CDIE
Impact Evaluation
United States Agency for International Development

ENERGY CONSERVATION IN THE PHILIPPINES

Designed on the heels of the 1979 oil crisis, a USAID energy management project was implemented in 1986 when conditions were less auspicious—oil prices had dropped and the Philippines was in political upheaval. Despite these drawbacks, the project succeeded in generating savings and cutting pollution.

USAID's $4.27 million, six-year Technology Transfer for Energy Management project

- helped 17 participating companies save $1.9 million worth of oil a year
- set up a $2.4 million development loan fund that was completely loaned out and repaid
- built up institutional capacity in the public sector
- achieved a 19.5 percent economic rate of return, conservatively estimated

Several factors inhibited even greater success:

- oil prices dropped by almost half in 1986
- government policy favored industrial energy users by taxing fuel oil at a lower rate than other petroleum-based products
- energy-saving technologies were not widely marketed, so few were replicated by other companies

Authors: Donald G. McClelland, team leader, CDIE; David Hess, environmental specialist, USAID/India; Mike Jones, energy economist, Development Alternatives, Inc.

PN–ABY–206

1996, Number 4

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SUMMARY

The $4.27 million Technology Transfer for Energy Management project was successful on several counts. Participating companies saved $1.9 million worth of oil a year, for an economic rate of return of 19.5 percent. Assuming minimal replication of the technologies demonstrated, the rate increases to 23 percent. Including environmental benefits and minimal replication, the economic rate of return jumps to 62.5 percent.

The objective of the project was to promote adoption of energy-efficient technologies in the industrial and commercial sectors—large consumers of energy and primary generators of carbon dioxide (CO_2) emissions. Energy conservation was especially important in 1984 when the project was designed, because the price of oil had risen to $28 a barrel and the Philippines depends on imported oil for 56 percent of its energy. Widespread replication of energy-efficient technologies was expected to reduce oil imports, conserve foreign exchange, and improve the competitiveness of Philippine firms.

By the end of the project, 30 technology demonstrations had taken place at the 17 participating companies. Financial payback periods ranged from 0.3 to 20.9 years, averaging 1.8 years. All $2.4 million set aside in the development loan fund had been loaned and all loans were repaid. All together, participating companies saved 109,331 barrels of oil per year. The estimated financial rate of return was greater than 12 percent for 11 of the firms, and greater than 28 percent for 8 of the firms.

The results, while positive, could have been even more impressive. Several factors help explain why more energy was not saved. When the project was implemented, government policy favored industrial energy users by taxing fuel oil less than other petroleum-based products. The financial incentive for these companies to conserve energy was less than for other companies. The incentive was reduced even further when the price of oil dropped from $28 a barrel in 1984 to $13 a barrel in 1986.

The energy-saving technologies demonstrated under the project were, for the most part, technically and financially sound. In some cases, though, they had little replication potential or were introduced to companies that would probably have adopted them without financing by the project. In addition, the project did not market the technologies widely, which explains why there was little direct replication beyond the 17 companies.

Institution building in the public sector, though not a high priority of the project, was nonetheless successful. In contrast, there is little evidence the project increased institutional capacity in the private sector to undertake energy audits, for example, or to make equipment sales, although this was a project priority.

The evaluation suggests six lessons learned:

- Government and donor commitment to energy conservation is fundamental to project success

- Private firms need substantial financial incentives to invest in energy-efficient technologies

- Such technologies will be replicated only if they have broad application, are cost effective, and are widely disseminated
- The public and private sectors have important, but different, roles to play in encouraging and implementing energy conservation
- Pressure to disburse donor funds can be counterproductive
- Energy-using firms consider environmental benefits from energy conservation ancillary

CDIE Study

In October 1995 a three-person team evaluated the Technology Transfer for Energy Management project. This was one of six impact assessments on energy conservation USAID's Center for Development Information and Evaluation (CDIE) carried out. Other countries in the series are Czech Republic, Guatemala, Hungary, Jamaica, and Pakistan.

Over two weeks, the CDIE team interviewed individuals involved with the project and visited 5 of 17 energy-using companies that participated: 3 companies manufactured a product (steel, cement, paper), and 2 provided a service (telephone, laundry). The project was implemented from 1986 to 1991.

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BACKGROUND

The Economic Problem

The Philippines is highly dependent on energy imports, primarily crude oil. In fact, imported fuels are the source of 56 percent of the country's energy. Before 1972 oil was cheap, about $4 a barrel, and oil imports were less than 12 percent of total imports. But in 1984, the price of oil was $28 a barrel, and oil imports accounted for 28 percent of total imports.

