DEVELOPING FINANCIAL INTERMEDIATION MECHANISMS FOR ENERGY EFFICIENCY PROJECTS IN BRAZIL, CHINA AND INDIA

Energy Efficiency and R&D Activities in Brazil: Experiences from the Wirecharge Mechanism (1998-2004)

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Abstract

It is very unlikely that initiatives in energy efficiency (EE) and energy research and development (R&D) in Brazil would have taken place without the regulators' enforcement of compulsory programs in 1998 and later with the implementation of Law 9.991/00 by the National Congress. This initiative allocated 1% of annual utilities' revenues to EE and R&D programs. In 2000, a national law was approved by the Congress which changed the allocation of the resources from the "1% obligation" and created a national fund - CTEnerg, in charge of investing in public interest energy efficiency and energy R&D. Power sector reforms in Brazil provided the opportunity to enhance support and in fact increase significantly the level of funding in these areas. While PROCEL, the national electricity conservation program initiated in 1985, invested an annual average of US$ 14 million during 1994-2003, utilities' compulsory investments averaged US$ 57 million per year during 1998-2004.

However, legislative acts alone are not a sufficient condition to ensure that resources are being used efficaciously to maximize the public interest in energy-related services. In spite of the increased investments, no independent ex-post evaluation of the programs implemented has been carried out as yet, and therefore the impacts in terms of avoided capacity and energy savings cannot be determined accurately.

Significant experience has been acquired by the regulator and utilities in terms of managing EE and R&D portfolios, there are, however, three main areas that require attention to improve the performance of the Brazilian "1% obligation": 1) the administration, governance and coordination of the resources and efforts (amongst utilities and CTEnerg); 2) the need to improve collaboration and pooling of more resources into the compulsory EE and R&D activities; and 3) program monitoring and ex-post independent evaluation. These areas can benefit greatly from the existing international experience and from the domestic experience acquired so far.

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1. PREFACE

This report presents an analysis of the Brazilian experience in implementing mechanisms to increase support for energy efficiency in the country. Since 1998, a percentage of utilities' revenues has been compulsorily invested in electricity efficiency (EE) programs, a measure which dramatically increased the resources available for EE.

The report's main objectives are to review the domestic experience and the impacts of the "1% obligation" so far. It also tries to show the main areas where improvements are needed in order to deliver cost-effective energy efficiency programs and contribute to reducing long-term energy costs for Brazilians.

Although the main objective is to analyze the recent impacts on energy efficiency achievements we also expand the analysis to include R&D activities for the following reasons: the legislative and regulatory instruments put in place addressed both areas; in 2000 a national public interest fund (CTEnerg) was created to support both activities; from 2006 onwards the current legislation allocates a higher percentage of utilities revenues to R&D at the expense of EE programs.

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June 2005

2. EXECUTIVE SUMMARY

Power Sector Reforms, Energy Efficiency and R&D in Brazil

1. Since the early nineties Brazil has implemented significant changes in its power sector, including privatization, introduction of competition and the creation of a regulatory agency. As reform started the traditional support to energy efficiency and research and development suffered a discontinuation, budget cuts at first and re-definition of roles of the public agents in charge of these activities. In the late nineties new regulatory measures introduced a "system benefits charge" and created a national public interest fund, helping to maintain and potentially enhance the country's effort to promote energy efficiency and R&D.

2. The Brazilian electricity sector has 86 GW of installed capacity, 78% of this is hydroelectric (2004). Electricity sales measured in current dollars, using data from total electricity consumption and national yearly average tariffs, shows that the total has been stable in recent years around US$ 15 billions per year up to 2003. However, due to tariff increases allowed by the regulator during 2004, partly to compensate utility revenue losses during the 2001/02 power crisis, total sales can be estimated to have reached approximately US$ 23 billions for that year. The industrial sector is the major consumer of electricity (54%) followed by the residential (26%) and commercial (16%) sectors. Public lighting is estimated to account for approximately 3% of total consumption.

The evolution of the Brazilian "systems benefits charge" to fund EE and R&D

3. In 1998, the regulator (ANEEL) issued a resolution mandating utilities to invest a minimum of 1% of their net annual revenues in EE and R&D programs ("1% obligation"). These programs had to be submitted to the regulator and, after receiving approval or amendments, were implemented by the utilities. At that time utilities had to invest a minimum of 0.25% of net annual revenues in end-use efficiency programs, 0.65% in supply-side efficiency programs and 0.10% in energy R&D. From 1998 to year 2000, only utilities were responsible for the formulation and implementation of EE and R&D programs and this procedure privileged the selection of types of programs that were perceived as more interesting to the utilities, with very short paybacks and potentially limited social impacts.

4. In 2000, a national law was approved by the Congress changing the allocation of the resources coming from the "1% obligation" and creating a national fund - CTEnerg, in charge of investing in public interest energy efficiency and energy R&D. The resources collected from the 1% obligation were split into two portions: utilities retained 50% and continued to implement their EE and R&D programs, with ANEEL's oversight, and CTEnerg received the other 50%. Also, from the year 2000 onwards, utilities could only implement end-use energy efficiency programs.

5. During the year 2004, the existing system benefits charge (the "1% obligation") created to fund EE and R&D suffered its first political attack and resources were diverted away from EE and R&D. After a period of debate, a new law was approved reallocating the funds collected from the "1% obligation": 40% each for CTEnerg and utilities, 20% for a recently created public Energy Planning Company (EPE). These percentages are applicable to Generation and Transmission utilities. In the case of Distribution utilities currently 10% of their "1% obligation" goes to the EPE. From 2006 onwards this will increase to 15%, according to current rules (see Table 1).

The Management of the "1% obligation" funds

6. In Brazil, since the year 2000 EE and R&D are administered by two entities: the regulator and the governing Board of the CTEnerg Fund, created after the legislative act 9.991/2000. It is therefore a mix of utility administration with the regulator's oversight and a non-governmental decision maker (the CTEnerg Board).

7. Different departments at ANEEL deal with the approval of EE and R&D programs.[1] Utilities in general also have different staff members (and departments) responsible for each one of the annual programs. At the utilities side, in general, program managers for EE are located in the Marketing or Commercial departments and for R&D in Engineering Departments. Very little interaction exists amongst the officers responsible for each of the two programs, both at the regulator side and the utilities.

8. ANEEL has produced guidelines (manuals) to help utilities to design their programs. However, the rules have changed almost every year and the submission and analysis time has taken longer than the utilities anticipated, leading to delays in implementation in many cases. These rules and guidelines are applicable to all utilities irrespective of their size and market characteristics.

9. During the initial years of the "1% regulation" ex-ante evaluation of EE programs was done by PROCEL, and later ANEEL transferred this evaluation to some State regulators. Now it has brought this activity back to its own staff. In 2005 ANEEL is contracting external consultants to evaluate the proposed utilities' annual EE programs.

10. The ex-ante evaluation of utilities' R&D programs was initially done by ANEEL staff. In a second phase ANEEL contracted the National Research Council (CNPq) to review the R&D proposals. More recently (2003), ANEEL contracted Universities and Research Centers for this task.

11. The CTEnerg is managed by a board of 9 members representing the Ministry of Science and Technology and its funding agencies (3 members), 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 public interest energy efficiency and R&D and multiyear programs.

12. According to CTEnerg guidelines, funds for R&D and EE should be in areas considered socially desirable and that are consistent with national development plans and goals, but are not being adequately addressed by the market actors. 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 for energy R&D and EE for projects that do not attract interest from private investors but are considered important for society. However, it should be noted that spending under CTEnerg has been severely curtailed for macro-economic and budgetary reasons since its establishment in 2000. If operated complementarily to the utilities' regulated programs and other private

[1] In the case of R&D programs, the approval of projects is done by each department responsible for the regulation of distribution, transmission and generation services, according to the type of utility.

investments, it has the potential to provide greater stability to the final commercialization of R&D results in the future and EE projects not directly funded by utilities (such as support to develop energy efficiency standards). CTEnerg projects are in general larger and have longer realization periods compared to those implemented by utilities.

The impacts of the "1% obligation" on investments in EE: utilities' programs

13. The regulatory requirement introduced since 1998 has increased by several times the amount of investments in energy efficiency traditionally made by PROCEL. Whilst PROCEL invested an annual average of US$ 14 million during 1994-2003, utilities investments averaged US$ 57 million per year during 1998-2004. However, no independent ex-post evaluation of the programs implemented has been carried out, so the impacts in terms of avoided capacity and energy savings cannot be determined accurately.

14. 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, and not by the ESCO and the client. There is no information that the utilities' resources have been leveraged by ESCOs or other agents by taking credits with financial institutions.

15. The performance contracts between utilities and their clients permit that a portion of the compulsory investment (on average 40%, but this may vary from 50% for industrial customers to 20% for public sector[2]) be paid back in monthly installments with the associated energy savings. The payments received by the utility are included in the rate making revision process which occurs every five years.

16. Over the years, ANEEL has determined varying expenditure shares for residential, commercial, industrial programs. This procedure which fixes percentage expenditure shares in the different sectors has to be observed by all utilities in the country and has not considered local market specific characteristics, missing some opportunities and sometimes forcing expenditure on less cost-effective programs.

17. Improvements in public lighting systems (mostly exchanging incandescent lamps for mercury vapor and mercury for sodium high pressure lamps) have represented almost half of the investments in end-use programs. During 1998-2004 public lighting dominated EE investments, followed by residential programs, industrial sector and more recently commercial sector programs.

[2] In some cases, utilities fund 100% of the EE program for public sector customers (hospitals, schools, for example).

18. The predominance of public lighting can be better understood when we consider the government program RELUZ administered by PROCEL and Eletrobrás. This program started in 2000. RELUZ can finance 75% of the investment in of new public lighting systems at very subsidized rates of interest.[3] The financing is via the utilities. The "1% obligation" funds can be used to provide the remaining 25% share, but the RELUZ funds can be counted towards the fulfillment of the "1% obligation. Other reasons also explain the preference for public lighting programs:

    - Municipalities pay a relatively low tariff for public lighting, despite its impact on peak load demand and their often poor payment history. From the utilities' perspective, investing in public lighting EE has been a way to minimize losses from their sales to municipalities, while at the same time taking advantage of the RELUZ.
    - Since 2002, the minimum cost-benefit ratio required for approval is >15% higher than for all other types of projects.
    - As shown below, public lighting projects are substantially larger than in other sectors, which may be attractive from an administrative point of view.

    A question raised is why has there been such an extraordinary EE public policy emphasis on public lighting?

19. Marketing was another area that attracted utilities' investments until 2000. Since then this type of project has not been allowed as part of the regulated energy-efficiency programs. During the electricity rationing crisis special priority effort was given to implementing lamp replacement programs in the residential sector.

20. The expenditure patterns of utilities' EE programs are varied. The investment costs per project range from a few thousand R$ to almost R$ 20 million. The analysis of EE projects by major categories indicates the predominance of public lighting as the largest projects implemented by utilities, with the average project costing almost 10 times more than the projects implemented in public buildings and more than 3 times the average cost of industrial sector EE projects.

