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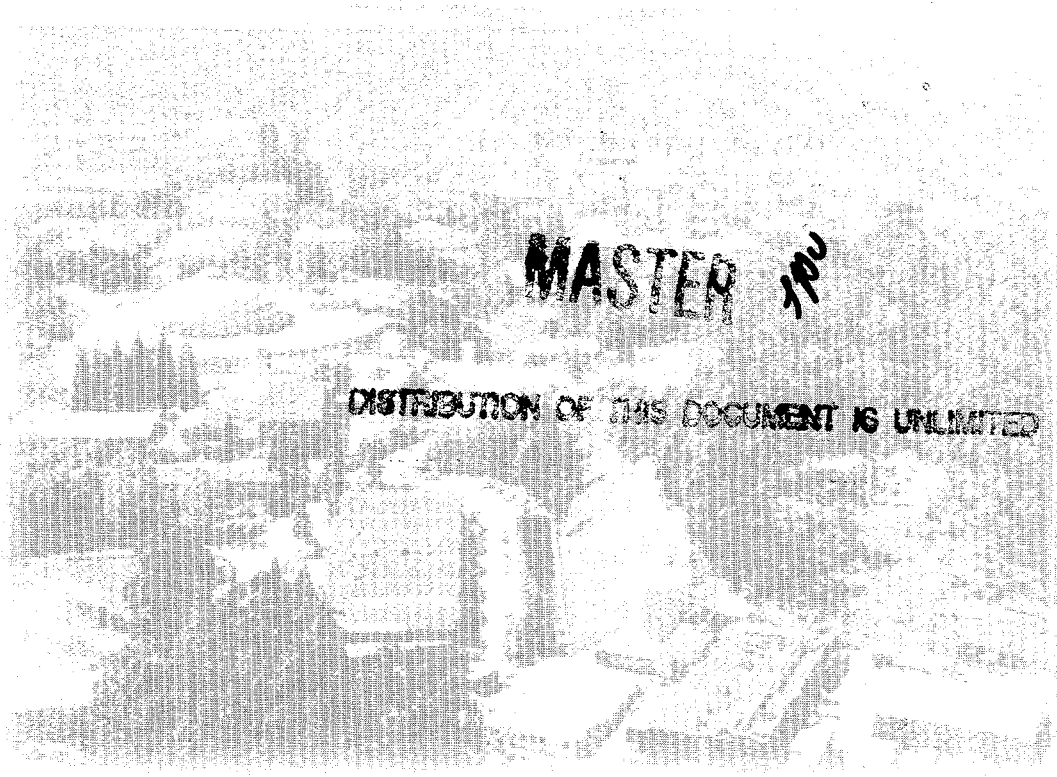
Improving Energy Efficiency: Strategies for Supporting Sustained Market Evolution in Developing and Transitioning Countries

Stephen Meyers

Environmental Energy Technologies Division

February 1998



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Improving Energy Efficiency: Strategies for Supporting Sustained Market Evolution in Developing and Transitioning Countries

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ABSTRACT

This report presents a framework for considering market-oriented strategies for improving energy efficiency that recognize the conditions of developing and transitioning countries, and the need to strengthen the effectiveness of market forces in delivering greater energy efficiency. It discusses policies that build markets in general, such as economic and energy pricing reforms that encourage competition and increase incentives for market actors to improve the efficiency of their energy use, and measures that reduce the barriers to energy efficiency in specific markets such that improvement evolves in a dynamic, lasting manner. The report emphasizes how different policies and measures support one another and can create a synergy in which the whole is greater than the sum of the parts. In addressing this topic, it draws on the experience with market transformation energy efficiency programs in the U.S. and other industrialized countries.

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1. INTRODUCTION

Improving the efficiency of energy use has become a well-recognized means of meeting national objectives such as enhancing productivity and competitiveness, reducing local environmental costs associated with energy supply and use, and increasing the security of energy supply. At an international level, it is considered a key element of strategies to mitigate the risk of climate change associated with anthropogenic release of greenhouse gases. In this context, improving energy efficiency in the developing and transitioning countries is particularly important because these countries exhibit considerable potential for such improvement and, in the case of the developing countries, they will contribute increasingly to future greenhouse gas emissions as their populations and economies grow.

At the same time that the importance of improving energy efficiency as a climate change mitigation strategy is receiving attention, concern about energy on the part of the public and the private sector has diminished as a result of years of low energy prices. In addition, the rise of "free market" ideology has brought a stronger questioning of the role of public policy with respect to improving energy efficiency. In many countries, restructuring of the electricity supply sector threatens to greatly diminish the opportunity for utilities to sponsor energy efficiency improvement. Finally, pressures to reduce public spending mean that fewer resources are available for government programs designed to increase energy efficiency.

The above factors pose real challenges to efforts to achieve significant improvement in energy efficiency, but they also present an opportunity to think about strategies to promote energy efficiency in a new way. In the past, many energy efficiency programs have been implemented to achieve short-term savings without a long-term objective to transform markets, and in some cases, with too little understanding of the target markets. Subsidizing the cost of investments in energy efficiency was often seen as the most effective means of achieving a sizable impact in a short time. The question of how policies and programs could support the sustained evolution of markets toward greater energy efficiency has generally received significant attention only within the past several years.

In the U.S. and some other OECD countries, the past decade has seen an increasing recognition among program planners of the value of working together with actors in the market being addressed. There has been a growing emphasis on so-called "market transformation" programs, which are ntended to bring about lasting changes toward higher energy efficiency in the target market. In contrast to traditional energy efficiency programs, market transformation programs typically take a more comprehensive and long-term view of the target market, addressing both the demand and supply sides of the market as well as the sustainability of the changes in the market after the end of the program.

A key feature of the new generation of energy efficiency programs is that they attempt to use a minimum of resources to leverage a maximum amount of desired change. The program is seen as a catalyst to enhance market forces. There is a strong emphasis on partnership between government, the private sector, and other institutions in order to achieve common goals.

In the economically advanced countries, where markets and the institutions that support them are highly developed, and capital and knowledge flows rapidly within and between countries, a market-oriented approach to improving energy efficiency has considerable merit. But what about for developing and transitioning countries? While the degree of economic development and the strength of market forces and institutions varies greatly among these countries, in general markets and their supporting institutions are deficient in many important respects. Economic reforms in the direction of freeing markets from government regulation and management have had an enormous impact throughout the world, and subsidies for energy prices have been reduced, but much still remains to be done in these areas. In addition, the weakness of supporting institutions, along with problems related to accessing capital, technology, and knowledge, diminishes the ability of local economic actors to survive and thrive in the new environment.

This report presents a framework for considering market-oriented strategies for improving energy efficiency that recognize the conditions of developing and transitioning countries, and the need to strengthen the effectiveness of market forces in delivering greater energy efficiency. It discusses policies that build markets in general, such as economic and energy pricing reforms that encourage competition and increase incentives for market actors to improve the efficiency of their energy use, and measures that reduce the barriers to energy efficiency in specific markets such that improvement evolves in a dynamic, lasting manner. The report emphasizes how different policies and measures support one another and can create a synergy in which the whole is greater than the sum of the parts. In addressing this topic, it draws on the experience with market transformation energy efficiency programs in the OECD countries.

This report is primarily intended for actors in governmental and other institutions involved in planning strategies for improving energy efficiency in developing and transitioning countries. It should also be of interest to the parties who support such strategies through national foreign assistance programs and international lending and assistance programs.

Organization of the Report

The chapter following this introduction presents an overview of market transformation to improve energy efficiency and the key role of market-building policies to support market transformation. Chapter 3 describes the key barriers that inhibit energy efficiency improvement in developing and transitioning countries. Chapter 4 describes a variety of market transformation measures that can contribute to sustained improvement in energy efficiency. Chapter 5 discusses market-building policies that support energy efficiency improvement. Chapter 6 discusses the design of market transformation strategies. Chapter 7 describes measures that are most appropriate for reducing barriers to energy efficiency in specific markets, and presents examples of promising strategies that have been implemented in developing and transitioning countries.

2. STRATEGIES TO SUPPORT SUSTAINED IMPROVEMENT IN ENERGY EFFICIENCY: AN OVERVIEW

A fundamental principle underlying many of today's strategies to encourage energy efficiency improvement is that the forces operating in markets characterized by high levels of competition and openness, in which market actors are able to reap the rewards of making good use of their assets, tend to encourage efficient use of resources, including energy. Put simply, a well-functioning market is an arena for economic activity in which the self-interest of the actors tends toward efficient use of energy, with the extent of this tendency depending on the relative costs of energy, capital, and labor, among other factors.

The experience of the economically advanced countries, in which market conditions approach the ideal of the above paradigm, provides strong evidence for the effectiveness of market forces in delivering higher energy efficiency, even in the absence of rising energy prices (Schipper and Meyers, 1992). Yet this same experience also shows that a variety of factors have inhibited progress in improving energy efficiency, and that there are areas where market forces operate relatively weakly.

In the developing and especially in the transitioning countries, the existence of markets that approach the neo-classical paradigm is an emerging phenomenon, and for the most part markets are much less developed than in the economically advanced countries. And as described further in the next chapter, barriers related to the macro-economy, energy pricing, international flows of capital, technology, and knowledge, and institutional weaknesses are typically much more significant in these countries.

An effective strategy to support the evolution of markets toward greater energy efficiency needs to address the full range of barriers that inhibit this tendency. In the context of developing and transitioning countries, therefore, such a strategy should involve both policies that build and strengthen market forces and institutions, and measures that reduce the barriers to energy efficiency in specific markets such that improvement continues over time.

A national or regional economy is comprised of numerous markets for various products and services, which in practice overlap. Throughout the economy, economic policies that promote greater competition and energy pricing reform increase the incentives for market actors to demand and supply more energy-efficient products and services. Policies that improve flows of capital, technology, and knowledge enhance the capacity of market actors to undertake actions that increase energy efficiency. Efforts to strengthen institutions support the evolution of markets toward higher energy efficiency in numerous ways. This report refers to all of the above as "market-building" policies; they are further discussed in Chapter 5.

At the level of specific markets, a variety of measures can be used to address barriers to energy efficiency that are related to market behavior and features. Six types of measures that can promote sustained evolution of markets toward improved energy efficiency are:

(1) Improving information about energy efficiency opportunities

(2) Financing of energy efficiency investments
(3) Financial incentives for energy efficiency investments
(4) Minimum efficiency standards
(5) Market aggregation and technology procurement
(6) Voluntary commitment and recognition.

These measures are discussed in Chapter 4. Properly designed and implemented, they can help to transform markets such that decisions that favor higher energy efficiency will be made to a greater degree in the future without incentives or other interventions in the market. The market-building policies are of critical importance in creating an environment in which market transformation measures can be effective and have sustained impact.

Market Transformation to Improve Energy Efficiency

Definitions of what constitutes a market transformation program vary somewhat, but the general consensus is that such programs "explicitly seek to cause changes in the structure of the market for an energy product or service, or in the behavior of some group of market actors, in such a way that energy efficiency is improved and the changes remain after the program has ended" (SRC, 1996). Compared to traditional energy efficiency programs, market transformation programs take a more macro perspective, and are designed to result in permanent change in the market. While there is considerable variation (and evolution) in the types of programs that can be designed to change markets, most market transformation programs to date share the following general characteristics:

Involvement of multiple market actors — Active, critical roles are often played by numerous organizations, such as:

- entities participating in a product's distribution chain (manufacturers, distributors, retailers, energy service companies)
- "trade allies" who are responsible for specifying targeted products (contractors, engineers, builders, trade associations)
- organizations responsible for implementing the program (utility companies, advocacy groups, special coordinating organizations)
- brokers/facilitators with knowledge and breadth of contacts (government agencies, trade associations)
- promoters (utilities, government agencies, advocacy groups, manufacturers and retailers).

Activities designed to remove or lower specific market barriers to energy efficient technologies — Typically, a number of market barriers must be addressed to produce permanent change in a market, and these barriers are usually on both the supply and demand sides.

Longer time frames (than traditional energy efficiency programs) before the majority of program impacts are obtained — Time frames can be a few years or a decade, depending on how much momentum for change may already exist and exactly what is required to change the market.

Significant activity upstream from the customer or end-user — Programs typically target product manufacturers and/or other actors in the supply of energy-efficient goods and services to a significant degree. Since the capabilities of these actors are often weaker in developing and transitioning countries than in more economically advanced countries, strategies may need to provide more support in this area.

In examining market transformation programs, one finds that they typically:

- Have the potential to achieve very large energy savings relative to traditional energy efficiency programs, but take more time to achieve results.

- Create a set of conditions under which the self-interests of key actors will be aligned and oriented toward achieving greater energy efficiency (use market forces to achieve energy efficiency).

- Often link energy efficiency with other product or service attributes that are of value to the end user (i.e., are focused on meeting consumer needs).

- Involve and depend to a significant extent on voluntary cooperation of a range of market actors.

- Look for opportunities where there is momentum in the market for the targeted or related changes.

The Process of Market Transformation[1]

An example of a market transformation process, in this case for motor systems, is shown in Figure 2-1. Although the transformation process in practice is not linear, as depicted in the figure, the figure nonetheless helps to illustrate the kinds of market changes and effects expected to occur. The key elements of the market transformation process shown in Figure 2-1 are:

- End users need to demand greater efficiency and improved performance as a result of increased awareness and knowledge; their interest and purchasing commitments would eventually create critical-mass market participation.

- The markets for more efficient and better performing products and services created through the purchasing commitments of users would provide clear business opportunities and incentives for design engineers, manufacturers, and distributors to proactively participate in developing, promoting, and selling new products and services.

- The suppliers of products and services who are capable of responding would be rewarded in the market.

- Users and suppliers of products and services who are not yet participating in the market would be exposed to new information, norms, and competitive pressures and may become new market entrants.

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[1] This section is drawn from U.S. Department of Energy (1996).

- Changes in market structures and in the behavior of market players would persist as dynamic, lasting improvements in the market.

Key Factors That Sustain Market Transformation

Key factors that sustain market transformations include product and service marketability, product and service availability, information management and technology access, availability of expertise, stakeholder benefits, behavioral and attitudinal change, and tracking and evaluation.

Product and Service Marketability. The level of demand may be the single most important indicator of the marketability of energy-efficient systems and services. The demand for efficient systems does not exist in and of itself; it is directly related to the things they make possible — increased productivity, reliability, environmental quality, and competitiveness, for example. The greatest value will be placed on the products and services that allow end-users to conduct business in the most efficient and cost-effective manner possible.

Product and Service Availability. In a transformed marketplace, energy-efficient products and services can be obtained cost-effectively and with relative ease. The availability, or lack thereof, of essential technologies, products and services can hinder or accelerate the market transformation process. Manufacturers may be reluctant to build energy-efficient products because their higher incremental cost makes them difficult to sell. Better economies of scale could reduce the incremental cost, but low user demand limits marketing and production runs.

Information Management. The availability of good information is central to developing and sustaining market transformation. Strategies must include options to establish information systems that are integrated across all levels to foster effective information and technology transfer. Energy-efficiency information needs to be supplemented with economic, financial, and policy-related information and presented in a format that is useful to the recipients.

Availability of Expertise. The availability of a wide network of expert groups and recognized expert centers is critical to the market transformation process. Strategies must be designed to promote and encourage the development of field performance and engineering analysis, marketing, and other interrelated services. The availability and accessibility of knowledge will strengthen the market transformation support framework. Equally important are provisions to encourage networking among expert groups to enhance their knowledge bases, share information, and encourage strategic alliances within and across markets.

Stakeholder Benefits. A key to successful market transformation is being able to provide clear answers when stakeholders ask, "What's in it for me?" If market transformation strategies are to receive a high degree of acceptance and support among stakeholders, the perceived benefits and expected outcomes must be clearly defined. The development of market transformation strategies must take the stakeholders' views as the starting point. Strategies should be designed to maximize the benefits to all stakeholders.

Behavioral and Attitudinal Change. Another key to the success of market transformation is creating sophisticated buyers who have information that allows them to make more informed and effective decisions. Among the behavioral and attitudinal changes that will affect market transformation are shifts in conventional thinking, heightened awareness, and increased knowledge.

Tracking and Evaluation. Assessment of market trends and performance is essential to track progress toward specific program objectives and overall market transformation goals. Such tracking helps program managers identify and respond to early signs of problems in the market. Tracking and evaluation must be an integral part of any program design, implemented to provide feedback into the market transformation process.

Experience With Market Transformation Programs[2]

Market transformation programs in the U.S. and western Europe have mainly focused on changing markets for new products. Many types of energy-using products have been the target of market transformation programs, including refrigerators, clothes washers, air conditioners, lighting equipment, office equipment, and residential furnaces. Some of these programs are described in Chapter 4. In general, the experience provides evidence of shifts in the markets for key products, including increased availability of models, increased sales of high-efficiency products, and changes in manufacturer, dealer, and consumer behavior. Although it is difficult to attribute particular market shifts to specific policies or programs, it appears that many of the market transformation approaches are having a positive impact.

The market transformation approach has also been applied for new buildings. For example, a program in the U.S. was quite successful in changing residential construction practices for electrically-heated new homes in the Pacific Northwest over the 1985-92 period (Watson and Eckman, 1993). The market transformation approach has been used less with respect to markets for retrofit of existing buildings and industrial facilities.

An example of successful transformation of a market for replacement equipment is the effort in the state of Wisconsin (U.S.) to promote high-efficiency gas furnaces (Schlegel and Prahl, 1994). This effort began in 1982 when the utility regulatory agency issued a directive requiring certain utilities in the state to offer programs to "weatherize" (make more energy-efficient) the homes of low-income customers. Under this directive, the major gas and electric utilities were required to provide weatherization services to low income customers free of charge and to install energy conservation measures, including high-efficiency gas furnaces, that met a 5-year simple payback. Utilities performed an audit and then took bids from local contractors for the installation of the measures recommended in the audit. Because installing high-efficiency furnaces garnered significant energy savings and was easily delivered through local

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[2] Two reports prepared by the American Council for an Energy-Efficient Economy provide descriptions of a number of market transformation programs in the U.S. Geller and Nadel (1994) apply a somewhat broader definition of market transformation than that given in this chapter in their review. Suozzo and Nadel (1996) describe several programs that are still underway in addition to some that have been completed. In addition, Eto, et al. (1996) review selected utility energy-efficiency programs in California to assess how programs not consciously designed to transform markets may have, in fact, contributed to market transformation.

contractors, many utilities began offering not only low-income services, but also high-efficiency gas furnace rebates to other customers. By the mid-1980s, utility rebate programs to promote high-efficiency furnaces were fairly widespread.

