

A.I.D. Technical Report No. 11

Assessment of A.I.D. Environmental Programs *Energy Conservation in Pakistan*

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The views and interpretations expressed in this report are those of the authors and are not necessarily those of the Agency for International Development.

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PREFACE

Only days before the Center for Development Information and Evaluation (CDIE) team arrived, Pakistan was hit by the worst monsoon rains in 50 years, according to local authorities and the press. Pakistan, like its south-Asian neighbors, is accustomed to the arbitrariness of the weather. But the country was not prepared for the environmental disaster that followed.

Rain water quickly washed down from hillsides denuded of forests and vegetative cover. With their river beds already filled with sediment accumulated from earlier rains, the mighty Indus river and its tributaries rapidly swelled and overflowed. The Government and media issued daily reports of the river's crest as it traveled its 1,200 kilometer route toward the sea, taking with it livestock, homes, and in some cases entire villages. Illegally cut logs, left on hillsides to be sent down the rivers during normal spring rains, were swept up in cresting waters and became battering rams that took out bridges and irrigation dams.

This environmental disaster was the most recent and to date the most dramatic manifestation of the country's neglect and abuse of its forest and soil resources. The flooding precipitated a public outcry for significant sustained action to cure the country's festering environmental ills. Pakistan's leaders—in both government and private circles—have begun to come together to hammer out programs for immediate remedial attention.

Fortuitously, a new environmental strategy for Pakistan had just been completed in a unique 2-year effort by the Government and local nongovernmental organizations. Pakistan must now find the political will to make the investments and changes in practices necessary to get the country on an environmentally sustainable course of economic growth.

The authors of this report believe Pakistan can overcome its environmental perils. This report identifies some of the tentative steps—visible, low-cost, quick pay-off, and self-sustaining steps—that the people of Pakistan have already begun to take. What Pakistan can show the world, and itself, are the ways that positive environmental forces can be unleashed to achieve environmentally sustainable economic development.

CDIE wishes to thank the staff of USAID/Pakistan for its support in conducting the field study work. CDIE also extends its thanks and appreciation to the scores of Pakistani technicians who contributed to this effort.

Phillip E. Church

FOREWORD

Development assistance programs, provided by the U.S. Agency for International Development (A.I.D.), have supported a broad spectrum of environmental and natural resources programs worldwide. The goals of these programs are environmentally sustainable economic development and an enhanced natural resource base. A.I.D. has formulated its environmental strategy to address the following five problem areas:

- Deforestation and loss of biological diversity
- Loss of sustainable agriculture systems
- Inefficient energy production and use
- Industrial and urban pollution
- Degradation of coastal and water resources

Pakistan is one of the countries where A.I.D. has provided support for two important areas of environment and natural resources management: energy conservation and forestry development. This report summarizes findings from an examination of Pakistan's energy conservation program. A separate companion report covers the environmental impact of Pakistan's forestry program.

In addition to the areas of energy and forestry, future studies in this series of A.I.D. environmental programs will examine the environmental dimensions of A.I.D. sustainable agriculture, coastal resources management, biological diversity preservation, and urban and industrial waste management programs. The program assessment studies are results-oriented in nature and seek to determine what difference A.I.D. assistance programs have had on the conditions of environmental and natural resources.

Over the 30-year span of its assistance programs in Pakistan, A.I.D. has supported a range of development initiatives with environmental benefits. A.I.D. programs with direct environmental and natural resources management objectives are only of relatively recent vintage in Pakistan, which since 1991 has only had an official environmental program, the National Conservation Strategy (NCS). This study focuses on the period from 1983 to 1992.

This evaluation examines how A.I.D. has assisted Pakistan in using market forces to promote the adoption of energy conservation practices and technologies. The central operating hypothesis of the evaluation is that the adoption of energy conservation practices and technologies responds to market incentives. The basic evaluation questions consist of the following:

1. In fostering the supply and demand for energy conservation practices and technologies, how important are A.I.D. strategies in

- Strengthening institutional capacity to plan, coordinate, and conduct energy conservation programs?
 - Conducting education and outreach programs to raise awareness and transfer information?
 - Developing or transferring information about energy conservation technologies?
 - Reforming policies to remove market distortions and other disincentives?
2. Can the market for the supply and demand of energy conservation services and technologies
- Function on a sustainable basis after A.I.D. assistance is terminated?
 - Expand its reach beyond those initial direct participants in A.I.D.-supported activities?
 - Generate benefits to society that exceed the value of public—A.I.D. and host country—resources invested in making the market work?

In addressing these questions, data were collected by the evaluation team at the levels of conditions, practices, and impact (biophysical and socioeconomic). The field work was conducted in October 1992 by a four-member team of environment and economic development specialists. During their 1-month stay in Pakistan, the team members worked in Islamabad and traveled to Lahore, Karachi, and Peshawar, as well as sites around these cities, to meet with public and private sector organizations and individuals. Over 120 individuals, firms, and organizations were interviewed.

SUMMARY

Overview

This report highlights a model of environmental management that appears to work...to work at least in the current political and economic context of Pakistan. The model, the outgrowth of U.S. Agency for International Development (A.I.D.) support to energy sector development in Pakistan, focuses on energy conservation. The objective of Pakistan's energy conservation program is greater public and private sector capacity to design and carry out energy saving activities.

The Pakistan energy conservation model (1) uses private sector profit incentives as an engine to sustain its activities and spread its impact; (2) employs an emerging partnership between the Government and private firms to accomplish its objectives; (3) introduces basic, low-cost technologies with quick and visible pay-offs to attract and hold the interest of participants; and (4) produces environmental benefits that can be enjoyed by others beyond direct program beneficiaries.

This evaluation examines how A.I.D. has assisted Pakistan in using market forces to promote the adoption of energy conservation practices and technologies. The central operating hypothesis of the evaluation is that the adoption of energy conservation practices and technologies responds to market incentives. The basic evaluation questions consist of the following:

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2. Can the market for the supply and demand of energy conservation services and technologies

- Function on a sustainable basis after A.I.D. assistance is terminated?

- Expand its reach beyond those initial direct participants in A.I.D.-supported activities?
- Generate benefits to society that exceed the value of public—A.I.D. and host country—resources invested in making energy conservation programs work?

At the time of this evaluation, the Pakistan energy conservation program was completing what might be characterized as its start-up or demonstration phase. Changes in public and private attitudes toward the program were apparent. In addition, new institutions were in place; new technologies and practices were introduced, tested, and adopted; and increases in the capacity of firms for more environmentally sound energy management were apparent. With A.I.D. funding terminating in less than 1 year, the Pakistan Government was close to officially adopting and funding the program. The Pakistani program managers were also seeking other donor funding to continue to expand activities beyond the areas and beneficiaries reached with A.I.D. start-up support.

The field study concludes that the Pakistani program of energy conservation activities, set in motion with A.I.D. support, cannot easily be reversed. With changes in political and economic policies toward the environment in Pakistan, greater and more sustainable impact is possible.

Program Description

Pakistan's energy conservation program began in 1983 with funding from a \$15.5 million component of a larger \$105 million USAID/Pakistan Energy Planning and Development (EP&D) project. The EP&D project component has financed most of the costs of the creation and initial operations of a National Energy Conservation Center (ENERCON).

ENERCON fosters energy conservation in partnership with private engineering consulting firms contracted to conduct "energy audits" and provide energy conservation advisory help in the industrial, agricultural, transportation, and building construction sectors. ENERCON also presents an array of training, education, outreach, and awareness programs for the general public and specific energy users.

Since its establishment in 1986, ENERCON has been challenged with "making the market" for its energy conservation services in a national political and economic setting where there was previously little concern about energy waste. With A.I.D. resources, ENERCON worked to develop both the demand and supply sides of the market for energy conservation services.

To stimulate demand, ENERCON, with guidance from a U.S. technical advisory firm, conducted free energy audits for interested manufacturing firms to identify visible, low-cost, quick pay-off measures to reduce their energy bills. ENERCON also placed A.I.D.-funded computerized automobile emissions analysis units in gas stations and shared

the cost of diagnostic services with station operators. Station operators in turn performed tune-ups for interested vehicle owners. ENERCON also conducted training seminars, distributed publications, and subsidized the sale of energy monitoring equipment to stimulate adoption of energy saving practices among interested participating industrial firms, as well as owners or operators of private passenger cars and trucks, farm tractors and irrigation pumps, and office buildings. ENERCON also targeted special energy saving workshops for homemakers.

To develop the supply of energy conservation consulting and advisory services, A.I.D. funds have underwritten contracts between ENERCON and private Pakistani civil, industrial, and electrical engineering firms to conduct energy audits and to provide energy management consulting services. Participation was also sought from individual automobile and farm equipment mechanics. To help get these firms and individuals up and running, ENERCON and its U.S. technical advisors provided specialized guidance and training. The potential for followup and new design and consulting business from the ENERCON energy audit program has Pakistani engineering firms eager to participate in the program and conscientious in the energy audit work they conducted. The scope for tune-up business also attracted interest from filling station owners and farm machinery mechanics.

Evaluation Findings

Program impact

Pakistan's energy conservation program—and the USAID/Pakistan EP&D project that funded most of its costs through 1992—has had an impact on energy savings and on reduced pollutant emissions by participants in the program. Although these savings and reductions are small in the context of overall national wastage, they demonstrate the potential for energy efficiencies in many sectors.

- **Industry.** Tune-ups of 600 boilers and 72 furnaces in 387 companies achieved an estimated average efficiency improvement of 6.3 percent for these firms; 84 steam system surveys had an average efficiency improvement of 8 percent; and 40 electrical system surveys reduced average electric power demand by 5 percent in participating firms. ENERCON estimates that improved energy conservation was associated with an average 50 percent reduction in hydrocarbon and carbon dioxide emissions. Estimated total annual savings after a 2-year pay-back period for firms participating so far in the ENERCON program is US\$3.682 million annually.
- **Transportation.** More than 4,500 private automobile tune-ups reduced gasoline consumption for their owners by an estimated average of 11 percent. ENERCON estimates carbon-monoxide and sulfur-dioxide emissions dropped

by 50 percent in tuned-up vehicles. Annual fuel savings for participating vehicle owners, after an initial 1-year pay-back period, is about \$450,000.

- **Agriculture.** One-hundred-twenty-four tubewells were audited and 43 were retrofitted with average savings of about 20 percent. A study of 21 tractors after tune-ups found an average of 18 percent savings in diesel fuel and a 50 percent cut in emissions during tillage operations.
- **Buildings.** Forty-three preliminary (lighting, cooling, and insulation) energy surveys in government and private building structures also contributed to energy savings. One participating hospital reported saving US\$224,000 in 1989 by adopting energy conservation practices recommended by ENERCON.

Program efficiency

The assessment estimates that A.I.D.'s rate of return on its EP&D project funding of US\$15.5 million from the estimated annual US\$3.682 million in energy savings in the industrial sector alone is about 19 percent, well within the range of alternative power generation investment programs in Pakistan. ENERCON also fostered an estimated US\$450,000 in annual energy savings through its initial computerized automobile diagnosis and tune-up program, as well as smaller annual energy savings from its activities in the agricultural and construction sectors. These energy savings, in addition to reducing pressures on fuel resources, have also benefited the environment by reduced emissions of pollutants. This assessment does not include these environmental benefits in efficiency measures, however.

Program effectiveness

Pakistan's energy conservation program shows demonstrable gains in performance effectiveness when compared against its own performance over the 10-year period of A.I.D. funding support. Initial per unit costs of audits and training activities have dropped to levels that appear sustainable. ENERCON has been most effective where it has sponsored focused energy audits (improved boiler efficiency, electric power use adjustments), and less effective where it attempted comprehensive total energy management surveys.

Program sustainability and replicability

This evaluation uses five categories to indicate program sustainability and replicability: (1) public institutional capacity, (2) private sector capacity, (3) technology development and capture capacity, (4) education and outreach capacity, and (5) the policy reform. These indicators measure the conditions that the Pakistan energy conservation program attempted to change to foster better energy saving practices.

Public institutional capacity. ENERCON remains a fledgling institution and its sustainability is uncertain. In response to evaluation team questions about ENERCON's usefulness, participating firms applauded ENERCON's partnership role but cautioned against ENERCON becoming an environmental police officer. Enforcement responsibilities were better left, the firms' believed, to the new Pakistan Environmental Protection Agency. They gave ENERCON high marks for its energy saving technical literature and its conduct of training programs. ENERCON also demonstrated staying power by securing additional financing from other donors to continue to expand some of its programs after A.I.D. funding ends. At the time of the evaluation, ENERCON had not yet secured funding from the Pakistan Government to absorb A.I.D. project-funded staff. The success of ENERCON's efforts to obtain special autonomous agency status is by no means certain. As a result, its ability to set its own salary scales to attract and hold qualified personnel has yet to be tested.

Private sector capacity. ENERCON expanded its scope beyond that of its own direct staff and resources by strengthening technical capabilities among Pakistani contract engineering and manufacturing firms. To the extent that markets for energy conservation consulting services seem to be burgeoning, Pakistan's efforts to save energy may continue and spread regardless of the future of public agencies such as ENERCON. Enhanced private sector technical capacity has been a positive by-product of the project, even though this was not the primary objective. When the U.S. advisory firm started its activities in Pakistan, it trained local engineers and professionals who worked as its subcontractors or consultants. Many of these trained engineers moved to other firms or started their own firms contracting with ENERCON. ENERCON continues to contract with local Pakistani engineering firms and has begun to invite tenders for conducting additional energy audits under other donor-funded programs.

