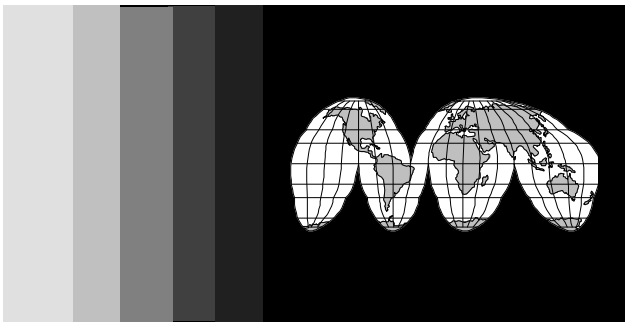

USAID Program and Operations
Assessment Report No. 19

Shining the Light On Energy Conservation

A Synthesis of Findings From Six Evaluations

by

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Center for Development Information and Evaluation
U.S. Agency for International Development

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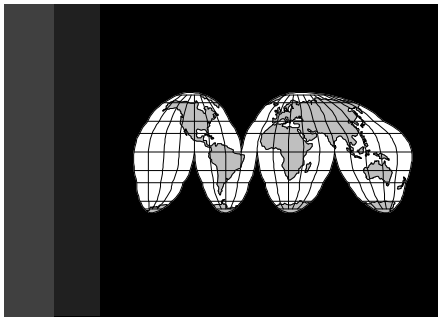

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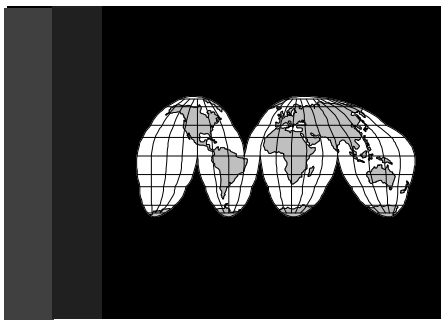


Preface

IN THE 1979 OIL CRISIS, oil prices more than doubled, jumping from $15 a barrel to more than $30 a barrel. (Six years earlier oil was less than $4 a barrel.) Many experts expected prices to reach $50 a barrel within a few years.

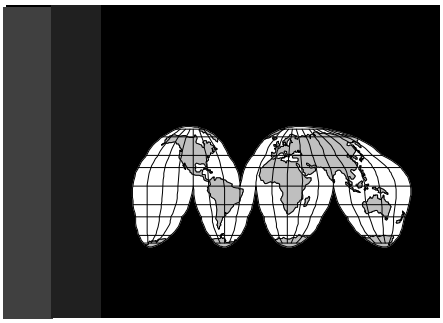
Oil price increases were particularly hard on developing countries, which needed more energy to support economic development. Rather than importing more oil, now they would have to cut oil imports in half, just to stay even. But there was another possibility: they could cut fuel costs by improved energy efficiency. In addition, by using fuel more efficiently, they would create less pollution. To support energy conservation, over the next 10 years the U.S. Agency for International Development launched some 20 energy conservation projects.

Individual projects were relatively modest, generally providing $1–3 million a year over three to five years. Projects followed a similar approach: using education and awareness campaigns to spur interest in energy conservation, funding energy audits to identify areas where savings were possible, training local energy conservation engineers, installing equipment at demonstration sites, supporting local energy conservation institutions, and working to improve energy policies.

This report is based on an evaluation of USAID experience with energy conservation in a sample of six countries: the Czech Republic, Guatemala, Hungary, Jamaica, Pakistan, and the Philippines. (The six individual country evaluation reports may be ordered from CDIE. See back cover for a list of the evaluations and how to order them. The studies were conducted with assistance from Development Alternatives, Inc.). These countries represent a good cross-section of USAID projects: different geographic regions, different levels of development and income, different levels of industrial development, and different fuel and energy use patterns. Data from a range of country situations make it possible to develop a common set of findings and lessons. A uniform analytical framework was used to assess the impact of the programs. This provided comparability among case studies and facilitated a synthesis of findings.

Each case was based on an in-country impact evaluation conducted by economists, engineers, and environmentalists working from the Agency's Center for Development Information and Evaluation (CDIE). Data were collected from the host government, other donors, factory managers, energy engineers, energy equipment suppliers, and companies that received energy equipment.

This synthesis identifies factors affecting program performance and program impact. It is designed to help USAID managers learn from the experience of other projects what works, what doesn't work, and the conditions that affect success. These lessons will help managers as they plan future energy conservation programs.



Summary

A VISITOR TO ALMOST any developing-country capital city, be it Bangkok, Cairo, Manila, or Mexico City, will have a common experience—almost continual traffic gridlock and the sight of factory smokestacks belching pollution. Those who last visited these places 10 or 15 years ago are struck by the massive increase in air pollution from automobiles, trucks, and factories. As development takes hold and growth accelerates, energy use increases dramatically.

Economic growth requires more energy, but in many cases developing countries are not efficient energy users. They often require two to four times more energy than developed countries to produce the same output. This excessive fuel consumption speeds up the accumulation of carbon dioxide, a greenhouse gas, in the atmosphere, contributing to possible global warming. In addition, fuel combustion is often dirty and incomplete, generating local pollution. A final burden is the heavy foreign exchange cost as developing countries sharply increase their fuel imports.

However, solutions do exist. Energy-efficient equipment and improved energy management can greatly reduce energy consumption. Over the last 10 to 15 years USAID launched a number of energy conservation projects centered on industrial energy use. These projects helped create an interest in energy efficiency, trained local engineers in energy management, and sponsored energy audits and demonstration investments. The projects had good economic rates of return. In most cases, fuel savings paid for the cost of investments in a year or two. By reducing energy consumption, pollution was also reduced at the same time at almost no cost.

Technology the Agency introduced is straightforward and effective. In many cases relatively simple technology (insulation, valves, thermostats, pumps, and motors) generated large energy savings. The USAID projects were successful—but what happened after they ended?

Although the projects had ‘‘a big bang for the buck,’’ they showed that once USAID funding ends, spreading technology beyond the original demonstration sites may be difficult. Investments at demonstration factory sites had good returns, but they were not high enough to persuade other factory managers to adopt the technology. Only a few other factories made similar investments. USAID-trained energy engineers had difficulty finding energy conservation jobs once projects ended. The Agency has learned it is hard to promote energy efficiency when

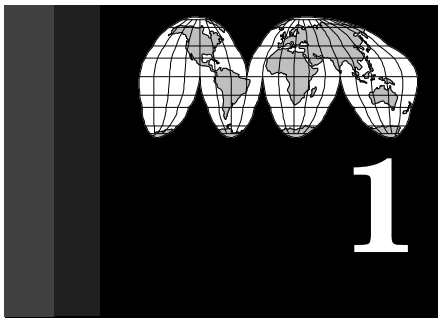
- The government and industrial managers are not seized with the problem
- Government policies, particularly energy price policies, discourage energy conservation
- The business climate is depressed, and financing is not available
- There is no awareness of or demand for energy conservaation

- Institutions are not available to bring together energy users, equipment suppliers, and energy engineers

USAID projects demonstrate how energy conservation saves money and reduces pollution. But successful demonstration projects in their own right do not automatically lead to development. A demonstration at one factory may succeed and have a good economic rate of return, but the key to success is whether the project induces other factories to adopt new energy practices.

In all too many cases demonstrations succeeded, but replication did not take place at other factories. Cheap energy, lack of market competition, government controls, or lack of investment funds deterred businesses from adopting new energy-saving technologies. Thus, demonstration projects, by themselves, may not be the best approach. USAID needs to carefully analyze prices, markets, institutional capacity, government controls, and the investment climate to determine whether the new technology stands a chance of being replicated.

There is clearly a need to help developing countries improve their energy efficiency. When a country's energy policies, investment climate, and institutional capacity are supportive, it is clearly possible to increase energy efficiency and reduce pollution through approaches such as energy audits and education–awareness programs. Alternatively, when there are problems with those enabling conditions, USAID assistance (for example, to improve energy policies, or to develop energy institutions) can lay the groundwork to launch an effective energy conservation program in the future.



1 Introduction

IN MANY DEVELOPING COUNTRIES economic growth is accelerating, owing in part to an expanding industrial sector. But, this has generated a problem. The increased energy use that has fueled higher output has also caused increased pollution and a buildup of greenhouse gases. In many cases the pollution, which contributes to local health problems, and greenhouse gas emissions, which may lead to global warming, are already high and growing rapidly.