As the saturation of high-efficiency gas furnaces increased and the market for these products appeared "sustainable", many utilities withdrew rebates for high-efficiency furnaces in 1988 and 1989. From 1982 through 1991 almost half of all furnaces were replaced with high-efficiency furnaces, and more than 90 percent of the furnaces replaced in the early 1990s were replaced with high-efficiency systems. This compares with significantly lower high-efficiency furnace penetrations in nearby states. In response to increasing demand for high-efficiency gas furnaces, prices declined, such that the costs of full condensing furnaces are now substantially less in Wisconsin than in most other northern states.

Schlegel and Prahl believe that the key to the success of the transformation of the furnace market in Wisconsin was contractor education. They suggest that together, low income weatherization and utility rebate programs enabled, and in some cases even required, contractors to become familiar with high-efficiency gas furnaces. Contractors recognized that such furnaces were often more reliable than standard furnaces, could generate higher than average profit margins, and were more likely to be specified by competitors. These factors, together with the fact that contractors in this largely "replace-on-failure" market play a key role in consumer purchasing decisions, were critical in shifting purchasing patterns.

Conclusion

The experience with market transformation programs shows that this approach can be successful in making effective use of program resources to bring about long-run change in markets. The market transformation approach may not be best for all situations or for meeting all objectives, however. Market transformation programs usually take more time to have an impact compared to other approaches such as traditional utility DSM programs. Thus, if slowing growth in energy demand to alleviate power shortages or to reduce the need to build new capacity is an objective, other approaches may be more effective, at least in the short run.

Cultural factors also play a role in deciding if a market transformation approach should be applied. The rise of market transformation in the U.S. is related to the more general shift in public policy away from "command and control" types of regulation of markets. In other countries, such regulation may still be a prominent feature of the policy environment.

Traditional approaches to energy efficiency improvement can proceed together with market transformation efforts. Indeed, traditional approaches can lead to greater reliance on more market-oriented strategies as the ability of market actors to play a role, and their interest in doing so, becomes stronger. For example, efforts over many years in the U.S. Northwest, involving utilities, the regional power supply entity, manufacturers, retailers, and state energy offices in the region, transformed the manufactured home industry from building a very inefficient product to a very efficient one (Eklund, et al., 1996). The process was primarily supported by utility financial incentive programs, but the industry established its own program to continue production of energy-efficient homes when the utility programs ended. This adoption of the process by the industry was neither foreseen nor expected when the efforts were begun.

The above example illustrates the dynamic nature of a market-oriented approach. Done well, such an approach can set forces in motion that build over time and bring about sustained improvement in energy efficiency. The foundation of a market-oriented strategy is a sound understanding of how particular markets work, and of the factors that tend to inhibit improvement in energy efficiency. These factors are the subject of the next chapter.

End-Users

- Increasing awareness and knowledge of options and benefits.
- Interest grows upon learning of high-efficiency products and systems.
- Higher levels of system performance and specific performance characteristics desired.
- Investment—end-users make purchases or purchasing commitments; significant demand is created by bringing a number of purchasers together.
- Critical-mass market participation achieved when customer purchases represent a significant portion of the market, and this is communicated to manufacturers.

Support activities to reinforce the demand (Market Pull)

Distributors, Engineering Consultants

- Support activities reinforce the demand.
- Increasing business opportunities for making improved products and systems available is stimulated by increased demand.
- Stocking practices altered by vendors.
- Engineering consultants include improvements in efficiency in product specifications, designs, and purchases, and provide more widespread performance optimization services or improve design practices.

Support activities to reinforce the supply (Market Push)

Manufacturers

- Support activities reinforce the supply.
- Recognition that market risks are reduced; aggregated, guaranteed markets and prospects for large potential markets exist.
- Product decisions are affected.
- Manufacturers develop and market improved engineering designs.

New Market Entrants

- Some nonparticipating organizations, exposed to new information, new norms, and competitive pressures, enter the market.
- Nonparticipant users enter into market for higher efficiency performance products.
- Nonparticipant distributors and engineering consultants include efficiency in marketing and services.
- Nonparticipant manufacturers follow suit and enhance future technology innovation.

Market Effects Persist as a Dynamic, Lasting Improvement in the Market

Figure 2-1 Market Transformation Process

Source: U.S. Dept. of Energy (1996)

3. BARRIERS TO IMPROVING ENERGY EFFICIENCY

In all countries, the levels of energy efficiency of existing capital stock and the levels built into new capital stock are far less than what could be achieved with available technology and knowledge. The extent to which the application of such technology would be of economic benefit is a matter of some debate, and the answer depends on one's perspective and assumptions, as well as the future evolution of energy prices. In general, however, many analysts agree that the levels of energy efficiency that markets are delivering are less than economically optimal from a societal perspective, even without accounting for reductions in environmental costs that would result from higher energy efficiency.[1]

Many factors account for the phenomenon of sub-optimal investment in energy efficiency, which some have called the "efficiency gap" (Jaffe and Stavins, 1994). Gaining a clear understanding of the barriers that inhibit energy efficiency improvement is of utmost importance, since it supports the design of strategies that can have the most benefits in the long run with the least cost. This section describes six different classes of barriers to improved energy efficiency, depending on whether they primarily relate to: (1) macro-economic conditions, (2) energy pricing, (3) international flows of capital, technology, and knowledge, (4) institutional weaknesses, (5) market behavior and features, or (6) features of energy-efficient products or services.

The above barriers operate in all countries. In the developing and transitioning countries, however, the first four classes of barriers play a much greater role than in the economically more advanced countries. Barriers in these categories not only inhibit improvements in energy efficiency. They typically have negative impacts in other areas as well, so strategies to address them may have a wide range of benefits.

This chapter presents a brief overview of barriers that inhibit improvement in energy efficiency. A recent review of current perspectives on market barriers to energy efficiency is given in Golove and Eto (1996). Discussions of barriers to improving energy efficiency in the context of developing countries may be found in Reddy (1991) and Lohani and Azimi (1992).

Barriers Related to Macro-Economic Conditions

The barriers discussed in this section pervade the economy of a country. In most cases, they inhibit energy efficiency improvement indirectly by maintaining conditions in which investments in energy efficiency are ignored, under-valued, or considered too risky by economic actors.

Low level of competition among firms resulting from regulation of the domestic market and/or policies that constrain entry of imported products into the market. This barrier impacts both the demand and supply sides of markets. On the demand side, firms facing little or no competition have low incentive to increase their productivity by reducing energy

[1] For a wide-ranging discussion of the behavior of markets with respect to energy efficiency and the implications for public policy, see Huntington, et al. (1994).

costs. On the supply side, manufacturers may be able to keep prices high or may have little incentive to market new, more efficient products.

High tariffs on imported goods. Import duties in developing countries have historically been high in order to both raise revenue and protect domestic industries. Since many countries rely upon imports for supplying high-efficiency equipment, duties can raise the price of imported energy-efficient equipment considerably. When both standard- and high-efficiency equipment are imported, the duty raises the price differential between the two. In contrast, imported equipment specific to electricity supply is typically free of duty. From a national economic perspective, import duties on energy-efficient equipment thus contribute to underinvestment in energy efficiency relative to energy supply.

Low level of capital market development. Capital for investment from domestic sources is scarce in many developing and transitioning countries, particularly if foreign exchange is required. The resulting high interest rates contribute to a situation in which only those projects with the quickest payback and greatest return for a limited amount of risk receive financing. In addition, many of the financial structures commonly used to facilitate investment in energy efficiency in advanced countries, such as equipment leasing or energy performance contracting, are not present or are unfamiliar in developing and transitioning countries.

High rate of inflation. The presence of high inflation tends to make consumers averse to investments that pay back over an extended period of time, which is generally the case with investments related to higher energy efficiency. It also contributes to an atmosphere of uncertainty in which investors demand a high real rate of return.

Uncertain status of firms. The process of privatization of formerly state-owned enterprises is still incomplete in the transitioning countries, and is also ocurring to a significant extent in developing countries. While many enterprises are making a successful transition, there are doubts about the economic viability of the enterprises that have not yet been privatized. Whether these firms are producers or consumers of energy-using equipment, uncertainty regarding their future status contributes to a poor climate for investments related to improving energy efficiency.

High level of income inequality. Poor households are least able to afford the often higher cost of more energy-efficient technologies, and tend to discount future savings at a higher rate than wealthier households. In addition, the persistence of high income inequality during the process of economic reform (or its growth in some cases) undermines public support for that process, and makes it more difficult to implement reforms in the area of energy pricing.

Weaknesses in the legal framework. Some types of contract structures specific to energy efficiency investments, such as those typically used by energy service companies, require a legal framework that may be lacking in a country.

Barriers Related to Energy Prices

Energy prices may not reflect the cost of supply that is borne by the supplier due to lack of marginal cost pricing or time-of-day pricing, or the presence of price subsidies (which may involve cross-subsidies from one customer class to another, and/or subsidies from the government budget). Although significant progress has been made in reducing energy subsidies in developing and transitioning countries, subsidies still remain, particularly in the residential sector. In addition, many utilities do not factor in sufficient maintenance and depreciation of capital stock in pricing calculations.

A further problem is that energy prices do not incorporate externalities such as environmental costs associated with the supply and use of energy. The extent to which environmental externalities are incorporated in prices depends on the strength of environmental regulations and the strictness of their enforcement.

Artificially low energy prices undermine the cost-effectiveness of energy efficiency investments, as does uncertainly with regard to future prices. While such uncertainty is in part a function of trends in international prices of fossil fuels, it may also be a result of government policies such as not keeping up with scheduled price increases.

A problem related to energy pricing is the existence of *weak feedback between energy consumption and payment for energy*. In some situations, payment for energy is based on a flat rate (for example, per unit of dwelling area), is bundled with other costs (for example, in dwelling rent), or is made by some entity (such as a building landlord) other than the person who makes decisions that affect energy use. Use of more energy-efficient products or services may thus provide little or no direct benefit to the end user.

Barriers Related to International Flows of Capital, Technology, and Knowledge

Since capital is relatively scarce in developing and transitioning countries, and most advanced technologies originate in the wealthy countries, it is hardly surprising that the topic of barriers to international flows of capital, technology, and knowledge is one that has generated rather heated debate. From the perspective of many observers in the developing countries, capital investment by foreign companies is a two-edged sword, its desirability as a means of economic development tempered by fears that profits will be taken out of the country. The terms on which technology is transferred are seen as less than favorable, and "dumping" of outmoded technology in developing countries is a significant concern.

From the perspective of the multinational corporations and others in the wealthy countries who have capital and technology to offer, the barriers are more a result of restrictive policies, or of factors that create an unattractive environment for investment. For a variety of reasons, developing and transitioning countries may be seen as an inappropriate setting for installation of advanced technologies.

Capital flows. Although barriers to flows of foreign capital have been greatly reduced by policies designed to attract investment and promote joint ventures, restrictions still exist, and policies tend to change over time. Large fluctuations in exchange rates also create problems for capital investment.

Technology flows. The transfer of state-of-the-art technology takes place mainly through licensing of designs for local production, joint ventures, and export/import. A variety of factors inhibit each of these modes, including practices of multi-national corporations and policies of developing and transitioning countries. In some cases, small market size limits the ability of countries to gain local production of technologies, continuing their reliance on assembly of components or import of finished products.

Knowledge flows. Although advances in communications technology have greatly enhanced flows of knowledge between countries, there are still barriers to accessing up-to-date information in developing and transitioning countries. These range from lack of resources to acquire books, periodicals, and other publications, to problems with reliable Internet access.

Barriers Related to Institutional Weaknesses

Education and research institutions. The resources devoted to basic and advanced education are inadequate in most developing countries, and facilities are lacking in computers and tools for research. In the transitioning countries, the level of basic and technical education is high, but education related to the business skills required in a market economy is underdeveloped. In both groups of countries, competing demands for scarce public resources limit funds for technology R&D.

Government institutions. Government agencies are often lacking in trained personnel to design and implement energy efficiency programs, and have difficulty attracting or retaining talented staff due to low salaries relative to the private sector.

Financial institutions. Financial institutions lack experience with evaluating investments associated with energy efficiency, or may be unfamiliar with financing schemes that can best facilitate such investments.

Electric utilities. While electric utilities can be important actors in efforts to improve customer electricity use efficiency, in many countries a combination of their traditional supply-side orientation and lack of incentives prevents them from taking on a significant role. Even where there is interest in conducting customer efficiency programs, utilities in developing and transitioning countries typically lack staff with the skills to design and manage such programs.

Barriers Related to Market Behavior and Features

Barriers to energy efficiency related to the macro-economy, energy pricing, and international flows of capital, technology, and knowledge play a major role in shaping decisions related to production and demand for energy-using technologies in all markets within a nation's economy, but in a sense they are external influences on specific markets. A variety of other barriers related to the behavior of market actors and the features of specific markets also inhibit improvements in energy efficiency. The majority of these barriers affect the demand for higher energy efficiency, but in many developing and transitioning countries there are also problems on the supply side of markets.

In considering barriers related to market behavior and features, it is important to recognize that consumers (broadly defined to include households, firms, and other actors) and producers/providers in specific markets are in continual communication. In general, suppliers deliver what they think consumers want. But in markets characterized by a high degree of inertia or aversion to risk on the part of suppliers, there may be latent demand for higher levels of energy efficiency than are readily available in the market. Suppliers may not expend the effort to cultivate the demand for more efficient products, or to develop marketing approaches to help overcome some of the barriers on the demand side (such as financing schemes).

The importance of particular barriers varies among specific markets. On the demand side, barriers tend to be greater with respect to households and small firms than with large companies who are more able to evaluate investments. Similarly, in markets where the supply side is heavily comprised of small firms with low levels of technical, managerial, and marketing skills, the barriers to improving energy efficiency tend to be higher.

Barriers on the demand side of the market

Lack of information. Consumers and managers often lack information regarding the costs and benefits of technologies or services that deliver higher energy efficiency. Even when information is provided by technology suppliers, consumers face difficulties in evaluating the veracity and applicability of claims made for a particular product or service. Within firms, trained personnel able to evaluate investments related to energy efficiency may be lacking.

"Irrational" behavior. This barrier refers to the way in which individuals process and act on whatever information they may have. The behavior of an individual during the decision-making process may seem inconsistent with their goals. More or better information alone may be insufficient to change behavior, which is strongly influened by habit or custom.

Within organizations, various factors discourage or inhibit cost-effective energy efficiency decisions. For businesses, the priority of other investment opportunities (for example, to maintain or expand market share and production capacity) may cause the firm to reject cost-effective energy efficiency investment opportunities. Where energy costs are a small component of total production costs, management may not provide sufficient support for energy efficiency investments. In addition, within a firm, no single party or department may have clear and explicit responsibility for managing energy costs.

Another facet of behavior that is often cited as a barrier to energy efficiency investments is the demand for a rapid payback that may be either explicit or implicit in behavior. To some degree, the so-called high discount rate applied by consumers could be seen as an aspect of "irrational" behavior. However, the demand for a rapid payback is also related to particular features of energy-efficient products or services (such as uncertain performance) or to macro-economic conditions, such as high inflation or uncertain future energy prices.

Misplaced incentives. In some situations, the incentives of the agent charged with purchasing a product or service are not aligned with those of the persons who would benefit from higher energy efficiency. The most typical example is in rental housing where the tenant is responsible for the energy bill, so the landlord has little or no incentive to undertake energy efficiciency improvements or acquire more efficient equipment.

Limited access to financing. Consumers may lack access to credit due to lack of collateral, or credit may only be short-term when long-term credit is needed.

Barriers on the supply side of the market

Limited availability of products or services may result from decisions and practices of manufacturers and/or distributors. Firms that provide services related to energy efficiency may be few in number. Availability is typically lower (and prices are higher) in towns and rural areas than in large cities. To some extent, limited availability of products and services is a "chicken and egg" problem which tends to be most problematic in the early stages of market development for a more efficient product or service.

Weakness of suppliers in market research. Firms may lack the resources or capability to do adequate market research, thereby inhibiting the development of new products or services for which there might be a demand.

Weakness of suppliers in product development. Firms may be lacking in skills required for development of new products, or in capital for investment in new production capacity. Gaining access to advanced designs and/or manufacturing techniques may also be a problem (related to international technology flows).

Weak marketing capabilities of suppliers. Firms may lack the skills for adequate marketing of more efficient products or services.

Low level of information exchange within an industry. Firms supplying products or services within a particular market learn from one another with respect to understanding the market and operating effectively in it. The processes and networks by which this learning takes place, such as professional associations, conferences, publications, and informal networks, are often weak in developing and transitioning countries.

Barriers Related to Features of Energy-Efficient Products or Services

Performance uncertainties apply to all technologies, but they are most problematic for technologies that are new and unfamiliar. Since more energy-efficient technologies often require a higher initial cost, their capacity to perform as expected is critical to paying back the investment through energy savings over time. For some technologies, the performance may deteriorate more rapidly under prevailing conditions in developing countries (such as electricity voltage fluctuations). While it is possible to reduce performance uncertainty by acquiring better information, doing so often has an associated cost.

Related to performance uncertainties are unexpected costs associated with energy-efficient products or services, which are often incurred after the acquisition of an energy-efficient product or service. These costs could include additional operating and maintenance costs associated with energy-efficient equipment, additional staff costs associated with monitoring or servicing transactions, or additional costs resulting from the quality of installation.

High first cost is a common feature of more energy-efficient technologies. Although the incremental investment relative to a less energy-efficient technology may be paid back fairly quickly from energy savings and other benefits, the higher first cost acts as a barrier for consumers and firms lacking in capital, particularly in situations where financing mechanisms to spread the cost over time are not readily available.

Transaction costs include the time, materials, and labor involved in obtaining or contracting for energy-efficient products or services. In situations where the supply side of the market is not well developed, these costs can be considerable.

Inseparability of product features. Energy-efficient features may only be available together with other features that increase the total cost of a product beyond what the consumer would be willing to pay. For example, higher energy efficiency may be available as an option only on the highest-priced models in a product line, which also include a variety of other amenities. In many cases, the combining of energy-efficient features with other amenities is not an inherent feature of the product, but rather a decision made by manufacturers.