By 1989, oil prices would drop to $16 a barrel, and oil imports would decrease to 13 percent of imports. But this was not anticipated in the late 1970s and early 1980s when the government started several energy conservation programs to move the nation from dependence on imported oil toward increased energy self-sufficiency. Nor was it anticipated in 1984, when USAID designed the Technology Transfer for Energy Management project to promote adoption of innovative energy-efficient technologies.

In 1986, just as the USAID project was getting under way, the Philippines underwent a major political upheaval. Corazon Aquino took over as president from Ferdinand Marcos. Aquino abolished the Department of Energy, among other actions. This clearly was not an auspicious time to launch an energy project.

The situation did not improve. By the late 1980s, inadequate electricity generation had become a serious economic problem. The geography of the Philippines (with more than 7,000 islands) and its large population (more than 64 million) add significantly to the cost of providing electricity. By the last half of the 1980s, the period of this assessment, the Aquino government had not installed sufficient generation capacity. The oil crisis of 1979 was replaced by the power crisis of 1992–93.

The Environmental Problem

Burning petroleum-based fuels and coal is a major contributor to air pollution. In the Philippines, these pollution-causing fuels are used primarily by two groups: electric utilities that generate, transmit, and distribute electricity through power grids; and individual industrial, manufacturing, and service companies that use these fuels to produce steam and heat as essential elements of their production processes.

Electric power generation has a significant environmental impact. Electric utilities consumed an estimated 34 percent of all fossil fuels used in the Philippines in 1993. That means 47 percent of power generation comes from petroleum-based fuels and 5 percent from coal.

The second group of energy-using companies—the many large, medium, and small industrial and commercial operations throughout the Philippines—consumed more than 31 percent of fossil fuels burned in the Philippines in 1993. The predominant fuel source for these companies is bunker fuel oil.

Air pollution emissions produced by burning petroleum fuel and coal include CO_2, methane, nitrous oxide, carbon monoxide, sulfur dioxide, tropospheric ozone, and particulates. All these emissions contribute to global warming except sulfur dioxide and particulates. Sulfur dioxide is a key contributor to acid rain and human health problems, and particulates cause respiratory disease.

The most significant contributor to global warming is CO_2. According to a recent report by an interagency committee on climate change chaired by the Philippines Atmospheric, Geophysical, and Astronomical Services Administration, fossil-fuel burning is the major source of CO_2 emissions in the Philippines, accounting for 53 percent of the total 72 million tons.

Of total CO_2 emissions caused by energy consumption (38.4 million tons), transportation contributed an estimated 35 percent; power generation, 28 percent; industry, 22 percent; refining, 4 percent; and other uses, 11 percent. The largest industrial contributors are cement (6 percent of the national total), mining (4 percent), and food and tobacco (4 percent). Iron and steel mills and paper-pulp mills and printing factories are also significant industrial sources of this greenhouse gas.

Because these firms and industries are relatively energy intensive, they have the most need of, and could gain the most from, more efficient energy use. Efficiency improvements for these firms also result in the largest reductions in release of CO_2, since petroleum and coal are the predominant fuel sources for electricity and process steam and heat. To illustrate: if losses due to inefficient power transmission and distribution had been reduced by 10 percent in 1990, more than one million tons of CO_2 would not have been emitted. This is because compensatory generation (which increases the emission of air pollutants, including CO_2) would not have been required to meet end user demand.

Energy Conservation: Killing Two Birds with One Stone?

The Philippines energy project was designed to achieve an economic objective, but, if successful, would have a positive environmental impact as well. Originally designed as a five-year, $4.6 million project, it was actually implemented over six years, 1986–91, and funded at $4.27 million. The project promoted adoption of energy-efficient technologies by industrial and commercial firms heavily dependent on fossil fuels and electricity. This was a good choice in 1983, because the industrial sector was a major energy user in the Philippines. At the time, total energy consumption, by sector, was: industry, 63 percent; transportation, 22 percent; and commercial and residential, 15 percent. The widespread adoption of energy-efficient technologies was expected to reduce the country's dependence on imported oil, conserve foreign exchange, and improve the financial position of Philippine industrial and commercial firms.

The project also sought to establish a strong institutional capacity in the private sector to undertake conservation-related investments. The private sector includes not only industrial and commercial energy consumers but also suppliers of equipment and services, engineering firms specializing in energy conservation, and lenders.

To achieve these objectives, the project tried to overcome two main constraints to energy conservation: lack of information about energy-saving technologies (especially technical and economic feasibility), and lack of capital to finance initial energy conservation investments (compared with more traditional investments to expand industrial capacity).

But appropriate technology and adequate financing are only two of three conditions typically associated with successful energy conservation programs. Sound pricing policy is the third. If domestic energy prices do not reflect international prices or long-run marginal costs, energy consumers (whether large industrial users or households) will underinvest in energy conservation. The greater the distortion, the worse the situation becomes, until there is virtually no private benefit from investing in energy conservation.

