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AUDIT OF
AID RENEWABLE ENERGY PROJECTS

Audit Report No. 9-000-86-3

February 21, 1986

AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D.C. 20523

Office of the
Assistant Inspector General
for Audit

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MEM RANDUM FOR SAA/S&T, Nyle C. Brady .
FROM: AIG/A,  James B. Durnil
SUBJECT: Audit of AID Renewable Energy Projects

This report presents the results of our audit of selected aspects of AID's Renewable Energy Program. Our objective was to determine whether certain types of renewable energy projects were designed and implemented in accordance with Section 106 of the Foreign Assistance Act.

Section 106 is very specific as to how renewable energy projects should be designed and implemented. AID, however, undertook projects which did not always adhere to this legislative mandate in that they were (i) not integral parts of agriculture and rural development efforts, (ii) not developed and implemented in a timely manner, (iii) complex and expensive to build, use and maintain, (iv) not suited to intended users, and (v) lacking in replication planning and potential.

AID's on-going reassessment of the renewable energy program is also identifying many of the problems outlined in this report. Our three recommendations should assist you as this effort is finalized.

Written comments provided by your office to the draft report were carefully considered. Changes were made to the report where appropriate. Comments addressing report content, conclusions and recommendations are attached as Appendix IV to the report.

Please advise me within 30 days of action taken or planned to clear the recommendations. Thank you for the courtesies extended to my staff during the audit.

EXECUTIVE SUMMARY

Due to the worldwide energy crisis, the Congress, in 1977, amended the Foreign Assistance Act to fund the AID energy program. Part of this legislation authorized renewable energy projects to be undertaken in *rural areas and in conjunction with agriculture and rural development programs*. Since 1978, AID has obligated \$170 million to develop, test and demonstrate technologies in such areas as solar, wind, biogas and small-scale hydroelectric generation.

The objective of the audit was to evaluate AID's management of its renewable energy projects involving "hard technology." Specifically, the audit sought to determine whether projects were designed and implemented in a manner to best achieve the legislative mandate set forth under Section 106 of the Foreign Assistance Act.

Indirect and intangible benefits have occurred and lessons have been learned and were being applied by the Agency to improve program management. The audit did, however, show that with the exception of the Bureau for Africa, AID generally undertook projects which were outside of the legislative mandates' five key aspects.

First, AID's renewable energy projects were seldom integral parts of agriculture and rural development efforts. All project papers and 21 Country Development Strategy Statements related to the 24 renewable energy projects were analyzed in the review. This analysis showed that 58 percent of the projects and 81 percent of the missions' energy programs were not integral parts of the missions' agriculture and rural development activities. For example, 26 irrigation pumping stations established under a \$19 million project in Egypt were not working due in part to a lack of electrical power at the pumping sites. At the same time, the Egypt Mission sponsored a separate \$22 million renewable energy project involving a water pumping demonstration without establishing a linkage to the irrigation project.

Second, although authorizing legislation was passed in 1977, renewable energy technologies were not sufficiently operational at the time of the review to have a measurable impact. Replication had not occurred to any significant extent. This was due, in part, to an overemphasis on research and development projects. Of the 24 projects at least 11, or 46 percent were oriented

toward research and development as opposed to applications. Few, if any, missions had the technical expertise to properly manage and monitor their multi-million dollar research and development projects.

Third, with the exception of the Bureau for Africa, AID's renewable energy projects were not simple and inexpensive to build, use and maintain. At least 12, or 50 percent, of the 24 renewable energy projects reviewed involved complex and expensive renewable energy technologies. The projects were too complex for effective implementation, required large capital investments, and had high operating costs e.g., (i) a \$28,000 rice hull fed thermal power plant in the Philippines, (ii) a \$500,000 solar dryer in the Dominican Republic, and (iii) a \$467,000 small-scale hydroelectric plant in India. In addition, a \$713,000 subproject in India installed a complex and expensive solar powered electrical system in a remote rural village. The system provided an integrated set of services including street lighting, water pumping and a community television set for entertainment. According to an evaluation report on this project, "A more inappropriate technology for a remote site occupied by uneducated villagers is hard to imagine."

Fourth, most of the renewable energy projects covered by the audit were not designed and implemented with a focus on the rural poor. Sixteen, or 67 percent, of the 24 projects reviewed involved technologies that were not suited to the needs of the intended users. A \$528,000 subproject in the Philippines built a single 315 kilowatt electric plant to power a government owned rice mill using rice hulls as an energy source.

Fifth, AID's renewable energy projects were not designed and implemented with a focus on replication. Twenty-one, or 88 percent, of the 24 project papers reviewed lacked replication planning. Further, 22 or 73 percent of the 30 evaluation and Inspector General reports reviewed identified problems which severely limited replication potential of the technologies. Specifically, the projects were too complex, too expensive or not suited to the needs of users. As a result, it is highly unlikely they will ever be commercially viable, thus reducing the likelihood of replication.

This situation occurred because of inadequate (i) energy, agriculture and rural development policy guidance, (ii) policy implementation oversight and (iii)

coordination and information exchange between the Office of Energy, geographic bureaus and missions. By correcting these problems, an estimated \$28 million in future annual renewable energy expenditures could be used more efficiently and effectively in meeting the overall legislative objectives and satisfying the energy needs of the rural poor.

The AID Administrator initiated a reassessment of the renewable energy program which had identified many of the problems outlined in this report. Further, some planned corrective actions are scattered throughout various documents such as individual project papers and country development strategy statements. However, to ensure a successful and needed AID-wide redirection of the renewable energy program, the Senior Assistant Administrator, Bureau for Science and Technology should (i) initiate action to amend appropriate segments of the energy, agriculture and rural development policy papers in line with Section 106 of the Foreign Assistance Act; (ii) initiate actions to establish the Office of Energy as the AID-wide office for monitoring implementation of energy policy; and (iii) assign to the Office of Energy responsibilities for coordinating the exchange of information on project results among geographic bureaus and missions.

Management generally disagreed with report finding and conclusions and stated that the recommendations were already being addressed by the Agency. They conceded that early renewable energy projects were not integrated into agriculture and rural development efforts. However, management said that early project results were used to design subsequent projects to more closely meet real agriculture and rural development needs. As a result, the Inspector General report simply restated conditions known to management.

This report does acknowledge that, in contrast to the technology driven approach used by the Agency for the past 8 years, recent efforts have been made to develop a needs-driven approach to renewable energy. According to this approach end user needs and economic and social sustainability will be primary considerations in future project design and implementation. This approach also provides for renewable energy efforts to be integrated into agriculture and rural development projects.

Accountability, however, for implementing this new approach has not been established. Audit report recommendations will create such accountability by (i)

modifying relevant Agency policy to reflect the new approach, (ii) ensuring that revised policies are implemented, and (iii) providing for the exchange of information concerning projects designed and implemented under this new approach.

Management comments are summarized and followed by Office of Inspector General comments beginning on page 22. Where appropriate, changes were made to the report based upon comments provided. A copy of management comments relevant to report content, conclusions and recommendations is included as Appendix IV to the report.

Office of the Inspector General

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PART I - INTRODUCTION

A. Background

Faced with a worldwide energy crisis, the Congress, in 1977, amended the Foreign Assistance Act to provide funds for the AID energy program. Part of this legislation specifically authorized renewable energy projects to be undertaken in rural areas in conjunction with agriculture and rural development programs.

Since 1978, AID has obligated \$304 million for 86 renewable energy projects. Our review was limited to fifty-six percent of these funds, or \$170 million, which supported efforts to develop, test and demonstrate hard technologies in such areas as solar, wind, biogas and small-scale hydroelectric generation; demonstrate more efficient methods for using wood, charcoal and coal; and increase fuelwood production. The remainder of the funds, not reviewed, supported institution building, participant training and energy needs assessments.

The Bureau for Science and Technology's Office of Energy manages centrally funded energy projects and provides to the bureaus technical support in energy matters. Further, each geographic bureau has an energy component whose responsibilities include project proposal review and technical assistance to the missions. The AID energy program, however, is highly decentralized with the majority of the funds spent at the mission level. Only 12 percent of funds for renewable energy projects were obligated by the central bureaus. Mission and regional projects accounted for the remaining 88 percent of total obligations.

In November 1984, the AID Administrator initiated a reassessment of the Agency's activities in renewable energy. The objectives of this effort were:

- to assess applications of renewable energy with an emphasis on productive uses in agriculture and rural industry,
- to recommend development and application of those renewable systems which, when compared with alternatives, are the least-cost site-specific solutions to supply energy needs and

-- to suggest means of developing local private sector capability to market and manufacture promising renewable energy systems and to involve the private sector at an early stage in AID projects.

This reassessment resulted in some improvement in program management. Other improvements were being considered by Agency management during the course of our review.

B. Audit Objectives and Scope

The objective of this audit was to evaluate AID's management of its renewable energy projects to determine whether these projects were designed and implemented to achieve their legislative mandate. To accomplish this, a total of 26 Agency sponsored project evaluation reports and 4 Inspector General audit reports on 24 renewable energy projects were reviewed (see Appendix 3). These 24 projects, with total project funding of \$101 million, obligated \$92 million for technology research and development. This \$92 million represented 54 percent of the \$170 million obligated for testing and demonstrating technologies since 1978.

All project papers and Country Development Strategy Statements (CDSSs) related to these 24 projects were also reviewed. Information and problems identified in the reports, project papers and CDSSs were categorized in accordance with specific project design and implementation criteria contained in Section 106 of the Foreign Assistance Act. Appendices 1 and 2 summarize problems identified by these reviews.

In addition, audit work was conducted at Office of Energy Bureau for Science and Technology (S&T/EY) and seven renewable energy projects in India, the Philippines, Egypt and the Dominican Republic were reviewed. The seven projects represented \$32 million in renewable energy obligations and contained 55 subprojects. This work, done between April and October 1985, included interviews with energy program officials, reviews of energy project files and visits to project sites. The purpose of the work was to determine whether problems identified in the project evaluation and Inspector General audit reports, project papers, and CDSSs continued to exist.

Assessment of internal controls only considered those controls for assuring central oversight of the program and did not consider management controls at the geographic bureau and mission levels. The audit was conducted in accordance with generally accepted Government auditing standards.

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PART II - RESULTS OF AUDIT

AID renewable energy projects have not been designed and implemented in accordance with legislative requirements. AID's renewable energy projects were not always integral parts of agriculture and rural development efforts. Except for the Bureau for Africa, energy projects were not simple and inexpensive to build, use and maintain. Also, many renewable energy projects did not focus on the rural poor or the potential for replication.

Our audit did show that indirect and intangible benefits have occurred. Also, lessons learned from past project experience were being used by Agency management to improve program management.

To ensure that AID's future renewable energy projects are designed to meet requirements of Section 106 of the Foreign Assistance Act, we are recommending that the Senior Assistant Administrator for the Bureau of Science and Technology revise current policy guidance on energy, agriculture and rural development. Existing policy guidance should require that energy projects (i) be integral parts of agriculture and rural development efforts, (ii) be developed and implemented in a timely manner, (iii) be simple and inexpensive to build, use and maintain, (iv) be suited to intended users, and (v) possess replication potential. Also, responsibility for policy implementation oversight should be identified and coordination and information exchange should be established between the Office of Energy, geographic bureaus and missions.

A. Finding and Recommendations

Renewable Energy Projects Did Not Meet Legislative Requirements

Section 106 of the Foreign Assistance Act is very specific as to how renewable energy projects should be designed and implemented. In the past AID has not adequately considered this legislative mandate, and undertook projects which were (i) not integral parts of agriculture and rural development efforts, (ii) not developed and implemented in a timely manner, (iii) complex and expensive to build, use and maintain, (iv)

not suited to intended users, and (v) lacking in replication planning. This occurred because of inadequate (i) energy, agriculture and rural development policy guidance, (ii) policy implementation oversight and (iii) coordination and information exchange between the Office of Energy, geographic bureaus and missions. By correcting these problems, an estimated \$28 million in future annual renewable energy expenditures could be used more efficiently and effectively in meeting the overall legislative objectives and satisfying the energy needs of the rural poor.