That the private sector firms have started designing and monitoring energy saving systems and conducting surveys and audits on their own is further evidence of the sustainability and replicability of Pakistan's energy conservation activities. ENERCON can help sustain this momentum by fostering information flows and skills up-grading, and encouraging demand among firms not yet reached by the program.

Technology development and capture capacity. ENERCON must find ways to remain current with advances in energy saving technology if it is to remain relevant to the needs of industrial energy users in Pakistan. It also must pursue more vigorous and systematic outreach programs (publications and seminars). Transfer of knowledge through training and publications appears to benefit industrial firms more than consulting services. Scope also exists for networking among energy conserving firms that can provide leadership in such manufacturing sectors as chemicals, textiles, sugar, and light manufactures.

Education and outreach capacity. Greater awareness among managerial and technical staff about energy conservation increases program sustainability and replicability. ENERCON expanded energy conservation awareness by (1) organizing about 120 workshops for more than 3,500 engineers, technicians, and managers; (2) producing

practical manuals and publications for use by technical staff; and (3) conducting energy demonstration programs. By creating an awareness of energy conservation and by focusing on a few simple, highly visible measures for quick returns, ENERCON is creating an effective, if modest, demand for energy conservation consulting services.

Energy conservation awareness is not uniform, however. It appears highest in larger and foreign subsidiary firms and lowest in smaller local and larger parastatal firms. Subsidiaries of the foreign firms appeared the most progressive and encouraged more networking among energy efficient firms (i.e., associations of mechanical engineers, ENERCON seminars, and demonstration visits to model plants). Firms preferred site visits to ENERCON more than publications and seminars. These visits became useful vehicles for spreading the impact of energy conservation programs.

Policy reform. A.I.D. enjoyed a constructive dialogue with the Government of Pakistan throughout the implementation of its energy project. This allowed for changes in rate structures and the introduction of penalties for electric power waste that certainly enhanced private interest in achieving savings through better energy use management.

Steps taken so far to change the pricing, trade, and finance policies have enhanced the impact for program sustainability and spread. By continuing on an "environmentally friendly" course, Pakistan may be making the lowest cost, highest pay-off investment it can. With A.I.D. support ending, ENERCON must operate outside the privileged status of the EP&D project and follow the same procedures as any Pakistani Government agency. To regain the freedoms enjoyed during EP&D project implementation, ENERCON will need to loosen up rules and regulations that restrict its access to energy conservation information and equipment from abroad and energy finance from home.

Lessons Learned

A favorable economic and political climate is critical to the successful acceptance and performance of an energy conservation program. With rising energy import bills and increased disruption of industrial production from power shortages occurring since the early 1980s, Pakistan's political leadership finally looked to energy conservation, along with price policy reform, as an important strategy for bringing energy supply and demand into better balance. The Government of Pakistan had already responded to A.I.D. policy dialogue on energy pricing and on penalties for electric power waste. Private industrial firms particularly were feeling the effects in their balance sheets. Consequently, there has been a greater receptivity to the plans and programs of ENERCON than is usually the case with many other development projects.

Energy conservation sells best when participants are given access to low-cost technologies with prompt pay-back benefits. At the outset, ENERCON began conducting comprehensive Total Energy Management audits and recommendations. It soon realized that instead of trying to change the whole system, it could achieve significant economies in fuel consumption with simple tune-ups in boilers and furnaces. In interviews with the

evaluation team, most firms mentioned that they were initially persuaded by the promise of visible and immediate changes in their energy bills. The energy conservation formula that seemed to work best was:

- ENERCON-sponsored energy audits or surveys that could be completed within 1 or 2 days without disrupting the operations of the firm
- Financial savings to cooperating firms that would show up quickly in lower energy fuel bills
- Investments in energy saving equipment or practices that could be recovered within 3 to 24 months

Local private engineering expertise is critical for spreading and sustaining the provision of energy conservation services. Pakistan has a reservoir of trained engineers who understand energy conservation engineering principles. They have good training in civil, electrical, and mechanical engineering fields either in Pakistan or abroad. What they lack is practical energy management knowledge and experience. With a little training and exposure to conservation practices, however, these engineers acquired the necessary expertise to undertake energy conservation consultants. The relatively large number of private civil, electrical, and mechanical engineering consulting firms in Pakistan are in a position to respond to the emerging market opportunities for energy conservation advisory and design services. Most of them are relatively small managed by two or three professionals with a number of associates. Pakistan's recent move towards privatization has stimulated the growth of such firms.

Flexible project design permits program managers to respond effectively to new conditions and opportunities. At the outset, the Pakistan energy conservation program focused on broad total energy surveys that took time, staff, and resources and produced large ambitious recommendations with little chance of implementation. Also, the A.I.D. EP&D project initially prohibited the local engineering firms it contracted to conduct energy audits and pursue further consulting or design business generated by the audit recommendations. It later revised the program so that "targeted" energy audits could identify quick pay-off changes, and it encouraged energy audit firms to engage in followup consulting, design, and implementation of recommendations. Such mid-course EP&D project adjustments were critical for achieving the program's energy conservation targets.

Outstanding Issues

The experience of Pakistan energy conservation program raises three issues that merit careful examination both in the contexts of Pakistan's future program implementation and in other countries. The evaluation recommends that these issues be the basis of a reexamination of the Pakistan energy conservation program after 5 years.

These issues will be studied during other CDIE field evaluations of energy conservation programs as part of this series of assessments of A.I.D. environmental programs.

The role of program subsidies

To support ENRCON's energy conservation program, A.I.D. approved use of a share of EP&D project funds (1) to subsidize energy audit contracts and consulting work for participating industrial firms; (2) to pay a share of the costs of computerized automobile engine diagnoses for individual vehicle owners; (3) to underwrite the distribution of training and information sources free or nominal cost to participating private firms and individuals; and (4) to off set a share of the sale prices of energy monitoring equipment. These subsidies, it was argued, appeared necessary to break down the initial resistance and skepticism about ENERCON's motives among the industrial firms, automobile owners, and other energy consumers. ENERCON believed that some subsidies were warranted to compensate private firms and individuals for a share of the costs incurred in reducing pollutants from more efficient energy use.

One danger associated with subsidies is their potential for creating market distortions that undermine the very conditions and practices they originally were used to promote. Once subsidies have "made the market," as appears to be for energy audits in the industrial sector and computerized automobile diagnoses in the transport sector, energy conservation programs might do well to terminate subsidies completely or partially. By terminating subsidies, private initiatives then have the scope to enter and sell services without the fear of competing with free public sector services.

A second concern over the use of subsidies is the efficiency and equity with which they are administered. Even during the initial start-up phase of the ENERCON program in Pakistan, some audits and other services were performed for firms or individuals quite able to pay the full costs (e.g., large subsidiaries of multinational firms and private vehicle owners who enjoyed special rates for energy audits and vehicle engine diagnoses).

The role of nonproject assistance

The adoption of energy conservation practices in Pakistan is due to other factors in addition to EP&D project support for the creation of ENERCON and its coordination of energy audit and consulting services. Also important were a range of price policy and structural adjustment measures undertaken by the Government of Pakistan. These measures were part of the Government's agreements with other donors for nonproject assistance in the energy sector and in support of economic reforms, such as price decontrol and market deregulation. In fact, the impacts of project and of nonproject assistance on energy conservation in Pakistan cannot be separated.

At issue is whether energy conservation cannot be fostered solely through nonproject assistance, saving the resources, human and other, that have gone into building institutions and programs aimed at teaching more efficient energy use to manufacturing, transport, and construction firms, as well as farmers, homemakers, vehicle owners, and others. The extent to which project and nonproject assistance are complementary and duplicative in their effects merits close examination in the course of the evaluation of A.I.D. energy conservation programs. The outcome will help define the best approaches to maximizing the return on development assistance to energy conservation.

The involvement of nongovernmental organizations

ENERCON may need not have been the only—or best—institutional mode through which the energy conservation program operated in Pakistan. In Pakistan, the nongovernmental world comprises a range of private professional organizations and associations to which energy-using industries and individual engineering firms and consultants belong.

Had the A.I.D.-funded program chosen to do so, it could have worked directly with the range of local associations of professional civil, electrical, and mechanical engineers and consultants, and with a broad range of local chambers of commerce and industry to which many of the firms reached by ENERCON belonged. Little attention seems to have been given to these networks of professionals and industries during EP&D project design and program implementation.

The case could be made, however, that with energy incentives already in place as a result of rising fuel and electricity pricing, engineering consultants and industries would have been equally responsive to assistance provided to and through their own professional associations as through one Pakistani Government agency. At the very least, future energy program activities ought to explore the potential for using professional associations and networks as extensions of ENERCON programs. Energy conservation programs planned in other countries should consider an active role for professional, industrial, and commercial organizations.

GLOSSARY

ADB	Asian Development Bank
A.I.D.	U.S. Agency for International Development
BTU	British Thermal Units—a heat measure of energy
CDIE	Center for Development Information and Evaluation
CFC	chlorofluorocarbon
EP&D	A.I.D. Energy Planning and Development Project
ENERCON	National Energy Conservation Center
FP&D	A.I.D. Forestry Planning and Development Project
GDP	gross domestic product
GNP	gross national product
GOP	Government of Pakistan
IBRD	World Bank
IMF	International Monetary Fund
IRR	internal rate of return
NCS	National Conservation Strategy
NIC	newly industrialized countries
PECC	Pakistan Energy Conservation Council
PEPA	Pakistan Environmental Protection Agency
TOE	Tons of Oil Equivalent—a volume measure of energy
UNCED	United Nations Conference on Environment and Development
UNDP	United National Development Programme

USAID/Pakistan A.I.D. country Mission

WAPDA Water and Power Development Authority of Pakistan

MAP OF PAKISTAN

1. INTRODUCTION

This report highlights a model of environmental management that appears to work ... at least, in the current political and economic context of Pakistan. The model is the outgrowth of U.S. Agency for International Development (A.I.D.) support to energy development in Pakistan and focuses on energy conservation. This evaluation examines the performance of Pakistan's approach to energy conservation.

The Pakistan energy conservation model (1) uses profit incentives as an engine to sustain its activities and spread its impact; (2) employs a growing partnership between Government and private firms or individuals to accomplish its objectives; (3) uses basic, low-cost technologies with quick pay-offs to attract and hold the interest of participants; and (4) produces environmental benefits beyond those enjoyed by direct program participants.

At the time of this evaluation, the Pakistan energy conservation program was completing its start-up or demonstration phase. Changes had become apparent in public and private attitudes toward the program. In addition, new institutions were in place; new technologies and practices were being introduced, tested, and adopted; and private sector capacity for environmentally sound energy management had increased. With A.I.D. funding terminating in less than 1 year, the Pakistan Government was close to officially adopting and funding the program. Pakistani energy conservation program managers were also seeking other donor funding to continue to expand activities beyond the areas and beneficiaries reached with A.I.D. start-up support.

This report examines how A.I.D. assisted Pakistan in using market forces to promote the adoption of energy conservation practices and technologies. Section 1 describes the Pakistan country setting of the energy conservation program. Section 2 describes Pakistan's energy conservation program and the A.I.D. support it has received. Section 3 presents findings from the evaluation of the program's impact on institutional conditions, on energy conservation practices, and on biophysical and socioeconomic changes. It also examines evidence of the program's efficiency, effectiveness, sustainability, and replicability. (See Appendix A for a discussion of these evaluation terms.) Sections 4 and 5 discuss lessons learned from Pakistan's energy conservation program and unresolved environmental issues that merit further examination in other developing countries.

Country Setting

With a population of nearly 110 million in 1992, Pakistan is the 10th most populous country in the world and the fourth largest in Asia, after China, India, and

Indonesia in Asia. It has an area of 803,943 square kilometers (about the size of California), excluding Jammu and Kashmir provinces whose territorial control is disputed with India. Pakistan borders on the west, northwest, and north with Iran, Afghanistan, and China, respectively, and shares a 2,000 kilometer border on the east with India.

Pakistan sits astride the Indus River basin, which over the millennia has endowed the country with a fertile, arable land base. Bracketed by the high Karakoram, Himalaya, and Hindu Kush mountain ranges to the north and dry desert areas to the east and west, Pakistan has harnessed the Indus River to supply one of the most extensive irrigated agricultural systems in the world. By applying "green revolution" technologies to this irrigated land, the country has succeeded in keeping food production ahead of the needs of its rapidly growing population. Pakistan's irrigated agriculture system has also provided rural jobs, generated a surplus for infrastructure and industry investment, and created domestic markets for new manufactures.

Hydroelectric power from the Indus River has, along with natural coal and gas reserves, fueled a modest industrial expansion that employs a growing share of the country's urban population. Textiles, steel, and leather products form an important segment of Pakistan's exports, generating the revenues to finance the country's imports. Local manufactures, chemicals, and pharmaceuticals meet much of the country's domestic needs. Pakistan's coastal fishery resources have been an added source of food, foreign exchange, and employment.

Since the mid-1970s, the economy of Pakistan has grown at about 6 percent annually, a respectable rate for Third World countries.

At the same time, the small industrial sector (20 percent of gross domestic product [GDP] in 1990) grew at about 9 percent annually bringing about significant structural change, notably greater urban population concentration. The agricultural sector, which accounts for about 25 percent of GDP, still employs more than 50 percent of the population and contributes one-third of the country's export earnings.