21. Seven utilities[4] alone were responsible for more than 70% of the total investments made in EE programs during 2003-04. The remaining 57 utilities located in more dispersed areas of the country have smaller programs and probably higher costs associated with their implementation and face different market conditions to exploit energy efficiency potentials. The regulator has not yet considered in any significant way different approaches to address the differences between utilities.

22. Ex-post evaluation has been one of the weakest points of EE programs, since no credible information can be consolidated from the history of EE programs until now. A credible and independent evaluation could contribute significantly to learning about the cost-effectiveness of EE programs, point towards more collaboration and very likely to help to attract other agents that could participate and expand the utilities' programs.

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[3] The interest rate and payment conditions are very favorable, considering existing market conditions in Brazil (5% interest/ year), while rates for BNDES loans are ~15%.

[4] Light, Cemig, Copel, CPFL, AES-Eletropaulo, Bandeirante and Elektro.

The impacts of the "1% obligation" on investments on R&D: utilities' programs

23. Utilities have invested almost US$180 million in R&D programs since 1998. They have not demonstrated any special interest so far in investing in R&D projects with direct implications for EE. During the 2003/2004 cycle only 2% of the investments in energy R&D projects by distribution utilities directly addressed efficiency issues. EE programs could help to disseminate more efficient technologies that could be results or products of R&D programs, creating more synergism between utilities' R&D and EE programs. This is very likely a result of the fragmented management already observed on both the utilities' and the regulator sides, which has prevented more convergence and synergy of the two programs.

24. About 61% of utilities' R&D projects are classified as applied research, 29% as development and 10% as basic applied research.

The impacts of the "1% obligation": the CTEnerg Fund

25. 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 electricity revenues. Funds allocated for public interest EE and R&D have been under-spent consistently since 2001. 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.[5] Although this procedure clearly contradicts the legislation that created CTEnerg, the practice has been maintained, compromising long-term research and EE programs.

26. The inability to allocate and disburse existing resources and demonstrate results has helped to increase criticism and offered opportunities for political attacks on CTEnerg and the rationale that created it, especially amongst the stakeholders associated with the utility sector.

27. In 2001-2002 about 4% of the CTEnerg budget was invested in EE training programs and events (a technological fair and national contest). A great part of the 33% invested in research laboratory infrastructure had the objective to up-grade facilities' capability to perform EE measurements of appliances and thus support the implementation of the energy efficiency law[6]. There has been no effort to create synergism between EE programs with CTEnerg funds and utilities' EE programs.

28. During 2003-2005, CTEnerg has funded projects in thematic areas related to renewable energy, electrical equipment, nuclear energy, supported the National Fuel Cell Program, and regional capacity building. In year 2005 it has offered R$ 4 millions (US$ 1.7 million)

[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).

[6] The Brazilian law 10.295/2001 set the principles for the "National Energy Conservation Policy and Rational Use of Energy". The law requires the development of energy standards for all of energy consuming equipment commercialized in the country.

to support end-use energy R&D, power quality and DSM programs. Projects are selected on a competitive basis and proponents also have to provide matching funds.

Main findings

29. It is very unlikely that initiatives in energy efficiency and R&D would have taken place in a privatized power sector without the regulators' enforcement of the "1% obligation" in 1998 and later with the implementation of Law 9.991/00 by the National Congress. Power sector reforms in Brazil provided the opportunity to enhance support and in fact increase significantly the level of funding in these areas as shown earlier.

30. Provisions in legislation alone are not a sufficient condition to ensure that resources are being used efficiently to maximize the public interest in energy-related services. With regards to energy efficiency there is very little evidence so far that the expanded financial resources available have been used to promote market transformation.[7]

31. Internationally, public benefits funds have been important mechanisms to secure continued support for EE activities, but complementary policies are required to sustain the transformation of energy markets. Examples of complementing policies can be: the establishment of building codes, minimum energy performance standards for appliances, regulatory incentives. During the existence of the 1% obligation in Brazil, public energy policies have not addressed important issues regarding energy efficiency that could help the regulator to increase coordination and synergy amongst utilities' programs, nor have they resulted in a more consistent pattern for investments by CTEnerg.

32. Analyzing the country's experience since 1998, an important learning process can be observed both on the part of the regulator and among the utilities. Some utilities have perceived the strategic importance of pursuing activities in R&D, such as the technical improvement of their own staff, the creation of some small technological companies as a result of some of the more successful projects and a better relationship between research centers and universities. Utilities' programs have also helped to create and maintain new businesses represented by small consulting firms and ESCOs.

33. The experience with the public benefit fund CTEnerg is more recent when compared with the regulated R&D programs. It is illustrative, however, that it has invested much less than the amounts invested under the regulated utilities' EE and R&D programs. 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.

34. The split administration of the resources collected by the "1% obligation" between CTEnerg fund and utilities is a model that is still evolving but clearly needs to demonstrate results. The lack of coordination amongst the main actors - regulator, utilities, and CTEnerg - has become evident. This fragmented approach together with the still fragile institutional setting and lack of public energy policies supporting EE and long-

[7] In this paper we refer to market transformation as strategic interventions with the purpose of creating long-lasting changes in the structure of market for specific end-uses appliances.

term R&D have precluded a strategic view as to how to maximize the social benefits from EE and R&D investments.

35. 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 to promote good EE programs (especially those that reduce kWh) since they have impacts on electricity sales[8] and consequently affect corporate profits. Rate design changes could help EE to become more attractive to customers and utilities, but this would also require significant regulatory changes in the current rate making process. 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.

36. The participation of market forces or customers in program design, a feature recommend ed by international experience (Wiser et.al. 2003, Blumstein et.al 2005) has been very limited in Brazil. In recent years all utility programs (EE and R&D) have been submitted to public hearings for comment and approval; however this has proved to be rather innocuous process. The public feedback on programs designed and proposed by utilities has been negligible.

37. The leveraging effects of the "1% obligation" have been very limited, both for the regulated utility EE and R&D efforts. As observed earlier most utility resources are spent on a grant basis and have not been used to attract additional resources. CTEnerg has been able to attract 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 R&D projects which received funds from CTEnerg.

38. On the other hand, the regulated EE and R&D programs (the utilities' programs) have been much more successful than CTEnerg in developing a routine for the approval and implementation of their projects. Utilities have been more efficient in the sense of designing, implementing R&D programs and spending the EE and R&D annual budget compared to the CTEnerg set-up.

39. Evaluation of EE and R&D programs (both the regulated and CTEnerg programs) is still extremely modest, especially ex-post evaluation. CGEE[9] had as one of its tasks to perform periodic evaluation of the investments made by CTEnerg, but this was never carried out. The regulator and utilities are not staffed presently to perform this kind of evaluation. International experience shows that successful Public Benefits Funds, such as the "1% obligation" analyzed here, generally place significant emphasis on independent evaluation. International experience also shows the dangers of Public Benefits Funds coming under political attack whenever their results are unclear and the programs are not well targeted or do not have clear objectives. Evaluation of programs funded by the "1% obligation" is therefore essential for both defending the very existence of the fund, and for identifying ways to improve the programs funded.

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

[9] CGEE – Center for Strategic Management in Science Technology and Innovation, is a NGO created by an initiative from the Ministry of Science and Technology (see page 26 for more information)

40. 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.

41. It is worrisome that concrete results are not available in terms of saved energy or R&D accomplishments, compatible with the levels of funding that have become available through the "1% obligation". Without such indicators there is the real danger of losing this funding to other activities.

42. The three main areas that require attention to improve the performance of the Brazilian "1% obligation" are related to 1) improve the management of the resources, including to achieve greater leverage of other resources; 2) improve the collaboration and pooling of resources between EE and R&D activities; and 3) monitoring and ex-post independent evaluation. These areas can benefit greatly from the existing international experience and from the domestic experience acquired so far.

Preliminary Recommendations

Some preliminary recommendations follow to improve the use of the "1% obligation" resources allocated for energy efficiency:"

1. Establish guidelines for a national energy efficiency policy with specific orientation for the "1% obligation", based on a comprehensive review of the market potential and barriers for energy efficiency in the country.[10] These guidelines should consider how to achieve a better coordination among the existing mechanisms to support EE activities, such as the "1% obligation", CTEnerg and the "Energy Efficiency Law.[11]

2. Establish a mid- to long-term programmatic strategy for utility programs:

3. Require resource acquisition and/or market transformation components in utility plans;

4. Require utilities to show how 1% is being leveraged and/or provide incentives for leveraging;

5. Require pooling of resources where cost effectiveness can be improved.

6. Simplify protocols for ex-ante project approval;

7. Provide different processes for approval and different program design rules according to utilities' size and market characteristics;

8. Introduce independent ex-post program evaluations. Possibly collect administrative fees for independent evaluation and monitoring.

9. Include resource acquisition and market transformation indicators as elements for evaluation.

[10] PROCEL is currently developing a comprehensive survey and evaluation of market potential for energy efficiency.

[11] Law 10.295/2001, bill that created the compulsory minimum energy efficiency standards in the country.

10. Reduce the share of resources applied on a grant basis. Develop possibilities to use resources from the compulsory EE investments to leverage performance contracting by ESCOs, approaching more closely a normal commercial financing model (including loans) and achieving higher leverage of resources.

11. A successful effort to use the compulsory investments in EE to attract new resources and other agents may require the development of new accounting procedures to allocate benefits from EE investments so that long-term electricity cost reduction for customers is achieved cost-effectively.

12. Consider complementing utilities' activities with those of independent non-utility agents to receive part of the funds for implementing EE programs.

13. Promote better integration and coordination between the "regulated utility programs" and CTEnerg, not only with regards to EE programs but also with R&D, and more especially R&D projects with higher impacts in the EE area. Promote better coordination amongst utilities' programs.

14. It is evident that the existing regulation does not provide incentives for utilities to invest cost-effectively in EE programs. The existing price-capped electricity tariff structure usually penalizes cases utilities that reduce their sales via EE programs. Alternative ways to administer EE programs such as the Efficiency Utility in Vermont, need to be investigated considering the Brazilian context.

3. INTRODUCTION

3.1 REFORMS, ENERGY EFFICIENCY AND ENERGY R&D

Brazil is one of the very few developing countries to have demonstrated a continued support to energy efficiency and energy R&D during the re-structuring process of its power sector. As reform started, the traditional support to energy efficiency and R&D suffered significant changes, as there were re-alignments of the relevant institutions and agencies. Most importantly there was an impressive effort to expand the traditional levels of funding to support these activities. New regulatory measures and the creation of a national public interest energy fund helped to maintain and potentially enhance the country's effort to promote energy efficiency and investments in energy R&D.

Over recent years the public sector (government and regulator) has had to develop an understanding of how markets operate, seek new funding mechanisms and develop criteria for allocating funds (both public and private) to support energy efficiency and R&D. This process meant a re-definition of the role of public agents and required the creation of new institutional structures.

