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Public policy analysis of energy efficiency and load management in changing electricity businesses

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Abstract

The focus of this paper is (1) the potential effectiveness of the reform of the electricity industry on promoting energy efficiency and load management, and (2) the potential effectiveness of new mechanisms for promoting energy efficiency and load management. Many countries are initiating reforms of their power sectors to stimulate private investment, increase operation and management efficiencies, and lower the cost of power. These countries are unbundling vertically integrated utilities into distinct generation, transmission, distribution and retail supply companies; introducing commercial management principles to government-owned monopolies; and in many cases transferring operation or ownership to private companies. Electric industry restructuring may force regulators and policy makers to re-examine existing mechanisms for promoting load management and energy efficiency. In some cases, electric industry restructuring replaces the long-standing relationship between a single monopoly provider and protected customer franchise with a new set of relationships among retail electricity suppliers and customers who may now be free to choose suppliers. In these types of situations, markets, not government regulators and utility monopolies, are seen as determining future energy production and consumption decisions. However, it is uncertain whether this type of restructuring will overcome important market barriers to energy efficiency that limit markets for energy-efficient products and services from functioning effectively. As a result of these barriers, a large, untapped potential for cost-effective energy-efficiency investments exists. Supporters of public policies argue that energy-efficiency programs are an appropriate government strategy to capture economic efficiencies that the market cannot secure unassisted.

Keywords: Restructuring; Policy analysis; Energy efficiency

1. Introduction

Many countries are initiating reforms of their power sectors to stimulate private investment, increase operation and management efficiencies, and lower the cost of power. These countries are unbundling vertically integrated utilities into distinct generation, transmission, distribution and retail supply companies; introducing commercial management principles to government-owned monopolies; and in many cases transferring operation or ownership to private companies (EPRI, 1998). In addition, independent regulation may be introduced for the first time for certain utility functions. Regulation or re-regulation is likely to continue. It is premature to say whether liberalization will result in higher or lower prices.[1] Early evidence suggests prices may increase for some customers and decrease for others. This is dependent upon the initial electricity sector conditions, the supply/demand balance, age and cost of existing compared to new supply, and the overall efficiency of the system.

Electric industry restructuring may force regulators and policy makers to re-examine existing mechanisms for promoting load management and energy efficiency. In some cases, electric industry restructuring replaces

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[1] Though many identify lower prices as a primary reason for reforming the electricity sector.

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the long-standing relationship between a single monopoly provider and protected customer franchise with a new set of relationships among retail electricity suppliers and customers who may now be free to choose suppliers. In these types of situations, markets, not government regulators and utility monopolies, are seen as determining future energy production and consumption decisions. However, it is uncertain whether this type of restructuring will overcome important market barriers to energy efficiency which limit markets for energy-efficient products and services from functioning effectively. As a result of these barriers, a large, untapped potential for cost-effective energy-efficiency investments exists. Supporters of public policies argue that energy-efficiency programs are an appropriate government strategy to capture economic efficiencies that the market cannot secure unassisted (Eto et al., 1998).

There are a number of questions surrounding how power sector liberalization might affect a country's efforts to improve the efficiency with which end users use electricity:

- How do reforms influence the use of energy efficiency in meeting important public interest goals?
- How have reforms influenced barriers to delivering energy efficiency?
- What mechanisms can stimulate energy-efficiency investments in a liberalized system?
- How can sector liberalization include specific mechanisms to support energy efficiency?
- What kinds of market infrastructure and capabilities are required to deliver energy efficiency in a reformed market?

Because power sector reform is still in its early stages, it is premature to expect concrete answers to these questions. But these are the kinds of questions that were used to guide this study.

One of the critical questions for this study is the role of government in promoting energy efficiency. This issue was examined by asking a broader question: will refinements in power pricing and changes in structural or regulatory roles for the power sector be sufficient to promote the market response to energy efficiency, or will there be a need for other public initiatives that could influence the size of the market response to efficiency?

This paper is a result of work completed within Task VI of the International Energy Agency's Demand-Side Management Program. The title of Task VI was "Mechanisms for Promoting Demand-Side Management in Changing Electricity Businesses." The work of Task VI was supported (through cost and task sharing) by 13 participating countries plus the European Commission. Participants provided one or more Experts who were responsible for contributing to the work of the Task. Reports resulting from this project are found in Crossley et al. (1998, 1999, 2000).

The focus of this paper is (1) the potential effectiveness of the reform of the electricity industry on promoting energy efficiency and load management, and (2) the potential effectiveness of new mechanisms for promoting energy efficiency and load management. This paper is organized in the following way. After first describing the types of reforms the electricity industry is experiencing (commercialization, privatization, unbundling, and the introduction of competition), we present four generic electric industry models for assessing the implications of changing industry structures on energy efficiency and load management activities. We then describe the barriers to the promotion of energy efficiency and load management and discuss the effects (if any) of electric industry reform in removing, or reducing, these barriers. Near the end of the paper, we describe new mechanisms for promoting energy efficiency and load management and assess how these mechanisms address barriers to energy efficiency and load management. We conclude by providing suggestions for groupings of mechanisms, which may work in competitive electricity industry structures.

2. Methodology

Task VI developed a range of practical mechanisms for promoting the implementation of energy efficiency and load management in changing electricity businesses, such as in restructured electricity industries and competitive electricity markets (see Appendix A). The mechanisms analyzed in this paper were developed by the authors during Task VI in consultation with the Task VI Experts. At Expert meetings, the authors discussed with the Experts the different components of the research: e.g., public policy goals and objectives, program and policy barriers, electricity industry models, and mechanisms for promoting load management and energy efficiency. The authors and the Experts identified "holes" where new mechanisms might be needed, developed new mechanism concepts, and held workshops to further refine the most promising of these concepts.

Drafts of the developed mechanisms were presented to Practitioners Workshops held in Australia, France and Japan. The purpose of these workshops was to present preliminary summaries of the mechanisms developed in Task VI for comment by a range of practitioners who might be involved in using the mechanisms. The Practitioners Workshops were designed to provide a "reality check" on the practicality of the developed mechanisms.

The information collected at the Experts meetings and the Practitioners Workshops was organized and analyzed by the authors in the context of the effects of electricity sector liberalization on energy efficiency and

load management activities. The results of that analysis are presented in this paper.

3. Definition of a mechanism

To clarify the following discussion, a distinction is made between mechanisms and programs. *Mechanisms* are initiatives that aim to overcome policy and program barriers that prevent the pursuit of cost-effective energy efficiency and load management activities and the achievement of national energy policy goals. Mechanisms assist the implementation of programs but are targeted at the organizations that develop and implement these programs. In contrast, energy efficiency and load management *programs* are specific actions taken by utilities and others, with the aim of influencing energy-using behavior. Programs are targeted at energy end users, as distinct from mechanisms that are targeted at the developers and implementers of programs. The examples in Table 1 illustrate the distinction between mechanisms and programs. In some cases, it may be difficult to distinguish clearly between a mechanism and a program; nevertheless, the distinction between the two should be kept in mind.

4. Electricity industry structures

Prior to examining energy efficiency/load management mechanisms in detail, it is important to understand the driving forces for change and the major influences shaping the reform of the electricity industry.

4.1. Reform of the electricity industry

In many countries, the electricity industry is starting to change as reforms are made to the present system. The reform process results in one, or typically more, of the following changes in the power sector: commercialization, privatization, unbundling, and the introduction of competition. It is important to recognize that most reforms occur over a period of years, and thus tend to occur in stages across a continuum of policy and structural changes.

4.1.1. Commercialization

Commercialization involves introducing commercial objectives into the management and operation of a state-owned (public) utility. Most countries view commercialization as an intermediate step toward privatization and other reforms. Under commercialization, the utility becomes a business entity subject to the same tax laws, prices and accounting rules as other private sector companies. Commercialization often imposes separate cost accounting for generation, transmission, and distribution services. Cost recovery is improved by changing tariff structures to better reflect the true costs of service to various customer classes, by upgrading revenue collection through more effective metering and billing practices, and by differentiating tariffs for a given customer class according to the time of day at which power is demanded.

4.1.2. Privatization

Privatization means transferring publicly owned power sector assets to private ownership. A country may decide to allow private development of some, or all, of the new power sector infrastructure. Many countries' electricity sectors have traditionally been publicly owned and often dominated by a central planning philosophy. Governments tend to view electricity as a public service. Regulatory institutions are established to protect the public interest and balance social objectives with the financial health of the utility. Under privatization, some countries are opening generation to private investment, further privatizing transmission and distribution, and even restructuring the sector to introduce competition and independent regulation. However, privatization can be undertaken while maintaining the franchise monopoly structure, as was the case in the United States for many decades.

4.1.3. Unbundling

When the electricity sector is "unbundled", vertically integrated utilities are separated into legally and functionally distinct companies providing generation,

Table 1
Examples of mechanisms and programs

Mechanism	Program
A regulator allows a utility to increase its prices to cover the cost of providing cash rebates to customers who purchase energy-efficient appliances	A utility provides cash rebates to customers who purchase energy-efficient appliances
A government establishes an energy-efficiency funding agency	A utility implements energy-efficiency programs that are funded by the energy-efficiency funding agency
A wholesale electricity pool establishes a protocol for demand-side bidding into the pool	A utility offers low-priced interruptible tariffs to customers and then bids demand reductions into the pool

transmission, distribution and retailing services. Implementation of unbundling varies between countries. In some unbundled power sectors, the distribution subsectors are horizontally divided according to geographic franchises. Some countries have separated the physical aspect of distributing electricity to final customers from retail services (marketing, bill collection, customer information, energy efficiency and load management, etc.) while others have kept them within the same entity. Unbundling can be combined with privatization, and/or can be undertaken for a government-owned utility without moving to privatization.

4.1.4. Competition

Although the "wires" portion of the electricity sector (transmission and distribution services) is generally considered a natural monopoly, competition may be introduced into the system for selling power to the grid (wholesale competition) and providing electricity to end use customers (retail competition).

In one form of wholesale competition, independent power producers (IPPs) bid for long-term contracts with power purchasers. Although there are almost as many different styles of bidding as there have been solicitations, in most cases, the monopoly utility issues a solicitation seeking bids from project sponsors for capacity and energy, with the award going to the lower cost supplier. The selection emphasizes lowest fixed costs and the winning bidder receives payment sufficient to cover levelized capital and operating costs.

In another form of wholesale competition, some countries are creating spot or short-term markets for wholesale power as an alternative to long-term contracts. Under this model, multiple generators bid (typically over half-hourly intervals) to be dispatched by a transmission company or independent operator of the transmission system (ISO). The wholesale purchaser relies on competition to ensure that bids approximate marginal costs.

In addition to wholesale competition, a few states and countries are experimenting with retail competition for some or all customer classes. Typically, retail competition is phased in over time to aid in the transition to competitive markets where it is believed it would not be possible to change the system for all customers at one time.

