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Power Sector Reforms and Residential Energy Efficiency Programs

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ABSTRACT

Energy efficiency plays a central role in promoting sustainable development. Energy efficiency programs particularly those targeting the residential sector are considered a public benefit since they generate public benefit outcomes such as economic prosperity, social equity and environmental sustainability. More often, the public benefit derived from these programs is greater than the private benefit. The reforms in the power supply industry in both developed and developing countries initially show that energy efficiency programs in general, and residential energy efficiency programs in particular are being threatened by these reforms since private market players do not prioritize public benefit investments. The paper reviews how different levels of reforms affected residential energy efficiency investments and discusses experiences and approaches in the UK, US and Brazil. With several developing countries undertaking reforms in their electricity supply industries, the paper presents fundamental elements such as robust policy and legislation, enforceable regulation, funding stability, institutional support and adequate capacity, in order to promote residential energy efficiency in reformed electricity markets.

1. INTRODUCTION

Energy efficiency plays a central role in promoting sustainable development. It can contribute to local and national economic development, through the generation of important economic benefits such as new jobs and income generating opportunities, improved capability to export technologically advanced products, a more efficient allocation of economic resources, improved technological base and production processes of important consumer sectors, and overall economic competitiveness. Energy efficiency helps to achieve energy sector objectives such as supply reliability and energy security, and brings about environmental benefits such as reduced water pollution and emissions of local air pollutants, acid-rain precursors and greenhouse gases. The efficient use of energy can also contribute towards poverty alleviation and improved social equity. In particular, efficiency in the use of energy can reduce poor households' monthly fuel cost burden and free up scarce funds for investment in other important areas.

The rationale for, and manner in which energy efficiency programs have been valued and implemented has evolved over time. In the US, utilities became interested in 'energy conservation and load management' (CLM) programs in the 1970s, then 'demand-side management' (DSM) in the mid 1980s and integrated resource planning (IRP) since the late 1980s. More recently, utilities have been offering energy services to customers on a tailor-made basis and are requiring customers to pay for the cost of the utility service rendered, which is known as 'energy services management' (ESM). Finally, utilities also tend to be returning to first era DSM – information, loans and shared savings. This is due

to a belief that these program approaches are less expensive for utilities, and that the design of programs originating in the 1970s and 1980s can be vastly improved upon (Nadel & Geller 1995).

As energy efficiency and demand-side management programs evolved in the United States, so did programs in Europe. Experience has been quite mixed in different European countries. Some countries have had some degree of pre-reform experience in this area (for example, Germany, Norway, Austria, Denmark, Luxembourg, The Netherlands, Spain, Belguim); others (e.g. Portugal, Greece) have not). Those which did not have any pre-reform tradition in this area (i.e. Portugal) have remained on this course as energy sector liberalization initiatives have proceeded, while reforms in other countries (for example, the United Kingdom and Italy) have brought about, at times, a profound increase in interest and investment in energy efficiency and demand-side management). Reforms have brought about the demise of such investment in some countries including France, Germany and Austria. In some countries, energy efficiency and demand-side management investment has not been significantly affected by reforms (as in Denmark).

Energy efficiency programs have also evolved from as early as the mid-80s in developing countries. What is new to both industrialized and developing countries though is the changing environment in which these programs are now being invested in and then implemented. Industrialized and developing countries alike are putting into practice, oftentimes, extensive reforms to deal with pressing electricity sector challenges. While specific reform drivers vary from country to country, common objectives are to improve operational, system and managerial efficiencies, lower the cost of electricity and stimulate private sector participation and financing. To achieve these objectives, electric utilities are corporatized and commercialized, unbundled and in some cases, competition is then introduced. New regulatory frameworks are also being established and increased private sector participation and financing is being encouraged.

Though experience is mixed, it initially appears that energy efficiency programmes in general, and residential energy efficiency programmes in particular, are being threatened by these reforms. The paper presents residential energy efficiency as a public benefit, reviews the impacts of reforms and the regulatory approaches adopted by the UK, US and Brazil, and makes recommendations on how investments in residential energy efficiency can be advanced as electricity sector contexts change.

2. RESIDENTIAL ENERGY EFFICIENCY AS A PUBLIC BENEFIT

Demand-side management (DSM) interventions can be broken down into four broad sub-categories. These are (i) strategic load growth, which creates additional electricity sales at defined times; (ii) load shifting, which modifies the time of day that power is used; (iii) interruptibility agreements which allow the generator to interrupt power supplied to a customer for a limited period of time; and (iv) energy efficiency interventions. These broad categories can be grouped into those that contribute towards a utility's financial performance, and those which, though present societal benefits, are costly for a utility to implement and tend to have a negative impact (short term financial negative impacts on electricity revenues) on the utility.. In general, strategic load growth, load shifting, interruptibility agreements and commercial and industrial energy efficiency services fit into the latter category, while residential energy efficiency programs (and some commercial energy efficiency programs) link with the category of programs that are costly – both financially and in terms of effort spent – to implement.[1]

The focus of this paper is on public interest residential energy efficiency programs. Indeed, this is the area of investment, which is likely to need 'special effort', particularly when electricity industries embark on the reform process. These programs are referred to here as "public interest"

[1] If customers pay the cost of the DSM activity directly to the provider, we might speak of a DSM *service*; otherwise, it is useful to refer to a DSM *program*. There are different types of DSM programs or services.

programs because utilities must have a public interest focus (or some degree of social orientation) to implement them. Residential energy efficiency programs include a range of activities, and these are the following:

