PD-AAF-471

RENEWABLE ENERGY APPLICATIONS AND TRAINING PROJECT

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July 1985
Office of Energy
Bureau for Science and Technology
Room 508, SA-18
Washington, D. C.

PDAAE-471

Renewable Energy Applications and Training (REAT) Project (936-5730)

Project Paper

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ACKNOWLEDGEMENTS

The authors gratefully acknowledge the assistance of Dr. Martin Bush in preparing the training section of this paper.

I. PROJECT DATA SHEET

II. DRAFT PROJECT AUTHORIZATION

III. PROJECT RATIONALE AND DESCRIPTION

A. Goal and Purpose

The goal of this project is to assist selected developing countries in meeting their energy needs for development through the expanded deployment of economically viable renewable energy options.

The purpose of the project is to bring about investment in renewable energy systems which contribute to the solution of development problems of concern to AID. Such systems, and the policies necessary to support their implementation, have the potential to strengthen developing country institutions, involve U.S. industry and the indigenous private sector, and be self sustaining once donor assistance is withdrawn.

AID's approach, wherever possible, will be to develop a portfolio of "bankable" renewable projects, that is, projects which will attract financial commitments from businesses and multi-lateral lending agencies. Preparation of this portfolio for specific countries will require significant donor coordination at an early stage in the pre-investment analysis. AID is in close consultation with senior World Bank staff, and will also work with other major lenders and providers of financial assistance. The facilitation of joint ventures or licensing agreements between U.S. and local manufacturers will be explored if appropriate.

The project will:

- Assess priority applications of renewable energy technologies, with emphasis on productive uses in rural industry and agricultural systems of various sizes, and to identify those renewable energy systems which offer economically viable options to meet important energy needs.

- Collaborate with AID missions and regional bureaus, as well as with international financial institutions and developing country decision makers, to select, design, and implement renewable energy systems which are technically, economically and socially viable.

- Encourage joint ventures and promote the development of U.S. and local private sector capability to manufacture, market, and maintain selected renewable energy systems in the developing countries.

- Generate credible renewable energy information and publish the output in the form of high-quality, peer-reviewed documents. This is essential for wide use and significant impact. The documentation will be for the benefit of all AID assisted countries, not just those being assisted directly.

- Strengthen institutional capabilities in developing countries by training selected personnel responsible for planning, design, implementation, management and/or maintenance of a targeted portfolio of renewable energy systems. Strengthen developing country institutions responsible for providing training in renewable energy systems.

AID and other donors are at an important juncture with respect to renewable energy. The industrial countries, donor agencies and developing countries have stressed up till now the engineering and technology aspects of renewables as part of a demonstration approach. While this approach has been fruitful, some renewable projects, including those of other donor agencies, have limited economic viability. Other problems have included inadequate institutional capability and lack of maintenance and spare parts. If renewable energy systems cannot be commercialized, they will lack a workable distribution system and most of them will not survive after AID's assistance stops.

This concern was expressed in a worldwide cable from the Administrator (State 345387, November 1984), in his call for a critical reassessment of AID's renewable energy activities. The Renewable Energy Applications and Training Project (REAT) provides a formal, continuing mechanism to carry out this reassessment. The relationship between the activities of the REAT project and the reassessment is shown schematically in Figure 1. Mission responses to the work plan as of May 1, 1985 are summarized in Appendix 8.6.

AID needs to pay more attention to end uses, development impact, institutional issues, user acceptance, economics, and private sector involvement. AID has to adopt a "demand-driven" applications approach rather than one which is technology driven. Other donors are coming to the same conclusions. With this approach in mind, the Administrator has asked for a review of AID's past experience to refocus the Agency's renewable energy efforts on systems with a high probability of success.

B. Rationale

1. Why Renewable Energy?

The steep increases in conventional fuel prices over the last decade, and the urgent need to develop substitutes for

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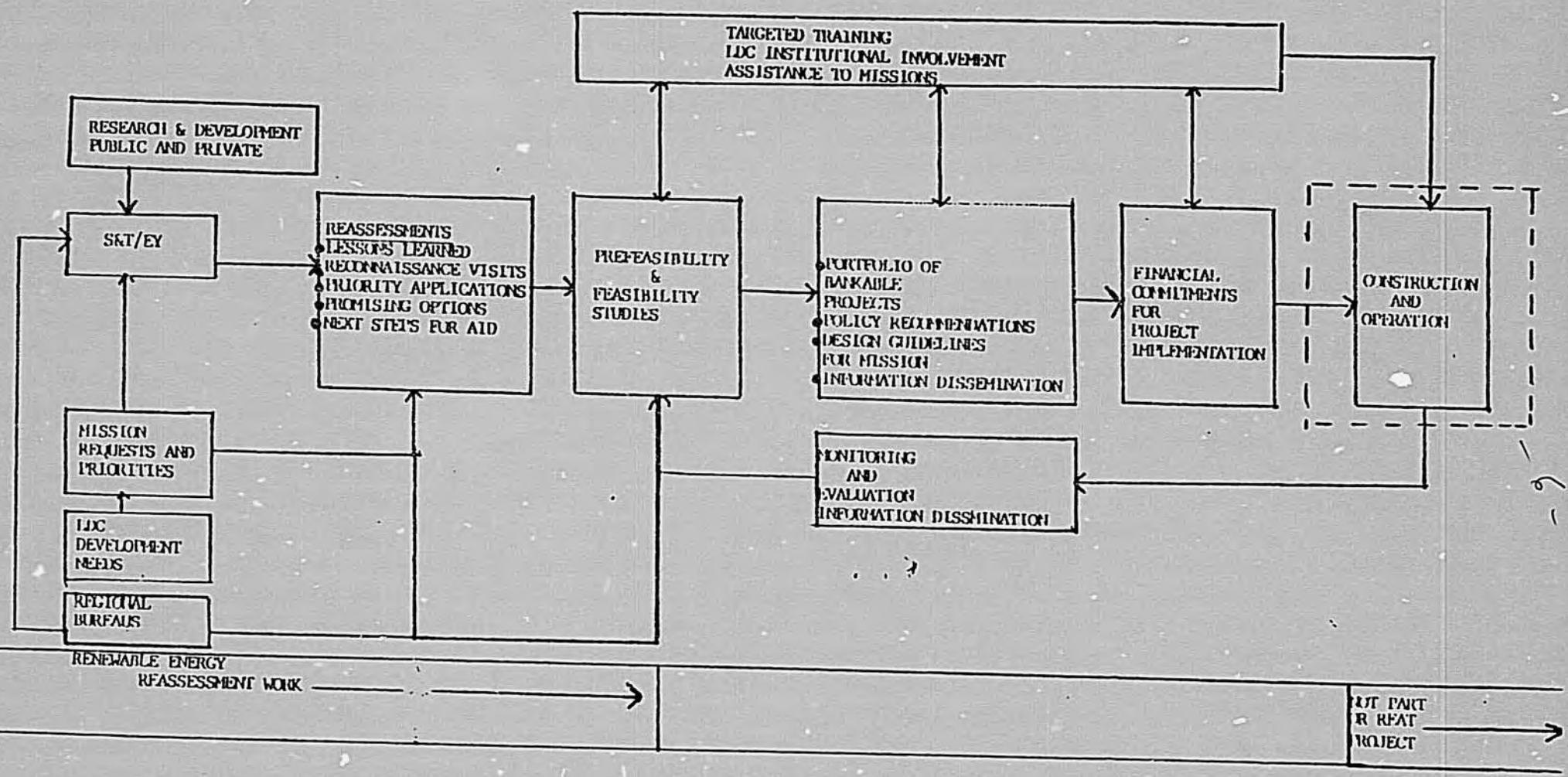

increasingly scarce and costly supplies of fuelwood, have prompted most developing countries to initiate remedial strategies.

Many developing countries, recognizing the critical role of energy in development, and the need to reduce petroleum imports, have launched major efforts to develop indigenous and renewable energy resources and to implement a number of high priority programs involving demand management, energy conservation, and pricing policy reforms.(1)

While the energy crisis appears to have abated in the U.S., energy problems in developing countries continue to grow more severe. While the U.S. is now paying less for oil, the developing countries continue to pay more. While the U.S. economy has adapted to the high price of energy without a serious loss of momentum, Third World countries have not. The following facts make clear the nature of the worsening energy crisis in less developed countries:(1, 2)

- Energy prices in local currencies of LDCs are still increasing, not declining. Since 1981, for example, the real price of fuel oil has increased 40% in Sudan, 140% in Peru and 170% in Ecuador. Twelve months ago, Jamaica paid J$86 per barrel of oil. Now, with a 32% devaluation in their currency, they pay J$126.70 per barrel.

- The demand for energy in LDCs is growing at an astonishing rate. Between 1980 and 2000, the population of AID-assisted countries will continue to grow rapidly, on average over 2%, and in some of the poorest African countries, over 4% annually. The urban population in many developing countries is growing twice that fast.

- Without adequate attention to the energy problem, economic growth in the Third World will be stifled. It is well established that growth in per capita GNP and commercial energy consumption (fossil fuels, hydropower and other modern forms of energy) are inextricably linked.(3)

- A large share of developing countries' foreign exchange is drained off to pay for imported energy, leaving too little to pay for development investments. In 1980, 22 AID-assisted countries spent over 40% of their foreign exchange earnings to pay for oil, 25 spent between 20 and 40 percent, and only 10 countries spent less than 20 percent. This drain, coupled with the serious debt crisis, leaves little for investment in agriculture, industrial development and other critical development programs.