R commendation No. 1:

We recommend that the Senior Assistant Administrator, Bureau for Science and Technology coordinate with the Bureau for Program and Policy Coordination to revise the AID Energy Policy Paper to reflect a "needs-driven" approach to renewable energy efforts in conformance with Section 106 of the Foreign Assistance Act. Specifically,

- a. establish as an Agency-wide policy addressing the energy needs of the rural poor as the overall objective of the renewable energy effort,
- b. establish interim goals to measure and evaluate progress toward overall objectives,
- c. integrate renewable energy efforts into agriculture and rural development projects,
- d. require the application of existing technologies prior to researching and developing new technologies, and
- e. specify duties and responsibilities of the Office of Energy Bureau for Science and Technology, the Center for Development Information and Evaluation Bureau for Program and Policy Coordination, the geographic bureaus and Missions in meeting renewable energy objectives and goals.

In the interim, the Senior Assistant Administrator, Bureau for Science and Technology in cooperation with the Energy and Natural Resources Sector Council should ensure that all new projects involving renewable energy technologies conform to the needs-driven approach. Where feasible, current projects should be amended to meet actual and specific energy needs.

Recommendation No. 2:

We recommend that the Senior Assistant Administrator, Bureau for Science and Technology coordinate with the Bureau for Program and Policy Coordination to revise Agency policy papers on agriculture and rural development to require that renewable energy efforts under Section 106 of the Foreign Assistance Act be integrated into agriculture and rural development projects under Section 103 of the Act.

Recommendation No. 3:

We recommend that the Senior Assistant Administrator, Bureau for Science and Technology expand the duties and responsibilities of the Office of Energy to include:

- a. monitoring implementation of renewable energy policy through the review of Country Development Strategy Statements, project papers and evaluation reports as they relate to renewable energy efforts, and
- b. coordinating and exchanging information, in cooperation with the Bureau for Program and Policy Coordination's Center for Development Information and Evaluation, between geographic bureaus and among Missions concerning successful renewable energy activities including technology research and development, applications and performance, and cost effectiveness and social acceptability.

Discussion

Section 106 of the Foreign Assistance Act authorized renewable energy projects to help meet energy needs of the rural poor. The legislation specified how these projects should be designed and implemented. Renewable energy projects were to:

- be integral parts of agriculture and rural development efforts under Section 103 of the Foreign Assistance Act,
- develop and implement energy technologies as early as possible,
- require minimum capital investment and be simple and inexpensive to use and maintain,

- be acceptable by the people using them, and
- be transferable from one region of the world to another.

Further, AID issued, in June 1985, an overall development plan called the "Blueprint for Development - The Strategic Plan for the Agency for International Development." This plan was compatible with Section 106 in that it emphasized the use of simple, inexpensive, commercially marketable and transferable technologies to solve development problems of the rural poor. In emphasizing this position, the plan stated that, "We have found that too often, for the poor, there are no technological packages to extend, and that research has not been focused on their problems."

Non-Adherence To Legislative And AID Direction

Renewable energy projects were generally not designed and implemented in accordance with requirements of Section 106 of the Foreign Assistance Act or AID's overall development plan. In fact, twenty-two, or 92 percent, of the 24 projects reviewed did not comply with at least two of the five Section 106 requirements. Eighteen, or 75 percent did not comply with three or more of the requirements. Although some corrective action has been taken, audit work in India, the Philippines, Egypt, and the Dominican Republic showed that significant problems still exist. Appendices 1 and 2 summarize problems identified for all 24 projects.

Program Integration - All project papers and 21 Country Development Strategy Statements related to the 24 renewable energy projects were reviewed in the audit. This analysis showed that 58 percent of the projects did not integrate energy with agriculture and rural development activities. In addition, 81 percent of the CDSS's did not integrate the mission's energy and agriculture and rural development programs.

Further, a computerized list of agriculture and rural development projects initiated by AID since 1978 and funded under Section 103 of the Foreign Assistance Act was obtained from the Bureau for Program and Policy Coordination. This list revealed that only 33, or less than five percent, of the 703 projects contained a renewable energy component.

An S&T/EY Project Identification Document for the proposed Energy for Agriculture Project summarizes this lack of program integration:

"While energy use in agriculture has been examined fairly extensively in the U.S., AID has paid little attention to this issue in developing countries. Agriculture and energy activities have generally been treated almost as if the two were unrelated. Agriculturalists often ignore energy due to its being a relatively small cost component in projects, or they simply assume that increased outputs due to project intervention will automatically pay for recurrent energy expenditures. Energy planners, on the other hand, are concerned with effecting changes in large energy using sectors such as industry and transportation and thus rarely examine the agricultural sector."

Our on-site review of seven renewable energy projects in the Dominican Republic, India, the Philippines, and Egypt showed similar results. These projects, involving 55 subprojects and renewable energy funding of \$32 million, were designed and implemented independent of rural development projects sponsored by the missions.

In the Dominican Republic, for example, two renewable energy projects were aimed at meeting industrial energy needs rather than needs of the rural poor. A pilot project to test and demonstrate a solar powered dryer was intended to improve the efficiency of boiler operation and electricity generation in large sugar mills. Another project initiated an industrial energy conservation program and developed small-scale hydroelectric and wood as alternative energy sources primarily for industry.

In India, the Philippines and Egypt, renewable energy projects tested and demonstrated solar, wind and biomass technologies for power generation. The three missions also sponsored Section 103 funded irrigation pump projects using conventional power sources such as diesel engines and electricity. However, possible linkages between the renewable energy technologies and the missions' agriculture and rural development irrigation projects were not established.

For example, the objectives of an irrigation project and a renewable energy project in Egypt could possibly have been achieved more effectively and at less cost through integration. Twenty-six irrigation stations established under the \$19 million Irrigation Pumping Project were not working due, in part, to a lack of electrical power

at the pumping sites. At the same time, the Egypt Mission sponsored independent field tests of several renewable energy technologies, including a photovoltaic system for water pumping, under the \$32 million Energy Policy and Renewable Energy Field Testing Project. The mission, therefore, did not take advantage of an opportunity to directly demonstrate the application of renewable energy technologies to meet a specific rural development need. Further, project integration could possibly have avoided costly operational delays at the 26 pumping stations.

The S&T/EY Project Identification Document for the proposed Energy for Agriculture Project also indicated opportunities existed for merging energy and irrigation projects:

"The amount and productivity of arable land can be increased by irrigation and other inputs, but gravity irrigation has been largely exploited and energy is not always available to provide pumped irrigation. In India, shortages of diesel fuel and electricity limit the development of groundwater irrigation to roughly half that possible."

CDSSs for India, the Philippines, Egypt, and the Dominican Republic also showed that energy programs and agriculture and rural development programs were independent of each other.

S&T/EY and the missions' officials acknowledge that their past renewable energy programs were not integrally related to agriculture and rural development efforts and that such a linkage would be desirable. In fact, all four missions were in varying stages of eliminating energy as a separate program. For example, USAID/India's new CDSS merged the energy, agriculture, and rural development programs and USAID/Philippines has placed the energy technician, who previously reported directly to the Mission Director, under the office responsible for agriculture and rural development.

Timeliness of Project Implementation - Although authorizing legislation was passed in 1977, most renewable energy technologies were not sufficiently operational at the time of the review to have a measurable impact. This occurred due to an overemphasis of research and development type projects. Analysis of the 24 projects in the review showed that 11, or 46

percent, were heavily oriented toward research and development as opposed to an applications approach.

Although research and development was authorized by Section 106 of the Act, more emphasis on applications could have met another legislative objective of directing programs toward the earliest practicable development and use of energy technologies. For example:

- Government of the Philippines and contractor personnel said that the \$2.8 million S&T/EY Coal Water Mix Project was extremely risky since low grade coal found in the Philippines had never been used for this technology. As a result, the project, begun in April 1984, is at a standstill since the Government of the Philippines still believes the level of risk is too great to invest up to \$445 million in a major power plant conversion. The contractor is now working with private industry in an effort to identify small manufacturing plants that might be candidates for smaller coal water mix conversions.

- The Mission Director in India said that he did not have the technical expertise on his staff to properly manage and monitor his \$6.3 million research and development oriented renewable energy projects. For example, nine project subcomponents of one project researched and developed complex methods for producing energy from coal and biomass products like charcoal and wood. He stated it would be better to deliver proven approaches rather than attempting to develop new technologies.

- In the Dominican Republic, USAID personnel characterized a \$500,000 regionally funded project as research and development oriented and highly experimental. The purpose of the project was to research, test and demonstrate the use of solar energy to improve efficiency of a sugar production by-product as an industrial energy source. The Mission declined participation in a similar S&T/EY project to produce alcohol from sugarcane because of its experimental nature.

Bureau officials acknowledged that much of their renewable energy programs emphasized research and development. The only exception was the Bureau for Africa where the missions only spent an estimated 10 percent of their renewable energy funds in this area.

Even for these missions, however, the renewable energy programs did not have measurable impact since the remaining 90 percent of the funds were used for institution building and participant training.

S&T and Bureau for Asia and Near East officials said that they are shifting away from technology research and development to technology application. A Bureau for Latin America and the Caribbean official stated that the Bureau is deemphasizing energy programs. However, he acknowledged that the recently approved \$10.2 million Los Alamos project is heavily oriented toward research and development.

Complex and Expensive Projects - At least 12, or 50 percent, of the 24 renewable energy projects in the review involved complex and expensive renewable energy technologies. The projects were too complex for effective implementation, required large capital investments, or involved high operating costs. For example:

- A \$713,000 subproject in India installed a solar powered electrical system in a remote rural village. The system provided an integrated set of services including street lighting, water pumping and a community television set for entertainment. The water pumping system, a primary objective of the subproject, was not working because the water table was too low for the lifting capacity of the solar pump. According to an evaluation report on this project, "A more inappropriate technology for a remote site occupied by uneducated villagers is hard to imagine." The electrical system consisted of complex solar thermal collectors, a steam engine, associated controls, motors and pumps which - according to the evaluation report - would require trained engineers to repair and operate. The report made the following comment concerning the technology:

"Electricity has the potential for drastically altering the lives of the rural poor. It can give them light, entertainment, new appliances and new opportunity to earn income. But an electrical plant that is much more difficult to maintain and far more costly than a diesel generator set, and that requires three trained engineers in residence, is not the solution."

- A \$467,000 subproject in India to install a small-scale hydroelectric system in a remote rural village used a computer to distribute power between uses such as irrigation and household lighting. The computer system was so complicated that commercial software could not be used, therefore, specialized programs had to be developed. A project evaluation team expressed serious concern about the long-term durability and reliability of a microcomputer used 24 hours a day in such a remote and inaccessible location. The technical expertise to implement and maintain such systems were not available in these rural villages.
- An evaluation report of a \$500,000 project in the Dominican Republic, which tested and demonstrated a solar dryer for use by sugar mills, rated the technology as infeasible and lacking in economic viability. According to the report, the average sugar mill would require a dryer 50 times larger than the prototype. The report concluded that any cost savings realized from this technology would be offset by costs of labor and replacement parts for the system.
- A photovoltaic power system was installed in a grain mill in Upper Volta (now Burkina Faso) under a \$3.7 million S&T/EY funded project. An automatic control was initially installed to regulate the system and reduce power drainage on storage batteries. According to a project evaluation report, the control system was unnecessarily complicated and would not even have been required with proper education of users.
- An AID evaluation of energy projects funded by AID and other donors in seven African countries to generate gas from animal dung found the digester systems too expensive for intended small-scale uses such as cooking. According to the evaluation report, the systems were complex and capital-intensive.

Four projects in India, the Philippines, and the Dominican Republic involved excessive equipment costs. Eighteen, or 42 percent, of 43 components had equipment costs ranging from \$25,000 to \$615,121. Equipment costs for 12, or 28 percent, of these components exceeded \$100,000. The rural poor cannot afford such costs. For example:

- A rice hull fed thermal power plant in the Philippines cost \$528,000.
- A solar dryer in the Dominican Republic cost \$500,000.
- A small-scale hydroelectric system in India cost \$467,000.

S&T officials acknowledge that several projects involved expensive equipment. They explained that much of the energy program was implemented along the lines of the capital intensive philosophy rather than the "small is beautiful" approach. Although projects involving expensive equipment may have technical merit, they are not consistent with the legislative mandate.