Since 1998 Brazil has enforced the collection of 1% from utilities' annual revenues and directed these funds to energy efficiency and energy R&D activities. In this paper this mechanism will be referred to as the "1% obligation".[12] The emphasis of the present analysis will be on energy efficiency issues, but energy R&D issues will be discussed, especially when they are relevant to the progress of energy efficiency programs.

This paper analyses the main impacts that have occurred during the past 6-7 years and the lessons learned with regards to energy efficiency resulting from the implementation of the "1% obligation" at the national level. The paper describes the regulatory and legislative changes that occurred with the allocation of resources collected. The international experience on the use of similar funding mechanisms for EE and R&D programs is also briefly reviewed, especially with regards to the areas that could improve the performance of the EE and R&D activities implemented recently. It is the purpose of this paper to outline recommendations for a mid-term strategy that can benefit from the lessons learned so far.

3.2 BASIC PREMISSES

The analysis presented is based on two broad assumptions regarding energy efficiency activities: there is the objective of maximizing social benefits from use of energy and, that there should be a wider framework for allocating resources for these activities, so that there is a gradual market transformation and the development of a sustainable market for energy efficiency.

[12] This "1% obligation" is a non-by passable charge. It is not a tax, but the minimum amount of annual investment each utility has to compulsorily dedicate to energy efficiency and R&D. It is a public benefit charge collected from utilities' revenues.

The first assumption is included in the formal justification presented in the documents that formally created the "1% obligation" in Brazil. It is also similar to the principle that guided the creation of the "system benefits charge"[13] in use in several parts of the USA and other countries (Nadel & Kushler, 2000; Wiser et.al., 2003). In particular, in Brazil, the main perceived social objectives derived from the efficient use of energy are related, but not exclusive, to:

- Reducing the potential costs of capacity shortfalls;
- Reducing the environmental impacts of electricity production; and
- Helping consumers in general and low income households in particular, to reduce their energy bills and afford energy services.

The second premise acknowledges that the "1% obligation" should be part of a broader strategy that has not only the objective of capturing the existing market potential for energy efficiency but also to create conditions for attracting other initiatives (other funds and stakeholders) in order to promote the transformation of energy markets. These strategies should be part of public policies and include better coordination of efforts, public sector interventions facilitating partnerships between utilities and other agents, and also the introduction of mechanisms that are capable to address market failures and barriers. Successful EE programs need to be complemented by several other policy efforts such as building codes, appliance energy efficiency standards, regulatory incentives, tax incentives, tariff reforms, information and others.

3.3 THE STRUCTURE OF THE POWER SECTOR

The Brazilian electricity sector has 86 GW of installed capacity, 78% of this is hydroelectric. About 54 million consumers were responsible for 365 TWh in 2003 (BEN, 2004). Since 2001 more than 80% of the electricity is sold through private distribution utilities. This contrasts with the situation on the generation side, which is dominated by state-owned companies, responsible for about 70% of electricity production.

The average annual percentage growth in electricity demand during 1990-2000 was 4.2%, dropping sharply by -6.2% in 2001 due to the power crisis and rationing which lasted from June 2001 through February 2002. Electricity growth during 2002-2003 was 5.4%, indicating a recuperation of economic activity after the crisis (Figure 1). Electricity sales measured in current dollars, using data from total electricity consumption and national yearly average tariffs, shows that the total has been stable in recent years around US$ 15 billions per year up to 2003. However, due to tariff increases allowed by the regulator during 2004, partly to compensate utility revenues losses during the power crisis, total sales can be estimated to have reached approximately US$ 23 billions for that year.

The industrial sector is the major consumer of electricity (54%) followed by the residential and commercial sectors. Public lighting is estimated to account for approximately 3% of total consumption (Figure 2).

[13] See section 7 for more information on the international experience.

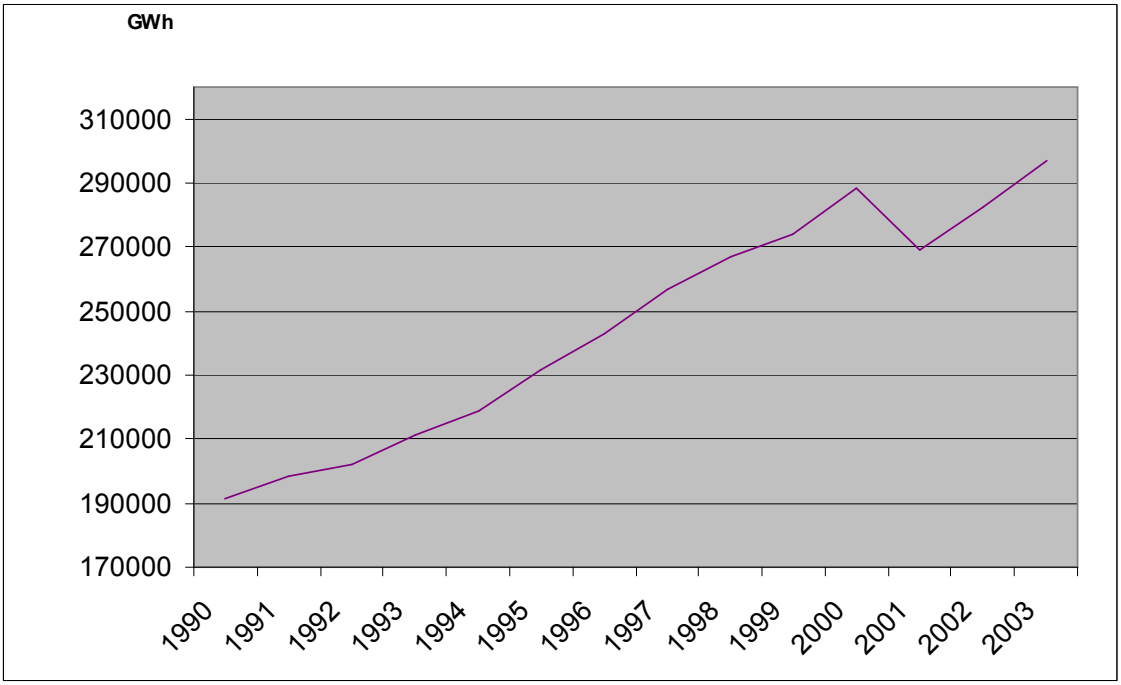

Figure 1: Total electricity consumption 1990-2003 (GWh)

Source: BEN (2004)

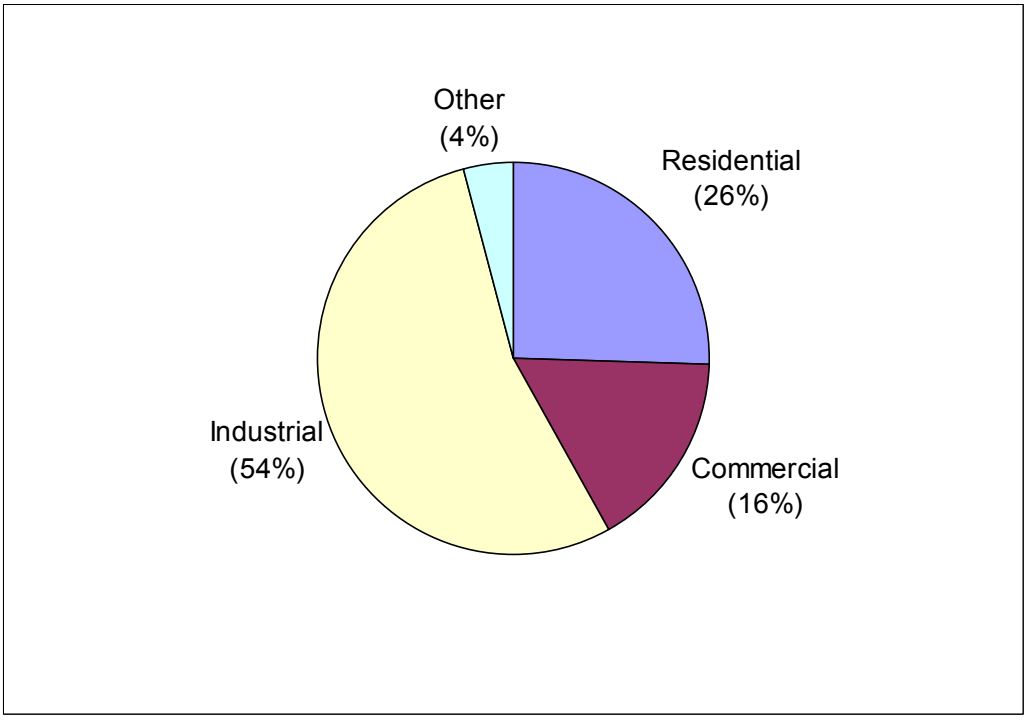

Figure 2: The structure of electricity demand in Brazil (2003)

Source: BEN (2004)

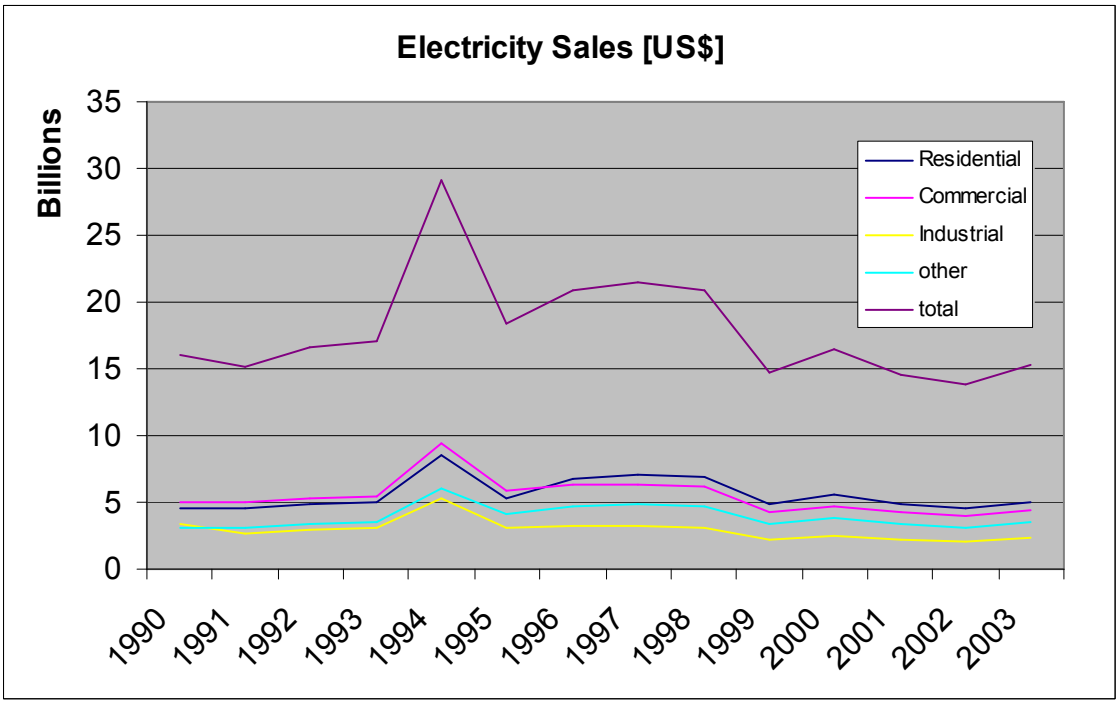

Figure 3: Electricity sales

Source: Author's estimates based on BEN (2004).

