USAID Impact Evaluation No. 2

Energy Conservation

JAMAICA

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EXECUTIVE SUMMARY

USAID implemented the Energy Sector Assistance project from 1981 through 1985, when Jamaica faced a severe energy crisis. Oil prices, which had quadrupled after the 1973 worldwide oil crisis, doubled again after the 1979 crisis. Before 1973, oil was less than $4 a barrel. By 1981, it was more than $30 a barrel, putting substantial pressure on foreign exchange earnings. Almost totally dependent on imported oil, Jamaica had to reduce oil consumption. One way to do that was through a program of energy conservation.

In July–August 1995, a CDIE evaluation team carried out fieldwork in Jamaica to determine the impact of the energy conservation component of the Energy Sector Assistance project. The team interviewed 15 firms in six urban centers throughout the island that had benefited from the project. Three were engineering consulting firms that had carried out energy audits. The other 12 were energy-using companies that had implemented various energy conservation measures recommended by the audits. Of the 12 energy-using companies, 5 manufactured a product (paper, soap, cement, refined sugar, alcohol), and 7 provided a service (hospital, banking, hotel). The team also interviewed representatives from the government, energy-producing companies, private sector organizations, nongovernmental organizations, and other donors.

The $13 million five-year project supported energy planning and management, development of alternative energy sources, and energy conservation. The energy conservation component, the subject of this evaluation, was funded at $3.3 million. The project's main goal was economic—reduce oil imports—but it had a positive environmental impact as well: less fossil fuel was burned and, therefore, less carbon dioxide (CO_2) was emitted.

Energy auditors were trained, 57 energy audits were carried out, and energy conservation investments were made in both the public and private sectors. Energy savings were significant—an estimated 13 percent in electricity usage. The payback for the public sector hotels and factories was rapid: in less than one year the value of the energy saved more than covered the cost of the investments.

Although the project achieved measurable results, the impact could have been much greater. For example, the government's cheap energy pricing policy retarded energy conservation. Electricity prices were well below costs until the early 1990s. The government was reluctant to offer tax, duty, or credit incentives to encourage conservation. Finally, the incentive to conserve energy was reduced by the dramatic decline in oil prices in 1986.

Ten years later, in 1995, petroleum prices are still relatively low and the economic rationale to

conserve energy is marginal, especially for industries in which energy costs are a small portion of operating costs. For example, in July 1995, Jamaican gasoline was selling for $1.25 a gallon, firms were paying $0.11 a kilowatt-hour for electricity, and fuel oil cost $0.96 a gallon. These prices are comparable to U.S. energy prices. In real terms, with prices adjusted for inflation, Jamaican energy prices are lower than they have been during most of the last 20 years. Under these circumstances, only private companies that are relatively energy intensive are likely to make major investments in energy conservation.

The project might have had a greater impact on energy consumption and achieved significant environmental benefits at the national level if it had targeted the largest companies in the most energy-intensive industries. In Jamaica, these include only a dozen firms in a few industries: electric power, bauxite–alumina, cement, plastics, and glass. These consume approximately 75 percent of the country's energy. Instead, the project targeted a large number of small firms and businesses. Clearly, there is a trade-off between conserving the maximum amount of energy and conserving energy at the maximum number of firms.

There is only scattered evidence of sustained or expanded energy conservation activities in the public and private sectors. Although the project trained a cadre of energy auditors and helped create a number of engineering consulting firms, few auditors exist today and only a few firms market energy conservation equipment. Most audit firms shifted to other lines of business shortly after the project ended. This was because the project had funded energy audits for virtually all government facilities, and there was little market demand from private businesses after 1986.

The evaluation suggests several lessons learned. They highlight the importance of a financial necessity to conserve energy; a sound economic policy and appropriate environmental regulations; a relatively quick payback for investments in energy conservation; a competitive economic environment; beneficiary commitment; and a limited role for government. These lessons parallel a recent World Bank analysis that identifies two factors as primarily responsible for the differences in energy use and energy efficiency in industrial countries as compared with developing countries: energy pricing policies, and the extent to which energy-using industries are protected from competition.

1. BACKGROUND

Energy Use

Jamaica's economic growth depends on imported oil. Oil has been a powerful factor associated with the pace of Jamaica's economic growth. Following the first global energy crisis, Jamaica's annual petroleum imports fell from 20.5 million barrels in 1973 to 12.2 million barrels in 1985. Gross domestic product (GDP) declined steadily over the same period. Since the mid-1980s, Jamaica has been able to reverse its economic decline and achieve positive economic growth. Not until the mid-1990s, however, has the country reattained the economic level of two decades earlier.