- For the poorest people in developing countries, the fuelwood crisis has dire human consequences. Nearly half the world's population today lives in areas where fuelwood is acutely scarce; if current trends continue, up to 3 billion people will be living in such areas by the year 2000. The past several years have seen dramatic rises in fuelwood and charcoal prices, up to 10% a year in some places, placing an intolerable burden on those least able to afford it.

The following arguments can be advanced in favor of renewable energy options as a means to address some of these problems:

- Renewable energy is an indigenous resource available in considerable quantities to all developing nations and capable, in principle, of having a significant local, regional or national economic impact. Renewable energy utilization therefore has the potential to conserve foreign exchange and generate local employment if conversion technologies are designed, manufactured, assembled and installed locally.

- Several renewable options are financially and economically competitive for certain applications, such as in remote locations where the costs of transmitting electrical power or transporting conventional fuels are high, or in locations well endowed with biomass, hydro or geothermal resources.

- The conversion technology is flexible and modular, and therefore amenable to relatively rapid deployment. The rate of implementation of certain distributed power generation systems, whether renewable or non-renewable, can be high. Other advantages over large, central-station options include flexibility in adding new capacity, lower risk in comparison with 'lumpy' investments, lower interest on borrowed capital because of shorter lead times, and lower transmission and distribution costs for dispersed rural locations.

- Rapid scientific and technological advances are expected to expand the economic range of renewable energy applications over the next 5-10 years, making it imperative for international decision-makers and planners to keep abreast of these developments.

2. Why haven't Renewable Technologies developed Faster?

Experience with renewable energy projects in the developing countries by AID and other donors indicates that there are a number of barriers to the effective deployment and widespread diffusion of renewable energy technology in the developing countries. These are:

- Inadequate gathering and evaluation of past experience, a paucity of validated field performance data, and no clear priorities for future work.

- Weak or non-existent institutions and policies to finance and commercialize renewable energy systems in a context in which there is already a high degree of institutional fragmentation in energy planning. Separate organizations are often responsible for petroleum, electricity, coal, forestry, fuelwood, renewables and conservation.

- Technical and economic uncertainties in many renewable energy systems; high economic and financial costs for some systems in comparison with conventional supply options and energy efficiency measures.

- A lack of familiarity and a degree of scepticism regarding renewable energy systems on the part of energy planners and decision-makers, and a severe shortage of trained personnel to design, manufacture, market, operate and maintain such systems.

- Inadequate donor coordination in renewable energy assistance activities, with little or no information exchange on successful and unsuccessful projects.

3. Why a Bureau of Science and Technology Renewable Applications Project?

The Renewable Energy Application and Training Project will directly address these major obstacles. This will be achieved through applied research, information dissemination, the design of investment and implementation plans for specific countries and development sectors, co-financing and collaboration with other donor organizations and lending institutions, and targeted training to strengthen LDC institutions responsible for selecting, designing, managing and maintaining renewable energy systems.

The project provides a coherent, guiding framework for selecting, designing and implementing renewable energy systems which are reliable, cost-effective and sustainable. The project is a unique vehicle to learn from the past experience of AID and other donors, and to follow up on opportunities created by other renewable energy projects.

The activities of the REAT project include: technical assistance for analysis and implementation, including policy formulation, pilot-projects*, investment portfolio design and the development of an on-line renewable energy data-base; targeted training to strengthen institutions responsible for managing renewable energy systems; applied research and technology transfer; and assistance in securing financial commitments from banks and other donor agencies.

4. What should be the role of the Office of Energy in Renewables?

The Office of Energy of the Bureau of Science and Technology, in consultation with the Regional Bureaus and the Energy Sector Council, is the appropriate organizational unit to implement a project which is global in character.

S&T/EY will act as a focal point to extract and disseminate lessons learned from past renewable energy activities, and to provide access to the renewable energy industry and to the U.S. Department of Energy.

The Bureau of Science and Technology has the organizational capacity to respond to regional bureaus and missions, to consult closely with multilateral development banks and other donors, and to capture 'networking' opportunities.

AID can play a unique role in providing support for preinvestment activities involving modular renewable energy systems which differ considerably in risk and scale, as well as in institutional and investment requirements, from large-scale energy systems.

S&T/EY will work with the Missions in exploring how new renewable energy pilot programs can be integrated with ongoing bilateral projects. The rationale for this is that renewable energy systems can contribute to rural employment and development, to the economic effectiveness of agro-industrial enterprises, and to increases in agricultural and industrial productivity.

Financial credit institutions, whether public or private, cannot lend money unless there is a financially viable organization to repay the loan. Since the institutional

* Pilot-Projects are defined to be small-scale projects which provide necessary information prior to long-scale investment. These are not technology demonstration projects, i.e. projects which demostrate technical feasibility.

delivery systems for renewable energy are highly fragmented in the developing countries, and are often dominated by small entrepreneurs, they lack the financing access of utilities or oil supply organizations. Consequently, the institutional context and appropriate marketing mechanisms for renewable energy are likely to weigh heavily in any financing decision. Because of this. AID's renewable work will also concern itself with means to strengthen institutional delivery and credit institutions, and private marketing mechanisms.

Significant investments in renewable energy systems and projects should be preceded by country specific studies and pilot projects to iron out technological wrinkles, test user acceptance and determine the private sector potential for delivery of energy to consumers. AID's involvement will produce little of lasting value if the technology is supported without a clear idea of the industrial, commercial, agricultural and other markets to be served, and of the private mechanisms to deliver renewable energy in a timely and affordable manner.

5. How does this project support AID's Energy Policy and Strategy?

The REAT Project is consistent with AID's energy policy. As set forth in the Energy Policy paper of July 1984, the objectives of this policy are to:

- o develop sound national energy policies that are integrated with national economic policies, and supportive of sustained economic growth;
- o expand the production of economic indigenous energy sources, substituting for high cost imported energy wherever economically justified, and
- o improve the efficiency of energy use

The goals and purpose of the REAT project are consistent with the long-term objectives of the Agency's policy with regard to energy. The activities to be carried out under the REAT project are in conformity with the strategies adopted by the Agency in support of its goals.

Assistance provided under the REAT project to AID-assisted countries will also be consistent with, and in support of, AID program objectives as set forth in the Country Development Strategy Statements.

6. How will this Project relate to other S&T/EY Projects

There will be active and synergistic ties between the REAT Project, other S&T/EY projects, such as the Biosystems and Technology Project, the Energy Policy Development and Conservation Project, mission projects and projects in other bureaus. For example, in carrying out the Administrator's renewables reassessment work plan, the resources of three existing S&T/EY projects will be drawn upon. These are the Bioenergy Systems and Technology Project (936-5709), the Small Decentralized [illegible] Project (936-5715), and the Low Cost Energy Technology Project (936-5701).

Pre-investment work may occasionally warrant consideration of decentralized power options dependent on a variety of renewable or non-renewable sources. Under such circumstances the project will collaborate with the Energy Policy Development and Conservation (EPDAC) project, conventional energy projects, and lending institutions to pursue such options.

The REAT Project will build on the assessments and feasibility studies carried out under other S&T/EY projects. There will also be jointly sponsored workshops and training activities if appropriate. The REAT Project will place greater emphasis, however, on activities leading to significant follow-on funding by multilateral lending institutions such as the World Bank and the Inter-American Development Bank, and to approaches that will involve the U.S. and local private sector.

7. How will this Project involve other Donors?

The Administrator's cable calling for a reassessment of AID's renewable energy activities states that "AID's Agency-wide effort will be coordinated with World Bank, regional development banks and other multilateral and bilateral donor agencies." S&T/EY staff have met with senior staff from the World Bank, the Inter-American Development Bank and the United Nations Department of Technical Cooperation for Development, and further meetings are planned with representatives of bilateral donor agencies, and the U.S. renewable energy industry.

AID could utilize its resources for pre-investment portfolio preparation provided there is some assurance that this could lead to actual hardware projects financed by others, e.g., the Work Bank. As an example of how this process might work, a report of an important meeting with senior staff at the World Bank is presented in Appendix 8.5.

8. How will this Project involve the U.S. Private Sector?

The project will employ the following mechanisms to involve the U.S. renewable energy industry.

1. Joint sponsorship of seminars with U.S. industry associations, LDC decision makers, and lending institutions on the state-of-the-art, financing of joint ventures, marketing and local business climate in LDCs. These seminars could be combined with field visits to U.S. renewable energy installations and manufacturing facilities.

2. Jointly fund field trips, to LDCs of teams composed of representatives from industry, experts on renewable energy technology, and people with specific knowledge of the host country's energy scene and development needs. These teams will meet with AID energy and agricultural officers, other AID representatives as necessary, and with host country decision-makers experts to update them on advances in renewable energy applications and near-term potential. At the same time, industry representatives on these teams will have an opportunity to be exposed to the problems renewable energy faces in an economic and social context. These field visits will give industry representatives and opportunity to display relevant equipment to LDC decision-makers.

3. Sponsorship of technical training and internship of LDC participants in U.S. renewable energy industries and/or installations.

4. Provide information, reports and assessments on opportunities in LDCs to the Industry Advisory Committee.

C. REAT Project Components

The REAT project components consist of technical assistance for assessments and pre-investment activities, information dissemination and training. The focus of the technical assistance component will be to:

- Review lessons learned, through a critical examination of the past experience of AID and other donors with renewable energy systems in developing countries. The product of this activity will consist of peer-reviewed publications and recommendations for promising projects.

- Perform country-needs assessments, and identify priority development-driven energy demands which can be met by the deployment of specific renewable energy technologies.

Reports produced under this activity will be used to solicit interest on the part of investment institutions.

- o Evaluate systems and technologies, provide support for equipment tests and certification if appropriate, and identify viable renewable energy systems and LDC institutions worthy of Agency support, and prepare projects for donor agency financing and private sector investment.