4. LEGISLATIVE AND REGULATORY FRAMEWORK

4.1 GENERAL OVERVIEW

The purpose of this chapter is to describe the evolution of legislative acts and regulatory resolutions regarding the collection and application of resources for EE and R&D initiatives.

Since the initial stages of the Brazilian power sector reforms[14], provisions regarding energy efficiency were inserted into the new concession contracts negotiated at the time of privatization of the first utilities. At that time, specific clauses were appended into each new concession contract mentioning the new owners' responsibility for investments in energy efficiency and research and development. However, the terms used were very vague and it was difficult to assess objectively any progress of utilities' investments in these areas.

In 1998, the regulator (ANEEL) issued a resolution which had the merit of enforcing a standard procedure that the privatized utilities had to comply with. This resolution stated that a minimum of 1% of the utilities' annual revenues had to be dedicated to EE and R&D programs submitted and approved by the regulator. The "1% obligation" is calculated based on annual revenues accrued by the utilities (net of taxes) including not only electricity sales, but also income from their other regulated services[15].

Over the years several changes were introduced with regards to the allocation of funds collected from utilities (and consumers) via the "1% obligation" to finance EE and R&D activities, and more recently (2004) part of these funds were used to support activities other than EE and R&D, as it will be explained below. Information on the evolution of legal acts that regulated the investments in EE and R&D programs in the country since 1998 is presented in Table 1 .

In the beginning only privatized utilities were obliged to invest in EE and R&D programs, but after the year 2000 all utilities were included, as their concession contracts were being renewed.

From 1998 to 2000, only utilities were responsible for the formulation of energy efficiency and R&D programs. Although these utilities' programs had to be submitted and approved by the regulator, in practice the procedure privileged the selection of types of programs that represented the most interesting opportunities from the perspective of the utilities.

Law 9991, enacted in 2000, represented a landmark in this process because it shows the understanding of the limitation of the system existing at that time, which relied only on the utilities' decisions regarding investments in these programs. Enough empirical evidence had accumulated suggesting the concentration on certain types of programs had not maximized

[14] The first utility was privatized in 1994 (Excelsa).
[15] Excluding financial gains, donations, by-passed charges related to use of distribution and transmission lines. Generators using renewable resources (solar, wind, small hydro-plants and biomass) are exempted from these requirements.

social benefits.[16] The Bill approved by the National Congress maintained the "1% obligation" of electric utilities annual revenues, but created a new national fund, called CTEnerg, in charge of investing in Public Interest Energy Efficiency Programs and Public Interest Energy Research and Development.[17]

This Law also formalized the understanding that only end-use energy efficiency programs should be considered under the regulated EE programs,[18] as will be further explained in section 6.1. The total amount collected from the utilities' revenues was split in shares varying from 0.25 to 0.5% for CTEnerg and the utilities' EE and R&D programs.[19]

During 2000-05 electricity distribution utilities have had to invest 0.5% of their annual revenues in end-use energy efficiency projects (note that only distribution utilities are obliged to invest in end-use EE programs). Generation and transmission companies allocate 0.5% for their regulated R&D program and collect the other 0.5% for the CTEnerg Fund – there is no contribution to EE programs.

The Law also states that from the year 2006 onwards the resources being invested by distribution utilities in EE programs would be reduced to 0.25% (instead of 0.50% during 2000-2005) of their annual revenues and the balance (0.75%) transferred to R&D programs (in equal shares to both CTEnerg and the regulated R&D program), indicating a relative higher importance given to R&D compared to EE activities. The reasons for this change are not clear, but it is probable that it reflects a stronger influence from the Ministry of Science and Technology which was in charge of creating several similar R&D Funds as part of a major economic reform in course at that time.[20]

The percentage of annual revenues that is dedicated to R&D varies from 0.5% (distribution utilities) to 1% (transmission and generation utilities). Half of these amounts are spent by the utilities themselves in internal R&D projects (regulated R&D programs); the other half is collected by the CTEnerg fund (which is also in charge of funding public-interest energy efficiency programs, as mentioned).

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[16] For example, in 1998/99 the total amount invested by utilities in supply-side efficiency projects amounted 0.72% of electricity revenues, the balance were end-use efficiency projects and R&D projects. Amongst these supply-side projects, a total of 0.54% of electricity revenues were destined to projects to reduce utilities' commercial and technical losses. In this period the amount of resources invested in marketing was the same as residential efficiency programs (Jannuzzi, 2000).

[17] CTENERG has a document that defines the scope of its activities and the definition of public interest energy efficiency and R&D. The document is available at http://www6.prossiga.br/ctenerg/docs_base/Diretrizes_Estrategicas.pdf.

[18] Until then supply-side energy efficiency programs could also be funded with the "1% obligation".

[19] In this paper these programs will be referred to as "regulated EE and R&D programs". They are programs proposed and implemented by electric utilities under the approval and supervision of the regulator.

[20] A total of 14 R&D National Funds were created over the period 1998-2002, as result of the privatization and economic reforms of the main infra-structure sectors (Water, Transport, Communications, Electricity, Oil and Gas, etc). By year 2003 a total of R$ 1 billion (about US$ 390 millions) were being collected annually by these funds to finance R&D in the country.

In 2004 another change occurred in the allocation of the funds collected from utilities' revenues. This was a result of Law 10.848/04 which had the main objective of setting up new rules for the power sector, and created a new entity (the Brazilian Company for Energy Planning or EPE[21]) at the expense of resources from the "1% obligation". Since the law's approval, CTEnerg and the regulated EE and R&D programs are entitled to 40% each of the funds collected from the "1% obligation" (instead of 50% as previously), the EPE receives the remaining 20%[22] . These percentages are applicable to generating and transmision utilities. In the case of distributing utilities currently 10% of their "1% obligation" goes to EPE and from 2006 onwards this will increase to 15%, according to current rules (see Table 1)

4.2 THE REGULATED PROGRAMS

These are the EE and R&D programs originally conceived by utilities and implemented by them once they receive approval from the regulator (ANEEL). The programs are submitted annually to the regulator, and are designed according to general rules and guidelines described in Manuals provided by ANEEL. Four versions of the EE and two versions of the R&D Manuals have been produced by the regulator since 1998.

An analysis of these manuals shows very little content in terms of concepts and implications from public policies related to energy efficiency[23] and research and development. The EE Manual, for example, provides detailed guidelines for preparing documentation and justification of proposed projects, with more emphasis on formal procedures than on ensuring the performance of the proposed projects.

It is important to recognize, however, that there has not been any major energy policy document or directive coming from the government that could be characterized as a public policy for energy efficiency or energy R&D. These policies should have come from the associated government Ministries and/or the National Energy Policy Council. They could have guided the Regulator in setting up appropriate rules for the approval and evaluation of the regulated programs, but did not.

Thus, the regulator has been operating these two programs since 1998 without any consistent public energy policy or strategy to orient and support its approval rules and criteria. Table 2

[21] EPE is a company owned by the Ministry of Mines and Energy and it is mainly in charge of performing studies and energy inventories.

[22] It is important to register that prior to the approval of Law 10.848/04 a much more drastic re-allocation of the "1% obligation" was being proposed by the current government. Initial proposals would have reduced the allocation of funds to EE and R&D down to 0.25% for CTENERG and 0.25% for regulated EE and R&D programs. This triggered a concerted reaction from academics and utilities which were able to influence Congress to restore the levels of funding. The episode illustrates how fragile is the support to EE and R&D amongst government officials and politicians.

[23] Some distortions regarding concepts of energy efficiency can be observed in ANEEL rules for approving EE utility programs. For example: projects that consider changes in technology that use solar, natural gas, or other fuel replacing electricity-based technologies are not permitted. The replacement of electric residential showers (*chuveiros*) was only permitted after 2002 to be included in the utility EE annual program.

illustrates the type of criteria used initially by the regulator to allocate investments for each utility. Over the years these criteria changed without much technical justification, often causing confusion among utilities, re-submission of programs, and implementation delays.

From 2001 a cost-benefit ratio of 0.85 was required in order to approve EE projects. This cost-benefit ratio is an ex-ante indicator that considers the estimated annual savings accruing from a specific project over the annual cost of the project (capital costs are annualized and O&M annual costs are included). It was also required that each project have targets that could be quantified and verified. The cost-benefit ratio permits a better screening of potential projects, ensuring some measure of comparison between similar projects from different utilities. In 2002 Public Lighting projects could yield a C/B ratio of 1.0.

The marketing component of EE projects has always been a concern to the regulator. Since the beginning it was clear that utilities realized that EE programs could serve as a useful tool to "secure" those of their clients' with the option to choose suppliers and to promote a better public image within their concession areas. In 2002, the regulator issued a resolution whereby utilities' expenditure with marketing should be considered under each relevant project and not separately as a category of energy efficiency project. Marketing expenditure was then limited to 4% of the utility overall annual program (this included all marketing components of each project of the annual program submitted).

It is interesting to observe that it was only in 2002 that ANEEL explicitly required that all appliances and equipment considered in utilities' EE programs had to comply with the PROCEL labeling program or efficiency standards set by PROCEL/INMETRO.[24]

Evaluation of project results has been explicitly required since 2000 and guidelines are included in the EE Manual, determining that each project must present a methodology for evaluation, monitoring and verification. In practice, however, there has been no systematic effort to evaluate the performance of EE programs, and an accurate estimate of the amount of energy saved and/or avoided peak capacity is not available.

Apparently the only type of evaluation that is formally performed is a preliminary ex-ante technical-economical evaluation based on estimated/expected savings (there are no hard measurements involved). The ex-post evaluation is done at the end of the year when each utility sends a final report declaring the results obtained. There is, nevertheless, a thorough accounting audit of program expenses done by ANEEL, in order to ensure that utilities are complying with the "1% obligation".

Some EE projects can now be done as "performance contracts" signed between the utility and its client. These contracts are similar to contracts signed by ESCOs and their clients, whereby the initial investment made by the ESCO is paid back with the clients' savings. In this case,

[24] PROCEL, (the National Electricity Conservation Program) has been in operation since 1985 and has projects in several sectors: buildings, education/training, industrial sector, energy labeling, energy efficiency prizes (annual reward for the most efficient appliance in each category), residential, public lighting. PROCEL has traditionally also invested in supply side efficiency projects.

ANEEL allows the return of a certain percentage[25] of the utility investment over a maximum of 36 months paid by the client (the project recipient) with its savings.

4.3 THE CTENERG FUND

As presented in section 4.1, CTEnerg was created in the year 2000 to use part of the funds collected from the "1% obligation". The CTEnerg White Paper (CTEnerg, 2002) establishes the general philosophy and directives that guide investments. It has been defined as a fund to support public interest energy research and development and energy efficiency. It is intended to have investment strategies that complement the activities initiated by the utilities' regulated programs.

