Energy Efficiency in Public or Privatized Power Systems: Contrasts of the Brazilian, Chilean, and Mexican Experiences

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ABSTRACT

The paper examines whether energy efficiency has been promoted and implemented more in public or in private power systems, contrasting the experiences of Brazil, Chile and Mexico.

Chile privatized its power sector almost 20 years ago. Believing firmly in the "free-market", Chile has implemented little energy efficiency. The few efforts sought to increase users' energy management consciousness. Energy-intensive enterprises that have implemented measures have sought to improve their processes, not reduce their energy costs.

Mexico until recently believed in a public, vertically integrated power sector. Energy efficiency institutions and regulatory frameworks have been created; minimum energy efficiency standards and labels have been enacted; and large-scale demand-side-management (DSM) projects and government procurement initiatives are underway. This incipient efficiency market's future is now uncertain, as Mexico considers privatization.

Brazil is in the midst of privatizing its previously public, power sector. Under the public sector system, energy efficiency institutions and DSM programs were implemented. Since 1997, the new private utilities are required to spend at least 0.25% of their revenues in end-use energy efficiency programs. This fund has yet to show significant results.

An eclectic mix of public and private system actions is proposed for the future of developing countries' power sectors. The specific conditions of these countries--regional development goals, large population without electric service whose market is unattractive to private investors and incipient funds for public interest research and development--are examined.

Introduction

A worldwide push to privatize public electric sectors to improve service, reduce costs, obtain cash for government coffers, and make these systems more “efficient”, also carries the potential for significantly reducing the future adoption of energy efficiency by end-users. This paper contrasts how much end-use electric energy efficiency has occurred in Brazil, Chile and Mexico. These three countries in our view exemplify distinct development paradigms that help examine how such paradigms affect energy efficiency adoption by end-users. Chile for over 20 years developed under a strong societal and government belief in private markets. Mexico in contrast, had developed with a societal belief that government has to ensure basic social needs (including energy) are met. Brazil represents a recent and evolving middle ground, where public systems are being privatized with some regulatory structures introduced to try to ensure continued attention to public goods. Although we realize that the leadership

in all three countries has embraced the view that private markets are the best resource allocator, their societies and in particular, their electric sectors, have embraced this view to different degrees. Thus, Chile's electric sector has been mostly privately run since the 1980's, whereas Mexico's is still almost entirely publicly held, and Brazil has begun to privatize its electric sector.

The three countries show strong contrasts in their institutional and programmatic approaches to ensuring efficient electric energy end-use. Chile has let the markets decide how much efficiency is implemented. Mexico and Brazil created significant public institutional capabilities in promoting and implementing end-use electric efficiency programs. Brazil's future capabilities are now uncertain, albeit the establishment of a trust fund based on utility revenues to support energy-efficiency programs. Mexico's future capabilities are uncertain; their strengthening or demise dependent on the next administration's views and of turf protection by current institutions.

The paper briefly describes the situation in each country and then the programs and policies that have been taking place and their immediate future expectations. Each country is described separately. We end with conclusions on whether public or privately held electric sectors have been more interested in promoting end-use electric efficiency. In view of the continued push to privatize electric systems, we give some recommendations to enhance the uptake and permanence of cost-effective programs.

Chile's Experience with End-use Electric Efficiency

Background

As happened elsewhere in Latin America, Chile's electric system began with small systems located near industrial demand centers, with excess capacity being also sold to urban customers. Due to terrible quality of service and coverage issues and a view of the State as a promoter of development (with electricity seen as a key energy infrastructure for development), the State created the Empresa Nacional de Electricidad S.A. (ENDESA) a public electric utility in 1943. By 1995 Chile had 6 GW of capacity and generated about 28 TWh; about 66% hydro based (down from 76% in 1985 and expected to continue to decrease with the access to Argentine natural gas since 1998). Over 90% of the population had access to electricity. About 65% of electric consumption was by the industrial and mining sector, and 29% by the residential, commercial and public sectors with the residential being 18%. Electric tariffs reflect real prices but do not include externalities.