Retail competition can be introduced through different mechanisms. In one, multiple power generators have direct access to the transmission and distribution networks (for a charge), allowing them to compete to supply final customers regardless of their location and who owns the wires. In another model, independent retail service providers (which do not own any generation facilities) buy power from generators, contract for the use of transmission and distribution facilities, and sell the power to end-use customers. Where distribution and retail functions remain within the same entity, the service provider buys from wholesale power producers and contracts only for transmission access.

Competition can be introduced with or without unbundling and with or without changing the ownership structure of the utility sector.[2] It is important to point out that competition does not necessarily mean deregulation. In fact, while the type of regulation may change, it appears that the amount of formal regulation may increase rather than decrease with the introduction of a competitive market (EPRI, 1998).

5. Electric industry models

For ease of analysis, this paper uses four generic electric industry models. Using a limited set of generic models enables the development of general and consistent comparisons and conclusions.

The four models are:

Model 1—vertically integrated, regulated monopoly.

Model 2—unbundled monopoly.

Model 3—unbundled, limited competition.

Model 4—unbundled, full competition.

It is important to note that these models represent a continuum of possibilities. It is likely that few countries will ever experience any of the structures exactly as described here, particularly Model 4, but rather will develop variations of these structures. Moreover, evolution to new structures may be neither sequential nor flow in only one direction. It is possible, for example, that a country which moves into Model 3 may later revert back to Model 2. However, the models act as useful tools for assessing the effects of changing industry structures on energy efficiency and load management activities.

Finally, the particular social and cultural context of the region within which the electricity sector reforms are taking place will be a critical factor in designing the actual structure of the electricity industry, and the ultimate roles of government, the private sector and other stakeholders (Figs. 1–4).[3]

[2] Examples: Norway did *not* privatize when it introduced competition into its electricity sector. The Public Utilities Regulatory Policy Act (PURPA) introduced wholesale competition into an already privatized electricity sector in the United States without unbundling. The UK unbundled, privatized and introduced competition almost simultaneously. Australia unbundled and introduced competition simultaneously but only one State (Victoria) privatized its electricity industry while in the other States the industry remains government owned.

[3] Some analysts have suggested that market failures, mergers and acquisitions could cause Model 4 to collapse into an unregulated monopoly or oligopoly structure. Though this is one possible outcome, it is the authors' opinion that such a model would have such negative implications for the public interest as a whole it would not be stable.

6. Implications of electric industry reform for promoting energy efficiency and load management

Electricity sector reforms affect energy efficiency and load management incentives among various market actors through multiple pathways. These include:

- changes in the role of energy efficiency/load management in meeting public interest goals and objectives and/or the addition of new goals to a country or state's list of priorities for the electricity sector;
- electricity sector reforms that affect barriers to energy efficiency—eliminating barriers, creating new barriers and/or changing the relative importance of barriers; and
- structural changes that affect the funding, implementing organization, roles of key players, basis for evaluation or general focus, and direction of mechanisms.

This section focuses on changes in the role and priority given to energy efficiency under generic models of electricity industry structures. It should be noted that because of social and cultural differences, each country's electricity industry structure is likely to be different from the generic models. Because the interaction between various reforms is by nature very complex, it is not possible to predict exactly what will happen. The effects discussed below are a "best guess" of how individual reforms may effect energy efficiency and load management. The actual effects of restructuring on the role of energy efficiency and load management will be a result of some combination of the impacts listed below.

6.1. Implications of commercialization [Models 1–4]

Relative to a "no-reform" base case, commercializing a public utility improves the utility's incentives to implement energy-efficiency measures up to the customer's meter. Because cost accounting is improved and government fiscal transfers to cover deficits are reduced, utilities pay greater attention to cost recovery (minimizing costs and increasing revenues). However, there is not any incentive for the utility to go beyond the meter (e.g., implement end-user energy-efficiency programs). Integrated resource planning (IRP) tends to encourage some energy efficiency beyond the meter in vertically integrated or independently regulated utilities if cost recovery is decoupled from profits. Otherwise a kWh saved is viewed as lost revenue. Load management, however, is an exception since it does not necessarily reduce consumption but rather focuses on shifting the time of usage. Customers may find their electricity costs rising if commercialization leads to the removal of tariff subsidies. This situation can make energy-efficiency programs more attractive to the end user.

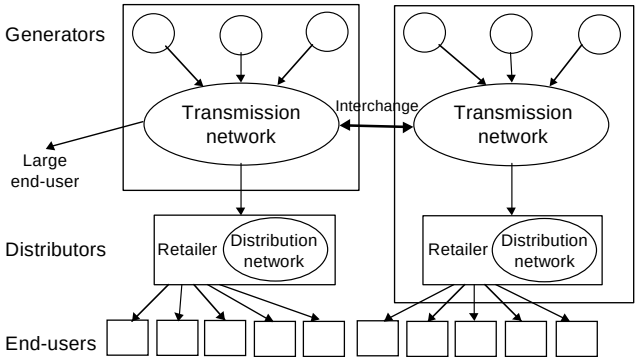

Fig. 1. Vertically integrated, regulated monopoly. The electricity utility controls and undertakes all business functions: generation, transmission, distribution, wholesale and retail energy supply and services. There is no competition at any level. Utilities have the obligation to serve customers within their own region. Government regulates the utility to prevent monopoly abuse. All customers in the region must buy energy from that utility.

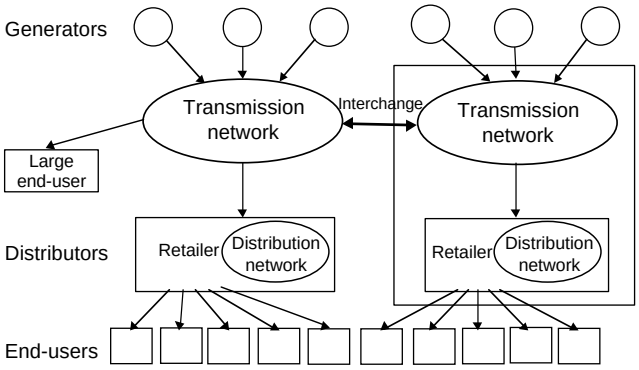

Fig. 2. Unbundled monopoly. Generation is separated from all other functions: several generation companies serve distribution companies and, possibly, major industries. Generators and distributors maintain monopoly status: the generation company has the exclusive right to supply customers within its franchise area, and the distribution companies have a monopoly to serve customers in their respective areas. Transmission is provided by generators, distributors, or a separate entity or entities. Government regulates the monopolies to prevent monopoly abuse. Competition may occur at the generation level, but there is no competition at the retail level. All customers in a region must buy energy from the retail utility, which holds the franchise to their geographical area.

A commercialized utility has an incentive to reduce sales (improve energy efficiency) whenever the marginal costs of supplying a kWh are greater than the revenues received. Energy efficiency may also offer opportunities for improving the utility's financial balance sheet. On the other hand these incentives may be negated by simultaneous unbundling.

To the extent that subsidies are reduced and revenue collection improved, customers have stronger incentives to adopt energy-efficiency measures because of higher bill savings from reducing consumption. This result

would create new market opportunities for firms providing energy-efficiency products and services. Government-sponsored energy-efficiency programs and load management might be implemented to dilute the burden of tariff increases.

In Models 1 and 2 where the utility is a "cooperative" or a company overseen by local government, consumers may have a strong influence on the utility's activities thereby exerting pressure to encourage greater use of energy efficiency and load management mechanisms.

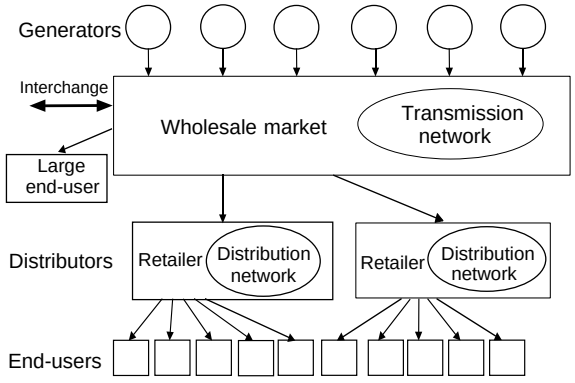

Fig. 3. Unbundled, limited competition. Generation is separated from natural monopoly functions: many generation companies serve distribution companies and, possibly, major industries through a competitive wholesale market. Generators have open access to the transmission and distribution grid. Transmission is provided by generators, distribution companies, or a separate entity or entities. Government regulates the transmission and distribution system to prevent monopoly abuse. There is competition at the wholesale level: primarily among generation companies, and there may be some competition through the use of self-generation by large customers. But with this one exception, there is no competition at the retail level.

6.2. Implications of privatization [Models 1–4]

A private utility requires full cost recovery and a return on investment in order to be profitable. The need for cost recovery strengthens the price signal received by customers to use electricity efficiently. The profit motive could also make the utility more interested in reducing peak demand to the extent that the cost of doing so is less than the cost of adding new capacity and/or running high cost peaking plants. At the same time, when ownership is transferred from the public sector to the private sector, the discount rate used in making investment decisions is likely to increase. As a result, energy-efficiency measures will yield a lower rate of return than they would under public ownership because costs are incurred in the near term, while benefits accrue over a period of years. The set of end-use energy-efficiency measures attractive to the utility becomes smaller.

Similarly, transferring ownership from the public to the private sector may be accompanied by decreased attention by the utility to achieving social goals (e.g., resource conservation, universal service, and environmental improvement), unless these goals coincide with the utility's profit incentive. Independent regulation of the electric industry is required when the sector is privatized to ensure these public interest goals are achieved. However, under common forms of economic regulation, electric utility shareholders receive economic returns for capital investments in new equipment while they receive little or no return for expenses (such as increased administrative costs and services that are "expensed"). Depending upon the structure of the

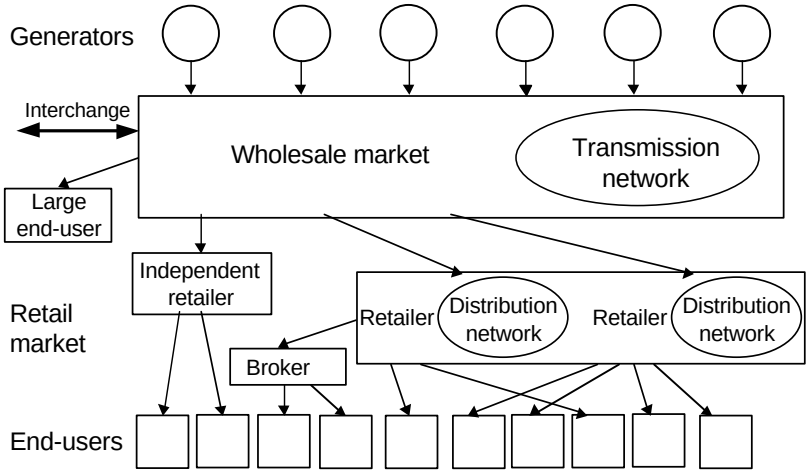

Fig. 4. Unbundled, full competition. Generation, transmission and distribution functions are separated. There is competition among generators (generators have open access to the transmission and distribution grids). There is complete competition at the wholesale and retail level. At the retail level, two new organizations supply electricity to end-use customers. Independent retailers (who have no interest in the distribution "wires" business) purchase electricity in bulk from the wholesale market and only sell to end users. Brokers provide a similar service without ever owning the electricity. There is some oversight (regulation) of the wholesale and retail markets to ensure a more efficiently operating market and to prevent abuse of market power. In addition, government regulates (or maintains ownership of) the monopoly transmission and distribution systems.

economic regulation, it can discourage a utility from promoting some types of customer energy-efficiency activities unless conscious efforts are made to adjust regulatory policy consistent with public interest goals.