These three aspects of the technical assistance component are discussed below:

1. Review of Lessons Learned

Now that considerable experience has been gained with renewable energy technology applications in the developing countries, a consensus is emerging among donor agencies of the need to take stock of the situation, and to critically formulate the future role of the renewables in meeting energy needs.

Assessments of renewable energy systems have been sponsored by AID, including evaluations perfomed by the Africa and Asia bureau, the U.S. Department of Energy, the World Bank, the UN Development Program, and others. There is a need to compile and review these assessments, conduct additional assessments as needed, and to design a coherent and comprehensive strategy for implementing renewable energy systems in developing countries.

The review of lessons learned will address two central questions:

- o What has been the economic, financial and technical performance of renewable energy systems in providing energy for agricultural, domestic, and industrial uses?

- o What problems have emerged with social acceptance, institutional compatibility, private sector involvement and delivery systems?

2. Country-Needs Assessments

(a) Criteria for Choosing Countries:

Priority will be given to those countries whose development is seriously constrained by energy problems; which have substantial renewable energy resources; where the government, private sector and AID mission are committed to fostering the

institutional and policy climate necessary for a successful project; where sufficient energy planning has been completed to ensure that a renewables project could be effective; and where AID project intervention can leverage larger investment funds from multi-lateral banks and the private sector.

Special emphasis will be placed on those countries where the private sector is capable of marketing, implementing and maintaining renewable energy systems once donor funds cease. The choice of countries will be made by S&T/EY in close consultation with the appropriate missions and regional bureaus.

(b) Priority Needs:

A careful assessment will be made of energy needs in selected developing countries in a context that emphasizes energy-development links. Energy needs for productive agriculture and rural development will be examined in the context of Agency energy policy and the country development strategy statements (CDSS).

Agro-industrial needs examined will include: energy for agricultural water pumping, crop and food processing, food storage, and industrial applications. Attention will also be given to energy needs for health, education, communications, lighting, transportation and other development sectors.

(c) Reports and Regional Workshops:

The needs studies will be based on World Bank sector studies, contractor reports, regional bureau studies, interviews with AID personnel familiar with each country, and other appropriate sources. If necessary, reconnaissance field trips will be made. Draft reports for each study will be reviewed by the host country and the appropriate AID mission before publication and distribution.

The studies will have a generic as well as a country-specific character. The generic aspects include a consistent approach to identifying needs, proposing technical solutions and institutional arrangements, and leveraging AID resources. The country-specific aspects will be exemplary for some missions and illustrative for others, depending on the degree of similarity to the country being studied. The studies will be brought to the attention of the AID community through regional workshops for mission and host-country government personnel, and through appropriate publications.

(d) Examples of Country Activities:

Some of the following examples are under discussion with the Mission and regional bureaus. Others are merely illustrative, and the REAT project is not limited by this list. Final decisions on these countries will be made following consultations with appropriate missions and bureaus.

- Madagascar - Formerly a rice exporter, Madagascar now must import rice. Energy imports, including oil for electricity production, also contribute to a worsening trade imbalance. Together, oil and rice constituted 30% of all imports in 1982. In consultation with the World Bank, S&T/EY is initiating a national renewable energy assessment to determine the appropriate role and subsequent implementation strategies for key renewable energy applications, primarily decentralized hydro. Two immediate issues are to be addressed: (1) agricultural revitalization through additional energy inputs and (2) diesel oil import substitution. The study will also examine long-term energy needs and plans and assess the role of decentralized hydro and other renewables in Madagascar's power sector, both stand-alone and grid-connected. Pre-investment studies will be carried out to identify applications where renewables offer viable energy options, and to assess the financial and economic feasibility of representative projects. These pre-investment studies will be conducted in consultation with lending institutions, and will be used to generate investment in hardware projects.

- Indonesia - Before committing investment sums to renewable energy programs, the Government of Indonesia should subject the renewable options to rigorous economic examination to determine (a) whether renewables are economically sound, and under what set of conditions, taking into account specific demands and the cost-effectiveness and reliability of competing supply sources; (b) whether renewable projects are financially viable, and under what conditions; and (c) whether there is a role for private-sector involvement in equipment manufacture, system financing, engineering, construction, operation, and ownership.

- The Philippines - The Philippines study may evaluate the experience in power generation for rural and productive uses, examining conventional options, geothermal, decentralized hydro, and dendrothermal in the context of integrated supply options to meet demand. The study will establish clear links between development needs and energy

supply options and provide options for future decision-making regarding development assistance policy. The assessment will illuminate the economically viable energy solutions with the highest developmental impact and the highest probability of successful financing and implementation.

- Thailand - The commercial energy production and consumption pattern in Thailand will be transformed by the emergence of a domestic fossil fuel industry - principally natural gas and lignite - and a substantial increase in hydroelectric capacity, both centralized and decentralized.

  In this context, the project could provide assistance to the AID Mission in reviewing renewable energy strategy in Thailand, paying special attention to the role of hydro development in an integrated resource management approach. The AID Mission in Thailand is planning an assessment of natural resource policy options, and S&T/EY's work will contribute to this assessment. S&T/EY examine (1) the role of decentralized hydropower and other renewable energy systems in meeting energy demands in Thailand and (2) Investment strategies for the economic development of selected renewable energy systems.

- Tunisia - Tunisia has experienced impressive economic growth fueled by high revenues from petroleum exports. However, rising domestic energy prices, the use of significant quantities of imported diesel in the agricultural sector, and the large and growing fraction of food production costs contributed by energy inputs, suggest a role for renewable energy sources in meeting agricultural production needs. In collaboration with the Mission, ST/EY will evaluate the potential economic role of renewable energy systems, such as wind energy for electricity or pumping, densifiers for briquetting cellulose materials, solar thermal technologies for water heating and crop dehydration, and biogas plants for agro-industrial units. This evaluation will treat national energy planning issues, as well as the economic viability of USAID funded projects such as the Renewable Energy Project which demonstrated the application of solar and wind technologies in the village of Hammam Biodha.

- Morocco - The Moroccan economy faces considerable balance-of-payments difficulties aggravated by a rising petroleum import bill and stagnant export performance. Morocco's domestic oil production is declining, and despite a recent natural gas discovery and extensive oil shale deposits, Morocco's continued economic development

will require the development of economically viable domestic energy resources. Renewable energy systems, especially small-scale hydropower, wind energy for water pumping and electricity, solar thermal technologies and improved biomass energy conversion (municipal solid waste, wood fuels/charcoal, and agricultural residues) will be examined to determine their economic potential in meeting Morocco's energy needs. In consultation with the Mission, ST/EY will evaluate the various needs which can be met by renewable energy systems in a technically and economically feasible manner. The study will be coordinated with an evaluation of USAID's support of Morocco's Center for Renewable Energy Development (CDER), and support to the Ministry of Energy and Mines for national energy planning and evaluation.

(e) Methodology:

The assessments will highlight energy solutions with high developmental impact, and with a high probability of successful financing and implementation. The reports will adopt an analytic approach emphasizing the following closely-related strategies:

- A planning strategy that sets national priorities for the role of renewable energy and power systems in development sectors, using an approach where economic costs and benefits, such as jobs and enterprise creation, can be measured.

- A sector strategy that selects specific renewable energy systems capable of having a measurable impact on agriculture, agro-industry, small enterprises, health and rural development.

- A "bankable" strategy, where AID technical assistance is used to prepare energy projects for financing by development banks, commercial banks and donor agencies.

To support these strategies, energy planning and assistance policy must be demand-oriented and driven by development needs. Existing and future energy demands will be quantified by analyzing development plans by activity and location, and assessing the impact of these sectoral policies on energy demand. Supply sources will be compared in their ability to meet this demand, taking account of costs, tradeoffs and major bottlenecks, such as foreign exchange, transportation facilities, and institutional implementation capability. Renewable systems will be compared with other supply options

in their ability to provide the energy needs of agriculture, agro-industrial enterprises, communications, health and urban/industrial concentrations.

The economically optimal investment decision requires two procedures to be followed. First, on the demand side, identifying priority sectors which require energy or power, and second, on the supply side, constructing an economically viable combination of conventional generating options, renewable energy systems, and energy-efficiency measures.

Prudent decision-making will have to be based on a systematic analysis of the effect of uncertainty on investment options, since there are numerous exogenous uncertainties not within the control of national decision-makers. These uncertainties include the price of oil, the state of the world economy, world prices for the principal export commodities and interest rates. There are also uncertainties in future energy demand, and project-related uncertainties such as technology cost and performance.

Technical, economic and institutional data obtained from systems in the field are an essential ingredient in reducing uncertainty in any future decision-making process. Technologies examined will include the renewable power systems, conventional power options, and energy efficiency measures. The "least-cost" solutions will be obtained for a variety of demand levels based on plausible development plans.

Specific technologies are discussed in the sections that follow.

3. Systems and Technology Evaluation:

(a) Questions to be Addressed:

A number of renewable energy technologies will be carefully reviewed and evaluated in order to determine their applicability to AID's development programs. These studies will be based on work sponsored by the AID, the World Bank, other multi-lateral and bilateral donors, the private sector and the U.S. Department of Energy. A uniform approach will be used to evaluate available information, to compare field performance and site specific cost data, and to assess the commercial readiness of each technology for use in developing countries.

The technology evaluations will address the following questions:

- What energy constraints to development are addressed by the technology?

- Under what conditions is the technology economically feasible?

- What specific physical resources does the technology require for application (water, wood, bio-waste, electricity etc)? What level of manpower skills, local manufacturing, repair and maintenance is required?

- In which AID assisted countries is the technology most likely to be applicable? How successful will the application be in terms of matching the technology to the physical and institutional environment?