Activities funded by CTEnerg have the objective to provide contributions to the country's main energy challenges, stated as (CTEnerg, 2002):

- Supply the increasing demand for energy services, including in rural and isolated areas of the country;
- The diversification of the electricity generation mix, currently dominated by hydroelectricity;
- The development of energy-efficient technologies with low environmental impact and high social benefits;
- Investments must ensure that public interest characteristics of energy services are preserved in an increasingly competitive environment (investing in areas where market agents have less interest)

The fund can solicit bids on research topics it considers relevant or contract projects directly. It also provides grants and scholarships in energy topics so as to promote capacity building.

The fund has the obligation to invest 30% of its annual budget in programs benefiting research institutions located in the North, Northeast and Centre-West regions.[26]

[25] The maximum value allowed is 50% of the utility's investment.
[26] These regions are comparatively less developed than the South and Southeast regions.

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).

Table 2: Limits for applications in Energy Efficiency Programs during first years of regulation 1998-99 (as % of Annual Utility Revenues)

Project	% Applied	
	End-use	Supply side
Public Lighting and Marketing	≤ 0,125 %	-
Industrial Consumer	≥ 0,025 %	-
Residential Consumer	≥ 0,025 %	-
Energy Conservation in Public Building	≥ 0,025 %	-
Improvement of Load factor and New tariffs for regions S, SE and CWO		≥ 30% of total supply- side programs
Improvement of Load factor and New tariffs for regions N, NE.		≥ 10% of total supply-side programs
Total	≥ 0,25%	≥ 0.65% *

Source: ANEEL (1998). Notes: Smaller utilities with annual revenues less than R$ 1 million (about US$ 370 thousand in 2004) were exempted from these limits. These limits were dropped after 1999, and utilities were required to submit at least one project for each category. (*) In early years investment in "supply side" efficiency measures was permitted as discussed in section 6.1, below.

5. INSTITUTIONAL FRAMEWORK FOR ENERGY EFFICIENCY AND R&D

The creation of new regulation and legislative acts to ensure the collection and application of resources had institutional implications in order to implement the support to EE and R&D via these new mechanisms. Since the year 2000 EE and R&D are administered by two institutions: the regulator and the governing Board of the CTEnerg Fund, created after the legislative act 9.991/2000. As seen in the previous section, since 2000, two different concepts have been adopted for these investments: a public interest fund and another in which utilities are directly responsible for the design and implementation, observing rules and final approval from the regulator. In this section we present the basic operational structure that has guided the conception and implementation of the funds available for these two sets of actions.

5.1 THE REGULATED PROGRAMS: UTILITIES AND REGULATOR

These "regulated programs" are conceived and implemented by utilities and funded as part of the "1% obligation". The regulator sets the minimum percentages to be invested by the utilities in different types of programs. Both the EE and R&D programs are initially conceived by the utilities according to their own priorities and interests, as mentioned in the previous section.

Different departments at ANEEL deal with the approval of the EE and R&D programs.[27] Utilities in general also have different staff members (and departments) responsible for each one of the annual programs. On the utilities' side, in general, program managers for EE are located in the Marketing or Commercial departments and for R&D in the Engineering Departments. Very little interaction exists between the managers responsible for the two programs, be it on the regulatory side or on the utilities' side. During the initial years of the "1% regulation", the ex-ante evaluation of EE programs was done by PROCEL. Later ANEEL transferred this evaluation to some State regulators. Now it has brought this activity back to its own staff.

The ex-ante evaluation of utilities' R&D programs was initially done by ANEEL staff. In a second phase ANEEL contracted the National Research Council (CNPq) to review the R&D proposals. More recently (2003), ANEEL contracted Universities and Research Centers for this task.

It is interesting to observe that in none of the two programs the existing institutional arrangement, PROCEL and CNPq for EE and R&D respectively, has proved successful in dealing with the new demands. In spite of the experience accumulated in both existing agencies[28] to analyze and evaluate specific projects, they were not prepared to deliver results in the time required. In addition, in the case of the CNPq, there is a strong bias towards more academic research created difficulties in evaluating more applied research proposals in many instances, such as those coming from the utilities.

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[27] In the case of R&D programs, the approval of projects is done by each department responsible for the regulation of distribution, transmission and generation services.
[28] PROCEL has 20 years of existence and CNPq more than 50.

Every two years ANEEL organizes a Congress[29] where utilities present their research results. This has been the only instance where there is some attempt to evaluate progress made with the annual regulated R&D programs. The Association of Distribution Utilities (ABRADEE) also organizes an annual meeting amongst its members to discuss program results as well as the common problems faced by utilities with their EE and R&D programs.

5.2 PUBLIC INTEREST ENERGY R&D FUND: CTENERG

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. As with all the existing 14 R&D Funds the Ministry of Science and Technology nominates the Board members.

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, research community and private sector is a novelty in the management of public funds in Brazil, especially in the R&D area, traditionally dominated by the academic and/or the government sector.

In the year 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 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 is 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.

[29] CITENEL - Congresso de Inovação Tecnológica em Energia Elétrica (Congress on Technological Innovation in Electricity). The event has also been sponsored by the Ministry of Energy and the National Science and Research Council. The first event was held in year 2001.

One of the main ideas to locate 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 facts demonstrated the weakness of such an institutional arrangement as 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.

6. EVOLUTION OF INVESTMENTS IN EE AND R&D

The mechanism introduced to collect funds for EE and R&D represented a new stage in the traditional funding levels for these activities. In this section we seek to analyze the volume of funds which were made available and the main areas and patterns of investments. We concentrate the analysis on the investments made by the regulated EE programs and CTEnerg's efforts in energy efficiency.

6.1 IMPACTS OF EE INVESTMENTS

The regulations introduced since 1998 have increased by several times the amount of investments in energy efficiency 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 (see Table 3 and Table 4).

Table 3: Investments and results obtained by PROCEL (1994-2003)

Results	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Approved investments (US$ millions) *	3.3	10.3	17.2	42.1	17.2	13.8	9.0	12.9	8.5	10
Saved electricity (GWh/year)	344	572	1970	1758	1909	1862	2300	2500	1270	1300
Avoided demand (MW)	70	103	293	976	532	418	640	600	305	312

Source: PROCEL, 2003.

Table 4: Total investment in regulated energy efficiency utilities' programs (1998-2004)

Cycle	Number of utilities	Investments (US$ millions)	% Supply-side programs	% End-use programs	Estimated avoided demand (MW)†	Estimated energy savings (GWh/y)†
1998/1999	17	68.3	68%	32%	250	754
1999/2000	42	75.9	60%	40%	369	994
2000/2001	53	35.4	6% (a)	94%	na	na
2001/2002	60	57.2	1% (a)	99%	496	1498
2002/2003(*)	28	39.8	-	100%	na	na
2003/2004 (**)	40	66.8	-	100%	na	na

Source: Jannuzzi & Gomes (2002) and ANEEL 2003. Notes: (a) After year 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. (**) author estimates based on personal information with ABRADEE. (†) Jannuzzi , Danella et al. 2004)

During the first years a part of the regulated investments could be used in supply-side efficiency programs. Since utilities were responsible for the selection of programs, their design and implementation, a significant amount was used to reduce utility's energy losses, including commercial losses. From Table 4 it can be seen that in the first cycle of efficiency programs, a total of 68% of the approved regulated investments were for supply-side energy-efficiency programs. These supply-side energy efficiency programs had the objective of reducing utilities' commercial losses or utilities' electricity demand in their own buildings and installations. Historically supply-side energy efficiency (including not only the reduction of technical but also commercial losses) projects had also at times dominated PROCEL's initiatives, e.g. improvements in power plants operations, investments/upgrades in transmission and distribution lines and also the purchase of electricity meters for low-income residential households.

However, though PROCEL had that type of investment pattern in the past and benefited state-owned utilities, the situation is different in the case of private utilities. Profit-seeking utilities should not need regulation to avoid commercial losses. As pointed out elsewhere (Jannuzzi, 2000; Jannuzzi, Gadgil *et al*. 1998), ANEEL's compulsory supply-side investments illustrated an apparent misunderstanding of the role of public interest policies (implemented by the regulator) and the operation of markets, producing a redundant regulation. In the 1998-99 cycle more than half of energy efficiency investments were used in loss reduction projects alone compared to 36% invested in all end-use programs (Table 4).

Over the following years, ANEEL gradually restricted the percentage allowed for supply-side efficiency investments, as can be seen from Table 4, and created rules to limit the approval of loss reduction projects (no programs that targeted the reduction of commercial losses were allowed) under the 1% regulation. Since 2000, all regulated investments for energy efficiency have had to be used for end-use programs. All supply-side efficiency improvement are now understood to be part of the business strategies of more competitive utilities. The values for saved energy and avoided capacity presented in Table 4 are very rough estimates based on efforts to consolidate EE program results reported by utilities.

Improvements in public lighting systems (mostly changing incandescent lamps for mercury vapor and mercury for sodium high pressure lamps) have represented almost half of the investments in end-use programs. Figure 4 shows the evolution of the shares by category of utilities' EE programs since 1998. Figure 5 shows that during the entire period public lighting dominated EE investments, followed by residential programs, industrial sector and more recently commercial sector programs.

Marketing was another area that attracted utilities' investments until 2000. Since then this type of project has not been allowed as part of the regulated energy-efficiency programs. During the electricity rationing crisis special priority effort was given to implementing lamp replacement programs in the residential sector, which explains the higher percentage expenditure observed for the cycle 2000/2001.

Over the years, ANEEL has determined varying expenditure shares for residential, commercial, industrial programs. This procedure which fixed percentage expenditure shares has to be observed by all utilities in the country and has not considered local market specific characteristics, missing some opportunities and sometimes forcing expenditure on less cost-effective programs.

An analysis of the programs during 1998-99 showed the following characteristics (Kozloff, Cowart et al. 2000):

- High costs for conserved electricity (R$/kWh);
- Hard to verify the program performance in terms of amount of saved energy;
- Most efficiency programs depend on continuous financing, no strategy for market transformation;
- Duplication of programs over the years and amongst utilities;
- Expenditure patterns: high proportion of expenditures on marketing and on small and uncoordinated projects;

Some of these issues have been resolved or improved over time. ANEEL now requires an ex-post evaluation plan for each project submitted, as observed in previous sections, and allows for multi-year projects, which has permitted larger and more cost-effective programs. Expenditure on marketing programs alone has not been allowed since 2000 and limits were included thereafter. Also, as part of the ex-ante evaluation procedure economic criteria (using cost-benefit ratios) are required and ANEEL tries to ensure that programs are cost-effective. Some estimates (Jannuzzi et al. 2004) indicate that the costs of avoided kW have been reduced by 50% from 1998/99 to 2001/02 EE programs.