Jamaica relies on imported petroleum to meet 90 percent of its overall energy needs and 98 percent of commercial energy consumption. Total oil consumption rose from 11.7 million barrels in 1985 to 19.7 million barrels in 1993. Mining and alumina refining, the country's leading economic sector in GDP and export earnings, was the largest consumer of petroleum in 1993 (41 percent); next were transportation and electric power generation (23 percent each).

Burning oil emits a variety of pollutants. This is especially true in Jamaica, where low-quality fuels (for example, fuels with a high sulfur content and heavy metals) are used with virtually no emission -control equipment. The major pollutants include sulfur dioxide (SO_2), nitrogen oxides (NO_x), and particulate matter. These are harmful to human health. Emissions from the power and bauxite–alumina plants account for an estimated 90 percent of the total sulfur dioxide emissions in Jamaica.

Carbon dioxide, a greenhouse gas thought to contribute to global warming, is also a major pollutant, emitted when fossil fuels are burned to produce electricity. Approximately 2.1 billion kilowatt-hours of electricity are produced in Jamaica annually. This translates into an estimated 2.5 million metric tons of CO_2 emitted into the atmosphere.

Project Rationale—Why Energy Conservation?

In the early 1980s, Jamaica had to reduce its oil consumption. When USAID launched the Energy Sector Assistance project in 1981, Jamaica faced a severe energy crisis and economic decline. Oil prices had quadrupled after the 1973 worldwide oil crisis, then doubled again after the 1979 crisis. Before 1973 oil was less than $4 a barrel; by 1980–81 it was more than $30 a barrel. With oil expected to rise steadily to $50 or higher, something had to be done.

But Jamaica was in a bind. Production of its major exports, bauxite and alumina, require

large amounts of energy. Yet, international demand and prices for alumina were down (owing to the severe worldwide recession from 1979 to 1981), while the cost of energy to produce alumina had sharply increased. USAID and World Bank support for rationalizing energy pricing and investment policy, encouraging privatization, and reducing government regulation and control of the economy were important, but more was needed to encourage firms to reduce oil consumption.

The Energy Sector Assistance project was designed against this backdrop. It was intended to support the government's strategy to increase economic production, stimulate employment, decrease the country's dependence on imported petroleum, and free up scarce foreign exchange. In addition, government institutions and private companies that used energy were expected to reap direct financial benefits from reduced electricity and oil costs. The $13 million five-year project authorized in 1981 had two phases. Phase I ($7 million) provided technical assistance and training and offered grants for public sector energy conservation and alternative energy schemes; phase II ($6 million) provided loans to the private sector to support similar activities. (Phase II was later reduced to $2 million.)

2. KEY PROGRAM ELEMENTS

The team examined the contributions of four elements to the economic and environmental impacts of the project:

1. Economic policy reform, including cost-based electricity and oil pricing.

2. Institution building, particularly a capability to conduct energy audits in the private sector.

3. Public education and awareness campaigns.

4. Technology transfer.

Economic Policy Reform

The government's cheap energy pricing policy retarded conservation in Jamaica. Electricity prices were set well below costs until the early 1990s, when they finally reached, then exceeded by some 15 percent the marginal costs of the public utility company. In addition, the 1986 drop in oil prices reduced the perceived need to reduce oil imports and thus to conserve energy. Domestic fuel oil prices were allowed to drop, fully reflecting the international price decline, and many industries found less incentive to maintain the momentum to conserve energy. (However, the government, to its credit, did not allow transport fuel prices to decrease, thereby maintaining incentives for fuel efficiency in transportation.)

The government was reluctant to offer tax, duty, or credit incentives to encourage energy conservation, both during and after the project, because of the country's high foreign debt service requirements. (Expenditures allocated to service foreign debt were 31 and 42 percent of the government budget in 1993–94 and 1994–95, respectively.) Government decision-makers were apparently more impressed with the short-term need for revenue (for example, from import duties on energy-saving equipment) than with medium-term opportunities to reduce foreign debt (for example, by eliminating duties on energy-saving equipment that would lower petroleum imports and reduce foreign debt two or three years hence). High interest rates also retarded private sector investment in energy conservation. And the public sector, without a profit motive, lacked motivation to maintain existing investments in energy conservation (see box 1).

Finally, in contrast to many European as well as developing countries, Jamaica does not use petroleum products as a major source of tax revenue, although this approach is convenient and relatively progressive. Prices for oil products in

Hospital Neglects Solar Collectors

A government-funded energy audit of a government hospital recommended, among other things, solar collectors for heating water. The government installed the collectors. But when they began to leak or required maintenance, the hospital expected the government to repair them. When it failed to do so, the collectors were abandoned. Although the hospital was the beneficiary, it had little commitment to energy conservation and was only marginally involved with the project.