- Information and education programs
  - Labeling programs
  - Customer information and education
  - Energy audits
  - Energy efficiency advice
- Direct installation programs
  - New installations
  - Retrofits
- Financing programs
  - Lowering purchase price with subsidies and cooperative procurement
  - Attracting new purchase with low interest loans, deferred payment schemes, rebates
- Market transformation
  - Efficiency standards
  - Technology procurement
  - Industry agreements
  - Information and education
  - Financial incentives

As noted, private or even publicly-owned utilities in new electricity contexts will not easily invest in these programs if they are not incentivised or obliged by regulation or legislation in some way to do so. Hence, the importance of government policy and legislation, regulatory mechanisms and fiscal interventions cannot be ignored

Public benefit programs are defined as those that provide public benefit outcomes such as economic prosperity, social equity and environmental sustainability. Often, the public benefit derived from these programs is greater than the private benefit. Thus investment in public benefit programs is not a priority for market players, and the public sector must assume a responsibility or obligation to ensure provision of such services.

Programs which promote efficient use of electricity in the residential sector are very unlikely to be developed by energy services companies or other private sector enterprises, unless residential customers are willing to pay for the services rendered, or if tariffs are low compared to the costs of producing and delivering electricity. Yet, over the years, numerous studies have highlighted the unambiguous benefits linked to energy efficiency, or residential energy efficiency.

Residential energy efficiency programs – particularly those targeted at poor households – yield 'public benefits' because they can result in high social and economic spin-offs including:

- More information and thus ability to make better informed decisions on allocating resources more effectively,
- A decrease in household energy bills (while level of energy services is not reduced), freeing up household income for expenditure on other household services, on an improved energy service, or on new income generating and job creating opportunities,
- An increased number of households being able to afford to use electricity where before this was not attainable (i.e. residential energy efficiency programs add value to access programs),
- A reduction in resource utilisation and environmental impact.

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3. BARRIERS TO ENERGY EFFICIENCY PROMOTION

Cost effective energy efficiency potential in most industrialised and developing countries is estimated to be substantial[2] but, due to a wide range of barriers[3], market failures or market imperfections that inhibit investment and/or implementation, this potential has not been fully exploited. Barriers inhibiting the promotion of energy efficiency are various, but can be classified into general, policy and program barriers, and are well presented by Vine et al (2003) (Table 1).

Clearly though, barriers range in intensity and importance between industrialised and developing countries. Jochem et al (2000) lists key 'developing' country barriers as follows:

- lack of awareness of potential benefits,
- lack of effective energy policy at national level,
- energy supply constraints,
- inappropriate energy pricing and cross-subsidies,
- lack of trained staff, operators and maintenance workers,
- lack of capital and import of inefficient/used plants, and
- proliferation of inefficient equipment and the desire to minimise initial costs (see UNDP/UNDESA/ 2000).

Table 1 General, Policy and Program Barriers to Energy Efficiency

General Barrier Lack of government attention to energy efficiency	**Impacts of Reform on Barrier**
Policy Barriers	
1. Excess capacity	1. None, directly
2. Short-term perspective	2. None, directly
3. Split (misplaced) incentives to energy providers	3. None, directly
4. Pricing Non-transparent pricing Non-cost-reflective pricing	4. Yes, direct impact on both non-transparent and non-cost reflective pricing approaches
5. Import tariffs and duties	5. None, directly
6. Lack of awareness by policy makers (of EE opportunities)	6. None, directly, unless highlighted in reform agenda
7. Imperfect information (restricted access to customer information)	7. None, directly
8. Inadequate competition (market power problems)	8. Yes, direct impact if reforms include moves to introduce competition
9. Customer instability (problem for energy providers)	9. None, directly
10. Lack of adequate paradigm (for evaluating the value of EE)	10. None, directly
11. Separation of energy policy process (from environment & social policy)	11. Perhaps an impact, depending on process
12. Little market transformation experience (by end-users or others)	12. None, directly
13. Lack of available expertise (in EE during transition periods)	13. None, directly
14. Utility price setting process Cost recovery barriers Decoupling of profits from sales	14. Depends on regulatory framework put in place

[2] See for instance UNDP/UNDESA/ (2000)

[3] A barrier can be defined as any factor that limits the promotion, in this case of, residential energy efficiency, and this includes barriers to implementation of policy goals and programs. See for instance Vine et al (2003).

General Barrier Lack of government attention to energy efficiency	**Impacts of Reform on Barrier**
Program Barriers	
1. Low cost of energy to end users	1. Depends on context
2. Lack of information to end users: Lack of energy consumption data Lack of energy provider information	2. None directly, unless specified in new regulatory framework
3. Information/search costs (to end users & other actors)	3. None directly
4. End users do not invest in EE because of habits or custom	4. None directly
5. Lack of end-user and other market actor's experience impacts: Lack of experience with proven cost-effective measures Performance uncertainties (may perceive EE to be unreliable) Reluctance to adopt new technologies Fear of disruption in routine	5. None directly, except to a fear of disruption in routine as a result of industry uncertainties
6. Financial barriers Limited investment capital available for EE High initial cost	6. Depends on extent of government policy on energy efficiency, and participation of private sector. High initial cost will not be affected.
7. Product/service unavailability	7. None, directly
8. Inseparability of product features	8. None, directly
9. Organizational (institutional) barriers Low priority of energy efficiency Views of upper management Multiple decision makers	9. Extent of priority depends on reform agenda and individual interests of reformers
10. Split (misplaced) incentives	10. None, directly

Source: Adapted from Vine et al, 2003

Using energy efficiently generally entails the purchase of equipment that tends, initially, to be more expensive (and more difficult to access) than conventional technologies. Most developing country citizens cannot easily afford to do this. This remains as one of the key barriers inhibiting widespread energy efficiency investment in developing countries.