During the 1980's Chile increasingly implemented a new paradigm that envisioned the State as a promoter of mature private markets, leading to a mostly privatized electric sector by 1990, with little government interference. Regulatory matters are the purview of the Comisión Nacional de Energía (CNE, National Energy Commission). The Superintendencia de Electricidad y Combustibles (SEC), fiscalices compliance with electric legislation. Neither organism has the authority or technical and financial means to fully carry out their duties. This institutional weakness was clearly exemplified by the electric sector supply crisis of 1998 and 1999, where a severe drought was compounded by private utilities' dispatching cheaper hydro to maximize profits. Despite the situation, energy efficiency was not promoted. The crisis was dealt with by restricting consumption through rolling blackouts.

CNE, theoretically responsible for promoting rational energy use, instead used short term restrictive measures (PRIEN 1999a).

Chilean Energy Efficiency: From Discourse to Reality

The development of policies and an institutional framework required to promote the efficient use of energy in Chile, only becomes relevant—or a topic of attention—starting in 1990. Between 1973 and 1990 policy focused on establishing prices that reflected costs of service and/or international prices. Yet even in the last decade, the attention and resources given to efficiency show how little weight it carries in policymakers views for future sector development.

End-users have also shown little interest in adopting energy efficiency. Government leadership is required to eliminate barriers that limit the role of markets and generate mechanisms and incentives that can complement the workings of a market that allocates resources efficiently.

The CNE has limited its intervention to dissemination, capacity building and technical assistance with little effort and poor results. Several universities have been carrying out energy efficiency research and providing technical expertise to some companies. A few electric-intensive industries have sought to introduce equipment or modify their processes to reduce their energy costs. Yet even among these large industries, that have the technical expertise and financial resources, the results are small compared to the potential.

CODELCO, the largest copper producer of the world, is breaking from this past pattern of minimal attention to efficiency. It has recently been examining and beginning to implement energy effficiency. Base studies were carried out that have led to the definition of policies to improve the company's energy efficiency use, particularly electricity. Barriers to energy efficiency were identified resulting in the adoption of energy efficiency policies governing the substitution of obsolete equipment, purchasing of new equipment and process expansions, a manual on how to measure motor efficiency in the field and maintenance shops, the identification of replicable projects, and the potential for improving electric efficiency and the definition of policies to obtain such potentials. Total savings potential of 639 GWh/year (15% of the energy consumption of the Divisions studied) was identified. CODELCO is now setting up an internal organization to implement the energy efficiency measures identified.

Electric Savings Potential in Chile

In 1996, the Programa de Investigaciones en Energía (PRIEN, Energy Research Program) of the Universidad de Chile, the International Institute for Energy Conservation (IIEC) and the Natural Resources Defense Council (NRDC) did a study on the electric energy savings potential in Chile during 1994 to 2020. The results showed that an energy efficiency scenario could save 3.2 GW (17%) compared to a baseline scenario, and avoid the use of 6.7 million tons of coal (PRIEN, IIEC & NRDC 1996).

PRIEN did a greenhouse-gases inventory and base and mitigation scenarios for the Comisión Nacional del Medio Ambiente (CONAMA, National Environment Commission). The results, based on conservative estimates, show that the mitigation scenario could reduce

final electricity consumption to 67.5 TWh (13.4 TWh savings), reducing CO2 emissions by 43.7% (PRIEN 1999b).

The Future of Chilean Efficient Energy Use

In 1999, the CNE asked PRIEN to elaborate the "Bases for a Regulatory Framework for the Efficient Use of Energy in Chile" (PRIEN 1999c). This is an important change in the Government's vision and shows a limited willingness to begin a process to improve the efficiency with which energy is used. The report will probably be discussed soon by the new administration, but its impact on government actions is yet to be seen.

With respect to the productive and the residential sectors, besides the CODELCO and a few other energy-intensive industries, there do not seem to be important changes in the offing. Continued reliance on public campaigns and the incentive of real prices that do not incorporate externalities, will result in results as meager as in the past. Significant government leadership is required to get energy efficiency to happen.