Declining illiteracy, increasing life expectancy, and expanding social institutions have contributed to slow but steady improvements in Pakistan's human resources. Trained technocrats and business leaders who return from abroad and a growing skilled labor force have positioned Pakistan to join the ranks of the newly industrialized countries (NICs) of Asia. However, per capita income in Pakistan remains low—about US\$375 annually in 1990—and about 30 percent of the population lives in poverty with limited or no access to social services, such as health, education, family planning, and potable water. An annual population growth rate of 3 percent continues to strain food supplies, social services, and natural resources.

Politically, Pakistan is a federation of four provinces—the Sind, Punjab, Balochistan, and the Northwest Frontier Provinces. Federally administered tribal areas also extend along much of Pakistan's border with Afghanistan. While national defense, trade, and monetary matters are the domain of the Federal Government, the provincial

governments exercise considerable autonomy in managing water, mineral, and forest resources, and administering health, education, and agricultural services in their territories.

Pakistan has five major urban areas. Karachi, the industrial and commercial seaport, with over 8 million people, is followed by Lahore, Rawalpindi, Islamabad (the current Government center of the country), and Peshawar.

During the 1970s and 1980s, Pakistan received large amounts of U.S. foreign assistance, particularly for developing its energy, infrastructure, agriculture, and social sectors. Assistance levels began to decline in 1990 with the imposition of the Pressler Amendment, which prohibits U.S. assistance to countries with nuclear arms development programs.

Still Pakistan remains an important South Asian ally and key contributor to maintaining the region's political and economic stability and growth. Pakistan presently faces an array of challenges: nurturing a fragile democratic system of government, sustaining its economic growth performance in the face of growing population pressures, and reversing environmental degradation and natural resource depletion.

Environmental and Natural Resource Conditions

By international standards, Pakistan is neither a major environmental polluter nor a major consumer of natural resources. Pakistan's 1992 report to the United Nations Conference on the Environment and Development (UNCED) points out that the average Pakistani contributes less than one-fifth of global per capita carbon emissions and less than 1 percent of global per capita sulphur dioxide emissions. Pakistan does not produce chlorofluorocarbons (CFCs) and its energy consumption is one-fourth the global per capita average (Government of Pakistan, 1992c).

However, environmental damage is tangible and mounting in Pakistan. Beneath the country's encouraging economic performance, disturbing environmental processes are at work. Large areas of agricultural land lie idle because of soil salinity build-up and water logging from poor drainage and irrigation. Soil erosion, aggravated by deforestation, is silting up reservoirs behind hydroelectric dams, thus reducing the dams' life spans to only a few decades. Deforestation is allowing soil sediment to fill up riverbeds, flooding nearby agricultural lands and damaging transportation systems and communications. Energy waste, both in use and transmission, results in supply shortages and disruptions of existing industry, discouraging further industrial expansion.

The consequences of the resulting environmental disrepair are already beginning to show up. Environmental disasters, such as recent destructive floods, slowed agricultural productivity and disrupted industrial power supplies, thus causing unemployment rates to rise and real economic growth rates to decline. These events suggest that natural resource depletion and environmental degradation are becoming a drag on the pace of the country's

development. Energy waste is a particularly troubling problem that A.I.D. has helped the Government of Pakistan address.

Energy Production and Use in Pakistan

Major commercial energy sources in Pakistan are oil, gas, coal, and hydroelectric power. These domestic sources accounted for nearly 68 percent of Pakistan's domestic energy supplies in 1987-1988. Noncommercial fuelwood and biomass accounted for the remainder of the country's domestic energy sources, largely used in rural users. Domestic commercial energy sources account for about two-thirds of Pakistan's commercial energy requirements.

At some point during its rush to industrialize in the mid-1960s, Pakistan became a net energy importer. Today, roughly one-third of Pakistan's commercial energy is supplied by imports, largely petroleum products. Pakistan's energy imports in 1990 represented about 21 percent of the country's merchandise exports (World Bank 1992a).

Pakistan's growing industrial sector accounts for about 30 percent of commercial energy consumption. Power, transport, and domestic households each absorbed about 20 percent of commercial energy supplies and the agriculture sector—including chemical fertilizer production—the remaining 10 percent. Domestic household use accounted for 90 percent of noncommercial energy with small industry consuming the balance.

Like many developing countries, Pakistan has experienced a high rate of growth in commercial energy consumption. Table 1 traces this growth in commercial energy consumption between 1971 and 1984. The 7.4 percent annual rate of growth for the 12-year period is more than the 5 percent annual gross national product (GNP) growth rate for the period reflecting both an increased energy intensification of the Pakistan economy and a rate of energy use not sustainable over the long-run. Today with a global ranking of 115 in per capita income, Pakistan ranks a low 103 in per capita energy consumption (11 million British Thermal Units [BTUs] per capita) but a high 33 globally in energy intensity as expressed as BTUs per dollar of GNP (World Resources Institute 1990). That Pakistan derives such a GNP level from its energy resources is cause for examining why its energy efficiency is so low.

Table 1. Total Commercial Energy Consumption by Sector
(In Thousands of Tons of Oil Equivalent [TOE])

Sector	1971-72	1976-77	1983-84	% Annual change
Residential	615	1,117	2,598	12.8
Commercial	137	267	538	12.1
Industrial	2,502	2,968	4,836	5.6
Agriculture	533	583	821	3.7
Transport	1,161	1,679	3,164	8.7
Power	1,078	1,595	2,592	7.6
Other	945	978	1,810	5.6
Total	6,971	9,188	16,359	7.4

Source: Pakistan, General Directorate of Energy Resources.

To meet increased domestic energy demand, Pakistan invested heavily in hydroelectric power generation and in coal and oil exploration and extraction. These investments, however, have not kept pace with the country's demand for fuel and electric power. During the 1960s and early 1970s, the Pakistan Government used energy price controls and subsidies to stimulate the country's industrialization process. The global petroleum crisis in the mid-1970s, along with the drag of growing energy subsidies on the Government budget, forced Pakistan to reconsider its cheap energy policies.

Assisted by A.I.D., the World Bank, and the International Monetary Fund (IMF), Pakistan began to restructure its energy sector, gradually allowing domestic fuel prices to rise to international market levels and allowing private investment in energy production and distribution. Reportedly, energy prices in Pakistan today are generally at or above world price levels for most consumers (World Bank 1992b).

Since the early 1980s, Pakistan has allowed energy prices, particularly for industry and commerce, to keep pace with or run ahead of other domestic prices. World Bank wholesale price index numbers for major expenditure categories in Table 2 confirm that between 1980-1981 and 1990-1991 energy rates, as reflected by fuel, lighting, and

lubricant whole prices, have run ahead of general prices as well as prices of all other commodity groups.

Retail prices for energy, particularly for residential users, continue low and lag behind other retail price categories.

Table 2. Wholesale Price Index Numbers, 1982-1983-1990-1991
(1980-1981 = 100)

Item	1982-1983	1986-1987	1990-1991
General	113.1	143.8	208.0
Food	116.9	146.7	204.5
Raw materials	105.3	129.4	195.5
Fuel, lighting, lubricants	116.0	155.8	218.5
Manufactures	110.2	141.2	216.6
Building materials	95.8	123.4	198.1

Source: Pakistan, Federal Bureau of Statistics, reprinted in World Bank (1992b).

At the time of the evaluation—and after two World Bank Energy Sector Loans and a decade of IMF economic price reforms support—Pakistan's energy rates were pegged to international prices. Natural gas for fertilizer production and electric power for residential use are two exceptions in which subsidized rates continue. Higher domestic prices have generated revenues to invest in expanding domestic power generation and energy production capacity but have only modestly stanching the growth in energy demand.

Growing energy demand has been accompanied by energy waste, particularly in areas of industrial activity where inefficient practices continue from Pakistan's cheap energy days. Adjustments to more efficient energy uses have lagged far behind adjustments in energy prices. In its report to the UNCED in 1992, the Government of Pakistan summed up the country's energy problem:

Pakistan is both energy deficient and energy profligate: deficient in the sense that its energy use per capita, at one-fourth of the world average, is one of the lowest in the world; and profligate because its consumption of energy in its relation to its GNP is one of the highest in the world—twice as high as [in] Brazil, Sri Lanka and Germany, and almost four times as high as [in] Switzerland. (Government of Pakistan 1992c, 31).

The contribution of energy conservation in reducing the country's energy shortfall has only recently received official attention in Pakistan. Fortunately, Pakistan has a significant potential for energy conservation. One leading energy expert estimates that Pakistan's potential energy savings are about equal in size to the country's total oil reserves and maintains that a comprehensive national energy conservation effort could increase available energy supplies by 15 to 25 percent in a relatively short time.

Pakistan must look to increased energy use efficiency as part of the solution to its energy supply problems.

Pakistan is rapidly moving toward its domestic energy supply threshold. Known coal, natural gas, and petroleum reserves are sufficient to supply projected domestic demand for only a few decades into the next century. By one estimate Pakistan's installed hydroelectric generation capacity of 2,900 megawatts in 1987 was already within 90 percent of the country's 3,100 megawatt technical potential; that is, the environmentally safe maximum level of electric power generation (World Resources Institute 1990).

Pakistani leaders now recognize the potential of energy conservation for addressing a share of Pakistan's energy needs and environmental problems. Until the mid-1980s, however, no national strategy or central Government leadership existed for fostering energy conservation. Recent A.I.D. assistance has helped Pakistan to identify and establish approaches for conserving energy as a means of improving more efficient and environmentally sound use of energy resources by all sectors of the Pakistani economy.

2. THE A.I.D. ENERGY CONSERVATION PROGRAM IN PAKISTAN

Energy conservation is one of several A.I.D. environmental and natural resource management initiatives underway in Pakistan. The broader USAID/Pakistan environmental program is detailed in Appendix D and summarized in Box 1.

A.I.D. has supported Pakistan's energy conservation program through a component of the USAID/Pakistan mission's Energy Planning and Development (EP&D) project (391-0478). The EP&D project has been a major source of funding for the Government of Pakistan's strategy to increase Pakistan's energy self-sufficiency and thereby improve the quality of life of its people. The EP&D project is designed to "assist the Government of Pakistan to formulate and implement plans and programs to assess, develop, and use Pakistan's indigenous energy resources and increase the efficiency of energy use" (U.S. Agency for International Development 1983). The EP&D project has the following three main component areas:

- ***Energy policy, planning, and manpower development.*** The purposes of this component area are to help the Government of Pakistan establish a permanent energy planning and formulation capability; upgrade the quality of its professional manpower in key energy sectors; and develop a leasing model and other related policies essential for establishing modern, large-scale mining operations.
- ***Energy resource development.*** This component area is designed to support Government of Pakistan efforts to assess and promote development of Pakistan's indigenous energy resources (coal, oil, gas, and small hydroelectric) and to strengthen the Geographical Survey of Pakistan and other organizations.
- ***Energy conservation.*** The purpose of this component area is to assist the Government of Pakistan to "enhance public and private sector capabilities to design and implement energy conservation activities." (U.S. Agency for International Development 1983).

Total A.I.D. funding for EP&D activities is \$105 million for the 10-year time-span of the project. Of that amount, \$15.5 million has been budgeted to support a new Pakistan energy conservation program.

BOX 1: USAID/PAKISTAN'S ENVIRONMENTAL PROGRAM

Pakistan today is experiencing a growing awareness about the need to address its environmental problems. Limited public sector financial resources and technical capability will constrain the Pakistani Government in its efforts to remedy its environmental ills. Pakistan faces the challenge of discovering how to create incentives that will encourage more sound environmental and natural resources management practices with limited government support or regulation. A.I.D. assistance has helped in identifying, developing, and testing promising approaches. Among them are the following:

- ◆ *The **Energy Planning and Development Project**, which began in 1983, is a 10-year effort that includes a major component to help Pakistan launch a nationwide energy conservation program.*
- ◆ *The **Forestry Planning and Development Project** also began in 1983 as a 10-year undertaking aimed at helping Pakistan reverse deforestation and expand Pakistan's forest resource base by generating interest among farmers to plant trees.*
- ◆ *In 1988 USAID/Pakistan and the United Nations sponsored a national seminar on the **role of the media in public environmental awareness** to identify techniques of environmental journalism, and to launch a sustained dialogue between the media and the various actors on the environmental scene.*
- ◆ *In 1991 USAID/Pakistan assisted the Pakistan Government in summarizing and analyzing current **legal aspects of environmental management** to identify legislative and regulatory approaches to environmental protection at provincial and national levels.*
- ◆ *In 1992 USAID/Pakistan and the Government of Pakistan collaborated in the pilot production of an **environmental docudrama** video film to demonstrate that environmental messages can be delivered through a human interest approach to increase awareness of the extent and nature of environmental problems in Pakistan; the need to maintain environmental quality and biological diversity; and how environmental problems can be corrected and sustainable development achieved through self-help.*
- ◆ *To mobilize domestic attention to environmental problems that threaten Pakistan's potential to sustain future agricultural growth, USAID/Pakistan collaborated with the Pakistan Government from 1990-1992 to sponsor a series of provincial and national workshops designed to obtain consensus on the critical issues affecting **agricultural sustainability** and to evolve an agenda and action plan for the next decade.*

These USAID/Pakistan environmental initiatives were undertaken to build foundations for a comprehensive long-run environmental program. When Pressler Amendment regulations suspended U.S. assistance to Pakistan in 1990, that process was disrupted and with it the pace of converting awareness into action. Fortunately, today Pakistani official and private concern kindled by earlier A.I.D. support appears inextinguishable.