4. MEASURES TO PROMOTE MARKET TRANSFORMATION TOWARD GREATER ENERGY EFFICIENCY

Barriers to improving energy efficiency operate on many levels, and a strategy designed to promote sustained transformation of markets needs to address as many of the significant barriers as possible. Reducing barriers related to macro-economic conditions; energy prices; international flows of capital, technology, and knowledge; and institutional weaknesses may require policy action at a high level. A brief discussion of these "market-building" policies is presented in the next chapter.

This chapter describes measures whose implementation would take place mainly at the level of specific markets. The categories covered are: (1) improving information about energy efficiency opportunities, (2) financing of energy efficiency investments, (3) financial incentives for energy efficiency investments, (4) minimum efficiency standards, (5) market aggregation and technology procurement, and (6) voluntary commitment and recognition. These categories do not exhaust all of the possibilities for influencing markets to improve energy efficiency, but they do encompass most of the measures that are likely to be part of a market transformation strategy.

Many of the measures discussed have been elements of traditional energy efficiency policies and programs. In the context of a market transformation approach, however, the design of the measure and/or the manner in which it is implemented may differ from the traditional approach (see Chapter 2). In addition, a market transformation strategy may combine several measures (at the same time or sequentially) so as to more fully address barriers to improving energy efficiency. Some examples of the application of specific measures are presented in this chapter; further examples are given in Chapter 7.

Improving Information About Energy Efficiency Opportunities

A large array of measures fall under the general category of improving information about energy efficiency opportunities. These measures mainly target users of energy-consuming products and systems, but they may also aim at increasing the understanding of energy efficiency opportunities among manufacturers of products, designers of buildings and other systems, and providers of energy efficiency services.

Marketing and Consumer Education. The foundation of the traditional approach to market diffusion is to promote products to consumers through advertising, product displays, educational materials, and other similar avenues. These efforts range from promotions of specific products to broad educational efforts that span a wide range of products. The bulk of marketing and consumer educational activities are undertaken by companies selling products, but government and utilities can play a supporting role. For example, several U.S. electric utilities have sponsored informational programs to promote high-efficiency refrigerators. The programs combine decals on floor models, other point-of-purchase informational materials, direct-mail informational brochures, lists of high-efficiency products, and a media advertising campaign (Anderson, 1990). Evaluations of consumer educational efforts indicate that consumer education alone generally results in little energy savings, but that education can complement other program approaches (Nadel, 1990).

Information Systems and Databases. To help technology users compare a product's performance with that of other available products, it is critical that product performance data be collected and presented in a form that is accessible to end-users. Many decisions are involved in the design of these types of databases, such as whether to accept manufacturers' reported data or to require independent testing verification.

Decision Support Tools. Application-specific tools can be a great help to designers and end-users. Various software are commercially available for designing and selecting equipment. Many of these tools also include financial analysis components to aid in the decision making process and to help justify the investment in energy efficiency. In addition, tools can be applied in the management of systems. For example, significant energy savings can be gained from effective motor repair and replacement policies; a motor inventory is integral to such a policy. Software tools can aid in this process and can also help schedule a preventive maintenance program.

Best Practices Guidelines. Proper application of equipment is a key element in establishing and maintaining an energy-efficient system. Although it is often difficult to make specific recommendations for the application of equipment, there are many cases where general application recommendations would help design engineers and the end-user. These suggestions can reflect the best practices implemented by others with a proven record of good system management.

Common User Specifications. The development of common specifications for the procurement of equipment is valuable for some applications. These specifications would provide guidance to less technically sophisticated purchasers in matters such as what performance parameters are important and what levels of performance within those parameters are appropriate for a given application. The specifications can also be used for other purposes, such as education, purchasing collaboratives, and best practices guidelines.

Demonstrations. Demonstration projects effectively generate technical information which helps manufacturers or builders address engineering and design issues and substantiate the viability and performance of the technologies in question. Once new products are developed, demonstrations provide an avenue for needed tests of performance in actual applications. Demonstrations also allow potential users to see how these technologies may be of benefit to them.

Demonstration projects have usually been supported with public funds, but private sector businesses may be amenable to funding demonstrations that give them an opportunity to try out new technologies. For example, in the U.S. Department of Energy's program to promote more energy-efficient industrial electric motor systems, some 30 companies have invested in demonstration projects in exchange for technical assistance (McKane, et al., 1997). These companies agree to undertake detailed monitoring and analysis so that the results of the demonstration can be widely known.

Product Rating and Labeling. A common rating or labeling system allows consumers to compare a product's efficiency with that of similar products and to select products by efficiency class. In addition to providing information on energy efficiency to purchasers, labeling can motivate manufacturers to improve the energy efficiency of their products in order to avoind the stigma of a low rating. Such a result ocurred in Brazil when labeling of refrigerators was instituted (Geller, 1990).

Product energy labels are increasingly popular in the U.S., Europe, and Asia (Harris and Casey-McCabe, 1996; Duffy, 1996). Even on the basis of limited studies, there is little doubt that product energy labels can have a positive impact on the market. During a two-year test of the European Union (EU) appliance efficiency label in Denmark, sales of refrigerators in the top 3 categories (of 7) increased their share of sales from 45% to 75% in a major retail chain representing about 25% of the Danish market (Karbo, 1995). Similar results were demonstrated for the EU label in Germany and France during the first two years of widespread use of the refrigerator label (Waide, et al., 1996).

Two main types of product energy label are in use around the world: comparison labels, which indicate how a specific model compares to others in its product class, and endorsement labels (or "quality marks"), which inform the consumer that the product's energy efficiency is above a certain level. Comparison labels provide more information to consumers, but endorsement labels are simpler to understand.

A very successful "endorsement" label, ENERGY STAR™, has been launched by the U.S. EPA. Beginning in 1992 with a label for efficient personal computers (PCs), monitors, and printers with an automatic low-power "sleep" mode, the ENERGY STAR program has grown to include an array of building-related equipment and appliances, and an active national marketing campaign to raise buyer awareness and enlist retailers as program partners. For office equipment, the extent of market transformation to date is impressive. Over 80% of PCs and nearly all monitors and printers sold in 1996 qualified for the EPA label. The EPA program has been adopted for office equipment sold in Japan, and talks are underway on coordinated programs in Europe and elsewhere.

An important issue is whether label formats are effective and correctly perceived, and what special steps may be needed to inform buyers about how to use the labels and what they mean. In many cases, product energy labels appear to have been designed with little input from social scientists or marketing experts.

Accepted test procedures to accurately measure the energy performance of products are an important aspect of an energy labeling program. Some type of independent testing is usually needed to verify manufacturers' claims.

Energy Audits. Many end-users do not have the time or expertise to identify how they can improve energy efficiency. Providing energy audits can help them identify and prioritize energy-efficiency opportunities. Audits typically identify generic efficiency opportunities, many of which involve maintenance, operational improvements, or incremental equipment upgrades. However, a number of programs offer in-depth process audits conducted by experts in particular industries. These efforts focus on system integration and performance optimization and normally involve site-specific evaluations of production processes, recommendations for elimination of waste, and changes in production processes.

Energy audits have been a central ingredient of energy efficiency programs in developing countries, especially in the industrial sector. In many cases, audits have been provided at low or no cost to the end user. Some countries, such as Thailand, have made audits mandatory for large energy users. Experience has shown that providing audits without some mechanism for assisting implementation of the audit's recommendations often yields little in the way of results. Increasingly, audits have been combined with schemes to provide financing (subsidized in many cases) for investment. An example of such a program (implemented in the Philippines) is presented in Chapter 7.

Technical Assistance

The lack of technical expertise is a common barrier to greater implementation of energy-efficient systems. It is frequently impractical or prohibitively expensive for individual end-users or design firms to develop in-house expertise, and end-users and designers may not be able to easily identify external expertise. Programs can help address this problem by providing technical assistance services that can either retain expertise or act as clearinghouses to put end-users and designers in touch with outside experts. These services can range from limited, no-cost assistance, to providing funding for experts to assist in the design of systems.

In addition to helping end-users and designers of products, buildings, and other systems, technical assistance can be given to providers of energy efficiency services. Energy service companies (ESCOs) can play a key role in identifying opportunities for improving energy efficiency and in providing management and financing of projects. Actions to strengthen the capacity of local ESCOs to develop, finance, and implement projects can have an important impact over the long run.

A program designed to provide technical assistance (and financing) to ESCOs is being developed by Thailand's national electric utility, the Electric Generating Authority of Thailand (EGAT). Based on statements of qualifications submitted by interested ESCOs, EGAT will provide grants to eight ESCOs to conduct detailed energy audits of commercial or industrial facilities. From these eight, EGAT will select four ESCOs to implement energy-efficiency improvements in the facilities they have audited. The ESCOs will negotiate the deals, including performance guarantees, with the facility owners, and EGAT will provide them with loans to cover the costs of implementing the energy-efficiency measures. Loan repayments will capitalize a revolving fund to provide additional loans.

The EGAT program was created in response to the unavailability of project financing by commercial lenders in Thailand. Banks are reluctant to finance ESCO operations until performance contracting has been successfully demonstrated. EGAT's effort is directed toward domestic ESCOs. International firms must be part of a joint venture with a local partner in order to participate.

Financing Of Energy Efficiency Investments[1]

Actions that improve energy efficiency often involve an initial investment of capital in exchange for future savings in energy costs (and sometimes other benefits as well). Provision of financing overcomes the barrier of lack of capital, and also spreads the end-user's payments over time, creating the potential for a positive cash flow. Financing can be involved in projects that improve the energy efficiency of existing buildings and facilities, as well as for investments in new products, buildings, and industrial facilities.

While multilateral development banks have historically been a major source for funds for energy efficiency investments in developing countries, commercial financial institutions represent an important source of untapped funds for energy efficiency projects. Commercial financing sources include loans and lines of credit, leasing, trade finance, consumer credit, vendor finance, mortgage finance, and project finance.

The most important sources of commercial financing for energy efficiency investments are local financial institutions: commercial banks, non-bank financial institutions such as leasing companies, and government- and privately-owned development banks that lend to commercial enterprises. Since many energy efficiency investments are small (under $100,000), local financial institutions play a very important role as retail distribution agents.

To attract the interest of commercial financial institutions, sufficient creditworthy demand for financing must be demonstrated. Demand can be demonstrated either by developing projects that are large enough to meet the minimum size requirements of any given financial institution, or by identifying and creating situations where multiple transactions are likely to occur. Brazil provides an example of the latter: the high cost ($0.14/kWh) of electricity to commercial customers is causing building owners to seek out financing for commercial building retrofits (lighting and HVAC systems). One engineering firm estimated that in Sao Paulo alone, commercial retrofit projects could total up to $250 million. This presents a business opportunity for a commercial financial institution to develop a lease or loan product that can be used for multiple commercial building retrofits.

A country with advanced capital market conditions is more likely to offer commercial sources of financing for energy efficiency investments. The more mature the capital markets, the more likely it is that medium- and longer-term financing will be available and possibly lower overall interest rates. For example, Chile has fairly well developed local capital markets, including long-term bond markets. As a result, municipalities were able to obtain lease financing from leasing companies for municipal lighting retrofits. Chilean leasing companies are able to offer attractive leasing terms because the leasing companies have access to funding from the Chilean bond market.

Many countries do not yet have developed capital markets that can provide the required wholesale funds for commercial banks and other financial intermediaries from domestic

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[1] This section is excerpted (with modification) from "Strategies for Financing Energy Efficiency," prepared by Hagler Bailly Consulting, Inc. for the U.S. Agency for International Development, July 1996. The reader seeking more information on options for financing energy efficiency investment, along with examples of their application in developing and transitioning countries, is encouraged to consult this report.

sources. In these countries, local financial institutions must turn to external financing sources.

Leasing. Although it has seen little use so far to support investments in energy efficiency improvement in developing and transitioning countries, leasing is an important financing structure that allows the user of a leased asset (the *lessee*) to avoid using capital up-front to acquire the asset. A typical structure for leasing equipment is the finance lease, in which repayments for up to 100% of the equipment and/or project costs are spread out over the lease term. The lessee usually has an option to take title to the equipment at the end of the term. There are many advantages to leasing. The lessee's requirements for initial cash are minimal or none. A second advantage is that the lease may be structured so that cost savings will be greater than the lease repayments, thus generating a positive cash flow for the lessee. Finally, lease contracts can be structured flexibly to be combined with other financing sources or to provide up to 100% of the total financing.

Performance Contracting has been widely used in the financing of energy efficiency projects in the United States and Europe (where it is called third-party financing). In performance contracting, an end-user, seeking to improve its energy efficiency, contracts with an energy service company (ESCO) for services and financing. Some part of the contract is based on the ESCO's performance in achieving energy savings. The energy cost savings can be turned into incremental cash flows to the lender or ESCO.[2]

Performance contracting through an ESCO transfers some technology and management risks away from the end-user to the ESCO. It also minimizes or eliminates the up-front cash outlay required by the end-user. Payments are made over time as the energy savings are realized.

Efforts to apply the ESCO model of performance contracting in developing and transitioning countries are still relatively new and perhaps it is too soon to predict this model's long-term applicability and replicability. The results so far have been mixed. Several companies have committed to investments only to pull out of them at a later date; other ESCOs have conducted initial business development and concluded that the development costs were too high, the financing unavailable, or the risks unmanageable. Yet some companies have been successful and have executed multiple performance contracts.

Apart from the newness of the fundamental concepts behind performance contracting, one explanation for why the success stories are few is the mismatch between the skill mix and resources of U.S. ESCOs and the requirements of doing business in developing countries. Many U.S. ESCOs are small and medium-sized business with relatively short track records operating outside of the United States, and many of them lack the financial resources to sustain high market-entry costs Improving access to affordable project financing is a critical factor for the success of ESCOs in developing and transitioning countries.

Vendor Financing provides a means of financing new products. Vendor financing works best in mass market applications to finance sales of common equipment with large

[2] Contracting based on performance does not necessarily have to be undertaken by an ESCO, but in practice, ESCOs have been the pioneers and major users of performance contracting for energy efficiency projects.

numbers of end-users (e.g., industrial motors, commercial lighting). A vendor finance program is a programmatic relationship between an equipment marketer (the "vendor") and a financial services company to provide financing at the point of sale. An equipment marketer may be the manufacturer, but may also be a distributor or retailer. The vendor becomes the motivated stakeholder behind the marketing effort, marketing financing in conjunction with equipment. The vendor assumes the responsibility for documentation and other administrative tasks, and shares in transaction costs. The vendor is also the "aggregator" of capital demand, and may provide certain credit enhancements. Contractually, there are two sides to a vendor finance program: 1) the agreement between the financier and the vendor, and 2) the agreement between the customer and the vendor.

Vendor financing is being used for industrial motors and adjustable-speed drives in a project in Mexico (described in Chapter 7). A major motor manufacturer intends to make $1 million available for purchase of energy-efficient motors at attractive market rates for a three-year term.

Special-Purpose Funds. Many different types of funds can be used for energy efficiency investments, including dedicated line of credit, revolving loan fund, and investment fund. Depending on the structure of the fund, recipients receive grants, loans (interest-free, subsidized, or at market rates), equity, debt, guaranties, or any combination of the above.

Special-purpose funds can provide a central point of knowledge for technical and engineering expertise in the evaluation of energy efficiency investments and/or the structuring of energy efficiency contracts. An energy efficiency fund can assist in organizing the market for efficiency investments. By providing additional services such as project preparation or project development along with financing, energy end-users may be more likely to make investments. Dedicated funds also strengthen the identity of energy efficiency markets by communicating to the market that financing is available in this area. Energy efficiency funds can also serve as a vehicle to finance smaller projects. By replicating types of transactions to the same type of borrower or by using standard financial structures, transaction costs can be lowered.

There are four primary applications for special-purpose energy efficiency funds:

(1) Across specific end-uses where many similar energy use characteristics allow for standardized project evaluation.
(2) Where the credit analysis can be reduced by having similar end-user credits.
(3) Where capital demand is large enough to justify a fund, and
(4) To assist an existing association in marketing its finance program to its members.

Multilateral development banks, foreign assistance agencies, and local government agencies have had the most experience with special-purpose energy efficiency funds. The history of using special-purpose funds to promote energy efficiency projects is a mixed one. There are examples where such funds have been very successful, but in many cases they have failed to attract sufficient demand. The key factor is ensuring that interest rates for energy efficiency projects are attractive to borrowers. Mixing a credit line on standard commercial terms with "softer" funds from donor agencies can result in a rate that provides an incentive to borrowers, and to local banks to develop energy efficiency loans as an area of business.

An example of a successful special-purpose fund for energy efficiency investments is the revolving fund managed by Magyar Hitel Bank in Hungary. Established in 1991 with assistance from the German Coal Aid Fund, the program has provided loans for energy efficiency investments totaling $40 million (through 1995). The success of this fund is attributable to several factors. Borrowers could apply some of the funds for other uses in addition to energy efficiency. Interest rates were below-market due to capital from the German Coal Aid Fund. Bank personnel received training on evaluation of energy efficiency loans. Loan approvals were conducted by specialized staff. A technical committee reviewed the technical feasibility and a credit committee reviewed the credit aspects. Lastly, the program was aggressively marketed by the bank.

Utility Financing Programs. Financing customer investments in energy efficiency can be an element of utility DSM programs. The utility can assume three roles in financing energy efficiency: facilitator, collection agent, or financial services provider.

As a facilitator, the utility is essentially acting to organize the market for the end-users (their customers), energy efficiency businesses, and financiers. Utilities are an ideal vehicle to perform the project pooling or aggregation functions needed to achieve the "economies of scale" that will draw financiers into the energy efficiency market. They can broker relationships between financiers and the end-users and energy efficiency businesses that need their financing. Utilities can enter into exclusive arrangements with financial services providers for energy efficiency financing programs, and then help market the program.

One method of aggregating capital demand and addressing credit risk in energy efficiency financing programs is for the utility to collect finance payments through its bills. End-user payments are passed through as collected and are typically aggregated for a single monthly payment to the lender. The convenience and regularity of utility bill payment by the customer makes for more dependable collections. The customer's utility bill payment history can also be checked as a quick and easy method of credit verification.

