the implementation of the Energy Efficiency Law. There was also interest in allocating funds to support the technical studies required for establishing minimum efficiency standards for energy-using equipment which could be supported by CTEnerg. Up to now, however, none of these possibilities have been explored or implemented on any significant scale, apart from the initial laboratory investments.

In a recent study completed by the CGEE on Energy Technology Foresight (CGEE 2004), energy efficiency was ranked as one of the priorities for investments in R&D. This study was done at the request of CTEnerg Board in 2002, in order to guide future decisions.

CTEnerg has been able to attract more resources from the private sector, as most of its grants required that a similar amount of investment had to be met by the contracting agency. Some utilities have associated with other institutions and proposed projects which received funds from CTEnerg.

The R&D program conducted by utilities have been much more successful in developing a routine for the approval and implementation of its projects. Utilities have been more efficient in the sense of designing, implementing R&D programs and spending the R&D annual budget compared to the CTEnerg set-up.

Evaluation of R&D programs (both the regulated and CTEnerg programs) is still extremely modest, especially *ex-post* evaluation. CGEE is tasked with performing periodic evaluation of the investments made, but these evaluations have never been performed. It is

[5] In year 2003 only 35% of the official budged (R$ 188 millions) approved by the National Congress was effectively spend. For year 2004, the budget approved was R$ 143 millions, but 49% of this was withheld by the Planning Ministry and not allowed to be spent. Up to July 2004 only 3% of the original budget was spent on approved projects (information available from http://www.mct.gov.br/Fontes/Fundos/CTs/CTEnerg/CT_Energ_Recursos_Orc_2003a2004.htm).

difficult to understand why this has not happened, but the situation suggest a lack of clear signs from the highest authorities both at the Ministry of Science and Technology (who presides the CTEnerg Board) and the Ministry of Energy (and the Regulator). The regulator and utilities are not equipped to perform this kind of evaluation.

Final Considerations

It is very unlikely that after the power sector reforms, Brazilian utilities would have invested in energy efficiency or R&D projects. The regulatory and legislative efforts put in place were important instruments for not only securing support but moving the country to a higher level of activity in these areas.

The rationale for a public role for energy efficiency and energy R&D after power sector reforms is particularly strong, and calls for specific actions such as the creation of public benefits funds (PBFs) in any country, and in Brazil in particular.

A number of important lessons were learned by utilities and legislators over the period. The evolution from a system where only utilities were responsible for investments in EE in 1998 has been substantial. The need to fund other types of EE and R&D programs motivated the creation of CTEnerg, a national fund responsible for public interest R&D and EE. The need to fund end-use projects rather than just supply-side, utility projects has become an accepted principle of Brazilian energy policy since 2000. And other advances can be cited. For example, utilities can design and implement multi-year projects; better *ex-ante* criteria are in place for screening projects to be approved by the regulator (i.e. cost/benefit criteria for project approval); and there are now limitations on expenditures by utilities for marketing using regulated public benefits funds.

The split administration of these resources between the CTEnerg Fund and the utilities (the "regulated funds") discussed here is a model that is still evolving but clearly needs to demonstrate results. CTEnerg has not been able to fully allocate the existing resources due to governmental influence and this shows the fragility of the management structure.

If utilities are to continue to be the main proponents and implementers of EE projects, regulatory changes should now seek to better align utility incentives with saving energy. Currently, utilities have strong disincentives that work against the promotion of effective EE programs (especially those that reduce kWh), since they have negative impacts on electricity sales[6] and consequently affect corporate profits. Changes in the rate design could help EE to become more attractive to customers and utilities. Very little innovation has been introduced in the structure of rates to customers in the last two decades or so in Brazil.

An alternative to the existing model is to transfer the utility role (or part of the funds) to another entity, which has positive incentives to plan and implement energy efficiency programs more effectively.

The Brazilian experience suggests that in spite of the importance of securing funds for energy efficiency and R&D, better governance of these efforts is required both for the regulated utility programs and for the centrally managed public benefit fund. The lack of coordination amongst the main actors -- regulator, utilities, and government -- has become evident. This fragmented approach together with the still fragile institutional setting has precluded a strategic view as to how to maximize the social benefits from EE and R&D investments. Also, the experience in Brazil has demonstrated that it is necessary to clearly establish broad public energy

[6] Electricity is "price capped", therefore profits are driven by increased sales.

policy goals in order to guide the regulator's and utilities' efforts to apply the resources available more cost-effectively.