Many of the barriers highlighted above will be affected by electricity reforms, while others will not be. Table 1 (second column) suggests an impact of reform on the barriers highlighted. With regard to generic barriers as outlined directly above, reform is likely to have some impact on the existence and/or nature of effective energy policy at the national level, on energy pricing and cross-subsidy approaches, and capital availability in the electricity industry. Thus, it could be argued that the reform period may bring opportunity to remove various existing barriers inhibiting investment in energy efficiency, while others will remain unaffected. Thus, if the period of reform is to advance investment in residential energy efficiency, careful attention should be given to remaining barriers as well as emerging new barriers.

4. IMPACTS OF REFORMS ON RESIDENTIAL ENERGY EFFICIENCY

The impact of reforms on residential energy efficiency programs depends on several factors such as the initial industry conditions (structure and ownership), existing programs and regulations as well as the treatment of residential energy efficiency during the reform process. This section *first* summarizes changes in power sector reforms, *second* reviews the implications of reforms on the

incentives of utilities to undertake residential energy efficiency programs, and *third* presents experiences of the UK, US (California) and Brazil.

4.1 Power sector reforms

Reforms in many countries consist of the following electricity supply industry changes: commercialisation, corporatisation, privatisation, unbundling, and the introduction of competition. Commercialisation involves the introduction of commercial objectives in the management and operation of government-owned utilities; corporatisation is a legal move from direct government control to legal corporation with separate management; privatisation transfers power sector asset ownership from public to private sector; unbundling separates vertically integrated utilities into distinct industry functions, competitive – generation and retail supply, and monopolistic – transmission and distribution; competition is introduced in high voltage electricity generation market (wholesale competition) and in low voltage electricity supply market (retail competition).

At present, only few countries have completely unbundled and privatised their electricity supply industries, and introduced wholesale and retail competition. Many developing countries have undertaken various degrees of commercialisation, corporatisation and unbundling of their electricity supply industries. The UK, US and Brazil – countries being focused in the paper – are among the countries with advanced state of power sector reforms.

The UK is among the first countries to introduce reforms in the electricity supply industry. In 1988, the conservative government first issued a paper that defined the framework for liberalization. The subsequent Electricity Act of 1989 provided the legal basis for unbundling the electric supply industry into generation, transmission, distribution and retail businesses and for privatising most power industry assets. Competitive wholesale electricity supply market was introduced with the creation of the electricity pool in 1990. The retail market was gradually opened to competition. Customers with peak load demand of more than 1 MW were able to choose their suppliers with the establishment of the power pool. The threshold was reduced to 100 kW in 1994 and since 1998 the retail market was fully opened to competition. The industry organization was changed with the New Electricity Trading Arrangement (NETA) introduced in March 2001. With this, the central dispatch of generation was abandoned and the new arrangement is mainly based on bilateral trading between generators, and suppliers, traders and customers.

In the US, power sector reforms at the Federal level started in the mid 1990s when the Federal Electricity Regulatory Commission (FERC) mandated open-access rules for wholesale trade requiring third party access to the network (IEA 2002). With this, FERC also encouraged the establishment of the Regional Transmission Organizations (RTOs), which resulted in the creation of Independent System Operators (ISOs). At the state level, reforms vary from state to state. The State of California for example, enacted the electricity reform law (Assembly Bill 1890) in 1996, which opened the electricity market to competition. Full retail competition was implemented in 1998. Two independent institutions were established in 1998: the California Power Exchange (CalPX) which manages the mandatory power pool and the Independent System Operator (ISO) which operates the transmission network. After the power crisis in the 2000, the CalPX was closed in January 2001. The state of California through the Water Resources Department took over the responsibility of power purchase in the spot market and long term contracts on behalf of the utilities. The California Consumer Power and Conservation Financing Authority (CPA) were created in August 2001 to mainly acquire power to meet California's needs and secure sufficient power reserves.

Brazil is among the latest countries to introduce competitive electricity markets. The main legislation to liberalize and privatise the electricity industry was passed in 1995. The new electricity regulator, Agencia Nacional de Energia Electrica (ANEEL), was established in 1996. In 1998, the National System Operator (ONS) and the wholesale electricity market (MAE) were created. ONS is

a not-for-profit association of electricity companies responsible for dispatch and transmission network operation. Privatization of generation and distribution utilities also started in 1995 while the implementation of the competitive wholesale electricity market was completed in 2001. Competition however is still limited because of the existing contracts. Only electricity generated from new projects can enter competition until 2004, and the existing contracts will be reduced by 25% each year from 2004 onwards.