Because of their customer relationship, market position, access to capital, and in-place systems to collect payments via utility bills, utilities have natural advantages as financial services providers. When providing financing services, the utility earns fees and/or recovers its investment with interest. The provision of financial services can take several forms, including direct loans or leases to customers. Or the utility may choose to work through equipment vendors, offering finance programs marketed by selected, qualified equipment sellers.

Financial Incentives For Energy Efficiency Investments

A variety of financial incentives have been used to overcome the barrier of higher first cost that often inhibits adoption of energy-efficient technologies. The most common incentives are consumer rebates or grants, low or zero-interest loans, tax credits, accelerated depreciation of energy-saving technologies, and no-cost direct installation.

In most cases, financial incentives have been directly offered to end-users. Another approach is to offer incentives to manufacturers or builders to encourage them to supply more efficient products, with the assumption that most of the incentive will be reflected in a lower price of the product. The relative merits of these approaches vary depending on the market niche and the goals of the program. Consumer incentive programs can provide the program sponsor with a direct contact with consumers and an opportunity to educate consumers regarding efficient energy use. Manufacturer incentives have the benefit of less paperwork and lower administrative costs. They can also result in a larger reduction in the retail product price for the same level of incentive: if the wholesale price to the distributor reflects the incentive, the distributor and dealer markups and value-added tax are all reduced. In addition, they have the potential to shift the market toward more efficient products (particularly if implemented in conjunction with minimum efficiency standards).

The use of manufacturer incentives is a feature of the Poland Efficient Lighting Project (IFC, 1996). A $5 million GEF grant channeled through the International Finance Corporation enabled a manufacturer's wholesale price reduction of approximately $2 per CFL. Over a two-year period, the project subsidized the sale of over 1.2 million CFLs. This project is further discussed in Chapter 7.

Combining manufacturer and consumer incentives is another option that has been used in several market transformation programs in the U.S. For example, in the Super-Efficient Refrigerator Program (organized by a consortium of parties from government, utilities, and NGOs), a competition was organized in which the manufacturer best able to produce a refrigerator that met the program's specifications received a large single payment (so-called "golden carrot"). In addition, participating utilities agreed to offer consumer rebates to encourage purchase of the super-efficient refrigerator (Fiest, et al., 1994).

The use of financial incentives in the context of a market transformation strategy is discussed in Chapter 6.

Minimum Efficiency Standards

Minimum efficiency standards can eliminate the least energy-efficient products from the marketplace, or require that new buildings meet a specified efficiency level. Such standards have mainly been used for new products or buildings, although certain improvements may also be required when existing buildings are renovated or sold.

Minimum efficiency standards can be either mandatory (regulations) or voluntary. Where voluntary standards have been formulated with substantial input from the private sector, they tend to be used as guidelines. In many cases where voluntary standards exist in developing countries, however, their effect appears to be minor.

Regulations usually have a greater impact, but often encounter resistance from the private sector, and can take time to implement. Efficiency regulations can potentially have a strong impact, depending on the minimum efficiency level that is specified. The higher the minimum level, however, the stronger the resistance from manufacturers or builders is likely to be (especially if meeting the standard requires costly re-tooling). Enforcement of compliance with the regulations can be a problem, particularly for new buildings.

Equipment Efficiency Standards. Worldwide, mandatory minimum efficiency standards have been adopted by seven countries for various household appliances, and in Western Europe, the European Union recently finalized energy efficiency standards for refrigerators and freezers (Turiel, 1997), At least six countries have adopted standards for industrial and commercial equipment (Duffy, 1996). Among developing countries, China, the Philippines, and Mexico have standards for household appliances, while China and Malaysia have standards for industrial equipment (electric motors and, in the case of China, boilers). The impact of these standards in terms of shaping the products brought to market varies, however.

The U.S. has the world's most extensive equipment standards program. Federal standards cover many types of home appliances, lamps, fluorescent ballasts, electric motors, commercial heating and cooling equipment, and plumbing fixtures. These standards are periodically reviewed and updated. Under law, new standards must be "designed to achieve the maximum improvement in energy efficiency which the Secretary [of DOE] determines is technologically feasible and economically justified." This language has been interpreted to mean that if a technology has been demonstrated in a prototype, it is technically feasible. Thus, the standards may force commercialization of previously developed technologies, if they are economically justified. More often, equipment efficiency standards remove inefficient products from the marketplace and force widespread production and sale of better technologies that are already available.

Equiment efficiency standards and the testing procedures on which they are based need to be appropriate for local conditions. To be effective, they should be introduced with sufficient consultation and agreement with the affected industry. The availability of testing facilities, and establishing industry trust in them, are also issues.

The impact of efficiency standards on local manufacturers is an important consideration. In some cases, small manufacturers may have difficulty in meeting standards because they may not have the necessary resources to invest in new designs or manufacturing processes. Larger companies are more able to afford to re-tool and often have the support of foreign backing. In these cases, assistance to small firms to help them produce higher-efficiency products may be appropriate.

Building Energy Codes. Building codes are used by governments at different levels to regulate the energy use characteristics of new residential and commercial buildings, including the efficiency of windows, roof and wall sections, and heating, cooling, and lighting equipment. Building codes are often set through a consensus or political process, so code requirements are generally limited to measures that are already well accepted. Once institutionalized, however, a code can be revised, strengthening the standards for efficiency and encouraging more widespread use of energy-efficient equipment and design practices. Both mandatory and voluntary codes have been adopted in developing and transitioning countries (Janda and Busch, 1994). Energy codes for new buildings are discussed further in Chapter 7.

Market Aggregation and Technology Procurement

One way to encourage the commercialization and early diffusion of a technology is to purchase the equipment in bulk, either by a single purchaser or a coordinated purchase by many parties. Bulk purchase can exert influence on the marketplace and attract the interest of manufacturers and suppliers. Bulk purchases can also help to reduce the cost of energy-efficient technologies by increasing the scale of production and reducing distribution and marketing costs. Many utilities in the U.S. and western Europe have purchased compact fluorescent lamps for resale or free distribution in large quantitites, obtaining very favorable prices. This approach was also used by the Mexican national electricity comany (CFE) in its Ilumex program to promote CFLs. Through a process of competitive bidding, CFE was able to obtain 1.7 million high-quality CFLs for an average wholesale price of $13-15. CFE has been selling the CFLs, with an additional subsidy, to its customers in two cities.

A variety of institutions can be organized to conduct bulk purchase. In many countries there are significant concentrations of residential units where the occupants do not pay individual electricity bills, instead paying some percentage of an aggregated charge for the entire building. Such multi-family complexes must pay for the electricity used by their occupants but often exercise little or no influence over the energy using products which the occupants bring into their buildings. They can offer their occupants significant discounts on energy-efficient products by banding together with other similar institutions to purchase in bulk.

Technology procurement can refer to the normal purchase of products by government agencies or other large buyers, or to special efforts to organize a market to entice technology suppliers to develop and/or commercialize products with higher energy efficiency. In the case of government procurement, policies that require higher levels of energy efficiency in products purchased by government agencies and in new public buildings can not only reduce energy costs for government. Taken as a whole, the magnitude of product purchasing by government is often significant enough to help move markets toward higher energy efficiency by assuring manufacturers of a major demand. For example, a directive that U.S. Federal agencies purchase only ENERGY STAR office equipment gave the ENERGY STAR program a major boost with manufacturers.

A major effort to enhance energy efficiency in product procurement is underway in the U.S. Federal government (McKane and Harris, 1996). A 1994 Executive Order directed all Federal agencies to purchase products that are in the upper 25% of the market in terms of energy efficiency. The Department of Energy is issuing guidance to agencies to provide government buyers with the tools that need to select more energy-efficient products: purchase specifications and sources of reliable data on product energy use.

Organized efforts to bring advanced energy-efficient technologies onto the market have been successful in the U.S. and western Europe. In most of these programs, technology procurement is a process in which different types of actors are brought together to define a technology goal which is reached through a competition among suppliers. These programs usually include some type of financial incentive to help the new product penetrate the market. Such programs can be promoted by government agencies, utilities, trade associations, and NGOs.

A leading example of technology procurement is the program run by the Swedish National Board for Industry and Technology (NUTEK). Between 1991 and 1996, NUTEK initiated some 30 technology procurements. Target products have included energy-efficient refrigerators, high-frequency ballasts for lighting systems, super-efficient windows, energy-efficient monitors, and small heat pumps for residential houses. A recent evaluation found that on average the procured technologies are 30% more energy efficient than prevailing products, the sales volumes are increasing, some learning effects have already been captured, and the unit costs of some technologies are decreasing (Lund, 1997).

In the U.S., the Super-Efficient Refrigerator Project (SERP) established a US$30 million pool of funding by electric utility companies to provide incentives ("golden carrot") for the most efficient refrigerator model that was CFC-free and at least 30% better than the forthcoming 1993 national efficiency standards. An evaluation study found that, while sales of this efficient new model were somewhat slower than expected, and prices somewhat higher, the program did impact the market both by introducing a line of competing models at significantly greater efficiencies, and by helping to set the stage for a consensus proposal by industry and environmental groups for a future round of national efficiency standards (Lee and Conger, 1996).

The SERP also gave rise to a new, nonprofit organization designed to carry out similar market-based programs for other products. The Consortium for Energy Efficiency now has 48 utility and governmental members and a series of active and planned projects to promote more efficient refrigerators, horizontal-axis clothes washers, ground-source heat pumps, residential and commercial air conditioners, motors and systems, chiller systems, and compact fluorescent lamps.

Voluntary Commitment and Recognition

Some companies are willing to make voluntary commitments to implement energy-efficiency measures in order to obtain recognition and other benefits. Programs that promote such voluntary commitments can accelerate the market introduction of new technologies and/or can stimulate consumers to increase implementation of cost-effective efficiency measures. An example of the former is the U.S. EPA's Energy Star Computer program. An example of the latter is EPA's Green Lights program in which corporations and other organizations agree to implement a large fraction of cost-effective lighting efficiency improvements in exchange for technical assistance and public recognition. Based on the success of the Green Lights program, EPA initiated other voluntary programs designed to increase energy efficiency in the buildings ector. In the Energy Star Buildings program, participants agree to improve the efficiency of building equipment such as heating and colling equipment and air distribution systems. In the Energy Star Homes program, participating home builders agree to incorporate high-efficiency heating and cooling equipment and appliances in their new homes. In both cases, participants in the program receive various kinds of technical assistance in addition to recognition.

Voluntary energy efficiency programs have played an increasingly important role as a climate change mitigation initiative among the OECD countries (Solsbery and Weiderkehr, 1995). In the Netherlands, for example, voluntary agreements on energy efficiency between the government and industrial sectors have proven effective (Nuijen, 1997). The government primarily aims for reduction of carbon dioxide emissions, while industry is primarily driven by cost benefits and the expectation that future regulation can be prevented by active participation. An intensive monitoring process assures that achievements are made visible. By 1995, the energy efficiency in industrial sectors covered by agreeements had increase by 10% relative to 1989, meeting the expectations of the program.

Recognition of voluntary efforts elevates the importance of energy efficiency in the eyes of corporate management by providing a public forum to demonstrate an interest in and broadcast accomplishments in energy efficiency In developing and transitioning countries, however, such recognition may be less valuable to the private sector.

5. MARKET-BUILDING POLICIES THAT SUPPORT ENERGY EFFICIENCY IMPROVEMENT

Some of the key barriers to improving energy efficiency are related to macro-economic conditions; energy prices; international flows of capital, technology, and knowledge; and institutional weaknesses. The effects of these barriers typically pervade an economy, inhibiting progress in energy efficiency in a variety of ways. Policies that can reduce these barriers include:

(1) Macro-economic policies that support stable growth and encourage competition in markets.

(2) Energy pricing reforms that send proper signals to market actors regarding the true cost of their energy use.

(3) Measures to improve flows of capital, technology, and knowledge between the local economy and the rest of the world.

(4) Strengthening the capacity of institutions to support improvement in energy efficiency.

A lengthy discussion of these policies is beyond the scope of this paper, but their importance should not be underestimated.

Macro-Economic Policies

Policies to improve macro-economic conditions can be grouped into two broad classes. In one are <u>traditional fiscal and monetary polices</u> that support stable economic growth, moderate price inflation and fluctuations in foreign exchange rates, and contribute to interest rates that are not excessively high. Such policies contribute to a favorable climate for investment in general, including investments that improve energy efficiency. Economic growth is associated with turnover of the capital stock, which provides opportunities to retire less efficient stock and to incorporate higher levels of energy efficiency in the new stock.

In the other class are <u>economic reforms</u> that encourage competition and increase incentives for market actors to improve the efficiency of their energy use. Historically, competitive processes in developing and transitioning countries have been inhibited by such factors as the regulation of profits, restrictions on licensing for new companies, and maintenance of monopolies by state-owned enterprises. All of these factors have tended to lessen management interest in improving productivity and constrained investment that might lead to higher energy efficiency. Deregulation of domestic industries and privatization of state-owned enterprises tends to increase competition and the incentive for firms to reduce costs. Lowering import duties and other barriers to imported goods can have a similar effect.

Energy Pricing Reform

Where energy subsidies exist, establishing a timetable for their reduction and ultimate removal can present energy users with a clearer signal in making decisions regarding energy efficiency. Where rapid increase in prices would lead to real social hardship, developing a realistic timetable for gradual increase provides consumers with greater certainty.

Externalities can be incorporated into energy prices in two main ways. The most common approach is to place requirements on energy suppliers and users to reduce environmental pollution and other damages associated with their energy activities, or to regulate the emissions from mass-produced products such as motor vehicles. Another method is to place taxes on emission of particular pollutants. In Poland, for example, sulfur dioxide and nitrogen oxides emissions are heavily taxed. Such taxes can serve as a source of revenues for funds to support energy efficiency and other environmentally-friendly investments (as is the case in Poland).

It can be difficult to find accurate empirical underpinning for setting appropriate levels for externalities. This is often true for local pollutants, and is especially the case for carbon dioxide and other greenhouse gases. Where it is difficult to incorporate externalities for practical (or political) reasons, factoring them into policy and project analysis in a less formal fashion is possible. Some form of shadow pricing that incorporates modest assumptions for the level of externalities can be a pragmatic first step.

Improving Flows of Capital, Technology, and Knowledge

Capital Flows. A variety of policies can encourage direct foreign private investment in new or existing local firms, which may support modernization of facilities and/or ventures to supply energy-efficient technologies. These include policies affecting repatriation of profits and taxation, regulation of joint ventures, as well as establishment of a clear legal framework affecting contracts.

Technology Flows. A great deal of technology transfer to developing and transitioning countries takes place through investment by multinational corporations. In negotiating terms with multinational corporations, the nature of the technology to be brought in can be a subject for discussion. Since the developing and transitioning countries tend to be recipients of technology from the more advanced countries, achieving success in this area will require international dialogue and cooperation involving governments and the private sector. Furthering transfer of promising technologies and practices among developing and transitioning countries is also important, particularly for technologies that address the needs of the rural sector.

Joint ventures between local and multinational companies are prime vehicles for the transfer of new designs and production techniques, as well as sources of capital for new production facilities. Joint ventures can be very important in increasing production of energy-efficient equipment. In China, for example, much of the more efficient fans, pumps, and other motor-driven equipment is produced by joint ventures between Chinese and foreign companies that were established to produce for domestic and export markets. Although the products from joint ventures are often targeted for Western markets (to earn hard currency), sales in the domestic market can be encouraged by measures to increased demand.

Selective reduction of duties for energy-efficient equipment that is not produced locally is a policy option that some countries have implemented. In Pakistan, for example, the import duty on compact fluorescent lamps (CFLs) was reduced in 1990 from 125% to 25%. As a result, the price of a single CFL dropped by almost half, and sales started to rise. In some cases, however, definition of what constitutes an "energy-saving technology" can be a problem. Where the domestic industry is just beginning to produce higher efficiency equipment, the situation may warrant maintaining import duties for a time. Reducing import tariffs on capital equipment for the production of energy-efficient products is also an option.

Knowledge Flows. Various measures can enhance the flow of up-to-date knowledge to support energy efficiency improvement. These include providing more resources for libraries and conferences, translation and dissemination of publications in native languages, better access to the Internet, and opportunities for specialized education abroad.

Institutional Strengthening

Strengthening existing institutions or building new ones can contribute to market transformation in many ways. In some cases, the impacts are perceived gradually over time as human resources are developed to plan, implement and support energy efficiency activities. In other cases, institutions can play a more immediate role in supporting energy efficiency improvement.

Education and Research Institutions. Strengthening education institutions such as universities and technical institutes enhances the capacity of these institutions to provide the human resources needed to design and supply more energy-efficient technologies and systems. Important activities include improving the education of engineers and architects with regard to energy efficiency. In transitioning countries, basic education is widespread and technical skills are relatively abundant, but skills related to business and marketing are in need of development.

Support for research institutions provides the basis for development and adaptation of energy-efficient technologies and systems that are suited for the local environment. Local R&D is especially important for technologies that are not produced by multinational companies but that may meet the needs of developing countries. This category includes technologies designed for the rural sector, such as those that deliver more efficient use of biomass energy.

Government Agencies. Most governments in developing and transitioning countries have agencies or departments within ministries that are responsible for promoting energy conservation. The capacity of these agencies to plan and conduct effective programs can be enhanced through various forms of training. Numerous development assistance programs have provided such training.

Financial Institutions. Local financial institutions can play a key role in facilitating investments to improve energy efficiency. Their capacity to perform such a role can be enhanced through training for staff in evaluation of loans related to investments in energy efficiency, and by providing information on the types of financing arrangements that are appropriate for loans related to energy efficiency investments.

In India, for example, the Industrial Credit and Investment Corporation of India, Ltd. has been working with the Asian Development Bank (ADB) and the U.S. Agency for International Development for over five years to strengthen its management's ability to support energy efficiency projects and to act as an agent bank for ADB in the development and commercialization of energy-efficient technologies.

Another example of a project in which building the capacity of local FIs to support investments in energy efficiency is a key component is the Hungary Energy Efficiency Co-Financing Fund (HEECF), a project begun in 1996 with GEF support. This project is described in Chapter 7.

Electric Utilities. Utilities can play a major role in efforts to improve the efficiency of electricity end-use if appropriate incentives are in place. The capacity of utilities to be effective in this role can be enhanced by training for staff in energy efficiency program analysis and program management. Training in techniques of Integrated Resource Planning can help utilities determine the value of programs to improve customer electricity-use efficiency, and to prioritize their efforts.