- What are the basic elements of a successful program to introduce the technology, e.g., feasibility studies, marketing studies, institutional strength etc.?

- In which AID assisted countries do all or most of these elements exist and in which countries can these be developed?

- Who are the key actors in developing the program: other S&T offices, regional bureau staff, World Bank staff, host country officials, Mission personnel and so forth?

- What is the schedule for successful implementation?

(b) Criteria for Choosing Technologies and Systems:

Renewable resources are defined in this project to include "direct" solar energy intercepted by collectors such as solar photovoltaic cells and thermal collectors, as well as 'indirect' solar energy such as wind, hydropower, and biomass resources managed in a sustainable manner. Geothermal fields tapped with present drilling technologies have a finite life, but are sometimes considered renewable for practical planning purposes, and geothermal systems will be included in this project. Traditional methods of utilizing biomass and its derivatives, such as wood and charcoal, are inefficient and non-renewable, in contrast with modern methods emphasizing proper forest management, sustained-yield fuelwood plantations, and efficient production and utilization.

Emphasis will be given to technologies capable of providing energy of the necessary quality, and at an appropriate level of power, and whose characteristics match user needs in priority development sectors such as agriculture and rural industry. Systems under consideration will include, but not

be limited to, modular electric power generation systems (small hydropower, wood-burning power plants, cane energy, photovoltaics and wind), industrial and agro-industrial process heat (solar thermal systems, biomass briquettes, anaerobic digesters, and biomass gasification), solar refrigeration, and water pumping wind systems.

The systems and devices to be examined in this project span a wide spectrum of power levels. Devices under consideration fall into two major groups, below 100 kilowatts, and between 100 kilowatts and several megawatts. Strategies to leverage follow-on lending and involve private-sector commercial interests will depend on the number of units and their power level.

But regardless of power level, the needs and technology evaluation studies will identify renewable energy technology applications which have, or could have, a strong impact on development. Once these technology applications are identified, Agency strategy to develop and implement appropriate projects must meet certain additional criteria.

These criteria require renewable energy systems to provide economically feasible solutions to the development problem, to involve the private sector, and to be self sustaining once donor assistance is withdrawn. In short, AID's strategy should develop a portfolio of "bankable" renewable projects, that is, projects which will attract financial commitments from private businesses and multi-lateral lending agencies. For private investment to occur, projects will have to be financially feasible and meet standards of performance with no significant operational or maintenance problems. In addition, implementing suitable renewable energy systems will require applied research and communication of research results through appropriate networks of collaborating institutions in the U.S. and abroad.

(c) Linking Renewables with Energy-Efficiency and Conservation:

Renewable energy is a means to reduce the demand for conventional energy forms. Thus, in performing economic, financial and policy analyses, there is no real methodological distinction between renewable energy and energy efficiency.

A key economic priority for all developing countries is energy efficiency improvement, because of the rapid payback of initial investment and the high rates of return involved. In the power sector, for example, investments to reduce losses and to improve the maintenance and reliability of existing units have the highest rate of return, and should be implemented before decisions to add new generating capacity - whether conventional or renewable - are made.

In performing pre-investment analyses for renewables, the REAT Project will have to examine investment options that include energy efficiency as well as hybrid systems involving conventional energy, renewable energy, and energy storage.

Energy efficiency improvements can be teamed with a variety of energy supply technologies, an important consideration when assessing the relative economics of renewable and conventional energy systems. For example, in the industrial sector, the use of energy efficiency approaches ranging from no or low-cost measures (such as reducing excess air in boilers, shutting down equipment when not needed) to systems requiring moderate capital investment (such as heat recuperators, boiler replacement, or cogeneration units) can improve the financial and economic feasibility of solar industrial process heat as well as that of conventional energy systems.

(d) Technology/Application Areas

The REAT Project will focus on several generic renewable energy technology and application areas likely to be of economic and market interest in the developing countries in the short to medium term future. These are:

o Biomass Power Generation

Crop residues such as bagasse and coconut husks have generally been used as the prime energy source for crop-drying and processing in the sugar and copra industry.

A major new development is the realization that significant quantities of residue are available for use in the economy (4) at costs that are competitive with imported oil. Assuming that suitable institutional arrangements can be devised, the production of electric power and process heat from bagasse, wood-waste and agricultural residues from rice and coconut cultivation could play a major role in appropriate countries and regions. Where wood wastes are readily available, wood-fired power generation costs are competitive with diesel power applications (5).

For example, the national benefits of growing cane for sugar and electricity production have been analyzed by AID, the World Bank and others. The World Bank has estimated that about 12 million tons of excess bagasse are produced annually in major sugar-producing countries beyond the amount that has traditionally been burned by sugar mills for power and process steam, and that the economic returns for converting this bagasse to electricity for public consumption are well over 10 percent at selling price of 6 cents per KWh.(1)

There is a large potential for using small to intermediate cogeneration systems in the range of 100 KW to 5MW if the waste heat in power generation can be productively used in industrial and agro-industrial settings. Co-generation systems in this power range are flexible, energy-efficient, relatively low in incremental capital cost compared with large-scale power systems, and amenable to rapid implementation. The boilers used with such systems can be designed to be fueled by a variety of agricultural wastes - bagasse and rice-husks, as well as by saw-mill residues, conventional fuels and mixture of biomass and fossil-fuels.

The Philippines have launched an ambitious program to generate electricity from 3 MW wood-fired power plants, where the wood is provided by sustained-yield plantations - the "dendrothermal" option - but the prospects for a successful program are still not well established.

Depending on the knowledge and skills developed during the Jamaica energy cane assessment being carried out by the Biosystems and Technology Project (BST), the REAT project will collaborate with the BST project to explore the potential for introducing sugar cane energy management and power production systems in other AID countries, possibly the Dominican Republic, the Philippines, and Thailand. The purpose of introducing sugar cane energy systems is to revitalize the sugar industry, produce jobs, and modernize existing sugar cane systems with the dual aim of obtaining high production levels of both sugar and electricity. Specifically, these studies should:

- o disseminate technical information on cane cultivation for the dual purpose of producing sugar and electricity
- o promote the development of economic and reliable bioenergy systems suitable for private investment
- o help AID missions and LDC governments identify and plan bioenergy activities and programs to meet development needs

o <u>Household Fuels and Biomass Briquetting Technology</u>:

In many developing countries, the sustainable annual production of fuelwood has lagged considerably behind demand, and the gap appears to be widening at an accelerating pace. There is little possibility that the gap can be narrowed through afforestation and demand management alone, and alternative fuels will clearly be necessary.

Even though the use of LPG, kerosene and electricity for home comsumption is likely to increase in the urban areas of many developing countries, the production of briquettes from agricultural residues in large-scale agricultural operations is likely to be a serious and cost-effective near-term

option. A good case for this option has been made in recent studies carried out for Ethiopia and the Pacific Islands.(6)

The REAT project will initially focus on those areas encountering the most serious fuel shortages -- certain special rural areas and urban centers, and will assess markets and design pre-investment plans to meet household energy needs in these special areas.

Photovoltaics for Remote Power Applications: Refrigeration, Pumping, Lighting and Communications

The solar energy technology with probably the greatest potential for providing energy to the developing countries is photovoltaics. The one major problem remains the high cost of photovoltaic systems. Although costs have declined steadily, they are still too high for many applications. At present module costs of around $5 - $7 a peak watt, photovoltaic devices produce expensive electricity.

Where diesel engines are used to generate electricity or to pump water, however, and where diesel fuel is expensive, photovoltaic systems are now a practical and economical alternative. For specialized low power applications such as village health care, photovoltaic technology is proving to be a cost effective option. PV-powered refrigerators are being used to preserve vaccines in rural clinics in about 25 developing countries. These systems are more reliable than the kerosene-fueled absorption cycle refrigerators typically found in rural health centers in the developing world. AID has played a significant role in pilot-testing such systems in a number of countries.

The market and developmental significance of photovoltaic lighting and communication systems will be examined for specific countries. The relation of market size to the delivered price of photovoltaic systems will be determined, and steps will be taken to accelerate the implementation of systems where important development impacts are likely.

Water Pumping for Irrigation in Africa

Increased irrigation in Africa is vitally important. In cooperation with the Africa Bureau, REDSO, S&T/EY and S&T/AG a feasibility study of water pumping for irrigation in various African countries will be performed. This will include wind and PV activated systems.

Special attention will be given to the state of the art, operating and maintenance issues, reliability and spare parts, comparative pumping costs and pump-matching problems. This study will also contain a work plan to address broader

irrigation issues in selected African countries such as agricultural development barriers due to irrigation shortages, pumping options to meet these development needs, and the cost-effectiveness of wind and PV pumping compared with diesel and other alternatives.

Solar Thermal Refrigeration

During the last decade the Refrigeration Laboratory of the Technical University of Copenhagen in collaboration with Danish industry under the sponsorship of the Danish Foreign Assistance Program, have developed small, stand-alone solar ice plants. These plants operate using flat-plate collectors and an ammonia-water cycle. These small units have been, and still are, field tested in FAO fishery projects and WHO medicine storage programs. Since the utilization of these units is increasing, it is important to assess this new technology, evaluate its technical potential and estimate the applicability of such systems in various AID countries with needs to preserve fish and agricultural products.

Because of their simplicity and relative low cost, these ice making systems are particularly suitable for applications in rural areas under the management of cooperatives. These units can be easily manufactured locally and private sector enterprises would be an excellent vehicle to promote them.