To carry out its energy conservation program, the Government of Pakistan restructured the Energy Wing of the Ministry of Planning to form an autonomous body, the National Energy Conservation Center (ENERCON). A.I.D. funding for energy conservation was divided among support for ENERCON's establishment, development, and initial operations in the following manner:

- US\$9.0 million to fund a contract with a U.S. technical advisory team of energy conservation specialists
- US\$3.5 million to the Government of Pakistan to fund the construction of and equipment for a new ENERCON headquarters building as well as the training and start-up activities
- US\$1.0 million to fund an energy conservation loan program through a commercial Pakistani bank
- US\$2.0 million for use by USAID/Pakistan for contract oversight and advisory support to ENERCON

ENERCON is organized by sectoral activities and major support functions. Its four major sectoral divisions reflect the priorities of its energy conservation strategy in terms of the impact and cost-effectiveness of its programs on energy savings. ENERCON's areas of sector activity include the following:

- **Industry.** Audits and advice on efficient use of electricity and gas and diesel powered electric generating systems in manufacturing firms
- **Transportation.** Diagnosis and tune-ups of private gasoline-fueled passenger vehicles and diesel-powered trucking fleets
- **Agriculture.** Diagnosis and tune-ups of diesel farm tractors and diesel and electric irrigation pumps
- **Construction.** Diagnosis of insulation, cooling, and lighting systems for commercial and residential buildings and the development of standards for new energy saving building codes

Energy audits conducted in the industrial, transportation, agricultural, and construction sectors constitute the core of the energy conservation program in Pakistan. Energy audits are conducted by private Pakistani mechanical, electrical, and civil engineers and engineering firms, independently or under contract to ENERCON. The purpose of the energy audits is to identify where energy waste occurs and where investments in new equipment or changes in energy use and management practices can produce energy savings and make less pollution from energy consumption.

Initially, participating firms and private individuals paid little or nothing for the ENERCON-sponsored energy audits and vehicle and building diagnoses conducted using A.I.D. funds. Participation was voluntary. Firms and individuals were not required to adopt energy-saving measures identified in the energy audits. Today, many of the recommendations from the energy audits are so simple and cost-free with quick pay-offs that participants have shown themselves quite willing to adopt the energy-saving recommendations.

To support its energy audit activities, ENERCON has also undertaken a range of information gathering, training, publicity campaign, and technical assistance activities to raise public awareness and interest in energy conservation and increase the capacity of private manufacturing enterprises and engineering consultants to conduct and implement energy audits on their own.

3. EVALUATION FINDINGS

Program Implementation

This evaluation examines the importance of the following four interventions or strategies as determinants of energy conservation program performance:

- Institution building
- Education and outreach
- Technological change
- Policy reform

The evaluation assesses the conditions set up by these strategies to foster the adoption of energy conservation practices. This section examines the implementation of the four strategies and the conditions they created or changed as part of Pakistan's energy conservation program. The examination is based on ENERCON reports and publications, A.I.D. documents and records, and in-depth interviews with the management and technical staff of ENERCON and A.I.D. In addition, information was gathered from in-depth interviews conducted by the evaluation team with 10 private engineering consulting firms that have been directly and indirectly contracted by ENERCON as well as with 10 client firms that received technical assistance from ENERCON. (Data collection methods are further discussed in Appendix A; interview schedules used to collect data are in Appendix B).

Institution building

At the outset of the EP&D project, Pakistan had not yet developed institutions for initiating and promoting energy conservation. For example, 10 years ago Pakistan had no education, advisory, or research institutions or regulatory agencies for energy conservation. Pakistani engineers received no formal training in Pakistani universities about energy conservation. There were no local Pakistani civil, electrical, or mechanical engineering contractors providing energy conservation design and consultant services. The EP&D project helped the Government of Pakistan form ENERCON, which would direct the Government's energy conservation program and help forge a partnership

between the Government and private engineering contractors in order to incorporate energy conservation consulting services in their for-profit businesses.

Establishment of ENERCON. An important A.I.D. program strategy was the creation of the semiautonomous ENERCON. As with many new concepts and start-up organizations, the formation of ENERCON was rocky. Although the Pakistan's Executive Committee of the National Economic Council approved obtaining A.I.D. funding in 1984, start-up of energy conservation activities was delayed until December 1986 when the Pakistani Government passed a resolution establishing ENERCON. Another 2-year delay occurred while the Government filled ENERCON's 12 professional staff positions.

ENERCON was formed out of the restructuring of the Energy Wing of the Ministry of Planning and Development. At the time of this evaluation ENERCON had not yet received parliamentary approval to function as an autonomous Government agency to be under the guidance of a new Pakistan Energy Conservation Council (PECC) with the Minister for Planning and Development as its Chairman and the Minister for Petroleum and Natural Resources as its Cochairman. It has also an advisory committee on which the private sector is represented.

As is often typical of new organizations, ENERCON, in tackling an ambitious range of energy conservation initiatives, initially performed unevenly. The flexibility in design and implementation of the EP&D-funded program allowed for feedback and adjustments during ENERCON's early years of operation, thus greatly enhancing its impact later on.

An important feature of ENERCON is what it is not. It is not, above all, an environmental watch-dog or enforcement agency. It has no regulatory powers as does the Pakistan Environmental Protection Agency (PEPA). Insulated from any enforcement role, ENERCON is perceived more as a partner than an enforcer among its industry sector clients of its advisory services. This partnership role has made it easier for ENERCON to approach private factories to conduct energy audits. Also, because ENERCON was set up to be a semiautonomous Government agency, it has the potential though not yet the assurance—an issue currently being debated by the Pakistani Government—to set technical and professional staff salaries at levels high enough to attract qualified employees, thus avoiding typical patronage controversies.

ENERCON is among a constellation of agencies involved with setting energy policy and managing energy resources in Pakistan. Several Government ministries and a host of semipublic agencies share responsibility for directing and implementing energy sector policy. The four leading Government agencies are the Ministry of Petroleum and Natural Resources, the Ministry of Water and Power, the Ministry of Production, and the Ministry of Planning and Development (from which ENERCON was created).

Other ministries—Agriculture, Transport, and Finance—are also consulted in setting energy price, investment, and trade policy as well. A Cabinet Committee on Energy, chaired by the Prime Minister, is responsible for review and approval of all

energy sector plans, policies, and projects, whereas an Energy Review Group coordinates and monitors all ongoing energy sector programs.

Major energy sector players, of course, are the public firms and utilities that manage coal, gas, and petroleum extraction and electric power generation and transmission operations. A.I.D. and other donors have provided these organizations with grant and loan support to improve the management of their energy extraction, production, and distribution operations. In addition to building national energy production capacity, this assistance has been aimed at making the sector more market oriented and attractive for private sector investment.

Relative to the assets and influence of these organizations, ENERCON's technical and advisory powers are understandably limited. The evaluation found that, for the limited amount of resources—mostly from A.I.D.—it has at its command, ENERCON has successfully injected energy conservation concerns into the market and trade policy formulation and national development planning processes. A qualified, competent, and dedicated staff should be credited for much of the accomplishments that ENERCON has achieved in its short existence.

However, the evaluation also found cause for concern in ENERCON's apparent preoccupation with a glamorous new energy efficient headquarters building and the design of elaborate projects with the intention of capturing new donor funding to sustain its operations and staff. Such preoccupations could distract ENERCON leadership from advancing further into what will certainly be more challenging areas of energy conservation, particularly with smaller firms as well as large public monopolies.

Other public institution building. A major objective of ENERCON has been to assist other public institutions in developing their own capabilities in the field of energy conservation. For example, ENERCON has promoted the teaching of the principles of energy conservation in Pakistan's educational system, particularly at the professional university level. Before ENERCON existed, energy conservation was not a part of degree training for Pakistan's engineering graduates. At the time of this assessment, a program of instruction in energy conservation was under review by Pakistan's university system.

ENERCON has also developed the outline and supporting material for a course entitled "Energy Management and Conservation," which was approved by the Pakistan Engineering Council as a numbered course for the third-year curricula of engineering universities. A textbook for this course is also in preparation. ENERCON also worked with local architectural schools to expand their curricula materials to include energy conservation in building design. It prepared a module on building energy analysis for discussions among professors of architecture.

Private sector "market making." One by-product of Pakistan's energy conservation program—a by-product that has now become a central program objective—was the creation of a domestic market for private energy management

consulting services. This market evolved out of program activities that strengthened both the demand and supply sides of the market equation.

On the demand side, ENERCON worked to interest private manufacturing firms to improve their energy use. The vehicle for building this interest was the "energy audit," a diagnosis of manufacturing plant operations to identify energy waste and opportunities for adopting energy saving measures. News of the ENERCON energy audit program spread via the media, word of mouth, and through ENERCON training and outreach programs. Most of the costs of the early energy audits were covered by ENERCON from EP&D project funds. In some cases combustion analyzers and other energy monitoring equipment was sold to participants at about a one-third subsidy to encourage their adoption by participants.

To stimulate the supply side of the energy conservation market, ENERCON formed formal partnerships with a range of civil, industrial, and electrical engineering contractors who traditionally did the design and consulting work for industrial investors and operators. To draw on the capacity of these private engineering firms, ENERCON issued a series of energy audit contracts for specified levels of effort in specific technical areas. Under these contracts and very often in close association with the A.I.D.-funded EP&D U.S. technical assistance firm, ENERCON enlisted these private engineering firms to conduct energy audits and recommend energy saving measures.

These partnerships enabled ENERCON both to greatly expand the reach of its energy audits and over the short run to build up capacity within private firms to undertake future energy audits on their own on a fee basis. Between 1986 and 1990, ENERCON had in place energy audit contracts with about 25 engineering contractors located in Islamabad, Lahore, Karachi, and Hyderabad.

Education and outreach

Education and training. The provision of training and education directly supports ENERCON's partnership with private engineering firms contracted to conduct energy audits and to advise on energy management practices. From the beginning, ENERCON was confronted with the need to upgrade the skills of these firms so that they could become effective partners in the energy audit process. A.I.D.-funded U.S. technical advisors managed as technical facilitators and transmitters the training of these firms. The U.S. advisors, through their hands-on association with these firms, also encouraged hands-on application of new skills to reinforce the retention by participants.

Most of ENERCON's training activities are specially targeted to engineers, technicians, and managers in public and private sector enterprises. Training in conducting industrial audits or surveys was one of the first activities ENERCON undertook. It organized 3-week training sessions, encompassing both classroom instruction and on-the-job training, which were attended by about 200 engineers, consultants, and Government

officials. This nationwide training effort was the first to promote technical expertise in energy conservation.

ENERCON has since designed 13 one-day workshops on various aspects of energy conservation. Over 3,500 engineers, technicians, and managers have participated. These workshops typically include lecture presentations, case studies, and application sessions dealing with problem solving, measurement, and other practical exercises. Comprehensive technical manuals are also provided to participants. Box 2 illustrates the nature and content of such a workshop.

Box 2. Energy Efficient Building Designs

Between September and November 1992, ENERCON planned to hold 9 one-day workshops in different cities of Pakistan to inform and train architects and engineers in energy efficient building design. The dates, venues, and times for these workshops were nationally advertised. A nominal fee of 200 Rupees was charged for each participant for course materials, and incidental expenses. Firms interested in sponsoring their staff at these workshops had to fill out application forms to be mailed to ENERCON along with the fee. The major topics covered in the workshop included energy efficient building design, building envelope (roof, wall, and window designs), site planning, building form (material, landscaping, and ventilation), lighting, and mechanical cooling and heating. Each participant received a copy of ENERCON's "Design Manual for Energy Efficient Buildings in Pakistan."

To improve energy efficiency in the residential sector, ENERCON organizes instructional lectures for homemakers, working women, and women students. In these lectures, the need and scope for energy conservation as well as tips for saving energy are presented. Although the program in the past focused on associations and private organizations, more recently it has begun largely to reach large audiences at schools. ENERCON estimates that over 14,000 women have attended these lectures.

Outreach and information dissemination. ENERCON has conducted information dissemination activities both to increase energy conservation awareness and to extend how-to information to willing energy conservation adopters. In promoting energy conservation awareness, ENERCON has undertaken a range of information dissemination activities.

During its first 4 years, ENERCON developed technical materials for larger energy consumers. For example, industrial energy tips and Total Energy Management materials were developed to support industrial programs. Specialized technical booklets were written for steam system survey, electrical system survey, power factor generation, and boiler/tune-up programs. As ENERCON expanded its activities to other sectors, similar material were developed for buildings, transport, and agriculture sectors. By the end of 1992, ENERCON had issued 240 publications, although a majority of them were technical reports and studies for a limited audience.

At the time of the evaluation ENERCON was mailing a quarterly newsletter to about 10,000 individual and institutional subscribers. The newsletter covers recent energy conservation activities and gives technical information for energy users.

Additional ENERCON awareness activities include disseminating energy saving tips on television, radio, and in the press; instituting through the media a National Energy Management Awards program to recognize outstanding examples of energy conservation practices in manufacturing and construction; and organizing international energy conservation seminars attended by experts from other countries as well as Pakistan.