It is worrisome that clear evaluations are not available of saved energy or R&D accomplishments, compatible with the levels of funding that have become available through the PBF. Without such indicators, there is a real danger of losing this funding to other activities, as already happened recently with the newly created EPE – the energy planning agency[7]. Energy efficiency is even more problematic than R&D because there is a direct disincentive for the utilities to promote efficiency and reduce their sales.

The literature (Wiser et. al, 2004) shows the vulnerability of PBFs to political attacks and re-appropriation of funds to other purposes. International experience demonstrates the difficulties in maintaining PBFs whenever their results are unclear and programs are not well targeted or do not have clear objectives.

Evaluation of PBF programs is essential both for defending the very existence of the fund, and for identifying ways to improve the programs funded. Therefore, successful PBFs, especially for EE, generally place significant emphasis on independent evaluation.

As final conclusions, we observe that the three main areas requiring attention to improve the performance of the Brazilian "1% obligation" are related to

1) The administration and governance of the resources;

2) The need to improve collaboration and pooling of more resources into EE and R&D activities; and

3) Monitoring and independent *ex-post* evaluation.

The Brazilian PBF fund and related mechanisms can benefit greatly from greater input from existing international experience, as well as from closer inspection and analysis of domestic experience acquired so far.

References

Chandler, W., Secrest, T.J., Logan, J., Shaeffer, R., Dadi, Z., Shukla, P.R., Tudela, F., Davidson, O., Alpan-Atamer, S., 2002. Climate change mitigation in developing countries: Brazil, China, India, Mexico, South Africa, and Turkey. Pew Center on Global Climate Change, Arlington, VA, USA.

Geller, H., M. d. Almeilda, et al. (2000). "Update on Brazil's national electricity conservation program (PROCEL)." Energy for Sustainable Development **IV**(2): 38-43.

Herzog, A.V., Kammen, D.M., 2002. Energy R&D: investment challenge. Materials Today, 5, 28-33.

Jannuzzi, G. M. (2000). Public Goods and Restructuring of the Brazilian Power Sector: Energy Efficiency, R&D and Low Income Programs. 2000 Summer Study on Energy Efficiency Buildings "Efficiency and Sustainability", Asilomar, California, ACEEE.

Jannuzzi, G. M. (2003). Public Interest Energy Research and Development: electricity sector reforms and their effects in energy R&D activities. Campinas, Brazil. International Energy Initiative**:** 45p. (available at www.iei-la.org).

Jannuzzi, G.M., 2005. Energy Efficiency and R&D Activitities in Brazil: Experiences from the Wirecharge Mechanism (1998-2004). World Bank, Washington, p. 50.

[7] EPE is in charge of providing support to the Ministry of Energy, such as annual national energy balances, long term energy planning, preparing

MCT (2006). Arrecadação, Dotação Orçamentária e Execução Financeira. **2006**.
Poole, A. D. and E. T. Guimarães (2003). Steps Towards Building an Effective Energy Efficiency Strategy in Brazil. Rio de Janeiro, Instituto Nacional de Eficiência Energética - INEE e Forum de Co-Geração**:** 22.
Sirinthorn Vongsoasup, Sirinthorn, Prasert Sinsukprasert, Peter du Pont, and Thomas Hernoe. 2002. "Piloting the Way to a More Effective Energy Strategy: Thailand's Simplified Subsidy and Finance Initiatives." Presented at the ACEEE Summer Study on Energy Efficiency in Buildings. Asilomar, California. August.
Turkenburg, W.C., 2002. The Innovation Chain: Policies to Promote Energy Innovations, in: Johansson, T.B., Goldemberg, J. (Eds.), Energy for Sustainable Development: a policy agenda. United Nations Development Programme, Bureau for Development Policy, New York, pp. 137-172.
Vidinich, R.: "Programas de Eficiência Energética – Novas Alterações"; presentation of SRC/ANEEL at the 6th Energy Business Encounter of CIESP, August, 2005.
Williams, R.H., 2001. Addressing challenges to sustainable development with innovative energy technologies in a competitive electric industry. Energy for Sustainable Development V, 48-73.
Wiser, R., Murray, C., Hamrin, J., Weston, R., 2003. International Experience with Public Benefits Funds: A Focus on Renewable Energy and Energy Efficiency. Energy Foundation, China Sustainable Energy Program.