To the extent that prices increase and revenue collection improves, customers have stronger incentives to adopt energy-efficiency measures because of higher bill savings from reducing consumption. This result creates new market opportunities for firms providing energy-efficiency products and services. However, because effective energy-efficiency measures reduce the amount of electricity consumed and thus the amount of revenue flowing to the utility, regulators often institute rate making strategies that decouple revenues from rate-of-return calculations. Government-sponsored energy-efficiency programs and load management may also be implemented to dilute the burden of tariff increases. There may remain some scope for regulators to require distribution utilities to assess energy efficiency and load management as an alternative to grid reinforcement.

6.3. Implications of unbundling [Models 2–4]

When a commercialized or private utility is unbundled into separate entities, the actual costs of providing generation, transmission, distribution, and retail services may not change, but each cost is assessed separately. The effect of this is to greatly reduce the incentives for the individual businesses to carry out any energy efficiency or load management. For example, the "wires" businesses (transmission and distribution) may be able to reduce costs by implementing energy efficiency and/or load management programs to reduce network constraints. However, the "wires" businesses may not have sufficient relationship with the retail customers to be able to implement customer programs (NGMC, 1994). Neither the generation business nor the retail business has any incentive to implement energy-efficiency programs since these will reduce sales of electricity. While load management programs may not reduce sales, there is no incentive for generators or retailers to implement load management since the benefits will accrue entirely to the wires business. In contrast, in a vertically integrated utility, energy efficiency and load management programs can be justified on the basis that the benefits accrue within the single business.

In a vertically integrated business where the functions have been separated into individual entities, the central management of the integrated business, having an overall view of the unbundled separate entities, could overcome this barrier by establishing a subsidiary to promote energy efficiency and load management. The role of the central management is then to resolve conflicts between the separate entities.

One key example is the effect of unbundling on the treatment of demand-related costs that may encourage or discourage end-user initiated energy efficiency. In general, the more closely that retail electric bills reflect the actual cost components of providing service, the more accurate the signals that customers receive to undertake energy-efficiency measures. However, if rates are not unbundled and demand-related costs are rolled into fixed charges or energy charges, the customers' energy-efficiency incentives are weakened (particularly if fixed charges constitute a larger share of total electric bills).[4] Under this scenario, however, the retail supplier and combined distribution and retail supply companies may have an incentive to reduce loads in locations where the marginal costs of service are high due to network constraints, inefficient use of distribution assets, or other reasons.

In a competitive energy market, conventional IRP is not practicable, but unregulated energy suppliers may wish to use similar planning techniques to assess future investment options and operations. This may be particularly true where demand side bidding arrangements allow load management option to contribute to matching supply and demand.

To the extent that unbundling shifts customers' bills toward fixed charges, opportunities for energy service companies (ESCOs) decrease. But if unbundling causes customers' bills to reflect separate energy and demand charges, market opportunities for ESCOs may be enhanced.

6.4. Implications of competition [Models 3,4]

The net effect of introducing wholesale competition is likely to be negative on end-user incentives to adopt energy-efficiency measures. Wholesale competition creates wholesale price signals based on short-term costs. If only short-term generation costs are passed through to end users, end users will have a weaker incentive to invest in energy-efficiency measures: short-term energy costs are expected to be lower than past costs of generation energy and capacity. Moreover, short-term energy costs are expected to be more variable, making savings from energy efficiency more uncertain.

Introducing retail competition to a fully unbundled power sector generally increases the retail supplier's incentive to maximize kWh sales as well as to provide the lowest rates to retain and attract customers. Under this scenario, competitive electricity suppliers have little incentive to engage in any energy efficiency and load management activities that raise rates to non-captive customers. However, when price/kWh among competitors is close, retailers may find it profitable to retain or

[4] "Energy charges" are volumetric (per kWh). "Demand charges" are based on a customer's peak or highest usage (per kilowatt).

attract customers by offering a package of services as a means of differentiating themselves from competing suppliers, even though energy efficiency and load management services may reduce sales. At this time, there is insufficient experience with stable (i.e., non-transitional) competitive markets to know whether energy efficiency and load management programs will be a significant marketing tool.

From the end-users' perspective, overall prices may decline and therefore make investments in energy efficiency and load management less attractive economically. Though individual energy savings may be small, in the aggregate there may still be substantial benefits to society at large. However, if energy-efficiency activities are divided among many small companies, a single company may not have a large enough clientele to economically justify the transactional costs involved in offering these services.

Additional energy suppliers may offer confusing claims regarding rates and special services they are marketing, further reducing interest in making energy-efficiency improvements. On the other hand, retail competition may stimulate the emergence of ESCOs that market both electricity supply and demand management to serve non-captive customers who want to optimize their combination of end-use services and total electricity costs.

6.5. Summary of incentives and disincentives for energy efficiency and load management

The incentives for energy efficiency and load management under commercialization or privatization changes can generally be maintained or strengthened through thoughtful regulatory and government support. The introduction of unbundling or competition substantially complicates the situation. However, even problems caused by unbundling are amenable to regulatory solutions. The most complex and difficult area is the introduction of competition because of the related pressures by many stakeholders for reduced governmental intervention. Where privatization, unbundling and competition are introduced simultaneously, it may be difficult for government to analyze the complex interactions and to anticipate the most likely outcomes.

Table 2 summarizes the incentives and disincentives for energy efficiency and load management under the four major electricity sector reforms. The table highlights some of the major features though there are likely to be many exceptions for a particular country. Also, there can be interactions when more than one reform is undertaken simultaneously, either magnifying certain effects or counteracting others. Finally, for some countries experiencing several reforms, it is unclear whether the impact of expected lower costs resulting from competition will be greater or smaller than the impact of increased electricity costs as price subsidies are removed and revenue collection is improved.

7. Barriers and energy efficiency and load management

This section analyzes the effects of reforms on the barriers to energy efficiency and load management, and discusses the general policy implications of changing barriers for energy-efficiency activities.

7.1. Barriers to promoting energy efficiency and load management

The potential benefits from energy-efficiency measures may not be fully realized because of various barriers. Energy efficiency and load management mechanisms are designed both to assist in the achievement of public interest goals and also to overcome barriers to those goals. The analysis of mechanisms must include then an analysis of barriers at two levels: (1) the policy level—barriers to achieving public interest goals through energy efficiency and load management (reflecting a societal perspective); and (2) the program level—barriers to the implementation of certain energy efficiency and load management programs (primarily reflecting an end-user perspective).

The policy barriers can influence program barriers, and mechanisms that address policy barriers may weaken some of the program barriers. In contrast, program barriers have relatively little influence on policy barriers, and mechanisms that address program barriers will likely have little impact on policy barriers. Unfortunately, there will be cases when it is unclear whether a barrier is a policy barrier or program barrier. The barriers are listed in Table 3, and described in detail in Appendix B.

Barriers are defined more broadly for the purposes of this paper than might be used by other analysts (e.g., Crossley, 1983). For this purpose, a barrier is any factor that limits the promotion of energy efficiency in society. Moreover, the definition of a barrier used here includes barriers to implementation of either policy goals or programs.

Many discussions of barriers refer to the role of "energy providers". This paper defines an energy provider as an organization that sells gas, electricity and other fuels and/or provides energy services (e.g., energy performance contracting, energy audits).

7.2. Effects of electric industry reform on barriers

This section describes how barriers to energy efficiency and load management are affected by electricity sector reforms that are included in the generic industry models. It is important to remember that for

Table 2
Power sector reforms and implications for energy efficiency and load management

Electricity sector reform	Incentives for energy efficiency and load management	Disincentives to energy efficiency and load management
Commercialization	Increased electricity costs, as tariff subsidies are removed and revenue collection improved	A kWh saved represents lost revenue; goal may be to maximize kWh sales, or to maximize profits, or some combination of the two
	Regulatory support for energy efficiency and load management that may include integrated resource planning	Key market barriers remain
Privatization	Regulatory support for energy efficiency and load management that may include integrated resource planning	A kWh saved represents lost revenue; goal may be to maximize kWh sales, or to maximize profits, or some combination of the two Key market barriers remain Higher discount rates
Unbundling	Regulatory support for energy efficiency and load management that may include integrated resource planning Separate energy and demand charges	A kWh saved represents lost revenue; goal may be to maximize kWh sales, or to maximize profits, or some combination of the two Key market barriers remain No IRP
Competition	Regulatory support for energy efficiency and load management that may include integrated resource planning Energy efficiency and load management as a marketing tool ESCO industry development Domestic consumers' costs may remain high	A kWh saved represents lost revenue; goal may be to maximize kWh sales, or to maximize profits, or some combination of the two Key market barriers remain Lower and more variable short-term costs (especially for large customers)

simplicity the characteristics are being discussed as though they occur separately from each other and are based on a "best guess" of how barriers are affected by electricity sector reforms. In the real world, actual electricity industry structures and the effects of reforms are much more complex than indicated here.

Many of the program barriers are inherent in all electricity industry structures. Some are more relevant for a particular structure than others, but all are found to some degree in all of the models. Many of the barriers like "excess capacity" and "import tariffs" have been present since before competition was an issue. For example, "utility price setting process" is most associated with the traditional electricity industry structures (Models 1–3). Some like "customer instability", "inadequate competition", and "lack of an adequate paradigm" are quite new and are related primarily to Model 4 in which the critical change is that all users have a choice of supplier. And some like "lack of awareness" and "imperfect information" are exacerbated by competition.

General policy barrier: An overarching policy barrier that affects all electricity industry structures but particularly Model 4 is "the lack of regulatory or legislative attention and interest in energy-efficiency issues". Lack of government interest is a major problem in any structure, but is most important in Model 4. In this model, the role of the utility changes and if programs are to happen, government (or an agent of government) has to take on some of the roles that may have been formerly performed by the monopoly utility.

Political will is therefore critical. Although energy efficiency and load management are invariably seen as good ideas to be promoted, they may not always be sufficiently important in the political agenda for action to be a priority. The barrier is not simply convincing political leaders of the merits of the required policies. Political priorities are set under pressures from a range of other actors, including business and wider society.

The role of energy efficiency in the restructuring process may therefore be determined by its prominence in wider social debates. Relatively small reductions in costs for energy consumers have a low visibility and therefore may not provide the basis for political prioritization. The prospects for energy efficiency and/or load management are better if restructuring occurs in a framework where there are other pressures for policy action. Traditionally these have arisen from geopolitical concerns about energy security, but increasingly, in many countries, climate change and the resulting Kyoto targets may also be critical. The following discussion illuminates some of the ways in which policy barriers are affected by electricity sector liberalization.