Mexico's Experience with End-use Electric Efficiency

Background

Installed electric capacity in Mexico is slightly more than 35 GW, with about 2/3 being fossil fuel based (3/4 with fuel oil, most of the rest with natural gas), about 28% hydro, and the rest nuclear and geothermal. About 95% of households have electric service, with about 5 million people living in rural areas still lacking electric service. Electric demand has been mostly between 5 and 7% annually over the last 20 years and is expected to grow between 5 to 6% in the coming decade. Industry is almost 60% of demand, followed by residential (about 25%), and then commercial, public services and agriculture. The highest growth in demand has been in the north (due to relatively increasing economic prosperity, ensuing population migration, and hot climate, which translates into significant AC use) and the southeast tourist development area around Cancun. The residential sector is a main determinant of both the winter evening peak load nationally, and the summer afternoon peak load in the north. Only residential and agricultural electric tariffs are significantly subsidized (more than 50%), with the other sectors usually having tariffs that cover or exceed slightly costs of service.

Mexico has two main public electric utilities, the Comisión Federal de Electricidad (CFE) and Luz y Fuerza del Centro (LFC). The Secretaría de Energía (Energy Secretariat-SE) oversees these utilities. The SE supposedly does future sector policy and planning. In reality, future demand forecasts and supply planning is done by CFE. The SE reviews the CFE plans, usually requiring minor adjustments. There has been some tension recently between the pro-market liberalization SE and the rank-and-file of the public utilities, who see their role as the main providers of electric service. Electric tariffs and utility budgets are approved by the Secretaría de Hacienda (SH, the Finance Secretary), after reviewing what the utilities propose.

The CFE generates about 90% of the electricity and manages the transmission and distribution system nationwide, with the exception of the greater metropolitan area of Mexico

City, served by LFC. CFE was created in 1937 to deal with an increasing problem of the then privately owned electric sector only focusing on serving large industrial loads. Since the early 1960's the process of public ownership was accelerated, with almost all the sector being publicly owned by 1970. This model of public electric sector has been under attack by the political elite since the early 1990's. In 1992 the new electric law redefined "public service", opening up the possibility of private electricity generation. Transmission and distribution remained the sole purview of the public utilities. Self-generation, cogeneration, small renewable-based electricity generation were all now permitted, but the electricity generated and/or any wheeling of electricity had to be by CFE.

To deal with the regulatory issues ensuing from the 1992 Electric Service Law, the Comisión Reguladora de Energía (CRE) was created in 1993. The CRE operates within the SE as a decentralized entity. The CRE has focused its efforts on elaborating clear rules for independent power production, sales and reserve purchase contracts between private generators and the public utilities, wheeling charges, and overseeing the many private power generation and natural gas concessions being awarded to ensure future sector investments are timely.

In 1999, President Zedillo proposed an in-depth restructuring of what is still mostly a publicly owned and run electric sector. The proposal envisioned a gradual move to a system similar to that in place in England, i.e., private investment in new generation, with eventual privatization of public assets as well, and an independent system operator and dispatch system. Although the proposal was not accepted in the current legislature and utility rank-and-file, it has had the effect of enhancing the interest in electric sector policy in the public eye. Criticism of the President's proposal has focused on labor and system stability issues. The environmental community and academics have made the case of the lack of attention to energy efficiency and renewable technologies in the proposal. The new widespread interest on the electric sector may allow for enhanced attention to energy efficiency and demand-side options in the future development of Mexico's electric sector.

Mexican Energy Efficiency Institutions

Mexico has, like Brazil, created institutions to foster energy efficiency since 1982, when the Programa Nacional de Utilización Racional de los Recursos Energéticos (PRONURRE, National Program for Rational Energy Resources Use) was created within CFE. PRONURRE languished with little funding and mostly did public information campaigns. In 1989, the Comisión Nacional de Ahorro de Energía (CONAE, National Energy Savings Commission), was created as a decentralized entity within SE by Presidential decree. CONAE was to coordinate all government actions to promote energy efficiency. As a response to the creation of CONAE, the PRONURRE was turned into the Programa de Ahorro de Energía del Sector Eléctrico (PAESE, Savings Program of the Electric Sector). Both CONAE and PAESE's creation can be seen as part of the new President Salinas administration's view of itself as a modernizing agent that would make all aspects of government more efficient, and was partly influenced the increasing impetus of IRP and DSM in the USA. PAESE was to serve as a coordinator and promoter of electric sector efficiency efforts, both within the utilities, and among end-users. Yet, its funding was minimal. In order to fund PAESE projects, a revolving trust fund, the Fideicomiso de Ahorro