Solar Thermal Technology for Industrial Process Heat

The cotton, dyeing, and food processing industries in developing countries use considerable amounts of energy in the form of moderately-hot water. Low-cost solar collector systems could save significanc quantities of fossil fuel. Furthermore, such systems are relatively simple and can be locally manufactured and installed, providing a variety of employment opportunities. A number of industrial countries have successfully used these systems, including the U.S., Japan, Israel, Australia, Greece and Cyprus. A technology evaluation that documents lessons learned and assesses the LDC potential for application will be a valuable contribution.

Ethanol Production

Another biochemical conversion route involves the processing of starch and cellulose, and the fermentation of sugars, to produce ethyl alcohol. The most ambitious alcohol program is in Brazil, but at least seven other developing countries have commercial ethanol plants either in operation or under construction.(8)

Ethanol can be manufactured from sugar crops (sugarcane, sugar beets, sweet sorghum), from grains (mainly maize, barley, and rice); from some root crops such as cassava and potatoes, from fruits such as grapes, and also from cellulose materials such as wood. Sugar cane is favored in many developing countries, including Brazil, since the plant is familiar and has been intensively cultivated in some regions for many decades. Over 40 developing countries grow sugar cane. Sugar cane also comes with its own fuel--bagasse--an important consideration for small distilleries in the rural areas of the developing countries.

Several developing countries (Malawi, the Philippines and Zimbabwe) have begun small alcohol programs and others are examining the prospects for this fuel. However, the experience of the last five years has confirmed that the economics of alcohol production are highly site-specific, and that successful alcohol projects require an integration of agricultural, industrial and transport strategies.

o Producer Gas Technology for Agro-Industrial Application: (9)

Producer gas is a low quality fuel gas, which can substitute for gasoline and diesel oil in conventional internal combustion engines, both vehicular and stationary, and can substitute for petroleum fuels in process heat applications. Gasifier technology has recently been revived and adapted by a number of developing countries--particularly in Brazil and in the Philippines.

The World Bank/UNDP is currently conducting a program to monitor the cost and performance of gasifier installations in a number of countries. S&T/EY is also planning to issue an interim report on field experience with gasification systems as part of the reassessment activity. This report will summarize past experience of several donors: AID, GTZ, Netherlands, SIDA (Sweden), World Bank, France, the EEC, FAO, and FINNIDA.

Commercial-Scale Biogas Digestors

Larger scale biogas systems are an effective means of waste disposal for feedlot operations and large livestock raising businesses, while simultaneously producing substantial amounts of fuel gas. This gas can be used to supply energy directly to the farm or business which generates the waste.

Large anaerobic digesters are in operation in China, the Philippines, India, Costa Rica, Indonesia, and many other developing countries. The world's largest biogas power plant is in the Guangdong Province of China, where 170 tons a day of nightsoil are fed to digesters that produce about 700 cubic meters of biogas daily. The gas is piped to dual-fuel diesel generators with an installed capacity of 135 kW. The Bacardi distillery in Puerto Rico operates a 12,600 cubic meter digester which treats 1200 m^3 of stillage each day, and produces nearly 29,000 m^3/day of biogas. The gas is used in the distillery as a fuel for generating steam.(10)

Small Hydro-Power(11)

Conventional hydroelectric generation is projected to increase by more than 150 percent during the period 1980-95. Even after this increase, less than 15 percent of the feasible hydropower potential of the developing countries will have been developed. Hydropower is a particularly promising resource in the highland areas of South America, Asia, and Africa. In these regions, the lack of electric power and diesel fuel greatly limit economic development.

Over the last few years there has been increasing interest in deploying decentralized hydropower systems. Although the technical principles are fundamentally the same, there are important differences, quite apart from scale, between very large and very small hydropower schemes. Large hydropower plants typically involve the construction of an expensive dams. Small hydropower schemes, however, often take water directly from a river, and immediately convey the water to a powerhouse for the generation of electricity.

Although decentralized hydropower has traditionally been seen as appropriate in rural areas remote from the national grid, it can also be an attractive option for supplying electricity to the grid. The principal need in developing decentralized hydropower is for cost effective national programs that can deal with hundreds of small, widely dispersed projects in a field traditionally served by large centralized facilities.

4. Information Dissemination

(a) Accurate Information

To assure credibility and wide-spread impact, the REAT project will produce and disseminate authoritative publications and documents. These reports will include an estimated eight country investment portfolios, eight major technology evaluation reports, five case studies, training monographs as appropriate, and the proceedings of five workshops and conferences.

Wide dissemination of accurate information is an indispensible part of effective renewable energy policy formulation, sector planning, and project design. Data from the field will be systematically collected, processed, and analyzed; and this information will be conveyed to planners, policy-makers, and Agency personnel working with renewable energy systems -- both in the US and in the developing countries.

Workshops and seminars will be held to promote regional communications and collaboration among developing country institutions responsible for renewable energy.

In the past, renewable energy technology projects paid scant attention to the systematic monitoring of field performance, either technical or economic, focusing instead on demonstrations of technical feasibility. 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.

REAT Project Staff will disseminate reports produced under this project to a wide international audience of developing country decision-makers, the U.S. and indigenous private sector, multilateral and bilateral agencies, and the scientific, technical and development community.

(b) Renewable Energy Data Base

To improve information exchange among energy policy-makers, planners, and renewable energy specialists, the REAT project will establish a comprehensive computerized data base on renewable energy technologies, applications, and projects. The renewable energy data base will be linked to the Development Information System (DIS), an automated on-line information storage and retrieval system in the Center for Development Information and Evaluation (CDIE), and will be set up in Washington, D.C. to provide detailed information on selected renewable energy application projects.

LDC's will have access to the data base through S&T/EY. The existence and scope of the data base will be broadly publicized, and instructions for giving access to the data base will be provided to all the Missions and host country governments. Developing country personnel will receive printed outputs of computer files on requests, since data transmission to LDC's over international telephone lines is unreliable.

Discussion will be held with the regional bureaus, the CDIE, and other agencies as appropriate in order to determine specific information needs. The information required will include: objectives and scope of projects; budget and duration; key personnel and institutions involved; major technical and economic parameters; information on performance and any technical, economic, and social evaluations; follow-up activities; relation to similar projects elsewhere (including those sponsored by other donors), and lessons learned.

The renewable energy data base will include systematic procedures to provide for routine updating. Effective working relationships will also be developed with in the Regional Bureaus, the Missions and major donors to facilitate the flow of information on both current and proposed renewable energy projects.

The REAT project staff will respond to requests for information and data from the Missions, the regional bureaus, and other groups involved with AID renewable energy projects. Routine requests for information about Agency-sponsored renewable energy projects will continue to be handled by the CDIE according to established procedures. The REAT project staff will provide listings from the renewable energy data base to the Missions, bureaus, and other approved parties, when a request is made for detailed data on the technical, economic, and social parameters associated with a specific project.

5. Training

(a) Approach and Purpose

The purpose of the training activity of the REAT project is to facilitate the successful implementation and management of specific renewable energy application projects. The objective is to strengthen host-country institutional capabilities in project selection, planning, design, implementation and management to help ensure that the infrastructure necessary to fully support selected application projects is in place.

Training programs will be targeted at LDC institutions which have major responsibility for energy sector management or project implementation.

The REAT project approach to training requires LDC institutional commitment in order to be fully effective.

Follow-up studies of the TAET program (the Training in Alternative Energy Technologies program at the University of Florida) suggest that skills acquired during training are unlikely to lead to new programmatic initiatives unless there is present an institutional mechanism which enables theory to be turned into practice. The training of individuals is a very necessary condition, but rarely a sufficient condition, for constructive changes to occur.

(b) Activities

Training will be project-specific and organized in response to an identified institutional deficiency. The training activity will flexible and adaptable, and tailored to strengthen selection, design, implementation, management, maintenance, performance monitoring and evaluation skills. For example, training may be required in order to:

- Present the selection, design and implementation aspects of the technology, economic and financial analyses of the project, and competing alternatives to policy-makers, planners and the private sector. Present case studies of similar renewables application projects, if available, and review the possible social, cultural, and environmental implications of the technology.

- Strengthen management at the project and sector level, highlighting the importance of rehabilitation, operation and maintenance. Provide training for operators in preventive maintenance and repair procedures.

- Demonstrate how financial and social arrangements such as cooperatives, credit bureaus, lending institutions, or extension services, might support the project and encourage the commercialization of the technology.

The format and duration of the training activities will depend on their objective and target audience. A course designed to train technicians in system operation and maintenance procedures could take several weeks and involve intensive practical training. On the other hand, a course presenting the economic and financial characteristics of a particular project to upper-level policy-makers and planners might only take a few days.

Training courses could be opened to permit missions and bureaus to include interested parties not directly involved in the applications project. Participants could also be invited to attend from countries where similar projects are planned or are under consideration.

The training component of the REAT project should be as flexible as possible, and capable of rapidly responding to needs for different kinds of training. For example, it is desirable to bring host-country personnel to the US for specialized training in system design and manufacturing techniques; in project planning, management or operational procedures; or to expose selected key personnel to the latest scientific and technological developments. "Hands-on" training in U.S. private sector and industrial facilities will be an integral part of the training activities.

(d) Target Group

Training is directed at strengthening host-country institutions which are involved in the implementation of a specific application project, or will play a part in managing the project once donor agencies have withdrawn; or will be necessary to foster and sustain the participation of the private sector in deploying the technology. Training will be targeted at those groups of people needing strengthening of their capabilities in order to fully support the implementation and management of the application project. The target group identified could include:

- Project managers; all personnel, both technical and non-technical, responsible either directly or indirectly for the management and supervision of the applications project.

- Plant operators; all personnel responsible for the day-to-day routine operation of the technology. This group includes people that may be engaged in feedstock processing, as in the preparation of wood fuel for a gasifier or wood fired boiler, for example, and people working on the disposal of materials or wastes produced by the operation of the technology.