Acceptability By the Rural Poor - Most of the renewable energy projects covered by the audit were not designed and implemented with a focus on the rural poor. Sixteen, or 67 percent, of the 24 projects reviewed involved technologies that were not suited to the needs of these users. Such projects required inputs unavailable in local areas, involved high operating costs, needed overly sophisticated repair capabilities, or were simply socially unacceptable. For example:

- An evaluation of the anaerobic digester component of a \$4.5 million project in Mali found the digester technology not suited to the needs of the poor. Daily inputs of water and dung required for continuous operation were scarce and daily filling and cleaning of the digester were time-consuming.
- An evaluation report of a \$3 million sub-project in the Philippines to test and demonstrate biomass gasifiers found the technology unacceptable to local villagers because of economic and technical problems and high operating costs. In addition, at the time of the evaluation only 2 of 103 gasifiers planned for one region of the Philippines were operational.
- A \$528,000 subproject in the Philippines built a single 315 kilowatt electric plant to power a government owned rice mill using rice hulls as an energy source. The government owned facility was selected although there were many small privately owned mills which could perhaps have benefited from a renewable energy source. A Government of the Philippines official and two local rice mill owners said that the size and cost of the power plant made

it ill suited to the needs of the small rice mill owner. According to a company representative, the power plant manufacturer produced a smaller and less expensive version which sold for about \$60,000. Although still expensive by Philippine standards, this plant would have been more suited to the needs of the small mill owner than the \$528,000 version that was tested. According to the Government of the Philippines official, other less costly alternatives, such as small steam engines, were not adequately considered.

The above examples raise serious doubts about the adequacy of need assessments for these projects. S&T/EY's Renewable Energy Reassessment Work Plan, issued at the direction of the AID Administrator in March 1985 to guide an agency-wide reassessment of renewable energy efforts, recognized this problem by noting that:

"We thus need to pay more attention to institutional issues, user acceptance, end uses, economics, and private sector involvement. In other words we have to adopt a 'need-driven' applications approach rather than one which is technology driven."

AID-wide adoption and implementation of this approach would materially improve the renewable energy program.

Transferability - AID's renewable energy projects were not designed and implemented with a focus on replication. Twenty-one, or 88 percent, of the 24 project papers lacked replication planning. Further, 22 or 73 percent of the 30 evaluation and Inspector General reports identified problems which limited replication potential of the technologies.

Most of AID's prior renewable energy projects will not be replicated because these projects did not meet one or more of the Section 106 project design criteria. As previous examples illustrate, the technologies were (1) too complex, (2) too expensive, or (3) not suited to the needs of users. As a consequence, the opportunities for their commercial viability are severely restricted.

Agency officials acknowledged that past renewable energy projects lacked focus on replication. They emphasized, however, that steps have been taken by S&T/EY, the geographic bureaus and missions to correct this problem as part of the renewable energy reassessment. They said that future efforts will focus on replicating renewable

technologies through commercially viable projects which apply renewable technologies to agriculture and rural development problems.

According to S&T/EY officials, an objective of the Renewable Energy Applications and Training Project is to identify proven energy technologies which are ready for widespread dissemination. By developing projects to commercialize these technologies, S&T/EY hopes to achieve dissemination by attracting financial commitments from business and other donors. In addition, the S&T/EY sponsored Energy for Agriculture Project will attempt to apply results of past energy research and development efforts to agricultural problems common to a number of AID countries and regions.

Regional evaluations of renewable energy technologies in Asia and Africa, prepared as part of the renewable energy reassessment, identified technologies ready for dissemination. They also specified the need for projects to meet the design criteria presented in Section 106 of the Foreign Assistance Act and discussed in this audit report.

The Bureau for Asia and Near East report, which included renewable technologies tested over a 10-year period in India, Nepal, the Philippines and Thailand, identified three technologies ready for immediate dissemination and four others that would be ready in the near-term. This is a needed and very positive step. It should be noted, however, that in the past AID has disseminated a vast number of technologies, of which only a few have achieved widespread replication.

The report also identified characteristics necessary for the successful dissemination of renewable technologies. These characteristics were very similar to the Section 106 criteria in that future project technologies should (i) be affordable to users, (ii) be technically suited to local resource availability, (iii) be suited to local repair and fabrication capabilities, and (iv) involve participation by local users in design and implementation. As noted in this report, most of the renewable energy projects undertaken by AID have not met these criteria.

The Bureau for Africa regional evaluation included renewable energy technologies tested in seven African countries. According to the evaluation report:

"The first generation of renewable energy systems installed in Africa were viewed mainly as experiments. The emphasis was on technical performance monitoring, technology adaptation and creating institutions to conduct renewable energy technology research and development."

To better ensure dissemination of renewable energy technologies, the report made recommendations for the design and implementation of future projects involving renewable energy. Many of these recommendations also closely paralleled project design criteria mandated by Section 106 of the Foreign Assistance Act. For example, according to the evaluation report projects should (i) incorporate energy systems in agriculture and rural development projects, (ii) track costs in relation to benefits, (iii) meet priority end-user needs, (iv) disseminate successful technologies as well as other project results, and (v) develop local production, maintenance and repair capabilities for equipment and systems.

Officials at missions in India and the Philippines said that renewable projects have emphasized technology research and development with little emphasis on replication. Mission Directors in both countries said that future renewable energy efforts will be carried out as integral parts of agriculture and rural development projects. They said renewable energy technology applications and commercial viability will be emphasized to help ensure that the projects continue after AID assistance stops and that technologies are replicated.

In addition to future projects, opportunities exist to amend planned and ongoing projects to conform to this modified approach. For example, at the time of the audit, USAID/India was planning a third renewable energy project along the lines of the two prior ones. According to preliminary plans the project was to be (i) research and development oriented, (ii) aimed at testing and demonstrating complex technologies, (iii) independent of agriculture and rural development projects, and (iv) lacking in commercial viability and replication potential.

The Agency's new focus on replicating renewable energy technologies through commercialization is a significant step in the right direction. However, this focus has not been formalized, there is no single office responsible for overseeing implementation, and current projects are not being reevaluated and amended.

Projects Did Not Meet Legislative Requirements For Several Reasons

Most AID renewable energy projects did not meet requirements of the Foreign Assistance Act because of four factors. First, the AID Energy Policy Paper did not provide adequate policy guidance and realistic program objectives for renewable energy efforts in conformance with Section 106 of the Act. Second, agriculture and rural development related policy papers did not incorporate renewable energy issues. Third, a central focal point responsible for implementing energy policy had not been established. The fourth factor was inadequate coordination and information exchange concerning renewable energy project design, implementation and results.

The Energy Policy Paper - The Energy Policy Paper did not conform to requirements of the Foreign Assistance Act. Project design and implementation criteria presented in Section 106 of the Act were not adequately considered.

According to Section 106, renewable energy projects should be integrated into agriculture and rural development efforts. However, the Policy Paper did not establish such integration. Although the Paper discussed in general terms the significance of energy to these areas, it did not specifically address the role of renewable technologies in meeting agriculture and rural development requirements.

Section 106 also directed that the benefits of renewable energy technologies be delivered to intended users as early as possible. However, the Policy Paper emphasized research and development of technologies with little emphasis on application, technology transferability and energy delivery. Other Section 106 criteria concerning technology affordability and complexity were not even addressed.

Further, program objectives established by the Energy Policy Paper were very broad and conflicted with the Foreign Assistance Act's Section 106 mandate that renewable energy efforts meet development needs of the rural poor. The objectives focused on national energy problems at the macro-level as opposed to delivering energy to the rural poor. The objectives emphasized (i) developing sound national energy policies, (ii) expanding energy production from indigenous sources, and (iii) improving energy efficiency. These objectives were so

general that almost any energy related activity could be justified.

The Paper provided no guidance as to the types of energy technologies to be pursued or the design, cost, size and scope of projects. According to the Director of the Energy Office, the Policy Paper and its objectives was a conglomeration of many views concerning energy policy and reflected the lack of consensus at the time the Paper was prepared.

The Energy Policy Paper also did not establish goals for meeting program objectives, nor did it assign responsibilities. The Paper described the program objectives as "long-term," however, no attempt was made to prioritize objectives or establish timeperiods for achieving them. Further, short-term goals for measuring and monitoring progress toward objectives were not set.

In addition, roles and responsibilities of the S&T/EY, the Center for Development Information and Evaluation Bureau for Program and Policy Coordination, the geographic bureaus and the missions in carrying out the objectives were not specified.

Agriculture and Rural Development Policy Papers - Energy is critical to agriculture and rural development. According to the United Nations Food and Agriculture Organization (FAO), each one percent growth in agriculture requires an additional commercial energy input of more than two percent. To achieve its goal of 3.7 percent growth in agricultural production, the FAO estimates that energy use in agricultural production must grow by over 7 percent annually. For example, irrigation pumping, which is critical to agricultural production in many countries, is energy intensive. Over 23 percent of all power generated in Pakistan was used to operate pumping systems. Along the Senegal River Valley in Senegal over 90 percent of power generation was used to operate irrigation pumps.

Although energy is vital to agriculture and rural development, AID policy papers for these program areas did not give consideration to energy requirements. Rural development related policy papers on water supply and sanitation and nutrition did not consider energy concerns at all.

The AID Food and Agricultural Development Policy Paper did mention energy but only as one of several research areas AID could pursue in developing more profitable

farming and marketing systems. It did not require that renewable energy considerations be incorporated as integral parts of agricultural projects as mandated by Section 106 of the Foreign Assistance Act.

Energy issues should be included in agriculture and rural development policy papers. This would encourage agriculture and rural development officers and engineers to pay more attention to energy constraints and potential solutions in the design and implementation of projects.

Central Focal Point - The third factor was the lack of a central focal point responsible for monitoring implementation of energy policy.

S&T/EY, could not effectively perform this function because of the decentralized nature of the energy program. According to its Director, S&T/EY did not consistently see mission CDSS's, project papers or project evaluation reports. In addition, S&T/EY managed only a small percentage of projects, with the vast majority designed, implemented and managed at the mission and geographic bureau levels. Specifically, S&T/EY managed only 11, or 13 percent, of AID's 86 renewable energy projects representing \$35 million, or 11 percent, of total funding. The balance of the projects were managed by the missions and geographic bureaus with little S&T/EY involvement.

Further, geographic bureaus did not provide a central focal point for the energy program. Generally, the bureaus were involved only in energy projects initiated within their geographic areas. They had no direct input into the design and management of projects in other regions. Even for mission sponsored projects within geographic areas, bureau input was usually limited to project paper reviews and technical assistance by bureau energy technicians when specifically requested by the missions.

Coordination and Information Exchange - The fourth factor which resulted in projects not meeting legislative requirements was the lack of coordination and information exchange among missions, geographic bureaus and the S&T/EY concerning project design, implementation and results. The project paper for the Renewable Energy Applications and Training Project, initiated by S&T/EY as part of the agency-wide renewable energy reassessment, described the situation as follows:

"The gathering and exchange of useful information among renewable energy technology personnel on successful program activities, economic technology applications, successful commercial ventures, experience gained and lessons learned, has been woefully inadequate. The result is that insufficient information exists on the performance, cost-effectiveness and social acceptability of renewable energy systems and technologies."

Officials at the S&T/EY and the geographic bureaus agreed that the level of coordination and information exchange within the Agency concerning energy projects could be improved. They readily conceded that in the past each geographic bureau has acted autonomously, setting its own policies and sharing little with the other bureaus. While coordination between the geographic bureaus and S&T/EY had improved in recent months, bureau coordination with the missions varied.

Officials at the missions visited in the audit agreed there was little coordination of energy projects between missions or exchange of information concerning results. For example, officials at USAID/Philippines were not distributing to other USAID missions information concerning the significant success the Philippine Government achieved in reducing dependence on imported oil. Oil imports were reduced by 34 percent between 1973 and 1984, from 92 percent of the country's total energy consumption to 58 percent. According to Philippine Government officials, a major factor in this reduction was the increased use of agricultural by-products as energy sources. Such information could be of benefit to USAID missions and host governments in countries with large sugarcane and other agricultural resources.

Another example of the lack of information exchange involved a planned energy research project in India. USAID/India officials were unaware of a project with similar objectives in the Philippines. According to the project officer, the objective of the USAID/India project was to research methods for more efficiently burning low grade coal by liquifying pulverized coal in a water suspension. The objective of the AID-funded project in the Philippines was to develop a coal-water suspension as an oil substitute in a retrofitted power plant. Although the applications may have been different, the technologies were very similar. Therefore, the project in India could have benefited from the Philippine project results.

Coordination is expected to improve. An objective of the Renewable Energy Applications and Training Project was to improve coordination and the exchange of information concerning renewable energy activities. According to the Project Paper, an information and dissemination component would publish and disseminate assessments of renewable energy technology applications, sponsor training programs and establish a computerized renewable energy data base.