In addition, fuel burned to produce energy often must be imported, which translates into a growing foreign exchange cost. Low energy efficiency makes the situation even worse, because it means extra fuel is required, which produces even more pollution.

The industrial sector in most developing countries is small, but there are usually several products with good growth prospects and some that can be exported. These countries manufacture and export items familiar to U.S. consumers: shoes, garments, leather goods, electronics, as well as bulk aluminum, processed agricultural products, and industrial parts and materials.

Export-led growth is important for many developing countries. Whether it be consumer goods, industrial goods, or semifinished primary products, many developing countries have been able to expand their production base and increase exports. An expanding economy with rising consumer income means increased domestic demand. An efficient manufacturing sector can benefit from a growing domestic market, and for most products, the domestic market will be much larger than the export market. But the cost of energy affects a country's manufacturing and trade prospects.

Although many developing countries have the raw materials and low-cost labor that should make it possible to produce and even export manufactured products, energy costs may be a problem. If several countries are producing the same product, the country that uses substantially more energy in the production process is at a disadvantage. On a per-unit-of-output basis, some developing countries use two to four times more energy than developed countries (see figure 1). High energy use offsets other advantages of the developing country. If energy use is very inefficient, the country's products cannot compete in the international marketplace. At the extreme, they cannot compete with imports in the home market.

The solution appears straightforward: energy-inefficient countries need to change their energy practices and technology. They need to upgrade their factories with improved burners, motors, insulation, thermostats, and energy-monitoring and -control devices. Energy-efficient technologies burn less fuel, produce less pollution, and reduce production costs.

Improved energy technologies are already in use in industrial countries; the task is transferring them to developing countries.

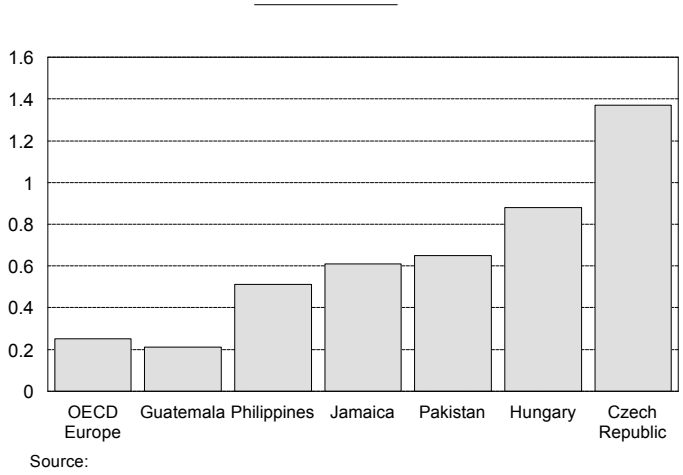
USAID has 35 years of experience in technology transfer in different development fields. In agriculture, for example, improved seeds, fertilizer, and irrigation have increased agricultural output. In health, immunization campaigns, oral rehydration therapy, and improved sanitation have reduced infant mortality and increased life expectancy. Energy conservation should work the same way: the United States has developed a wide range of techniques and equipment to reduce energy consumption. In most cases, developing countries could use off-the-shelf (existing) technology. With new energy-efficient equipment and USAID-trained engineers, developing countries should see energy efficiency improve.

Improved technology solves problems and saves money. The energy equivalent of ''Build a better mousetrap and the world will beat a path to your door'' seems obvious. That is, demonstrate energy-saving technology, and industry will be eager to use it to save money. The steps in the process are clear: 1) Identify areas where energy can be saved. 2) Adapt technology to local conditions. 3) Train local engineers. 4) Run demonstrations at actual factory sites to prove the technologies work and save money. And 5) through education and promotion campaigns, spread the message to other energy users throughout the country.

Over the past 10 to 15 years USAID energy projects followed this classic strategy. USAID did an excellent job of implementing energy conservation demonstration projects. The Agency held seminars and training sessions, trained energy auditors, launched education programs, and identified energy-saving investments. Demonstration projects at factories and commercial buildings proved the technology was sound and could be adapted to the needs of developing countries. It reduced pollution, saved energy, and generated good economic rates of return.

Figure 1. Energy Efficiency

A country's energy efficiency is measured by comparing gross domestic product (GDP) with total commercial energy use. Various energy sources are converted to their equivalent in tons of oil and a ratio computed for tons of oil needed to produce $1,000 of GDP.



Source:

Despite successful demonstrations, new technologies spread slowly beyond demonstration sites. The question then is, Why did the energy conservation message not spread rapidly throughout each country? If the technology works, pollution and energy use drop, and rates of return are high, why don't all plants adopt and use the technology? The evaluation found no single reason, but rather a bundle of factors:

1. Energy policies. When the government uses fuel subsidies and price controls to make energy cheap, energy conservation will not succeed. State-owned enterprises are not usually seized with the need to reduce costs and thus have little interest in energy conservation. Energy conservation efforts are much more successful when state-owned enterprises are privatized and acquire a foreign partner. When people risk their own money, they are interested in reducing costs.

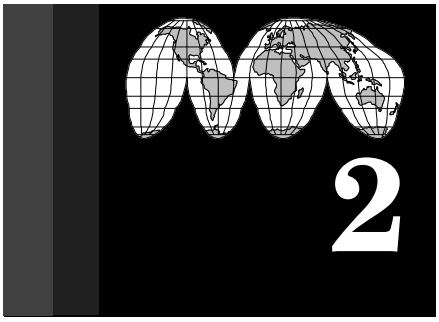
2. Economic climate and business culture. An uncertain or negative economic climate will deter most investments, including those in energy conservation. This was the case in the countries evaluated. In addition, business managers were often skeptical about investments in energy conservation. They preferred investments that would increase output and sales immediately, rather than waiting a year or two for promised energy cost savings.

3. Appropriate technology. When technology was sophisticated and project benefits took several years to achieve, problems developed. Projects were most successful when they promoted simple technologies that generated a rapid payback.

4. Energy education and awareness. If energy conservation is not actively promoted, results are minimal. But even a good energy conservation sales campaign is doomed if energy is highly subsidized, supporting institutions are weak, and investment capital is hard to find.

5. Institutional capacity. Public sector institutions did a poor job of delivering conservation services. The government, rather than administering energy conservation itself, may be best at helping create the conditions and incentives for private firms to perform the services.

The next section of this report, section 2, provides individual country data on the five factors affecting performance. Section 3 examines program impact with an analysis of economic and environmental impact and the sustainability and replicability of USAID programs. Section 4 provides lessons learned. It includes the five key factors affecting program performance along with economic and environmental impact, sustainability and replicability, and finally, operational considerations.



2 Factors Affecting Program Performance

Energy Policy

TAXES, SUBSIDIES, and other energy price policies provide the market signals that determine how much fuel a factory uses and the type of production process it will invest in. When energy prices are ''cheap,'' there is little interest in energy conservation, and USAID projects have limited success.

Closely related is privatization policy. The evaluations found most state-owned firms have little interest in energy conservation. However, once they are privatized, attitudes change. When owners have capital at risk, they are concerned about costs and view energy conservation as an important way to save money.

Energy Price Policies

Government policies affect energy efficiency and pollution. Energy prices are a key policy. In most countries the government can set energy prices at any level it feels is ''reasonable.'' That is when problems begin.

Energy is a commodity, and like most other commodities its cost is a major factor determining demand. If energy is cheap, demand will be high. If energy is expensive, demand will drop and users will try to economize and limit use. Most developing countries have a tradition of government policies that made energy cheap.

There are reasons for a cheap-energy policy. Developing countries view energy as important to their economic growth. Once poor and backward, the United States and Western Europe modernized thanks to an agricultural and industrial revolution that replaced human and animal muscle power with mechanical power. Productivity skyrocketed in agriculture, industry, and transportation as ever more efficient machines were developed and increasingly efficient fuels were used. Most developing-country governments decided their countries could modernize through increased mechanization; they used cheap energy as a major policy tool to encourage investment in machinery.

In all the case studies, governments tried to keep energy prices low. When international prices increased, they provided subsidies to keep prices down. Even when international oil prices quadrupled (in 1973), and then doubled (in 1979), they provided massive subsidies in an attempt to keep domestic energy prices ''reasonable.''

Some sectors received extra benefits. In every case, coal, electricity, and fuel oil for industrial use received the heaviest subsidies. At times, governments established other special subsidies—for example, kerosene for household cooking in Jamaica, and fuel for home heating and cooking in Hungary and the Czech Republic.