- Private sector people; entrepreneurs, businessmen, financiers, etc., who might be interested in participating in the development of a local or national capability to manufacture and market the technology.

- Policy-makers and planners interested in the design and management of the applications project in the context of national energy policy and planning.

(e) Selection Criteria for Trainees:

In general, the REAT project staff shall organize a training program if

- o training is in support of selected technologies, applications and systems. Specific projects must be economically viable and capable of having a significant developmental impact.

- o training is intended to make up for a deficiency in the infrastructural elements necessary for success.

In general, participants in a training program should:

(i) be affiliated with the institution, or institutions, targeted for training; and

(ii) be involved, either directly or indirectly, in the planning, implementation, or management of the project; or in the operation, maintenance or supervision of the renewable energy system.

(iii) have the appropriate qualifications and background.

However, selection criteria should be flexible so that people peripheral to the project but genuinely interested in its purpose and organization can participate. People from the U.S. and local private sector will have a key role to play in the promotion of the project, and in the eventual commercialization of the technology.

(f) Location

Training will primarily take place in the country or region where the application project is, or will be, located. There are a number of reasons why regional or in-country training programs are preferable.

- o More personnel from targeted institutions can attend the training activity. One problem with US-based training is not all appropriate personnel can attend. REAT project personnel, in consultation with the missions, will select the developing country participants in all training activities.

- o The organization and presentation of the training activity focuses attention on the project, and provide a mechanism to facilitate communication, cooperation, coordination, and the promotion of the project. For example, bringing personnel together from a number of implementing institutions provides an opportunity to show how each group is important to the success of the project, thus fostering a spirit of teamwork and collaboration.

- It permits the participation of host-country training institutions and strengthens their expertise in the technology and its application. Private sector participation in the deployment of the technology may generate long-term interest in the application of the technology and call for similar or related training or extension services.

(g) Teaching Material

Training manuals, background material, operating manuals, computer software and other teaching aids, including audio-visual material where appropriate, will be organized well before the start of any training activity. This material will be derived from the technology assessments, evaluations, analyses, and case-studies produced as part of the technology assessment activity of the REAT project.

Teaching material should be designed and assembled well in advance of the training activity. But since training should be flexible and tailored to suit the task, the teaching material must be adaptable and capable of rearrangement.

To meet these objectives, the best approach is probably a "modular" one. For each approved technology and application there should be a set of self-contained training units available - each examining, analyzing, and presenting a different aspect of the applications project. Units will consist of written material, audio-visual aids and microcomputer software . These modular units will vary not only in their focus - technical, socioeconomic, operational, or policy and planning - but also in their level of analysis and exposition. For example, a detailed technical presentation could be given to audience of university researchers or scientists interested in the engineering aspects of the project, but an abbreviated version could be presented to an audience of technicians and plant operators. Similarly, a financial and economic analysis could be presented to suit different audiences and target groups.

Training Modules:

The training component of the REAT project is targeted at institutions responsible for implementing a specific renewable energy application project, and which are judged to require training of their personnel in order that they may fully contribute to the successful completion of the project. The precise structure and content of the training programs presented by REAT project staff will be decided upon after careful review of the capabilities of the implementing institutions.

The REAT project staff should be capable of conducting training activities on any aspect of a particular application project. The following description are for illustrative purposes only.

Background and review: The purpose of the project, the needs to be met, the resource being used, alternative technology options. Why this technology was selected - criteria used, case studies; summary of economic and financial aspects.

Economic review: Costs, benefits, foreign exchange requirements, economic analysis; financial analysis. Rate of return, net present value, and other measures of worth. Sensitivity analyses - the effects of variations in technology performance, world oil prices and internal rate on the financial and economic analysis. Project lifetime - maintenance requirements, availability and the cost of replacement parts; implications for cash flow and profitability. Effects of taxes, subsidies, and the price of competing fuels.

Technical review: Basic technical principles and the way the physical performance of technology is related to them. The effects of source variation on performance. What can go wrong and why. Maintenance requirements.

System Operation: Start up, shut down, and control. How to spot problems and correct them. Feedstock handling, quality, and waste disposal (bioenergy systems). Maintenance requirements, procedures, and schedules. Repair work and spare parts.

Project management: Manpower requirements - skills and experience. Lessons learned from similar projects. Potential problems - social, cultural, institutional - and how to avoid them. Infrastructural elements required for success.

Private sector participation: Market opportunities and profitability. Small scale production and manufacturing, economies of scale. Financing, subsides, quality control and its relation to performance and profitability. Adaptation of the energy technology to match local skills, expertise, and fabrication techniques. Maintenance requirements, repair services.

(h) Relationship to Other Training Programs

The training activities of the REAT project will complement other training programs sponsored by AID and other donor agencies. If existing training programs are adequate, then

additional training under the REAT project will not be necessary. REAT training builds on the educational and vocational base provided by other training programs, but its fundamental thrust is the strengthening of institutions with the responsibility, to design, implement and manage renewable energy systems.

D. Outputs

The REAT Project will emphasize the publication and production of credible and high-quality documentation. This is essential for wide use and significant impact. The project staff will issue the following reports over the duration of the project. An estimated eight country investment portfolios, eight major technology evaluation reports, five case studies, and training monographs as appropriate. Other outputs will include a renewable energy data-base and approximately five workshops or conferences.

The training manuals and monographs will focus on priority renewable energy applications, and will be written in a clear, concise style for a targeted group of trainees.

The information dissemination activity of the REAT project will be partly based on a comprehensive computerized data base on renewable energy technologies and their application in the developing countries. The output from this effort will be information and data on all aspects of the technologies.

The output from the Renewable Energy Reassessment initiated by the Administrator will be an integral part of the project. This output will consist of an interim and final report. The interim report, to be submitted in May 1986, will include the results of the review of AID experience, and highlights from the development needs studies and technology evaluations. An outline for the interim report is attached as Appendix 8.2.

The final report of the Reassessment to be submitted in May 1987 will include a review of the experiences of other donors with renewables, a summary of lessons learned, and promising applications of renewables that further AID's development objectives. A preliminary outline of the final report is attached as Appendix 8.3.

IV. COST ESTIMATE AND FINANCIAL PLAN

Approximately eight million and two hundred thousand dollars will be expended by S&T/EY over the life of the project which will be run from FY-85 through FY-89. Annual expenditures are, planned as follows: FY-85, $900,000; FY-86, $650,000; FY-87, $1.55 million;

FY-88, $2.5 million; FY-89, $2.6 million. These outlays include estimated funding from Regional Bureaus and Missions having major renewable energy components in their projects. It is estimated that 25 percent of the total project budget will consist of "buy-ins." Co-funding with multilateral or bilateral donors may also be possible in some cases.

Annual project budget estimates, broken down by level and category of activity, are shown in Table I.

AID financial inputs to the project as a whole, organized by expenditure category, are estimated in Table II.

V. IMPLEMENTATION PLAN

The prime responsibility for the implementation of the REAT project rests with the AID Project Manager. The project components include technology evaluations and country assessments, research and networking*, and training. The output of these activities will be a series of reports, and a proposed Agency strategy for renewable energy. The timely publication of these reports, as well as successful completion of key training activities, workshops and seminars will indicate that the project activities are being carried out on schedule.

The implementation mechanism proposed is designed to meet the diverse requirements of this project, in particular:

(a) An institutional capability which facilitates access to networks of R&D institutions, credible data-bases, and training facilities.

(b) The flexibility to provide for maximum responsiveness to Agency needs, accountability for results, and cost-effectiveness.

(c) A core group of professionals to work closely with the AID Project Manager in Washington, D.C.

(d) Private-sector capability to prepare investment portfolios, carry out market analyses, and work closely with financial institutions.

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* Networking here is defined to include active collaboration in applied research and training among selected institutions in the U.S. and abroad.

TABLE I*
(thousands)

	FY 85	FY86	FY87	FY 88	FY 89	Total
1. Agency-wide Renewable Energy Data Base	50	40	30	80	80	280
2. Review of Lessons Learned	110	50	150	250	250	810
3. Technology Reassessments/Evaluations	130	50	250	250	250	930
4. Country Needs Studies	150	50	320	320	320	1,160
5. Research and Network Activities	110	110	150	250	250	870
6. Training, Workshops, Seminars, and Information Dissemination	250	300	400	700	700	2,350
7. Investment Portfolio Development	100	50	200	650	650	1,650
8. Project Evaluation			50		100	150
Total	900	650	1,550	2,500	2,600	8,200

*This table presents the estimated budget for the different catagories of activities. Most activities will be carried out in parallel, due to clear linkages that exist among them. The relative emphasis (and funding) may change depending on the results of the technology assessments and country needs studies.

TABLE II

	(Thousands)
Salaries and Fringe Benefits(1)	$ 2,000
Overhead, G&A Fees	2,000
Travel and Transportation(2)	750
Other Direct Costs	
Commodities(3)	500
Documents and Publications	400
Training, conference facilities, training materials and logistics	1,000
Overseas Living Expenses (4)	400
Consultants(5)	1,000
Evaluations	150
	$ 8,200

(1) This covers about 8 people per annum.
(2) This allows for approximately 4 foreign and 2 domestic trips per person per annum.
(3) Computers, data-loggers, resource measurement instrumentation, renewable energy components, etc.
(4) For resident personnel
(5) This allows for approximately 20 person months of consulting per annum, including foreign travel and reporting.

These requirements can best be fulfilled by two contractor groups.

(1) A group from a national laboratory. This group will be assembled to meet the institutional capability for technology evaluation, access to U.S. industrial and research networks, and training.