One approach to enhancing the capacity of utilities to engage in energy efficiency activities is to provide utility managers from developing and transitioning countries long-term, on-the-job training based at utilities in the OECD countries with experience in such activities. A program operated by a U.S. NGO in cooperation with utilities organizes 6-to-9 month training periods for mid-level utility managers. The program is designed to operate in tandem with technical assistance projects and power sector loans from development agencies and multilateral development banks. Participants gain networking opportunities such as attendance at conferences and seminars, and business relationships can be formed between the "sending" and "training" utilities. When the participants return to their home utilities and take on managerial roles in energy efficiency units, they may continue to receive technical assistance from the program to help them implement their first projects.

Energy Conservation Centers. An energy conservation center (ECC) can be established as a semi-autonomous government body or non-profit organization. ECCs facilitate an integrated approach to energy efficiency programs. They typically carry out several basic functions: educating the public about the benefits of energy conservation; conducting energy audits or feasibility studies; and training professionals, such as engineers and plant managers whose work has a direct impact on energy use. An ECC provides convenient "one-stop shopping" for energy efficiency services for businesses and the general public. ECCs are also convenient recipients of foreign donor support.

A number of Asian countries established energy conservation centers, with the assistance of foreign donors, in response to growing concerns over energy use, and thus increased interest in energy efficiency, in the 1980s. These include China, India, Indonesia, Pakistan, and Thailand. While none of the centers can be regarded as a universal success, each center has elements that have been successful (Rumsey and Flanigan, 1995a). Training programs in particular have been popular. There is some question regarding the effectiveness of energy audits, however, in part because the centers have not offered financing for energy efficiency projects. Energy conservation centers have also been established in several transitioning countries.

Professional Associations. Professional associations for engineers, architects, building managers, and others can play a number of roles in promoting energy efficiency. Their primary focus is activities to enhance their members' skills, such as training and dissemination of information. Professional associations can also perform an important networking function, keepings their members abreast of new developments in the field. Professional associations may also be involved in development of concensus standards with respect to energy efficiency, as has been the case in the U.S. with energy efficiency provisions of codes for new building construction.

Providing training in conjunction with professional associations can help to affirm their value to members. Promoting links with counterpart professional associations in the advanced countries can provide an important channel for flow of information.

6. DESIGNING MARKET TRANSFORMATION STRATEGIES[1]

Design of traditional energy efficiency programs requires asking two basic questions: What will the program attempt to accomplish? And how will it accomplish its goals? For a market transformation strategy, a third question is also critical, and requires careful thought: What will happen to the target market after the program is over? How can a strategy yield market improvements that are sustainable even after external facilitation and support resources are withdrawn?

Formulating a Market Transformation Strategy

In assembling a portfolio of actions to achieve market transformation goals, the following criteria are important to consider:

- *Offers the greatest leverage potential.* The selected actions should target the market deficiencies with the greatest likelihood of being overcome, the least resistance to change, and the greatest opportunity to leverage the impact of other relevant actions. They should target the market actors most ready to change established patterns of behavior and decision making processes.

- *Breaks down common market deficiencies.* The selected actions should, as much as possible, address those barriers causing multiple market deficiencies and address problems that are common to various market segments.

- *Yields the greatest technical opportunities.* The implementation of market transformation actions that result in the greatest efficiency gains will prove the effectiveness of the approach, catalyze expanded industry and other stakeholder support, and help build a foundation for long-term actions with less quantifiable results.

A key element of strategy design is to seek synergy between various elements in order to support sustained evolution of the market in the direction of improved energy efficiency.

An important issue in designing a market transformation strategy is whether to provide financial incentives (subsidies) to reduce the cost of energy-efficient technologies and thereby encourage their use, and if so, how large they should be. The issue of financial incentives is especially important in developing and transition countries, where the first cost of products is often a primary consideration, and various factors lead to high discounting of future energy savings (either explicitly or implicitly).

On the one hand, incentives may be necessary to build demand for the technology in the early stages of its market penetration. When an energy-efficient technology is unfamiliar,

[1] Several sections in this chapter are adapted from U.S. Department of Energy (1996). See also Dowd, et al. (1995).

an incentive can help overcome initial reluctance to its use. By creating larger demand for the product, incentives can contribute to greater production volume and associated economies-of-scale, which in turn lower the cost of the technology.[2].

On the other hand, the use of incentives may pose problems after the program ends and the incentives are no longer available. Potentially, incentives can be counter-productive to the goal of creating a sustained demand for the energy-efficient technology if it is not able to compete without subsidy. One approach is to gradually reduce incentive levels over time, monitoring market adoption of the energy-efficient technology in the process.

The provision of incentives can take up a large share of a program's budget. In government programs, funds have typically come from budget allocations or from special funds based on specific taxes. Money for incentives in utility DSM programs usually come from utility revenues (i.e., from all ratepayers) or from a special fund. Where payment of an incentive involves a transfer from the general population to program participants, there may be equity concerns.[3]

Given the potential problems and cost associated with financial incentives, their use should be considered carefully. Other methods of dealing with the higher-first-cost problem, such as financing or leasing strategies, may have a smaller impact in the short-run but lead to a more sustainable market development in the long run.

Combining different actions in a strategy

In formulating a market transformation strategy, it is useful to distinguish between three different types of actions:

- Those that lead directly to enhanced system performance and reductions in energy consumption — direct market actions.
- Those that lay the foundation for actions with direct results — infrastructural and enabling actions.
- Those that are essential for ensuring effective communication — network organization development.

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[2] The use of incentives is sometimes justified as a way to compensate for subsidies in the price of energy products or the failure of market prices to reflect environmental and other externalities associated with production and use of energy. Since, it is argued, removal of subsidies in energy prices is politically difficult in many cases, and incorporation of externalities poses practical problems in terms of quantification and valuation, the next-best strategy is to subsidize energy-efficient technologies (and/or "clean" energy supply technologies).

[3] An approach that avoids the need for incremental funds is the so-called "feebate" scheme, in which funds for rebates for more efficient products come from fees placed on less efficient products. The "feebate" approach is most suitable for products for which purchasers must pay a duty or registration fee (such as for motor vehicles).

Direct market actions attempt to directly influence the behavior of those in the marketplace. Examples of direct market actions include purchasing collaboratives, financial incentives such as rebates, and audit services to identify and quantify savings.

Infrastructural and enabling actions build and strengthen the market infrastructure and enable future market actions to take place. Examples of these actions include test protocols, training and education, equipment ratings, and labeling guidelines. In general, without these enabling actions, direct market progress would be limited. For example, rebate programs are possible only if protocols for equipment testing and labeling are already in place.

Development of network organizations of stakeholders, including end-users, manufacturers, distributors, designers, researchers, and other market players, is fundamental to sustaining market transformation.

Successful market transformation typically requires execution of a number of actions in parallel, with the infrastructural and enabling actions and direct market actions coordinated in some way. The actions selected and the form that they take are determined by the product, market characteristics, and the market barriers to be addressed. Strategy development involves decisions about whom to involve, where in the market actions should occur, and when actions should take place.

Market transformation actions may target manufacturers, distributors, installers, or end-users. Actions may be targeted at specific segments within each market. For example, within the market for industrial fan and blower systems, one can find several application subsegments, such as mechanical draft, exhaust, drying, and air cleaning systems. Typically, each market segment has unique characteristics, displays varying deficiencies, is at a different point in its development, and requires varying amounts of movement toward greater energy efficiency.

Market transformation strategies may also target actions at different levels of technical systems. Actions may be aimed at a component such as a motor or fan, a packaged system, or an integrated system.

The decision point at which players initiate investment transactions is an important consideration in strategy design. For example, some transactions (such as the stocking of energy-efficient models by manufacturers or equipment selection or system design by in-plant or contracting engineers) are made prior to the sale. Other transactions, such as end-user repair and replacement policies, are made at the time of the sale. Still others are made long after the sale (for example, repair, component replacement, and O&M). The first two relate to actions involving new or replacement equipment, the third relates to the installed base. Transactions prior to or at the time of the sale are attractive from a program point of view because of the high potential to leverage program efforts.

Parallel actions may be the best way to address issues of timing. For example, creating a demand for motor system expertise without addressing the lack of available experts will likely cause the first action to fail.

While an enabling action is often a prerequisite for "conditioning" the market to accept a direct market action, there are some cases where it may not be necessary. An example is development or promotion of decision support tools, such as equipment selection software or a database on equipment, which encourage demand for energy-efficient equipment without the need for financial incentive actions. Similarly, there are other instances where direct market actions may proceed independently and without the need for an enabling action (for example, voluntary commitment and recognition activities).

Combining actions to achieve market transformation: an example

In most instances, market transformation actions need to be implemented as a series of linked enabling and direct market activities. This is illustrated in the following example of a market transformation process for the air compressor systems market segment.

Packaged industrial air compressor systems were identified by market participants as an area in need of improved standards, voluntary test procedures, and performance certification guidelines. Conditions in this market segment make it difficult to compare performance across compressor types and among manufacturers, and it is difficult to select the most efficient packaged air compressor system.

The promulgation of widely accepted voluntary test procedures for air compressors would provide a foundation for comparison of compressor performance. Also, as the end-users of industrial air compressor systems become more sophisticated and demanding in their purchasing practices, equipment manufacturers would be encouraged to adhere to energy-efficiency rating and labeling guidelines to maintain their market share and satisfy customer requirements. Broadly endorsed certification programs for professional skills or validation of test results would help assure system purchasers that their decision process was informed by professionals knowledgeable in the "systems approach" and was based on validated product testing.

Successful transformation of this market segment requires a combination of both enabling or infrastructural actions and selected direct market actions. One enabling action is development of a voluntary test protocol for air compressor package efficiency testing. However, existence of the protocol alone may do little to move the market toward greater efficiency. Complementary direct market actions, including voluntary certification, purchasing collaboratives, and common purchase specifications for packages, are needed to move the market transformation process forward.

In this example, the enabling action (establishing the air compressor package testing procedures) prepares the market for the direct actions to follow. The testing procedures alone would have little market impact without a means of certifying the accuracy and application of the procedure, encouraging end-users to specify the testing and certification of purchased compressor systems, and focusing the combined market power of groups of customers in collaborative ventures to demand equipment meeting the testing requirement. These linkages are typical of the relationship between the enabling and direct market action.

Roles for different actors

A market transformation strategy may have appropriate roles for private industry, utilities, government agencies, and other organizations. Private industry usually leads marketing efforts, and may conduct R&D. Government agencies can assist with R&D and demonstrations as well as participate in bulk purchases and promotion efforts. Government agencies also adopt efficiency standards and building codes. Utilities can offer conventional consumer incentives as well as less traditional commercialization incentives (e.g. "golden carrot"). Utilities can also participate in R&D and demonstrations and can sponsor training, education, and evaluation efforts. Other organizations can help to coordinate the efforts of these different parties into an integrated market transformation strategy.

Government agencies and utilities can play a role in ensuring that energy-efficient technologies meet performance requirements, are properly installed, and are used in ways that maximize energy savings and other benefits. For example, some utilities have adopted power factor and harmonic distortion requirements in their incentive programs for electronic ballasts, CFLs, and ASDs, thereby stimulating technological modifications that improved the non-energy performance and marketability of these products. Some utility CFL programs have also emphasized products with flicker-free operation and with light output truly equivalent to that of incandescent lamps and provide accurate and reliable performance information, which in turn has stimulated development of better-quality technologies.

The incentive for electricity supply companies to participate in market transformation activities is likely to be influenced by the power sector reforms that are being undertaken in many developing and transitioning countries. In the industrialized countries, power sector restructuring and the resulting increased competition is reducing the incentive for utilities to pursue DSM as they have in the past. In those areas where utility involvement in increasing their customer's electricity use efficiency survives, however, market transformation type activities may be an effective method of achieving strategic goals with a minimum expenditure of resources. [4] The capacity for a well-designed market transformation strategy to leverage utility resources may prove to be especially important in developing and transitioning countries.

The Process of Strategy Design

The process of strategy design described in this section assumes that a target market has already been selected by those who intend to implement a market transformation strategy. Such a selection would typically be the outcome of an assessment conducted at either a national or sectoral level. For example, in the context of developing strategies for climate change mitigation, analysis that identifies and roughly characterizes potential opportunities should be conducted. Such a study might include, or be followed by, a process that applies multiple criteria in order to prioritize options. A national team might

[4] For a discussion of key issues with respect to promotion of energy efficiency in reformed electricity markets, and a review of the experience in six countries, see U.S. Agency for International Development (1997).

then conduct further analysis of the most promising options, leading to a selection of target markets for programs or projects (U.S. Country Studies Program, 1996).

Assembly of an appropriate team that is responsible for the design and implementation of a market transformation strategy is an important first step. The experience of market transformation programs indicates the importance of a strong lead organization to coordinate the activities and involvement of various parties and to be responsible for timely implementation of the actions that comprise the strategy. This lead organization might be a government agency, an electric utility, or a non-governmental organization. The size of the team depends on the likely scope of the program. One approach is to have a core team with ultimate responsibility for design and management, supported by an advisory team comprised of a larger number of stakeholders in the market.

Developing an in-depth understanding of the target market, the relevant technologies, and the barriers to improving energy efficiency is an essential prerequisite for design of an effective strategy. The next section describes the process of market analysis. Such analysis can be usefully supplemented with informal input from key market actors through meetings. It is also important to consider relevant programs that may already be in the process of implementation. The actions selected should complement existing programs and address market barriers that are not dealt with by those programs.

The above steps set the stage for assembly of a portfolio of promising actions. The next step is to assess the prospective actions with respect to the criteria listed earlier, and others that may be important. This assessment, which should involve key stakeholders, would result in a recommended set of policies and actions to include in the strategy. Further analysis is then needed to better quantify the expected impacts of each of the actions, and to identify the human and financial resources required to implement them.

Quantifying expected impacts is more complicated in the case of a market transformation strategy than with traditional energy efficiency programs. The impacts of certain types of actions, especially those whose effect may build gradually over time, can be quite difficult to quantify. In addition, a key aspect of a well-designed market transformation strategy is that the overall impact of a set of policies and actions taken together is likely to be greater than the impact if they were taken independently.

Market analysis

Devoting sufficient effort and resources to understanding the target market before designing a market transformation strategy is critical to formulating a strategy that is likely to produce the most results with the least amount of intervention and cost. In addition, the very process of market analysis will identify market actors who can play a significant role in designing and implementing the strategy.

Key goals of a market analysis include the following:

- Obtain a better understanding of the structure of the market and its distribution channels.
- Gain insight into how equipment and systems are designed, specified, and operated.

- Estimate the potential energy savings from improved equipment efficiency, improved system design, application of controls (where possible), and improved O&M practices.
- Identify key barriers to improving energy efficiency.
- Identify key leverage points of influence in the marketplace.

A market analysis can also identify which market segments are most in need of attention or offer the best opportunities.

A market analysis would typically involve gathering market intelligence through telephone and in-person interviews with a variety of market organizations (manufacturers, distributors, design firms, and end-users) as well as with industry associations and experts. The research would review and analyze primary and secondary information, such as manufacturers' product literature and other publicly available materials. The amount of effort required for market analysis in a given situation depends on the state of existing information. In many cases, some type of survey will be needed.

Market-Building Policies and Market Transformation

Ideally, a market transformation strategy should be accompanied by market-building policies that create a conducive environment for the actions designed to transform specific markets. In practice, it may be difficult for those who are responsible for designing strategies to promote energy efficiency to have very much impact with regard to the implementation of macro-level policies, since such policies are motivated by much broader concerns than improvement of energy efficiency. What planners of energy efficiency strategies can do, however, is identify which market-building policies are likely to be most significant for a particular market. In trying to transform the market for agricultural pumping systems, for example, policies to reduce subsidies for electricity or diesel prices may be critical to the success of other efforts.

Although macro-level reform policies may be broadly beneficial, especially in the long run, they can be difficult to fully implement because influential sectors of society may be harmed in the short run. To some extent, market transformation actions to improve energy efficiency can help to reduce negative impacts. By expanding the opportunities for consumers to increase the efficiency of their energy use, the actions can soften the impact of higher energy prices resulting from removal of subsidies or incorporation of externalities. They can help businesses increase their productivity and thereby better adapt to a more competitive environment resulting from market liberalization policies and/or privatization.

Strategies to improve the energy efficiency of locally-made products can also help local manufacturers compete in the domestic and also export markets. For example, minimum efficiency standards can reduce the competitive threat from cheap and inefficient imports. And to the extent that they motivate local manufacturers to improve the quality of their products, standards and other actions can help domestic manufacturers succeed in international markets.

7. MARKET TRANSFORMATION STRATEGIES FOR SPECIFIC MARKETS

The preceding chapter emphasized the importance of taking into account the nature of the target market in designing a market transformation strategy. The types of actions that are most likely to be effective vary among different markets, as does the way in which actions can best be combined to meet objectives. This chapter discusses approaches for market transformation strategies for three broad classes of markets: new products, new buildings, and existing buildings and industrial facilities. The chapter also addresses strategies that target an entire sector or end-use and seek to affect decisons regarding both existing buildings or facilities and the acquisition of new technologies. Each section presents examples of strategies that have been used to promote market adoption of energy-efficient technologies in various countries, with particular emphasis on developing and transitioning countries. Although most of these examples are not comprehensive market transformation strategies, they represent approaches that can be part of such strategies.

Strategies For New Products

New energy-using products are an important target for market transformation strategies because they represent opportunities for incorporating energy efficiency that would otherwise be lost. New products are an especially important target in developing countries because their sales are growing at a rapid rate in many cases. A market transformation strategy may seek to increase the market penetration of more energy-efficient products that are already available, and/or to encourage development and commercialization of very efficient products that are not yet on the market.

To be effective, a strategy must recognize the market demand for a given product, which may be concentrated in one sector, or may cut across sectors. For example, domestic refrigerators are mainly purchased by households. For room air conditioners, on the other hand, there may be a significant demand in the commercial/government sector as well as in households. For products whose demands cuts across sectors, a market transformation strategy needs to take into account the different characteristics of the various end-users.

A strategy must also recognize the structure of production, as well as the distribution channels for products. Production may be dominated by a few business firms, perhaps with strong links with foreign companies. Such firms may have considerable technical and marketing expertise. Or, there may be many small companies involved in production, with relatively low levels of expertise.