PROGRAM ELEMENTS

According to the final report on the results of the project, 20 companies were selected to implement energy conservation technologies; 17 actually participated. The project sponsored 30 technology demonstrations at the participating companies. Nine private financial institutions were trained and certified to administer loans to companies where new energy-saving technologies were demonstrated; five actually participated. This evaluation examines four program elements to ascertain their relative importance in contributing to energy savings: economic policy reform, technology transfer, education and awareness, and institution building.

Economic Policy Reform

In the 1980s, the government exercised monopoly control of the supply and price of oil and electricity. Because fuel oil was taxed less than other petroleum-based products (such as gasoline), prices for industrial consumers were distorted, leading to inefficient supply and use. In addition, fuel for power generation was exempted from normal taxes, which, together with other subsidies, contributed to undercapitalization and overconsumption of electricity. This ultimately led to the power crisis of 1992–93.

By 1995 energy policies had improved substantially. The government began to privatize, starting with Petron, the marketing subsidiary of the Philippine National Oil Company. The energy sector is also being deregulated, slowly, so people can adjust to anticipated higher energy prices. And most new capital investment for electricity supply will be private. In 1993, private supply represented 18 percent—1,223 of 6,695 megawatts installed nationally; by 1994, private supply had reached 26 percent—2,075 of 8,014 megawatts.

In addition, the government is expected to increase taxes on petroleum fuels used by industry. This will help reverse the situation whereby in 1995 users of regular gas, kerosene, and diesel were paying 5.268 pesos per liter into the oil stabilization fund, while industrial users of fuel oil actually were drawing 1.858 pesos per liter out of the fund as a subsidy.

Finally, energy conservation has become a national priority, largely as a result of power shortages. For example, the reconstituted Department of Energy was implementing a major public education and awareness campaign in 1995, using posters to promote conservation, demonstrating renewed government commitment to energy conservation.

Technology Transfer

Technology demonstrations were partially successful. Eleven of the 17 participating companies achieved a financial rate of return greater than 12 percent, and for 8, the return was greater than 28 percent. In several instances, however, the technologies did not appear to have strong replication potential (for example, the air conditioner chiller optimization technology demonstrated at the Philippines Long Distance Telephone Company). In other cases, the team learned the technologies would have been adopted without project support. The Trust International Paper Corporation, for example, would have improved its power factor without the project. (Improving the power factor allows for more efficient and balanced use of electricity to avoid energy loss.)

The team assessed the effect of energy-saving technologies through site visits at 5 of the 17 companies. Three manufacture a product (steel, cement, paper) and two provide a service (laundry, telephone).

- **Electric arc furnace.** Armco-Marsteel Alloy Corporation (now GST Industries) invested $218,500 for an “oxy-fuel” scrap metal melting system expected to improve furnace efficiency by 12 percent and increase steel production by 15 percent. The estimated payback period was 3.9 years. However, because of technical problems associated with poor fuel oil quality and adverse market conditions that hampered the firm’s ability to purchase spare parts for the burner, the firm did not maintain and operate the system beyond one and a half years. As a result, the financial rate of return was negative, and the technology has not spread.

- **Process improvement and steam efficiency.** Kalinisan Steam Laundry is an institutional launderer; it also dyes and washes new denim products for a U.S. corporation. The company installed a continuous washing process to replace old batch equipment for $377,000. Payback was more rapid than anticipated, 2.8 years compared with 3.6 years, owing to increased productivity. Output increased from 4.3 million to 6.1 million kilograms of linen; steam use per unit of output was reduced by 21 percent; water use was reduced by 58 percent; and oil savings amounted to 1,296 barrels per year. The estimated financial rate of return was 21 percent. This innovative technology is a good example of the synergy between energy conservation and production benefits, but it had little replication potential except internally within the same firm.

- **Air conditioner chiller optimization.** The Philippines Long Distance Telephone Company linked the air conditioning systems of two adjacent buildings to improve efficiency and reliability. Although the $237,000 investment was initially estimated to have a 1.4 year payback, savings suggest cost recovery will take 20.9 years. As a result, the financial rate of return was negative (though at the outset the investment was expected to yield 16 percent). There has been no known replication.

- **Heat exchanger improvement.** The Republic Cement Company invested $285,200 to install two two-stage expanded and improved cyclone units for raw cement preheating. Production increased by 5–10 percent. Energy efficiency improved, with a payback period of about 2.4 years and a financial rate of return of 28 percent. At least two other dry process cement plants have adopted a similar technology, and it's likely other cement factories (though there are relatively few in the country) will follow suit.