Impact of Projects on Legislative Mandate

Twenty-four projects representing 28 percent of all renewable energy projects were reviewed during the audit. These 24 projects obligated \$92 million or 54 percent of total obligations for technology testing and demonstration. Audit of these projects showed that much of the funds spent to test and demonstrate renewable energy technologies have not been used effectively in meeting the program's legislative mandate.

In analyzing audit sample results, any project which did not comply with three or more of the five specific requirements in Section 106 of the Foreign Assistance Act was considered to be inconsistent with the basic legislative intent for the program. Eighteen of the 24 projects in the sample did not comply with at least three legislative requirements. The 18 projects contained obligations of \$55 million for testing and demonstrating technologies which represented 55 percent of the \$101 million in total project obligations for the 24 projects in the sample. Assuming that (i) the sample was representative of all projects and (ii) future funding levels will be consistent with the 1986 total program projection of \$50 million per year for renewable energy projects, an estimated 55 percent, or about \$28 million, in future annual renewable energy expenditures for testing and demonstrating technologies could be used more efficiently and effectively in meeting the overall legislative objectives and satisfying the energy needs of the rural poor.

Conclusion

AID's renewable energy program has not met its basic legislative mandate of addressing the energy needs of the rural poor. Specifically, future AID renewable energy projects must be designed and implemented to: (i) be integral parts of agriculture and rural development efforts; (ii) develop and implement renewable energy technologies as early as possible;

(iii) be simple and inexpensive; (iv) be acceptable to the intended users; and (v) be transferable from one region of the world to another. AID initiated a reassessment of the renewable energy program which had identified many of the problems outlined in this report. Further, some planned corrective actions are scattered throughout various documents such as individual project papers and country development strategy statements. However, a successful AID-wide redirection of the renewable energy program toward meeting the legislative mandate will depend on (i) adequate energy, agriculture and rural development policy guidance, (ii) policy implementation oversight, and (iii) coordination and information exchange between the Office of Energy, geographic bureaus and missions.

Management Comments

Although not integrated into actual agriculture and rural development projects, most renewable energy projects were aimed at testing and developing technologies for rural applications.

AID has used its early experience to modify renewable energy projects so they are more closely related to real agriculture and rural development needs. In addition, projects have been moving toward replication and commercialization of technologies.

The Inspector General report simply restates findings and recommendations which have been known for some time and which were used to reshape the renewable energy program prior to the audit.

Office of Inspector General Comments

AID has followed a technology demonstration approach to renewable energy since the program began in 1977. Under this approach technologies were researched, tested and developed with little consideration for application or intended end user needs. Resulting technologies generally proved unsuited or inappropriate for specific energy problems.

In November 1984, the AID Administrator directed that the Office of Energy take the lead in an Agency-wide reassessment of AID renewable energy efforts. He expressed concern that Agency projects had put too much emphasis on the engineering and technical aspects of renewables with little consideration for technology application, end user needs and economic sustainability.

In response to the Administrator's concerns, the Office of Energy issued the Renewable Energy Reassessment Work Plan in March 1985 to guide the Agency-wide reassessment. The plan called for a new needs-driven approach to renewable energy. This new approach would emphasize end user applications, economic sustainability and private sector involvement in renewable energy efforts.

To implement the work plan, the Office of Energy is initiating two centrally funded projects. The Renewable Energy Applications and Training Project initiated in August 1985, will: (i) assess priority renewable energy applications, (ii) seek to implement economically and socially viable renewable energy systems, and (iii) encourage development of private sector capabilities to manufacture, market and maintain such systems. The project paper for the second project, Energy for Agriculture, had not been finalized at the time of the Inspector General audit. However, according to a draft, this project will identify appropriate renewable energy applications in agriculture and rural development. The project will initially emphasize energy needs related to irrigation.

The Inspector General report acknowledges recent efforts to implement the needs-driven approach. However, activities have focused primarily on the Office of Energy. There is no assurance that the new approach will be adopted by the regional bureaus and the USAID missions.

To assure full Agency-wide implementation the needs-driven approach must be institutionalized. Agency policies on energy, agriculture and rural development must be changed to reflect the new approach. In the interim, action must be taken to ensure that all new projects involving renewable energy conform to the needs-driven approach and current projects are adapted to better meet this goal. The Inspector General report recommendations will establish accountability for such actions and ensure full implementation of the needs-driven approach Agency-wide.

Management Comments

The Country Development Strategy Statement for India discusses energy as a constraint to rural development. Renewable energy projects in India are consistent with the CDSS.

Office of Inspector General Comments

The report acknowledges that the new 1987 CDSS for India merges the energy, agriculture and rural development programs. Projects initiated under this CDSS were in the early planning stages and, therefore, not included in the review. Although the Mission obligated more than \$6 million for renewable energy projects between 1978 and 1985, earlier CDSS's either did not address energy problems or treated energy as a separate program area.

Management Comments

Projects in India and the Philippines are linked to rural development needs through projects in energy planning that were not included in the audit. Examples presented in the report support linkages between energy and agriculture and rural development.

Office of Inspector General Comments

Renewable energy efforts should be integral parts of agriculture and rural development projects to ensure that technologies are developed to meet specific applications and end user needs. Only within the last year has AID taken steps to implement this concept. Examples presented in the report show recent progress along these lines made by USAID/India and USAID/Philippines.

Management Comments

The Inspector General report narrowly selects renewable energy technologies from the scope of activities supported by AID under Section 106. These include institution building, training and energy conservation.

Office of the Inspector General Comments

Early audit work considered the range of energy activities sponsored by AID. For several reasons, however, the scope of subsequent work was limited to renewable energy projects which developed, tested and demonstrated technologies. First, preliminary audit work indicated that technology related projects had generally not been implemented in accordance with legislative direction. This situation existed even though the renewable energy program had been underway for eight years. Second, technology testing and demonstration was a logical break in the overall energy program. The Agency generally separated such projects

or project components from activities such as conservation, institution building and training. Third, the impact of technology related projects could be more readily assessed to determine whether resulting technologies solved specific energy problems. The results of institution building, training and conservation are far more intangible and are, therefore, more difficult to measure. Consideration will, however, be given to a comprehensive review of these other areas.

Management Comments

The report neglects the fact that many renewable energy projects are funded under Section 103 of the Foreign Assistance Act.

Office of Inspector General Comments

Section 106 specifies how projects to develop "hard" renewable energy technologies should be designed and implemented. All projects which develop such "hard" technologies should conform to this criteria regardless of how they are funded. As presented in the audit report, an analysis of 703 projects funded under Section 103 revealed that only 33 or less than five percent contained a renewable energy component.

Management Comments

Report conclusions are based on early AID activities rather than projects initiated in the last two years such as the sugarcane project in Jamaica and the small-scale hydroelectric project in Madagascar.

Office of Inspector General Comments

The sample of 24 projects reviewed during the audit included early renewable energy projects as well as more recent ones. Projects in very early stages of development like the sugarcane project in Jamaica and the small-scale hydroelectric project in Madagascar were not included because they were not sufficiently operational at the time of the audit. However, energy personnel at USAID/Dominican Republic described the Jamaica sugarcane project as research oriented and highly experimental. The Mission declined participation in this project which was centrally funded by the Office of Energy. Mission personnel also cited prior problems with a similar centrally funded project.

Management Comments

The AID renewable energy program began nearly a decade ago. At that time, LDC's lacked infrastructures to support renewable energy projects and Missions lacked technical expertise to manage such projects. The Inspector General report fails to recognize progress made in these areas through renewable energy projects.

Office of Inspector General Comments

Early renewable energy projects emphasized researching and developing new and highly technical energy technologies. AID adopted this approach even though most LDC's lacked the infrastructure to support such projects and USAID Missions lacked technical expertise to design and manage them. As a result, severe implementation problems occurred, appropriate technologies were not introduced and the \$170 million was not expended in the most effective and efficient manner. This lack of institutional capability by both recipient countries and USAID missions was strong support for simple and inexpensive renewable technologies mandated by Section 106 of the Foreign Assistance Act.

The objective of the Inspector General audit was to evaluate AID's progress in developing and implementing "hard" renewable energy technologies in accordance with Section 106 of the Foreign Assistance Act. The level of institutional capability that may have resulted from renewable energy projects was outside the audit scope.

Management Comments

Renewable energy systems such as small-scale hydroelectric, wind water pump, wind electric generator and photovoltaic are simple and require little maintenance. They are less costly than conventional energy systems such as diesel.

Office of Inspector General Comments

The general statement that renewable energy systems such as those identified above are less costly and less complex than conventional systems is misleading. The cost and complexity of a particular energy system should be assessed in the context of the intended application. Factors such as education and income levels of intended users, local maintenance capabilities and location should be considered. For example, power storage

batteries for a photovoltaic system in a rural Indian village required weekly maintenance. A crew from the State-owned power company visited the village each week because no one in the village could perform the required maintenance.

Management Comments

The Inspector General report quotes costs of renewable energy systems out of context. For example, the 315 kilowatt rice hull plant built in the Philippines at a cost of \$528,000 is not necessarily expensive. This amounts to a cost of \$1676 per kilowatt. This figure compares favorably to a cost of \$2200 per kilowatt for a coal fired plant.

Office of Inspector General Comments

If the initial cost of a renewable energy system is too expensive for its intended users, then the cost per unit of energy produced by the system becomes irrelevant. The average rice mill owner in the Philippines cannot afford an energy system costing \$528,000.

Management Comments

The argument that most renewable energy systems applied through AID projects were not inexpensive is out of context. AID projects in less developed countries reflected the status of renewable energy projects worldwide. For example, projects in the developed world including the U.S., Europe, Australia and South Africa were also not inexpensive. The complexity, high cost and emphasis on research and development have been necessary to achieve early introduction of renewable energy everywhere.

Office of Inspector General Comments

The comparison of renewable energy experience in less developed countries to that in the developed world ignores important factors. Developed countries could better afford to experiment with complex, risky and high cost technologies. Such experimentation could even have long-term benefits for less developed countries by identifying and proving technologies that could be transferred. However, limited resources restricted the amount of experimentation that could be done by the less developed countries. Thus, the simple and inexpensive approach to renewable technologies directed by Section 106 of the Foreign Assistance Act would have been more appropriate.

Management Comments

Report conclusions are based on an examination of a few high technology projects in the Philippines and India which do not represent the "rural" nature of projects in other countries. For example, all projects in Africa are rural in nature.

Office of the Inspector General Comments

Report conclusions are based on examination of 24 renewable energy projects implemented in Africa, Asia/Near East and Latin America. Projects in this sample, representing 28 percent of the 86 projects funded by AID, were sponsored by the Office of Energy, regional bureaus and Missions.

Renewable energy projects in Africa were generally more "rural" in nature than projects in other geographic regions. The sample of 24 projects included 8 African projects involving such technologies as water pumping systems, biodigesters and improved cookstoves. These projects did tend to be more oriented toward the appropriate user. However, analyses of these 8 projects still revealed problems in complying with the five criteria contained in Section 106 of the Foreign Assistance Act.

Management Comments

A recent evaluation by the Bureau for Asia and Near East identified several technologies which have begun widespread dissemination and others with dissemination potential.

Office of the Inspector General Comments

After 8 years of experimentation and expenditures of \$170 million, AID should be well into disseminating proven replicable technologies rather than considering potential.

Management Comments

A government owned rice mill was used to assess the cost effectiveness of rice hulls as an energy source because it was more conducive to project success than privately owned mills.

Office of the Inspector General Comments

This example illustrates the technology driven approach to renewable energy projects that AID has followed since the program began. The primary objective of the project was to test and demonstrate the rice hull technology with little consideration for the needs of intended users or the replication and commercialization potential of the technology. As a result, the project tested and demonstrated a technology that was too expensive, unsuited to needs of intended users and lacking in replication potential.

Management Comments

A fair and adequate assessment of AID's renewable energy program requires participation by expert teams familiar with renewable energy technologies and their research and development by AID and other donors.

Office of Inspector General Comments

Audit report conclusions were based, in part, on assessments of renewable energy projects contained in Agency sponsored regional and individual project evaluation reports. We have made the assumption that AID selected expert teams to perform these evaluations. We also conducted the audit using generally accepted governmental auditing standards which are adequate to properly assess program results.

Management Comments

The audit report suggests that AID not do renewable energy research and development. It also fails to recognize that planning, conservation and resource availability are important considerations in determining where and when a technology should be applied.