In many cases, advanced energy-efficient products are not manufactured in a country, and must be imported. Reduction of import duties can help to increase demand, which might prompt local entrepeneurs to begin production, or encourage foreign companies to invest in local production capacity to meet the demand (and perhaps for export also). Local production can be encouraged by various means. For example, in one of the programs described below, participating manufacturers are required to conduct a substantial portion of their production in the country. Encouraging local production can result in lower prices (depending on the level of duty on imported energy-efficient products), and also generate employment and other economic benefits.

The remainder of this section describes strategies to promote energy efficiency for four types of products that are significant energy users in developing or transitioning countries: residential lighting products, residential electrical appliances, fluorescent lamps, and industrial motors.

Residential lighting products

The compact fluorescent lamp (CFL) consumes only around 25% of the electricity of an incandescent light bulb, and lasts 8 to 10 times longer, but its retail price is typically 20-30 times higher. Although CFLs offer a relatively short payback period for many households in applications where a light is used for several hours per day, the large price difference poses a significant first-cost barrier to consumers.[1] Thus, most programs to promote CFLs have involved some type of product subsidy to lower the retail price. Such subsidies have been effective in raising consumer awareness and increasing purchase of CFLs in the U.S. and western Europe (Mills, 1993), but their impact on long-run market development (when the subsidies are no longer available) is less clear.

The pros and cons of alternative strategies can be seen in the different approaches that have been used to promote CFLs in programs recently implemented in Mexico, Peru, and Poland. In Mexico, CFLs were purchased in bulk by the national utility after a competitive bidding, and then re-sold to customers at a subsidized price. The program in Poland provided subsidies directly to CFL manufacturers, and required that they pass on the full value of the subsidy in the form of lower wholesale prices. In Peru, there was an explicit policy to avoid the use of subsidies and instead rely on market forces. The program used a combination of an intense publicity campaign and a financing plan in which the price of the CFL was charged on the customer's monthly electricity bill over a two-year period. As each of these programs is rather recent, it is too soon to evaluate their impact on the long-run development of the CFL market, but some speculation is possible.

Mexico's Ilumex Project. The national utility (CFE) acquired 1.7 million CFLs from several manufacturers after a competitive bidding process. The cost to CFE was $13-15 per CFL. The lamps were sold at CFE district offices in two cities at a price of $5-6. Customers could either pay cash or pay over time through their electric bills. The subsidy was supported by funds from the GEF pilot phase and from Norway.

Although sales have been brisk, a program such as Ilumex raises questions with respect to its impact on the long-run development of the CFL market. If the utility is selling CFLs at a price far below what normal retail outlets charge, it would seem likely that sales through normal channels would greatly decrease. Several questions arise. Does the utility intend to be in the business of selling CFLs over the long haul? Can it sustain a subsidy indefinitely? If not, what might happen to consumer demand when the subsidies are reduced or removed? While it is clear that a high level of subsidy will encourage purchase and thereby make consumers more

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[1] CFLs are also used in commercial and industrial buildings. Indeed, sales to the commercial sector account for a large share of the market in most developing and transitioning countries. Lights are typically on for many hours per day in commercial applications, and commercial sector electricity prices are usually not subsidized, so the payback period for a CFL is quite rapid. In addition, commercial establishments can save labor costs by not having to replace burned-out incandescent bulbs as often.

familiar with CFLs, it is less evident whether they will continue to purchase CFLs at regular prices.

Poland Efficient Lighting Project. In the U.S. in the early 1990s, some utilities re-focused their CFL-promotion programs away from direct sales or consumer rebates and began to rely more on private sector involvement to encourage manufacturers, wholesalers and retailers to increase the availability and decrease the price of CFLs to consumers. This approach was used as a model for the Poland Efficient Lighting Project (PELP), which was developed by the International Finance Corporation (IFC) in conjunction with U.S. and Polish NGOs (IFC, 1996).

Prior to the project, CFLs were manufactured in Poland by a local/foreign joint venture company, but most of the production was exported. To develop the local market, PELP was designed to use a combination of direct manufacturer subsidies, other DSM approaches, and consumer and lighting professional education. It sought to achieve direct replacement of more than 1.2 million incandescent light bulbs with CFLs over an eighteen month period.

PELP was supported by $5 million in GEF pilot phase funds, much of which wereused to "buy down" the manufacturers wholesale price for CFLs at the beginning of the product distribution chain. This buy down results in lower retail prices for each unit of subsidy than, for example, providing rebates directly to consumers. Retail shops in Poland and other countries typically calculate retail prices by multiplying the wholesale prices they pay by a set markup percentage. In addition, VAT (value added sales tax) in Poland is also based on a percentage of the wholesale price. A rebate given to the consumer decreases the price of the CFL after both the retail markup and VAT. When the rebate is given to the manufacturer to reduce the wholesale price of a CFL, both the retail mark up and the VAT paid are also reduced. For example, by the time a 15% wholesale markup, a 25% retail markup, and a 22% VAT are factored in (75% total increase over manufacturer's price), a $1.00 subsidy on a CFL in Poland reduces the retail price by $1.75. The direct manufacturer subsidy approach also has many administrative benefits compared to retail-level programs, including greater control over product price and availability, and reduced program overhead costs.

The average manufacturer subsidy in PELP is slightly more than $2.00/unit. The subsidies are potentially available to any CFL manufacturer that can meet the technical requirements of the program and substantially manufactures its product in Poland. All CFLs must meet minimum technical standards. Manufacturers must pass on the full value of the subsidies as lower wholesale prices, and are also encouraged to provide additional wholesale price reductions and advertising. They are encouraged to propose subsidies which vary by the type of CFL, applying only the minimum subsidy necessary to each model to achieve the desired sales. Manufacturers are also required to help where they can to ensure that consumers actually see substantially lower prices for PELP subsidized products.

The subsidy in the PELP results in a reduction in the retail CFL price of approximately 40%, and reduces the payback period from three to two years. While the PELP is intended to support sustained growth in the market for CFLs, it remains to be seen what will happen to sales when the PELP subsidy is no longer in effect. A survey found that 80% of consumers purchasing a PELP-subsidized CFL said that they intend to buy more CFLs in the future, but how many will actually do so if the price is higher is uncertain. It is possible that the PELP will expand the market for CFLs such that the private sector can sell greater volume and reduce its profit margin per unit.

Peru's CFL Program. The initial program idea in Peru -- motivated to address shortage in peak power supply -- involved bulk purchase of one million CFLs by the government for free distribution to low-income groups (Romani-Aguirre, 1996). This idea was not approved, however, because the government was promoting an economic policy that sought to consolidate a free-market economy and was eliminating state subsidies. The policy guideline that was set forth for the program made clear that private-sector companies had to sell the CFLs at market prices. No customs duties exemptions would be granted, nor would there be any direct subsidies.

Despite the high price of CFLs, it was believed that the upper-middle economic sector would purchase the product. Demand would be generated by means of an intense publicity campaign. For the campaign, the name compact fluorescent lamp was rechristened "energy-saver light bulb", which is far more understandable for the majority of the Peruvian population. In addition to television and radio broadcasting spots and ads in the press, informative material was printed and demonstration activities were carried out.

A financing plan was implemented for the lower-middle sectors in the provinces. The guideline for its design was that monthly payments should be, to the extent possible, equivalent to or less than the economic savings achieved when substituting an incandescent light bulb with a CFL. A marketing scheme, consisting of the distribution of coupons to the users, was designed. The coupons could be exchanged for CFLs in authorized dealerships, and the price was charged on the user's monthly electricity bill. This installment plan extended the payment over two years.

It appears that the publicity campaign had a significant effect. Prior to the program, annual CFL sales were believed to be about 20,000 units. In the year after the campaign, 430,000 CFLs were sold (mainly on a cash payment basis). The program sponsors in the government hope that a limited information campaign will be sufficient to support the CFL market in the future.

The level of electricity prices clearly plays a role in motivating consumers to consider purchase of a CFL. The success of the program in Peru in promoting CFL sales without the use of subsidies may be partly attributable to the high price of electricity of $0.12/kWh (in Lima). At this price, the average payback period for a CFL costing $20 is only 14 months.

Market Development Issues. Because CFLs are so expensive, their durability is a key concern, particularly when they are used under the conditions of large electricity voltage fluctuations that are common in many parts of the developing world. This problem was addressed in the Mexican Ilumex program. The specifications for the CFLs asked for lamps that could take +-10% of nominal line voltage of 127 V (this range is what CFE is allowed to put out). Although there have been claims that the program helped to establish a CFL technology suitable for developing country conditions, it is not clear whether the CFLs delivered for Ilumex were specially made by the manufacturers to withstand the voltage variations expected in the Mexican grid.

In some countries, the expanding CFL market has led more manufacturers to enter the market, some of whom are selling substandard products which do not deliver expected performance. This problem can be addressed by the establishment and marketing of a mark or logo that is independent of all manufacturers and which only CFLs meeting rigorous technical specifications are permitted to carry. Participating manufacturers submit products for testing before applying the program mark to their products. By providing an independent assurance of product quality, this approach lowers the consumers' perceived risk when investing in energy efficient lighting. A special logo is being used in the Polish CFL program to help consumers identify high-quality products, and a similar logo has been developed in Mexico.

An issue that affects the long-run development of the CFL market is the promotion of hard-wired CFL luminaires. Screw-in CFLs are designed to replace an incandescent lamp in a traditional Edison socket and will fit into many luminaires designed for incandescent lamps. However, lighting manufacturers can also produce hard-wired luminaires which are optimized to the optics and electronics of a CFL. In these luminaires the ballast is incorporated into the housing and the socket will only accept an appropriate fluorescent tube. Although their initial cost is higher, hard-wired CFL luminaires are the optimal long-term option for consumers because they maximize the performance of the fluorescent technology, and allow the tube to be replaced without discarding the ballast. The replacement tube typically costs only one-third as much as a screw-in CFL. The promotion of hard-wired CFL luminaires is particularly appropriate in new homes or in residential buildings undergoing renovation.

Summary. Consumer education to inform consumers of the benefits of CFLs is a key part of a strategy to promote their use, but their high first cost poses a major challenge to their widespread adoption in the residential market, particularly for first-time buyers. However, the experience with CFL programs indicates that relatively moderate per unit price reductions can result in large increases in CFL sales, when coupled with appropriate marketing and a sophisticated delivery approach. Buying down the manufacturers' wholesale price yields the greatest reduction in retail prices for a given amount of subsidy, provided that the reduction gets passed along the entire distribution channel.

The first cost barrier can also be addressed by providing financing which enables the consumer to stretch payments out over time, or by leasing CFLs to consumers with the ownership, and performance risk, being retained by a leasing entity. Any organization which has the capacity to cost-effectively handle billing for a large number of small transactions is potentially a candidate for managing and implementing a CFL leasing/financing program. Typically, this would be an electric utility, but a local government or even a housing complex could also play the role if it has a pre-existing billing system for other utilities or rent.

Residential electrical appliances

Residential electrical appliances that might be targets for market transformation efforts include refrigerators, air conditioners, clothes washers, and other smaller appliances such as fans and rice cookers. Compared to CFLs, the first-cost differential between more energy-efficient models and standard models is much less extreme, but still poses a barrier. A complicating factor is that more energy-efficient models are often higher-quality in other respects as well, which tends to place them in a niche at the upper end of the market. At the same time, design features that deliver higher energy efficiency may also provide other benefits, such as quieter operation in the case of refrigerators.

As examples of market transformation strategies for residential electrical appliances, this section describes two programs that work at opposite ends of the market. The standards and labeling program that has been implemented for air conditioners in the Philippines establishes a floor for energy efficiency and a foundation for more informed purchasing by consumers. The U.S-China Super-Efficient CFC-Free Refrigerator Project, in contrast, aims at the development and commercialization of an advanced product not yet on the market. While different in approach, both programs rely on a cooperative effort between government and industry.

Air Conditioners -- Standards And Labeling. The Philippines Residential AirCon Standards and Labeling program represents a successful model of how government can accelerate the transformation of the market for household appliances at low cost by working in collaboration with manufacturers.[2] The Philippines AirCon program is similar to appliance standards and labeling programs in the United States and other countries. The standards establish minimum levels of efficiency that all units must meet in order to receive government certification to be sold in the country. These standards can be ratcheted upwards over time to continually remove the least efficient products from the market. Meanwhile, the labeling component educates consumers on the benefits of energy-efficient appliances. As consumers become energy-conscious, manufacturers are provided with an incentive to use energy efficiency as a marketing tool and to outstrip their competition in producing cost-effective, energy-efficient products.

As part of the energy conservation program of the Philippines government, air conditioners were given a high priority because, while only penetrating a small fraction of households, they represented one of the most dramatic areas of increased demand for electricity in the residential sector. It took over ten years to implement the Residential AirCon program, however. This was a function of the major government changes in the mid-1980s, the ensuing economic slowdown, and the painstaking (though ultimately rewarding) process of bringing the private sector into the negotiations in order to develop reasonable standards that could be improved over time.

Officially begun in early 1994, the AirCon program involves two government agencies. The Department of Energy (DOE) administers the program and runs the Fuels and Appliances Testing Laboratory (FATL). FATL serves as an independent testing laboratory to verify manufacturers' assertions of the efficiency of their units. The Department of Trade and Industry's Bureau of Product Standards is responsible for enforcing the standard. Initially covering only domestically produced units, the program was modified to cover imported air conditioners as well.

The standards established through the program set a floor Energy Efficiency Ratio (EER) for all air conditioners. The EER also serves a key labeling function. Prominently displayed on a certified yellow card on every residential air conditioner sold, the EER can be a means for manufacturers to promote their high efficiency units. FATL analysts suggest that prior to the initiation of the program, only half of the annual sales volume for small-sized, window-type air conditioners met the standard, while none of the larger units did. The standards were made more stringent in 1996.

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[2] This section is adapted from Rumsey and Flanigan (1995a). For further information on the Philippines program, see Rumsey and Flanigan (1995b).

The AirCon Program has been a success because it has been a carefully crafted effort between the public and private sector. Rather than forcing a tough set of standards on the manufacturers, the Philippines government established a technical committee to develop the program —headed up by the president of the trade association of home appliance manufacturers—and worked diligently to reach consensus. Testing and certification has been the most contentious aspect of the program.

While manufacturers have had to retool their factories and invest in designing more efficient units, they have benefited from using the labels as market tools. For its part, the government has played an important role in promoting the labels, raising awareness of the value of energy-efficient products and creating a means of product differentiation.

Refrigerators -- Development And Commercialization Of An Advanced Product. The U.S-China CFC-Free Energy-Efficient Refrigerator Project was initiated in 1989, formalizing prior cooperation between the US Environmental Protection Agency (USEPA) and China's National Environmental Protection Agency (NEPA). In the ensuing years, USEPA, NEPA, and the China National Council for Light Industry worked together to develop a prototype CFC-free refrigerator that uses up to 50% less electricity than comparable baseline models (Fine, et al., 1997). The effort included technical assistance to test alternative refrigerants, modeling of refrigerator designs, and safety and performance testing of the prototype. This work was undertaken in conjunction with CFC phase-out at a Chinese factory, funded by the Montreal Protocol Fund, and demonstrates the feasibility of increasing energy efficiency simultaneously with the phase-out of CFCs.

With the successful completion of prototype development, the project has entered a new phase, in which the technical expertise gained in the first phase of the project is to be replicated throughout the industry. The primary goals of the project are to increase the energy efficiency of manufactured refrigerators and to stimulate market demand for these models. Given the large reductions in CO_2 emissions possible through reduction of demand for power in refrigerators, the Global Environmental Facility (GEF) has provided funding support.

The development of the full project is presently underway, involving various preliminary research activities. The project's expected main activities are:

- Creation of a national energy-efficiency labeling program for refrigerators.
- Establishment of a program to provide financial incentives to promote the production and sale of energy-efficient refrigerators.
- Establishment of mandatory efficiency standards.
- A training program directed at refrigerator designers, engineers, and planners on technical aspects in refrigerator design and production, and training on the economic benefits of energy efficiency directed to company officials, economists, and planners.
- A consumer education campaign, using print and broadcast media, aimed at raising consumer awareness of the benefits of purchasing energy-efficient refrigerators.
- Technical assistance in upgrading compressor efficiency in domestic manufacturers, and in refrigerator redesign.

The core activity of factory conversion will require additional funding. It is estimated that conversion costs will be approximately US$2 million per factory, or a total of about $20 million for 10 refrigerator and compressor factories. Part of this funding is expected to come from the factories themselves, but it will be necessary to secure other support as well in the form of credit from international financial organizations.

The conversion projects would likely be 'bundled' for the sake of simplifying financing through one financial intermediary, who would on-lend funds and guarantee repayment. Some questions need to be addressed, such as how to best use a mix of factory own funds, domestic Chinese funding sources, and international financing; the establishment and role of the intermediary; possibility of concessional funding and/or grants; and financing in joint venture refrigerator factories, among others.

The success of this project promises to provide China with substantial savings in avoided power plant costs and avoided emissions of GHGs and regional pollutants. With refrigerators already accounting for some 25-30% of household power use–and residential power demand recording a 10-year average of 16% annual growth–increasing refrigerator efficiency offers a route to achieving both energy and environmental goals.

Fluorescent lamps

Fluorescent lamps are the primary lighting technology in the commercial sector, but are also used in residences in some developing countries. There has been considerable progress in improving the efficiency of fluorescent lighting technology in the past two decades, but advanced technologies have been slow to penetrate the market in developing and transitioning countries.

An example of a successful effort to transform the fluorescent lighting market is the Fluorescent Lamp Campaign, which was recently conducted in Thailand by the Electric Generating Authority of Thailand (EGAT), the national utility.[3] This program was the initial component of a large demand-side management program that has been undertaken by EGAT. Lighting is responsible for 25 percent of national electricity use in Thailand, and fluorescent lamps dominate the lighting market. In 1993, EGAT began its campaign to promote the use of 36-watt, T8 lamps. The 36-watt lamps produce as much light output as their 40-watt (T12) counterparts by using a thinner diameter tube. They can replace the T12s without changing the ballast. Furthermore, they cost the same or less than their T12 counterparts, as their smaller size requires less materials during production. Fluorescent lamps are produced by a limited number of domestic manufacturers in Thailand, so EGAT had an opportunity to transform the market at low cost.