- **Power factor improvement.** The Trust International Paper Corporation improved its electrical power factor to avoid penalties imposed by the National Power Company, thereby reducing its electrical charges. This $138,500 investment had been planned prior to the demonstration project. The payback period was 4.5 years, and the financial rate of return was 4 percent. Six units were added after the original three. Although results of the demonstration were not widely publicized, a significant number of similar investments have recently taken place.

Table 1 summarizes energy savings, actual payback period, and estimated financial rate of return for the 17 participating companies. Companies listed in bold were visited by the evaluation team. Savings at the 17 companies totaled 109,331 barrels of oil equivalent (nearly $1.9 million), and the average payback period was 1.8 years. Including only reported replication beyond the 17 companies, 127,198 barrels of oil, or $2.2 million, were saved per year, equal to 52 percent of USAID's total investment. This savings is small in relation to total energy consumption (only 0.03 percent of total oil consumption by the industrial sector in 1989). However, had technologies been replicated more widely, the energy savings could have been multiplied many times over.

Education and Awareness

The project was marketed well, but project results—the benefits of the new technologies—were not. A considerable effort was made early on to raise awareness about the economic benefits of energy conservation. This was necessary to encourage companies to participate in the project and to promote the project's development loan fund. Marketing and outreach were carried out through promotional seminars for lenders and equipment suppliers, and direct sales calls were made to potential companies. The project was also promoted through technical conferences offered in association with the Energy Management Association of the Philippines and other organizations.

- In 1987, the project contacted potential clients through letters, presentations, exhibits, and site visits to give the project maximum exposure.

- In 1988, the project made 107 marketing calls to potential clients; some were followed up with energy audits. This resulted in four firms receiving development loan funding.

- In 1989, the project made 158 contacts, which generated 15 loan fund applications. Four demonstration projects resulted.

- In 1990, with the development loan fund significantly depleted, the project contacted only 20 new companies; it made 31 follow-up calls with companies identified previously.

In contrast to the substantial effort made to promote the project, very little effort was made to inform firms with similar production processes about project results. Yet, creating an awareness of the benefits of adopting energy-saving technologies was the main mechanism for ensuring replication. Promotion was inadequate partly because there was too little time left in the project and partly because some successful technologies were not replicable. As a result, replication beyond the initial 17 companies was relatively insignificant by the end of the project.

Table 1
Estimated Energy Savings and Financial Rates of Return,
17 Companies Under the TTEM Project, Philippines

Company	Industry/sector	Technology	Investment ($)	Energy savings (BOE/year) *	Energy savings	Simple payback (years)	Financial rate of return (%)
1	Wood/plywood	Steam system improvement	85,200	2,646	41,807	2.0	36.4
2	**Steel/metal grinding balls**	**Oxy-fuel burner system**	**218,500**	**3,525**	**55,695**	**3.9**	**-37.7**
3	Carpet making	Cogeneration/waste heat recovery	43,000	750	11,852	3.6	4.5
4	Copper mining	Power factor improvement	25,600	123	23,438	1.1	80.9
5	Copper mining	High efficiency motors	35,200	538	10,547	3.3	14.4
6	Wood/plywood	Centralized boiler control system	75,600	10,527	166,327	0.5	210.0
7	Wood/plywood	Steam system improvement	165,600	41,565	656,727	0.3	386.6
8	Electric utility	Technical loss reduction program	211,100	10,263	162,155	1.3	65.7
9	Sugar	Power factor improvement	25,200	174	21,076	1.2	72.8
10	Chemical/ alcohol	Cogeneration system	711,100	12,804	202,303	3.5	12.5
11	**Laundry service**	**Process modification**	**377,000**	**1,296**	**134,643**	**2.8**	**21.3**
12	Chemical/ caustic soda	Steam system improvement	32,200	2,679	42,328	0.8	121.2
13	**Telecom-munications**	**Chiller optimization**	**237,000**	**585**	**11,328**	**20.9**	**-28.0**
14	**Cement**	**Waste heat recovery**	**285,200**	**7,520**	**118,816**	**2.4**	**28.1**
15	Rubber footwear	Boiler load optimization	150,700	2,910	45,978	3.3	8.6
16	**Paper**	**Power factor improvement**	**138,500**	**1,549**	**30,469**	**4.5**	**4.0**
17	Glass bottles	Waste heat recovery	574,100	9,877	156,057	3.7	10.9
Sub-total			3,390,700	109,331	1,891,546	1.8	
Replication				17,867	309,122	1.6	
Grand Total				127,198	2,200,668	1.8	

*Barrels of oil

Institution Building

Institution building in the public sector, though not a high project priority, has nonetheless been successful. There is little evidence, however, of institutional capacity in the private sector. The overthrow of the Marcos regime affected the energy project more than most bilateral projects, because the Aquino government abolished the cabinet-level Department of Energy and made other radical changes in the government's organization of energy activities and institutions. The principal constituent institutions, including the Philippine National Oil Company, Energy Regulatory Board, National Power Company, and Office of Energy Affairs were reconstituted to report individually to the office of the secretary of the presidency. These measures were reportedly taken because the energy department was perceived to be corrupt.