de Energía (FIDE) was created in 1990. This fund was established by contributions from the utilities, their labor unions, and utility suppliers, to the tune of 0.7% of all utility purchases. The FIDE is a non-profit, private entity. Yet it works closely with PAESE as both have the same Director. This allows FIDE to be very effective as through PAESE it has access to CFE data and support, and through its Board membership that includes the main industrial chambers of business, also has very good access to the entrepreneurial sector. Being a private entity, FIDE is unencumbered by government purchasing and staffing requirements. Previous institutions, particularly academics and the Instituto de Investigaciones Eléctricas (IIE, Electric Research Institute) have also expanded their work to include energy efficiency. IIE in particular, has been the developer of the technical support documentation and testing for the establishment of minimum energy performance standards and labels (MEPSL).

Mexican Energy Efficiency Programs and Policies and Their Impacts

A wide range of energy efficiency programs and policies has been implemented during the past decade in Mexico (Friedmann & Sheinbaum 1998). There have been information dissemination, capacity building, electric tariff reforms, financial arrangements, DSM, MEPSL, and summer savings time. CONAE, after early efforts at implementing a wide gamut of projects, has focused more on coordinating government efforts (to reduce both, government and end-user energy use; for example in public buildings and procurement practices), enactment of MEPSLs (18 to date, impacting over 5 million units sold yearly), promoting summer savings time, facilitating the emergence of cogeneration, ESCOs, financial arrangements, capacity formation and education and information dissemination. PAESE carried out early residential CFL DSM projects that set the stage for Ilumex (a 2.5 million residential CFL project, mostly in the States of Jalisco and Nuevo Leon) and ASI (a 0.5 million residential CFL and home AC and building shell improvement project in Mexicali) by CFE, and a nationwide 6.1 million CFL project underway by FIDE, with over 104 sales points in 72 cities or towns in 18 States (FIDE 2000). PAESE mostly serves as an outreach support for both CFE and FIDE efforts now. FIDE has become the main implementer and disseminator of end-user pilot and demonstration incentive programs in all sectors, the implementer of summer savings, capacity building, education to students, teachers and parents, and supporter of MEPSL, Sello FIDE (an efficiency seal given to the most efficient equipment), and a national energy efficiency prize.

It is estimated that private and public efforts to increase energy efficiency will save between 1995 and 2000 about 2 GW of electric capacity, equivalent to at least about 2 billion dollars. The MEPSL for example, have saved a cumulative 6.5 TWh and 740 MW between 1995 and 1999, reducing end-users bills by about 260 million dollars (De Buen 2000). The summer savings program is expected to save 618 MW in 2000 and 16.8 TWh between 1998 and 2007. FIDE's incentive and demonstration programs were expected to save 0.8 TWh and 132 MW in 2000 (SE 1998).

Future Uncertainty in Mexican Energy Efficiency Efforts

The current restructuring proposal for the electric sector completely ignored energy efficiency. Due to the public outcry on this (among other issues), a newer version is expected

to discuss how to include efficiency in a privatized electric sector scheme. Meanwhile, CFE efforts in DSM are drawing to a close and in-house capabilities are in some cases being disbanded (Ilumex in particular). FIDE has taken the lead in program implementation and with a recent loan of 23.8 million dollars from the IADB, has substantially increased the amount of financing available to interested parties. Yet the permanence of FIDE's core funding that is based on public utilities purchases, has not been discussed at all publicly under the proposed privatization scheme. Even with a public benefits charge like that of Brazil, it is not clear if FIDE would receive a part or all of those funds. CONAE's existence cannot be assured in the next administration. The CRE has yet to work on examining the regulations that may be needed to ensure at least a level-playing field for energy efficiency, in either the current or a modified electric sector scheme. Private utilities have no incentive to pursue end-user energy efficiency except for the highly subsidized users (if these subsidies remain, a highly unlikely situation).