However, ANEEL has not addressed several of the utilities' disincentives that hamper the performance of programs. The main one is the impact of reducing sales. Also, the lack of more comprehensive studies of the existing potential for the introduction of energy efficiency measures in the Brazilian market together with better program evaluation procedures have, in our view, limited the potential electrical system-wide benefits from these programs. ANEEL's role as the supervisor of utilities programs could be further enhanced with more coordination amongst individual programs.

At the same time, these activities have impacted positively some utilities' behavior towards energy efficiency. Some utilities have detected business opportunities and created their own ESCOs. This is an unregulated activity (different from the electricity sector) and they can operate in other concession areas and capture economic returns on their investments in energy efficiency.[30] Many utilities have also used programs as part of their strategies to retain their large (and non-captive) consumers.[31]

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 their main funding sources for their activities (ABESCO, 2005). Some of the largest utilities in the country are increasingly outsourcing the design of EE projects by ESCOs. These utilities decide the types of projects they have interest and ESCOs compete for implementing the projects. During year 2002 117 performance contracts were signed with ESCOs representing about 20% of the investments in the EE utilities' regulated programs (Table 5).

Table 5: ESCOs: Information on performance contracts with utilities' EE regulated programs (2002)

Sector	Number of EE projects	Investments (millions R$)	Average Energy Savings (%)	Pay-back (years)
Commercial	35	5,454	18.5	2.4
Public	25	3,670	18.0	1.2
Industrial	57	14,415	19.5	3.0
Total	117	23,539	18.8	2.2

Source: ABESCO 2002, from Jannuzzi, Danella et al (2004). Notes: US$ 1.00 = R$ 3.53 (Dec 2002).

Public lighting has captured most of the resources of the energy efficiency programs of the utilities, as can be seen in Figure 4 and Figure 5. It is striking how the investment patterns have very little relationship with the structure of the electricity market as presented in Figure 2. 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 lighting systems up to the year 2010. RELUZ can finance 75% of the capital costs of new lighting systems to

[30] ANEEL started to introduce accounting procedures to ensure that economic benefits from investments done under the 1% obligation are also returned to consumers, at the time utilities' tariffs are reviewed.

[31] Non-captive consumers are the ones with demand greater than 3 MW and can choose their electricity provider.

utilities at very subsidized rates of interest.[32] This partial grant helps explain the overwhelming preference for this type of measure by the utilities, particularly the resurgence of utilities' investment in energy efficient public lighting in 2001/2002 (see Figure 4). 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.

[32] The interest rate and payment conditions are very favorable considering existing market conditions in Brazil (5% interest/ year, whilst market rates have varied 18-19% and the National Development Bank – BNDES, has an average rate of 15% per year).

Table 6 presents summary statistics for 396 EE projects from the distribution utilities' annual 2003-2004 cycle EE approved by ANEEL. The data were collected from the ANEEL website in the published approval Resolutions, and they illustrate the pattern of projects implemented by utilities. ANEEL has not maintained a comprehensive and updated record on the utilities programs. The first and only review of EE programs was published in 1999 covering the first set of utilities' annual programs.

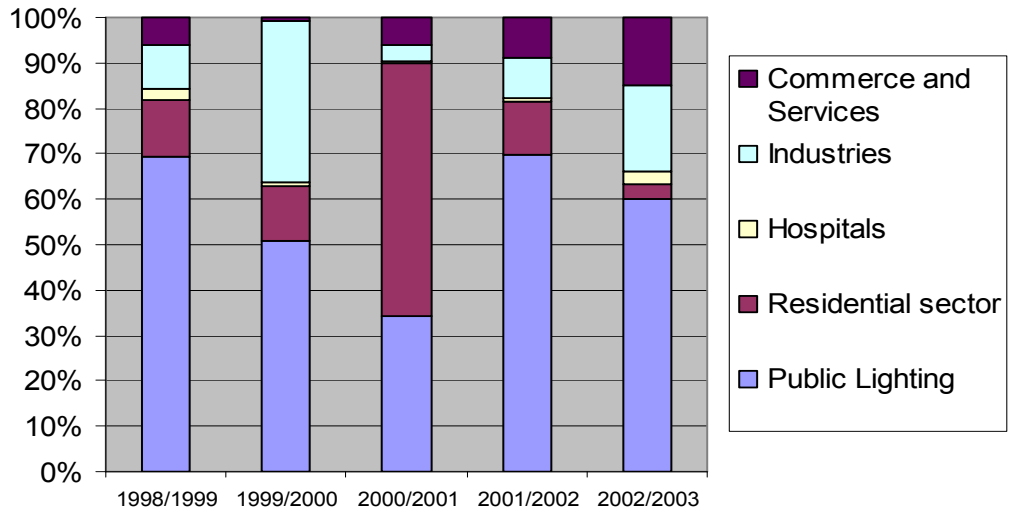


Figure 4: Breakdown of utilities' investments in EE (%) by period (1998-2003)

Source: ABRADEE (2005)

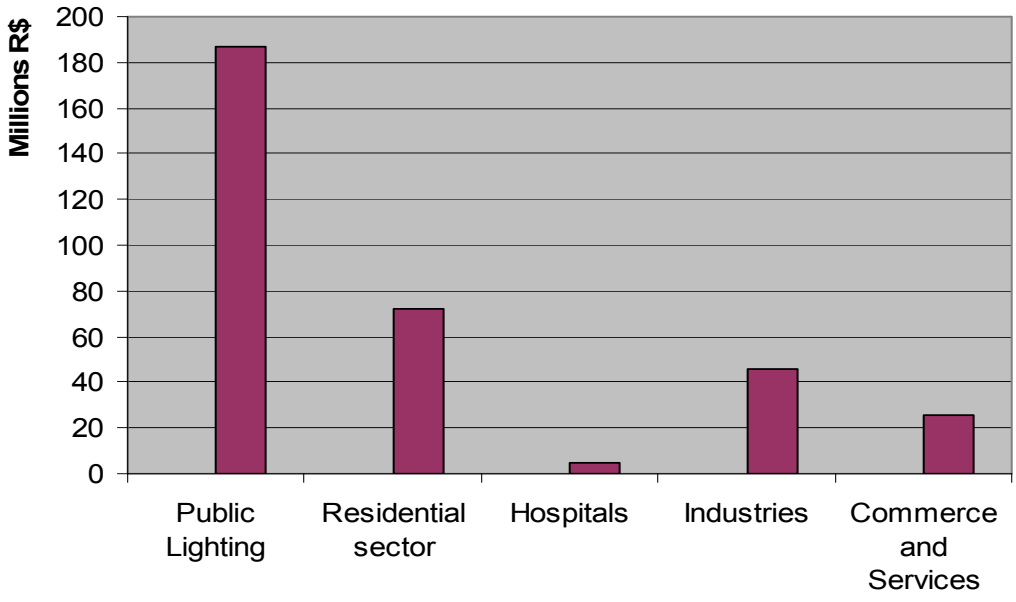


Figure 5: Total investments by utilities by main sectors during 1998-2003 (millions R$)

Source: ABRADEE (2005).

There are great differences amongst utilities in the average cost of EE projects and the number of projects submitted (Table 6). Seven utilities[33] alone are responsible for more than 70% of the total investments made in EE programs during 2003-04.

The analysis of EE projects by major categories in Table 7 indicates once again the predominance of public lighting as the largest projects implemented by utilities, costing almost 10 times more than the projects implemented in public buildings and more than 3 times the average cost of industrial sector EE projects. Public Lighting projects represented more than 41% of total expenditure in EE for 2003/2004, whereas public buildings and industrial sector projects accounted for about 14% each.

Data collected from the approved utilities´ annual plans (ANEEL, 2005) suggests that the cost-effectiveness of EE programs may vary greatly due to the significant differences of scale. Even if we compare projects under the same category we note large differences in expenditure. For instance, utilities' public building EE projects vary from R$ 1,646 to R$ 3 million, while public lighting programs range from R$ 32,000 to R$ 20 million (Table 7).

[33] Light, Cemig, Copel, CPFL, AES-Eletropaulo, Bandeirante and Elektro.

Table 6: Number of EE projects and average costs (R$) by utility (cycle 2003-2004)

Utility	Number projects	Average expenditure R$ /project	Utility	Number projects	Average expenditure R$ / project
AES-SUL	15	396,685	ENERGIPE	8	126,937
CELTINS	2	438,636	CEB	2	1,723,090
COELBA	8	117,470	CEMAT	8	489,973
HIDROPAN	1	45,925	COOPERALIANÇA	2	45,028
EEVP	2	396,801	CELG	5	1,432,540
CJE	4	165,574	CEMAR	3	572,394
SAELPA	2	794,566	CEMIG	28	1,176,279
CELB	2	292,520	COSERN	6	204,374
CEA	1	521,394	CELPA	2	250,000
CEAM	1	183,603	COELCE	14	325,151
CLFM	1	164,350	BANDEIRANTE	9	1,292,971
RGE	3	1,802,168	CFLCL	6	185,578
LIGHT	20	1,925,093	CNEE	1	422,073
ELFJC	1	12,226	ENERSUL	8	334,253
ELFSM	2	119,564	MESA	3	641,676
CPEE	1	264,000	CENF	4	58,070
ELEKTRO	5	1,803,177	AES-ELETROPAULO	32	829,796
CELPE	10	437,641	CPFL	93	115,522
CEPISA	2	1,706,355	COPEL	58	414,430
AMPLA	9	556,824	ESCELSA	7	732,075
CLFO	3	71,500	CAIUÁ	2	534,091
Total number of EE projects: 396		Total expenditure: R$ 220,863,131		Average: R$ 557,735/project	

Notes: These figures refer to total program costs by utilities. Some programs are composed by multi-year projects; therefore total differs from the number presented in Table 4. Source: ANEEL (2005).

Table 7: Energy Efficiency projects basic statistics for main categories (cycle 2003-2004)

	Public Buildings	Industrial sector	Public lighting	Total EE projects
Total number of projects	162	64	48	396
Average expenditure (R$S/project)	196,212	507,311	1,911,494	557,735
Minimum (R$/project)	1,646	4,994	32,649	1,646
Maximum (R$/project)	3,000,000	3,783,672	20,350,001	20,350,001
Total expenditure	31,786,429	32,467,879	91,751,692	220,863,131

Source: ANEEL (2005).

Figure 6 displays a plot ranking the HH[34] index per utility (represented in the x-axis as its average project cost). The HH index indicates the concentration levels in investments in types of EE projects. Most utilities present a high concentration of investments in few types of projects. In most cases Public lighting is the type of EE project that receives the largest share of investments, as shown before. In smaller utilities the concentration of investments still exists, but it differs from the large utilities, as preferred projects are developed for public buildings, rural sector and education/training courses. The small utilities present in most cases only one EE project, hence the cluster of highest concentration shown in the upmost left corner of Figure 6.

Amongst the seven largest utilities, only AES/Eletropaulo showed a low concentration of investments in EE projects, and Bandeirante and Light had moderate concentration of investments. These three large utilities presented more diversification of investments amongst the types of EE projects allowed by the regulator.