4.2 Implications of reforms on residential energy efficiency

Power sector reforms affect the incentives of utilities to implement energy efficiency programs and services. Vine et al (2003) presents the implications of reforms on the incentives of different market actors under different generic models of industry structures[4]. Customers may be interested in energy efficiency as the cost of electricity rises due to removal of subsidies particularly during commercialisation and privatisation, and in response, utilities and energy service companies may offer energy efficiency services. Utilities may be interested in energy efficiency as a marketing tool to fend off potential competitors when competition is introduced. At any stage of reforms, utilities will only undertake energy efficiency programs if mandated by the regulators to do so. The disincentives to energy efficiency are even stronger with the changes in the electricity supply industry: utilities may not invest on energy efficiency programs since it implies electricity sales reduction and represents loss revenues; energy efficiency program investments may not be consistent with profit maximization objective of electric companies (particularly when there is no constraints in distribution network); electricity rates may be lower in competitive markets since power pool prices are based on short-run marginal costs; and reforms may alter several market barriers but not eliminate key barriers.

Table 2 Implications of reforms on residential energy efficiency

Reform Stage	Implications on Residential EE
Commercialization initiatives	No incentives to invest on residential EE: ii) programs are costly to implement, and ii) kWh savings means forgone revenue. Customers might be interested on EE; utilities may or may not react on new customer demand. Utilities may seek cooperation with ESCOs, but ESCOs may be more interested on large industrial and commercial customers.
Corporatization initiatives	Utilities may or may not invest in residential EE, but depends on the extent to which i) the utility is obliged to contribute to social and environmental goals, ii) these goals are defined, iii) the capability of the regulatory authority to enforce these duties. In most cases, utility's interest is weakened. In seeking to address environmental and social objectives, utilities may however focus attention on electrification and industrial and commercial EE programs.
Privatization Initiatives	Residential EE programs are perceived not to recover project costs and to provide sufficient returns. Strong incentives will be for system efficiency improvement. Private utilities may no longer be obliged to directly supporting national social and environmental objectives, unless obliged by regulation or if these objectives correspond to their business initiatives. Residential EE programs initiated prior to privatisation would most likely not be voluntarily sustained by privatised utilities.

[4] Refer to Vine et al (2003) and Hagler Bailly (1998) for more elaborate discussions on incentives and disincentives of to energy efficiency under power sector reforms.

Reform Stage	Implications on Residential EE
Wholesale Competition	Publicly-owned distribution companies are most likely to maintain residential EE than privately-owned companies.
	Distribution utilities may be interested in EE programs if they can help avoid investment in distribution infrastructure though emphasis would be likely on lucrative business linked to industrial and commercial customers.
	Wholesale prices may drop if linked to short-term costs. This may disincentivise efficient use of electricity.
Retail Competition	With partial retail competition (residential customers remain captive), suppliers may offer EE activities to large industrial and commercial customers to maintain customer loyalty and to increase their customer base, and revenues.
	With full retail competition, retailers will not engage in residential EE that may result in price increase in order to maintain and attract customers.
	A single company may not have large customer base that would justify the transaction costs, thus avoiding the provision of EE services. Companies will be unlikely to invest in public interest EE programs which other competitors can free-ride.
	Retail competition may stimulate growth of energy service companies, though these companies are likely to cater large customers.

When analysing different electricity market segments, the above market incentives may not exist at all in residential electricity market. As summarized in Table 2, utilities' incentives for residential energy efficiency are diminished as the reforms progress from commercialisation to full retail competition. Residential energy efficiency programs are costly to implement and yield relatively low returns than those programs targeting large industrial and commercial electricity customers. Under reforms, utilities therefore would only engage in residential energy efficiency if regulatory authorities oblige them to do so or if it is consistent with their load demand management objectives.

4.3 Impacts and regulatory approaches in selected countries

4.3.1 Spending and savings targets in the UK

Pre-reform utility-based energy efficiency programs in the UK were limited and focused mainly on peak load management and industrial cogeneration. Energy efficiency was not specifically addressed during the reforms since it was believed that once the electricity market would be established it would take care of energy efficiency investments[5]. In the aftermath of privatisation, the prospect of power companies increasing or even maintaining their investments in DSM and energy efficiency seemed bleak. The performance-based price cap formula that existed at the time – whereby electricity companies' allowed revenues was directly linked to the number of kWhs sold – posted a strong incentive to the Regional Electricity Companies (RECs) to maximise sales, and an equally strong disincentive to RECs to institute DSM[6].

[5] Refer to Hagler Bailly for example (1998)

[6] Since the distribution function has a high degree of fixed cost, each additional kWh sold generated a high degree of profit once fixed costs were covered. Consequently energy efficiency programs directly resulted in a high loss of margin (King et al 1996)

The electricity regulator, OFFER (now OFGEM) soon realised that the development of the competitive electricity market would not sufficiently incentivize investments in energy efficiency. During the first (1994) review of the distribution services price cap, OFFER initiated a partial decoupling of the volume sales from profits.[7] About 50 per cent of the revenues allowed through the price cap would be collected through fixed charges. In the 1993 Supply Price Control review, the volume related element of the revenue allowance was also reduced significantly (Curtis 1995, King et al 1996). At this same time, OFFER introduced (i) a special revenue allowance to be used by RECs to achieve end-use energy savings on behalf of their customers, and (ii) the Standards of Performance (SOPs). The special revenue allowance was to be raised by collecting the equivalent of £1 from each franchise customer account over the first and the second phases of SOP (SOP1 from 1994-1998, and SOP2 from 1998-2000) and £1.20 annual allowance per account during the third phase (SOP 3 from 2000-2002 (Curtis 1995; King et al 1996). SOP 1 generated a total allowance of £101.7 million, SOP 2 £48.1 million, and SOP3 £150 million (OFGEM 2000). These funds were to be channelled, initially through the electricity suppliers, and later through gas companies as well, and used to subsidize household efficient appliances and equipment purchase as well as residential building insulation measures.