Industrial fuel subsidies were designed to spur industrial growth. Usually, though, they had the opposite effect—creating an inefficient, noncompetitive industrial sector. Because of the subsidies, industry had no incentive to use energy efficiently. Wasting fuel in one year is bad enough; wasting it over many years is far worse. Cheap energy encourages energy-intensive investments in the wrong production technologies, equipment, and factories. Energy-inefficient capital investments are around for many years, thus mortgaging long-term industrial efficiency far into the future.

Starting in the mid- to late 1980s, each of the countries moved to eliminate subsidies and bring energy prices in line with world market prices. USAID energy conservation projects helped support those efforts.

When Communism ended in Hungary and the Czech Republic in 1989, both countries instituted major structural reforms as they moved toward free markets and international prices. The previous socialist policy of cheap energy to support industrial development ended. The governments raised energy prices dramatically, so that they approached world market prices. Forty years of socialism, though, made ingrained cheap energy policies hard to reverse. After an initial burst of enthusiasm, the pace of price reform has slowed. Energy price increases are starting to lag behind inflation in both countries. Most industrial energy prices are close to market costs, but household heating and cooking fuel prices are still heavily subsidized.

In Jamaica government policy has given energy conservation low priority. A cheap energy policy, with electricity rates set well below costs, retarded conservation until the early 1990s. Now, most energy prices are close to world market prices. However, in contrast to many other countries, Jamaica imposes very low taxes on petroleum products. Thus, market prices in Jamaica are low by international standards, reducing the incentive to conserve fuel.

Guatemala continues to concentrate on providing low-priced and dependable power to users. Public and private investments in expanding hydroelectric power capacity continue to dominate the government's energy agenda. The most common comment heard from energy-using firms is that industrial energy conservation is a low government priority. In Guatemala the oil shocks that sparked interest in energy conservation in the 1970s and 1980s were relatively short lived. Government efforts are directed largely toward power production, not conservation by energy users.

In the Philippines the government encouraged industrial energy inefficiency by subsidizing industrial fuel oil and electricity. In addition, because of protectionist import policies, industry could pass along increased energy costs to the Philippine customer. But this strategy had its limits. As the global economy became increasingly competitive and open, Philippine industry needed to reduce costs to retain market share. By 1992–93, after rapid growth in electricity consumption, power failures increased. As a result, energy prices are finally being raised.

During the 1960s and 1970s, Pakistan used energy price controls and subsidies to stimulate the country's industrialization. However, by the end of the 1970s, with the rapid run-up in international oil prices, the government could not continue to fund large energy subsidies. It moved steadily to link domestic fuel prices to international levels. By the 1990s, except for natural gas for fertilizer production and residential electricity, most energy prices were at world market levels. However, the legacy from years of subsidies remains. It is estimated inefficient energy equipment and practices still cause losses equal to 15–25 percent of energy supply.

Privatization Policy

In almost every case energy providers (oil, gas, and electrical power companies) were state owned. They had easy access to foreign exchange, government-guaranteed loans, and

government subsidies. Because they had access to foreign exchange at the official rate and credit at the government rate, they received a large subsidy. Little incentive existed to keep prices down or to provide good service.

Starting in the late 1980s, governments in most countries took steps to privatize these companies. But experience shows privatization by itself is not enough. The power company usually holds a monopoly, and if market incentives are not changed, its behavior will not change. There must be an independent regulatory body (a public utility commission) that supports economic prices, minimizes cross subsidies, has a framework for public participation, and develops rate structures that support conservation.

Of even more interest is privatization of factories and other energy users. In the 1980s each of the case-study countries started to privatize some of its state-owned factories. Since many of these were heavy energy users, it is important to trace how privatization affected energy conservation.

State-owned factories have always had important political responsibilities. In addition to producing output, they were charged with nonmarket objectives—keeping sales prices low, earning foreign exchange, maximizing employment, and buying equipment from other state-owned factories. Energy conservation was rarely a concern. Now with privatization, new factory owners are interested in something different—making a profit. This means keeping costs down, and energy is a significant cost.

The evaluation found that privatization affects how firms approach energy conservation. Managers at factories that are still state owned continue to emphasize production, not costs, and have little interest in conservation. It's different with privatized companies, and in particular with companies that have foreign partners. The partners bring new technology as well as management, finance, and marketing skills. They also are concerned with cost controls and are willing to make cost-saving investments—notably, investments in energy conservation. The major change resulting from privatization is factory management now motivated to cut costs.

Business and Investment Climate

Energy conservation measures are, before anything else, business investments. The type and level of investments a firm is willing to make depend on the economic climate and the business culture. An energy conservation program may be effective at reaching clients, and the technology may be sound, but if business managers are unwilling to invest, all is lost. Thus, much depends on the investment climate, including inflation, interest rates, capital availability, and growth prospects.

The second factor is the business climate. A new government energy policy or new set of energy prices can be introduced quickly. But business attitudes develop over many years and change slowly. Even with the right policies in place, business managers may still be operating with outdated attitudes.

Investment Climate

An uncertain economic climate will deter most investments, not the least those in energy conservation. During the past 10 years, most developing countries experienced major economic changes requiring economic restructuring. The end of subsidies, protected markets, price controls, and administrative allocations was a boon to long-term efficiency. Changes were needed and long overdue, but the process was painful for many industries. Individual firms realized they should improve their energy efficiency but other tasks—finding working capital, maintaining production, finding new markets—seemed more urgent. When in crisis, firms tend to their short-term needs, not to investments in energy efficiency, which generate longer term cost savings.

When an economy is depressed there is a general reluctance to invest. The same is true if factory managers are unsure about the pace and coverage of government privatization plans and market liberalization. In extreme cases, management makes no new investments, and most maintenance is curtailed. In such a situation firms are unwilling to invest in energy conservation.

A final concern is availability of capital. When governments are running large budget deficits, they need large amounts of capital. They bid up interest rates and crowd private borrowers out of the capital market. The small amount of credit available to private firms is available only at high interest rates. Faced with capital shortages, business managers are reluctant to make investments, and energy conservation suffers.

Business Climate

Each country has its own business climate. In Hungary and the Czech Republic socialism is dead, but socialist attitudes are not. The mentality of central planning (concentrating on production targets and output, and not necessarily on costs) remains in all too many firms. In the past, a straight engineering solution to a production problem may have been enough. But in a world of high energy prices and market competition, firms need to consider costs and cost reduction in their plans, along with marketing, finance, and energy conservation. Factory managers who still emphasize production over costs make it difficult to promote energy-saving investments.

Although Hungary and the Czech Republic suffered from socialist central planning, they were not alone. Jamaica, Pakistan, and the Philippines were strongly statist, with a large government sector, controls on investment and production, protection from competition for many firms, and import/export controls. Their statist approach generated business attitudes very similar to a those in Hungary and the Czech Republic.

USAID energy audits introduced energy conservation ''hardware'' (equipment and machinery) into Hungary and the Czech Republic. Even more important was the introduction of ''software''—new ways of thinking about old problems. The Agency introduced, for example, the practice of total energy management, which includes energy operations and maintenance and financial analysis. Most business managers had always thought of problems in technical terms. The idea of improving production and reducing costs by better scheduling, tighter inventory control, improved lighting, and better energy monitoring required a change in management attitudes.

In Jamaica the business culture has historically been oriented toward trading(import/export and buying/selling) rather than investments in manufacturing. Firms also operated in a protected market, with little competition. The situation was similar in the Philippines, which had a history of protectionist import policies. In both countries businesses were used to raising selling prices rather than reducing costs. The trading mentality and cost-plus approach made it hard to convince firms of the need to reduce costs through energy conservation.

Great political and economic uncertainty often permeates thinking in developing countries. In addition to normal commercial risks, business owners are unsure of future inflation rates, foreign exchange rates, and changes in government controls and regulations. When they make an investment they seek a rate of return high enough to cover those uncertainties. They also prefer investments with a short payback period—the point where profits generated by a new investment cover investment costs. In the face of chronic uncertainty, a payback period of, say, six months is much preferable to one of two years.

In most of the country cases, business managers expect a 25–40 percent rate of return on investments. If an energy conservation investment cannot achieve that rate, it will not be adopted. In many cases business managers do not believe energy conservation investments

will generate a high enough rate of return to cover costs or the inconvenience and risk of making the changes.