Brazil's Experience with End-use Electric Efficiency

Background

Installed electric capacity in Brazil now stands at slightly more than 65 GW. Overall electric consumption has been growing at a rate of about 5-6% annually. The installation of new generation capacity has been lagging behind this growing demand, with some acute supply shortages, as occurs in Manaus and in Rio de Janeiro in 1997. Hydroelectricity has always been an important energy source in the country. In 1960 about 72% of the country's capacity came from hydro sources, and peaked in 1995 at 87%. However, more fossil-fueled generation is expected with hydel reducing its participation to between 80 to 85% by 2010. Privatization will bring new natural gas fueled thermal plants. About 44% of electricity consumption is by industry (was 52% in 1990). During the last decade the residential and commercial sectors have increased their shares of total electric consumption to 26% and 13% in 1998, up from 22% and 11% in 1990, respectively (Electrobras 1994, MME 1999).

Brazilian Restructuring: Energy Efficiency, Planning and Regulatory Context

The restructuring process started in the country without a prior establishment of a clear regulatory framework and at the same time the tradition of centralized planning ended. ELETROBRÁS, the state national holding electrical utility, previously organized, planned, financed, built, and operated the entire electrical power system. The current 2015 Plan (ELETROBRÁS 1994) is the latest edition of a periodically updated document that served in the past to focus ELETROBRÁS' resources and those of its subsidiaries. Now, this Plan is only indicative of the course that overall system expansion may follow. The execution of electricity expansion plans is no longer led by ELETROBRÁS, from now on these decisions being made by the private sector in a market subject to growing competition.

More importantly, re-structuring process in Brazil comes at a time when the experience with energy efficiency is in its infancy and the public debate is non-existent, or poorly informed about the complex issues surrounding energy matters, re-structuring and privatization. We are not stating that the public ownership of the power sector implies

necessarily that certain public benefits, such as energy efficiency, are provided. Indeed, it is relevant to observe that while utility structure and ownership are important, they do not fundamentally determine the success of Demand Side Management (DSM) efforts. It has been shown (Boyle 1996) that when adequate policy and economic incentives to the utility and other actors are present, DSM can occur under many diverse circumstances. A recent study (Gouvello, Jannuzzi & Cauret 1998) compared the development of DSM efforts in the public-dominated electrical systems of France and Brazil, and showed that the relatively better performance of the energy conservation efforts in Brazil can be credited to the experience of ELETROBRAS in coordinating multi-actor initiatives which are necessary for implementing energy efficiency. For these two countries it was also shown that energy efficiency efforts received attention much later and played only a marginal role than in other countries. This also happens when the model of supply-side optimization (nuclear in France and hydroelectric in Brazil) together with public macro-economic policies showed signs of exhaustion. Therefore, public ownership does not necessary means that investments in energy efficiency will take place In the case of Brazil, efforts done in the past towards greater efficiency were not enough to ensure that these values would remain important to consumers, businesses and policy makers.

The National Electricity Regulatory Agency - ANEEL. In late December 1996 the Brazilian Congress passed a law creating the Agência Nacional de Energia Elétrica (ANEEL). Until then all the utilities being privatized were regulated only by the terms of the contract at the time of the sale of assets by the public utility. This new agency has been entrusted with regulatory oversight of the restructured Brazilian electric industry. Initially ANEEL relied on the structure of the previous DNAEE, or National Department of Electric Energy, a now-extinct MME department, and started to function only in December 1997. ANEEL is establishing the regulatory regime necessary to provide the right signals to the market and other measures in accordance to the national energy policies that will be promulgated by NEPC. ANEEL is still being structured, hiring, training personnel, and defining its activities without major policy guidelines from the National government. ANEEL is still being structured, hiring, training personnel, and defining its activities without major policy guidelines from the National government.

ANEEL regulates the power sector, sets guidelines for tariffs and rate-making, approves tariffs, and has the authority to grant concessions to service providers. ANEEL is also charged with establishing competition among the actors, as well as reliability and cost effectiveness of service, including to rural areas. ANEEL has decentralized its activities; transferring regulation oversight to some State Public Utility Commissions that are better positioned to monitor the performance of distribution utilities.