7.2.1. Effects of commercialization [Models 1–4]

Program barriers are a greater concern to a recently commercialized utility where improved cost accounting

Table 3
Barriers to the promotion of energy efficiency (EE) and load management

Barrier type	Barriers	
General barrier	Lack of government attention to energy efficiency and load management	
Policy barriers	1.	Excess capacity
	2.	Short-term perspective
	3.	Split (misplaced) incentives to energy providers
	4.	Pricing
		(a) Non-transparent pricing
		(b) Non-cost-reflective pricing
	5.	Import tariffs and duties
	6.	Lack of awareness by policy makers (of EE opportunities)
	7.	Imperfect information (restricted access to customer information)
	8.	Inadequate competition (market power problems)
	9.	Customer instability (problem for energy providers)
	10.	Lack of adequate paradigm (for evaluating the value of EE)
	11.	Separation of energy policy process (from environment & social policy)
	12.	Little market transformation experience (by end-users or others)
	13.	Lack of available expertise (in EE during transition periods)
	14.	Utility price setting process
		(a) Cost recovery barriers
		(b) Decoupling of profits from sales
Program barriers	1.	Low cost of energy to end users
	2.	Lack of information to end users
		(a) Lack of energy consumption data
		(b) Lack of energy provider information
	3.	Information/search costs (to end users & other actors)
	4.	End users do not invest in EE because of habits or custom
	5.	Lack of end-user and other market actor's experience impacts:
		(a) Lack of experience with proven cost-effective measures
		(b) Performance uncertainties (may perceive EE to be unreliable)
		(c) Reluctance to adopt new technologies
		(d) Fear of disruption in routine
	6.	Financial barriers
		(a) Limited investment capital available for EE
		(b) High initial cost
	7.	Product/service unavailability
	8.	Inseparability of product features
	9.	Organizational (institutional) barriers
		(a) Low priority of energy efficiency
		(b) Views of upper management
		(c) Multiple decision makers
	10.	Split (misplaced) incentives

and greater attention is focused on minimizing costs and increasing revenues. To the extent that this more detailed cost accounting is new to employees of recently commercialized utilities, they may lack much of the cost, consumption and other types of information and expertise necessary to craft successful energy efficiency and load management programs.

7.2.2. Effects of privatization [Models 1–4]

When privatization is introduced, program barriers, as a group, tend to dominate. Those program barriers that tend to increase in importance with privatization include: "organizational barriers" (because of increased focus on profit and sales volumes); "low priority of energy"; and "views of upper management". The privatized companies prioritize financial objectives over public service obligations, so that social and environmental goals are only relevant to the extent they are enforced by regulatory action and/or consumer pressure. Regulation by an independent regulatory body is often introduced along with privatization. Any barriers to energy efficiency and load management created in the structures of price regulation are particularly important. The role of government in setting social, environmental and energy-efficiency objectives for regulation and the participation by consumer representatives and environmental organizations in the regulatory process (where that is allowed) becomes increasingly important.

7.2.3. Effects of unbundling [Models 2–4]

The policy barriers that are magnified with utility unbundling are most commonly: "split incentives" and

"multiple decision makers". Because separate companies are involved in the generation and retail electricity business (split incentives), organizational barriers such as "low priority of energy efficiency" and "lack of interest by upper management" will tend to reduce energy efficiency's perceived value. On the other hand, where there is over capacity in an unbundled market, it is possible a specialist retailer (ESCO) will have as much or more interest in supplying energy efficiency and load management than a generator, especially where there is upstream competition. The extent to which specialist retailers might be interested in becoming ESCOs is an open question and probably depends on incentives and the regulatory regime.

Retail services (such as metering and meter reading, billing, and other types of customer services) may also be separated from the natural monopoly services such as the "wires" business (transmission/distribution services). In many regulatory regimes, the level of profit allowed on electricity transmission and distribution is linked to the amount of electricity that flows through the wires. This gives wires businesses which are also retailers an incentive not to undertake energy efficiency and load management. In this case, unbundling retailing from the wires business removes a regulatory barrier to energy efficiency.

It should also be noted that profit (revenue minus cost) can also increase through cost reduction. Costs can be reduced by electricity businesses through implementing energy efficiency and load management programs, especially energy efficiency and load management projects that enable wires businesses to reduce peak loads by avoiding or postponing network enhancement.

7.2.4. *Effects of competition [Models 3,4]*

Competition increases the effects of such economically related barriers as: "excess capacity", "low cost of energy", "limited investment capital", "high initial cost", "short-term perspective", "customer instability", and "pricing barriers". Any activities that increase risk (or are perceived as increasing risk) or negatively affect profits are likely to be rejected.

The introduction of competition tends to lead to cost-reflective pricing, thereby removing artificially low marginal prices, which are a barrier. Prices related to peak loads, in particular, may increase in many industries, making peak-shaving load management more attractive. Moreover, competition may allow the entry of new actors other than traditional utilities. These may provide new opportunities to reduce barriers. For example there may be a role for specialist energy service companies (ESCOs) to sell packages including both electricity units and energy efficiency and load management, thereby reducing barriers related to customer expertise, information, and finance. In addition, non-profit organizations, such as municipalities, social housing providers, and environmental organizations, may wish to enter the market to provide energy-efficiency services for non-commercial reasons, thereby addressing barriers such as "lack of an adequate paradigm" and "short-term perspectives".

On the negative side, however, competition may introduce entirely new barriers such as the complexity of dealing with competing retailers and deliberate misinformation (worse information barriers). The introduction of competition absorbs very large amounts of time for government, regulators, and energy companies, limiting the resources available for energy efficiency. Competition increases some key barriers, but no form of restructuring of the electricity supply industry removes the main program barriers—the market imperfections on the customer side of the meter.

7.3. *Summary of the effects of industry reform on barriers to energy efficiency and load management*

In general, no form of restructuring will remove all (or even most) of the barriers to energy efficiency and load management, although it may change them. While electricity industry reforms may help to reduce some barriers to energy efficiency and load management, they also leave untouched other barriers to implementation of end-use improvements (such as inadequate information and capital, and environmental externalities). They may also increase the magnitude of some barriers such as split-incentives. To the extent that the presence of these barriers justified government intervention in the pre-reform situation, they still do.

Policy barriers that are related to market structure may change significantly with restructuring (especially unbundling and competition). In Model 4, the utility no longer plays all of the roles it has assumed in traditional structures, and so some barriers become more significant. Program barriers will remain and some may be increased by commercialization and competition, regardless of whom is responsible for the programs. In all cases, the legal, policy and regulatory framework is critical as this affects the incentives to energy suppliers. To the extent that privatization is introduced into any of electricity industry structure, this will magnify the importance of many of the program barriers. The combination of variables (commercialization, privatization, unbundling, and competition) within any particular structure results in a complex interaction so that there may be barriers and incentives unique to that particular situation. The case for intervention remains for any structure if energy efficiency is an important policy goal or tool, but the nature of the intervention (i.e., the appropriate mechanisms) will change.

Table 4 summarizes the barriers that tend to increase in importance under certain industry reforms. There can be interactions when more than one reform is

Table 4
Summary of barriers that tend to increase in importance under certain industry reforms

Electricity industry reform	Barriers
Commercialization	All program barriers (1–10)
Privatization	All program barriers but especially 9. Organizational barriers but especially (a) Low priority of EE (b) Views of upper management Policy Barrier: 14. Utility ratemaking process
Unbundling	Program barrier: 9. Organizational (a) Low priority of EE (b) Views of upper management (c) Multiple decision makers 10. Split incentives
Competition	Lack of government attention to EE & LM Most policy barriers but especially 1. Excess capacity 2. Short-term perspective 3. Split incentives to energy providers 7. Imperfect information 8. Imperfect competition 9. Customer instability Program barriers 1. Low-cost of energy to end users 2 & 3. Lack and search costs of information 5. Lack of available expertise & experience 6. Financial barriers

undertaken simultaneously, either magnifying certain barriers or counteracting others. This table clearly indicates that barriers to the promotion of energy efficiency and load management will remain in all electricity industry structures: i.e., market mechanisms by themselves will not be able to remove these barriers.

8. Mechanisms for promoting energy efficiency and load management

8.1. Identification of mechanisms

In identifying concepts and ideas for mechanisms to be developed, the authors worked with the Task VI Experts in reviewing existing mechanisms which were already implemented in the 13 countries which participated in Task VI. The authors and the Experts then developed a set of generic mechanism types into which all the existing mechanisms could be categorized. Each of these generic types was then examined to determine which types were suitable for further development. Factors taken into account in making this determination included:

- whether the mechanism addressed more than one barrier to energy efficiency and load management;
- whether the mechanism would be effective in restructured electricity industries;
- whether the mechanism would require modification to become effective in restructured electricity industries;
- whether the mechanism had already been extensively developed and implemented.

During this process, the Task VI Experts decided not to develop the following mechanisms because there is already a great deal of information about them:

- subsidies for energy efficiency and load management provided by governments or electricity businesses;
- codes and standards (e.g., building codes and minimum energy performance standards);
- licenses, permits and trading schemes for greenhouse gas emissions.

The authors and the Task VI Experts also undertook a brainstorming workshop to identify any "new" mechanisms that could be developed to promote energy efficiency and load management in restructured electricity industries.

Following the completion of both the identification process and a subsequent review process, the Experts identified 25 mechanisms for further development. These mechanisms are listed in Table 5 and are described in Appendix A.

8.2. Development of mechanisms

Mechanisms were developed by preparing a comprehensive mechanism description for each mechanism. Mechanism descriptions for all 25 developed mechanisms are found in Crossley et al. (2000).

Each mechanism description includes:

- an outline of the mechanism;
- identification of the barriers to energy efficiency and load management addressed by the mechanism;
- effects of electricity industry restructuring on the mechanism;
- potential outcomes from the mechanism;
- previous experience with related mechanisms;
- driving forces behind mechanism development;
- important conditions for effective implementation of the mechanism;
- funding requirements for the mechanism;
- effects of the mechanism on electricity businesses;
- the institutional and policy framework for the mechanism;
- identified problems with the mechanism;
- public policy implications of the mechanism;
- evaluation of the effectiveness of the mechanism;
- sources of information about the mechanism.

8.3. Classification of mechanisms

The Task VI Experts classified the developed mechanisms into a small number of categories. Mechanism for promoting energy efficiency and load management can be classified in a variety of ways, depending on the "dimension" chosen. A *multiple dimension* classification involves several issues (e.g., actors, type of market and government structure) being analyzed simultaneously in the classification system. In contrast, a *one-dimensional* classification uses one issue as a starting point for classifying mechanisms.

The Task VI Experts initially experimented with several multiple dimension classification systems for classifying the developed mechanisms. One of these multiple dimension systems was used in a previous paper (Crossley et al., 1999). However, for simplicity, it was finally decided to employ a single dimension classification system which uses the method of operation of the mechanism (i.e. what the mechanism does) to classify the developed mechanisms into four categories:

- Control mechanisms—direct energy businesses to change behavior.
- Funding mechanisms—provide funding for other mechanisms.
- Support mechanisms—provide support for behavioral changes by end users and energy businesses.
- Market mechanisms—use market forces to encourage behavioral changes by end users and electricity businesses.