Technology

USAID projects generally emphasized ways to make existing equipment work more efficiently and promoted relatively simple energy-saving technologies. This approach reflected both the difficulty of introducing high-cost, complex equipment and the importance of achieving results quickly.

Some technologies introduced by USAID were very simple: insulating steam boilers and pipes; replacing defective valves, pumps, and steam traps; or tuning up boilers and furnaces. Other technologies were only slightly more complicated: installing meters and gauges, using correctly sized motors, and installing more efficient burners.

Since technologies were simple and not revolutionary, in most cases equipment could be purchased locally or ordered from a company in the United States. It was almost always ''off the shelf'' equipment, available from a number of different manufacturers. Local engineers usually knew about the technology, having read about it in trade journals or seen it in operation.

Although technologies were simple, returns could be large. If a factory uses steam in its production process and has inadequate insulation, steam leaks, defective steam traps, and bad condensation pumps, it can easily lose 10–15 percent of its steam energy. An investment of several thousand dollars would generate an immediate fuel saving. In most cases two to three months' worth of fuel savings would pay for the energy-saving investments. Such investments generate very high financial rates of return.

Energy can also be saved on the production line through the use of improved manufacturing techniques and better planning and work scheduling. An energy audit of a glass factory in Hungary found the plant, with its three production lines, was running at only 30 percent of capacity. By shutting down two of the lines and running the remaining line at full capacity, managers cut energy costs in half. In the Philippines a laundry replaced old ''batch'' equipment with a continuous-washing process. Output increased 50 percent, steam and water use dropped sharply, and the financial rate of return was 21 percent.

In other cases technologies were more complicated, and problems developed. In Jamaica, USAID promoted solar collectors. (A solar collector is a water tank that mounts on the roof and uses sunlight to heat water.) Sunlight is a free energy source, and Jamaica has 12 hours of sunlight almost every day throughout the year. But solar collectors require custom manufacture and installation and need regular maintenance. What's more, hurricanes can rip them off a roof. Five years after the project was completed, all of the USAID-funded solar collectors had been abandoned, and only a handful of tourist hotels were using the technology.

In Pakistan, computerized automobile engine diagnostic equipment and energy-monitoring equipment were used during the USAID project, but continued use after the project appeared doubtful. A similar fate will probably happen with exhaust gas analyzers and other measuring equipment in Hungary and the Czech Republic. In Guatemala and the Philippines, installation of capacitor banks (devices to temporarily store electricity) has improved the power factor (a measure of how efficiently energy is used). But capacitor banks are not used consistently throughout industries. They are expensive and slow to return investment, and are used mainly by a few large factories with a strong financial base. Few other factories purchase them.

A number of other energy-saving technologies standard in the industrial world are rarely used in developing countries. USAID projects had only limited success with cogeneration (using waste heat to generate electricity), preheating with recovered waste heat, alternative lighting systems, computerized equipment

control, and start-up timing of equipment to minimize peak demands.

The projects had the most success with low-cost technologies that had a prompt payback. These were often housekeeping types of energy conservation (repairing steam leaks and boiler tune-ups). But the issue is not strictly about technology. In countries with a history of cheap energy, limited capital markets, and an uncertain economic environment, business managers are reluctant to make long-term investments. Initially they will invest in energy-saving measures that will pay for themselves in a few months to a year but not in investments with a four- or five-year payback. They are particularly cautious with investments in the new field of energy conservation.

Growth in demand for more advanced energy conservation technologies is a normal development in countries where energy subsidies are being reduced and energy costs become an important financial consideration for managers. The USAID projects successfully introduced factory managers to low-cost, basic energy conservation technology. As long as energy prices, government policies, and the investment climate are supportive, factories should progress naturally up the technology ladder from simple housekeeping techniques to more comprehensive investments.

Energy Education And Awareness

Before the USAID projects, spending money to save energy was a novel concept for most businesses. Energy was cheap, markets were protected, and governments were willing to subsidize many industries. In some cases the government and public interest groups had been urging citizens to save energy to help the nation, but such public service pleas were usually ignored. Before the USAID projects could start, they had to create an awareness and demand for energy conservation. It had to be marketed and sold.

Although the projects did conduct some general public education, most efforts targeted energy users and those who could change energy practices. Those entities included business managers and engineers, trade and professional associations, government officials, lenders, and equipment suppliers. Marketing and outreach were carried out through seminars, publications, technical conferences, and direct calls on potential user companies.

Although seminars and pamphlets are helpful, nothing sells the idea of energy conservation better than equipment operating in a local factory and actually saving fuel and lowering costs. All of the projects funded demonstrations at a range of business sites.

To identify the most promising sites, specialists completed surveys at government and private factories and buildings. Then U.S. and local energy engineers conducted energy audits at selected sites. (An energy audit is a technical analysis by an engineer of how a factory uses energy. It identifies ways to eliminate energy waste and increase efficiency.)

Energy audits are central to energy conservation efforts, but engineers in developing countries are unfamiliar with the process and need training. As a way of ingraining energy conservation into the thinking of local engineers, the projects provided training in energy auditing. Engineers were given training in energy management, operations, and maintenance. In addition to engineering skills, the training included energy-related finance, marketing, and factory production processes. By training local energy auditors the projects created a pool of skilled engineers for USAID-funded energy audits. They were a key part of the project.

But there was an even more important reason for training energy auditors. After the USAID projects were completed, energy auditors could continue to work with local businesses to identify energy-saving investments. They would continue to promote energy conservation long after the USAID project had ended.

In all of the country cases, seminars, workshops, and training quickly raised interest in energy conservation. Managers of factories, office buildings, hospitals, and hotels who had never thought of energy in the past were now looking at their energy budget to see what could be cut. The interest was not, however, long lived. As USAID projects came to an end, energy awareness began to lag. Part of the problem was due to external factors (real energy prices dropped), but more was due to a failure to develop an institutional mechanism to keep promoting and selling energy conservation.

In Guatemala the momentum of energy awareness has dropped markedly. In Jamaica energy awareness is almost nonexistent, and efforts launched by USAID were not sustained. In Pakistan, Hungary, the Philippines, and the Czech Republic, USAID projects are winding down or have just ended, and energy awareness is declining

In many ways, promoting energy awareness is like an advertising campaign for a new soft drink. You want to let potential customers know your product is available and that it has important benefits. But after the ad stirs initial enthusiasm, other efforts are required. It is important to keep promoting energy conservation, but even more important to ensure that the institutions, markets, and incentives to sustain new activities are in place. As one observer in Hungary noted: ''Energy conservation seminars, training, and other promotional activities are fine, but success depends more on having in place realistic energy prices, effective incentives, supporting institutions, and cost-conscious factory managers interested in making a profit.''

Institutional Capacity

Institutions are the glue that holds together and manages the various actors and inputs needed to promote energy conservation. An effective institution also makes energy conservation sustainable—helping deliver benefits long after USAID assistance ends. With a single exception (Hungary) the projects supported (and in some cases created) institutions to help implement USAID project activities (see table 1). Institutions attuned to the needs of the private sector and responsive to market forces were the most successful. Since public sector institutions generally did a poor job, USAID needs to look at nongovernmental organizations and other private sector approaches.

Table 1. Country Institutions Used To Promote Energy Conservation

Jamaica	Energy Division and Energy Information Center, Ministry of Mining and Energy, Government of Jamaica
Philippines	Department of Energy, Government of the Philippines
Pakistan	National Energy Conservation Center (ENERCON), Government of Pakistan
Guatemala	Central American Industrial Technology Institute (ICAITI), a regional organization supported by donors and Central American governments
Czech Republic	SEVEn, an energy and environmental nongovernmental organization
Hungary	Project did not place major reliance on government or private institutions

Different Approaches To Institutional Development

In Jamaica the project stressed almost entirely public sector institutions. It established an Energy Division and Energy Information Center in the Ministry of Mining and Energy and trained personnel from other government bodies.

The Energy Division, where USAID directed most of its efforts, never became a strong player in energy policy development. The Ministry of Finance made key energy decisions and had little interest in energy conservation. Since little government support existed for energy reform, the Energy Division received minimal government staffing and limited funding. It was unable to encourage public or private sector interest in energy conservation.

Within a few years of project completion, most staff trained by the project had moved to other jobs, and the Energy Division was a hollow shell. Almost all private energy auditors and energy firms shifted to other lines of business shortly after the project ended. The project trained people and created institutions, but once Agency funding ceased they melted away. Institutionalization failed in both the public and private sectors, because of government policies that failed to promote energy conservation.