The Standards of Performance required RECs (and later gas suppliers) to achieve certain energy savings levels through a variety of programs focusing on small and low-income customers.[8] As the reforms moved into full retail competition, OFGEM moved from a spending target to a more focused savings target program or the Energy Efficiency Commitment (2002-2005) that measures how effectively and innovatively suppliers meet their savings target. EEC requires gas and electricity companies encourage or assist domestic customers to take up energy efficiency measures to meet the savings target for 2003 to 2005, of 62 TWh (OFGEM 2001). The savings target is apportioned to suppliers according to their domestic customers. Fifty percent of this target must be achieved from a priority group of low-income consumers. It is planned that suppliers will meet these targets through wall insulation measures, energy efficient appliances, condensing gas boilers and low energy lamps. Suppliers will be accredited for gas and electricity savings as well as for coal, oil and LPG savings. In addition to EEC, gas and electricity suppliers are obliged by their licenses to provide energy efficiency advice to their customers. It is estimated that electricity suppliers' investments will reach £165 million per year.

More recently, OFGEM has included these initiatives in its Social Action Plan established specifically to support the UK government's attempts to reduce the number of households experiencing fuel poverty. The UK government remains committed to helping low income consumers through the EEC. It proposes that suppliers should secure 50 % of their annual savings from the priority groups – those on low incomes, pensioners, or those in receipt of certain passport benefits.

SOP was administered by the Energy Savings Trust (EST) on behalf of OFFER.[9] EST was also involved in several energy efficiency programs focusing on the residential sector. The current EEC (2002-2005) is directly managed by OFGEM (formerly OFFER).[10] EST continues to implement its government-supported residential energy efficiency programs including several programs promoting residential energy efficiency such as community partnerships (Energy Efficiency Advice Centres,

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[7] Allowed revenues would be based partially on sales performance but also other factors such as good customer interface, public benefit programs, growth in customer base etc.

[8] In 1994, the RECs were required, for example, to save 0.675% of distributed energy.

[9] The Energy Savings Trust (EST) is a private government-guaranteed company, established in 1992 as a means towards meeting the UK's obligations under the Rio Declaration. OFFER retained EST's services to: (i) negotiation with OFFER and the RECs to set each company's energy savings targets; (ii) evaluate all projects to ensure compliance; (iii) assist in the development of projects in association with the RECs; (iv) develop and manage national projects on behalf of RECs (EST, 1999d).

[10] OFGEM (2001).

practical help for local authorities, Home Energy Conservation Act assistance to local authorities) and supplier partnerships (Community Energy Program, Energy Services, Lightswitch Program, School Energy and Housing Energy Efficiency Best Practice Program).

On the whole, the UK energy efficiency program as described above has been successful. The three SOP phases implemented more than 10.6 million measures, generated £144 million of supplier investments, 18.4 TWh of saved energy and 225 thousand tonnes of carbon savings (OFGEM 2000). Customers were said to benefit by £4.60 for every £1 of program investment in reduced energy costs. The program directly stimulated the equivalent of 400 jobs per year over 4 years (EST, 1999).

4.3.2 Public benefits charge in the US

The United States has had extensive pre-reform success in implementing energy efficiency programs. At the federal level, the Department of Energy (DOE) and the US Environmental Protection Agency (EPA) have been managing programs to promote energy efficiency for about two decades before reforms set in. At the state level, several state energy agencies promote end-use energy efficiency, and regulated electric utilities implemented and funded public interest programs as part of their public obligations. State regulatory commissions recognized that these programs provided public benefits to the society and that the government must ensure these benefits. Thus, utilities were incentivized in pre-reform times to invest in energy efficiency programs through regulatory instruments such as net lost revenue adjustments, and the decoupling of sales from revenues and profits. Through shared savings mechanisms, bonus mechanisms or mark-up mechanisms, some state regulators even allowed utilities to earn a profit on energy efficiency investments.

Demand-side management became popular in many US states in the 1980s and was used by utilities as a new tool to improve system performance. In California, investor-owned utilities adopted several types of DSM programs: energy efficiency, load management, fuel substitution programs and load building programs. It was reported that 70-90 percent of all DSM spending went to energy efficiency programs (CEC, 1999). The fall of energy prices in the mid-1980s resulted in a downturn of DSM programs with investments declining from a peak of $284 million in 1984 to below $100 million in 1989. In the early 1990s, the California Collaborative (consisting of public interest groups, government and utilities) rekindled the utilities' interest in DSM by paying utilities for every measured kWh saved. The California Public Utilities commission allowed the utilities to collect ratepayer funds to purchase energy conservation resources.

As plans to reform state electricity markets developed, investment in energy efficiency programs notably declined. On a national level, utility spending on energy efficiency reached $1.9 billion in 1993, and declined to $1.2 billion in 1996 (Eto et al 1998). Californian utility spending on energy efficiency reached a record high of US$362 million in 1994, and dipped to around $211 in 1996, due to the growing uncertainty directly related to reform. This decline came about as a direct result of pressure on utilities to remain competitive, thus cutting all costs deemed to be "non-essential". Regulatory mechanisms that had been put in place to safeguard energy efficiency investment were no longer as powerful as they had been.