8.4. Evaluation of mechanisms

Evaluation criteria were developed to assess the likely effectiveness of each mechanism in promoting energy efficiency and load management. In developing the evaluation criteria, it was not possible to use a simple quantitative indicator, such as the amount of energy saved through implementing the mechanism, to assess the actual effectiveness of each mechanism. The levels of such quantitative indicators vary depending on the context within which each mechanism is applied and exactly how it is implemented. Further, there is no quantitative date for "new" mechanisms and it proved difficult to obtain quantitative data for mechanisms that have been implemented already. Therefore, it was decided to use the evaluation criteria in Table 6 to

Table 5
Mechanisms

Control mechanisms	
C1	Mandatory sourcing of energy efficiency
C2	Energy-efficiency license conditions for electricity businesses
C3	Integrated resource planning
C4	energy efficiency and load management as alternatives to network expansion
C5	Revenue regulation
Funding mechanisms	
F1	Public benefits charge for energy efficiency
F2	Financing of energy efficiency by electricity businesses
Support mechanisms	
S1	Sustainable energy training schemes for practitioners
S2	Energy centers
S3	Creating entrepreneurial energy organizations
S4	Developing the ESCO industry
S5	Promotion of energy efficiency by industry associations
S6	Aggregating electricity purchasers to achieve energy efficiency
S7	Voluntary agreements for energy efficiency
Market mechanisms	
M1	Taxes on energy
M2	Tax exemptions and incentives for energy efficiency
M3	Providing consumption information on customers' electricity bills
M4	Communicating pricing and other information for energy efficiency
M5	Energy performance labeling
M6	Developing an energy-efficiency brand
M7	Cooperative procurement of energy-efficient appliances and equipment
M8	Energy performance contracting
M9	Competitive sourcing of energy services
M10	Competitive sourcing of demand-side resources
M11	Demand-side bidding in competitive markets

characterize the likely effectiveness of each of the mechanisms.

8.5. Policy analysis of mechanisms

8.5.1. Effects of electricity industry restructuring

Table 7 summarizes the usefulness and/or relevance of each of the 25 mechanisms developed in Task VI under three aspects of electricity industry restructuring:

- unbundling;
- commercialization/privatization; and
- competition.

It is interesting to note that the relative importance of two mechanisms does not change in response to any of the aspects of electricity industry restructuring. These mechanisms are: *M1 taxes on energy*; and *M2 tax exemptions and incentives for energy efficiency*.

Unbundling: When unbundling occurs, the relative importance of many of the mechanisms remains unchanged. Two mechanisms become less useful or relevant: *C3 IRP*; and *S6 Aggregating electricity purchases to achieve energy efficiency*. Eleven mechanism become more useful or relevant: *C1 Mandated sourcing of energy efficiency*; *C4* Energy efficiency and load management *as alternatives to network expansion*; *C5 Revenue regulation*; *S2 Energy centers*; *S3 Creating entrepreneurial energy organizations; S4 Developing the ESCO industry; S5 Promotion of energy efficiency by industry associations; S7 Voluntary agreements for energy efficiency; M4 Communicating pricing and other information for energy efficiency; M5 Energy performance labeling; and M6 Developing an energy-efficiency brand*. The mechanism *F1 public benefits charge for energy efficiency* is the most useful and relevant.

Commercialization/Privatization: When commercialization/privatization occurs, only one mechanisms becomes less useful or relevant: *C3 IRP*. Eighteen mechanisms become more useful or relevant: *C1 Mandatory sourcing of energy efficiency; C2 Energy-efficiency license conditions for electricity businesses; C4 Energy efficiency and load management as alternatives to network expansion; F2 Financing of energy efficiency by electricity businesses; S2 Energy centers; S3 Creating entrepreneurial energy organizations; S4 Developing the ESCO industry; S5 Promotion of energy efficiency by industry associations; S6 Aggregating electricity purchases to achieve energy efficiency; S7 Voluntary agreements for energy efficiency; M3 Providing consumption information on customers' electricity bills; M4 Communicating pricing and other information for energy efficiency; M5 Energy performance labeling; M6 Developing an energy-efficiency brand; M7 Cooperative procurement of energy-efficient appliances and equipment; M8 Energy performance contracting; M9 Competitive sourcing of energy services; M10 Competitive sourcing of demand-side resources; and M11 Demand-side bidding in competitive markets*. As with

Table 6
Evaluation criteria

1. Previously demonstrated effectiveness
Has the mechanism already demonstrated energy efficiency and load management outcomes in previous applications?

2. Ability to address recognized barriers to energy efficiency and load management
What barriers does the mechanism overcome?
Will it overcome barriers associated with market-driven situations?

3. Effects of electricity industry restructuring on the mechanism
What are the effects on this mechanism of the three aspects of electricity industry restructuring—unbundling, commercialization/privatization and competition?

4. Transferability
Can the mechanism work in more than one national/regional context?
What is the potential for transferability between different national/regional contexts?

5. Flexibility within the social/political environment
Is the mechanism flexible, and able to continue achieving its goals during political or industry-based changes?

6. Potential for market transformation
Will the mechanism lead to infrastructural or organizational changes, which ease the promotion of energy efficiency and load management?

7. Cost effectiveness
What level of financial and human resources would be required to implement the mechanism?
Does the mechanism have a low cost (program costs and cost per kWh saved)?
Is the free-rider effect minimized? (i.e. the mechanism does not subsidize those who would have implemented energy-efficiency initiatives anyway)
Is the free driver effect maximized? (i.e. the mechanism stimulates energy efficiency in several ways, some of which are cost free)

8. Social and environmental impacts of the mechanism
Are the social consequences of implementation benign? (i.e. the mechanism does not penalize low income groups, small users at the expense of large, etc.)
Are the overall environmental consequences of implementation positive?

Table 7
Usefulness and/or relevance of developed mechanisms under various aspects of restructuring

Mechanisms		Effects of various aspects of restructuring on mechanisms*		
		Unbundling	Commercialization/ privatization	Competition
Control mechanisms				
C1	Mandatory sourcing of energy efficiency	↑	↑	↑↑
C2	Energy-efficiency license conditions for electricity businesses	X	↑	↑↑
C3	Integrated resource planning	↓↓	↓	↓
C4	energy efficiency and load management as alternatives to network expansion	↑	↑	↑↑
C5	Revenue regulation	↑	X	X
Funding mechanisms				
F1	Public benefits charge for energy efficiency	↑↑	↑↑	↑↑
F2	Financing of energy efficiency by electricity businesses	X	↑	↑
Support mechanisms				
S1	Sustainable energy training schemes for practitioners	X	X	↑
S2	Energy centers	↑	↑	↑↑
S3	Creating entrepreneurial energy organizations	↑	↑	↑↑
S4	Developing the ESCO industry	↑	↑	↑↑
S5	Promotion of energy efficiency by industry associations	↑	↑	↑
S6	Aggregating electricity purchasers to achieve energy efficiency	↓	↑	↑↑
S7	Voluntary agreements for energy efficiency	↑	↑	↑↑
M1	Taxes on energy	X	X	X
M2	Tax exemptions and incentives for energy efficiency	X	X	X
M3	Providing consumption information on customers' electricity bills	X	↑	↑↑
M4	Communicating pricing and other information for energy efficiency	↑	↑	↑↑
M5	Energy performance labeling	↑	↑	↑
M6	Developing an energy-efficiency brand	↑	↑	↑↑
M7	Cooperative procurement of energy-efficient appliances and equipment	X	↑	↑
M8	Energy performance contracting	X	↑	↑
M9	Competitive sourcing of energy services	X	↑	↑↑
M10	Competitive sourcing of demand-side resources	X	↑	↑↑
M11	Demand-side bidding in competitive markets	X	↑	↑↑

*Key to effects on mechanism
↓↓ Mechanism is much less useful and/or relevant
↓ Mechanism is less useful and/or relevant
X No change
↑ Mechanism is more useful and/or relevant
↑↑ Mechanism is much more useful and/or relevant

unbundling, the mechanism *F1 public benefits charge for energy efficiency* is the most useful and relevant.

Competition

When competition occurs, the relative importance of most of the mechanisms changes, with most of them becoming more useful and relevant. One mechanism becomes less useful or relevant: *C3 IRP*. Three mechanisms remain unchanged: *C5 Revenue regulation, M1 Taxes on energy; and M2 Tax exemptions and incentives for energy efficiency*. The remaining mechanisms become more, or much more, useful or relevant.

8.5.2. Barriers addressed by developed mechanisms

As noted earlier, one of the criteria for selecting mechanisms for development in Task VI was their ability to address one or more barriers to energy efficiency and load management. In Tables 8 and 9, we indicate which policy and program barriers could potentially be addressed by the mechanisms in this paper.[5]

Policy Barriers

Key findings from Table 8 include the following:

- One policy barrier is not addressed by the mechanisms: *5 Import tariffs and duties*.
- All other policy barrier are addressed by at least one mechanism. However, it is more prudent to select a portfolio of mechanisms, rather than rely on one mechanism, to address specific policy barriers.
- Most mechanism address the "lack of awareness" of energy efficiency by policy makers, either explicitly or more indirectly by affecting consumers' awareness (and, hopefully, getting the attention of policy makers).
- Many of these mechanisms appear to be particularly responsive as they address multiple policy barriers. Furthermore, 11 mechanisms address seven or more policy barriers: *C1 Mandatory sourcing of energy efficiency; C3 IRP; C4 Energy efficiency and load management as alternatives to network expansion; S4 Developing the ESCO industry; S6 Aggregating electricity purchases to achieve energy efficiency; M5 Energy performance labeling; M6 Developing an energy-efficiency brand; M7 Cooperative procurement of energy-efficient appliances and equipment; M8 Energy performance contracting; M10 Competitive sourcing of demand-side resources; and M11 Demand-side bidding in competitive markets*.
- If these mechanisms are implemented, expertise in energy-efficiency technologies and services will increase, and there will be a greater focus on market transformation.

Program Barriers

Key findings from Table 9 include the following:

- Two program barriers are not addressed by the mechanisms: *1 low cost of energy to end users*; and 10 *split* (*misplaced*) *incentives*.
- As noted in Table 8, it is more prudent to select a portfolio of mechanisms, rather than rely on one mechanism, to address specific program barriers.
- Most mechanism address the "lack of information" and "information/search costs" either directly (e.g., by having ESCOs or energy centers provide all the information) or indirectly (e.g., through cooperative procurement of energy-efficient appliances).
- Many of these mechanisms appear to be particularly responsive as they address multiple program barriers. Furthermore, 10 mechanisms address five or more program barriers: *S2 Energy centers; S3 Creating entrepreneurial energy organizations; S4 Developing the ESCO industry; S7 Voluntary agreements for energy efficiency; M4 Communicating pricing and other information for energy efficiency; M5 Energy performance labeling; M6 Developing an energy-efficiency brand; M7 Cooperative procurement of energy-efficient appliances and equipment; M8 Energy performance contracting; and M9 Competitive sourcing of energy services*.