The project was implemented under the government's reorganized Office of Energy Affairs. It took about two and a half years from project authorization to initiation of full project implementation. In 1995, four years after project completion, staff were assigned to a reconstituted cabinet-level Department of Energy, where functions that were part of the project, such as energy conservation financing, are still performed.

Insufficient attention was paid in the project to creating conditions and incentives for private firms to perform energy audits and supply energy conservation equipment, or for private financial institutions to lend to investors for energy conservation. As a result, in 1995 there was no direct evidence that the private sector could perform energy audits, sell equipment, or design shared savings projects. In fact, the government, through the energy department, maintains a virtual monopoly on the energy conservation audit business. Although the private sector is substantially involved through engineers working for energy users and equipment vendors, there are no significant energy audit or conservation businesses that owe their origin to the project.

There are, of course, legitimate roles for the public sector in energy management and conservation, including policy development and regulation; data gathering, monitoring, and analysis; public education and awareness; and promotion of new technologies. These roles are reflected in the energy department's 1996–2025 energy plan, which includes, among other things, energy audits (with an objective to implement these jointly with private sector energy service companies) and information and education campaigns.

Thus the USAID project helped create a public sector capability to promote adoption of energy efficient technologies and practices by industrial and commercial energy consumers. But it was less successful in establishing a capacity in the private sector to manage energy conservation investments and programs. However, most staff who implemented the project have moved on to private sector jobs, which could be seen as an indirect positive influence in private sector institution building. (Staff departures are explained by relatively low public sector salaries and the unsustainably high salaries USAID paid contractors who served as principal government counterparts.)

IMPACT

Economic Impact

The overall economic impact of the project was positive, with an economic rate of return conservatively estimated at 19.5 percent. The value of reduced oil and coal imports and reduced need for power generation capacity are typically included among the direct economic benefits of energy conservation programs. This analysis looks only at fuel savings, not reduced investment in power generation capacity. In addition, it does not include indirect benefits such as increased quality or reliability of supply (for example, fewer power outages and improved voltage regulation for electricity) because they are difficult to quantify.

The value of oil savings is measured by using international oil prices (excluding local taxes) for 1990 to 1995; thereafter, prices are projected, assuming an average international inflation rate of 5 percent. No premium is applied to foreign exchange savings. Electricity savings are valued in terms of oil equivalent energy values (including generation losses), because it was infeasible to disaggregate electricity savings in all cases. This tends to underestimate electricity benefits.

Costs are limited to direct contributions from USAID ($4.2 million). The Philippine Government contribution is not considered. USAID funds were used to finance technology demonstrations ($2.4 million) and pay for administration and technical assistance ($1.8 million).

Economic efficiency, the relationship between benefits and costs, is measured by estimating net present values and economic rates of return arising directly from project investments. The real discount rate is assumed to be 12 percent, consistent with that typically used by international agencies. Project savings are assumed to last for 7 years, which is conservative since much of the equipment should easily last 10 years or more. A 10 percent annual decay rate, the rate at which conservation benefits are reduced because of poor maintenance or aging equipment, is assumed. And zero salvage value is allowed for investments.

From these assumptions, three estimates of the economic efficiency of the project are presented in table 2. The first assumes zero replication and considers only the returns from the 17 demonstration projects.

The second includes benefits from replication of the technologies beyond the 17 demonstration companies. It covers the major industries reporting energy conservation investments in 1991, 1992, and 1993, and assumes 10 percent of reported replication of USAID project (or similar) technologies can be attributed to the project. It also assumes an equal amount of unreported conservation investments attributable to the project. Thus, it does not include spontaneous or price-induced replication that cannot be attributed to the project.

The third estimate includes environmental benefits of reduced greenhouse gas emissions. Environmental benefits reflect avoided costs—costs that do not need to be incurred to mitigate CO_2 emissions. They are based on U.S. experience and are intended to reflect the value society places on control of these pollutants. Note, however, that low-income countries like the Philippines may place a lower value on pollution control than high-income countries like the United States, because they cannot afford the costs.

Without replication, the estimated economic rate of return is 19.5 percent; with replication, 23 percent; and with replication and environmental benefits, 62.5 percent. Thus, returns are positive under each scenario and exceed the social discount rate of 12 percent, which is the return that could be earned on alternative investments elsewhere in the economy.