In Pakistan, USAID also directed its efforts toward a public sector institution, ENERCON, the National Energy Conservation Center. ENERCON was tasked with making a market for energy conservation with training, seminars, publications, educational outreach, awareness programs, and energy audits for manufacturing firms. It also funded energy audits by private engineering firms and provided automotive emissions analysis equipment for gasoline stations.

ENERCON is still a fledgling institution, and its viability is uncertain. As USAID funding ends, it is not clear whether ENERCON will be able to secure funding from the Pakistan government to continue its programs and hold on to qualified technical staff. While ENERCON's fate is uncertain, markets for private energy conservation services are burgeoning. As long as Pakistan continues to follow its present energy policies and continues to deregulate its economy, private demand for private energy conservation services should continue to grow, and private energy firms can service the market.

In the Philippines, USAID worked to support a government energy conservation institution within the Department of Energy. The department promotes public energy awareness, develops policies and regulations, performs energy audits, and provides financing for energy conservation. Though at one point the Energy Department was abolished for political reasons, it was later reinstated. Almost all project attention went to the Energy Department; private institutions were not encouraged.

The project was designed to create the conditions and incentives for private firms to perform energy audits and supply energy conservation equipment and for private financial institutions to lend to investors for energy conservation. The private sector, however, does not perform energy audits, sell energy conservation equipment, or design energy conservation projects. In fact, the government, through the Department of Energy, maintains a virtual monopoly on the energy conservation audit business. The USAID project helped create a public sector capability to promote energy-efficient technologies and practices, but it was not successful in establishing a capacity in the private sector.

In Guatemala the USAID project helped the Central American Industrial Technology Institute (ICAITI) develop technical capacity for energy conservation and environmental management in Guatemala and other countries in Central America. To make a market for energy conservation services among industrial users, the project trained engineers from ICAITI and the private sector in the techniques of energy audits. The project ended in 1989. On the private sector side, 30 to 40 project staff and

trainees are now independent energy consultants and energy managers for Guatemalan industrial firms. But industrial and other client demand remains limited, so consulting engineers conduct energy audits as a small sideline to their other businesses.

Since the project ended, energy conservation momentum has wound down. ICAITI has greatly reduced its publication and training activities and lacks a strategy for aggressively marketing its energy training and outreach services. The institute depended too much in the past on international donors to finance its core operating costs and must now take an aggressive approach to marketing it services if it is to remain viable. It plans to pursue a more entrepreneurial approach to generate revenues needed to be a player in energy conservation. It has developed a business plan but does not yet have a firm grasp of how it will generate revenues to carry out the plan.

In Hungary the USAID project provided some assistance to the Hungarian Energy Office and other government agencies but did not try to develop governmental or private institutions. The project directed almost all attention to training energy auditors who would then operate their own private sector energy firms. As a direct result of the project, a number of private consultants and small firms are now working in the energy market. Since the project is just drawing to a close, it is too early to judge whether this noninstitutional approach will work.

In the Czech Republic the USAID project zeroed in on a local energy nongovernmental organization (NGO) known by its Czech acronym, SEVEn. SEVEn has done it all, combining the missionary zeal of an NGO with technical savvy. It has actively gone after business contracts and has shown good business sense, in contrast to some environmental NGOs that, figuratively, want to save the earth but don't know how to balance a checkbook.

SEVEn has organized annual technical interchanges (such as the Energy Efficiency Business Week) and seminars, newsletters, demonstrations, and other forms of information dissemination. It has promoted energy policy reform with the government and served as a matchmaker, linking energy users with engineering and equipment firms. It helped create two private companies that provide energy consulting services to industry. Probably as important as the technical side of energy conservation, SEVEn has learned how to package and market energy conservation proposals. It is now highly skilled at training others in preparing business plans, feasibility studies, and loan applications. USAID provided start-up funding for three years, but now SEVEn is self-sustaining, able to fund operations by selling services to the commercial market.

Which Institutional Approach Works Best?

Each of the projects took a slightly different approach to institutional development: in Jamaica and the Philippines a government ministry received support; in Pakistan, a government agency; in Guatemala, a regional institute; in the Czech Republic, an energy NGO; and in Hungary a noninstitutional approach that relied almost solely on the private sector.

In Jamaica, Pakistan, and the Philippines, USAID provided major support to a single public sector institution. The Jamaican project ended in 1985, and it is clear that a government institutional approach was not successful. The Pakistan project has just ended, and there is some doubt whether ENERCON will be a viable institution 10 years hence. The Pakistan evaluation suggested it might be more effective to work with private sector engineering consultants and industrial firms directly or through organizations of local professional engineers and consultants and local chambers of commerce and industry.

USAID's approach in the Philippines included both private and public sector institutions, but government policies virtually exclude private sector institutions, which reduces the viability of program efforts. In addi-

tion, political and bureaucratic problems have hobbled the program, dimming chances of success. In Guatemala, ICAITI depended heavily on donor and government support. It had many of the same problems as a government agency: it is difficult to be entrepreneurial and responsive to market needs if funding and direction come from the government and donors. All in all, results from a public sector approach are not encouraging.

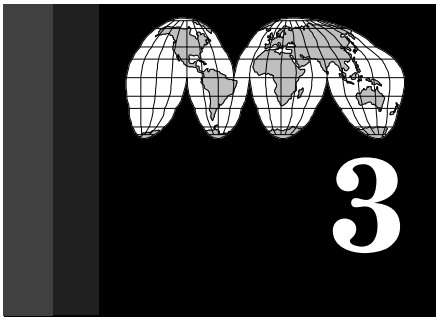
There are, of course, legitimate roles for the public sector in energy management and conservation. Those roles include energy regulation; energy price, tax, and policy development; data gathering, monitoring, and analysis; public education and awareness; and promotion of new technologies. Most commercial areas, though, seem better left to the private sector. Government institutions, by their nature, are not well attuned to changing commercial markets, new technology and investment opportunities, and market-driven profit maximization. The government, rather than administering energy conservation itself, may be best at helping create the conditions and incentives for private firms to perform energy audits and supply energy conservation equipment.

USAID experiences in the Czech Republic and Hungary provide alternative approaches. In the Czech case an energy NGO is the pivotal institution. It has the fire and passion of a committed NGO, along with the technical and entrepreneurial skills essential for success in the marketplace. It has graduated from donor assistance, and it tailors its programs and services to what the market demands and what customers are willing to pay. In Hungary, the project did not create an energy conservation institution; it placed its faith in the private sector. It trained energy auditors and helped establish energy auditing firms.

Since energy institutions in both the public and private sector are weak, and energy conservation is not well established, there may be a problem maintaining the momentum USAID has started. Although it is too early to judge whether the Hungary private sector approach will be successful, the Czech NGO approach seems promising—particularly compared with the weak results achieved with government institutions.

It might also be useful to step back from the classic question of whether to work through public or private institutions and examine alternatives to standard project assistance. USAID has used nonproject policy-reform assistance with good success. At issue is whether energy conservation can be better fostered through policy assistance rather than by building institutions designed to teach more efficient energy use.

The extent to which project and nonproject assistance are complementary or duplicative, and the question of which to emphasize, must be determined in each country case. It is clear a project-based institutional approach cannot be successful without the right policy environment. It is also clear that viable institutions are necessary to promote energy conservation. Since the Agency has had largely unsatisfactory results with public sector institutions, there might be cases where nonproject policy assistance might be enough by itself—or where some minimal level of institutional development directed at the private sector is appropriate.



3 Program Impact

Economic Impact

ONLY IN JAMAICA was the economic rate of return low. In the other country cases for which data were available, economic rates of return were good or very good. The payback period for energy investments (a rough indicator of the financial benefit to the firm) was good in two countries and weak in two others.

USAID projects generate benefits, but to judge whether benefits are sufficient, they need to be compared against something else. One important measure is cost: what is the bang for the buck? If benefits merely exceed costs, that is not enough; they should be equal to or greater than the return that could be earned on alternative investments.

One can look at costs and benefits in two ways: first, from the perspective of the entire country; and second, from the perspective of the individual firm. Economic analysis finds the economic rate of return. The analysis examines costs and benefits to the country, including externalities (secondary effects, good or bad, anticipated or not) such as benefits from reducing pollution.

The firm has a quite different perspective; it is interested only in its own financial rate of return as determined through financial analysis. The firm looks at the cash it takes in and pays out. It receives no cash benefit from less pollution and has to turn part of its profits from energy savings over to the government in the form of taxes.