Office of Inspector General Comments

The report supports the needs-driven approach to renewable energy projects being developed by AID. According to this approach the energy requirements of intended beneficiaries will determine project design and implementation. Technology research and development, energy planning and conservation are tools that can be used to meet specific needs.

Management Comments

The report contains no explicit description of the scope and methods used in the Inspector General review. The analysis seems to be based on a review of 45 project evaluation reports and limited field visits to three projects in India and the Philippines. Statements about various projects have been taken out of context and used incorrectly to make inappropriate points.

Office of Inspector General Comments

The objective of the audit was to evaluate AID's management of its renewable energy projects to determine whether projects were designed and implemented to achieve their legislative mandate. As described in the Audit Objectives and Scope section of the report, several audit techniques were used to achieve this objective. One technique involved analysis of Agency sponsored project evaluation reports and Inspector General audit reports on 24 renewable energy projects. These 24 projects represented 54 percent of the \$170 million obligated for testing and demonstrating technologies and 28 percent of the 86 projects sponsored by AID since 1978. A second audit technique involved reviews of all project papers and Country Development Strategy Statements related to the 24 renewable energy projects. The third technique included reviews of seven renewable energy projects and audit work at the Office of Energy Bureau for Science and Technology and four USAID Missions. Report conclusions were a synthesis of these three audit techniques.

Management Comments

The report adopts a negative attitude in drawing conclusions. For example, rather than saying that 46 percent of the projects examined were research and development oriented, a more appropriate statement would be that 54 percent were applications oriented.

Office of Inspector General Comments

Sufficient evidence was not available to support a conclusion that 54 percent of the projects were application oriented. Statistics presented in the report were based, in part, upon analyses of project evaluation reports, project papers and Country Development Strategy Statements. These analyses sought to determine whether renewable energy projects conformed to requirements of Section 106 of the Foreign Assistance

Act. Documents reviewed, however, were not prepared with focus on the five criteria contained in Section 106. As a result, percentages presented in the report ranging from 46 to 88 percent are minimum statistics which most likely understated the problem.

B. Compliance and Internal Control

Compliance

The audit revealed that AID had not complied with requirements of Section 106 of the Foreign Assistance Act in designing and implementing renewable energy projects. Contrary to its legislative mandate, AID undertook projects which were (i) unrelated to agriculture and rural development efforts, (ii) behind schedule in developing energy technologies, (iii) complex and expensive to build, use and maintain, (iv) unacceptable to intended users, and (v) lacking in replication potential. Compliance issues related to other applicable laws and regulations were not noted.

Internal Control

The audit revealed that internal controls for providing central policy guidance and oversight for the energy program were inadequate. The AID Energy Policy Paper did not establish specific, measurable and realistic goals and objectives for the energy program. Also, the Agency lacked a central focal point for overseeing energy policy implementation. Weaknesses with other internal controls were not identified.

AUDIT OF
AID RENEWABLE ENERGY PROJECTS

PART III - APPENDICES

Summary of Problems Identified in Project Evaluation Reports,
Inspector General Audit Reports and Site Visits,
Project Papers and Country Development Strategy Statements

<u>Project Number</u>	<u>No Program Integration</u>	<u>Untimely Implementation</u>	<u>Complex or Expensive</u>	<u>Unacceptable to Users</u>	<u>Impediments to Transferability</u>
6330209	X	X		X	X
6150205	X	X			X
6320206		X			X
6880217		X		X	X
6980410		X	X	X	
6850208				X	X
6850219			X	X	X
6980407	X	X	X	X	X
2630016				X	X
3860465	X	X	X	X	X
3860474	X	X	X	X	X
6080159	X	X		X	X
3670132					X
4920294	X		X	X	X
4920375	X		X	X	X
4930304			X	X	X
4930324	X			X	X
5170144	X				X
5380030	X	X	X	X	X
5320065	X			X	X
5250190	X				X
5960089			X		X
9365701			X	X	X
9365710	<u>X</u>	<u>X</u>	<u>X</u>	<u>X</u>	<u>X</u>
TOTALS	14 (58%)	11 (46%)	12 (50%)	16 (67%)	21 (88%)

Problems Identified In Project Evaluation Reports,
Inspector General Audit Reports and Site Visits,
Project Papers and Country Development Strategy Statements

AFRICA

1. Botswana - Botswana Renewable Energy Technology
Project No. 6330209

No Program
Integration

- The project paper did not integrate the renewable energy project with specific agriculture or rural development projects.
- The CDSS did not integrate energy, agriculture and rural development.

Untimely
Implementation

- The project was aimed at demonstrating technologies rather than building indigenous manufacturing, marketing or maintenance capability (evaluation report).

Unacceptable
to Users

- The project paper did not define a process for linking renewable energy technologies to end user needs (evaluation report).

Impediments to
Transferability

- The project paper did not include replication planning.
- A project output was the installation of energy technologies in two villages. The evaluation team concluded there was no assurance the technologies would be spread beyond the two villages (evaluation report).
- Not enough attention was paid to the introduction of renewable energy systems through marketing programs using private sector financing and local production facilities (evaluation report).

AFRICA (Cont)

2. Kenya - Renewable Energy Development
Project No. 6150205

No Program
Integration

- The project paper did not integrate renewable energy project with specific agriculture or rural development projects.
- The CDSS did not integrate energy, agriculture and rural development.

Untimely
Implementation

- Implementation of the project was slower than anticipated and several planned activities such as establishing an energy development loan fund and developing an improved charcoal kiln were never started (evaluation report).
- This project aimed at demonstrating technologies rather than building indigenous manufacturing, marketing, or maintenance capability (evaluation report).

Impediments to
Transferability

- The project paper did not include replication planning.
- Not enough attention was paid to the introduction and widespread distribution of renewable energy systems through marketing programs using private sector financing and local production facilities (evaluation report).

3. Lesotho - Lesotho Renewable Energy Technology
Project No. 6320206

Untimely
Implementation

- The project was delayed 14 months because of an inordinately long contracting process. This delay resulted in additional project costs of \$70,000 to \$80,000 due to inflation, and the loss of a Peace Corps volunteer recruited for the project (evaluation report).

AFRICA (Cont)

Unacceptable
to Users

- Solar drying of crops, grains and fish was not economically feasible or attractive to small-scale farmers and food processors (evaluation report).
- The project purpose to disseminate a set of renewable energy technologies, resulted in a narrow research focus which failed to address other high priority rural development needs (evaluation report).

Impediments to
Transferability

- The project paper did not include replication planning.
- Not enough attention was paid to the introduction and distribution of renewable energy systems through marketing programs using private sector financing and local production facilities (evaluation report).
- This project aimed at demonstrating technologies rather than building indigenous manufacturing, marketing or maintenance capability (evaluation report).

4. Mali - Mali Renewable Energy Project No. 6880217

Untimely
Implementation

- The project aimed at demonstrating technologies rather than building indigenous manufacturing, marketing or maintenance capabilities (evaluation report).

Complex or
Expensive

- Work with solar dryers and solar hot water heaters should be de-emphasized if the cost/benefit ratio remains high (evaluation report).

Unacceptable
to Users

- The problems of adopting promising renewable energy devices by the intended beneficiaries was not resolved. The project had not given enough priority to products that could be self-adopting (evaluation report).

AFRICA (Cont)

- In a research and product development project such as this one, a market survey should have been accomplished (evaluation report).
- Work with solar thermodynamic energies should be discontinued. This work would require a first-rate machine shop and engineering experience which were not available (evaluation report).

5. Rwanda - Renewable/Improved Traditional Energy, Regional Project No. 6980410

Untimely Implementation

- The project aimed at demonstrating technologies rather than building indigenous manufacturing, marketing or maintenance capability (evaluation report).

Unacceptable to Users

- The project should have involved fewer technologies with more emphasis on economic and social analysis (evaluation report).

Impediments to Transferability

- The project should have placed more emphasis on dissemination and information exchange (evaluation report).

6. Senegal - Bahel Solar pump, Project No. 6850208

Complex or Expensive

- Solar thermal pumps were complex and difficult to keep in operation. They were plagued by a lack of in-country spare parts and trained repair personnel (evaluation report).
- According to the project paper, the cost per pump exceeded \$1 million.

Unacceptable to Users

- The potential of solar thermal pumps in meeting agricultural applications in Africa was low (evaluation report).

28

AFRICA (Cont)

Impediments to Transferability -- According to the above comments, solar thermal pumps lacked replication potential because they were expensive, complex, not suited to agricultural applications and not technically sound (audit conclusion).

7. Senegal - Senegal Fuelwood Production,
Project No. 6850219

Complex or Expensive -- The project's high labor costs resulted from low productivity which was a function of insufficient supervision and inefficient organization (evaluation report).

Unacceptable to Users -- Intended project beneficiaries were the urban populations of Dakar rather than the rural poor (evaluation report).

Impediments to Transferability --- This project lacked replication potential (evaluation report).

8. Tanzania - Improved Rural Technology,
Regional Project No. 6980407

No Program Integration -- The project paper did not integrate renewable energy project with specific agriculture or rural development projects.

-- The CDSS did not integrate energy, agriculture and rural development programs.

Untimely Implementation -- There was to be no delivery of the photovoltaic technology to intended beneficiaries. This was to be a pilot activity under supervision of the engineering department of a host country university and as such was conceived as a university research activity (evaluation report).

-- This project never reached implementation stage because of personnel and procurement problems (evaluation report).

AFRICA (Cont)

- Complex or Expensive -- USAID/Tanzania questioned the applicability of the photovoltaic technology as a power source for rural health dispensaries because of high costs. All parts and equipment needed for construction of the photovoltaic plant were expensive and had to be imported (evaluation report).
- Impediments to Transferability -- The project paper did not include replication planning.

ASIA/NEAR EAST

9. Egypt - Applied Science and Technology and Research
Project No. 2630016

- Unacceptable to Users -- Social and economic considerations resulted in limited acceptance of biogas technology subproject (evaluation report).
- Impediments to Transferability -- The project paper did not contain replication planning for the biogas technology.

10. India - Technologies for the Rural Poor
Project No. 3860465

- No Program Integration -- The project paper did not integrate renewable energy project with specific agriculture or rural development projects.
- The CDSS did not integrate energy, agriculture and rural development programs.
- Several of the subcomponents funded under this project had only a tenuous connection with cost-effective rural development (evaluation report).

ASIA/NEAR EAST (Cont)

Untimely
Implementation

- Although the project agreement was signed in 1978, as of mid-December 1984, only one of the subprojects was complete. Field testing of the other subprojects had not begun (evaluation report).
- The project was delayed about three years because of inadequate guidance and criteria for subproject approval, inadequate staff attention and lack of dialogue between USAID officials and the Government of India (evaluation report).

Complex or
Expensive

- A number of the technologies that emerged from this project were scientifically interesting, but too expensive and too complex for remote site operations and maintenance (evaluation report).
- Recurring costs and sustainability were potential problems for a subproject which provided solar powered street lights and a community television set to a rural village (evaluation report).
- Complex solar collectors used in a subproject were of little utility to rural poor. They pushed the border of existing technology not just in India but anywhere in the world (evaluation report).

Unacceptable
to Users

- With respect to the Salojypolly subproject which provided street lighting and a community television set to a rural village, more inappropriate technology for a remote site occupied by uneducated villagers was hard to imagine (evaluation report).
- The extent to which villages would be willing and able to operate and maintain the facility installed under the Salojypolly subproject had not been determined (evaluation report).

ASIA/NEAR EAST (Cont)

- Impediments to Transferability
- The project paper did not include replication planning.
 - The evaluation team did not foresee a major role in India for the Salojypolly subproject system, and certainly not in rural areas (evaluation report).
 - Neither the USAID Mission, nor the Government of India, had developed plans for replicating technologies from this project (audit conclusion).

11. India - Alternative Energy Resources Development
Project No. 3860474

- No Program Integration
- The project paper did not integrate the renewable energy project with specific agriculture and rural development projects.
 - The CDSS did not integrate energy, agriculture and rural development programs.
 - USAID/India officials said the project was research and development oriented and not intended to be integrated with agriculture and rural development projects.

- Untimely Implementation
- The Mission Director characterized the project as research and development oriented.

- Complex or Expensive
- The Mission Director said that he did not have the technical expertise on his staff to manage and monitor such research and development oriented projects.
 - The project officer said he could not effectively manage and monitor the energy subprojects because of their complex and highly technical nature.