Lesson: When beneficiaries do not buy in and become true stakeholders, benefits are often not sustained.

Jamaica therefore are low by international standards, making overall incentives for conservation low.

Institution Building

Institutional development was, for the most part, unsuccessful. The project mainly targeted public sector institutions. It established an Energy Division and an Energy Information Center in the Ministry of Mining and Energy. It carried out energy analyses, instituted energy planning, developed a national energy model, established an energy accounting system, and prepared national energy standards.

It also trained government personnel from the ministry, Jamaica Petroleum Corporation, Jamaica Public Service, the Bureau of Standards, and the Ministry of Public Utilities and Transportation. By 1985, 50 people had received training in the United States (8 long-term); 87 had received in-country training (26 long-term); and 15 local energy auditors had been trained and certified. Another 12 were scheduled for postgraduate education in the United States in energy economics, energy conservation, and alternative energy.

However, the Energy Division never became a strong player in government policy development. It was unable to motivate the public sector or encourage sustainable private sector interest in energy conservation. Part of the problem was low government salaries and high staff turnover. Probably more serious was a lack of strong government support for energy reform. At the time of this evaluation the remnants of the Energy Division were housed in the Ministry of Public Utilities and Transportation. The ministry plays a modest information role when called upon, but is not a leader in energy policy or programming. The ministry has limited staff and resources. However, some of its former personnel, including some trained under the project, now work for parastatal or semiautonomous agencies, such as the Jamaica Petroleum Corporation and Jamaica Public Service, as well as private companies where they have made good use of their energy training and experience.

The government has generally assigned low priority to energy conservation. For example, energy efficiency standards for buildings, first developed during the project period, became the basis for current mandatory standards for public buildings. Although these building and construction codes undoubtedly influenced private sector construction, it took more than 10 years, until 1995, before the commercial and institutional building code was revised. It has yet to be published and implemented.

Private energy audit companies were designed to institutionalize an energy conservation capability in the private sector and to promote pri-

vate sector investment in energy conservation equipment. In fact, private energy auditors and retrofit contractors, once in place, were expected, through their own sales initiatives, to accomplish more in spin-offs than the project could ever hope to fund. Unfortunately, by 1995 few firms were conducting energy audits. Most firms participating in the project had shifted to other lines of business shortly after the project ended. The project had already funded energy audits for virtually all government facilities, and there was little market demand from private businesses after 1986.

Only a small energy audit market existed after the project ended—for example, in the hotel and export-oriented industries. This is because of low electricity prices, low oil prices after 1986, high taxes and duties on imported conservation equipment, high interest rates for financing capital investment, and devaluation of the Jamaican dollar. Nonetheless, when the World Bank designed its Energy Sector Management Assistance Program, it found that one of the most enduring benefits of the USAID-sponsored energy conservation program was the development of a cadre of energy auditors and efficiency specialists. Perhaps under the right policy framework, they can go to work.

Education and Awareness

Public education and awareness were not sustained. Primary goals of the project were to establish a government Energy Information Center and to implement a public education program. The center was intended as both a technical resource and a vehicle to promote conservation awareness. During the project, it supported media advertisements, organized seminars, gave energy education programs in the schools, and disseminated handbooks and other materials. Many people interviewed from the hotel, government, power, and petroleum sectors highlighted the importance of motivating people to improve energy efficiency. However, though the ministry maintains a library and continues to hold meetings of an energy coordinators group begun during the project, these efforts are poorly funded and appear to have low priority.

Technology Transfer

The project transferred conventional technology, not sophisticated or advanced technology. Energy audits at public sector facilities emphasized ways to make existing equipment work more efficiently. This approach reflected both the difficulty of introducing high-cost, complex equipment and processes and the desire to achieve results in the near term.

For the private sector, the main strategy was to train engineers to perform energy audits and to create or strengthen local firms (retrofit contractors and solar water heater suppliers) that could respond to recommendations of the energy audits. Although a technical capability and capactiy still exists in Jamaica, the demand for energy conservation services has been weak, generally limited to those sectors that must compete on the world market.

3. RESULTS

Energy audits were seen as the key to conservation. The energy conservation component of the project supported development of a national energy conservation plan, promoted public education and awareness programs, and prepared an energy conservation manual. But its main thrust was energy audits. An energy audit is a technical analysis by an engineer of how a firm uses energy. It identifies ways to eliminate waste and increase efficiency.