Technological change

The introduction of new energy conservation technologies and practices is also an important EP&D project strategy. Energy conservation technologies take the form of either new energy use or management practices—such as total quality management concepts employed in the United States—or new energy use and management equipment. ENERCON employed the following two vehicles for introducing new energy conservation technologies: direct technical assistance to energy using firms and individuals, and subsidized sale of imported modern energy use and management equipment.

Shortly after its creation, ENERCON began to provide technical assistance to public and private energy consumers. The technical assistance was incorporated into ENERCON-sponsored energy audits and surveys, provision, and installation of equipment as a part of demonstration programs, feasibility studies, or simply expert advice on energy conservation.

Initially, ENERCON devoted a high proportion of its resources to technical assistance with a view toward demonstrating the feasibility as well as the benefits of energy conservation activities. This emphasis apparently was necessary at the time because ENERCON programs were initially viewed with a degree of suspicion and skepticism. As people became more aware of the benefits of energy conservation, ENERCON adopted an approach that also draws more on training and policy research.

At the outset of the EP&D project, ENERCON also followed the Total Energy Management approach, which is widely used in industrialized countries. This approach involved conducting comprehensive energy surveys to identify areas of energy waste and

to make suitable recommendations dealing with all major areas of energy use. Following this approach, energy audits were conducted in 42 industrial plants. In retrospect, these surveys were expensive and not practical. They usually involved complex alterations in equipment and procedures. Managers as well as the technical staff did not show much enthusiasm for implementing their recommendations.

However, the analysis of the data generated by these surveys revealed that major energy savings could be achieved by focusing on those systems that consume most of the energy in industrial enterprises. Based on this finding, ENERCON formulated a strategy of "targeted technical services" and by the time of the assessment had conducted targeted energy audits, adjustments, and tune-ups for 600 boiler systems, 72 furnace systems, 84 steam systems, 40 electric generation systems, and 5 electric capacitor systems.

A second type of support for energy technology transfer in the industrial sector was the import and installation of energy combustion analyzers. Because of their high initial cost, availability only on the local market, and unfamiliarity to engineers in Pakistan industrial firms, the units were sold by ENERCON at only two-thirds their original cost.

ENERCON also undertook several demonstration projects that included a waste recovery system, a boiler replacement at Bata Pakistan, a burner control system at a steel foundry, and energy accounting systems in several participating factory plants.

In the agricultural sector, energy audits focused on irrigation (tubewell) pumps, which account for 20 percent of national electric power demand, and farm tractors, which use 15 percent of annual diesel supplies. ENERCON developed an efficiency measurement instrumentation package and a tubewell energy audit manual. The agency audited 134 tubewells and retrofitted 43. A pilot project is planned to test the tubewell retrofit program at an expanded scale. In addition, ENERCON conducted energy audits for 65 municipal potable water tubewells on a cost recovery basis. ENERCON has also adapted instruments and methods to measure tractor energy efficiency and completed about 50 tractor energy audits.

In the transport sector ENERCON focused on private vehicles and commercial trucking fleets. It used A.I.D. funds to import computerized automobile engine analyzers that it rotated over 1-year periods at private filling stations in Karachi, Lahore, and Islamabad. ENERCON reimbursed the filling stations about US\$6.00 for each computer diagnosis; the filling stations collected another US\$2.00 fee from vehicle owners to cover the costs of the diagnoses. At the time of the assessment, about 4,500 vehicles had been diagnosed and tuned-up under the program.

In the building construction sector, ENERCON has completed energy audits and retrofits of 52 buildings, including the a large hospital in Karachi and a Government of Pakistan Secretariat Complex in Islamabad.

Policy reform

A.I.D. has supported policy reform both within and outside the EP&D project for fostering more efficient energy use. Several Government economic measures impose subtle but substantial constraints on the pace and scope of energy conservation in Pakistan. Their reform or removal may be one of the highest future pay-off activities that Pakistan could undertake. ENERCON has had time only to begin an environmental examination and to cleanse Government economic policies of disincentives for adoption of environmentally sound energy use. ENERCON has attempted to introduce policy change through both the national planning process as well as through price and trade policy reform.

ENERCON prepared the energy conservation section of the 7th Five-Year Plan (1988-93) in which achievable targets were set for different sectors. It also drafted sections of the 8th Five-Year Plan (1993-98); however, only a highly condensed version of ENERCON's energy conservation section was incorporated in the draft 8th Five-Year Plan. To the extent these documents represent "wishful thinking," such ENERCON activities have little practical value except that they contribute to legitimizing the concept of energy conservation in national planning documents.

ENERCON drafted a National Energy Conservation and Management Law, which lacks political support. It also prepared a new Building Energy Code, a supplement to the Building Code of Pakistan introduced in 1988. The new code recommends specifications for both the building design as well as for the mechanical equipment, such as fans, lights, and air conditioning. As its sequel, ENERCON prepared a handbook on compliance requirements of the code. The code, however, has no mandatory sanctions behind it.

Pakistan's current import tariff structures deter the importation of energy efficient equipment and devices needed to monitor energy use. Tariff protection for local industry causes firms that use energy either to purchase inefficient domestically manufactured equipment (boilers, electric motors, lighting) or pay high duties to obtain more efficient imported units. Duties as high as 100 percent—often on equipment not manufactured in Pakistan—were reported by respondents during the field surveys. Trade restrictions on spare parts further discouraged acquisition of energy efficient equipment from abroad.

ENERCON won an initial victory in 1991 when it convinced the Government of Pakistan to abolish a 90-percent duty on energy saving fluorescent lamps having a minimum cost and freight unit price of US\$5.00. An ENERCON study of import restrictions on thermal insulation materials also led the Government to change import duties.

ENERCON has also found that finance and credit policy appears to constrain steps to curb energy waste. Credit for energy saving or pollution abatement equipment were often the first to suffer at the hands of bankers and investors concerned about the security of their investments and about the solvency of borrowing firms. To overcome this resistance, A.I.D. and ENERCON worked with a local Pakistani bank to set up a

US\$1 million energy conservation loan program to finance (or provide guarantee loans for) energy saving equipment. At the time of this assessment, however, the energy conservation loan program had not yet been implemented.

Program Impacts

Pakistan's energy conservation program has produced well-documented changes in local conditions. The most visible of these changes is the presence on the institutional scene of ENERCON. In the active competition among engineering contractors for energy auditing and consulting business locally, another visible sign is an active market for energy conservation services. Two other manifestations are a modest relaxation of trade restrictions on energy efficient equipment imports and a greater availability of energy conservation information and educational materials.

The evaluation examined the impact of these changed conditions on energy management practices, the environment, and the economic well-being of energy users. Evaluation findings about program impact derive from two sources: direct interviews and site visits by the evaluation team with program participants. The interview guidelines and methods of data collection are discussed in Appendix B. Data on biophysical and socioeconomic impact are drawn from secondary sources, mainly survey data compiled by ENERCON's own program monitoring staff. The analytical framework for examining impact and the approaches to collecting data on indicators of impact are discussed in Appendix A.

Impact on practices

Before ENERCON began operations, there was little consciousness about the need for and benefits of energy conservation among business managers, engineers, architects, transport officials, industrialists, agriculturalists, and policymakers. Energy conservation was seldom mentioned in national policy and technical discourses. In fact, no Urdu language word exists for energy conservation.

The impact of Pakistan's energy conservation program activities on energy conservation attitudes and practices in Pakistan is manifested in several ways. A.I.D.-funded ENERCON energy audits demonstrated that marginal changes in operating technology or small improvements in maintenance can produce significant energy savings, that it is indeed financially profitable for firms or consumers to invest in energy saving efforts, that the required technologies and maintenance facilities are available in the country or can be acquired from abroad, and that ENERCON as a governmental agency exists to provide the needed help, albeit in a limited fashion.

One proxy indicator for changes in attitudes and practices is that every month ENERCON responds to nearly 60 requests for information and technical advice. The assessment team found a general consensus among both government policymakers and

technical experts about the contribution that ENERCON has made in this regard. A sample of comments made during evaluation team's interviews are given in Box 3.

These comments reveal that awareness and adoption of energy conservation practices among program participants is not uniform, however. For example, large enterprises, particularly subsidiaries of multinational firms, are relatively well-informed on the subject. They have technical staff, resources, and capabilities to introduce and maintain energy conservation programs. Small firms both in formal and informal sectors of the economy are not as aware of energy conservation—and will probably not be for a long time. Indications are that many mid-size firms are becoming increasingly aware of the need for energy efficiency because of rising power costs. Mid-size firms have just begun to implement ENERCON's energy conservation practices.

Another important impact in practices relates to changes in the way Pakistani engineering contractors do business. These changes derive from their taking on energy conservation consulting work as a result of their partnership with ENERCON. This enhancement of private sector energy management consulting capacity was not articulated as the primary objective of the program when it was designed. Rather, it has evolved as an important byproduct of program implementation and now appears to be a critical factor in the successes achieved by this model of environmental management.

The contribution of ENERCON to increasing the capabilities and changing the practices of private Pakistani engineering contractors are illustrated by a few concrete examples in Box 4.

Box 5 provides sample comments that were made during the course of interviews with consultant firms.

Environmental (biophysical) impacts

ENERCON, through its energy data collection and monitoring program, has begun to examine the impact of better energy management on environmental conditions as well as on energy savings. The most direct environmental measures are those that reduce air pollutants from lower emissions because of more efficient energy use.

For example, car engine tune-up programs regularly conducted by ENERCON not only improve fuel efficiency by 10 percent but also reduced carbon-monoxide and sulfur-dioxide emissions by 50 percent. Similarly, ENERCON's boiler replacement and tune-up programs for industry reduce energy consumption by 5 to 10 percent and cut hydrocarbon and carbon-dioxide emissions by more than 50 percent. ENERCON's tractor energy audits, driving training, and tune-up programs produce energy savings of 18 percent and a 50-percent reduction in emissions. In fact, ENERCON'S programs in all sectors—industry and power, transport, buildings, and agriculture—while aimed at achieving large-scale energy savings, have positive environmental impacts on reducing emissions as well (Soofi 1992).

Box 3. Contribution of ENERCON to Energy Conservation Awareness

"If you ask me about the single most important contribution of ENERCON, I would say that it lies in demonstrating to us that we can have significant economies in energy use without major financial investments....They have shown us the way."

System manager of a large manufacturing firm

"We were aware about energy savings much before ENERCON was established, but it was an intellectual awareness.... ENERCON has been a catalyst in giving it a much needed focus."

Managing director of a consulting firm

"We hardly talked about energy conservation 5 years ago. Now we seriously examine its potential in the designs submitted to our clients.....Credit goes to ENERCON."

Engineering manager of a firm

"I would say that there is still not much appreciation of the need for energy conservation in this country. Whatever appreciation exists, it is among large firms. It has definitely not reached smaller firms and probably never will....Yes. ENERCON has definitely contributed to whatever little awareness exists at present. Of course, you know that foreign subsidiaries have a better access to energy saving technologies."

Deputy managing director of a foreign subsidiary

"ENERCON has definitely raised consciousness about energy conservation, but much more needs to be done."

Managing director of a public sector firm

Box 4. Examples of Engineering Contractors Helped by ENERCON

Control Systems Engineering (CSE) Pvt. Ltd. is a Lahore-based consulting firm that has done tune-ups of over 150 boilers and furnaces. One of its senior staff members attended an early training course organized by ENERCON. He worked as a subcontractor for the U.S. advisory firm, but later joined CSE. Two other professionals from this firm also attended ENERCON's workshops. According to its senior official, ENERCON helped CSE by training CSE's staff; by creating a market for its services; and by giving CSE a credibility by selecting it as a subcontractor.

AFTEC Pvt. Ltd. is also a private sector consulting firm contracted by ENERCON to provide targeted technical services. Founded in 1989, AFTEC has a qualified staff possessing experience and expertise in energy conservation activities. Its chief executive worked for many projects financed by A.I.D. and other donor agencies. Its director participated in energy surveys conducted by ENERCON at Glaxo Laboratories (Pakistan) Limited. AFTEC officials indicated that ENERCON's contribution to the growth of private sector expertise has been significant by enabling firms to focus on energy efficiency and raising its awareness of the benefit of energy conservation.

Zelin Pvt. Ltd. is a consulting firm employing 400 people in Pakistan. The firm worked with Arthur D. Little, which undertook the feasibility study for Pakistan energy conservation program leading to the establishment of ENERCON. Since then, Zelin has extensively contracted or subcontracted with ENERCON. Its staff participated in the workshops organized by ENERCON, wrote manuals and documents for it, and conducted energy surveys for the program. Company technicians stated that the relationship with ENERCON, particularly its U.S. advisory firm, was mutually advantageous. While the U.S. advisory firm brought a wealth of technical information, Zelin provided an intimate knowledge of Pakistan's needs and capabilities. Moreover, ENERCON energy conservation efforts have opened new engineering services opportunities for Zelin PVT.

Box 5. Staff of Private Sector Firms Comment on ENERCON

"When I started working for the U.S. advisory firm, I was a qualified electrical engineer from Punjab University. I knew engineering but little about energy conservation. The USAID-ENERCON program trained me; its staff explained techniques for conducting energy audits and gave practical demonstrations. They also provided me manuals which we still use. But for this association, we would have ventured in this field."

Sales engineer of a consulting firm

"I am a German trained engineer. The U.S. advisory firm contracted me for conducting industrial audits as well as for preparing technical manuals. Since then, I have conducted many energy surveys. I have also designed co-generation systems for large buildings. You can say that ENERCON helped us tread a new path."