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ASIA/NEAR EAST (Cont)

- Unacceptable to Users -- The subprojects were not applicable to the needs of the rural poor. They involved complex and highly technical methods of producing energy from coal and biomass products like charcoal and wood (audit conclusion).
- Impediments to Transferability -- The project paper did not include replication planning.
- Neither the USAID Mission nor the Government of India had developed plans for replicating technologies from this project (audit conclusion).

12. Morocco - Renewable Energy Development
Project No. 6080159

- No Program Integration -- The project paper did not integrate renewable energy project with specific agriculture or rural development projects.
- The CDSS did not integrate energy, agriculture and rural development.
- Untimely Implementation -- The project was an experimental attempt to exploit renewable energy resources in Morocco (evaluation report).
- Project progress was hampered by a conflict between USAID/Morocco and AID/Washington over project focus. USAID/Morocco emphasized the project's research and development role while AID/Washington viewed the project as a financially viable commercial investment (evaluation report).
- Impediments to Transferability -- Project paper did not include replication planning.

ASIA/NEAR EAST (Cont)

13. Nepal - Resource Conservation and Utilization
Project No. 3670132

Deficiencies in meeting the Foreign Assistance Act's Section 106 project design criteria were not noted in evaluation reports, the project paper or the Nepal CDSS.

14. Philippines - Nonconventional Energy
Project No. 4920294

No Program
Integration

- The project paper did not integrate renewable energy projects with specific agriculture or rural development projects (evaluation report).
- The CDSS did not integrate energy, agriculture and rural development.
- Mission personnel stated that there was no intent to integrate the project with agriculture and rural development projects.

Complex or
Expensive

- A solar refrigeration subproject was started in 1979 but was subsequently cancelled in part because of cost overruns (evaluation report).
- A subproject to test and demonstrate a rice hull fed thermal power plant involved equipment costs of \$500,000 (audit conclusion).

Unacceptable
to Users

- The Inspector General audit team observed a 315 kilowatt electric power plant built under a \$528,000 subproject to power a government owned rice mill using rice hulls as an energy source. The government owned facility was selected although there were many small privately owned mills which could have benefited from a renewable energy source.

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ASIA/NEAR EAST (Cont)

- A solar refrigeration subproject was cancelled in part because it lacked a rural focus (evaluation report).
- The value to the Philippines of the various technologies under this project was questionable (evaluation report).

Impediments to Transferability

- The project paper did not include replication planning.
- Widespread dissemination of wind water pumps in the Philippines was hampered by low efficiency of the units, the lack of readily available credit and shortages of spare parts (evaluation report).
- At the time of the Inspector General audit team visit, neither USAID/Philippines nor the Government of the Philippines had developed replication plans for technologies included in this project.

15. Philippines - Rural Energy Development
Project No. 4920375

No Program Integration

- The project paper did not integrate renewable energy project with specific agriculture or rural development projects.
- The CDSS did not integrate energy, agriculture and rural development.

Complex or Expensive

- Gasifiers were unacceptable to local villagers because of high operating costs (evaluation report).

Unacceptable to Users

- Only 2 of 103 planned gasifiers in a region of the Philippines were operational because of resistance from local villagers to the gasifier technology (evaluation report).

Impediments to Transferability

- The project paper did not include replication planning.

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ASIA/NEAR EAST (Cont)

16. Thailand -- Renewable Nonconventional Energy
Project No. 4930304

- Complex or Expensive -- A system developed in Thailand to burn husks as fuel was too complex and costly for dissemination and commercial manufacture (evaluation report).
- Unacceptable to Users -- Four of eight technologies had limited impact on rural areas. Three technologies were rated as difficult for local adoption. The design of technologies should take into consideration the setting in which they will perform (evaluation report).
- Impediments to Transferability -- The project paper did not include replication planning.
- Widespread dissemination of wind water pumps in Thailand was hampered by low efficiency of the units, lack of credit and shortages of spare parts (evaluation report).

17. Thailand - Micro/Mini Hydroelectric
Project No. 4930324

- No Program Integration -- The project paper did not integrate renewable energy project with specific agriculture and rural development projects.
- The CDSS did not integrate energy, agriculture and rural development programs.
- Impediments to Transferability -- The project paper did not discuss replication plans or potential.

LATIN AMERICA

18. Dominican Republic - Energy Conservation and Resource
Development
Project No. 5170144

LATIN AMERICA (Cont)

No Program
Integration

- The project paper did not integrate renewable energy project with specific agriculture or rural development projects.
- The CDSS did not integrate energy, agriculture and rural development programs.

Unacceptable
to Users

- According to the project paper, the project was aimed at meeting the energy needs of industry through conservation and developing alternative fuels. The project was not aimed at benefiting the rural poor.
- The project scope of work called for development of a national energy investment plan for which there was no known customer. The economy of the country was in a difficult period where there were few sources of funds for energy investment, especially foreign exchange (evaluation report).

Impediments to
Transferability

- Project paper did not include replication planning.

19. Dominican Republic - Solar Bagasse Dryer
Project No. 5380030

No Program
Integration

- The project paper did not integrate renewable energy project with specific agriculture and rural development projects.
- The CDSS did not integrate energy, agriculture and rural development programs.

Untimely
Implementation

- USAID personnel characterized this project as research and development oriented and highly experimental.

Complex or
Expensive

- Fuel oil savings resulting from use of the solar bagasse dryer would not cover labor costs and replacement parts for the system. A solar bagasse dryer to handle a sugar mill's production would have to be 50 times larger than the prototype unit. Such scale-up did not appear feasible (evaluation report).

LATIN AMERICA (Cont)

- Unacceptable to Users -- The project was not aimed at providing direct benefit to the rural poor. The project purpose was to research, test and demonstrate a solar bagasse dryer as a source for steam and electricity for sugar mills (evaluation report).
- Impediments to Transferability -- The project lacked replication potential because (i) the dryer produced marginal energy savings, (ii) scale-up to meet 24 hour a day sugar mill production was infeasible and (iii) the system would be used only on a seasonal basis (evaluation report).

20. Jamaica - Energy Sector Assistance
Project No. 5320065

- No Program Integration -- The project paper did not integrate renewable energy project with specific agriculture and rural development projects.
- The CDSS did not integrate energy, agriculture and rural development programs.
- Impediments to Transferability -- The project paper did not include replication planning.

21. Panama - Program Development and Support
Project No. 5250190

- No Program Integration -- The project paper did not integrate renewable energy project with specific agriculture and rural development projects.
- The CDSS did not integrate energy, agriculture and rural development.
- Impediments to Transferability -- The project paper did not include replication planning.

LATIN AMERICA (Cont)

22. Regional - Fuelwood and Alternative Energy Sources
Project No. 5960089

- Complex or
Expensive -- Potential technologies should be subjected to cost effectiveness analysis to eliminate unlikely technologies. For example, a cattle corral at an experimental bio-digester site cost almost as much as the digester (evaluation report).
- Unacceptable
to Users -- The evaluation team did not see the value of a subproject within the Central American context (evaluation report).
- Impediments to
Transferability -- A major project weakness was the lack of an information dissemination capability. The evaluation team recommended establishing a dissemination system that would make project experience widely available (evaluation report).

CENTRALLY FUNDED

23. S&T/EY - Low Cost Energy Technology
Project No. 9365701

Deficiencies in meeting the Foreign Assistance Act's Section 106 project design criteria were not noted in evaluation reports or the project paper.

24. S&T/EY - Photovoltaic Technology
Project No. 9365710

- No Program
Integration -- The project paper did not integrate renewable energy project with specific agriculture and rural development projects.
- Untimely
Implementation -- The project was aimed at demonstrating technologies rather than building indigenous manufacturing, marketing or maintenance capabilities (evaluation report).

CENTRALLY FUNDED (Cont)

- Complex or Expensive -- Automatic controls initially installed to limit usage were unnecessarily complicated and could be eliminated with proper education of users (evaluation report).
- Unacceptable to Users -- Photovoltaic systems installed in Upper Volta confirmed the need for simple, low maintenance system components (evaluation report).
- Impediments to Transferability -- The project paper did not include replication planning. --
- Not enough attention was paid to the introduction and widespread distribution of renewable energy systems through marketing programs using private sector financing and local production facilities (evaluation report).

AID RENEWABLE ENERGY PROJECTS
PROJECT EVALUATION AND
INSPECTOR GENERAL AUDIT REPORTS REVIEWED

AFRICA

- Botswana - Renewable Energy Technology, February 3, 1984, Project No. 6330209.
- Kenya - Attempts Should Be Made to Sustain the Successful Aspects of Kenya's Renewable Energy Development Project, Audit Report No. 3-615-85-5, December 11, 1984, Project No. 6150205.
- Lesotho - Renewable Energy Technology, Project Evaluation Summary, March 10, 1982, Project No. 6320206.
- Lesotho - Renewable Energy Technology, Project Evaluation Summary, January 20, 1984, Project No. 6320206.
- Mali - Renewable Energy: Mid-Project Evaluation, Project No. 6880217.
- Regional - Renewable Energy Technologies in Africa: An Assessment of Field Experience and Future Direction, December 1983, Project No. 6150205, 6320206, 6330209, 6850208, 6880217, 6980410, 9365710.
- Rwanda - Renewable/Improved Traditional Energy, Project Evaluation Summary, June 29, 1982, Project No. 6980410.
- Senegal - Fuelwood Production, Project Evaluation Summary, June 15, 1984, Project No. 6850219.
- Tanzania - Improved Rural Technology, Project Evaluation Summary, May 9, 1983, Project No. 6980407.

ASIA-NEAR EAST

- Egypt - Applied Science and Research Special Evaluation Report, January 1982.
- India - Application of Science/Technology To Rural Development, 1981 Evaluation Summary, April 9, 1981, Project No. 3860465
- India - Technologies for the Rural Poor, 1982 Project Evaluation Summary, Project No. 3860465.

PROJECT EVALUATION AND
INSPECTOR GENERAL AUDIT REPORTS REVIEWED

ASIA-NEAR EAST (Continued)

India - Technologies for the Rural Poor, Project Evaluation Summary 1983, August 1, 1983, Project No. 3860465.

India - Technologies For the Rural Poor Project: Findings and Recommendations of AID/DNES Evaluation Team, January 1985, Project No. 3860465.

Morocco - Renewable Energy Development I, March 15, 1982 and Attachment, Project No. 6080159.

Morocco - Renewable Energy Development Project in Morocco Needs to Make Progress in 1984 or the Project Should be Redesigned or the Funds Deobligated, July 13, 1984, Project No. 6080159.

Philippines - Nonconventional Energy Development: An Evaluation, December 1981. Project No. 4920294.

Philippines - Nonconventional Energy Development, Audit Report No. 2-492-82-14, August 31, 1982. Project No. 4920294.

Regional - Renewable Energy Systems Installed in Asia: Current Successes and the Potential for Future Widespread Dissemination, April 12, 1985. Project No. 3670132, 3860465, 4920294, 4930304, 4930324, 4920375.

Thailand - Renewable Nonconventional Energy, Project: An Evaluation, September 1982, Project No. 4930304.

LATIN AMERICA AND THE CARIBBEAN

Dominican Republic - Energy Conservation and Resource Development Project Evaluation Summary, Intermediate Evaluation, Project No. 5170144.

Dominican Republic - Solar Bagasse Dryer, Field Evaluation Report (Draft), Project No. 5380030.

Jamaica - USAID/GOJ: Energy Sector Assistance, Project Evaluation Summary, December 21, 1983, Project No. 5320065.

Panama - Evaluation Report of the Project of Alternative Energies, February 1981, Project No. 5250190.

PROJECT EVALUATION AND
INSPECTOR GENERAL AUDIT REPORTS REVIEWED

LATIN AMERICA AND THE CARIBBEAN (Continued)

Regional - Fuelwood and Alternative Energy Sources, July 20, 1982, Project No. 596008.

Regional - Fuelwood and Alternative Energy Sources - CATIE, January 17, 1983, Project No. 5960089.

Regional - Fuelwood and Alternative Energy Sources - ICAITI, January 17, 1983. Project No. 5960089.

CENTRALLY FUNDED

Low Cost Technology for Rural Poor, Development Support Project Evaluation, December 9, 1981, Project No. 9365701.

Photovoltaic Development and Support Program, Special Evaluation Report, February 27, 1981, Project No. 9365710.

Volunteers in Technical Assistance, Inc., Audit Report No. 82-46, February 22, 1982, Project No. 9365701.