ANEEL has focused most of its effort on creating competition on the generation side and ways to ensure that future energy prices will drop, yet, at the same time maintain attractive conditions to private entrepreneurs to invest in new plants.

The Electrical Conservation Agency (PROCEL). Brazil's national electricity conservation program PROCEL was established in 1985. ELETROBRAS is responsible for PROCEL's operation. PROCEL directs its work toward eliminating energy waste on both the supply and the demand side. PROCEL runs projects in a number of areas — including testing and

labeling of appliances and motors, financing audits and retrofits, metering, and rebates, assisting also the implementation of DSM programs in several regional utilities.

By 1994 PROCEL's programs resulted in an estimated 294 GWh of total electricity savings. About 60 percent of the savings resulted from lighting efficiency improvements. In 1995, PROCEL was given an annual budget of nearly US $27 million: US $6 million for core programs and various projects funded through grants, and US $21 million for low-interest loans from the capital investment fund for the power sector. A large portion of the 1995 budget was spent on purchasing meters for unmetered households and T&D loss-reduction projects, but a number of end-use efficiency projects were initiated or expanded as well. These projects included research and development efforts, demonstration projects, education and promotion initiatives, and implementation projects with state and local utilities. In 1995-1996, emphasis was given to end-use efficiency and peak load reduction in regions with overloaded transmission and distribution systems. PROCEL estimates that its cumulative activities resulted in approximately 5.3 TWh/year of savings in 1998, equivalent to 1.8 percent of electricity use in Brazil. In addition, PROCEL took credit for approximately 1.4 TWh of additional power production due to power plant improvements that year. The electricity savings and additional generation enabled utilities to avoid constructing approximately 1,560 megawatts (MW) of new capacity, meaning approximately $3.1 billion of avoided investments in new power plants and transmission and distribution (T&D) facilities. In contrast, PROCEL and its utility partners spent approximately $260 million on energy efficiency and power supply improvement projects during 1986-1998 (Geller et. al, 1998). Approximately 33 percent of the savings in 1998 were due to efficiency improvements in refrigerators, freezers, and air conditioners; approximately 31 percent from lighting efficiency improvements; 13 percent from installation of meters; 11 percent from motor projects; 8 percent from industrial programs; and 4 percent from other activities. In addition to the energy savings, PROCEL has contributed to the development and commercialization of various new technologies in Brazil (Geller et al., 1999).

PROCEL has been very successful in achieving their goals and also in coordinating actions with bilateral and multilateral agencies and donors such as CIDA, the World Bank, the European Community (ALURE), and the United Nations Development Program (UNDP). PROCEL is seeking a $43 million loan from the World Bank and a complementary $20 million grant from the Global Environmental Facility (GEF) in order to increase its funding base and range of activities.

Until very recently, PROCEL was very well organized and well connected with all the agents in the power sector (utilities, energy service companies—ESCOS, ANEEL, ELETROBRÁS, MME, industries and many others).

Although PROCEL has staff and equipment, they lack a more independent management from the electrical sector (ELETROBRÁS) and more stability to conduct their programs. This agency has suffered discontinuities and several of its on-going activities were interrupted or re-defined due to the new context of the electrical sector. During some time it was suggested that PROCEL should merge with the existing Electric Power Research Center (CEPEL) and it is still unclear to outsiders how it will survive.

Many of the privatized utilities are not interested in supporting CEPEL's activities, at least at the moment. One role that PROCEL has assumed is the review of efficiency projects

that are being submitted to ANEEL as the result of the 1% Charge on Annual Revenues, as discussed below.

Brazil's One-percent Charge for End-Use Efficiency, R&D and Supply-Side Efficiency

Since 1998 the regulatory agency ANEEL enforces the application of at least 1% of the previous year revenues in energy efficiency measures and research and development. These funds are allocated to end-use efficiency measures (0.25% of total operational revenues), research and development (0.1%) the rest goes to the improvement of supply efficiency.

ANEEL is responsible for the definition of investment priorities, and approval of the annual plans submitted by the energy companies. PROCEL is giving technical support to analyze the Energy Efficiency plans.