However, they are much lower than those estimated in project documents, which assumed extremely short payback periods. For example, the project paper estimated an 11- to 31-day payback after investing in combustion monitoring, yielding an economic rate of return of 1,110 percent. It estimated a 1.5 month payback for insulation, yielding an economic rate of return of 738 percent; 15 days for steam system maintenance, with a 2,300 percent economic rate of return; and 6 months for power factor improvement, with an

Table 2
Estimated Economic Returns on Investments in Energy Conservation in the Philippines, TTEM Project

Scenarios	Net present value (millions)	Economic rate of return
Without replication	$1.1	19.5%
With replication	$1.9	23.0%
With replication and environmental benefits	$9.1	62.5%

economic rate of return of 126 percent. Excluding all replication benefits, but including $595,000 of government costs and assuming 80 percent of the investments would be successful, the overall economic rate of return estimated in the project paper was 140 percent. Although energy conservation projects of this nature typically yield substantial returns, it's clear in retrospect that the project designers were overly optimistic.

These economic returns represent benefits to society. It is important to keep in mind, though, that the main reason the private sector invests in energy conservation technologies is financial returns, net cash benefits (see table 1). Unless they are positive, private firms will not undertake these conservation measures.

Environmental Impact

Environmental impact, though positive, was a minor consideration. The project was designed to increase the economic efficiency of industrial firms generating and using energy from electricity and petroleum fuels. The cursory environmental analysis in the project paper concluded, "any environmental effects stemming from the project will be positive, as increased efficiency means more complete fuel combustion, a reduction in fossil fuel use, and less pollutants discharged to the environment." Indeed, following practices in effect at the time, neither an environmental impact statement nor an environmental assessment was required. In contrast to USAID's strategies and priorities in 1995, environmental impact was not the centerpiece of projected results.

Nevertheless, that impact was positive, both directly and indirectly. Direct positive effects can be seen at the 17 demonstration sites, where estimated annual savings total 109,331 barrels of oil equivalent. Including replication of the technologies, annual savings as of 1995 total 127,198 barrels. These savings are impressive given the fact at least one firm, GST (formerly Armco-Marsteel Alloy Corporation) was no longer using the technology and two others were no longer operating.

Table 3 shows the extent to which industry and power generation contributed to CO_2 and other greenhouse gas emissions in the Philippines in 1990. Using standard conversion rates, it calculates the CO_2 equivalent for the other gases and estimates their economic values or costs. Though only approximate, the orders of magnitude allow one to begin to judge the cost versus the benefit of implementing energy conservation programs as one option to mitigate greenhouse gases.

Thus the table shows that industry and power generation produced 26.8 million tons of CO_2-equivalent greenhouse gases in 1990. Going by U.S. average estimates, the economic value of reducing these greenhouse gas emissions was $670.8 million; however, low-income countries like the Philippines may not be able to afford pollution control and therefore may not value it as highly. Energy savings for the project, excluding savings from replication, were 0.3 percent of fossil fuel consumption by the industry and electricity sectors. The economic benefit of greenhouse gas reductions associated with the project was about $2 million (.003 x $670.8 million), roughly equal to the cost of importing this fuel. When the value of greenhouse gas reductions is treated as an additional economic benefit, the overall economic rate of return of the project increases to 62.5 percent (see table 2).

By promoting cost-effective technologies that reduce CO_2 emissions, the project had an indirect positive environmental impact. The project tested making better use of process steam, optimizing boiler load, recovering waste heat, increasing the power factor, and reducing technical loss. The demonstration process itself illustrated a method for continuing and expanding these and other means of reducing greenhouse gas emissions.

PROGRAM PERFORMANCE

The team assessed the extent to which the project was effective, sustainable, and replicable.

Effectiveness

Program effectiveness concerns how well project-sponsored activities reached the intended target groups—whether the benefits went to the right groups.

The primary beneficiaries were supposed to be energy consumers in the industrial and commercial sectors; the project reached only a few. There was little carry-over from the 17 companies where new technologies were demonstrated to other industrial and commercial energy consumers. Project planners didn't anticipate the need to market the results of the demonstrations. But since the project started late, there was not enough time at the end to do so anyway.

Moreover, the project did not generate increased demand for, or substantial additional capability in, private sector conservation services, equipment sales, or manufacturing. One equipment supplier, for example, stated he had noted no significant change in conservation investment or growth of new firms providing energy services.

The concessional interest rate for the $2.4 million development loan fund averaged 17 percent, compared with commercial rates of 20 to 26 percent. Eight of 17 companies borrowed the maximum—$200,000. The project placed no limit on the size of firm or building for financing, since the overriding objective was to save as much energy and foreign exchange as possible. This approach recognized that a few large firms consumed much of the energy in the industrial sector. However, these firms may not have needed subsidized funds as much as smaller firms.