Before the project could carry out energy audits, it had to train auditors, develop technical standards, and put in place an outreach and education program to encourage firms to undertake audits. Audits were first launched in the public sector. From that experience, the project provided a subsidized loan program to

finance audits and energy conservation investments in the private sector. Energy audits and energy conservation investments for the public sector were grant-funded by the project.

Of 62 planned audits, 57 were completed. Energy conservation investments were made at all selected government installations. But this was not the case with private firms. A $6 million credit fund had been established in 1983 to stimulate private sector investments in energy conservation technology. As an added incentive, below-market interest rates of approximately 20 percent were charged for funds, over a maximum five-year period. Still, only five loans had been approved by 1985, and from 1984 through 1986, only $2 million had been loaned out. Lack of interest by private companies in taking out loans prompted USAID to deobligate the remaining $4 million.

Several factors explain the lack of private sector demand: slow processing of loan applications, "high" duties on imported equipment, the depressed state of the economy, the dramatic fall in international oil prices, a business preference for investments that increase production over those that *might* reduce costs, and industry's unwillingness to incur additional debt carrying a variable interest rate.

Although participating firms did not implement all recommendations of the energy audits, energy savings were still significant—an estimated 13 percent saving in electricity usage in the audited firms and organizations. The payback for public sector hotels and factories was rapid—in less than one year the value of energy savings was more than enough to recover the cost of energy conservation investments. The first 29 completed retrofits generated an estimated saving of $1 million a year.

Much more energy might have been saved, however. In 1985, the bauxite–alumina industry used 33 percent of the country's oil; the transport sector accounted for 27 percent; and power generation another 24 percent. The project worked primarily with commercial firms, government facilities, hotels, and other entities, however, which used only about 10 percent of the country's oil in 1985. Had the project targeted the major oil-using sectors of the economy, oil imports might have been reduced much more.

Finally, the relatively good showing during the project did not continue. At the time of this evaluation, 10 years after completion, energy conservation in Jamaica was limited:

- The project trained a cadre of energy auditors and helped create some energy conservation firms. But few auditors are working today, and because of limited demand, only a few companies market energy conservation equipment.

- Companies (particularly in the public sector) that made conservation investments have little to show for them. Most of the equipment has been abandoned or is gone.

- The government speaks of the need to conserve energy, but policy and budget actions do not encourage such action. As a result, private companies and government agencies are reluctant to make investments to conserve energy.

4. IMPACT

Economic Impact

The main economic benefit of the project was reduced oil imports. Most participating entities received tangible benefits. They reduced their energy costs. As indicated above, energy retrofits, on average, reduced energy consumption by 13 percent, and the 26 firms and government operations that completed retrofits by 1985 were expected to reduce energy consumption by about 36,270 barrels of oil equivalent a year. In 1985 prices, this amounts to $1.02 million a year. In addition, energy conservation ac-

tions already under way in 1985 were expected to save another 40,000–60,000 barrels of oil equivalent per year.

Although total project costs funded by USAID were $9 million ($13 million, less the $4 million deobligation), the energy conservation component for both phases I and II was only $3.3 million. (The other $5.7 million funded the other project components, energy planning and management and development of alternative energy sources.)

Table 1 estimates the economic efficiency of the conservation component of the project by its net present value and economic rate of return. Only one benefit is included: the quantity of oil saved by the public and private sectors that can be attributed to the project. However, three scenarios are presented, one for each of three estimates of the quantity of oil saved: low estimate (36,270 barrels); medium estimate (76,270 barrels); and high estimate (96,270 barrels). No attempt is made to quantify the benefits of investing in public information and education campaigns, preparation of an energy conservation manual, or related activities.

All three scenarios assume a) the benefits (oil savings) continue for five years, b) benefits decrease over the five years at 20 percent per year, and c) benefits are replicated by other firms at a rate of 10 percent of the first year's benefits for each of the following four years.

Under these assumptions, the net present value ranges from –$1.2 million to $2.2 million, and the economic rate of return ranges from 2 percent to 34 percent. The best estimate lies somewhere between these extremes. Of course, any estimate depends on the underlying assumptions. Therefore, a series of sensitivity analyses was undertaken to determine how the rate of return varies when assumptions are modified.

For example, the economic rate of return decreases from 24 percent to 18 percent for the second scenario (76,270 barrels of oil saved) when the investment life is only three years rather than five. Conversely, the return increases from 24 percent to 26 percent when the investment life is seven years rather than five. Thus, the economic rate of return is quite sensitive to the life of the investment when it is reduced by two years, but not so sensitive when it is increased by two years. Similarly, the decay rate (the rate at which energy conservation benefits decrease over time) also affects the return. For example, when benefits decrease more slowly (10 percent a year rather than 20 percent a year), the economic rate of return under the second scenario increases from 24 percent to 30 percent.