Managing director of a consulting firm

"I would say that we certainly benefited from ENERCON which had been a catalyst for energy conservation efforts in this country. We definitely knew the essential principles before ENERCON was established, but we were not aware of the potential. Our staff attended ENERCON's workshops, did surveys for it and used its manuals and publications. We are incorporating energy conservation measures in electrical designs we prepare for clients...While ENERCON has given some impetus for private sector, it is still small."

Director of a large Pakistani firm

"ENERCON provided a boost for private sector consulting firms, but you should recognize that most of them are still in infancy. They have a long way to go before you can make a definitive conclusion."

Senior official of a large consulting firm

Of course, these benefits are shared by the public at large, not just by energy users. However, it is not yet possible to put a monetary value on these benefits. Their impact on total air pollutants in Pakistan at this early stage in ENERCON's energy conservation program is also insignificant. Nevertheless, on an individual basis these benefits reflect the relative improvements that can be achieved by widespread adoption of energy conservation practices in industry, agriculture, transport, and construction.

Socioeconomic impacts

The socioeconomic impact of the program’s activities is manifested mainly in fuel savings, lower operating costs, and higher profits of participating industrial firms—or of individuals in the case of automobiles, tractors, and irrigation pumps. Nationally, total gross economic benefits can be roughly estimated by converting the savings for each type of energy resource (electric power, gas, petroleum, coal) into a common equivalent, and then assigning a value to that amount, for example, the world market price for crude oil, to convert all these measures to a common monetary figure. From this value of gross benefits are deducted the \$15.5 million cost of A.I.D. project funding plus the capital investments made by participating firms and individuals in adopting more efficient energy use practices. (Net benefits, costs, and internal rates of return attributable to the A.I.D. EP&D project investments are discussed in the section on program efficiency later in this chapter).

ENERCON has begun to collect data on energy savings by firms and individuals that have participated in its programs during the period of A.I.D. EP&D project support. The most comprehensive data on energy savings have been collected for the ENERCON energy audit work. Some of these data are compiled in Table 3 for selected energy use systems.

Table 3. Estimated Energy Savings for Selected Users

	Boiler Systems	Electric Systems	Steam Systems	Capacitor Systems
Number of firms	387	40	84	5
Percent improvement	6.3%	5.0%	8.0%	6.0%
Annual savings per firm	\$ 6,000	\$ 8,000	\$12,000	\$ 6,400
Total program savings (US\$1,000)	\$ 2,322	\$ 320	\$ 1,008	\$ 32
Total annual energy savings from all firms: US\$3.682 million				

Source: Soofi (1992).

These estimates of energy savings were compiled from followup surveys conducted by the ENERCON Data and Analysis staff as part of the ENERCON program's management information system. Impartial estimates of energy savings from an independent source were not available for the assessment. There are important assumptions about the estimated US\$3.862 million value of total annual energy savings attributed to the EP&D project:

- All other benefits from EP&D-funded activities in the transport, agriculture, building, and domestic (home) use sectors are excluded. In all but the transport sector these savings are small because of the limited number of audits and adjustments made during project implementation. In the transport sector, benefits from the roughly 4,500 computerized auto diagnoses averaged about US\$100 in annual gasoline savings per tune-up. This would add another \$450,000 annually to the flow of net benefits after the second year—allowing for 1 year of benefits to be netted out to cover tune-up costs.
- The flow of benefits from the auto tune-ups—as well as estimated benefits from the few commercial truck, irrigation (tubewell) pump, and farm tractor audits and adjustments performed thus far under the energy conservation program—are not included in the Table 3 tabulation of benefits because of their short life and the periodic maintenance costs that vehicles, tractors, and pumps incur.
- ENERCON investments in strengthening the capacity of Pakistani research and education institutions to address energy conservation issues might be expected to yield long-term and diffuse returns. This evaluation does not attempt to measure and include these benefits in its estimates of impact at even the condition or practice levels. In forecasting its estimates of the direct financial returns to program activities, the evaluation does contend that such efforts will create conditions to sustain if not increase returns from energy conservation steps taken as a result of project activities.
- The constant annual flow of energy-saving benefits assumes that participating plants make no additional energy-saving improvements as a result of being introduced to energy conservation concepts by the project. Industry interviews, however, suggest that many firms will continue to pursue energy cost-cutting measures based on expertise or knowledge gained from their cooperation with ENERCON. Estimates of added energy saving from such measures, however, would be highly speculative.
- The analysis is based on an infinite flow of benefits at the same level of average savings measured at the time ENERCON compiled its data. This may be optimistic, if, as discussed later, a hostile policy and trade environment made it difficult for firms to obtain equipment and expertise in the future to sustain these energy saving rates. Again, however, any estimate

of backsliding to the old ways would be highly speculative. Moreover, to restrict the flow of benefits to only 20 or 25 years reduces the programs economic rate of return by less than 0.5 percent.

Specific examples of the nature and extent of energy savings achieved by some of the firms interviewed for this assessment are given in Box 6.

An additional unanticipated socioeconomic benefit attributable to the program is the employment and revenue generated in the emerging energy conservation design and consulting services sector. While the amount of their new business could not be calculated, some engineering contractors that began in the ENERCON energy audit program reported they had expanded their operations to include designing and monitoring energy-saving projects and conducting audits on their own without any involvement of ENERCON. The evaluation team's interviews revealed that such activities had been insignificant in the past but were likely to grow in significance over time. The assessment team could not measure and calculate the added employment, incomes, and profits from energy conservation consulting services nor could it separate out those EP&D funds that made up their contract revenues during project implementation. Employment and profits from energy consulting should be recognized, however, as added project benefits.

This evidence justifies concluding that EP&D-sponsored technical assistance by ENERCON in partnership with its Pakistani engineering contractors has helped manufacturing firms or other consumers to save energy, reduce costs, and increase profits or incomes. However, while these savings may have been significant for participating firms and individuals, at this stage their direct impact on the national energy scene is negligible. The importance of these savings lies more in the fact that they have demonstrated the vast potential for improving energy efficiency in the country if such activities are encouraged to continue and spread, while generating significant savings to individual participating firms in the program.

Program Performance

This section examines the performance of the A.I.D. energy conservation program in Pakistan from its efficiency, effectiveness, sustainability and replicability. A discussion of the evaluation's analytical methodology in Appendix A defines how each of the performance measures is used.

Box 6. Firms Saving Energy Because of ENERCON's Assistance

Bata Pakistan Ltd., a Canadian shoe manufacturing subsidiary in Lahore, is very proud of its energy conservation achievements. In 1987, Bata engineers were approached by ENERCON with the offer to conduct a free audit of its boiler system. The audit revealed substantial scope for energy conservation. Consequently, Bata made minor adjustments within the existing system that increased energy efficiency from 62 to 70 percent. This turned in savings that produced a payback on the initial expenditure of 2 million Rupees within 10 months. The company then installed a new boiler replacing its 50-year-old boiler. The data provided by the company indicated that the energy cost savings approximated 1.9 million Rupees in 1990 and 2.4 million Rupees in 1991. Bata projected 1992 savings to be even higher.

Frontier Foundry, Ltd., a Pakistani iron works company in Peshawar, provides an example of a small firm that has achieved significant energy efficiency because of the technical assistance received from ENERCON. The company, which manufactures steel billets and bars, had heard about ENERCON's technical assistance and sought its help. After undertaking a full audit, ENERCON recommended many changes in the existing equipment and some additional machinery. As a result of the adoption of technical recommendations, the Foundry could accomplish major savings in energy. For example, the company estimates that it will achieve yearly energy cost savings of nearly 0.5 million Rupees.

Program efficiency

The data from Table 3 in the discussion of the EP&D project's socioeconomic impact is used in this section to calculate a stripped down estimate of program efficiency; that is, the return expressed as the value of annual net benefits that can be attributed to the \$15.5 million in A.I.D. funding. The conservative estimate of US\$3.682 million in annual net energy savings is used here as the return to EP&D project investments. This value yields an internal rate of return (IRR) of about 19 percent for EP&D project investments.

The following two assumptions were used in the internal rate-of-return calculations.

Benefit flows. The analysis assumes a constant infinite stream of net benefit flows from the energy-saving measures adopted by participating firms. This means that the firms have an infinite life and that no new investments are required to sustain energy savings at the rates attained when the firms were surveyed by ENERCON. While neither of these assumptions is totally realistic, they are acceptable given that the discounted

present value of both future costs and benefits decline rapidly beyond 10 years from the time of investment. Moreover, the assumption also excludes any additional steps that firms may take to further boost energy savings as a result of ENERCON's intervention under the program. On balance, therefore, holding net energy savings to a constant value probably introduces no major bias of overestimation, particularly given that the net benefits from other ENERCON interventions have not even been factored into the analysis.

Investment costs. The analysis reduces the gross flow of benefits by the value of the first 2 years of benefits, which are assumed to be necessary in order to offset all investment costs in these improvements. This assumption is based on the frequent claims by participating firms that they would not incur any costs in energy-saving measures that they could not recover them within a 2-year time period (that full 2-year time period is used in the IRR calculation). This assumption is probably safe to make; interviews with firms and examination of company data revealed that most firms had pay-backs often immediately, sometimes without any capital investment by simply adopting better energy-use monitoring and management practices with the same staff and equipment.

It remains to examine whether there could have been greater benefits from the use of A.I.D. project funds in other energy program activities. For example, had US\$15.5 million been invested instead in increased power generation capacity, would Pakistan have more energy at its disposal? *Ex post* estimates of rates of return for power generation projects in Pakistan vary widely. The 19 percent IRR calculated here for the energy conservation component of the EP&D project falls within the low side of the range for investments in which comparable estimates exist. What power generation investments do not produce, however, are the unmeasurable positive external benefits of improved environmental conditions associated with better private stewardship of power usage under the energy conservation program.

A final question relates to how well the US\$15.5 million was used for energy conservation itself. If A.I.D. had simply put all EP&D project funds into a technical assistance contract with a U.S. advisory firm to undertake energy audits, could an even greater rate of return have been achieved? In all likelihood, had the U.S. technical assistance contractor conducted all its own energy audits and energy consulting, retrofitting, and adjustment instead of diverting its efforts to institution building, training, and consciousness raising, there might indeed have been a greater short-run gain in energy savings. However, it is not likely that in the absence of a public agency such as ENERCON to promote greater awareness, encourage policy reform, and facilitate the flow of information that such energy conservation gains would be sustainable.

There might be a better balance of EP&D project resources between the four strategies of building institutions and private sector capacity, awareness raising, technology transfer, and policy reform (see Section 5). However, there have been sufficient returns to justify the A.I.D.-funded energy conservation program in Pakistan employing the public-private sector partnership model supported by the A.I.D. EP&D project.

Program effectiveness

As shown, ENERCON in the past 6 years has been able to carry out a number of activities and the record of its accomplishments is certainly encouraging. To sum up in the words of a former contractor: "It has done well given the milieu in which it operates."

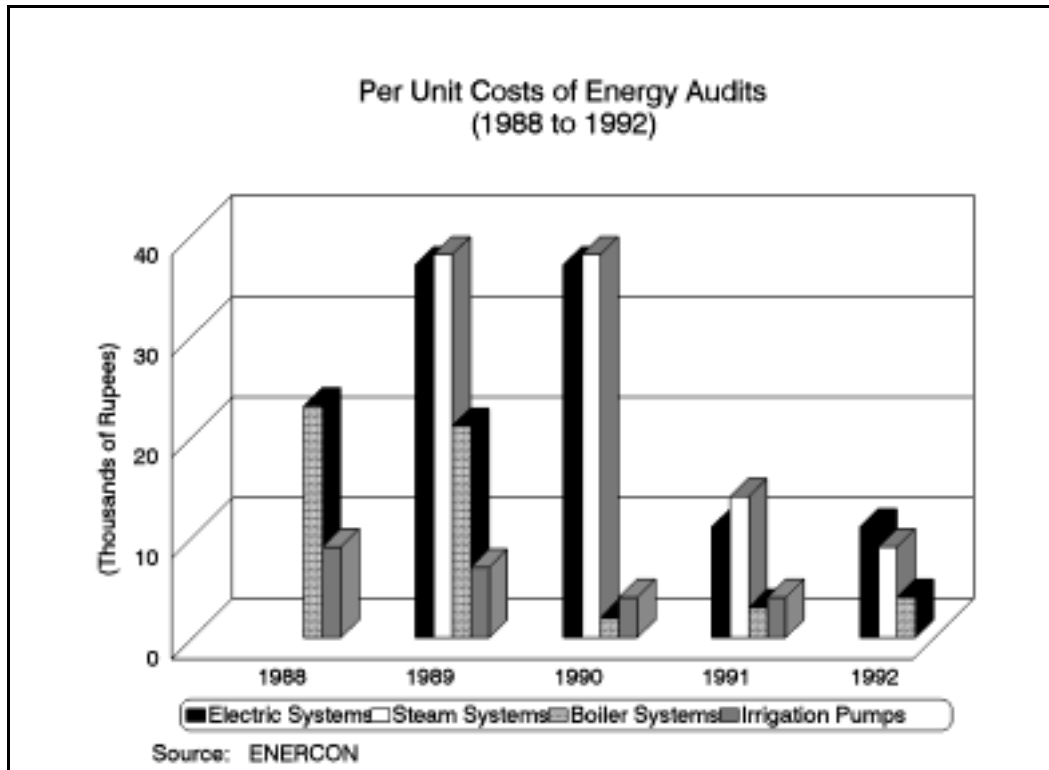
There is no standard against which to compare the cost-effectiveness of ENERCON activities. The evidence suggests that ENERCON has progressed in improving its effectiveness both in managing its program resources and in bringing about changes in capacity and practices of participating private industrial and consulting firms.