When the program began, one lighting company already had switched all of its local production to the 36-watt lamps. However, there was a public perception that the lamps did not produce the same amount of light, that they would likely fail prematurely, and that they might not work in existing fixtures. EGAT's challenge was to convince all five domestic manufacturers of fluorescent tubes to completely switch their production of 40-watt lamps to

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[3] This section is adapted from Rumsey and Flanigan (1995a).

36-watt lamps. EGAT would work to change the public perception of the technology, using its financial resources and corporate strength to transform market demand for fluorescent lamps.

After a series of negotiations, a Memorandum of Understanding was signed between EGAT management, Thai government officials, and fluorescent lamp manufacturers. The manufacturers agreed to completely change over their production within two years. EGAT, in turn, agreed to undertake a $8.8 million advertising and awareness building campaign over a two-year period.

To promote the 36-watt lamp technology, EGAT engaged in a massive promotional campaign involving television, radio and newspaper ads. EGAT supplemented this effort with demonstrations and campaigns in each of the country's provinces. In approximately eighteen months, the market share for the T8 lamps increased from about 30 percent to nearly 90 percent.

A national survey found that 97% of the people surveyed were aware of the "thin tube" technology, and 90% said they would purchase the lamps the next time they needed a four-foot lamp. Another indicator of the program's success is that manufacturers are using the energy efficiency aspect of their products as a marketing tool.

Selecting a product produced by a limited number of manufacturers, EGAT was able to establish a powerful collaboration that can serve as a model for future initiatives. EGAT is working on a program to promote low-loss ballasts specifically designed for the 36-watt lamps.

Industrial motors[4]

Industrial motor systems are the largest single electricity end-use in most developing countries, and are also a major end use in transitioning countries. While choosing a high-efficiency motor instead of a standard-efficiency motor represents only part of the potential for improvement of motor system efficiency, such motors are often cost-effective for motor users.[5] As with other products, however, the greater initial cost of high-efficiency motors (which may be compounded by the need to import them), acts as a barrier to their purchase. The types of measures that can encourage the market penetration of high-efficiency motors include provision of better information on motor efficiency, motor efficiency standards, and financial incentives for high-efficiency motors.

Motor Efficiency Information. Standardized rating of motor efficiency is a prerequisite to the evaluation of alternative products, establishment of efficiency standards, and promotion of high-efficiency equipment through incentive programs. A variety of test procedures for motors are used in different parts of the world. In any given country, establishing a testing regime requires standardized testing protocols, independent testing facilities, and a monitoring system to ensure manufacturer compliance.

In contrast to appliances, new motors are rarely seen by customers prior to purchase, so energy labels have limited value in the buying decision. Labels may be somewhat useful in the

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[4] This section draws on Meyers, et al. (1993).

[5] Improvement of motor system efficiency in general is discussed later in this chapter.

used motor market by telling purchasers the motor's nameplate efficiency when the motor was new. Instead, efficiency information in catalogs is critically important in the new motor market.

Assessment of the costs and benefits of high-efficiency motors can be facilitated by calculational aids. In Canada, Ontario Hydro distributes a free spreadsheet program to motor distributors and customers that calculates the energy savings, demand savings, return on investment and simple payback of high-efficiency versus standard motors.

Motor Efficiency Standards. Standards can be an effective means of moving the market for new motors toward higher efficiency. Standards can take the form of voluntary agreements between manufacturers and the government or mandatory laws that manufacturers must meet. Voluntary standards are typically in the form of guidelines established by manufacturers' associations. In the U.S., for example, the manufacturers' association (NEMA) published a standard in 1989 that listed the nominal and minimum efficiency a motor must meet or exceed in order to be designated as "high-efficiency." The NEMA standard was met by nearly all high-efficiency product lines and even by some standard-efficiency motors.

China has a voluntary standard for motors and driven equipment. The Ministry of Machinery and Electronics regularly publishes lists of efficient and inefficient equipment to encourage removal of the latter from the market. In some cases, these inefficient models have in fact been eliminated, but in others, manufacturers have continued to produce the older equipment trusted by users.

In the U.S., the Energy Policy Act of 1992 set mandatory minimum efficiency standards for major types of new motors in the range of 1-200 hp. The standards, which are based on minimum efficiency values developed within the motor industry, vary with motor size, speed, and enclosure type. As an indication of the stringency of the standards, the minimum efficiency levels meet and generally exceed the levels that NEMA had specified in 1989 in order for motors to be designated as "high-efficiency." They will eliminate 80% of the currently sold motors from the market, but manufacturers wiere given five to seven years from the date of enactment before the standards take effect.

In the developing country context, stringent mandatory standards may face several problems. One is concern about the ability of small manufacturers to meet the standard. These companies typically have less access to capital for upgrading production than larger firms that may be connected to foreign companies. There is also the issue of enforcement of standards in situations where there are many small manufacturers. One option would be to introduce standards only on the larger motors that are not made by small manufacturers. A general concern is that by removing relatively cheaper motors from the market, standards will make it more difficult for some consumers to purchase a new motor, and encourage rewinding instead. This problem could be lessened through financial incentive programs.

Financial Incentives. In North America, many utilities have offered rebates for high-efficiency motors. Rebates are typically about $10 per horsepower, which covers much of the price difference between new standard- and high-efficiency motors and, in sizes up to about 30 hp, the difference between rewinding and a new high-efficiency motor. The size of the rebate has been critical to program participation. While the average motor rebate program has had only limited participation, a few programs have reached a wider audience.

One successful program was promoted through mailings and extensive personal contacts with eligible customers and motor dealers. The program also included procedures to qualify applications over the phone, so that when a motor failed, the customer could quickly purchase a new high-efficiency motor and still qualify for a rebate (Calhoun, 1984). Another program allowed customers to receive rebates for a reasonable number of motors purchased for inventory stock. When an old motor fails, the new high-efficiency motor is already in the warehouse and can be quickly installed.

The experience of BC Hydro (Canada) indicates the importance of combining customer rebates with incentives for equipment vendors (Nelson and Ternes, 1993). After some eight years of education and promotional efforts, the market share of high-efficiency motors in British Columbia in 1988 was only 3.5% (in part due to relatively low electricity prices). Most vendors did not carry high-efficiency motors in stock, and the required lead time for supply was often beyond the purchaser's time-frame. After three years of incentive programs (customer rebates and vendor incentives to encourage stocking and sales of high-efficiency motors), the high-efficiency motor market share had grown to over 60%. The rebates covered much of the incremental cost of high-efficiency motors. To encourage purchase of the most efficient high-efficiency motors, the rebates are based on kW saved (in contrast to paying the same amount per hp for all units above a high-efficiency qualifying line).

In addition to offering financial incentives, BC Hydro also developed an educational booklet for customers, computer software for dealers and large customers to use to estimate energy savings, and a list of all dealers in the province supplying efficient motors. Program marketing emphasized personal contacts between field representatives and large customers, consulting engineers, and motor suppliers. Many motor suppliers actively promoted the program.

Strategies for New Buildings

As with new products, the design and construction of a new building offers a one-time opportunity to produce a more energy-efficient addition to the capital stock. While it is possible to make improvements after a building is completed, it is more costly to do so. Furthermore, the design of a new building offers opportunities to treat energy efficiency at a system level, optimizing the interaction of numerous components to provide higher energy efficiency and also other benefits of value to the users.

Although the additional cost for higher energy efficiency is often a relatively small portion of the total investment in new buildings, a variety of factors tend to prevent the potential for higher energy efficiency from being realized. These barriers include lack of information regarding energy efficiency opportunities, lack of design or engineering expertise, aversion to a higher first cost (even if modest), short time schedules due to competitive pressures, and the inertia of traditional practice. Those who purchase a new home or occupy a commercial building often have low interest in the energy performance characteristics of the building, as energy costs are typically a small component of the overall costs that building owners or occupants face. For their part, builders are generally motivated to minimize the initial cost, which often involves a trade-off with energy efficiency.

As in other markets, a strategy to transform the market for new buildings in the direction of greater energy efficiency needs to involve activities that both increase the demand for more energy-efficient buildings and enhance the capacity and motivation of designers and builders to provide such buildings. Inclusion of provisions regarding energy efficiency in building codes can shift the market and provide an opportunity for educating designers and builders. Other measures can support the process of meeting the code and also encourage designers and builders to go beyond the code requirements.

Building codes

Minimum standards regarding energy efficiency can play an important role in changing the market for new buildings. As buildings are complex structures with numerous components affecting their energy requirements (particularly commercial buildings and multi-family residential buildings), the formulation of standards is more complicated than for generic products. Whereas production of new products may be concentrated among a few firms, a country usually has a large number of architects and builders. Implementing a building energy code requires information, analytical tools, or procedural instructions for designers and builders to enable them to comply with the standard, as well as means of certifying compliance. Because building construction is site-specific, inspection to certify compliance with the standard is subject to problems.

Building codes may regulate the building "envelope" (also known as the shell), the lighting system, and the heating and/or cooling equipment. Methods of establishing standards fall into two basic categories: prescriptive and performance. Prescriptive standards require that buildings use certain materials such as double-pane glass, prescribed levels of insulation, and specific lighting components. The most common non-shell requirements are for lighting power density not to exceed a given number of watts per square meter, and for cooling equipment efficiencies to be greater than a given minimum. Performance-based codes afford a greater degree of flexibility to building designers than the prescriptive methods, but also are more complex. Such codes require that computerized simulations of energy use, based on the interaction between the building's envelope and its lighting system and cooling systems, be performed prior to construction. These simulations allow tradeoffs between various building components and systems to be considered freely. With respect to the building envelope, a performance-type approach is to require that the overall thermal transmittance value (OTTV) not exceed a specified level (e.g., in watts per square meter).

An example of development and implementation of building codes at a regional level comes from Southeast Asia. Five countries adopted energy codes for commercial buildings as a result of an assistance project supported by the U.S. Agency for International Development over the 1982-92 period (Levine and Busch, 1992). The codes focus on improving the efficiency of building shells, cooling equipment, and lighting systems. In each country, a slightly different set of codes was developed based on local climatic conditions and the judgment of local energy planners. In all cases, however, the codes were based on the OTTV method.

Each country has implemented and enforced the codes with different degrees of rigor. In Singapore, the code is strictly enforced. In the Philippines the code has been issued, but it is not enforced. Thailand is implementing a mandatory code in 1997. In Malaysia and Indonesia, the code is voluntary, providing a guideline that building designers are encouraged to use.

Other measures

In addition to building codes, a variety of nonmandatory measures have been used in OECD countries to encourage the construction of more energy-efficient residential and commercial buildings. These include technology demonstrations, financial incentive programs, consumer information and marketing programs, and technical information programs. In some cases, these measures have sought to encourage construction practices that exceed code requirements. A review for the U.S. found that many different types of programs appeared to be successful in overcoming barriers to energy efficiency in new buildings (Vine and Harris, 1990). Education, training, and design assistance activities were especially important. Successful programs often were characterized by intervention early in the design and planning process in order to minimize delays in the project design, aproval, financing, and construction process.

Technical Assistance for Architects and Engineers. Various forms of training and technical assistance can provide architects and engineers with the means for designing more energy-efficient buildings in general or for meeting requirements of building codes in particular. These include professional guidelines, design tools, design assistance, and standards-related training. In the U.S., provision of design assistance has been a feature of a number of utility DSM programs.

Financial Incentives. Financial incentives to encourage construction of energy-efficient new buildings have included rebates, reduced utility hookup fees, reduced loan interest rates, and tax credits. Incentives targeting builders or consumers have been a feature of many utility DSM programs in the U.S. Vine and Harris found that the greatest impact of incentives on program participation occured when the incentives were offered in conjunction with technical assistance, training, and education.

Strategies For Existing Buildings and Industrial Facilities

Existing buildings and industrial facilities in developing and transitioning countries offer substantial opportunities for energy efficiency improvement, and many programs have sought to tap that potential, especially in the industrial sector. Such programs have enhanced local capacity to identify and implement energy efficiency projects, and some programs have involved local financial institutions in providing loans. In most developing and transitioning countries, however, there are few firms that are actively engaged in conducting energy conservation projects, and the provision of loans for such projects is a novel area for local financial institutions.

The foundation of a strategy to expand the retrofit markets is helping building owners and industrial managers to identify opportunities for improving energy efficiency. Programs offering energy audits are the most common approach for accomplishing this task. Once the costs and benefits are known, providing project financing that minimizes the need of the facility owner to use his capital can be critical for achieving implementation of energy efficiency measures.

In the context of promoting sustained development of the "retrofit" markets, the key task is to enhance the capacity of the private sector and financial institutions to deliver technical and financial services to support improvements in energy efficiency. A major challenge in promoting energy efficiency improvement in existing buildings and industrial facilities is getting facility owners to invest in projects that have a payback period longer than 2-3 years, which is a typical expected payback (some owners may even avoid projects whose payback is more than two years). Schemes that reduce the owner's risk, such as performance contracting and innovative financing mechanisms, can help, but there may also be a need for financial incentives or low-interest loans to encourage projects with longer payback periods.

Existing industrial facilities

The industrial sector includes large firms operating relatively modern facilities as well as small companies relying on simple and often inefficient technologies. Both the nature of the opportunities and the motivation and capacity of the actors to take advantage of them vary considerably.

Programs to provide energy audits to industrial facilities at low or no cost have probably been the most common type of energy conservation program implemented in developing countries over the past two decades. Most of these programs have been implemented by government agencies or energy conservation centers, often with financial and technical support from bilateral donors and multilateral organizations as well. Building local capacity to conduct audits and better understand energy efficiency opportunities in industry has been a standard feature of these programs. Some of the programs have also provided industrial consumers with means of financing the measures recommended by the audit.

An example of a program that successfully combined energy audits, financing, and building of institutional capacity is the Technology Transfer for Energy Management (TTEM) program in the Philippines.[6] TTEM provided energy audits and technical assistance for industrial establishments and complemented these services with financing at below-market interest rates. TTEM's primary purpose was to promote and accelerate the adoption of energy-efficient technologies and operational practices by industrial consumers. The program was also intended to enhance the financial sector's capability to evaluate the technical and economic viability of energy efficiency investments, and to develop local expertise on energy-conserving technologies.

Begun in 1985, TTEM was supported by $4.6 million in funding by the U.S. Agency for International Development. Half of this money was used to provide information and technical assistance services, the other half for an innovative loan program. The program was coordinated by the Office of Energy Affairs (OEA), which subsequently became the Department of Energy, and received substantial input from a Steering Committee composed of representatives from government agencies, the Central Bank, and the private sector.

The centerpiece of the four-year program was the Demonstration Loan Fund, which was established to finance energy efficiency investments at below-market interest rates. The fund was intended to demonstrate efficiency technologies and practices not widely used in the Philippines. Recipients of loans had to agree to share their experiences with other industries and to allow tours of their facilities, so that their projects might serve as catalysts for similar efforts. The demonstration projects addressed two major constraints to implementation of

[6] This section is adapted from Rumsey and Flanigan (1995a).

energy efficiency in the Philippines: the lack of reliable information on energy-efficient technologies, and reluctance on the part of management and financiers to provide funding for efficiency upgrades.

From the borrower perspective, the program was attractive because approved projects were eligible for funding at a maximum interest rate of 14 percent, while market rates were on the order of 18 percent. (There was a provision that if market rates fell, the Demonstration Loan Fund rates would fall proportionately). Accredited banks lent money for efficiency upgrades to approved customers using loans with five-year terms. These banks were allowed to collect fees for various services.

One of the most important features of the program was its focus on building institutional capabilities for energy efficiency within both the public and private sectors. Within the OEA, staff received technical training, and a library was created to provide means to track new and appropriate technologies. Instruments necessary to accurately measure and monitor projects were purchased. Nearly 1,100 participants attended 25 seminars that were conducted nationwide to familiarize energy users and the financial sector with energy efficiency opportunities.

The TTEM program provided free technical assistance to over 120 companies. From these activities, TTEM was able to identify about 100 potential projects; thirty demonstrations were carried out, with 16 of these funded using the program's financial assistance component. These 16 projects had an average internal rate of return of 41 percent. Many of the other projects were financed internally by the companies involved.

The TTEM loan program was designed with only slightly concessionary interest rates. TTEM program designers feared that very low-interest-rate loans would distort the market and limit the future ability of commercial lenders to make efficiency loans at market rates. Most end-users in the program were pleased with the financing and took the loans at the terms provided. Program staff suggest that the technical assistance aspect of the program, not the financing, was the key to the program's success.

Existing buildings

The stock of existing buildings is a particularly important target for efficiency improvement in the transitioning countries due to the considerable demand for heating and the poor state of much of the building stock. Opportunities for improving the energy efficiency of existing buildings also exist in developing countries, in most cases more in the commercial sector than in homes.

The basic measures needed to encourage sustained improvement in the energy efficiency of existing buildings are the same as for industrial facilities. Building owners need to have reliable information about the opportunities for improvement, and an attractive way of financing the necessary investments. The roles of energy service companies and local financial institutions in meeting these needs are discussed in the following sections. Other measures may also be needed to support the development of the building retrofit market. Institutional changes regarding ownership of buildings and responsibility for maintaining them are important in the transitioning countries, particularly in the residential sector (Meyers, et al., 1995). Metering of heat consumption needs to be improved in order to give building occupants and tenant/owner associations more incentive for energy efficiency investments. The judicious use of financial incentives may also be appropriate, especially in the early stages of the market's development. Such subsidies should not be so large that their removal dampens demand for retrofit projects, thereby hurting the budding industry.

Building retrofit demonstration projects can help lay a foundation for the development of a local retrofit industry by better identifying the costs and savings associated with different types of measures in different types of buildings, and establishing the effectiveness of different energy-conserving techniques. Many such projects have been implemented in the transitioning countries in recent years, though not all of them have had adequate monitoring and evaluation.

Demonstration projects are likely to be most useful when they are coupled with capacity-building activities and development of plans for encouraging bldg retrofit on a larger scale. A GEF project in West Africa is combining these elements (GEF, 1994). One of the objectives of the project is to develop portfolios of retrofit projects for public and private buildings. The GEF project is nurturing the technical and institutional capacity that is required for development of retrofit projects that can attract investment. In the framework of the demonstration projects, innovative financial mechanisms such as third-party financing will be tested, thus laying a foundation for financing of future projects.