It's instructive to consider one additional point: the impact of policy analysis. In the mid-1980s, the international price of oil dropped. Despite this, the Government of Jamaica decided to maintain relatively high prices for transport fuel (but not for other petroleum-based products). As a result, transport fuel use decreased, and

Table 1. Economic Return on Investments in Energy Conservation in Jamaica, Energy Sector Assistance Project

Barrels of Oil Saved	Value of Oil Saved ($000)	Net Present Value ($000)	Economic Rate of Return (%)
32,270	1,427	–1,239	2.1
76,270	3,000	1,066	24.4
96,270	3,789	2,219	33.5

energy was saved. This reduction in transport fuel use constitutes an additional benefit in energy saving beyond the saving in the industrial and commercial sectors. Assuming 10 percent of this saving in the transport sector can be attributed to policy studies carried out under the project, the economic rate of return more than doubles, from 24 percent to 54 percent.

The economic rate of return is not the only indicator of the economic impact of investments in energy conservation. Another potentially useful indicator is the energy/GDP ratio. This ratio reflects the energy intensity of an economy. It measures the amount of energy, in barrels of oil equivalent, used to produce $1,000 of product (GDP in constant dollars).

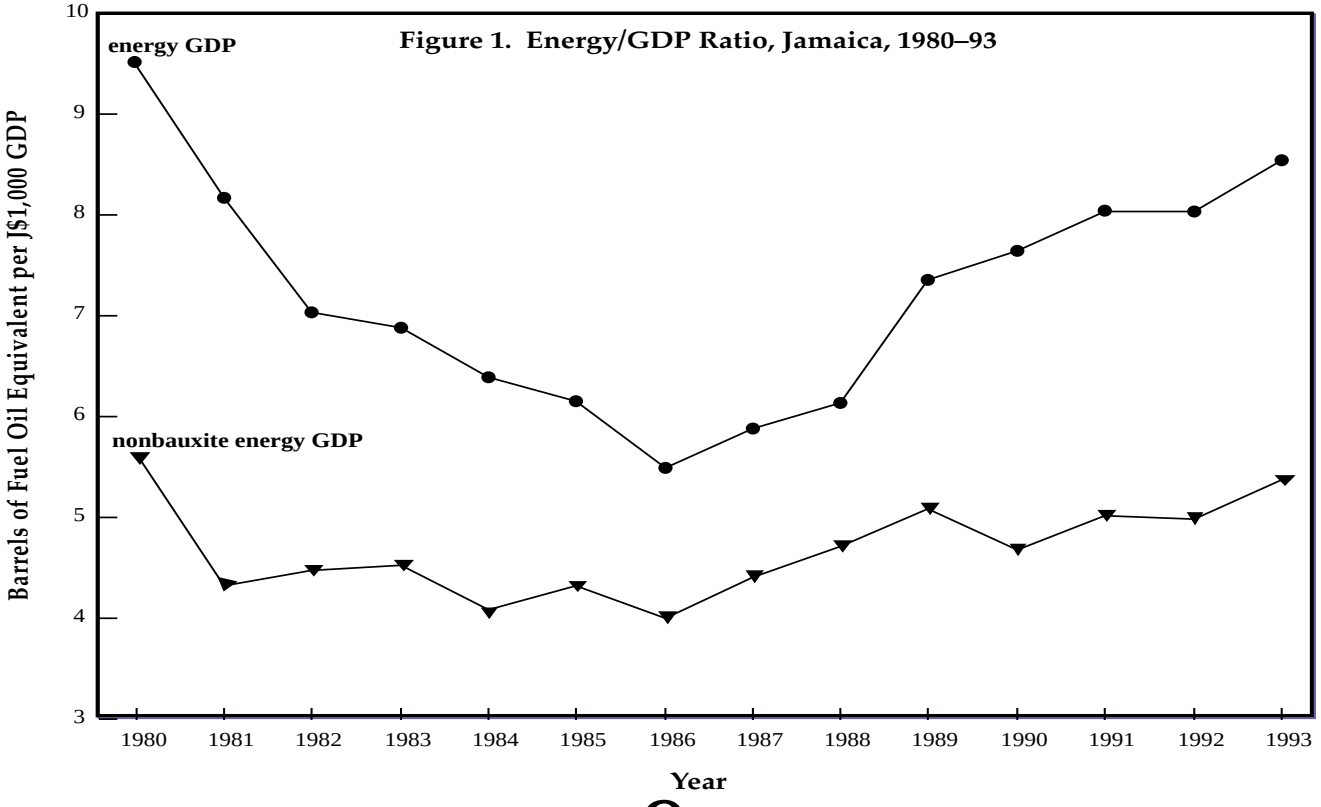
Figure 1 depicts the energy/GDP ratio for Jamaica from 1980 through 1993, both for the economy as a whole and for the nonbauxite sectors of the economy. The ratio fell for the nonbauxite sectors from 5.6 barrels per J$1,000 of GDP in 1980 to 4.0 barrels per J$1,000 in 1986—a drop of 29 percent. For the overall economy, energy intensity dropped by 34 percent during the same period. This was a period when international oil prices rose to $32 per barrel, declining to $28 per barrel in 1986. It was also the period when the project was implemented.