Effectiveness of program resource management. Annual per unit costs of delivering training and audit services are one source of information on the effectiveness with which program resources are used. ENERCON data show that its home energy lecture costs declined from about 200 to about 80 Rupees per participant between 1989 and 1992 when this assessment was conducted. Figure 1 illustrates the per unit costs of some of the ENERCON-directed energy audits conducted under the EP&D project from 1988 to 1992. The declining cost pattern for each of these audit activities is an encouraging performance indicator.

An examination of ENERCON performance helps explain these trends. At the outset little consideration was given to the costs of its operations. ENERCON's U.S. contract advisor paid high salaries and fees to attract qualified subcontractors, resulting in initially high per unit costs of auditing, consulting, and training. As the volume of ENERCON business has increased and costs have been better managed, ENERCON has been able to lower per unit costs substantially.

Program performance has also been affected by the dissipation of ENERCON energies over a whole spectrum of activities. With a permanent professional staff of only 12, ENERCON tried to direct a range of activities: energy planning, energy policy research, provision of technical assistance in a range of technical sectors, training, information dissemination, and so forth. ENERCON has not established a set of priorities among all these activities or even criteria for setting those priorities on the basis, for example, length of time to pay-off, cost of operation, or total impact and spread. Setting priorities is always difficult in new institutions with broad mandates and plenty of political pressures to perform and respond to a range of interests. However, now is the time for ENERCON to sharply focus on a limited range of activities based on its competitive strengths and advantages. ENERCON senior management is conscious of this need and is formulating a coherent strategy for future activities.

Figure 1. Per Unit Costs of Energy Audits
(1988 to 1992)



ENERCON'S effectiveness has also been affected by internal tensions and conflicts that have adversely affected the institution's image in political and bureaucratic quarters. The morale of the staff is also low because of the uncertainty about the future. With the proposed reorganization of ENERCON and additional funds from international donor agencies, staff morale may improve.

Effectiveness at private sector capacity building. There are no engineering contractors which exclusively function in energy conservation in Pakistan. Rather, Pakistani civil, mechanical, and electrical engineering firms have begun to add energy conservation to their regular design and consulting services. The following four factors help explain the effectiveness with which the energy conservation program helped build this new energy conservation consulting capacity in the private sector.

- **On-the-job training.** When the U.S. technical advisory firm started working in Pakistan, it required a number of well-trained engineers or firms to work as subcontractors, conducting energy surveys and audits, preparing technical manuals, and organizing workshops and seminars. In many cases, the U.S. advisory firm provided training to these local engineering subcontractors who over time acquired the necessary skills to carry on energy conservation activities.

- **Mandatory training.** Attendance in ENERCON training workshops and seminars was required of those engineers and managers of private engineering consulting firms participating in the energy audit program. Most of the participants in these workshops were sponsored by private sector firms. Nearly all of the 10 engineering consulting firms that the evaluation team interviewed had at least one of their professional staff participate in at least one workshop. In most cases, the staff participated in 2 to 3 workshops. Consequently, many private sector firms have acquired technical expertise, which they have now started marketing.
- **Practical experience.** ENERCON contracts with private sector firms for most of its activities, thereby strengthening their technical and managerial capabilities. For example, it recently invited tenders for conducting energy audits and quite a few firms responded, which is an indication that private sector firms not only possess technical skills but are also using them. The evaluation team interviewed the professional staff of one of the firms that qualified for energy audits. They were optimistic about their contract, which they hoped would provide them with direct access to other firms.
- **Demand stimulation.** By creating awareness for energy conservation and focusing on simple, highly visible operating and maintenance technologies, which generate quick returns, ENERCON has been successful in creating effective demand for engineering-based energy conservation consulting services, although at a modest level. And private sector firms have started responding appropriately .

Three factors have also acted to limit the effectiveness of building energy conservation consulting capacity in the private sector.

- **ENERCON contract dependency.** The energy consulting experience of the majority of the engineering firms under contract to ENERCON is limited to contract consulting for ENERCON. ENERCON has no apparent strategy to wean these firms away from these contracts and support them in pursuing consulting business on their own.
- **Limited information access.** Participating Pakistani engineering consulting firms have only limited access to new technologies that are being developed in industrially advanced countries. Many professionals feel the need to upgrade their skills but do not know where to turn. They still rely on the manuals and procedures that were prepared by ENERCON, but some are skeptical about ENERCON's ability to generate and disseminate information about new energy-saving technologies in the future.
- **Market growth.** Practically all the firms interviewed by the evaluation team see only a limited market for their consulting services in the near future under current political conditions and economic policies.

Program sustainability and replicability

A.I.D. support of Pakistan's energy conservation programs ends in mid-1993 when funding under the EP&D project terminates. At this point ENERCON is fledgling, with its new headquarters building ready for occupancy and its professional staff and ongoing program ready for incorporation within the Pakistan fiscal process as an autonomous Government agency. There is also new capacity, experience, and interest among private civil, mechanical, and electrical contractors to continue to provide energy audit and advisory services. Finally, an initial group of manufacturing industries and other energy users, reached by ENERCON in partnership with Pakistani engineering contractors, have adopted a range of energy-saving measures.

The evaluation team attempted to determine how sustainable these results of Pakistan's energy conservation efforts will be after A.I.D. funding terminates. The evaluation team also examined whether the Pakistan model of public-private partnership had promoted energy conservation practices beyond the target group of participants and beneficiaries reached during EP&D project implementation. The outcome of the evaluation team's findings on these questions of sustainability and spread is mixed.

Public institutional capacity. The sustainability of ENERCON is perhaps the most uncertain. At the time of assessment ENERCON was still struggling to gain recognition from the Pakistan treasury as an official autonomous agency worthy of regular core funding at levels sufficient to attract qualified staff and to effectively implement its programs. Currently, it is under the wing of the Ministry of Planning and Development where its salary structures, staff recruiting, and budget allocations are dictated by Governmentwide civil service scales and political pressures.

The evaluation found little replication or spread of ENERCON's activities beyond those funded by the EP&D project. At the time of the evaluation ENERCON's energy conservation program was supported almost in its entirety by EP&D project funds. ENERCON had not yet expanded its activities to include other programs and participants. The pending termination of EP&D funding brings to a close what might be characterized as the start-up and demonstration phase of ENERCON's activities. A reexamination of ENERCON accomplishments in about 5 years after termination of A.I.D. funding would be the best way to measure the growth and spread of its impact.

One healthy sign for ENERCON is the credibility it has established within the Pakistani political milieu. The assessment team saw evidence of this in ENERCON's role in preparing of the energy conservation component of the 8th Five-Year Plan, in developing university-level curricula and instructional materials for energy saving in the engineering and architectural disciplines, and in changing building codes and import duties on lighting systems.

ENERCON's ability to survive and spread the impact of its programs is enhanced by its success at attracting financial and technical support from other donors to underwrite some of the ongoing activities of greatest benefit (e.g., audits and outreach services). So

far ENERCON has secured United Nations Development Programme (UNDP) funding for further energy conservation in the transport sector and Asian Development Bank (ADB) funding to improve the efficiency of industrial electric power use. This UNDP and ADB support are the most tangible evidence that the impact of EP&D energy conservation model advanced by A.I.D. will spread beyond the initial population of participants.

The UNDP grant funding will enable ENERCON to launch a program to audit and tune up many of the diesel trucks that move commodities on Pakistan's road system. Not only do these truck fleets waste fuel as a result of their body design and engine maintenance, but they are also major polluters, particularly in urban areas. The UNDP grant will introduce measures to streamline the body design of trucks as well as institute systems for systematic diagnosis and tune-up of diesel truck engines.

A \$5 million ADB loan will fund the purchase and installation of electric power factor capacitors by about 2,400 industries nationwide. Electric utilities impose stiff penalties in Pakistan for low-power factor usage, the result of inefficient handling of reactive power load by the industrial user that reduces the range of the power utility's distribution network. In 1992 more than 6,000 industrial units were paying these penalties, an outcome of earlier A.I.D. policy dialogue with the Pakistan Government that led to the institution of these penalties. ENERCON worked with the Water and Power Development Authority of Pakistan (WAPDA), as well as other local electric utilities, to arrange loan repayments as installments to be charged to participating customers' electric bills at rates that would not be more than the average power factor penalty paid before installation.

Private market capacity. The evaluation team found reason for cautious optimism in that the Pakistani civil, electrical, and mechanical engineering consulting firms will continue to provide energy conservation consulting services but probably at levels below those when in partnership with ENERCON during EP&D implementation. In interviews with managers of these firms, they expressed a keen interest in continuing to do energy consulting work—in some cases whether their industry clients requested it or not.

For example, one electrical contractor indicated to the assessment team that he planned, as a matter of practice, to include in all future design work the more energy efficient office lighting systems he learned about through the EP&D project. One of the Pakistani filling station owners interviewed had purchased his own automobile engine diagnostic equipment and was continuing an active business in selling diagnostic and tune-up services. Other filling station participants were discouraged from conducting computerized engine diagnoses on their own for lack of money to buy computer units and for fear they could not get followup services and parts.

The evaluation team also noted that private engineering contractors expressed uneasiness about the future of the market for their energy conservation services. They pointed out that they could only design energy-saving systems for clients that did not require equipment and spare parts whose import was currently restricted from entering the country. They were aware of some of the major advances abroad in energy saving

equipment, but until the Government was willing to liberalize import duties and licenses, they could not use them.

Ironically, the same program of ENERCON-subsidized energy audits that drew engineering contractors into the energy conservation services business appeared in 1992 to be dampening their enthusiasm for going after more business. Contractors clearly had become accustomed to pursuing energy-audit business through ENERCON (e.g., as ENERCON subcontractors). But they did not want to compete for business independently in a still growing market if potential manufacturing clients felt they could get those same services cheaper through ENERCON. This notion on the part of private energy conservation consultants, many of whom were spawned by ENERCON during the course of EP&D project implementation, raises an important issue with regard to the use of subsidies in conducting environmental and natural resources management programs. (For further discussion, see Section 5).

Private industry capacity. The most promising private industry capacity, perhaps, is the sustainability of the energy conservation practices adopted by private industries that participated in the energy audit program. The financial "bottom line" costs and profit incentives that motivated private industry's actions to improve energy efficiency are not likely to be reversed. In fact, factory engineers trained by ENERCON expressed their intent to continue aiding their firms in adopting further cost-saving energy conservation measures. As a result of the ENERCON awareness campaign among company engineers and managers, some of these firms had begun to tackle energy conservation problems beyond those addressed during their participation in EP&D-funded activities.

This was most evidenced in interviews with engineers in manufacturing subsidiaries of foreign firms. The international companies for which these engineers worked had in place more ambitious awards, training, and other incentive systems for achieving energy cost savings than did smaller Pakistani firms. The engineers also had better access to energy conservation information from abroad in the form of overseas training courses, professional journals, and data on energy saving measures in other foreign subsidiary plants. This situation contrasts sharply with the situation in government parastatal firms, in which the evaluation team observed little evidence of professional incentives for engineers.

However, the manufacturing firms engineers and managers uniformly felt that improved Pakistani finance and trade policy conditions would greatly assist their energy conservation efforts. Under prevailing trade and finance disincentives, that is, when it becomes time to replace energy conservation equipment, there is a risk of retrogression. That engineers were already having difficulty obtaining parts and services for energy monitoring equipment introduced by the EP&D project is a troubling indicator of the nature of sustainability of energy conservation practices.

Education and outreach. The quality of ENERCON training and outreach activities is to be as important a determinant of program sustainability and spread as of impact. The evaluation team met with more than three dozen engineers and managers

who had participated in previous ENERCON training sessions and workshops. Most respondents found ENERCON training to be informative and relevant.

Although evaluation forms were filled out in many of these presentations, the gathered data were seldom analyzed. At the request of the evaluation team, ENERCON analyzed data for a sample of 100 presentations. The results are presented in the Table 4.

The evaluation team identified some workshop limitations from respondents' comments. For example, most workshops were conducted in English, but the majority of the technical personnel of small and medium sized firms do not understand English. Consequently, they cannot profit from the workshops. Second, most of the distributed material is in English. Finally, in many instances, 1-day workshops are not enough to do justice to the topic—but probably all the time initially that companies are prepared to let their engineers take.

Table 4. Participant's Evaluation of Lectures

Quality of Energy Lectures	
Average or less	5%
Good	60%
Very good	30%
Excellent	5%
Usefulness of Energy Lectures	
Yes	95%
No	5%

Source: ENERCON

With few exceptions, ENERCON publications are written in English, which restricts their audience. Only recently has ENERCON begun translating some its publications into Urdu, the national language of Pakistan. The technical experts interviewed by the evaluation team generally agreed that the quality of publications, particularly manuals, is good, providing relevant information in a succinct manner.

A problem, however, has been their availability. ENERCON has not developed an effective system to market its publications. People interested in obtaining publications

have to call or write to ENERCON in Islamabad. ENERCON has no arrangements with, for example, local book dealers or filling stations or service companies to distribute its materials outside the capital city.