During the early years of electricity reform, proponents of public purpose energy efficiency programs were able to convince most US state regulators that barriers to energy efficiency were likely to continue even after the competitive market had been developed and that continued regulatory support was necessary to mitigate these barriers (Hagler Bailly 1998). State regulators' response to this was to introduce a non-bypassable public benefits charge (or a non-bypassable systems benefit charge) that could be used to replace, reshape and extend utility-funded energy efficiency (and other public interest) programs. Such a distribution charge is generally based on usage (kWh), demand (kW) or a combination of these two, and is used to pay for various public benefits including energy

efficiency, low-income programs, R&D and renewables. The Public Goods Charge in California comprises approximately 1% of each customer's electricity bill.

The administration of public benefit funded energy efficiency programs in the US varies from state to state. Many states have allowed the utilities to continue with the administration of programs while others have transferred the administration to either existing state agencies or non-profit institutions (Eto et al 1998). In California, the administration of public benefits energy efficiency and low-income programs was assigned to the California Public Utilities Commission (CPUC) while the renewables and R&D is administered by the California Energy Commission[11].

As a direct consequence of a public benefits charge (implemented in 1998), energy efficiency spending has stabilised, and has risen in California to $362 million in 2001 (CPUC 2001). These funds have been allocated to different public benefit programs. In California, energy efficiency programs supported by public benefits charges covers a broad range of electricity consumers though residential sector and low-income households form part of the important target groups.[12] California residential programs include services from energy guides and centres to educate residential consumers, lighting and appliance programs offering financial incentives and education, comprehensive energy management services, which provide financial incentives to customers and encourage comprehensive energy management; construction services which offer tools and incentives to contractors to facilitate the inclusion of energy efficiency in new construction and retrofit projects. Low-income programs provide a discount on electric and natural gas bills, and weatherization services at no cost. It was observed that the public benefit funding for residential programs has increased above pre-reform levels.[13] In 1997, utility expenditures on residential energy efficiency amounted to 30% of total expenditures (Eto et al 1998), while expenditures on residential energy efficiency programs (as a result of the public benefits charge) increased to 38% in 2001 (CPUC 2001).

4.3.3 Mandatory public interest investments in Brazil

Brazil has had wide-ranging pre-reform experience in public-interest energy efficiency programs. Much of this experience was attained by PROCEL, a national electricity conservation program established by government in 1985 in response to an electricity crisis prevailing at the time.[14] PROCEL is housed in Eletrobras, the national electric utility holding company and coordinating company. PROCEL funds or co-finances energy conservation projects carried out by state and local

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[11] In the State of Rhode Island, public benefit funds are administered by the utilities implementing the programs. Utilities are subject to regulatory oversight by the public utilities commission. That utilities have been left to administer these public funds has been the result of widespread stakeholder support and the utilities proven track record in successfully implementing such programs and working with non-utility service providers. In New York, the New York Energy Research and Development Authority (NYSERDA), a non-profit organization, was designated by the New York Public Service Commission. The view in this state has been that third-party administration would result in the most efficient and neutral management of funds. In the Pacific Northwest, local energy efficiency efforts are administered by local utilities subject to regulatory oversight while regional efforts are administered by the newly created Northwest Energy Efficiency Alliance, a non-profit corporation with board of directors composed of representatives from various stakeholders.

[12] Interestingly, before electricity reforms began in California, the state government set aside a large amount of money earmarked to continue investments, without interruption, in energy efficiency, renewable energy and low income programs (Blue Book CPUC 1994).

[13] Eto et al (1998).

[14] Indeed, PROCEL was established with a mandate to make investments that would contribute to the reduction in need for new power sector investments.

utilities, state agencies, private companies, universities and research institutes[15]. These projects involve research and development, demonstrations, education and training, marketing, direct installation of conservation measures, support of ESCOs, development of legislation, and DSM programs.

The reform process has changed the overall energy efficiency promotion landscape in Brazil. In 1998, ANEEL introduced a regulatory resolution requiring privatised distribution utilities to invest 1% of their net annual operational revenues in energy efficiency programs, and research and development (R&D). ANEEL's initial motivation and justification was to secure private investments to promote the provision of public benefits associated with the industry. According to the aforementioned regulatory resolution and law, utility programes were to be submitted to ANEEL for approval prior to implementation. In October 2001, the National Act for Energy Conservation and Rational Energy Use of Energy[16] (Law no. 10.295) was passed into law. Its passage is not linked to the current reforms but to the electricity supply crisis that had hit the country at that time.

With the mandatory 1% investment on energy efficiency, stable financial resource for energy efficiency has been established for the first time in Brazil; and, privatised distribution utilities have become the key organisations implementing energy efficiency programs in Brazil. During the period 1998 to 1999, end-use energy efficiency investments were mandated to be ≥ 0.25 % of the distribution utilities annual net sales revenues (of this ≥ 0.025 % was earmarked for residential customers). This is due to increase to ≥ 0.50 % during the period 2000-2005 and thereafter to decline back to ≥ 0.25 % from 2006 onwards. This regulation also requires utilities to spend at least 0.025% of operational revenues on residential sector energy efficiency programs. Actual utility spending on residential energy efficiency during the period 1998-1999 was 0.034% (Jannuzzi 2000).[17] Interestingly, the mandatory spending targets in Brazil have generated higher and stable energy efficiency investments than those from the previous programs supported by the government and implemented by PROCEL. During the first year of operation, total investments for energy efficiency amounted to US$ 112.7 million (Jannuzzi & Gomes 2002).