Table 3
Greenhouse Gas Emissions (000 tons) and Economic Cost of Emissions ($/ton) From Fossil Fuel Combustion (Industry and Power Generation), Philippines, 1990

Greenhouse gases	Emissions (000 tons)	CO_2 equivalent multipliers	CO_2 equivalent (000 tons)	Economic cost ($/ton)	Total economic cost ($000)
Industry					
CO_2	8,512.00	1.0	8,512.0	25	212,800
CH_4	0.32	6.8	2.2	25	55
No_x and N_2O	33.60	131.2	4,08.3	25	110,208
Subtotal			12,922.5		323,063
Power Generation					
CO_2	10,696.00	1.0	10,696.0	25	267,400
CH_4	0.39	6.8	2.7	25	68
No_x and N_2O	24.48	131.2	3,211.8	25	80,295
Subtotal			13,910.5		347,763
Total			26,833.0		670,826

Notes:

1. CO_2 multipliers adjust CH_4, NO_x, and N_2O emissions so they are equivalent with CO_2 emissions in terms of their relative possible contribution to global warming; for example, a ton of CH_4 has 6.8 times the global warming impact of CO_2.

2. The economic cost per ton ($25) corresponds to CO_2 equivalents. Actual costs per ton for controlling pollution caused by NO_x and N_2O are $1,980 per ton and $4,580 per ton, respectively, for an average of $3,280 a ton. The cost of controlling pollution caused by CH_4 is $170 per ton.

Secondary beneficiaries, about 1,000 people, including plant managers, engineers, equipment suppliers, finance executives, and technical consultants, received technical assistance and training. They participated in seminars and more than 25 workshops held around the country. The project provided 45 person-months of long-term technical assistance and 14 person-months of short-term technical assistance. Ten individuals received four weeks of intensive training in the United States, and one attended a six-week program. Government staff received training locally. The project conducted three policy-oriented studies and 13 energy audits. It reached these secondary beneficiaries through extensive efforts to market the project and the loan fund, including publication of the *TTEM Channel*, the project newsletter.

Sustainability

Promotion of energy-efficient technologies has generally been sustained. Sustainability is examined in the context of a) current and future funding of the loan fund; b) use of the energy conservation technologies supported under the project; c) institutions strengthened under the project; and d) incorporation of environmental concerns in promoting energy conservation technologies.

No new loans to finance energy conservation technology demonstrations were made between 1991, when the project ended, and 1995 largely because reflows were commingled in the government's general account. In 1995 the government reinstituted a separate account for reflows to continue similar project-type lending. The government assigned 8–10 million pesos as loan funds in 1995 and programmed 20 million pesos for disbursement from the development loan fund in 1996 and subsequent years. However, higher levels of funding could have been provided if reflows from the original development loan fund had been placed, as intended, in an interest-bearing account. Nevertheless, the concept of the demonstration project appears to have been revived.

Use of energy conservation technologies implemented under the project has been sustained. The evaluation team observed four firms using installed technologies, three of which were deemed significant contributors to the firms' cost savings and productivity increases. There was also internal replication in two large firms in the paper and cement industries, as well as in the laundry company. For example, the paper company added six sets of capacitors for power factor improvement beyond the original three funded by the project. However, there were several exceptions, in most cases related to external factors. For example, two firms went out of business, and another firm sold the part of its manufacturing process that used the technology introduced by the project.

Institution building was successful in the public sector, although this was not originally a project objective, but unsuccessful in the private sector, which was! The government's current emphasis on improving energy sector performance and management, both supply and demand, suggests the functions supported by the project in the energy department are likely to continue.

However, the failure to build significant private sector energy conservation capabilities does not augur well for development of private sector capacity to perform energy audits or supply energy conservation equipment. In addition, no private financial institution was found to be active in making or promoting investments in energy efficiency. Inadequate demand for private firms to develop these capacities, coupled with the provision of energy audit services by the energy department, are the principal reasons.

Environmental impact was not a project concern during design and implementation. However, energy conservation and efficiency are directly linked to environmental issues, particularly global warming, because energy generation, transmission, distribution, and use are sources of greenhouse gases. The most immediate and largest reductions in greenhouse gas emissions (and thus, positive environmental effects) in the energy sector can be achieved from a) improving the generation efficiency of existing and future electric power plants; b) increasing efficiency of electric power transmission and distribution; c) switching from oil and coal to natural gas for utilities and industries; and d) reducing demand for electricity by demand-side management and efficiency improvements. The project supported technologies in all four areas. Their use is by and large being sustained, as is the environmental benefit of reducing greenhouse gas emissions.

Replicability

Project-promoted technologies were not widely replicated during the project. Project success according to the project paper "will be measured by the extent to which it stimulates both successful demonstration projects, and, more importantly, extensive replication outside the scope of the project itself with financing by other donors and commercial investors." For several reasons, this did not happen.