(2) A minority 8A firm will provide private-sector expertise in pre-investment activities, market analysis and securing financial committments.

The AID Project Manager will be responsible for the coordinated and effective functioning of these two contractors by working closely with the respective team leaders and developing a working and possibly a contractual relationship between them. The project manager will meet frequently and regularly with the two team leaders to ensure that all management issues are dealt with in a coherent and timely fashion. S&T/EY staff believes that this is the most effective mechanism to implement this project that requires considerable flexibility and regular course correction.

The National Laboratory

The laboratory will be responsible for leading the following activities based on proven expertise.

a. Renewable Energy Reassessment Reports to the Administrator
b. Technology Assessment and Evaluation Studies
c. Training, Workshops, and Seminars
d. Technical Field Support

The U.S. renewable industry is still in its infancy, largely supported through Federal and State tax incentives. It is comprised of very small-highly specialized firms lacking institutional resources and capabilities.

Private-sector renewable energy institutions experienced in the broad spectrum of the technology are practically non-existent. Small and medium size consulting firms with various expertise exist. However, they all lack the broad scope spanning through the components of this project, namely, access to the U.S. research community, universities, and training institutions, access to the experience and expertise developed through the extensive Federal R&D programs and their corporate history and to the broad knowledge and data-banks developed throughout the U.S.

Technology and training expertise covering the entire range of requirements are not likely to be encountered at anyone laboratory. Consequently, in addition to close collaboration with the minority firm, the contracting laboratory will be required to interact with other national laboratories and engage a variety of consultants.

The U.S. National Laboratories have played a major role in the research, development, and promotion of renewable energy systems in the U.S. The National laboratories have had over a decade experience in R&DS areas such as reliability and maintenance of renewable energy systems, materials development, low cost-light weight collectors, desiccant materials and systems studies, field studies and training. Such experience is not to be found in any single private-sector firm. It is however readily accessible through the National Laboratories. Many of the laboratories have represented the U.S. renewable energy activities in various bi-lateral and multilateral programs with the industrial countries. Many have developed expertise in renewable energy work in the LDCs. In addition, the laboratories are well interconnected with the U.S. research community, universities, and training institutions. It is for these reasons that the Laboratories can offer a unique capability of offering the best access to the U.S. and foreign industrial and research networks. This particular and unique capability is not competitive with private enterprise and can be utilized, in accordance with Section 632(a) of the Foreign Assistance Act of 1961 without interfering unduly with domestic programs.

The following criteria will guide the selection of the national Laboratory.

Expertise in:

a. setting-up, operating, maintaining, and accessing renewable energy technology data bases.
b. technology and engineering aspects of a wide range of renewable energy systems including their design, testing, operation, and maintenance.
c. technology transfer with special emphasis on LDCs
d. energy planning for LDCs

°Committments to:

a. responsive project management
b. close collaboration with the minority firm

°Proximity of the laboratory to Washington, D.C.

°Intergration of the REAT project activities of the laboratory with other in-house energy programs.

The Minority Firm

The minority firm will be responsible for leading the following activities based on proven expertise.

a. Country Studies including Market Analysis, Investment Portofolio Preparation, and Securing Financial Committments.
b. Adding the Private-Sector Dimension to the Training Activities.
c. Tasks requiring Rapid Response and REAT Project support for S&T/EY.
d. Private Sector Field Support.

The Following criteria will guide the selection of the minority firm.

°Access to Expertise in:

a. Financial and economic appraisal of energy and powr sectors in LDCs with special reference to planning and economic comparison of centralized and decentralized options.
b. Investment portfolio preparation in LDCs
c. Setting-up joint ventures between U.S. and LDC manufacturers
d. Securing financial committments from lending institutions to fund renewable energy systems and joint venture preparation activities.

°Committment to:

a. responsive project management
b. collaborate closely with the national laboratory

Regardless of the contracting mechanism chosen for each country activity, the basic managerial structure will always entail regular collaboration and communication among S&T/EY, the appropriate Regional Bureau, the Mission, and the host government.

Specifically, collaboration with the Bureaus will be achieved through the formation of an AID/W advisory group. This group will be composed of ST/EY and Bureau representatives, will be chaired by the project manager and will meet 3-4 times a year.

S&T/EY proposes to establish a renewable energy advisory committee with representatives from industry, financial and lending institutions and other appropriate organizations. The committee will meet 3 times a year. The committee will also be available for informal consultation in determining with S&T/EY the appropriate scope of technology evaluations and implementation approaches for specific countries.

Implementation Schedule

1.	PP reviewed by Sector Council	May 1985
2.	Project authorized	May 1985
3.	Prepare PIO/T	May 1985

4.	Select prime contractors	July 1985
5.	Sign contract	August 1985
6.	Initiate technology evaluations, country needs studies, investment portfolio preparation and data base development	October 1985
7.	Publish report on solar thermal and electrical applications	January 1986
8.	Publish report on bankable hydropower projects in Madagascar	January 1986
9.	Publish interim report on Renewable Energy Reassessment	May 1986
10.	Publish final report on Renewable Energy Reassessment	May 1987
11.	Interim evaluation of project	December 1987

VI. PROJECT ANALYSES

6.1 Economic Analysis

Though difficult to quantify, the benefits of the Renewable Energy Applications and Training Project can be measured by reviewing the major strategic objectives of the project. These are:

- A planning strategy that sets national policies and priorities for the role of renewable energy and power systems in critical development sectors, using an approach where economic costs and benefits, such as jobs and enterprise creation, can be measured.

- A sector strategy that selects specific renewable energy systems and technologies capable of having a measureable and timely impact on key sectors such as agriculture, agro-industry, small enterprise, health and rural development.

- A bankable strategy, where AID technical assistance is used to prepare energy projects for financing by development banks, commercial banks and donor agencies.

A list of benefits from these strategies would include: design and implementation of policies and projects which will ensure that current and future energy needs are met; saving foreign exchange now being used to import high-cost crude-oil and petroleum products; providing substitutes for increasingly costly and dwindling supplies of fuelwood; leveraging funds from other donors, lenders and businesses to expand the deployment of domestic energy resources; and promoting pricing, tax and financial incentives to encourage economically efficient use of domestic, renewable energy resources.

In most developing countries, the central government plays an important role in providing pricing and other incentives to individuals and private corporations. In addition, governmental or parastatal organizations are generally responsible for the production and delivery of energy to end-users. Given this pivotal role, inefficient institutions exact a heavy toll in human and economic resources.

The REAT project will pay attention to good systems management and maintenance issues. The project aims to strengthen institutions responsible for implementing renewable energy systems by targeted training of individuals who can design, manage and maintain these systems. By providing adequate energy supplies to important development sectors, and by mitigating the economically disruptive effects of unreliable electric power, the project can contribute to the growth and development of the indigenous private sector.

Finally, by focusing on donor coordination at an early stage in the pre-investment analysis, the REAT project aims to prevent waste and unnecessary duplication in development assistance activities. This approach is particularly important in Sub-Saharan Africa, for example, where the needs for concessional finance are far greater than the international donor community is able to provide, and where very few countries in the region can afford to meet their capital and foreign exchange needs on purely commercial terms. To deal with these severe constraints, the REAT project will be coordinated with the renewable energy assistance activities of other donors in order that limited resources can be allocated efficiently.

Conclusions:

While the economic costs and benefits of the systems and technologies to be promoted in this project can be quantified to a reasonable degree, quantifying the benefits of activities such as institutional strengthening, improved management, training, indigenous private sector development and donor coordination is very difficult. Nevertheless, most donor agencies function on the premise that the benefits of these activities greatly exceed the costs in the long-term.

6.2 Technical Feasibility Analysis

The question to be addressed in this section is whether the systems, technologies and methodologies to be deployed in the project will be effective in achieving the project purposes.

The REAT project is multifaceted, covering a variety of technologies, systems, applications, policy approaches and institutional arrangements. While each activity will include innovations and some applied research, the project as a whole will

not deal with basic research. Hardware needs will be limited to well-established items such as small-computers, data-loggers, pumps, motors, diagnostic equipment and renewable energy components. Software requirements, such as packages for systems design, economic and financial analysis, energy and power systems planning, statistical analysis and data-base management are standard tools in the repertoire of most competent renewable energy analysts.

In common with other technical assistance and training projects, the Renewable Energy Applications and Training Project will operate to transfer know-how and skills to the developing countries. The country needs assessments, technology evaluations, pre-investment activities and training programs will draw on techniques such as economic and financial analysis, long-run marginal cost-pricing, resource assessment, uncertainty analysis, demand forecasting, energy supply and demand balancing, power systems simulation, ecology and engineering economics.

Where energy or power audits are necessary to determine a possible niche for renewable energy systems, the project will rely on inputs from other projects, such as the Energy Policy Development and Conservation Project.

In conclusion, the systems, technologies and approaches in this project do not pose any obstacles to its implementation. On the contrary, they are designed to facilitate achievement of the project's objectives.

6.3 Financial Analysis

The project will operate at a level where a small full-time staff can be provided by a contractor. Because of the complexity and diversity of activities planned in the project, subcontracting mechanisms will be necessary, and individual consultants are expected to supplement the core staff.

This is a cost-effective and efficient means of implementation. The core staff, subcontractors and consultants should be available to respond to requests for assistance at the country level, and should be responsible for preparing high-quality documentation in substance as well as in appearance for the benefit of all A.I.D. assisted countries, not just those being assisted directly.

6.4 Social Soundness

Agency energy policy stresses the need for cost-effective applications in productive agriculture and rural industry. The REAT project is an instrument of this policy, and also supports efforts to encourage the participation of the private sector in the deployment of economically viable renewable energy systems.