Although investing in energy conservation tends to reduce the energy/GDP ratio, and although the ratio decreased from 1981 through 1986, other factors can cause the same result. For example, rehabilitation of power plants in Jamaica in the early 1980s increased energy efficiency, which tended to decrease the energy/GDP ratio. This makes it difficult to attribute changes in the ratio to one factor or another.

Environmental Impact

The project was not designed to address environmental issues. This is not surprising, given the severity of the oil crisis in the early 1980s. Nevertheless, the project did have real environmental benefits directly related to the reduction of fossil fuel–based electrical generation. Investments in energy conservation reduced oil consumption by about 36,270 barrels by 1985, and additional savings of 40,000 to 60,000 barrels of oil equivalent per year were expected after 1985.

Figure 1. Energy/GDP Ratio, Jamaica, 1980–93



Environmental benefits from these energy savings included a reduction in greenhouse gases, principally CO_2, as well as in SO_2, NO_x, and particulates, which are harmful to human health. These environmental benefits are quantified in table 2 as reduced air emissions. The estimates are based on the following assumptions: a) 1.19 kilograms of CO_2 are emitted per kilowatt-hour of energy generated—that is, more than half a ton of CO_2 is emitted from each ton of oil burned; b) the oil Jamaica imports contains an average of 3 percent sulfur; with no sulfur control technology in place, all of it is emitted as SO_2 when the oil is burned; c) 3 pounds of NO_x are emitted per barrel of oil used to generate electricity; and d) about three fourths of a pound of particulate matter is released for each barrel of oil burned to generate electricity.

Effectiveness: Who Benefited?

Program effectiveness answers the question: who received the benefits and were they the right people (those who could generate the greatest energy savings)? A related issue is cost-effectiveness. If two groups receive similar energy-saving benefits, but it costs less to reach one, greater cost-effectiveness lies with that group.

The overwhelming majority of audits and program funding benefited the public sector. Most public sector beneficiaries were government-owned hotels and manufacturing firms. Government ministries, banks, and hospitals also benefited. Government beneficiaries did not have to pay for their audits or their investments. That may explain why there was little difficulty

Table 2. Estimated Reductions in Air Emissions in Jamaica, Energy Sector Assistance Project (Kilogram)

Pollutant	Barrels of Oil Saved Per Year 32,270	76,270	96,270
Carbon dioxide (CO_2)	20,584,300	43,274,000	54,636,000
Sulfur dioxode (SO_2)	446,850	939,400	1,186,050
Nitrogen oxides (NO_x)	49,300	103,700	130,900
Particulate matter	12,330	25,900	32,700
Total Reductions	**21,092,780**	**44,343,000**	**55,985,650**

5. PROGRAM PERFORMANCE

The team assessed the extent to which the energy conservation component of the USAID project was effective, efficient, and sustainable and replicable.

getting audits and investments completed. However, in many cases the investments were poorly maintained and managed.

In contrast, private firms had to pay for energy audits. They were then given access to project loan funds at terms more favorable than on the local commercial market. Owing to the extremely depressed economic environment,

however, most firms were reluctant to undertake any investments, even energy-saving investments.

Although market conditions were bleak, some private companies did pay for audits and make energy-saving investments. These were firms that were selling products whose prices and demand were favorable. Judging from data records and visits to private plants that were beneficiaries, firms appeared to follow commercial market discipline—that is, they invested only in energy conservation recommendations that promised a high rate of return. Thus, the program was highly effective in reaching a limited number of private firms that made sound energy-saving investments.

USAID did not target the largest companies in the most energy intensive industries. Energy consumers include a range of industrial, commercial, and service-oriented companies along with households and the agriculture and transportation sectors. In Jamaica, a dozen firms in a few industries—electric power, bauxite–alumina, cement, plastics, and glass—consume more than 75 percent of Jamaica's energy. The project did target smaller energy-intensive firms but did not target the bauxite–alumina industry (which consumes half of Jamaica's energy). It also excluded the electrical power company (Jamaica Public Service). If the power company had reduced its generation, transmission, and distribution losses by even a few percentage points, the energy saving would have been large. Had USAID wanted to cut energy consumption dramatically for the country, targeting the dozen biggest energy users probably would have been more effective.