This figure shows also the predominance of smaller EE projects across utilities, as can also be seen from Table 6. Except for CPFL, all the major utilities present larger EE projects. Some small utilities (CEPISA, CEB and RGE) invest in one or two projects, leading to a relative higher average investment per project, as can be seen in Figure 6.

[34] The HH index (Hirschman-Herfindahl Index) is often used to analyze market concentration by firms. In the present case, it is the sum of the squares of share of the investment by project type in the total EE utility investment.

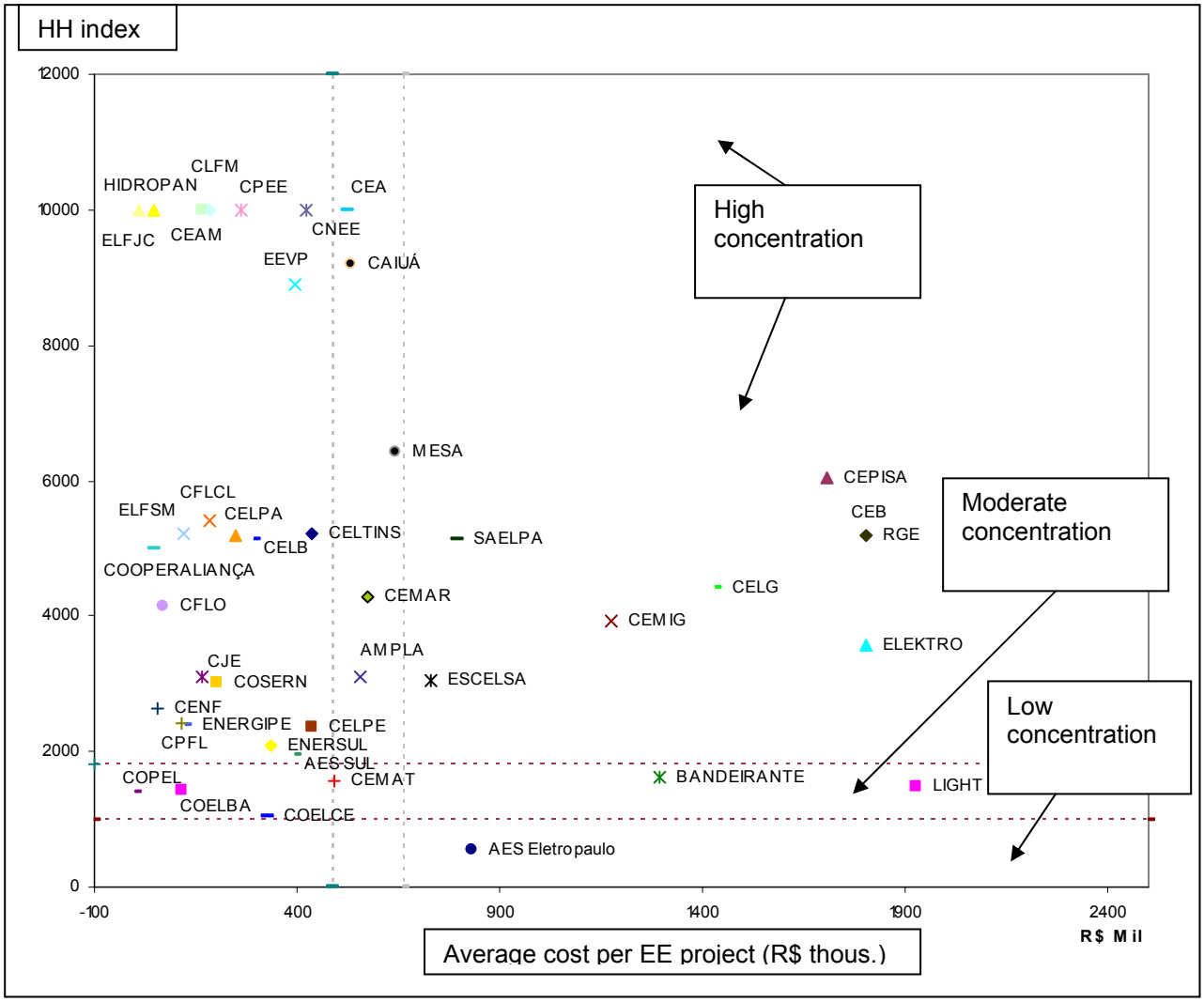


Figure 6: Levels of concentration of EE investments in types of projects by utility using the HH index (2003/04) plotted against the average expenditure per project

6.2 IMPACTS OF R&D INVESTMENTS RELEVANT TO EE SERVICES

Here we use the available information to investigate whether there has been a concerted effort and strategy to align investments in R&D that could have spill-over results for future EE programs.

6.2.1 Utilities' R&D Programs

Utilities have invested almost US$180 million in R&D programs since 1998 (Table 8). They have not demonstrated any special interest so far to invest in R&D projects with direct implications for EE. During the 2003/2004 cycle only 2% of the investments in energy R&D projects by distribution utilities directly addressed efficiency issues (Table 9). There seems to be very little synergy between both R&D and EE utility programs. This is very likely a result of the fragmented management observed on the utilities' side

and also from the regulator that could influence more convergence and synergy of the two programs.

Table 8: Total investments in regulated utilities' R&D Programs (1998-2003)

Cycle	Number of utilities	Number of projects approved	Total invested (US$ millions) *
1998/1999	13	63	4.4
1999/2000	43	166	10.2
2000/2001	67	405	39.1
2001/2002	72	499	53.9
2002/2003	101	416	69.0
Total		1549	176.6

Source: ANEEL 2003 and Pompermayer & Melo Jr (2005). Note: Current R$ were converted into US$ using exchange rate as of 31/Dec.

Table 9: Utilities' program expenditure in R&D projects related to Energy Efficiency (cycle 2003/2004)

	Total R&D projects	Only EE related R&D projects	Total EE projects
Number of projects approved	386	6	396
Average cost/project (R$ thous.)	596	850	558
Total expenditure (R$ million)	230	5	221

Note: US$ 1= R$ 2.8 (2003)

6.2.2 The CTEnerg Fund

According to the current CTEnerg guidelines, it 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, but are not being addressed by the market actors. 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 the society. If operated complementarily 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 millions (Table 10). 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. Current 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 numbers in the table show, the funds allocated for public interest EE and R&D have been under-spent consistently. 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 EE programs.

In 2001-2002 about 4% of the CTEnerg budget was invested in EE training programs and events (a technological fair and national contest). A great part of the 33% invested in research laboratory infrastructure (Table 11) had the objective to up-grade facilities' capability to perform EE measurements of appliances and thus support the implementation of the energy efficiency law.[35] A continuation of investments in studies and laboratory infrastructure to support the creation of EE standards was proposed by the Technical Secretariat to the CTEnerg Board in 2002 (CGEE, 2003).

[35] The Brazilian law 10.295/2001 set the principles for the "National Energy Conservation Policy and Rational Use of Energy". The law requires the development of energy standards for all of energy consuming equipment commercialized in the country.

Table 10: Estimated and actual budget/expenditures by the CTEnerg Fund (2001-2004) in US$ millions

	Total budget (US$ millions)	% spent in R&D projects
2001	34.5	62%
2002	20.1	34%
2003	64.8	35%
2004	54.1	9%
2005	39.4	75% (official projection)

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

Table 11: Investments in energy programs (%) by CTEnerg during 2001 and 2002

Energy topics	2001-2002
Research Laboratories (upgrade)	26
Fuel Cells	14
Hydro-meteorological studies	8
Thermoelectricity (conventional)	18
Biomass	4
Energy efficiency training programs and events	4
Other	26
Total	100%

Source: Authors' compilation based on CGEE, 2003.

7. PUBLIC BENEFITS FUNDS: THE INTERNATIONAL EXPERIENCE

Public Benefits Funds (PBFs), such as the one established in Brazil, are one of several policy tools that can be introduced to secure (and enhance) support for energy efficiency. This approach has been practiced by several countries (India, Australia, Europe, Thailand, Mexico, amongst others) and, in particular, across several states in the US (Cowart, 1997; Dubash, 2002; Wiser, Murrey et.al., 2003). In several of these countries PBFs have not only supported EE, but also other "public goods" such as renewables, energy services to low-income households and R&D. The rationale behind the creation of PBFs has been the perceived benefits of energy efficiency programs (and other "public interest" programs), and the persistence of externalities and market failures to provide these services after power sector reforms[36] (Eto et.al., 1998; Nadel and Kushler, 2000).

The literature shows a wide variety of instruments to collect and administer funds from energy companies or consumers for the establishment of PBFs. The level of funding also varies and can be as high as 2.6% of electricity revenues for energy efficiency, as is the case of state of Vermont. There are also differences in the procedures for applying these funds to support EE programs. Nevertheless, it is possible to identify three interrelated areas where analyzing the existing international experience could help to maximize the societal benefits from the Brazilian Public Benefit Fund or "1% obligation": a) Administration and governance; b) Increase collaboration and pooling of resources, and c) Program evaluation.

7.1 ADMINISTRATION AND GOVERNANCE

The literature 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.

[36] Thailand, Vermont (USA) and Austria are exceptions and created PBFs without the pressure arising from power sector reforms (Wiser et.al. 2003).

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. Other countries created non-governmental non-utility agencies to manage their EE programs Mexico, UK and Australia.

In fact, PBFs can be admistered in many different ways and by many different organizations. Wiser et.al. (2003) concludes that:

The appropriate administrative structure for any specific jurisdiction will depend on the institutional context, and there are advantages and disadvantages of each administrative approach. For RE (renewable energy) and EE PBFs, the two most attractive administrative options include housing the PBF in an existing or new government agency, or allowing an independent organization to administer the PBF programs.

Regardless of administrative structure, the degree of planning, program development and implementation, contract management, and program evaluation to effectively implement a PBF requires a full time, dedicated professional staff. Staff must be deeply experienced with RE and EE markets to ensure that funds are used most effectively. On a percentage basis, it is not uncommon for 5-10% of PBF funds to be used to cover administrative and management costs.

A more recent experience with a non-utility administrator was undertaken in Vermont, with the creation of a single entity (an energy efficiency utility called Efficiency Vermont) responsible for investing in EE on behalf of the state rate payers and accountable to the regulator. This model avoids the patchwork of several programs across utilities and provides a contrast to the current system in Brazil. More information on Efficiency Vermont is presented in a separate box.