During project implementation, pressure to reduce the pipeline of obligated funds in the development loan fund (which exceeded the demand for subprojects) led to a vigorous attempt to drum up support for the project. In the process, certain technologies (such as oxyfuel burners for certain steel products and continuous batch-washing equipment for large commercial laundries) were selected for demonstration projects, even though there was little potential for replication. In addition, large companies were often targeted, even though there were few other large companies in the Philippines where replication could take place.

Moreover, equipment suppliers and engineering consulting firms in the private sector were not adequately informed about results, even though they were expected to sell energy-saving equipment to energy-using firms and, in principle, would have the greatest interest in knowing about new technologies. Also, the project ended before all demonstrations were fully operational, which also helps explain why replication was modest.

The major external factor retarding spread of energy conservation investments was the government's irrational energy pricing structure, which subsidized electricity and fuel oil prices at a time when electrical capacity was becoming critically short.

However, replication of several technologies has occurred. For example, at least nine companies replicated power factor improvement; at least 11 companies adopted boiler and steam system improvements; and at least 8 companies adopted cogeneration and waste heat recovery technologies. Although these examples cannot be attributed entirely to the project, it did play a role in their adoption, especially of the waste recovery technology at two companies in the cement industry (Hi Cement and Continental Cement) and accelerated adoption of power factor improvement at the Trust International Paper Corporation.

LESSONS LEARNED

- **Commitment**

  Government and donor commitment to energy conservation is fundamental to project success.

  The Philippines underwent a major change in government in 1986, just as the project was getting under way. When President Aquino abolished the Department of Energy, widely perceived to be corrupt, and diffused its responsibilities among other government agencies, she deemphasized the energy sector. At about the same time, a new USAID management team arrived in Manila and assigned relatively lower priority to the energy sector than did the previous team. Commitment to energy conservation was not strong. After project completion, however, in response to daily 12-hour brownouts in 1992–93, the government resurrected the Department of Energy; investments to increase the energy supply once again assumed high priority; and by 1995 the energy conservation program, including use of project reflows, was back on track.

Financial Incentives

Energy conservation programs are most successful when they offer private firms substantial short-term benefits and when energy is a significant cost of production.

In the Philippines, the government favored the industrial sector through tax and pricing policies, in effect subsidizing industrial consumption of oil and electricity. For example, fuel oil, a major production component of many industries, was taxed at a lower rate than other forms of energy; in addition, the government allowed the National Power Company to sell power under subsidized terms directly to industry. Cross-subsidies of this nature tend to create distortions that act as serious disincentives for energy conservation. When short-run energy prices do not reflect long-run energy costs, the financial incentive to use energy efficiently is severely eroded.

A Corollary: Energy conservation programs are most successful in a competitive environment. Private sector firms in the Philippines were not compelled to conserve energy. Because of protectionist import policies, they could pass along increased energy costs to the consumer in higher prices. But this strategy has its limits. As the global economy becomes increasingly competitive, Philippine industry will need to reduce costs to retain market share. Improving energy efficiency is one way to do that.

Replication

Demonstration projects will not be replicated, and therefore cannot succeed, unless the energy-saving technologies have broad application, are cost effective, and are widely disseminated and marketed.

Various energy-saving, cost-cutting technologies were demonstrated in the Philippines. But the project did not market, publicize, or disseminate the positive results of the demonstrations. As a result, major potential benefits were delayed or entirely lost. New technologies cannot be transferred through demonstration projects alone. The demonstrations must be coupled with an effective marketing strategy designed to apply the technologies on a wide scale in the private sector.

Role of the Public and Private Sectors

Public agencies can help establish an enabling environment conducive to energy conservation investments and transferring energy-saving technologies. However, private sector investors and private financial institutions must mobilize their own resources and take risks if energy conservation programs are to be sustained.

The public sector has a legitimate role in establishing an appropriate policy and regulatory environment and supporting public awareness campaigns to promote energy conservation. Even energy audit programs administered by the government constitute a valuable service where the private sector is unable to perform this function. At some point, however, the public sector must step aside and allow private sector firms (equipment suppliers, service providers) to perform the functions they can do more efficiently and sustainably.

Pipeline Pressure

Pressure to disburse funds can lead to selection of less than optimal technologies and firms.

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

Environmental Benefits

Achieving environmental benefits from energy conservation, particularly "global" benefits, is largely outside the interests of private energy-using firms and public agencies promoting energy conservation.

In the Philippines, the primary objective of energy conservation under the project was economic (save money by saving energy), and the primary target was energy users (industries and commercial firms). Although investments in energy conservation contribute to environmental benefits, such as reducing the buildup of greenhouse gases, the project did not maximize environmental benefits because it focused primarily on end-use energy consumption. Investments designed to improve the efficiency of electricity generation, transmission, and distribution will normally have a larger near-term effect on reducing greenhouse gas emissions than investments restricted to end-use efficiency.

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