At least half of the consulting firms that the evaluation team interviewed had seen ENERCON's newsletter. Only three of 10 received it on a regular basis, although all would like to have it. The team looked at several back issues and found the newsletter well-written and informative, although again only for those who could read English.

Technology transfer. During the interviews with the evaluation team, several firms indicated that installation of analyzers had been beneficial. Factory engineers also indicated that initial subsidies allowed them to secure management approval to purchase combustion analyzers. However, at the time of the evaluation, a few firms reported problems in getting the combustion analyzers serviced and repaired because the Pakistani distributor did not have adequate maintenance facilities or access to spare parts from abroad. Respondents considered joint ventures with foreign firms as one way of obtaining more energy efficient technologies. Current Pakistani privatization efforts might advance this process.

Filling station operators interviewed were uniformly enthusiastic about the tune-up business they generated by operating the computerized auto emissions analysis equipment supplied by the program. Most wanted to purchase and operate these systems independently. One had done so already. The others complained, however, that they could find no bank willing to underwrite the purchase costs of the equipment and that at present there was no way to import such equipment into Pakistan without paying punishing duties. ENERCON won the battle of creating a market for auto tune-up services but had not succeeded in creating economic, regulatory, and financial conditions in which this market could prosper.

Policy reform. Survey respondents argued that much broader tariff reforms were needed to stimulate import and manufacture of energy efficient equipment. The few successes for ENERCON touched only a small portion—and probably only the least politically influential share—of the energy using equipment. Respondents offered a range of examples of energy efficient equipment that was kept out of Pakistan by tariffs, quotas, and licenses in order to protect similar, much less energy efficient, equipment manufactured locally. Inefficient locally manufactured electric lights, electric motors, electric heaters, furnace units, and energy monitoring equipment remain protected by tariff and other trade restrictions. As a result local industry must turn to energy-wasting equipment that is locally manufactured.

Industrial firms complained to the evaluation team that bankers, not yet "energy conscious," were hesitant to make loans for energy cost-cutting equipment. Others felt that banks were indifferent as long as the proposal was financially sound with a reasonable pay-off. Firms were as a rule reluctant to overextend their collateral commitments for bank loans to make the often heavy up-front investments in energy efficiency even when the long-term costs were evident.

A spokesperson for an autonomous state chemical company said the company felt trapped by current high energy costs that were working against its employees' efforts to purchase and privatize the firm. Without introducing major energy cost-cutting measures, the company's employees would not be able to pay off bank financing required to buy out the firm. However, there was no public or private financing available to finance the energy use improvements needed to make the company profitable enough to buy. Pakistan might consider special financing to achieve both its energy conservation and privatization goals.

The evaluation revealed that price incentives, or disincentives, can encourage investments in more efficient energy use. For example, industrial electric power users frequently cited the current WAPDA practice of imposing payment penalties as the reason why they had begun to look for ways to achieve more energy efficiency.

4. LESSONS LEARNED

The stated findings have already hinted at some useful lessons from A.I.D.'s experience of supporting energy conservation in Pakistan. Particularly noteworthy for their broader application to A.I.D. support for energy conservation efforts elsewhere are the following:

- *A favorable economic and political climate is critical to the successful acceptance and performance of an energy conservation program.*

Since the early 1980s, Pakistan's economic fortunes swung on the availability and cost of energy. A rising energy import bill bled the country's foreign exchange resources; electric power load-shedding and brownouts disrupted industrial production and impact economic growth and investment; and a growing gap between the demand and supply of energy was felt through all sectors of the Pakistani economy and society.

The country's political leadership finally looked to energy conservation for bridging this gap. The Government of Pakistan had already responded to A.I.D. policy dialogue on energy pricing and penalties for electric power waste. Private industrial firms particularly were feeling the effects financially. Consequently, there has been greater receptivity to the plans and programs of ENERCON than is usually the case with many other development projects.

- *Energy conservation sells best when participants are given access to low-cost technologies with prompt pay-back benefits.*

A.I.D. and its U.S. technical advisor learned this lesson during ENERCON's years of operation under the EP&D project. At the outset, ENERCON began conducting comprehensive Total Energy Management audits and recommendations. It soon realized that instead of trying to change the whole system, it could achieve significant economies in fuel consumption with simple tune-ups in boilers and furnaces. In interviews with the evaluation team, firms mentioned that they were initially persuaded by the promise of visible and immediate changes in their energy bills. The energy conservation formula that seemed to work best consisted of the following:

- ENERCON-sponsored energy audits or surveys that could be completed within 1 or 2 days without disrupting the operation of the firm

- Financial savings to cooperating firms that would show up quickly in lower energy fuel bills
- Investments in energy saving equipment or practices that could be recovered within 3 to 24 months

The Managing Director of a foundry explained it to the team in the following words:

We are business people. We only understand the language of money when business is concerned. If a chap comes and tells me that I should save energy to protect the environment or reduce reliance on foreign oil, I will politely listen to him, but will do nothing else. But when the ENERCON team came they explained to me that they would save me so much money within 3 months.

- ***Local private engineering expertise is critical for spreading and sustaining the provision of energy conservation services.***

Pakistan has a reservoir of trained engineers who understand energy conservation engineering principles. They have good training in civil, electrical, and mechanical engineering fields in Pakistan or abroad. What they lacked is practical energy management knowledge and experience. With little training and exposure to conservation practices, however, these engineers acquired the necessary expertise to undertake energy conservation consultancies.

The relatively large number of private civil, electrical, and mechanical engineering consulting firms in Pakistan are in a position to respond to the emerging market opportunities for energy conservation advisory and design services. Most of them are relatively small managed by two or three professionals with a number of associates. Pakistan's recent move towards privatization has stimulated the growth of such firms.

- ***Flexible project design permits program managers to respond effectively to new conditions and opportunities.***

A.I.D. and host-country program planners need to provide sufficient flexibility and adjustment in new programs where there is initially little awareness, interest, or support from target program beneficiaries. Experience implementing the initial phase of the Pakistan energy conservation program demonstrates the importance of management flexibility.

At the outset, the Pakistan energy conservation program focused on broad total energy surveys that took time, staff and resources and produced large ambitious recommendations with little chance of implementation. Local

engineering firms, which were first contracted to conduct audits, were also prohibited from promoting their services or doing followup work to implement audit recommendations.

The program was later revised so that "targeted" energy audits could identify quick pay-off changes. Energy audit firms were encouraged to assist as engineering consultants. Such adjustments were critical to achieving the programs energy conservation targets.

5. OUTSTANDING ISSUES

The Pakistan energy conservation program experience raises three issues that merit examination both in the contexts of Pakistan's future program implementation and in other countries. The evaluation team recommends that CDIE consider revisiting the Pakistan energy conservation program after a 5-year interval to reexamine these issues as well as any further changes attributable to A.I.D. assistance. The following three issues identified in the Pakistan energy conservation program will also be studied during other CDIE field evaluations of energy conservation programs as part of this series of assessments of A.I.D. environmental programs.

- *What should be the role of subsidies in energy conservation program implementation?*

During the course of EP&D project implementation, ENERCON made extensive use of subsidies. ENERCON used project funds to underwrite energy audit contracts and consulting work for participating industrial firms and to pay a share of the costs of computerized automobile engine diagnoses for individual vehicle owners. A.I.D. funds also enabled ENERCON to distribute training and information sources for free or nominal cost to participating private firms and individuals. Finally, A.I.D. funds were used to off-set a share of the sale prices of energy monitoring equipment.

At issue is the need and appropriateness of program subsidies to achieve program impact, efficiency, sustainability, and replicability. To address this issue, it is necessary to examine the type of activity subsidized, the nature of the beneficiaries receiving the subsidy, and the level and length of time of subsidies granted.

In Pakistan subsidies for energy audits appeared necessary to break down the initial resistance and skepticism about ENERCON's motives among industrial firms, automobile owners, and other energy consumers targeted as potential energy savers. Subsidized training and information for civil, electrical, and mechanical engineering firms also appeared warranted to encourage them to build up sufficient capability to conduct energy audits, surveys, and consultancies.

Another case for granting subsidies to participants in energy conservation programs derives from the "externalities" achieved from more efficient energy management. While energy savings achieved as a result of ENERCON

supported audits, training, consultancies, and information services are captured by participating firms and individuals in lower energy costs and greater profits and incomes, the external benefits of reduced pollutants from more efficient energy use are enjoyed by everyone. The case can be made that some public subsidies are warranted to compensate private firms and individuals for a share of the costs incurred in reducing pollutants from more efficient energy use.

One concern associated with energy conservation subsidies is their potential for creating market distortions that may undermine the very conditions and practices they originally were used to promote. Once subsidies have "made the market," as appears to be the case for energy audits in the industrial sector and computerized automobile diagnoses in the transport sector, energy conservation programs should terminate subsidies altogether or at least do so in those sectors and move on to others. By terminating subsidies, private initiative then has the scope to come in and sell its services without the fear of competing with free public sector services.

A second concern about the use of subsidies is the efficiency and equity with which they are administered. Even during the initial start-up phase of the ENERCON program in Pakistan, some subsidized audits and other services were performed for firms or individuals quite capable—and perhaps willing—to pay full costs. Subsidiaries of foreign firms and vehicle owners of the well-to-do neighborhoods adjacent to filling stations offering subsidized computer engine diagnoses are examples of those who might have paid full cost for services provided under the program.

In Pakistan the evaluation found, however, that not all firms were equally skeptical about energy audits and reluctant to seek out information and advice about energy saving practices and equipment. The evaluation found the most enthusiastic firms to be larger firms and subsidiaries of foreign companies. The most skeptical and reluctant were small local companies and parastatals, suggesting that any future subsidized energy audit program might have a differential subsidy scale, with subsidies granted only where the spread of energy saving practices into new still untouched sectors was needed.

It is unlikely that all beneficiaries would require the same subsidies or the same length of time to participate in energy conservation programs. In all likelihood, ENERCON might well have found 4,500 automobile owners willing to pay the full US\$8.00 for computerized engine diagnosis instead of only US\$2.00 and receiving the rest as a subsidy. However, it is also likely that a different group of vehicle owners—probably those more energy conscious—would have paid the full amount of the computerized diagnosis cost. And these may not have been the greatest energy wasters or air polluters. Again some sort of targeting of engine diagnosis subsidies might be attempted in the future.

- ***What should be the mix between project and nonproject assistance for the greatest impact on efficient energy use?***

The development project approach is only one mechanism for achieving energy conservation goals. The evaluation has already pointed out the extensive role that nonproject assistance played, primarily through World Bank energy sector lending and IMF structural adjustment assistance, in Pakistan's relaxation of energy price controls and subsidies and the resulting impact that had on energy demand management and efficient use. The reforms that the Government of Pakistan had already introduced into electric power rate structures—partly as a result of earlier donor dialogue over price levels—were clear market incentives for greater energy-use efficiency among industrial users. It merits examining if further energy-use efficiency could have been achieved from further nonproject assistance aimed at removing remaining price and market distortions instead of technical assistance and institution building activities funded by A.I.D. through the EP&D project.

The evaluation suggests that structural adjustments that result from nonproject assistance do not produce the same responses in all energy users. Some users will respond to higher energy prices by improving the efficiency of their operations while others may trim back operations altogether. Those who respond by adopting energy conserving measures are those with the best access to information, financial resources, and management know-how in order to take advantage of market opportunities. In Pakistan there are language barriers to receiving information, collateral barriers to receiving credit and capital, and trade barriers to receiving imported modern energy-saving equipment. This same situation prevails in many other developing countries today.

Governments are also constrained politically from promptly adopting necessary adjustments in return for nonproject assistance. Where political pressures do not permit immediate action, indirect measures, such as those employed in the ENERCON program, work to demonstrate the private and public benefits of energy conservation, spread of such awareness and gradually erode resistance to needed market reforms. Further evaluation work should help to define the balance between supporting needed structural and policy changes with nonproject assistance and building the project-funded technical capacity within public agencies, such as ENERCON; and private firms, such as engineering contractors, to help energy users to respond more promptly and more efficiently to new price and supply conditions.

- ***Could greater involvement of nongovernmental organizations increase the effectiveness with which program objectives are achieved?***

The A.I.D. EP&D project spent much to build ENERCON into an official Pakistani Government institution responsible for fostering energy conservation

in Pakistan. There were several years of delay before ENERCON was up and running and several more before it sorted out its priorities and began to function effectively. ENERCON still has to earn official recognition from Pakistani Federal Government budget brokers.

ENERCON may need not have been the only institutional mode through which the energy conservation program operated in Pakistan. Private professional organizations and associations to which energy using industries and individuals belong could have been used or certainly included more directly in energy conservation activities.

Had the A.I.D.-funded program chosen to do so, it could have worked directly with local associations of professional civil, electrical, and mechanical engineers and consultants and with a broad range of local chambers of commerce and industry to which many of the firms reached by ENERCON belonged. There seems to have been little attention given to these networks of professionals and industries during EP&D project design and program implementation.

However, that with energy incentives already in place as a result of rising fuel and electricity pricing, engineering consultants and industries alike could have been equally responsive to assistance provided to and through their own professional associations as through a Pakistani Federal Government agency. At the least, future energy program activities in Pakistan ought to explore the potential for using professional associations and networks as extensions of ENERCON programs. Energy conservation programs planned in other countries should consider an active role for professional, industrial, and commercial organizations.