For this study we are primarily interested in the net benefits to the economy (including pollution reduction), so we examine economic rates of return. Economic rates of return are calculated by first taking all program investments, next valuing the flow of benefits, and finally comparing costs with benefits to calculate an annual rate of return—the net economic benefits. The flow of benefits occurs for a number of years, and that flow, less all costs incurred in their generation, yields the net annual benefit. For example, in a simplified case, if a $100 investment generates a net annual benefit of $30, the project has a 30 percent rate of return.

The economic rates of return for the six country case studies are shown in table 2. The rates of return varied among projects, and average rates were then calculated for each country. In some cases a range rather than a specific number had to be used. Economists would probably agree that the minimum rate of return should be no lower than 15 percent. That is, of course, a minimum; ideally, it should be substantially higher. In most country cases the rate was above the minimum, though possibly not in Jamaica. Hungary and the Czech Republic had excellent returns, whereas the others were lower.

Another way of assessing impact is through financial rates of return—the return to the in-

Table 2. Economic Rates of Return And Average Payback Periods		
Country	**Economic Rate of Return (percent)**	**Average Payback Period (months)**
Czech Republic	50	9.8
Guatemala	N.A.	N.A.
Hungary	165	2.4
Jamaica	2–33	N.A.
Pakistan	19–25	24.0
Philippines	20–63	22.0

dividual firm. No matter how good the economic rate of return, if the financial rate of return is not high enough, businesses will not invest. Financial rates of return were available for only two of the country cases, so it was not possible to compare rates among countries. There is, however, an alternative measure, the payback period. That is the number of months it takes a firm to recover its investment costs through increased profits.

If a firm invests $100 in energy-saving equipment that reduces fuel costs by $100 a year, the investment has a payback period of one year. If the investment generates a $200 return in a year, then the payback is only six months. A quick payback is clearly desirable. Compared with industrial countries, most developing-country business owners are very risk adverse and reluctant to make long-term investments. They generally would like to recover their investment in a few months, though they might be willing to wait a year or two. Using that standard, from the perspective of the business manager, the Czech and Hungarian programs are clear winners, the Pakistan and Philippines programs are strong, and data are not available for Guatemala or Jamaica.

Environmental Impact

Energy efficiency and positive environmental effects go hand in hand. When factories use less electricity or burn less coal, less pollution goes up the smokestack. USAID energy conservation projects helped reduce energy consumption, which in turn reduced air pollution and the production of greenhouse gases. By improving energy efficiency, the projects reduced environmental damage at no additional cost.

Pollution is harmful, but it is difficult to place a dollar value on cleaner air. Because long-term health costs, the possible effects of greenhouse-gas accumulation, and aesthetic values from pollution are hard to determine, environmentalists often use alternative ways of valuing cleaner air.

One approach is to look at abatement costs—how much it costs to reduce pollution by installing pollution-control devices at a factory. If new burners and stack scrubbers remove a ton of sulfur dioxide pollution from the air, and the burners and scrubbers cost $800, then that is a good proxy for the value of

reducing air pollution. It costs $800 to eliminate one ton of pollution.

Another way to place a value on cleaner air is to count the abatement cost avoided. If the same factory reduces sulfur dioxide pollution by one ton by burning less fuel or by burning fuel more efficiently, it avoids the costs of new burners and stack scrubbers. The value of reduced pollution is counted as the money saved by not having to invest in pollution-control devices—in this case, the same $800.

Environmental economists value developing-country abatement costs avoided at half of abatement costs in the United States. This lower amount reflects two factors: 1) the difference in income levels and 2) the technical stage of pollution control. U.S. incomes are higher than those in developing countries, and compared with developing countries, the United States is willing to pay more to reduce pollution. On the technical side, developing countries have high pollution levels, and measures to substantially reduce pollution are much cheaper than in the United States, where easy and low-cost early measures have already been completed.

Table 3 shows reduced pollution resulting from USAID energy conservation equipment installed at factories in the Czech Republic, Hungary, and the Philippines (data were not available for the other countries). The table links pollution benefits to energy equipment costs.

The value of reducing annual emissions needs to be compared with the one-time investment costs to the firm. The simplest relationship is the amount of time required for pollution benefits to cover the cost of energy-saving equipment. In Hungary pollution benefits equal equipment costs in just 4.5 months. In the Czech Republic it is 11 months, and in the Philippines 14 months. But time to recover investment tells only part of the story. Take the Philippines as an example. Although pollution savings cover costs in 14 months, the equipment has a life of 5 to 10 years. Every 14 months it generates benefits equal to investment costs. Over the life of the equipment, pollution benefits equal four to eight times investment costs—a good return indeed.

But in one sense equipment costs are not really an environmental cost. Pollution benefits are almost a gift, since energy conservation equipment was installed by factory managers as a way to save on their fuel bill; the financial rate of return on the energy-saving investment is high enough to pay for the investment. From the manager's perspective, the equipment pays for itself in fuel savings, and the country receives the bonus of reduced air pollution as a gift. This is one of the most powerful justifications for energy efficiency: cost-effective energy efficiency investments

Table 3. Estimated Annual Reduction in Air Pollution As a Result of USAID Projects

Country	Original Investment in Energy Equipment	Annual Pollution Reduction	Months to Recover Investment
Czech Republic	$93,000	$104,000	11.0
Hungary	$203,000	$552,000	4.5
Philippines	$2,400,000	$2,000,000	14.0

yield surplus environmental benefits to the country.

Sustainability And Replication

In most cases energy benefits were sustained at the original project sites, even after USAID assistance ended. In other factories or buildings, though, replication of energy conservation techniques was limited (see table 4).

Issue or Problem

A foreign aid project transfers resources and provides benefits, which is fine. However, of equal interest is what happens after a project ends. Have project benefits been sustained? Have they been replicated beyond the original demonstration sites? And what factors affected sustainability and replication?

Table 4. Program Sustainability And Replication

Country	Sustainable?	Replicated?
Czech Republic	yes	no
Guatemala	?	no
Hungary	yes	no
Jamaica	no	no
Pakistan	?	?
Philippines	yes	?

Sustainability deals with whether program benefits continue at project sites after a project ends. The question is whether the new equipment and technology are still being used. Evidence of sustainability includes continued use of energy-saving equipment at the demonstration factories, energy auditors trained by the project still working at energy conservation, and project-supported energy conservation institutions still operating effectively.

Sustainability is important, but there is also the question of replication: have project benefits spread beyond the original project sites? Has there been a demonstration or spread effect of information and technology among plants and industries? If energy-saving equipment was installed at five factories and five years later it is still operating efficiently, sustainability has been achieved. But it is even more important if technology spreads beyond those 5 factories to another 20 factories; that is successful replication.

USAID projects could not cover all industries and all factories, so they were designed to create a few successful examples that would be picked up and replicated at other factories. The ultimate test is whether practices promoted by the projects spread beyond the original demonstration sites, trainees, and institutions to cover a large part of the economy.

Country Findings

In Hungary the evaluation team found the eight plants that received energy conservation equipment were using the equipment effectively, all investments were generating a high rate of return, and in several cases the plants were expanding their energy conservation efforts. That is the equipment side of the project. What about the people side—the activities of energy auditors trained by the project?

This is another way to measure sustainability. Are the energy auditors still in the business, and has demand for their services increased? The CDIE evaluation team conducted in-depth interviews with 9 of the 10 energy auditors certified as energy managers after their USAID training. All were still in the

energy business, and all had received follow-on energy contracts and related energy engineering jobs. They were also able to identify new energy investments that resulted from the USAID program.

To test for actual spread effects, the evaluation team interviewed a broad range of Hungarian engineers, factory managers, equipment providers, and government officials. The team did uncover some instances where firms were making energy conservation investments. The numbers were small, though, in relation to both the size of the industrial base and the existing high levels of energy inefficiency. Project replication was very limited.

Little information flows among Hungarian industrial firms; most plants are isolated and unfamiliar with what others are doing in energy conservation. Several managers spoke wistfully of the days of communist central planning, when technical directives and instructions came out regularly from the government or industrial trusts. Now managers receive little guidance.

In contrast to programs in other countries, the Agency made no attempt to create a Hungarian energy conservation institution. The project relied on a cadre of energy auditors to establish successful examples that could be replicated by other plants. But project-supported efforts have not spread widely. Replication within an industry or even within a geographic region is limited. Hungary lacks the institutions that disseminate information in the West: trade associations, technical societies, industry newsletters, industry seminars, and in particular private sector equipment salesmen.