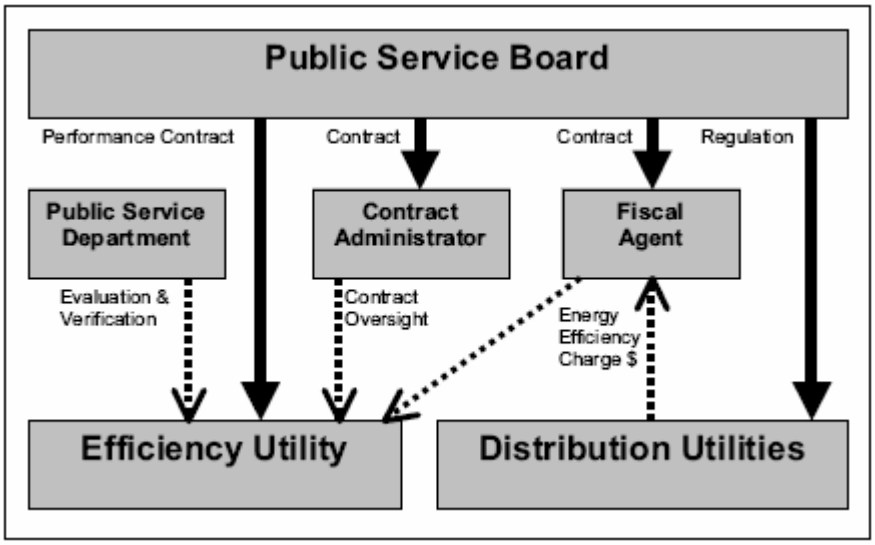
In Brazil, EE and R&D resources (from the 1% obligation) have so far been administered by the utilities (with the oversight of ANEEL) and by CTEnerg in a quite independent manner. It is therefore a mix of utility administration with the regulator's oversight and a non-governmental decision maker (the CTEnerg Board). Price capped Brazilian utilities have a disincentive to promote end-use efficiency; on the one hand their business is to sell electricity to customers, and on the other hand, they are the implementer of programs to reduce electricity usage.

In 1999 Vermont created the first "Energy Efficiency Utility" in the United States. Vermont's experiment has had four years of field testing, feedback, refinement and evolution. By the end of this period, the new efficiency utility – called "Efficiency Vermont" – was providing approximately 3% of Vermont's electricity and had reduced Vermont's rate of annual load growth by 50%.

Efficiency Vermont is managed by a private, nonprofit organization that operates under a direct contract to the state regulator – Public Service Board (PSB). The contract for the delivery of the efficiency utility is a fixed-price contract that is based upon the multi-year performance of the contractor. Efficiency Vermont is responsible for the design, marketing and implementation. Funds to support Efficiency Vermont are collected as part of utility rates by all electric utilities.

The contract between the PSB and the nonprofit contractor contains tightly specified indicators of performance designed to reflect and weight the multiple policy, resource acquisition and market transformation objectives of the state, as represented by the PSB. In the contract, the Efficiency Vermont contractor has the opportunity to earn a significant performance award, which is an incentive payment that is held back until the end of the contract.

A separate state agency – the Department of Public Service (DPS) – has responsibility for reviewing and verifying the claims of energy savings made by the Efficiency Vermont contractor each year. The DPS engages with Efficiency Vermont in an ongoing process of review and update of prescriptive savings algorithms, and conducts an annual verification process of all savings claims. The DPS is also responsible for assessing and reporting on market potential, determining standard-practice baselines, program evaluation, and making recommendations to the PSB on directions and priorities for the future of Efficiency Vermont.



Box 1: The Efficiency Vermont

Source: Information extracted from Hamilton et al (2005).

7.2 INCREASE COLLABORATION AND POOLING OF RESOURCES

PBFs are not and should not be the only source of funding for EE projects. They can be used to attract and expand the funding available for EE and R&D activities, as is recommended by the more successful cases in the international experience regarding market transformation and its sustainability.

Programs and strategies should be discussed with and agreed upon by as a wide a stakeholder group as possible. The pursuit of increased collaboration helps to build support for the PBF and its efforts, and may give the fund added stability in times of political threat. Stakeholders can also provide additional funding when they perceive that PBFs can help to reduce financial risks and transaction costs of delivering EE services (Kozloff et.al. 2000).

The participation of market forces or customers in program design, a feature recommend by international experience (Wiser *et. al*. 2003, Blumstein *et. al.* 2005), has been very limited in Brazil. In recent years all utility programs (EE and R&D) were mandated to be submitted to public hearings for comment and approval; however this has proven to be rather innocuous. The public feedback on programs designed and proposed by utilities has been negligible.

CTEnerg has introduced mechanisms that have been able to co-finance projects by offering resources to fund projects in specific thematic areas requiring that the proponents also present matching funds. The projects are selected on a competitive basis, and can therefore at least double the amount of resources invested in energy R&D. During 2002-04, five public requests for project funding were made available totaling about US$ 14 millions offered by CTEnerg.

7.3 EVALUATION AND MONITORING

The international experience also demonstrates the dangers of PBFs being under political attack 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[37], and for identifying ways to improve the programs funded. Therefore, successful PBFs, especially for EE, generally place significant emphasis on independent evaluation.

Significant experience in EE program evaluation exists in the US relating to DSM programs since the seventies and more recently with PBFs in that country and elsewhere.[38] The creation of “energy efficiency utility” in Vermont (see the Box above) placed a significant emphasis on evaluation and rigorous accountability of results.

PROCEL has had some experience with program evaluation in the past. More specifically a residential lighting program served as a pilot exercise, but it was never implemented in any systematic way.

[37] As reported earlier, the 1% obligation has already suffered such attacks resulting in reduction of resources originally destined to EE and R&D.

[38] The Energy Valuation Organization – successor to the International Performance Measurement and Verification Protocol (IPMVP) will soon publish a proposed international protocol for program evaluation. Wiser et al. (2003) presents the status of the evaluation processes in several countries and US.

8. LESSONS LEARNED AND QUESTIONS FOR THE FUTURE

It is very unlikely that many initiatives in energy efficiency and R&D would have taken place without the regulators' enforcement of the "1% obligation" in 1998 and later with the implementation of Law 9.991/00 by the National Congress. Power sector reforms in Brazil provided an opportunity to significantly increase the level of funding in these areas as shown earlier.

However, provisions in legislation alone are not a sufficient condition to ensure that resources are being used efficiently to maximize the public interest in energy-related services. With regards to energy efficiency there is very little evidence so far that the expanded financial resources available have been used to promote market transformation. In the next sections we provide more details concerning the recent experience with the "1% obligation" mechanism introduced in Brazil.

8.1 ENERGY EFFICIENCY

Since 1998 the amount of resources available for energy efficiency investments, in the range of US$ 40-60 million/year, is significantly higher the historical average of US$ 10 million/year spent by PROCEL. The new format also made it possible for EE investments to be spread out across the country through the local distribution companies.

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 amongst 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.

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 to promote good EE programs

(especially those that reduce kWh) since they have negative impacts on electricity sales[39] and consequently affect corporate profits. Rates design changes could help EE to become more attractive to customers and utilities. Very little innovation has been introduced in rate-making structure and design to customers in the last decade 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.

8.2 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 are perceiving the strategic importance of pursuing activities in R&D, such as the technical improvement of 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 the public benefit fund 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 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.[40] The management of this fund is done by representatives from government, academia and the private sector. This has been a novelty in the administration of public funds in Brazil, and has contributed to a better screening of investment options, during the period 2001-2002. This model, however, still needs to be consolidated and CTEnerg has to demonstrate a higher degree of consistency and predictability in disbursements over time. Interestingly enough, legislation gives conditions for a more stable operation, but indigenous institutions have not been able to implement these conditions.

Important investments were made in upgrading laboratories that could serve as certification and testing sites for energy equipment. These investments were done

[39] Electricity is "price capped", therefore profits are driven by increased sales.
[40] 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).

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 efficiency standards for energy equipment which could be supported by CTEnerg. Up to now, however, none of these possibilities were explored nor 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 year 2002 in order to guide future decisions.

CTEnerg has been able to attract more resources from 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 to other institutions and proposed projects which received funds from CTEnerg.

The regulated R&D program has 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 had as one of its tasks to perform periodic evaluation of the investments made, but this was never implemented. The regulator and utilities are not equipped to perform this kind of evaluation.

8.3 FINAL CONSIDERATIONS

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 in several countries and in Brazil in particular.

There were important lessons learned by utilities and legislators over the period considered. The evolution from a system where only utilities were responsible for investments in EE in 1998 has been substantial. For example: a national fund responsible for public interest R&D and EE initiatives has been created; only end-use projects can now be funded; multi-year projects are possible; cost/benefit criteria for project approval; limitation of expenditure on marketing using the “1% obligation” 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. The Brazilian experience suggests that in spite of the importance of securing funds for energy efficiency and R&D, a 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 policies 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 "1% obligation". 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. 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.

Public Benefits Funds have been important to secure continued support to EE activities, but complementary policies are required to sustain the transformation of energy markets. Examples of complementing policies can be: the establishment of building codes, minimum energy performance standards for appliances, regulatory incentives. During the existence of the 1% obligation in Brazil, public energy policies have not addressed important issues regarding energy efficiency issues that could help the regulator to increase coordination and synergism amongst utilities' programs, nor a more consistent pattern for investments by CTEnerg.

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 ex-post independent evaluation.

These areas can benefit greatly from the existing international experience and from the domestic experience acquired so far.

8.4 PRELIMINARY RECOMMENDATIONS

Some preliminary recommendations follow to improve the use of the "1% obligation" resources allocated for energy efficiency:"

1. Establish guidelines for a national energy efficiency policy with specific orientation for the "1% obligation", based on a comprehensive review of the market potential and barriers for energy efficiency in the country.[41] These guidelines should consider how to achieve a better coordination among the existing mechanisms to support EE activities, such as the "1% obligation", CTEnerg and the "Energy Efficiency Law.[42]

[41] PROCEL is currently developing a comprehensive survey and evaluation of market potential for energy efficiency.
[42] Law 10.295/2001, bill that created the compulsory minimum energy efficiency standards in the country.

2. Establish a mid- to long-term programmatic strategy for utility programs:
3. Require resource acquisition and/or market transformation components in utility plans;
4. Require utilities to show how the 1% is being leveraged and/or provide incentives for leveraging;
5. Require pooling of resources where cost effectiveness can be improved.
6. Simplify protocols for ex-ante project approval;
7. Provide different processes for approval and different program design rules according to utilities' size and market characteristics;
8. Introduce independent ex-post program evaluations. Possibly collect administrative fees for independent evaluation and monitoring.
9. Include resource acquisition and market transformation indicators as elements for evaluation.
10. Reduce the share of resources applied on a grant basis. Develop possibilities to use resources from the compulsory EE investments to leverage performance contracting by ESCOs, approaching more closely a normal commercial financing model (including loans) and achieving higher leverage of resources.
11. A successful effort to use the compulsory investments in EE to attract new resources and other agents may require the development of new accounting procedures to allocate benefits from EE investments so that long-term electricity cost reduction for customers is achieved cost-effectively.
12. Consider complementing utilities' activities with those of independent non-utility agents to receive part of the funds for implementing EE programs.
13. Promote better integration and coordination between the "regulated utility programs" and CTEnerg, not only with regards to EE programs but also with R&D, and more especially R&D projects with higher impacts in the EE area. Promote better coordination amongst utilities' programs.
14. It is evident that the existing regulation does not provide incentives for utilities to invest cost-effectively in EE programs. The existing price-capped electricity tariff structure usually penalizes cases utilities that reduce their sales via EE programs. Alternative ways to administer EE programs such as the Efficiency Utility in Vermont, need to be investigated considering the Brazilian context.

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