8.5.3. Concluding thoughts on mechanisms

The 25 mechanisms vary in their usefulness and/or relevance under the three aspects of electricity industry structure, unbundling, commercialization/privatization and competition. However, the majority of the developed mechanisms are either unchanged or more useful or relevant under all three aspects. Under competition, the majority of the developed mechanisms are more, or much more, useful or relevant. Therefore, the developed mechanisms are likely to become more effective in promoting energy efficiency and load management as restructuring of an electricity industry proceeds.

In relation to policy and program barriers, some of the mechanisms appear to be more responsive in addressing one type of barrier as compared with the other. However, the majority of developed mechanisms address several program and policy barriers. This also suggests that the developed mechanisms will be effective in promoting energy efficiency and load management in restructured electricity industries.

9. Conclusions

9.1. Effectiveness of reform

The incentives for energy efficiency and load management under commercialization or privatization changes

[5] See Appendix A for a description of program and policy barriers to DSM and energy efficiency.

Table 8
Policy barriers addressed by developed mechanisms

Mechanisms		Policy barriers*													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Control mechanisms															
C1	Mandatory sourcing of energy efficiency			•			•	•	•	•	•	•		•	•
C2	Energy-efficiency license conditions for electricity businesses			•			•				•	•		•	
C3	Integrated resource planning		•				•				•	•	•	•	•
C4	Energy efficiency and load management as alternatives to network expansion	•	•				•	•			•	•	•	•	
C5	Revenue regulation	•		•											•
Funding mechanisms															
F1	Public benefits charge for energy efficiency						•				•	•	•	•	
F2	Financing of energy efficiency by electricity businesses			•			•			•				•	
Support mechanisms															
S1	Sustainable energy training schemes for practitioners						•	•					•	•	
S2	Energy centers						•	•					•	•	
S3	Creating entrepreneurial energy organizations						•	•					•	•	
S4	Developing the ESCO industry						•	•	•	•	•		•	•	
S5	Promotion of energy efficiency by industry associations		•				•	•						•	
S6	Aggregating electricity purchases to achieve energy efficiency		•				•	•	•	•	•		•	•	
S7	Voluntary agreements for energy efficiency		•				•	•					•	•	
Market mechanisms															
M1	Taxes on energy		•		•			•			•	•			
M2	Tax exemptions and incentives for energy efficiency		•				•	•			•	•			
M3	Providing consumption information on customers' electricity bills		•	•				•							
M4	Communicating pricing and other information for energy efficiency				•		•	•		•				•	
M5	Energy performance labeling		•				•	•			•	•	•	•	
M6	Developing an energy efficiency brand		•				•	•	•	•	•		•	•	
M7	Cooperative procurement of energy-efficient appliances and equipment		•				•	•		•		•	•	•	
M8	Energy performance contracting		•				•	•	•	•	•		•	•	
M9	Competitive sourcing of energy services						•	•	•		•		•	•	
M10	Competitive sourcing of demand-side resources			•			•	•	•		•		•	•	
M11	Demand-side bidding in competitive markets				•		•	•	•		•		•	•	

*Key to policy barriers:
1. Excess capacity
2. Short-term perspective
3. Split (misplaced) incentives to energy providers
4. Pricing
5. Import tariffs and duties
6. Lack of awareness by policy makers (of EE opportunities)
7. Imperfect information (restricted access to customer information)
8. Inadequate competition (market power problems)
9. Customer instability (problem for energy providers)
10. Lack of adequate paradigm (for evaluating the value of EE)
11. Separation of energy policy process (from environment & social policy)
12. Little market transformation experience (by end-users or others)
13. Lack of available expertise (in EE during transition periods)
14. Utility price setting process

can generally be maintained or strengthened through thoughtful regulatory and government support. The introduction of unbundling or competition substantially complicates the situation. However, even problems caused by unbundling are amenable to regulatory solutions. The most complex and difficult area is the introduction of competition because of the related pressures by many stakeholders for reduced governmental intervention. Where privatization, unbundling and competition are introduced simultaneously, it may be difficult for government to analyze the complex interactions and to anticipate the most likely outcomes. There can be interactions when more than one reform is undertaken simultaneously, either magnifying certain effects or counteracting others. For some countries experiencing several reforms, it is unclear whether the impact of expected lower costs resulting from competition will be greater or smaller than the impact of increased electricity costs as price subsidies are removed and revenue collection is improved.

Table 9
Program barriers addressed by developed mechanisms

Mechanisms		Program barriers*									
		1	2	3	4	5	6	7	8	9	10
Control mechanisms											
C1	Mandatory sourcing of energy efficiency							•			
C2	Energy efficiency license conditions for electricity businesses		•					•			
C3	Integrated resource planning		•								
C4	Energy efficiency and load management as alternatives to network expansion		•					•			
C5	Revenue regulation										
Funding mechanisms											
F1	Public benefits charge for energy efficiency		•			•		•			
F2	Financing of energy efficiency by electricity businesses		•			•	•	•			
Support mechanisms											
S1	Sustainable energy training schemes for practitioners		•	•		•		•			
S2	Energy centers		•	•	•	•		•			
S3	Creating entrepreneurial energy organizations		•	•	•	•		•			
S4	Developing the ESCO industry		•	•	•	•	•	•	•	•	
S5	Promotion of energy efficiency by industry associations		•	•		•		•			
S6	Aggregating electricity purchases to achieve energy efficiency		•	•		•		•			
S7	Voluntary agreements for energy efficiency		•	•		•		•		•	
Market mechanisms											
M1	Taxes on energy										
M2	Tax exemptions and incentives for energy efficiency						•				
M3	Providing consumption information on customers' electricity bills		•	•	•						
M4	Communicating pricing and other information for energy efficiency		•	•	•	•	•	•			
M5	Energy performance labeling		•	•	•	•		•			
M6	Developing an energy-efficiency brand		•	•	•	•		•			
M7	Cooperative procurement of energy-efficient appliances and equipment		•	•		•	•	•			
M8	Energy performance contracting		•	•	•	•	•	•			
M9	Competitive sourcing of energy services		•	•	•	•		•			
M10	Competitive sourcing of demand-side resources		•			•		•			
M11	Demand-side bidding in competitive markets		•			•		•			

*Key to program barriers
1. Low cost of energy to end users
2. Lack of information to end users
3. Information/search costs (to end users & other actors)
4. End users do not invest in EE because of habits or custom
5. Lack of end-user and other market actor's experience impacts
6. Financial barriers
7. Product/service unavailability
8. Inseparability of product features
9. Organizational (institutional) barriers
10. Split (misplaced) incentives

9.2. Effectiveness of the developed mechanisms

The public policy analysis of the developed mechanisms has attempted to provide some indication of their likely effectiveness in promoting energy efficiency and load management. However, it is difficult to make definitive statements about the effectiveness of these mechanisms for the following reasons:

- the "field experience" in relation to restructured electricity industries is limited, particularly for Models 3 and 4 (one might argue that Model 4 does not yet exist in a mature form);
- resources for the promotion of energy efficiency and load management in competitive electricity industry structures have, in most cases, been limited, especially compared to the potential energy savings that exist and compared to the funding of these activities in traditional electricity industry structures; and
- transforming markets to promote energy efficiency is a long-term process that requires patience and time.

9.3. Competitive electricity markets

For those countries and states moving to a competitive electricity industry structure, there are some things that are known even at the outset. We know that competitive markets are good at:

- allocating similar resources;
- efficient short-term transactions; and
- incremental improvements in resource allocation.

We also know that competitive markets are not good at:

- explicit tradeoffs between the present and the future;
- valuing externalities;
- equity issues;
- information barriers; and
- non-transparent benefits.

There are also predictable market failures, such as those listed below, which will affect the ability to successfully deliver energy efficiency and load management outcomes.

- Markets require good consumer information in order for consumers to make informed decisions but good information becomes a valuable commodity making it more difficult to obtain in competitive markets.
- There are large environmental impacts from the use of electricity but they are varied and diffuse.
- These varied and diffuse environmental impacts result in short-term price signals masking long-term benefits.
- The market power of incumbent firms can be a problem for the sharing of customer information, and for obtaining capital for new firms to work in the competitive market.

9.4. Possible groupings of mechanisms

It is possible to provide suggestions for groupings of mechanisms, which may work to achieve similar results, particularly in competitive electricity industry structures. However, it should be noted that these groupings are simply suggestions. Before decisions are made about which mechanisms to implement, a detailed analysis should be completed, both of the goals and objectives required to be achieved, and of the particular situation in which the mechanisms will be implemented.

9.4.1. Information provision mechanisms

Mechanisms that provide accurate and useful information will be particularly important for competitive electricity markets. Therefore, general information provision mechanisms should be given a high priority. Consumer protection activities are also closely related to general information requirements. Mechanisms in this category include:

- *S1 Sustainable energy training schemes for practitioners.*
- *S2 Energy centers.*
- *S5 Promotion of energy efficiency by industry associations.*
- *S6 Aggregating electricity purchasers to achieve energy efficiency.*
- *S7 Voluntary agreements for energy efficiency.*
- *M3 Providing consumption information on customers' electricity bills.*
- *M4 Communicating pricing and other information for energy efficiency.*
- *M5 Energy performance labeling.*
- *M6 Developing an energy-efficiency brand.*

9.4.2. Funding and action mechanisms

Financial incentive mechanisms to collect funds to promote energy efficiency and load management work well together with mechanisms, which lead to action in implementing energy efficiency and load management initiatives. Such mechanisms might include:

- *F1 Public benefits charge for energy efficiency.*
- *F2 Financing of energy efficiency by electricity businesses.*
- *S3 Creating entrepreneurial energy organizations.*
- *S4 Developing the ESCO industry.*
- *M2 Tax exemptions and incentives for energy efficiency.*

9.4.3. Market shaping mechanisms

New market-shaping mechanisms that capture the value gained from implementing energy efficiency and load management initiatives will particularly help to overcome some of the problems of split incentives, where the organization which implements energy efficiency and load management may not gain any benefit from doing so. Mechanisms in this category include:

- *C4 Energy efficiency and load management as alternatives to network expansion.*
- *C5 Revenue regulation.*
- *M11 Demand-side bidding in competitive markets.*

9.4.4. Market transformation mechanisms

Market transformation mechanisms that are designed to alter the way in which energy efficiency and load management is sourced or procured are critically important for competitive markets. These include mechanisms moving from regulations and financial incentives to strategic market interventions designed to result in more efficient products and services:

- *C1 Mandatory sourcing of energy efficiency.*
- *C2 Energy efficiency license conditions for electricity businesses.*

- *S4 Developing the ESCO industry.*
- *S7 Voluntary agreements for energy efficiency.*
- *M2 Tax exemptions and incentives for energy efficiency.*
- *M7 Cooperative procurement of energy efficient appliances and equipment.*
- *M8 Energy performance contracting.*
- *M9 Competitive sourcing of energy services.*
- *M10 Competitive sourcing of demand-side resources.*

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Appendix A. Mechanisms for the promotion of energy efficiency and load management in a restructured electricity industry

The different mechanisms for the promotion of energy efficiency and load management is given in Table 10.