PROCEL currently serves as technical adviser to ANEEL on energy efficiency regulation, and continues to implement curtailed energy efficiency programs. This curtailment was the result of decreased funding from Eletrobras, as well as the announcement of ANEEL's new energy efficiency regulation (Jannuzzi 2000). Only key programs such as information campaigns, energy efficiency awards and appliance labelling have been retained by PROCEL. Furthermore, PROCEL now focuses more on market transformation while the regulation secures a dedicated fund for residential energy efficiency.

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[15] PROCEL also helps utilities obtain low-interest financing for major energy efficiency projects from a loan fund known as the RGR. This fund has been an important source of financing for energy efficiency in the country, while PROCEL has been funded mainly by Eletrobras (Geller, Jannuzzi, Schaeffer & Tolmasquim 1998).

[16] The Law defines the authority of the government to i) establish mandatory minimum energy efficiency standards for energy consuming equipment and appliances and ii) develop mechanisms to promote energy efficiency in buildings. Secondary legislation and the development of technical standards are, however, needed to implement the above measures.

[17] Every year energy efficiency spending targets change, and now it is required that at least one residential program is implemented. This is however subject to negotiations between ANEEL and utilities. In more and more instances, it is becoming increasingly harder for smaller utilities to secure cost-effective residential programs (Jannuzzi 2003).

5. PROMOTING RESIDENTIAL ENERGY EFFICIENCY IN NEW POWER SECTOR CONTEXTS

Ensuring real and sustained investment in residential energy efficiency requires a 'special effort'. This is because the market cannot be relied upon to make this investment, and thus public sector intervention must be considered as an alternative. Policy choices, regulatory instruments, financing mechanisms and role players that support residential energy efficiency are different from those that support energy efficiency investment in industry and commerce.[18] As electricity industry contexts change in response to power sector reforms, so too must the nature of the effort required to promote and sustain residential energy efficiency programs. This section seeks to draw up a broad plan outlining elements fundamental to an effort to ensure residential energy efficiency investment in changed electricity markets. Cornerstones of sustainable investments in residential energy efficiency include: robust policy and legislation, enforceable regulation, funding stability, institutional support and adequate capacity.

5.1 Strengthening policy and legislative frameworks

5.1.1 Taking guidance from national energy policy and legislation

Energy efficiency investments and initiatives can take their lead from national energy policy frameworks and perhaps more critically, from energy efficiency and conservation laws. Where national energy policy or legislation is not in place, government departments and agencies find it more difficult to justify investment in this area, as their mandate generally comes from these broader frameworks. That policy or legislation does exist is important, particularly during times of change. The study indicates that policy which outlines a vision, and legislation that provides guidance on how that vision is to be achieved helps to create stability and certainty within the power sector.

5.1.2 Seeking ownership for energy efficiency

Achieving appropriate policy and legislation in this area is a difficult task, and depends on numerous factors including how issues are placed and accepted on to, the decision-making agenda. International experiences indicates that whether legislation and policy on energy efficiency and conservation is established or not also depends on the strength and influence of lobbying and interest groups that are in existence, and whether or not there are champions for energy efficiency and conservation in government.

5.1.3 Differentiating between energy efficiency and residential energy efficiency

As noted, it is important when developing policy and legislation to differentiate between energy efficiency investment in general, and residential energy efficiency investment, more specifically, when developing policy and legislation. Without clearly distinguishing between energy efficiency services that the market (or private players) will invest in if the environment is acceptable, and residential energy efficiency programs, the latter will fall by the wayside. This is because implementers and agents of energy efficiency investments are far more likely to invest in commercial and industrial

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[18] For example, government facilitation of the development of viable energy service companies (ESCOs) is not likely to result in more residential energy efficiency investment though it is likely to result in the promotion of increased commercial and industrial energy efficiency investment.

energy efficiency activities, and will avoid extending efforts in the residential sector unless specifically obliged – generally though regulation or contract of sale – to do so. Thus, policy and legislation must specifically guide investments into the area of residential energy efficiency.

5.1.4 Linking mainstream legislation with a vision for energy efficiency

Finally, if energy efficiency services and residential energy efficiency programs are to genuinely feature in new electricity contexts, it is imperative that new mainstream electricity legislation that sets out the structure and ownership of generation, transmission and distribution in the new electricity also indicate the future role of and vision for energy efficiency. The study indicates that if the link between mainstream electricity business and energy efficiency investments is not made, then the latter is likely to be sidelined.

5.2 Defining a regulatory framework and enforcing it

5.2.1 Establishing a regulatory authority

Numerous developing countries – including Thailand and Indonesia in the study – have not yet established independent regulatory authorities. While pros and cons to the establishment of regulatory authorities in the area of energy efficiency exist, regulation plays a key role.

5.2.2 Establishing an energy efficiency policy framework

Where the efficient use of energy is regarded as an important aspect of national energy and developmental policy, regulatory authorities should seek, without delay, to establish energy efficiency policy. This policy is important in terms of signalling to role-players in the electricity industry what is expected of them by the regulatory authority. The regulator's policy framework should distinguish between residential energy efficiency policy and general energy efficiency policy for the reasons explained above. The general and residential energy efficiency policy must be established with ongoing collaboration and participation from electricity sector role players and customers.