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SENIOR ASSISTANT ADMINISTRATOR

JAN 22 1986

MEMORANDUM

TO: AIG/A, James B. Durnil
FROM: SAA/S&T, N.C. Brady 
SUBJECT: Response to the Draft Inspector General Report:
"Audit of AID's Renewable Energy Projects"

We have reviewed the draft audit report transmitted by your memorandum of November 25, 1985. Our response includes comments from the Energy and Natural Resources Sector Council.

As stated in the report, the objective of this audit was "to evaluate AID's management of its renewable energy projects to determine whether they were designed and implemented to achieve their legislative mandate."

We are pleased that the report lends support to the recent approach and activities adopted by the Agency. The report cites the Administrator's request for a renewable application assessment, the Renewable Energy Applications and Training project, and the Energy in Agriculture project as being timely and appropriate. These activities are a result of the Agency's recognition, early in 1984, that the time has arrived to take a new, needs-driven and economically sustainable approach to renewable energy. This approach is a result of experimentation and experience during the early years. Not only AID but also other donor agencies have come to this same conclusion, and we appreciate your recognition of it as well.

However, we have a number of substantive difficulties with the IG report's findings and recommendations, specifically:

1. The first conclusion, that renewable energy projects were not an integral part of agriculture and rural development, does not follow logically from the IG review and is based on selective evidence that in part supports the opposite conclusion.
2. The second conclusion, that renewable energy technologies were not sufficiently operational at the time of the IG review to have substantial impact on meeting host countries' energy requirements, is misleading.

3. The third conclusion that AID's renewable energy projects were not simple and inexpensive to build, use and maintain is erroneous, misleading and based on a lack of technical understanding of renewable energy systems and their alternatives.
4. The fourth conclusion, that the renewable energy projects were not designed and implemented with a focus on the rural poor, is unjustified.
5. The fifth conclusion, that AID's renewable energy projects were not designed and implemented with a focus on replication, represents a serious misunderstanding of not only the history of AID's projects but also the process of project development.

These points are discussed in detail in Attachment 1. Our comments on the draft report's recommendations are presented in Attachment 2.

We trust that our comments will be helpful to you as you finalize your audit report. If you have any questions please call Jack Vanderryn (235-2243) or Alan Jacobs (235-8902).

Attachments:

1. Response to Report's Findings
2. Agency Response to Report's Recommendations
3. AFR/TR/SDP Memo dated 1/12/85
4. AFR/TR/SDP Memo dated 9/12/85
5. AFR/TR/SDP Memo dated 9/30/85
6. ARD Report dated 4/12/85
7. AFR/TR/SDP Memo dated 10/1/85

RESPONSE TO REPORT'S FINDINGS

The IG report draws erroneous conclusions from its review.

1. The first conclusion, that renewable energy projects were not an integral part of agriculture and rural development, does not follow logically from the IG review and is based on selective evidence that in part supports the opposite conclusion.

Most field projects are initiated, implemented, and reviewed by Mission project committees. These committees have proper rural development and agricultural representation. Most of the renewable energy applications are strongly related to agriculture and rural development - water pumping for irrigation using wind or photovoltaic systems, rural electrification projects using hydro or agricultural waste, woodstoves of various types, and biodigestors are all integrated in agriculture and contribute to rural development. Although not components of agriculture and rural development projects, renewable projects were mostly aimed at developing and testing technologies for important rural applications. The IG report offers unsupported criticism without even discussing what the auditors consider priority applications for rural development. If the above mentioned projects are not, then what is? It would be constructive criticism if the IG report would spell out what kind of priority applications are suitable for rural development.

In the particular case of India, the CDSS clearly discusses energy and forestry as constraints to rural development and various renewable energy projects in India are consistent with the CDSS.

The projects in India and Philippines are linked to rural development needs in those countries through other projects--both field and central projects--in energy analysis and planning that the IG did not review. The examples in the last two paragraphs of page 13 of the report acknowledge these links and in fact support a conclusion opposite to that drawn by the IG.

The IG Report does not adequately show how AID has used its early experience in modifying many of its renewable projects to more closely match real agricultural and rural development needs. We found Appendix 2 "Problems Identified in Project Evaluation Reports, Inspector General Audit Reports and Site Visits, Project Papers and Country Development Strategy Statements" to be particularly misleading with respect to the renewable projects in Africa. This section focuses on problems in early project design and implementation.

Had the IG's office reviewed recent project implementation reports a much clearer picture of AID's renewable projects would have emerged. (See Attachments 3-6)

Early in 1984 the Agency recognized that not enough was being done to examine energy needs in agriculture and rural development. S&T/EY prepared a series of preliminary country assessments and concurrently identified the need for an AID project in this area, "Energy for Agriculture". In addition to this project, S&T/EY has made strides in other program activities to examine energy concerns in agriculture along with the new office program plan in which several initiatives directly pertain to agriculture.

The regional bureaus are working closely with S&T/EY and general support exists for better consideration of these program efforts. For example, an April 1985 conference in the Philippines identified critical links between energy, agriculture, and rural development and initiated dialogue between energy and agriculture officers in the field.

Energy strategies for AFR/TR/SDP state that energy issues need to be integrated in plans for country development. One of the priorities of the Africa Bureau Energy Strategy is opportunities for using energy more effectively in USAID projects to increase agricultural productivity, including energy-efficient irrigation and water-development alternatives, and to develop off-farm employment opportunities.

The report adopts an arbitrary and unsupportable interpretation of Section 106 of the Foreign Assistance Act. Section 106 discusses "energy from fossil fuels", "energy from indigenous resources", "energy production from renewable, decentralized sources and energy conservation", "renewable energy sources for rural areas carried out as integral parts of rural development efforts" and other similar phrases. Assistance activities Section 106 discusses include "data collection and analysis, the training of skilled personnel, research on and development of suitable energy sources, and pilot projects to test new methods of energy production."

The IG report seems to put all the burden of Section 106 requirements on its own narrow definition of renewable technologies. In fact, AID carries out the 106 mandate by supporting activities in renewable energy, energy conservation, energy analysis, energy training, institutional development, scientific interchange and other activities described in that Section, all of which should be included in any discussion of energy projects. The IG report narrowly selects renewable technologies from the full range of analysis, training, institutional development and other related activities needed to successfully apply those technologies.

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Furthermore, by arbitrarily imposing this interpretation of Section 106, the IG report neglects the fact that many renewable energy projects are funded under Section 103.

By focusing on a selected set of early project papers and evaluations the IG report simply restated findings and recommendations which have been known for some time and which were used to reshape AID's programs prior to the IG's audit. In fact, the Agency has recognized the need to further develop the links between agriculture and energy. This concern gave rise to the development of the Energy for Agriculture project in early 1984. In 1985 the Asian agricultural and energy field officers met in the Philippines to discuss improved links between energy and agriculture and commissioned a number of studies along these lines.

2. The second conclusion, that renewable energy technologies were not sufficiently operational at the time of the IG review to have substantial impact on meeting host countries' energy requirements, is misleading.

At the time renewable energy technologies were introduced by AID and the LDC's, these technologies were still new in the industrial world in general and in the less developed world in particular. The requirement that renewable energy technologies be heavily integrated into rural development and yet supply a substantial amount of the country's energy requirement is very often a contradictory requirement since the rural sector is not always a significant energy consumer in terms of quantity of energy consumed. Furthermore, if the rural poor can not afford relatively expensive systems, how can we expect the introduction of significant energy supply systems (renewable or conventional) into the sector.

The IG report has based its conclusions on an examination of early AID activities rather than Agency projects initiated in the last two years. The sugarcane project in Jamaica and the hydro project in Madagascar are just isolated examples.

By examining very early Agency involvement in renewable energy activities, the report fails to recognize that most difficulties encountered were not Agency-specific but rather a status of renewable technologies world-wide. The report fails to recognize that no infrastructure related to renewables was in place a decade ago in the LDCs and thus exhibits a lack of consideration of the institutional and human development process which has been an integral part of many renewable projects. The report does not recognize the context in which most early projects were designed.

The IG report fails to recognize that lack of Mission technical expertise, "growing pains" and shifts in institutional responsibilities in the LDC's were important and natural barriers to a rapid deployment of operational systems. The renewable energy technology is a new area for the industrial world, AID and the LDC's. Early project design often overestimated capacity of counterpart institutions to plan and implement RD&D programs. These problems do not necessarily invalidate the basic need to develop technical capabilities in renewables in the LDC's and within AID. The IG report consistently fails to mention what progress has been made in developing LDC institutional capacities to overcome operational difficulties.

3. The third conclusion that AID's renewable energy projects were not simple and inexpensive to build, use and maintain is erroneous, misleading and based on a lack of technical understanding of renewable energy systems and their alternatives.

Small hydroelectric systems, wind water pumps, wind electric generators and photovoltaic systems are simple, not complex, and have little maintenance requirements. The cost of diesel systems in remote rural areas is much higher than photovoltaic or wind systems and is associated with severe problems of spare parts and maintenance. The IG report fails to quote any comparative costs. Furthermore the IG report quotes project costs and evaluation reports out of context which is very misleading. For example, the rice hulls power plant of 315 Kw built in the Philippines at a cost of \$528,000 is not necessarily expensive. It amounts to \$1676 per Kw. If this is compared to the cost of an installed Kw of a coal fired plant which is \$2200* (in 1982-84 prices) the picture is quite different. Even though the OTA report gives high cost per installed Kw of conventional power plants, and a more realistic figure might be the range of \$1,500-\$2,200 per installed Kw the rice hulls plant offers a very reasonable cost alternative.

A more careful and accurate examination by the authors of the IG report would reveal that the information given on pages 20-21 of their report is incorrect and that quoting a price of \$60,000 for an unspecified size power plant is totally meaningless. Furthermore, the statement that small steam engines "were not even considered" is absolutely false. A real examination of the facts would show that under the

* See "New Electric Power Technologies" OTA Report OTA-E-246 July 1985.

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non-conventional energy project a request for bids has been issued for small (10-15 HP) steam engines with boilers designed to meet the needs of small rice mills (those handling approximately 30 bags of 50kg/bag per day), and about 7-8 bids have been received. A preliminary estimate shows that the price range of such a system would be \$15,000-\$20,000. This corresponds to systems in the size range of 7-11Kw at a cost of approximately \$1400 - 2800 per installed Kw. This figure makes sense for such small systems when compared to the \$1,676 per Kw for a larger rice mill. Where then is the validity of the IG's criticism? Furthermore, according to the U.S. Office of Technology Assessment, the "foremost among the options necessary to accelerate technology development is a sustained Federal presence in research, development, and demonstration of new electric and load management technologies"*. Most of AID's renewable energy projects have been implemented by US companies and have, without any question, contributed to the development of the US renewable energy technology and industry.

The IG report totally fails to point out that renewable energy applications were a new topic of development in the late 70's about which very little was known in the industrial as well as the less developed world. Thus one might naturally expect an early emphasis on R&D and field experimentation with a much higher failure rate than in more tried and developed technologies.

To argue that most renewable energy systems applied through AID projects were not inexpensive is out of context. Neither were the renewable energy projects in the US, Europe, Australia and South Africa. The complexity and high cost have been a necessary price to pay for the early introduction of renewable energy everywhere. The alternative of waiting a decade and then getting AID involved in renewable energy may be measured in terms of savings for the Agency but would not necessarily be an economic/institutional advantage to most LDCs.

The \$18M Philippines project discussed on page 20 of the IG report is again a case of misinformation. The project contained a \$3.38M testing program, but the rest was applied for the development demonstration and field operation. It is incorrect that 2 out of 103 gasifiers were operational. As stated in the project evaluation, the facts are as follows: a total of 319 gasifiers were installed; 128 were operational and 191 were non-operational. Out of the operational gasifiers, 32 were in use and 96 were not in use. The prime reason for the non-use of these gasifiers had to do with unforeseen oil price increases in 1980 and issues of rice harvest and rainfall.

* See "New Electric Power Technologies" OTA Report OTA-E-246 July 1985.

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The IG report falsely implies (page 18) that the biogas projects in seven African countries were funded by AID. In fact AID evaluated the experience of other donors. AID's own biogas demonstrations were concerned specifically with the technical, social, and economic feasibility of Indian and Chinese technology in Africa.

Similarly, the statement on page 20 suggests that the entire \$4.5 million project in Mali was concerned with biogas. In fact, the biogas work was only a small part of a project focused primarily on photovoltaics.