The Czech Republic, with its recent break with Communist central planning, has a history and set of problems similar to those in Hungary. The evaluation found all five plants that received energy conservation equipment were using the equipment effectively and in most cases installing new equipment. When, for example, a few project-provided steam valves failed at a wood products factory, plant managers used their own money to buy replacements. To improve efficiency, managers installed additional steam pipe insulation, and they plan other energy-saving investments.

A brewery targeted by the project used its own money to replace two boilers with energy-efficient models that include preheaters. It also installed improved burner combustion controls and better insulation. An auto parts company is using project equipment, and the firm has upgraded the heating system and installed more energy-efficient manufacturing equipment. A district heating plant had added to the USAID-supplied equipment by purchasing new valves, thermostats and meters. A dairy plant, which is close to bankruptcy, is the one case in which maintenance and investment are almost nil and energy efforts have not been sustained.

The Czech projects were clearly sustainable, but replicability was a different matter. Except for the auto parts factory, part of an industrial conglomerate, the demonstration effect or spread of information between plants and industries is limited. Little information flows between plants or between city heating systems; the plants are isolated, and managers are unfamiliar with their competition and what others are doing in energy conservation. Although plant managers know they have energy problems, they are not sure how to find solutions or what equipment or services are available. The evaluation team found little or no evidence of replication. SEVEn, even with its successes, is only one small institution. It is unable to cover all of the country's needs.

In the Philippines, energy-efficient technologies have generally been sustained. The evaluators observed four companies still using installed technologies, and for three of the companies the investments were generating significant cost savings. Internal replication had taken place at paper and cement factories as well as a laundry. The paper company, for example, added six sets of capacitors for power factor improvement beyond the original three funded by the project. There were, however, some sustainability failures, in most

cases related to external financial or market problems. For example, two participating firms went out of business, and another sold the part of its manufacturing process that used technology introduced by the USAID projects.

Energy conservation technology is being adopted by some concerns that were not project participants. For example, at least 9 companies have invested in power factor improvement; at least 11 have adopted boiler and steam system improvements; and at least 8 have adopted waste-heat recovery technologies. Not all these examples can be attributed directly to the project, but at least two are directly related to project efforts.

Several problems affect replicability. When the project ended in 1991, the government's energy conservation loan fund stopped making new loans. In addition, private financial institutions are not actively making loans for investments in energy efficiency. An even bigger threat to replication is the failure to develop private sector capabilities. The private sector has limited capacity to perform energy audits or supply energy conservation equipment. The lack of private sector interest results in large measure from the government's policy of subsidizing electricity and fuel oil prices. The subsidies discourage interest in energy conservation investments.

In Pakistan, ENERCON continues to conduct training programs and disseminates technical literature on energy conservation. Its sustainability is uncertain, though, since it has not secured adequate budget support from the government. Awareness of energy conservation is highest in larger firms and lowest in smaller local firms and public enterprises. Subsidiaries of foreign concerns are the most progressive and most willing to make energy-saving investments.

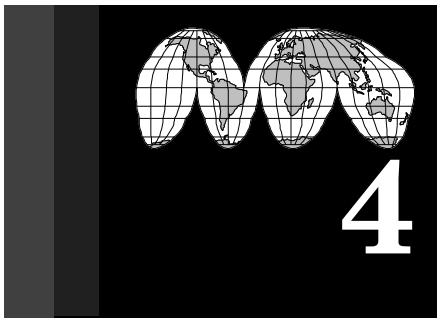
Two signs point to program sustainability and replicability in Pakistan. They are 1) a growing private market for energy conservation services and 2) public policies that encourage energy conservation. Private sector energy auditors trained by the USAID project have seen rapid growth in demand for their services. Pakistan's efforts to save energy may continue and spread regardless of the future of public agencies such as ENERCON. While training, dissemination, and demonstrations are important, steps taken by the government to change pricing, trade, and financial policies have raised interest in energy conservation and present the best hope for sustained action on energy conservation.

In Guatemala none of the energy engineers who participated in the USAID project have been able to make a living from the sporadic requests they receive for energy conservation services. Occasional energy conservation messages appear in the media, and occasional media announcements encourage users to conserve energy, but energy awareness remains low. ICAITI continues to offer energy conservation services at cost to industrial companies in Guatemala and other countries in the region but has no plan to reach smaller enterprises. By targeting relatively large industrial concerns for energy audits and training, the project sacrificed opportunities to reach a broader range of smaller industrial and nonindustrial energy users. That approach was probably the low-cost way to achieve energy savings quickly, but it may have limited replication.

In Jamaica, energy specialists are concerned about conservation, but few business managers or government officials appear interested. Most of the equipment installed under the USAID project has worn out or been discarded. Companies have not replaced the equipment, and there is little new investment. Several engineers who were trained as energy auditors occasionally conduct audits in Jamaica but generally as a minor sideline to other engineering work.

It is notable that Jamaican engineering firms do perform energy audits and related energy-engineering business in other Caribbean countries. The energy auditors argue that, compared with other countries, Jamaica lacks a viable framework of regulatory policies and price incentives to push energy users toward

more responsible energy management. Thus they find little demand for their energy services in Jamaica.



4 Lessons Learned

FROM THE CDIE EVALUATION, a number of lessons emerge under nine broad topics.

1. Energy Policy Reform

When energy is cheap, little incentive exists to use it efficiently. As long as there are major energy subsidies, broad-based energy conservation is difficult.

In each country case the government had supported a cheap-energy policy for decades. Energy costs were subsidized, with most of the subsidy directed toward industry. Low energy prices, particularly for industry, appeal to politicians as a good way to spur industrial growth. However, in almost every case it had the opposite effect. Wasting fuel in one year is bad enough; wasting it over many years courts disaster. Energy-inefficient capital investments stay around for many years, thus mortgaging long-term industrial efficiency.

The situation becomes further confused when some sectors receive large subsidies and others do not. Within the last five years all of the countries have finally scaled back energy subsidies, and in most cases energy prices are close to international prices. Hungary and the Czech Republic are exceptions at the opposite end. There industry overpays on its energy bill to provide a cross subsidy of cheap energy to households. As a result, households have almost no incentive to use energy efficiently.

Privatization affects how firms approach energy conservation.

Managers at factories that are still state owned continue to emphasize production, not costs, and show little interest in energy conservation. It's different with private firms. They are concerned about costs and see energy conservation as a key investment. All of the countries had a large state-owned industrial sector, and privatization efforts have brought significant changes in attitudes toward energy conservation, among other things. Privatization brings in new capital, new management, and an interest in energy conservation. It is most successful when it brings in a foreign partner with deep pockets and a commitment to compete in the international marketplace.

2. Economic and Business Climate

Without adequate incentives, it is difficult to find capital to fund energy-saving investments.

Experience in the United States shows that funding will be provided only when the market provides an opportunity to make money. In the United States, starting in the mid-1970s, energy prices rose sharply, and the states and federal government established incentives to make energy investments attractive. Higher energy prices and other incentives are needed

to create a market for energy efficient equipment.

An uncertain economic climate will deter most investments, including those in energy conservation.

There is a general reluctance to invest in an unpredictable economic climate. In most of the countries, firms tend to concentrate on short-term needs such as increasing production, not on investments in energy efficiency that generate longer term cost savings. Business managers want investments that have a high rate of return and a relatively quick payback. A related issue is capital availability. If interest rates are high and firms find it difficult to borrow, energy conservation is usually a low priority. Energy conservation measures are, before all else, business investments. The type and level of investment a firm is willing to make depends on the business climate.

Government policies and international prices can move rapidly, but business attitudes often change slowly.

Many developing countries have a history of state planning and a large public sector. Almost all had protectionist economic policies. Under such conditions business managers were rarely concerned about reducing costs, since they could sell whatever the factory produced. Business managers are now trying to respond to price changes and new international markets, but their attitudes toward marketing, finance, investment, and cost controls lag. Energy conservation requires different attitudes and approaches, which may not fit with traditional ways of doing business. Each country has its own unique business culture, which influences decisions on energy investment. Business attitudes may fail to change rapidly enough to reflect new market realities.

3. Technology Transfer

USAID projects succeeded by promoting relatively simple energy-saving technology and emphasizing ways to make existing equipment work more efficiently.

Technologies were simple, not revolutionary, and almost always based on standard ''off the shelf'' equipment available from a number of different manufacturers. More sophisticated technologies had mixed results. When energy efficiency is low, simple techniques can generate large returns.