Instead of collecting utilities 1% revenues and administer a general fund, ANEEL preferred to let each utility specify its own investment plans, for energy efficiency and R&D. It is their understanding that utilities have a better knowledge of customers behavior and more capable to design efficiency programs and what is best to achieve in their respective markets. Very little debate has been promoted to decide on important issues of governance, administration and public policy strategies associated with the use of such funds.

It is true that current ANEEL's regulation provides a window of opportunities for investments in energy efficiency and energy R&D, but present serious distortions in our view that reveal an apparent misunderstanding of the role of public interest policies and the operation of energy markets. It seems that common sense would indicate that profit-seeking utilities would not require any legislation to direct investments to reduce commercial losses that currently may have a privileged portion of the one- percent charge, for example. Although ANEEL ultimately approves the utilities' plans, alternative plans that may yield greater societal benefits but are less financially interesting to the utilities will have lower priority or will not even be considered. This may be well the case of public interest research and development that may present relatively long payback periods.

Conclusions

The contrast of the energy efficiency experiences and infrastructure created in Chile, Brazil and Mexico over the last twenty years shows:

- A paradigm that assigns a value to these efforts is paramount, regardless of whether actions should be seen as mostly the purview of the public or private sectors.
- Such a paradigm has been more evident in Brazil and Mexico, and basically non-existent in Chile. Since all these countries have limited technological RD&D (despite their technical capacity and at times, broad industrial base), and the majority of their populations are income constrained, it is not surprising that energy efficiency is not being pursued avidly by the private sector.
- Brazil and Mexico have carried out a wide variety of energy efficiency enhancing policies and projects with significant savings results. Chile has done almost nothing beyond getting the prices "right" and results have been meager. Leaving the initiative to the natural workings of the current markets, as has been the case in Chile, clearly shows that

current market barriers and failures will result in many missed opportunities for energy efficiency uptake.

- As a result of government actions, Brazil and Mexico have established an incipient energy efficiency infrastructure; yet mature energy efficient markets still are far in the future. Chile has basically no energy efficiency infrastructure.
- This infrastructure is crucial to eliminate current barriers that impede markets from allocating resources in the most socially efficient manner. This infrastructure includes institutions that can coordinate government actions, prepare and enact equipment and building efficiency standards, certify quality of products and service providers, promote the emergence of energy efficiency firms, give fiscal or other incentives, and establish a regulatory level-playing field for all energy options--both supply and demand-side (e.g., establishing all-resource bidding processes for future sector expansion).
- The effectiveness of a public benefits charge levy as has been done in Mexico or Brazil depends in part on oversight and public input. Mexico's FIDE fund has effectively served as a financier and promoter of pilot and demonstration-scale projects. Brazil's 1 % levy on revenues has yet to fund projects. The Brazilian and Mexican experiences seem to show that although funding can be established to support programs, this funding needs to garner buy-in from the entrepreneurial sector as well. The Brazilian experience shows the growing pains of instituting a public benefits charge, even in a country where some infrastructure has been put in place due to past PROCEL programs--simply because the new privatized structure requires regulatory oversight that is new to all parties. Government policies and public participation and oversight are required to guide the use of these funds.
- The State seems to be best poised to help the early development of an energy-efficiency infrastructure, as initial information and transaction costs can be high, while lost public benefit opportunities are large. Market push-pull activities and policies should be sponsored, as well as institutional and human capacity building, and financing to break the barriers impeding the efficient working of markets.
- The long-term sustainability of any of these efforts will need to rest on a new paradigm for all sectors of economy--based on full internalization of externality costs, and concern for future generations and socially disadvantaged classes. To implement this paradigm need to closely link efficient energy policy with environmental policy. Fully internalized costs should be used in electric sector development planning, and in the establishment of prices and tariffs. Also useful is linking greenhouse-gases emissions reduction targets with energy efficiency measures.
- Other developing countries must strive to find ways to ensure that under a private or public sector, the societal uptake of energy efficiency and renewable technologies are obtained. The Mexican and Brazilian efforts have many lessons on how to do this.

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