Appendix B. Barriers to the promotion of energy efficiency and load management in a restructured electricity industry

As part of the analysis of public policy implications of mechanisms, we examined barriers to promoting energy efficiency and load management in a restructured electricity industry. The barriers presented below are at two levels: (1) the policy level (primarily reflecting a societal perspective), and (2) the program level (primarily reflecting an end-user perspective). The policy barriers can influence program barriers, and mechanisms that address policy barriers may weaken some of the program barriers. In contrast, program barriers have relatively little influence on policy barriers, and mechanisms that address program barriers will likely have little impact on policy barriers. There will be cases when it is unclear whether a barrier is a policy barrier or program barrier.

Many of the barriers listed below are interrelated. Because this list is designed to be inclusive, rather than limited, all of the important barriers are listed without collapsing them into broader categories. Where appropriate, we note how the barriers are related to one another. Furthermore, we have tried to keep barriers that are connected to one another close together.

This paper defines barriers more broadly than other analysts may. For the purposes of this paper, a barrier is any factor that limits the promotion of energy efficiency in society, and a barrier is a barrier to implementation of either policy or programs. "Market barriers" are those barriers that call into question the assumptions of a perfect market (e.g., lack of available information is a market barrier). More formally, a market barrier is any characteristic of the market for an energy-related product, service or practice that helps to explain the gap between the actual level of investment in, or practice of, energy efficiency and an increased level that would appear to be cost beneficial. However, in this paper, the broad definition of barriers is used for the review and discussions of mechanisms.

Many of the discussions on barriers refer to the role of "energy providers". In this paper, energy providers are organizations that sell gas, electricity and other fuels and/or provide energy services (e.g., energy performance contracting, energy audits, etc.).

B.1. Policy barriers

An overarching policy barrier that affects all electricity industry structures is "the lack of regulatory or legislative attention and interest in energy-efficiency issues". In Model 4, the role of the utility changes and if programs are to happen, government (or an agent of government) has to take on some of the roles that may have been formerly performed by the monopoly utility.

Table 10

Control mechanisms		
C1	Mandatory sourcing of energy efficiency	Mandatory sourcing of energy efficiency is a legal requirement imposed by government on electricity businesses and large electricity customers to include in their retail sales mix or wholesale purchases defined energy-efficiency outcomes
C2	Energy-efficiency license conditions for electricity businesses	This mechanism establishes a legal framework to require electricity businesses to consider and promote energy efficiency, as part of the conditions under which they are granted a license to carry out their business
C3	Integrated resource planning	Integrated resource planning (IRP) is a planning methodology that seeks the least cost option for meeting customers' energy service needs. In determining the least cost option, IRP evaluates all supply and demand-side options over a forecast period from a societal perspective. IRP implies significant regulatory oversight, which can be applied by a number of means
C4	Energy efficiency and load management as alternatives to network expansion	This mechanism comprises the development and implementation of regulation, which requires network operators to investigate whether demand-side alternatives to network augmentations are more cost-effective than the 'build' option. This regulation can also require network operators to make network planning processes open to public scrutiny and involvement by stakeholders
C5	Revenue regulation	Under revenue regulation, the total 'allowable' revenue of an electricity business is set each year at a particular dollar figure. Within this revenue cap, the business is free to set the structure and levels of retail prices in any way it chooses. Any over- or under-collection of revenue in 1 year is corrected in determining the 'allowable' revenue for the following year. This mechanism is applicable only to monopoly electricity businesses
Funding mechanisms		
F1	Public benefits charge for energy efficiency	A public benefits charge is a method of raising funds from the operation of the electricity market, which can then be directed into DSM and energy-efficiency activities
F2	Financing of energy efficiency by electricity businesses	This mechanism focuses on developing the role that electricity businesses can play in bundling together financing and energy-efficiency services for their customers, particularly as a means of developing new business opportunities
Support mechanisms		
S1	Sustainable energy training schemes for practitioners	The training schemes covered by this mechanism are designed to improve the trainees' ability to achieve sustainable energy outcomes, and are generally more vocationally oriented than energy information programs targeted at end-users or consumers. The schemes would emphasize energy efficiency and renewable energy technologies and applications
S2	Energy centers	This mechanism involves the establishment of organizations with the sole or main purpose of promoting energy efficiency and DSM. These organizations may operate independently from electricity businesses or they may be linked to such businesses in a variety of ways
S3	Creating entrepreneurial energy organizations	This mechanism involves the creation by government of organizations with clear responsibilities for achieving energy-efficiency outcomes. Entrepreneurial energy organizations are distinguished from energy centers because their objectives are more commercial than those of energy centers and they aim to eventually become self-funding over time
S4	Developing the ESCO industry	This mechanism involves government encouraging the development of a diverse energy services sector, which is commercially focused and independent of electricity market regulation. Energy service companies (ESCOs) within this sector will provide energy services across the board to a range

Table 10. (*continued*)

		of customers. ESCOs could be established in parallel with electricity businesses or even as distinct business units within existing electricity businesses
S5	Promotion of energy efficiency by industry associations	This mechanism involves industry associations promoting energy-efficiency services to their members. An industry association may be able to provide its members with access to energy efficiency services, which the individual members themselves may be unable to obtain
S6	Aggregating electricity purchases to achieve energy efficiency	This mechanism enables customers to influence electricity businesses through exercising consumer purchasing power in a competitive retail electricity market
S7	Voluntary agreements for energy efficiency	Voluntary agreements for energy efficiency involve a formal agreement between a responsible government body and a business or organization. The agreement states that the business or organization will carry out specified actions to increase the efficiency with which it uses energy
Market mechanisms		
M1	Taxes on energy	Energy taxes are imposed by government at some point in the energy supply chain. The effect of an energy tax is to increase the final price that end-users pay for each unit of energy purchased from their energy supplier, although the tax may be levied at any point in the supply chain. One effect of increased prices to the end user is to encourage more efficient use
M2	Tax exemptions and incentives for energy efficiency	This mechanism uses tax exemptions and incentives to provide signals promoting investment in energy efficiency to end use customers
M3	Providing consumption information on customers' electricity bills	Under this mechanism, electricity businesses provide specific information about a customer's level of electricity consumption on that customer's electricity bills. This may encourage the customer to improve the efficiency with which they use electricity
M4	Communicating pricing and other information for energy efficiency	This mechanism motivates customers to alter their electricity-using behavior through the electricity retailer communicating strong pricing incentives and other information to change behavior
M5	Energy performance labeling	Energy performance labeling provides information to end users about the energy-using performance of products such as electrical appliances and equipment, and even buildings
M6	Developing an energy efficiency brand	This mechanism involves increasing awareness of efficiency products and services by means of a marketing campaign focussed around a specific product brand. Branding usually involves the development of a clearly identifiable graphic image or logo that is applied to all qualifying products and services. Products and services may require accreditation by a recognized authority before they qualify for the brand
M7	Cooperative procurement of energy-efficient appliances and equipment	In this mechanism, buyers who purchase large quantities of energy-using appliances and equipment cooperate to define their requirements, invite proposals from manufacturers and suppliers, evaluate the results, and actually buy the products. The buyer's requirements may include energy-efficiency specifications that are equal to, or in advance of, world best practice
M8	Energy performance contracting	Energy performance contracting involves a contractor (typically an ESCO) guaranteeing energy savings for a site over a specified period; carrying out the appropriate energy-efficiency improvements and receiving payment from the actual cost reductions achieved through the energy savings
M9	Competitive sourcing of energy services	In this mechanism, proponents specify their requirements for energy services to several providers such as electricity businesses and ESCOs. The responses to the specification are then evaluated on a competitive basis and commercial arrangements implemented with the selected providers
M10	Competitive sourcing of demand-side resources	In this mechanism, electricity businesses and/or other parties specify their requirements for DSM and energy efficiency in a

Table 10. (*continued*)

M11	Demand-side bidding in competitive markets	public request for proposals (RFP). The responses to the RFP are then evaluated on a competitive basis and commercial arrangements implemented with the selected respondents. In North America this mechanism is called "demand bidding" Demand bidding schemes provide the opportunity for a customer's offer of electricity demand reduction to offset the requirement for either increased generation of electricity or increased purchase of wholesale electricity by electricity retailers. Typically, this opportunity is realized by the customer bidding into a wholesale electricity pool a price level above which the customer will reduce their demand for electricity

1. *Excess capacity*. *Comment*: Excess capacity may be more of a problem in isolated electricity systems than in countries with strong connections/trading with neighbors. Where there is excess capacity, it may be more difficult for energy providers to "sell" energy efficiency and load management. Where there is a lack of excess capacity, energy efficiency and load management may be more attractive for energy providers at the retail level; at the wholesale level, energy efficiency and load management may also be attractive for both the short- and long-term balancing of supply and demand. In a competitive market, this barrier may not be important for energy providers that do not own generation facilities but may be important for those that do own generation facilities.

2. *Short-term perspective*. *Comment*: In a competitive market, short-term goals and approaches (e.g., short-term pricing) may be emphasized by most (if not all) energy providers. The emphasis in the market will be on immediate savings and shorter pay backs, compared to energy efficiency and load management (offsetting the cost of generation) and market transformation which emphasize long-term savings. The emphasis on short-term goals and approaches often presents a problem at the societal level where longer-term goals and objectives (and paybacks) are important, and energy is not viewed as just a commodity. *Related to*: split incentives. *Market barrier*.

3. *Split (misplaced) incentives*. *Comment*: Energy providers may not be motivated to promote energy efficiency and load management although other organizations may want to do this (i.e., self-interest of energy providers versus public interest). In a competitive market, this barrier may be exacerbated or may be resolved, depending on the ingenuity of energy providers and regulators. *Related to*: short-term goals. *Market barrier*.

4. *Pricing*

4a. *Non-transparent pricing*. *Comment*: End users and other market actors need to see what they are paying for, in order to assist their decision to invest in energy efficiency and load management. In a competitive market, this barrier may become even more important. *Related to*: non-cost-reflective pricing. *Market barrier*.

4b. *Non-cost-reflective pricing*. *Comment*: Generally, pricing does not include environmental costs nor reflect the marginal cost of energy production, supply, and distribution. This is even more difficult when environmental impacts are varied and diffuse. In a competitive market, there may be pressure for cost-reflective pricing, but most likely non-cost-reflective pricing will continue, unless mandated by a regulatory authority. *Related to*: non-transparent pricing. *Market barrier*.

5. *Import tariffs and duties*. *Comment*: In a competitive market, import tariffs and duties on energy-efficiency products and expertise may disappear, or continue, depending on a country's policies. *Market barrier*.