5.2.3 Integrating energy efficiency policy with mainstream regulation

For reasons explained above, it is useful and generally appropriate that the essence of energy efficiency policy is reflective of mainstream electricity regulation. In other words, energy efficiency policy and instruments used by the electricity regulator should be seen as integrated elements of overall electricity regulation, and not as add-ons to it. As the electricity industry transforms, and new regulatory approaches are adopted, there will be long-lasting discussion and debate on the nature of new regulation. Most common nowadays is a move towards incentive-based regulation. It is appropriate that regulatory instruments utilised to encourage energy efficiency investment are also incentive based. International experience indicates that where different types of regulation are utilised for different areas of regulation, then biases or distortions in investment levels are likely to occur.

5.2.4 Formulating obligations to invest in energy efficiency

An effective way to ensure and even advance investment in residential energy efficiency programs by publicly- or privately-owned distributor companies is to make such investment a condition of a distribution licence agreement. This has been done successfully in various industrialised and developing countries. Regulators – as in Brazil – may require distributors to invest a percentage of their (previous year's) annual revenues on public interest programs (such as those promoting energy

efficiency, renewable energy and public interest R&D, or services for low income customers). This approach typically utilises "spending targets". Or retail suppliers – as is now being required in the United Kingdom – must achieve a certain level of energy savings per annum ("savings targets"). International experience indicates the importance of specifying the source of the energy savings, or the beneficiaries of the investments. Experience also suggests that the specification of program components (such as the type of residential energy efficiency initiative requested) is useful. Specification of this nature helps to prevent distributor utilities from targeting the easiest customer group when seeking to achieve compliance with regulation.

5.2.5 Establishing comprehensive systems of monitoring and enforcement

Regulatory instruments such as those outlined above are useful as long as there is appropriate monitoring, oversight and enforcement of the regulation adopted. Otherwise, they are futile, and should be avoided.

5.3 Establishing a stable financing stream

5.3.1 Dedicating funds for residential energy efficiency

While the power sector is in transition, it is important to ensure that stable source of funds are available for public interest energy-efficiency programs. What does *not* work, as electricity industries are in transition, is for funds for these programs to be allocated by distributor utilities themselves. The electricity regulator, or other public interest body, must play a role in the assignment and approval of these funds.

5.3.2 Establishing a public benefit fund and charge

dicating finances to residential energy efficiency programs is to establish a fund, which collects monies from a surcharge on the electricity tariff. This approach is particularly useful as competition is introduced into areas of the electricity industry and as elements of it are either privatised, or where private sector participation is encouraged. The reason for this is that a dedicated public benefit fund with associated surcharge does not place any energy company at a competitive disadvantage.

Aside from residential energy efficiency initiatives, public benefits funds, internationally, have been utilised for different programs that contribute towards sustainable development within the energy sector. These have successfully included renewable energy investments, and services for low-income electricity customers.

Public benefit funds have been administered in different ways. For example, the Danish Electricity Savings Trust is funded by the levy (0.08 cents/kWh) paid by domestic customers and collected by public utilities. Companies are invited to tender for the design and implementation of the projects. An independent board oversees the operation and selects the projects with the highest reduction of CO2 emissions per unit of program investment. The Danish program runs for 10 years from 1998-2008. In Rhode Island State, United States, utilities collect a levy charge of 0.23 cents/kWh and, subject to regulatory oversight, remain the program administrator of these monies. In New York, utilities collect a levy of 0.1 cent/kWh and transfer the collected funds to NYSERDA, a non-profit entity, to manage and administer the fund. In California, utilities collect a levy of 0.3 cents/kWh for the public benefits programs, which are then managed by the California Public Utility Commission (CPUC) and California Energy Commission (CEC).

How these funds are administered generally depends on the level of credibility that distributor utilities have built up.

5.4 Establishing institutional support structures and capacity

5.4.1 Ensuring support for regulatory requirements

Regulation to guide investments into residential energy efficiency programs and identification of sustainable funding to ensure such investment is critical if residential energy efficiency programs are to be advanced. Nevertheless, if mechanisms are not put in place to institutionally and organisationally support such initiatives, it is unlikely that such efforts will succeed. This is particularly essential where electricity industries are in transition: where role payers are changing and regulatory and policy frameworks are being advanced.

Support structures that must be established include highly responsive assistance to distributor companies in establishing residential energy efficiency programs, training and capacity building facilities (in program design, finance, implementation) for new energy sector players and financiers; and assessments of re-training needs. Indeed, it makes little sense to establish regulations when the skills and ability to comply with the regulations are not in place or do not exist.

5.4.2 Establishing an agency dedicated to support energy efficiency

The question then is: who will provide such support to distributor companies? Oftentimes, regulatory authorities are highly stretched to the hilt with core regulatory duties, and may not even have the capacity and training to provide such support. Staffs of energy departments generally face similar predicaments. A common solution to this is the establishment of an energy agency. The approach adopted by Ghana for example is most insightful with the establishment of the Energy Foundation, the result of effective collaboration between government and the private sector.

5.4.3 Stimulating the formation of consumer and industry associations

In the context of power sector reforms, regulatory authorities could find alliance from consumer and industry associations in developing regulatory frameworks on residential energy efficiency. Consumer groups or associations best understand consumers' needs and could assist in identifying consumer responsive delivery mechanisms. Regulated utilities on the other hand could effectively develop and implement residential energy efficiency programs and meet regulatory requirements in partnership with appliance manufacturers/suppliers, home builders and other energy efficiency service providers. These industry associations have better knowledge on technical aspects as well as markets of residential energy efficiency. In many developing countries, these associations are non-existent and regulatory authorities could stimulate or assist in the formation of these associations by establishing consumer and industry liaison units.

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