Instead, the project mainly helped government agenices and a few private sector firms. This approach can be effective, but only if the demonstration package—energy conservation programs in some 60 hotels, manufacturing firms, and offices—is so attractive it is quickly adopted throughout the country. In Jamaica in the 1980s, that did not happen.

On the positive side, the project *was* effective in developing a cadre of trained energy auditors, supporting private sector energy conservation firms, creating an education and awareness program, and analyzing and encouraging development of improved energy policies. These efforts benefited both the public and private sectors and generated reduced energy consumption, but the cost per unit of energy saved was greater in the public sector than in the private sector. Private sector investments also yielded benefits for a longer time, thereby making them more cost-effective.

Efficiency

For a program to be efficient program efficiency looks at project benefits compared with costs. It answers the question: how much bang for the buck? For a program to be efficient, benefits must at least equal the return that could be earned on alternative investments elsewhere in the economy.

Estimates of the economic rate of return ranged from 2 to 34 percent. But depending on important assumptions, the range could be even wider. The first step in calculating an economic rate of return is to specify the initial investment. In this project, USAID funding was $9 million ($13 million, less the deobligation of $4 million). The Government of Jamaica pledged $19 million equivalent. Thus, the total project investment was $28 million. However, since the Jamaican local currency contribution does not constitute a net additional resource to the economy, only USAID's $9 million is included when calculating the economic rate of return. Of these USAID costs, only $3.3 million funded the energy conservation component, including a portion of project overhead and institutional development costs.

The next step is to estimate project benefits—the amount of energy saved. A 1985 project evaluation identified *potential* energy savings of $4.6 million from 54 completed audits. How-

ever, commercial firms generally implemented only some of the recommendations—those with the quickest payback (within one or two years) and highest rate of return. Public sector operations had a longer time horizon and were willing to implement recommendations with a longer payback period, but they often did not achieve projected savings because of poor maintenance and inadequate management.

Economic rates of return, of course, are based on assumptions. For example, if only half the audit recommendations were implemented and if many of the conservation measures generated benefits for only two to four years, then project benefits would total $2–$3 million, less than project costs of $3.3 million. Under these assumptions, the project would have a negative rate of return. However, the project would have a positive economic rate of return assuming that benefits were greater than $2–$3 million, or the benefit stream continued for five to seven years rather than two to four years. (see table 1).

Sustainability and Replicability

There was only scattered evidence of sustained and expanded energy conservation activities after the USAID project. There is an undercurrent of concern for energy conservation that can be detected among the few energy specialists in government agencies, private firms, and nongovernmental organizations that continue to struggle to get energy issues on the public agenda. These people are easy to locate and are aware of each other's existence. At the same time, there has been no sea change of activity in official or private circles or among the public at large aimed at improving energy use. One observer argued the government should lead by example: it should use energy efficiently at its own enterprises and agencies. But it does not. Moreover, there is no incentive or regulatory framework to encourage efficient energy use.

Still, there is modest institutional sustainability in government agencies concerned about energy management and the environment. Government agencies are preparing emissions and air-quality standards to be used first for monitoring CO_2, NO_x, SO_2, and particulate concentrations and then in regulatory and enforcement programs. Promulgation of these standards appears to be a few years away; it is not a priority among the government's environmental concerns. Use of standards and regulations to drive energy conservation remains negligible.

More tangible is the continued operation of an energy information service in the Ministry of Public Utilities and Transportation, which the project originally helped establish in the Ministry of Mining and Energy. This service distributes publications and brochures produced by the project and stores posters, videocassette players, slide projectors, and other material for energy conservation awareness campaigns. The project introduced a dual salary structure to attract good people, but that was not sustainable after USAID support ended. The staff has fallen from 14 to 3—a director, librarian, and assistant. They report light demand for their services.

Energy conservation appears to have made some inroads into Jamaica's education system. It is on the curriculum of a private Jamaican hotel school, and the University of the West Indies offers special energy conservation programs. Government agencies and private, professional associations regularly call on Jamaican energy consultants, trained as auditors under the project, to conduct training courses on energy conservation.

A more visible private sector capacity exists among engineers in environmental consulting firms that continue to do energy audits in Jamaica, though irregularly. What keeps these firms in business is not energy audits but environmental impact assessments for development projects in Jamaica and elsewhere in the Caribbean. These are financed in many cases by the World Bank, the Inter-American Development Bank, and other international donors.