6. *Lack of awareness*. *Comment*: In a competitive market, the lack of awareness of energy-efficiency issues by policy makers may increase as energy providers and customers focus on the price of energy. An exception is that some energy providers may inform/educate end users and other market actors about energy efficiency, as a business opportunity (product differentiation). *Related to*: non-cost-reflective pricing, non-transparent pricing, split incentives.

7. *Imperfect information*. *Comment*: Access to customer information is restricted by major energy providers. In a competitive market, this barrier may continue to be important, unless regulatory action is taken. *Related to*: inadequate competition. *Market barrier*.

8. *Inadequate competition*. *Comment*: Too much market power held by an energy provider may result in little promotion of energy efficiency. In a competitive market, it is expected that market power will diminish as more competitors enter the marketplace, raising the possibility of more players promoting energy efficiency (even with lower prices). However, it is not evident, so far, that this will occur as energy companies merge with one another. *Related to*: imperfect information. *Market barrier*.

9. *Customer instability*. *Comment*: The loyalty of customers is uncertain as they may frequently switch energy providers, particularly if price is the major motivation. This is a problem for energy providers, but not for society. In a competitive market, this instability may increase, unless restrictions are placed on contract length, high fees are set for switching

suppliers, etc. Energy providers may try to promote Energy efficiency to retain customers, or they may not wish to install measures in homes and facilities for fear of losing that investment if the customer switches to another energy provider (stranded benefits).

10. *Lack of adequate paradigm*. *Comment*: This refers to the lack of an adequate paradigm to evaluate the value of energy efficiency under new market structures. An example of different paradigms: emphasis on improving energy efficiency from a technical viewpoint, in comparison to providing customers with services on an energy-efficient basis. In general, public interest goals, such as market transformation, may not be addressed under current paradigms. In a competitive market, this barrier may diminish as energy providers provide services to customers that meet their needs. Another example: the traditional planning mind-set tends to associate greater credibility with highly centralized electricity production centers and does not favor investments in energy-efficiency measures. In a competitive market, this barrier may diminish if more decentralized electricity production is pursued, and the role of energy efficiency and load management becomes more important. *Market barrier*.

11. *Separation of energy policy process*. *Comment*: This refers to the separation of the energy policy process from environmental and social policy processes**.** Different organizations are usually responsible for developing energy, environmental and social policies. In a competitive market, this barrier is likely to continue or be exacerbated with changes in the energy sector not being ''tracked'' in the environmental and social sectors, unless a regulatory body intervenes. *Related to*: fewer places for policy intervention.

12. *Little market transformation experience*. *Comment*: End users and stakeholders have little experience with market-driven systems and ''upstream'' market mechanisms in promoting energy efficiency. For example, market transformation initiatives may target multiple stakeholders, such as manufacturers, distributors and retailers. In a competitive market, this barrier will be significant early on, but will diminish as competition proceeds over time, as more attention is paid to energy-efficiency services, including market transformation initiatives.

13. *Lack of available expertise*. *Comment*: There may be a lack of available expertise to work on energy efficiency during transition to a competitive market. In the transition to a competitive market, it is feared that the energy-efficiency experience and expertise will be lost as priorities focus on providing low-cost electricity rather than energy-efficiency services. In a competitive market, this barrier may be significant early on, but may diminish as competition proceeds over time and more attention is paid to energy-efficiency services.

14. *Utility price setting process*

14a. *Cost recovery barriers*. *Comment*: This refers to the institutional and legal barriers that impede setting prices at levels which allow utilities to recover the costs of energy efficiency and load management programs. The costs of these programs could be treated as an operating expense, allowing the full expenditure to be recovered during the financial year in which it is incurred. The cost of energy efficiency and load management programs could also be treated as an asset in utility price regulation, in which case the cost of a program is paid over time with an associated rate of return. In a ''limited'' competitive market, these barriers may diminish if competition proceeds over time and price setting is based on the performance of energy providers. In a fully competitive market, energy-efficiency improvements (products and services) could be funded (partially or wholly) by the beneficiaries of these improvements and/or by a ''public goods'' charge. *Related to*: decoupling of profits from sales

14b. *Decoupling of profits from sales*. *Comment*: There is a need to decouple profits from increased sales for promoting energy efficiency and load management. This barrier could be a major barrier during the transition period to a competitive market. In a competitive market, this barrier may diminish if competition proceeds over time and price setting is based on the performance of energy providers. *Related to*: cost recovery.

B.2. Program barriers

1. *Low cost of energy*. *Comment*: The cost of energy to end users is relatively low compared to production and operating costs. As a result, end users are not aware of energy-efficiency opportunities. This is especially true for residential customers, particularly low-income households. In a competitive market, this barrier may increase in importance if the price of energy decreases as expected.

2. *Lack of information*

2a. *Lack of energy consumption data*. *Comment*: Many end users do not have information on their energy consumption. Examples: lack of apartment metering, and lack of monthly utility bills. As a result, end users are not aware of energy-efficiency opportunities. This is especially true for residential customers, particularly low-income households. In a competitive market, this barrier may be resolved if energy providers offer time-of-use meters and more detailed and frequent utility bills. *Market barrier*.

2b. *Lack of energy provider information*. *Comment*: Many end users do not have information on energy providers. This is especially true for residential customers, particularly low-income households. In a competitive market, this barrier may increase if more energy providers enter the market. Or the barrier could

decrease if energy providers provide more information, or if a neutral organization provides information on energy providers. *Market barrier*.

3. *Information/search costs*. *Comment*: End users and other market actors do not have sufficient time to investigate all possibilities for investing in energy efficiency (hassle/transaction costs). As a result, end users and other market actors are not aware of all energy-efficiency opportunities. This is especially true for residential customers, particularly low-income households. In a competitive market, this barrier may decrease if energy providers offer concise information and "one-stop" shopping. However, this barrier may increase if many energy providers offer many different kinds of services to end users. *Related to*: lack of information. *Market barrier*.

4. *End users do not invest in energy efficiency because of bounded rationality*. *Comment*: Many end users use "rules of thumb" (i.e., matters of habit or custom) when deciding about energy-efficiency products and services, in response to the potentially high search and information processing costs associated with trying to make every decision based on first principles (e.g., net present value). This is especially true for residential customers, particularly low-income households. In a competitive market, this barrier may decrease if energy providers offer concise information and "one-stop" shopping. However, this barrier may increase if many energy providers offer many different kinds of services to end users. *Related to*: lack of information and search costs. *Market barrier*.

5. *Lack of experience impacts*

5a. *Lack of experience with proven cost-effective energy-saving measures*. *Comment*: End users and other market actors do not have experience with proven cost-effective energy-saving measures. As a result, end users and other market actors are not aware of energy-efficiency opportunities. In a competitive market, it is unclear how much experience customers will have with energy efficiency and load management. In addition, if previous utility contacts have changed jobs and new players with little experience in energy efficiency have entered the market, customers may face a situation where expertise in energy efficiency is very limited.

5b. *Performance uncertainties*. *Comment*: End users and other market actors perceive energy-efficiency technologies to be unreliable, particularly if they have not installed the measure. In a competitive market, performance uncertainties may increase if new entrants with little experience in energy efficiency and load management offer these services to end users. *Related to*: reluctance to implement new technologies.

5c. *Reluctance to adopt new technologies*. *Comment*: End users and other market actors are reluctant to adopt new, innovative technologies. In a competitive market, energy providers may offer the latest (most energy-efficient) technologies with little field experience; only "innovators" will adopt these technologies in the beginning. *Related to*: performance uncertainties, disruption in routine.

5d. *Disruption in routine*. *Comment*: End users fear a possible disruption in routine caused by the implementation of energy efficiency measures, particularly if they have never installed the measure. Implementation of some energy-efficiency measures may require end users to vacate part of their premises or stop production until the measures have been installed. In a competitive market, this barrier is likely to remain. *Related to*: performance uncertainties, reluctance to implement new technologies, disruption in routine.

6. *Financial barriers*

6a. *Limited investment capital*. *Comment*: The amount of investment capital available for financing energy-efficiency measures is limited. This is especially true for residential customers, particularly low-income households. In a competitive market, financing may become more available if energy providers offer financing assistance or conduct energy performance contracting. *Related to*: high initial cost, product unavailability. *Market barrier*.

6b. *High initial cost*. *Comment*: Many energy-efficiency technologies have a high initial cost. The cost of energy-efficiency technologies is often attributed to low demand for technologies; if demand were higher, then supplies would be more abundant and costs would go down ("economy of scale"). In a competitive market, the market for energy-efficiency products may increase if energy providers "sell" energy services, end users demand more energy-efficiency products, and market procurement efforts are initiated. Otherwise, the relative cost of energy-efficiency technologies will remain high, especially if the price of energy decreases. *Related to*: limited financing, product unavailability.

7. *Product/service unavailability*. *Comment*: In many countries, the availability of energy-efficiency technologies and expertise is limited because: (a) the technology is still at the development stage; (b) the technology is not manufactured locally and nobody is prepared to import the technology from another country; or (c) the technology is being actively suppressed by vested interests. In a competitive market, the availability of energy-efficiency products and expertise may increase if energy providers "sell" energy services, end users demand more energy-efficiency products, market procurement efforts are initiated, and more financing becomes available. On the other hand, the availability of energy-efficiency products and expertise may decrease or remain the same, if research and development funds decrease, import taxes are high, or vested interests continue to suppress the technology. *Related to*: high initial cost, limited financing.

8. *Inseparability of product features*. *Comment*: Energy-efficiency features are often combined (bundled) with other features of products, making it difficult for end users to choose certain features they want. In a competitive market, energy providers wanting to differentiate themselves from their competitors may continue to bundle features. However, the unbundling of energy efficiency from other features may also occur if energy providers try to give customers more choices and to distinguish themselves from other energy providers.

9. *Organizational (institutional) barriers*

9a. *Low priority of energy efficiency*. *Comment*: It is difficult for organizations to invest in energy efficiency when energy efficiency measures have relatively low priority compared to other concerns within the organization (i.e., competition between energy efficiency and non-energy issues).

9b. *Views of upper management*. *Comment*: It is difficult for organizations to invest in energy efficiency when upper management is not interested in energy efficiency, has a short-term view of the world, is generally skeptical about the performance and merits of energy-efficiency measures, and considers energy-efficiency investments to be "discretionary" rather than "core" business activities.

9c. *Multiple decision makers*. *Comment*: It is difficult for organizations to invest in energy efficiency when many decision makers are involved, increasing the transaction costs.

In a competitive market, these barriers (9a–9c) may increase in importance if: (1) organizations want to cut all costs and are less willing to make investments in products and services that are not core business activities; and (2) the price of energy is expected to decrease, making the "energy problem" less of a business problem. These barriers may decrease in importance if: (1) energy providers market energy-efficiency services to large organizations, and (2) energy is now more actively discussed among upper management.

10. *Split (misplaced) incentives*. *Comment*: Investment in energy efficiency is unlikely to occur when split (misplaced) incentives exist: e.g., owners of buildings are not willing to make investments in energy efficiency if tenants are the ones who receive the benefits. In a competitive market, this barrier may be exacerbated or may be resolved, depending on the ingenuity of energy providers and regulators. *Market barrier*.

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