Finally, by excluding energy conservation projects from its review, the IG neglects an entire series of energy projects that are simple and inexpensive. The project paper of the Renewable Energy Applications and Training Project, for example, properly shows this relationship.

- The fourth conclusion, that the renewable energy projects were not designed and implemented with a focus on the rural poor, is unjustified.

It is unfortunate that many of the projects reviewed by the IG audit were not "rural" in nature. In fact, the development and commercialization of cookstoves, water pumping systems, cold storage for vaccines, school and village lighting, power for remote communication, and simple biodigestors are examples of AID projects that focus directly on the rural poor on the African continent, the Near East, the Far East, and Latin America. Obviously the poor are generally unable to afford large and expensive energy systems. The suitability of a technology must be considered in relation to its affordability: Kerosene and electricity are suitable to rural areas, but many cannot afford these technologies. Few energy producing technologies can be managed and operated by subsistence farmers, but renewable systems are usually more suitable than their alternatives. Rural and household energy surveys conducted in many countries have helped narrow the focus to several renewable energy systems directly meeting rural needs.

The reports' sweeping conclusions that AID's renewable projects were not aimed at the rural poor are based on a very selected examination of a few high-technology projects in the Philippines or in India (for example, the two sophisticated solar thermal projects) that are representative of projects carried out in other countries. In Africa, on the contrary, all projects are aimed at the rural poor. A recent evaluation carried out by the Asia Bureau of their renewable energy projects in four countries supports the view that many, although not necessarily all, of the technologies are suitable to the needs of the rural poor and are acceptable to them.

The Executive Summary of this evaluation is included here as Attachment 6. The evaluation points out that several technologies have this potential for, or have already begun, widespread dissemination within their host countries and to other Asian countries.

Contrary to the findings of the IG report (page 22), the biogas component of the Egypt Applied S&T Project was very successful. Biogas digesters, hybrids of the Chinese and Indian models, were adopted to the local situation through modifications which accommodate the high water table. The success of the project led the Government of Egypt to include the application of biogas in rural areas in their Five Year S&T Plan. The Supreme Council of Renewable Energy now has a subcommittee which addresses ways to extend biomass and biogas usage, and formulates biomass policies. The primary social constraint to the digesters was not disdain for manure handling, a common and accepted peasant activity. Rather, digesters serving more than one household created problems as to who should use the gas when the digestion had been stocked by others.

The example of the Philippine rice mill on pages 20-21 again fails to take into account the R&D nature of the project. Controlled conditions to examine the cost effectiveness of the technology of using rice hulls as an energy source--not a well commercialized technology in the Third World--were considered to be more conducive to project success in the government plant rather than in the private plants.

While it is important to address the energy needs of the rural poor, it must also be noted that they do not necessarily consume significant amounts of energy on a national scale. The apparent contradiction between the need to develop projects that have the potential to replace significant amounts of imported fossil fuel and projects that benefit the rural poor must result in a variety of projects dealing also with sectors other than the rural sector. Many of these projects, in agro-industry and in sectors such as transportation and commerce, also benefit the rural poor along with the country as a whole.

In this regard the IG audit subjectively and incorrectly interprets the AID energy policy paper and its relevance to the Foreign Assistance Act. The Policy Paper does not, as the IG report implies, authorize projects "which effected (sic) the entire economy of a recipient country with only indirect benefit to the poor." AID-assisted countries are largely rural, on the order of 80% in most cases. One cannot address the entire economy of these countries without improving the lot of the rural poor, nor can one address the problems of the rural poor without addressing the entire economy. The AID energy program focuses on rural energy needs and the AID policy paper amply stresses that point.

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Nowhere in the Foreign Assistance Act is there a prohibition--as is implied by the IG on page 19--against projects aimed at urban energy problems. Such projects do not receive paramount emphasis in the Agency, but they are not excluded altogether. This is in full accord with the Foreign Assistance Act and with the "Blue print for Development - The

The fifth conclusion, that AID's renewable energy projects were not designed and implemented with a focus on replication, represents a serious misunderstanding of not only the history of AID's projects but also the process of project development.

The Agency, like all other donors and industrial countries, has gone through a Learning process of technology development and project implementation that has given rise to a better understanding of the role renewable energy systems can play in economic development in the LDCs. This in turn has reshaped, and continues to reshape, our approach to project development.

The Agency has not simply designed all of its renewable energy projects for replication according to some fixed formula - indeed it would be a mistake to do so, particularly with technologies in the earlier stages - but rather the projects have been refined, based on our own experience and that of other donors, to enhance their replicability, primarily through the private sector. Thus the emphasis of AID renewable energy projects has been moving to commercialization of technologies. Several examples of technologies successfully replicated in Africa are discussed in Attachment 3, including residential stoves, small decentralized hydropower systems, improved charcoal production, photovoltaic applications, biomass, and improved building design.

The IG report overlooks some existing means of information dissemination. For example, it presents no evidence for the point it makes on page 33 that AID had not distributed information on Philippine use of biomass. AID does in fact disseminate such information both through publications, conferences, and other means. For example, the Philippine information is reported on extensively in the Bioenergy System Report published with AID support and distributed to all Missions with bioenergy interests. The Office of Energy supports the Bioenergy Users Network to disseminate such information.

Although AID and other donors have shared project plans and experiences, with benefits to AID/W and the missions, the lack of funds in the Office of Energy have severely limited the opportunities to exchange information. For example, a meeting planned to discussed Caribbean projects in energy and environment had to be cancelled due to budgetary restrictions.

Also due to budgetary restrictions, the Indian mission was unable to send its energy officer to a meeting in the Philippines, hence missing the occasion to learn about the coal work there, as mentioned on page 34 of the IG report. (See also Attachment 7.)

6. Other comments on the Report's Methodology and Approach:

Obviously, such an evaluation requires a broad understanding of what renewable energy technologies are and how they can compete with alternative energy supply modes. Furthermore, such an evaluation requires familiarity with the state of related R&D, in the U.S. and the LDCs, over the last decade, prospects of the future, state of the art in the industrial world, and last but not least - a familiarity with the experience other donor organizations have.

Through most of its comments the IG report exhibits incomplete understanding of renewable energy technologies, their evolution, state of the art and potential future. Certainly, by advocating that no R&D be done, the authors of the IG report subscribe to the belief that A.I.D. should start in the middle of the scream. Planning and conservation efforts are often key indicators as to which technologies should be tried and where. While application should be a consideration, it must be recognized that applicable technologies - once they are finally available - are dependent upon resources within the target countries.

Although the authors of the IG report state that the "audit was conducted in accordance with generally accepted government audit standards," the lack of participation of an expert team to contribute to a fair professional evaluation raises questions of the applicability of these standards to such a unique area as renewables. Management of projects is usually a reflection of project design in the broad context; thus to better understand the management aspects, a familiarity with renewable energy technologies is a necessary condition for a credible evaluation.

The report contains no explicit description of the scope and methods used in the IG review. The analysis seems to be based on a review of 45 project evaluation reports and IG audit reports and only limited field visits to three projects in India and the Philippines. Many statements about various projects have been taken out of context and used incorrectly to make inappropriate points.

In general the IG report adopts a negative attitude in drawing conclusions from the "statistics" of the limited analysis presented. For example, the Executive Summary points out that 46 percent of the examined projects were heavily oriented towards R&D. Wouldn't it be more appropriate to recognize that 54 percent of the project were applications oriented - a fairly large percentage at the time that R&D in the newly applied renewable technologies is an essential activity in all industrial countries as well as in the LDCs. Another example of the negativistic approach is contained in the comment that 50 percent of the reviewed projects involved complex and expensive technologies. Why not state that 50 percent of the projects reviewed were well applied? This is a fairly high percentage for the introduction of a new and as yet non-mature technology.

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AGENCY RESPONSE TO REPORT'S RECOMMENDATIONS

The IG report makes recommendations that are already being addressed by the Agency.

Recommendation No. 1: The renewable energy component of the energy policy statement be revised.

Response: This recommendation is already being addressed. Through its reassessment of renewable energy projects sponsored by AID and other donors, the Renewable Energy Applications and Training Project (936-5730), authorized in May 1985, will recommend changes in Agency policy to better establish and document goals, objectives, and priorities. These recommended changes will be consistent with Section 106 of the Foreign Assistance Act, including not only renewable energy projects but also their proper coordination with energy conservation and energy analysis, all within the context of training, institution building, and information exchange required for the successful implementation of renewable energy technologies. Note, however, that a policy paper provides only guidelines for action, with specific details to be outlined in strategy papers and program action plans.

Recommendation No. 2: Agriculture and some rural development policy statements be revised to include renewable energy as an integral part of agriculture and rural developments.

Response: A year ago AID started to develop and Energy for Agriculture Project (936-5731). The background work done for this project, along with other analyses, form the basis for supplemental Agency guidance on the inclusion of renewable energy considerations in Agriculture and other sector projects. We will initiate efforts to prepare such guidance.

Recommendation No. 3: The Office of Energy be established as the central office with overall responsibility for providing oversight of the energy programs within the geographic bureaus and missions.

Response: This would require a major reorganization that would affect the operational mode of the missions and other bureaus, as well as require major changes in the responsibilities and required budget and staff for the Office of Energy. This is not appropriate within the overall context of the Agency's organization. (See also the response to Recommendation No. 4).

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Recommendation No. 4: The Office of Energy be assigned responsibility for coordinating information exchange on project results.

Response: During the past year, in which the Agency shifted from technology-driven to needs-driven activities in renewable energy, the need for better coordination and cooperation has been stressed by not only the Office of Energy but also PPC and the geographic bureaus. The Office of Energy, in all of its activities, collaborates closely with regional bureaus and missions. In carrying out its functions of technical backstopping, technology transfer and research, training, and energy analysis and policy development, the Office of Energy gathers information from all of the regional bureaus and most missions. This information is then used in designing programs and projects that have Agency-wide applicability and impact. In addition, as part of its Renewable Energy Applications and Training Project, the Office of Energy is producing and disseminating reports on a number of country-needs assessments, evaluations, case studies, training programs, workshops and conferences. The project will also establish a comprehensive data base on renewable energy technologies, applications, and projects. This data base will be linked to the Development Information System, and automated on-line information storage and retrieval system in the Center for Development Information and Evaluation in Washington, where it will be available to regional bureaus, missions and others.

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<u>Recommendation No. 1:</u>	5
<p>We recommend that the Senior Assistant Administrator, Bureau for Science and Technology coordinate with the Bureau for Program and Policy Coordination to revise the AID Energy Policy Paper to reflect a "needs-driven" approach to renewable energy efforts in conformance with Section 106 of the Foreign Assistance Act. Specifically,</p>	
<p>a. establish as an Agency-wide policy addressing the energy needs of the rural poor as the overall objective of the renewable energy effort,</p>	
<p>b. establish interim goals to measure and evaluate progress toward overall objectives,</p>	
<p>c. integrate renewable energy efforts into agriculture and rural development projects,</p>	
<p>d. require the application of existing technologies prior to researching and developing new technologies, and</p>	
<p>e. specify duties and responsibilities of the Office of Energy Bureau for Science and Technology, the Center for Development Information and Evaluation Bureau for Program and Policy Coordination, the geographic bureaus and Missions in meeting renewable energy objectives and goals.</p>	

In the interim, the Senior Assistant Administrator, Bureau for Science and Technology in cooperation with the Energy and Natural Resources Sector Council should ensure that all new projects involving renewable energy technologies conform to the needs-driven approach. Where feasible, current projects should be amended to meet actual and specific energy needs.

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Recommendation No. 2: Page
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We recommend that the Senior Assistant Administrator, Bureau for Science and Technology coordinate with the Bureau for Program and Policy Coordination to revise Agency policy papers on agriculture and rural development to require that renewable energy efforts under Section 106 of the Foreign Assistance Act be integrated into agriculture and rural development projects under Section 103 of the Act.

Recommendation No. 3: 6

We recommend that the Senior Assistant Administrator, Bureau for Science and Technology expand the duties and responsibilities of the Office of Energy to include:

- a. monitoring implementation of renewable energy policy through the review of Country Development Strategy Statements, project papers and evaluation reports as they relate to renewable energy efforts, and
- b. coordinating and exchanging information, in cooperation with the Bureau for Program and Policy Coordination's Center for Development Information and Evaluation, between geographic bureaus and among Missions concerning successful renewable energy activities including technology research and development, applications and performance, and cost effectiveness and social acceptability.

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