The role of energy service companies

Energy service companies (ESCOs) can play a key role in identifying opportunities for improving energy efficiency and in providing management and financing of projects in both buildings and industrial facilities. Potentially, they can be the foundation for the supply of the services needed to expand the market for retrofit of buildings and industrial facilities. As discussed in Chapter 4, however, the successful establishment of ESCOs in developing and transitioning countries faces several barriers.

An effort to overcome these barriers is underway in Central/Eastern Europe, where the European Bank for Reconstruction and Development (EBRD) is providing funding to develop a network of ESCOs. The EBRD has developed an approach to award contracts to a single firm who will manage a string of smaller projects, thus balancing risk and creating a mechanism to provide funding for smaller projects that could not previously be addressed by development banks. The EBRD will provide finance for each ESCO in the form of debt and equity. Three western companies have signed agreements with the EBRD. These companies will work together with local partners, providing both financing and capacity building.

The ESCOs will target energy-saving opportunities in the public and private sector. ESCOs will install appropriate technology in their clients' premises to reduce energy consumption and provide a guaranteed level of service in terms of heating, lighting and other energy-related needs. ESCOs will recover their cost from the energy savings which will result from the project.

ESCOs will be supported in Poland, the Slovak Republic, the Czech Republic, and Hungary. The EBRD will provide financing for each ESCO in the form of debt and equity. In some cases

ESCOs were already active and now can be financed by the EBRD. In the Slovak Republic, CGC-Termotech has been active since 1993 with help from Compagnie Générale de Chauffe. CGC-Termotech's main focus is heat savings in district heating systems in the city of Poprad. In Hungary, Prometheus has been active since 1992 with help from Compagnie Générale de Chauffe. Its main focus is heat savings in public and municipal buildings. Prometheus has targeted 8 hospitals, 100 schools, 50 administrative buildings, and 12 industrial and commercial buildings for projects.

Increased use of performance contracting involving ESCOs requires better methods for measuring and verifying energy cost savings, which provide the means to repay the initial investment. In response to this need, the U.S. Department of Energy has worked with professional organizations to develop the North American Energy Measurement and Verification Protocol. This protocol is designed to become industry standard practice in the U.S. and also in Canada and Mexico.

Creating sustainable financing for energy efficiency projects

In order to sustain a market for projects to improve energy efficiency in buildings, industrial facilities, and other sectors, financing needs to become a normal business for banks and other institutions rather than a special activity dependent on short-lived programs. A project designed to contribute to creation of a sustainable commercial marketplace for energy efficiency project financing is currently underway in Hungary with support from the GEF.

Since 1990, the state-owned Hungarian Credit Bank (HCB) has operated an energy efficiency financing program (using monies granted from Germany) offering financing at well below commercial rates. This so-called German Coal Aid Fund (GCAF) has operated as a separate fund wholly segregated from HCB and other commercial capital sources. Its limited capital is now fully lent with new financings possible only with returning principal and interest payments. The GCAF has stimulated demand for energy efficiency financing far greater than its resources. While its operations have been successful, it is generally recognized that energy efficiency financing in Hungary must move beyond the experience and methods of GCAF toward commercial capital sources and terms.

The objectives of the Hungarian Energy Efficiency Co-Financing Fund (HEECF) are to: (i) reduce credit risk on energy efficiency financing for local financial institutions (making transactions possible and gaining approval for use of the financial institution's own funds); (ii) provide targeted technical assistance (in support of financial institution marketing and delivery of energy efficiency financing services and preparation of projects for investment); (iii) reduce transactions costs borne by project participants; and (iv) provide or make possible longer term financing (in order to lower annual finance payments, finance longer payback projects, and make energy efficiency projects attractive to the end-user by allowing them to be self-financing from energy cost savings).

GEF resources will be leveraged with capital from domestic and international financial institutions, laying a foundation for energy efficiency financing on a sustainable, commercial basis over the medium to long term. The Fund will enter into credit support and co-finance relationships with Hungarian financial institutions. Primary financing modalities are likely to include: (i) partial credit guarantees applied to both specific transactions and portfolios of transactions; and (ii) co-financing on a long-term basis with extended grace (interest only) periods. International financial institutions with Hungarian operations will participate as their capital is accessed and blended with the resources of the domestic financial institutions and the Fund. Financial support will be provided at the margin as needed to induce domestic financial institution participation. The profile of energy efficiency financing as an important market opportunity will be raised with domestic financial institutions. Payment and financial performance histories on energy efficiency project financings, including their ability to be self-financing through energy cost savings, will be documented. These materials can be used for promotion to both financial institutions and end-users for further project development and financing.

The experience gained and the increase in energy efficiency market size will reduce transactions costs for and encourage development of subsequent projects. Entry of additional financing sources will encourage competition, lower rates and promote greater marketing efforts.

Comprehensive Sectoral and End-Use Strategies

A market transformation strategy may address an entire sector or end-use and seek to affect decisons regarding both existing buildings or facilities and new technologies. As an illustration, this section discusses such strategies in the case of industrial motor systems.

Industrial motor systems

Industrial motor systems in developing countries offer substantial potential for energy efficiency improvement (Meyers, et al., 1993). In addition to use of high-efficiency motors, energy savings can result from use of variable-speed drive control, proper selection and maintenance of transmission hardware, use of more efficient driven equipment (pumps, fans, compressors), ongoing maintenance of the entire motor system, and other measures as well. For new systems, avoiding oversizing in design is important.

In developing countries, strategies might initially focus on the efficiency of motors rather than broader system issues due to the existing low level of efficiency of the motor component (at least in the case of small and medium-size motors). In transitioning countries, on the other hand, where the efficiency of new motors is relatively high, a focus on motor system issues may be appropriate.

Measures for promoting high-efficiency motors were described earlier in this chapter. Such measures can also be used to encourage more efficient driven equipment. Other measures to promote more energy-efficient motor systems include education and technical assistance programs.

Education Programs. Education programs to increase awareness of the value of motor system efficiency and develop expertise to implement measures can take the form of seminars and courses, publications, databases on efficiency technologies, and well-publicized demonstration projects. In the OECD countries, the focus of education programs has been on technologies like high-efficiency motors, variable-speed drives (VSDs), and power factor correction. While such topics are also relevant in developing countries, education programs should also encompass less capital-intensive improvements, emphasizing basic information on motor system design, O&M, motor sizing, rewinding practices, and use of multi-speed motors as a low-cost alternative to VSDs.

Information dissemination in the form of publications, brochures, and other communication tools can enhance awareness of energy efficiency options. A collaboration between India's National Productivity Council (NPC) and the Center for Energy and Environment Studies (CEES) of Princeton University (U.S.) produced a "technology menu" for motor drive systems (NPC and CEES, 1993). Intended as an aid for designing and implementing motor efficiency improvement programs and projects, the set of materials in the "menu" is a concise, user-friendly, source of reliable data and analyses relating to the performance and costs of both components (motors, pumps, fans, etc.) and systems.

Seminars and training courses can build upon information dissemination campaigns and help upgrade professional skills. In addition to professional education, there is a need to place greater emphasis on motor system efficiency in the engineering curricula of universities and technical institutes. Particular emphasis should be placed on proper system design and other aspects of process optimization.

Less extensive training could be given to key personnel at all points in the distribution chain — from distributor to dealer to salesperson. A study in the U.S. (Fryer and Stone, 1993) found that distributors are the market participants best positioned to promote motor efficiency, particularly since the replacement of a failed motor often requires fast turn-around.

In developing countries, motors are typically rewound several times rather than replaced due to the low cost of labor and the high cost of a new motor. Rewinding typically results in some degradation in performance, but motor rewind practices can be improved with proper training. In some cases, it may be appropriate to encourage motor users to replace a failed motor with a high-efficiency motor rather than rewinding it.

Technical Assistance Programs. Since technical expertise in industrial firms in developing countries is often in short supply (or over-burdened with managing normal operations), programs that provide technical assistance can be extremely valuable in identifying and evaluating opportunities for improving motor system efficiency in both existing and new applications. Assistance can be provided to consulting engineers and motor salespeople as well as to the end-users.

On-site assessments and follow-up assistance entail a high degree of interaction and expense, but have the advantage of being site-specific. Process design studies may be offered to firms that are building a new factory or expanding an existing factory. This type of program requires the ability to move quickly in order to fit the customers' schedules.

Comprehensive Strategies. An example of a comprehensive effort to encourage more energy-efficient industrial motor systems is the U.S. Department of Energy's Motor Challenge Program (McKane, et al., 1997). The Motor Challenge Program is an industry/government partnership that promotes industrial energy efficiency through the use of energy-efficient electric motors, drives and driven equipment and effective motor-driven system integration and optimization. Program offerings include: the Information Clearinghouse, which provides up-to-date information about the practicality and profitability of electric motor system strategies; design decision tools, such as MotorMaster+software; Showcase Demonstration projects; training; workshops, and conferences.

The Motor Challenge Program recognizes the benefits of working with the existing marketplace of companies and organizations that provide products and services to industrial users of electric motor-driven systems. Motor Challenge recruits suppliers, distributors, utilities, state agencies, consulting engineers, and others as Allied Partners. The Allied Partner effort has been highly successful in recruiting companies interested in working with Motor Challenge as a way to provide an added benefit to their customers. Allied Partners use Motor Challenge publications and decision tools in communicating with industrial end users in the course of their daily business or in conjunction with customer education meetings or workshops. An emerging initiative under Motor Challenge, the Excellence Partner program, is designed for companies that commit to undertake efforts aimed at continuous improvement of their motor systems management practices.

The current portfolio of educational materials, workshops, and software tools available through Motor Challenge focus primarily on energy-efficient motors and drives. To broaden the scope of the program offerings to include motor-driven equipment such as air compressors, pumps, and fans and blowers, Motor Challenge is forming Industry Partnerships. These partnerships can include: industrial trade associations, energy providers, efficiency experts, and industrial end-users, and are formed for the purpose of developing new educational products, materials, and services.

An initiative modeled on the U.S. Motor Challenge Program is being planned for India.

In Mexico, an ongoing project designed to promote energy efficiency improvement of industrial motor systems is combining bilateral aid for technical assistance with financing from the private sector. The Industrial Motors Pilot Project is an initiative between USAID and FIDE, a trust fund for energy efficiency. The project considers all types of energy efficiency measures related to industrial motor and drive systems, including maintenance and the purchase and installation of motor control systems, high-efficiency motors, high-efficiency transmission systems, and adjustable-speed drives. The core of the program consists of motor system audits conducted in 20 medium-sized plants. The audits are performed by local consultants, at no cost to the industries. However, prior to the audit, the end-user signs a contract agreeing to implement all measures with a payback of less than 6 months or reimburse the cost of the audit.

The project will test various delivery mechanisms for measure implementation, including installation by the industry, local contractors, energy service companies or vendors. The project involves equipment manufacturers and vendors in its promotional and technical activities. Four U.S. equipment manufacturers have promised concessions in pricing and financing for the project participants. In addition, FIDE is negotiating with co-financiers so as to offer attractive financing packages for longer-term efficiency measures via a revolving fund.

Designing an Appropriate Market Transformation Strategy[7]

As the examples presented in this chapter indicate, the preferred market transformation strategy varies from product to product, depending on the characteristics of the technology and the market being served. Some technologies and end-use markets are relatively mature, while others are undergoing rapid expansion and a high degree of technological innovation. For some products, such as lamps or ballasts, efficiency is a prominent feature and consumers are relatively interested in energy efficiency. For other products, such as refrigerators or personal computers, energy efficiency is a hidden attribute and consumers pay little attention to it. Some products, such as lighting products, are made primarily by large companies that can perform R&D on their own. Other products are made by a large number of smaller companies that conduct little R&D. And in some cases energy-efficiency measures are feasible for all uses, while in other cases measures are application specific.

The preferred market transformation strategy for a particular product follows from the above characteristics. Support for R&D and demonstration is critical for some products, but may not be necessary for others. Manufacturer-oriented commercialization incentives could be valuable for products in which advanced technologies are ready to be introduced. Consumer, dealer, or manufacturer incentives, and bulk purchases are important for products such as CFLs or adjustable-speed motor drives (ASDs) for which first cost is a barrier to adoption. With both new technologies and existing but underutilized technologies, a key objective is to establish a significant initial market that is sizable enough to benefit from economies of scale and to support R&D to produce improved second- and third-generation products.

The appropriate scale for market transformation efforts depends on the type of technology and market. For mass-produced devices in which climate does not affect performance to a significant degree, a national approach is appropriate. But for new construction or even certain building technologies, a regional approach may be desirable so that policies and programs can take into account local conditions and target key actors such as builders or architects.

The range of impacts provided by energy-efficiency improvements is another factor affecting the transformation strategy. In some cases, efficiency improvements provide multiple benefits and "sell themselves" to a large degree. For these products, a modest amount of policy intervention is required in order to accelerate the diffusion process or even transform the market. In the case of other products, efficiency improvements primarily provide energy savings and are not widely adopted on their own. More aggressive policy initiatives are required to transform these markets.

The experience across a wide range of products and end uses shows that minimum efficiency standards can play a critical role in market transformation. For products for which standards are appropriate, standards alone can result in market transformation by removing inefficient products from the marketplace. Standards can greatly shorten the diffusion cycle—the time between technology introduction and full utilization—and prevent market penetration from reaching a plateau well below the full market potential. Standards also focus the attention and R&D efforts of manufacturers on energy efficiency, and can even force manufacturers to develop, commercialize, and/or widely use new technologies.

[7] This section is adapted from Geller and Nadel (1994).

8. CONCLUSION

This report has presented a framework for considering strategies for improving energy efficiency in developing and transitioning countries that aim at strengthening the effectiveness of market forces in delivering greater energy efficiency. Barriers related to the macro-economy, energy pricing, international flows of capital, technology, and knowledge, and institutional weaknesses tend to be significant in these countries, as are barriers related to market behavior. An effective strategy to support the sustained evolution of markets towards greater energy efficiency needs to address the full range of barriers that inhibit this tendency. In the context of developing and transitioning countries, such a strategy should involve policies that build and strengthen market forces and institutions, and measures that reduce the barriers to energy efficiency in specific markets such that improvement evolves in a dynamic, lasting manner.

Throughout the economy, economic reforms that result in greater competition and energy pricing reform increase the incentives for market actors to demand and supply more energy-efficient products and services. Policies that improve flows of capital, technology, and knowledge enhance the capacity of market actors to undertake actions that increase energy efficiency. Efforts to strengthen institutions support the evolution of markets toward higher energy efficiency in numerous ways.

At the level of specific markets, a variety of measures can address barriers related to market behavior and features. Key measures that can promote sustained evolution of markets toward greater energy efficiency are (1) Improving information about energy efficiency opportunities, (2) Financing of energy efficiency investments, (3) Financial incentives for energy efficiency investments, (4) Minimum efficiency standards, (5) Market aggregation and technology procurement, and (6) Voluntary commitment and recognition.

Properly designed and implemented, these actions can help to transform markets such that decisions that favor higher energy efficiency will be made to a greater degree in the future without incentives or other interventions. The market-building policies help to create an environment in which market transformation measures can be both effective and have sustained impact.

To be effective in the long run, market transformation programs need to create a set of conditions under which the self-interest of market actors will be aligned with achieving greater energy efficiency. Such programs involve and may depend to a significant extent on voluntary cooperation of a range of market actors. These include various entities participating in a product's distribution chain (manufacturers, distributors, retailers, etc.), "trade allies" who are responsible for specifying targeted products (contractors, engineers, builders, trade associations), organizations responsible for implementing the program (utility companies or other coordinating organizations), brokers/facilitators with knowledge and breadth of contacts (government agencies, technology-specific organizations, trade associations), and promoters (utilities, government agencies, advocacy groups, manufacturers and retailers).

In most cases, a number of barriers must be addressed to achieve permanent change in a market, and these barriers are usually on both the supply and demand sides. Market transformation programs typically target product manufacturers and/or other actors in the supply of energy-efficient goods and services to a significant degree.

Market transformation programs in the U.S. and western Europe have mainly focused on changing markets for new products, including refrigerators, clothes washers, air conditioners, lighting equipment, office equipment, and residential furnaces. In general, the experience provides evidence of shifts in the markets for targeted products, including increased availability of models, increased sales of high-efficiency products, and changes in manufacturer, dealer, and consumer behavior. The market transformation approach has also been applied for new buildings, and to a lesser extent, for markets for retrofit of existing buildings and industrial facilities.

The experience to date suggests that a market transformation approach can make effective use of program resources to bring about long-run change in markets. The market transformation approach may not be best for all situations or for meeting all objectives, however. Market transformation programs usually take more time to have an impact compared to other approaches such as traditional utility DSM programs. Thus, if slowing growth in energy demand to alleviate power shortages or to reduce the need to build new capacity is an objective, other approaches may be more effective, at least in the short run. Traditional approaches to energy efficiency improvement can proceed together with market transformation efforts, however. Indeed, traditional approaches can lead to greater reliance on more market-oriented strategies as the ability of market actors to play a role, and their interest in doing so, becomes stronger.

Market transformation efforts in developing and transitioning countries are likely to take a somewhat different shape than programs in the industrialized countries. Strengthening of key institutions requires attention, as does increasing the knowledge and skills of actors on the supply side of markets. Minimum efficiency standards for new products and buildings can play an important role in setting a market "floor" for energy efficiency and encouraging market actors to upgrade their products, but make take time and patient effort to successfully implement. Enlisting voluntary cooperation of market actors in efforts to promote energy efficiency is an important strategy, but may require development of outreach skills on the part of program sponsors.

The higher first cost of many energy-efficient products, or the investment required for energy-efficiency retrofits, is an even greater barrier in these countries than in the industrialized countries, so the development of appropriate financing mechanisms is of great importance. The capacity of local financial institutions to implement such strategies needs to be nurtured. Financial incentives to lower the cost of energy efficient products or services may be necessary to build market demand, especially in the early stages of market evolution. Care must be taken not to create a dependency on such incentives, however. Using market aggregation strategies is another way to build demand for new products and services.

Together, market-building policies and market transformation programs can create a synergy in which the whole is greater than the sum of the parts. When grounded in a thorough understanding of how particular markets work, and of the factors that tend to inhibit improvement in energy efficiency, such strategies can set forces in motion that build over time to yield sustained improvement in energy efficiency.

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