4. Energy Education And Awareness

Good energy conservation technology is not enough; effective and continuing dissemination is needed.

While USAID projects were being implemented and energy seminars and promotional activities were in full swing, engineers were interested in energy conservation. Once projects ended and promotional activities wound down, awareness and interest dropped off sharply. Lack of successful dissemination may be a design weakness in USAID energy projects. Projects devoted much effort to demonstrations of energy technology but paid little attention to postproject dissemination. The Agency needs to determine what is the most effective way to disseminate the results of a demonstration project in a given environment, who is the right audience, and how to make the effort sustainable. When USAID designs a project it should also develop a longer term (postproject) dissemination strategy that relies mainly on the private sector.

Education and awareness campaigns cannot overcome bad energy policies and weak institutions.

Before the projects could start, USAID had to create an awareness and demand for energy conservation. In all of the countries, seminars, workshops, and training quickly raised interest in energy conservation. Factory demonstrations and energy surveys and audits proved to local business owners that energy conservation could save money. As the projects came to an

end, though, awareness began to lag and in some cases fell off sharply. Promotional activities are important in getting the process started, but success depends on having in place incentives, financing, supporting institutions, realistic energy prices, and cost-conscious factory owners who have a stake in making a profit.

5. Institutional Capacity

Development of market-driven institutions is critical to project success.

All but one of the projects supported institutions that helped implement project activities. While such institutions were important to project success, they had an even more important role to play after project completion. They were expected to encourage energy conservation and service delivery after the project ended, making Agency efforts sustainable. Each project took a slightly different approach to institutional development. In three cases USAID supported a government ministry or government agency. In the others it supported a regional institute, an energy NGO, and in the final case, no institution.

To make energy conservation work, institutions have to be entrepreneurial and responsive to market needs. Results from the government institutions were not encouraging. An energy NGO was successful in the Czech Republic, since it had an energized and motivated leader, a clear vision of what it wanted to accomplish, and a market-driven approach to getting things done. Institutions are the critical glue that holds together and manages the actors and inputs needed to promote energy conservation. The performance of government agencies was disappointing. USAID should look for alternatives such as NGOs or the private sector.

6. Economic Impact

Energy conservation needs to generate a strong economic rate of return if it is to be successful.

All projects achieved a minimum acceptable economic rate of return of 15 percent. Jamaica at 16 percent was marginal. The other rates: Pakistan 22 percent, the Philippines 41 percent, the Czech Republic 50 percent, and Hungary 165 percent. The projects demonstrated that modest energy conservation investments provide a fair to very good economic rate of return.

Energy conservation investments require a rapid payback.

In countries with a history of cheap energy, limited capital markets, and an uncertain economic environment, business managers are reluctant to risk long-term investments on any new technology. Business managers will invest in energy-saving measures that pay for themselves in a few months or a year, but not investments with a two- to five-year payback.

7. Environmental Impact

Although energy conservation efforts are important, stressing pollution control through regulation may be the most effective way to cut harmful emission and improve energy efficiency.

In the Czech Republic, air pollution controls are strictly enforced. Factory managers, faced with fines for excessive emissions and, by 1998, a threatened shutdown of the worst polluters, have reacted by switching to cleaner fuels, improved burner combustion, and redesigned production processes. All of these measures reduce emissions and are more energy efficient.

But the Czech Republic is an exception. In the other countries, government pollution regulations are minimal to strict, but they are rarely enforced. Governments can talk about the importance of clean air and even have strong measures on the books, but if laws are not enforced, practices do not change. Pollution controls can do more than just cut down on pollution; they can discourage wasteful and

inefficient energy consumption, but only if the government takes a strong initiative.

Energy efficiency and positive environmental effects go hand in hand.

When factories use less electricity or burn less coal, less pollution goes up the smokestack. The Agency's energy conservation projects helped reduce energy consumption, which in turn reduced air pollution and the production of greenhouse gases. By improving energy efficiency, the projects helped reduce environmental damage at almost no cost.

Pollution benefits are almost a gift, since managers installed energy conservation equipment as a way to save on their fuel bills; the financial rate of return on energy-saving investment is high enough to pay for the investment. From the manager's perspective, the equipment pays for itself in fuel savings, and the country receives the bonus of reduced air pollution. This is one of the most powerful justifications for energy efficiency: cost-effective investments in energy efficiency yield surplus environmental benefits to the country.

8. Sustainability And Replication

Use of energy-efficient technologies has generally been sustained, but replication has been a problem.

In all cases except Jamaica, energy conservation equipment installed at factories is still being used, and most of the energy auditors trained by the projects are still working (at least occasionally) on energy conservation. But there has been little spread of information, technology, or equipment to other sites. The problem is inadequate incentives (energy prices, cost savings), institutions (to spread the message and bring energy users together with those that can help them save energy), and capital markets (to provide financing needed for energy investment). Demonstration projects won't be replicated unless the energy-saving technologies have broad application, are cost-effective, and are widely disseminated and marketed.

9. Operational Considerations

The individual country evaluations identified a number of tactical issues affecting project performance. Listed here are five of the most important factors:

There are energy-intensive firms and firms that use only small amounts of energy. USAID needs different tactics for reaching different types of energy users.

Plants engaged in ore smelting, heavy industry, and electrical generation use large amounts of energy (in many cases energy accounts for 50 to 80 percent of total costs). In such cases it is possible to achieve major energy savings by targeting a small number of energy-intensive firms. The alternative is to try to reach thousands of small energy users (where energy might be only 10 to 20 percent of costs). Either approach will work, but from a donor's perspective it is clearly easier to disseminate new technology to 10 or 20 large companies rather than several thousand small ones. And because energy is a major cost of production in the energy-intensive concerns, managers should be more interested in reducing fuel costs and more responsive to the project's message.

In Guatemala, Hungary, and the Philippines, the Agency directed its efforts at larger, more energy-intensive firms. That approach resulted in good energy savings. In the Czech Republic and Jamaica, USAID took the opposite tack, trying to reach a large number of firms for which energy was a small share of costs. In those countries the Agency provided energy conservation demonstrations at a only a few plants, and the technology was slow to spread to other plants. USAID lacked an effective dissemination plan to reach the large number of firms that were not energy-intensive. When targeting energy users, USAID needs to decide on a clear strategy; it can go after a small

number of large energy users or a large number of small energy users, but there is little to be gained by affecting a small number of low energy users.

Energy conservation is more than just energy equipment—it is also energy management.

The evaluations demonstrated that conservation requires more than just ''hardware'' (equipment and machinery); there is also the ''software'' side of energy management—operations and maintenance. It is relatively easy to bolt a new valve or motor in place, but that does not always generate the greatest energy saving. Other decisions can have an even greater effect: fuel choice, maintenance schedules, energy monitoring and measurement, and the choice of goods to produce and the production process. These represent the software side of energy and include management, finance, and marketing. The United States has much to offer on the software side, and USAID projects introduced valuable new ways of thinking about the total practice of energy management.

Beneficiary, government, and donor commitment is critical to program success.

In the Philippines in 1986, just as the USAID project was getting under way, the new Aquino government abolished the Department of Energy, the institution tasked with implementing the project. At about the same time, a new Mission management team arrived in Manila and assigned relatively low priority to energy conservation. Without strong government and USAID commitment, the project got off to a slow start.

In Jamaica the project provided free energy conservation measures to publicly owned enterprises. When the equipment wore out or needed maintenance, the user assumed the government was responsible for repair. When the government did not repair equipment, the equipment was abandoned. This occurred at government buildings with surprising regularity. When intended beneficiaries lack a sense of ownership and are not true stakeholders, project benefits are not sustained.

USAID should not let its own internal budget needs distort project technology and beneficiary selection.

In the Philippines, the project responded to pressure to disburse funds quickly by choosing ''winners,'' including larger and more financially viable companies. Some companies were already planning to adopt a particular technology and did not require the incentive of subsidized financing. As a result of budget pressure, smaller firms and widely replicable technologies were not always selected.

Important distinctions set developing countries apart from transitional countries.

Compared with developing countries, the Czech Republic and Hungary had many advantages owing to their large industrial base and highly trained engineers. They also had disadvantages, since the industrial base was old, it used energy-inefficient technology, and it was designed to function under communist central planning. In contrast, low-income developing countries lack the large industrial base and trained technical workers. They also do not have a large and energy-inefficient industrial sector. Transitional countries require a different assistance approach.