In fact, all of the engineering firms contacted indicated that they do energy audits and related energy-engineering business in other Caribbean countries, a sign that this line of work is promising, although the demand is not strong enough in Jamaica alone. What Jamaica is missing, they argue, is a framework of regulatory policies and price incentives that would push energy users—factories, offices, or residences—toward more responsible energy management. Several point to the experience in nearby Barbados, where rebates and other incentives for energy conservation have led to the installation of solar heaters on the roofs of nearly "every other residence and office building in the country."

6. LESSONS LEARNED

- **Absent an energy crisis, only private firms that are relatively energy intensive will make major investments in energy conservation.**

  The Energy Sector Assistance project was implemented in 1981–1985, shortly after the second oil price shock in 1979. It was designed in response to a doubling of international oil prices and the subsequent pressure on foreign exchange earnings. Fifteen years later, in 1995, petroleum prices are relatively low. The economic pressure to conserve energy has been reduced, especially in industries where energy costs are a relatively small portion of operating costs. For example, in July 1995, Jamaican gasoline was selling for $1.25 a gallon, firms were paying $0.11 a kilowatt-hour for electricity, and fuel oil cost $0.96 a gallon. These prices are comparable to U.S. prices. With prices adjusted for inflation, Jamaican energy prices are lower than they have been during most of the last 20 years, and there is little incentive to adopt energy-saving techniques.

- **Successful energy conservation programs require supportive economic policies and appropriate environmental regulations.**

  This kind of policy and regulatory environment was not in place in Jamaica from 1981 through 1985. (Nor is it fully in place now.) Electricity prices were subsidized. Petroleum prices reflected international prices, on average, but certain fuels were subsidized or taxed, thereby distorting economic incentives. Tariffs and duties were levied on imported equipment, including equipment needed to conserve energy. High interest rates reduced incentives to invest in energy conservation equipment. Finally, there were no environmental regulations requiring industries to reduce air pollution caused by fossil fuel combustion. When national energy policy and associated environmental regulations are not conducive to energy conservation, the effectiveness of donor programs is severely hampered.

- **A relatively short payback period, a firm's long-term financial viability, and a positive investment climate are critical to making major investments in energy conservation.**

  There is a general reluctance to invest in an unpredictable economic climate. In the case of a government-owned distillery, for example, the government was considering privatization. Management, therefore, had made no new investments in several years, and most maintenance had been curtailed. Under these circumstances, an enterprise is reluctant to make any investment, even one that has a high economic rate of return. At the same time, a privately owned hotel had made major investments in energy conservation. Not only was the hotel's long-term profitability favorable, it also had adequate internal funds, obviating the need for long-term financing at high interest rates.

- **Energy conservation programs are likely to perform better in a competitive economic environment in which the business culture rewards firms that reduce production costs.**

In the early 1980s, private sector entrepreneurial activity was not encouraged in Jamaica. State-owned enterprises, parastatals, and public service operations were not geared toward profit maximization. Even many private Jamaican firms operated in a highly protected market—they did not have to compete with other firms. As a result, they could increase their revenues by raising prices rather than by reducing costs. When firms do not have to reduce costs to stay in business or make a profit, energy conservation is severely compromised.

- **Beneficiary commitment is critical to a sense of ownership and program sustainability.**

  In Jamaica, the government provided free energy conservation measures to publicly owned enterprises. When the equipment wore out or needed maintenance, the user assumed the government was responsible for repair. When the government did not repair the equipment, it was abandoned. This occurred with surprising regularity at many government buildings. When the intended beneficiaries do not buy in and become true stakeholders, project benefits are often not sustained.

- **Government is most effective when its role in energy conservation is limited to establishing an appropriate policy framework and providing education and information.** Establishing sound energy policies and regulations and promoting public information and awareness about energy efficiency are legitimate public sector roles. The government can also lead by example, by building and operating energy-efficient public buildings. In the 1980s the Jamaican government created unfulfilled expectations in the private sector when it funded energy audits and paid for implementing many of the audit recommendations in the public sector. Private firms thought the government would do the job of energy conservation, and all they had to do was wait their turn.

- **The environmental benefits of energy conservation are realized in two ways: when less fossil fuels are used to generate energy or when the same amount generates more energy.**

  When energy is generated from the combustion of fossil fuels, greenhouse gases (such as carbon dioxide) and other pollutants are emitted. In Jamaica, approximately 1.19 kilograms of carbon dioxide are emitted for each kilowatt-hour of electricity generated. Cutting the amount of fossil fuel burned can reduce these emissions. Energy conservation programs that either reduce demand for energy or increase the efficiency of energy consumption (generating more energy per unit of fuel burned) can achieve this goal.

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