Among the beneficiaries of the successful introduction of renewable energy systems into the rural areas of the developing countries will be the farmers and villagers who live in those areas. The REAT project therefore directly contributes to the economic development of the rural areas of AID-assisted countries and to a better quality of life and standard of living for poor people in those regions.

An important component of the REAT project is training - an activity which enhances expertise and skill, which promotes self-assurance and independence, and which often leads to a job position of greater responsibility and increased status for the trainee. The training activity of the REAT project is targeted at institutions involved in specific application projects, and which are judged to need training in order to strengthen their capability to participate in the implementation or management of the projects. These institutions may range from government ministries responsible for energy policy and planning, to rural cooperatives organized to install and operate a small hydropower system. The personnel who are selected to undergo training could therefore come from a wide range of backgrounds and socioeconomic levels depending on the nature of the training. Training program participants are likely to include people from the agricultural sector, the private sector, and others working in the rural areas.

6.5 Administrative

The Office of Energy, S&T/EY, will have overall responsibility for the project. The S&T/EY project manager will ensure that all aspects of project implementation are in accordance with Agency procedures.

The team implementing this project should have the following proven expertise:

- Investment portfolio preparation for renewable energy systems in developing countries.
- Successful private sector marketing of renewable energy technology in the developing nations.
- Wide experience with government industrial and academic institutions involved with renewable energy in the United States and abroad.
- Wide developing country experience with analyzing, selecting, financing, implementing, managing and monitoring renewable energy systems and technologies,

- o experience with: the organization and presentation of training programs in developing countries; the preparation of high-quality documentation training including manuals, teaching aids, audio-visual materials and microcomputer software.

- o wide experience in planning and technical assistance, policy development, project management and facilitation in the field of renewable energy technology.

6.6 Environmental Analysis

Project activities will not have any impact on the quality of the environment. Environmental analysis might be necessary when the investment portofolios attract financial commitment from lending institutions. At this stage, however, future activities will not be part of the REAT Project.

VII. PROJECT EVALUATION

7.1 Reporting Procedures

A major purpose of the REAT project is to assess the prospects for renewable energy applications in the developing countries, and to recommend systems for financial support. The output from these assessments and evaluations will consist of reports and papers analyzing energy needs, economic feasibility, and specific country requirements.

Each report will produced in close consultation with the relevant Missions and the Regional Bureaus. Input from the missions and bureau will be sought on the scope of the work, the level of analysis applied, the methodology employed, the validity of the study's fundings, and the appropriateness of the report's recommendations. The purpose is to ensure that the REAT project staff are in touch with field experience conveyed to the regional bureaus via the Missions, and that the assessments include the latest field information about technology performance. All reports will be made available to a wide audience. In addition, the project team will prepare and issue progress reports every six months over the life of the project.

There will be two independent evaluations of the project. The first will take place two years after the commencement of the project, when the studies related to technology evaluation should be completed with the data base system in place. The second will take place two years later, when the impact of the project should be evident. Indicators of project progress after two years will include the following:

(a) Quality of project reports as measured by the usefulness of these reports to USAID Missions, U.S. industry, and lending institutions.

(b) Usefulness of the Renewable Energy Data Base to AID/W, AID missions and host country governments.

(c) AID Missions and host-country government response to regional workshops and seminars.

(d) Interest in buy-ins and financial commitments.

All evaluations will include interviews with participants, counterparts, users of work products, other donors and the private sector; detailed review of all work products; examination of financial and administrative records; and consultation with appropriate A.I.D. officials in Washington and in the field. Evaluation plans will be prepared in advance by A.I.D. staff.

Evaluators will be given instructions on obtaining detailed and specific answers. Some key questions to be addressed are listed in the section that follows.

7.2 Evaluation Questions:

Has the country progam produced notable results in terms of:

(a) A portfolio of specific renewable energy projects which have been successfully financed, implemented or managed, and which have had a significant impact on development?

(b) A portfolio of renewable energy components that have been implemented in other projects, such as agriculture, rural development, education, health-care and small enterprise development?

(c) An improved national renewable energy data base?

(d) Strengthened renewable energy planning, policy-making or implementing institutions?

(e) Improved skills of LDC energy professionals in counterpart institutions (public and private)

(f) Policy innovations that contribute to the achievements of the project's goals and purposes?

(g) Positive image of the project by host country officials and plans for sustaining achievements?

(h) Importance to A.I.D. missions and nature of follow-on projects planned?

Other central questions, not country specific are:

- How is the contractor's performance rated in terms of cost-effectiveness, efficiency of management, responsiveness to the need of A.I.D. and the host country needs, and overall quality of work?

- Did the project provide significant information and important lessons that can be applied in other A.I.D.-assisted countries?

- Did the project produce high-quality, credible documentation that has been found useful by host-country personnel, A.I.D. missions, the U.S. private sector and other donor agencies?

- Was the project successful in attracting collaboration and financial support from the missions and regional bureaus?

- Did the project solve any significant applied research problems?

VIII. ANNEXES

APPENDIX 8.1

References and Notes

1. "The Energy Transition in Developing Countries", World Bank, Washington, D. C. 1983.

2. Oak Ridge National Laboratory, "Implications of World Oil Market Conditions for Developing Countries," Draft Report to the Office of Energy, April 1985

3. C. J. Cleveland, et al, "Energy and the U.S. Economy: A Biophysical Perspective". Science Vol. 225, pp. 890-897, August 31, 1984.

4. Identifying the Basic Conditions for Economic Generation of Public Electricity from Surplus Bagasse in Sugar Mills. Energy Department Paper No. 13, World Bank Energy Department, October 1983.

5. Liberia: Issues and Options in the Energy Sector. World Bank, December 1984.

6. The Commercial Potential of Agricultural Residue Fuels: Case Studies on Cereals, Coffee, Cotton and Coconut Crops. Draft Study, October 1984, The World Bank.

7. "Small-Scale Solar-Powered Pumping Systems: The Technology, Its Economics and Advancement", Main Report, UNDP Project GLO/80/003, 1983.

8. "Alcohol Fuels: Options for Developing Countries", National Academy of Sciences, BOSTID, Washington, D. C., 1983.

9. Producer Gas: Another Fuel for Motor Transport, National Academy Press, Washington, D.C. 1983.

10. These data are taken from the Bioenergy Systems Reports, S&T/EY. Five reports were issued between March 1982 and June 1983.

11. Small and Mini Hydropower Systems: Resource Assessment and Project Feasibility. edited by Jack Fritz, McGraw-Hill Book Co., New York, 1984.

APPENDIX 8.2

OUTLINE: INTERIM REPORT TO THE ADMINISTRATOR

I. Executive Summary

(a) Purpose and goals of the report
(b) Overview of content and findings

II. Introduction

(a) Origin of the study
(b) History & Scope of Renewable Energy Activities in AID
(c) Problems, Failures, and Successes
(d) Outlook for the Future
(e) Approach to the Energy-Development Linkage

III. Renewable Energy Applications, Systems, and Resources

(a) Major Development Applications of Renewable Energy Systems
(b) Principle Renewable Energy Options for Specific Applications
(c) Status, Cost, Commercial availability and Projections of various Renewable Technologies*
(d) Physical, Human, and Institutional Resource Requirements for Successful Operation and Maintenance of Renewable Energy Systems

IV. Renewable Energy in Africa-AID's Experience and Future Prospects

(a) Energy Issues and Impact on Development (in Africa)
(b) Renewable Energy Applications including:

(i) wind and PV pumping
(ii) solar thermal
(iii) decentralized hydropower
(iv) bioenergy systems
(v) household fuels & cookstoves

The following will be addressed:

(i) objectives and scope of activities undertaken
(ii) estimated expenditures to date
(iii) findings and conclusions (including previous evaluations)
(iv) institutional and policy issues
(v) follow-on activities and recommendations

*Highlights only - details in Annex.

V. Asia (Similar outline)

VI. LAC (Similar outline)

VII. Near East (Similar Outline)

VIII. Interim Conclusions and Recommendations

(a) Summary of findings in Chapters III-VII
(b) Preliminary recommendations for Mission's access to technical assistance, training and consultations
(c) Preliminary recommendations for future field work
(d) Preliminary recommendations for a revised Agency policy

IX. Annex - Material on Status of Selected Renewable Technologies

APPENDIX 8.3

OUTLINE: FINAL REPORT TO THE ADMINISTRATOR

I. Executive Summary

(a) Purpose and goals of the report
(b) Overview of content findings and recommendations

II. Introduction

(a) Review and update of interim report findings

(i) inputs from country assessments
(ii) inputs from technology assessments
(iii) findings from the REAT project
(iv) findings from other centrally funded Renewable Energy projects.

III. Summary of Other Donors Experience with Renewable Energy

(a) Experiences with specific technologies broken down by applications and region.
(b) Issues of Donor coordination and its impact on the introduction of sustainable Renewable Energy systems
(c) How does the above experience compare to AID's.

IV.
V. Update of the corresponding chapters on Africa, Asia and Near East in the Interim Report.

VI.

VII.

VIII. Conclusions and Recommendations

This chapter will contain clear guidance regarding AID renewable energy assistance activities. It will answer the following questions:

(a) Under what range of financial and economic conditions are investments in renewable technologies, for specific development applications, justified? e.g. prices of PV systems applications for remote telecommunication and refrigeration applications versus prices necessary for bulk power (electric) production.

(b) What institutional capabilities does an effective and financially viable delivery system require to support sustainable renewable energy systems?
What are the related policy requirements?

(c) What are the development impact factors that justify investment in renewable energy delivery systems?

(i) what do these systems contribute to energy production
(ii) to resource conservation
(iii) to labor utilization
(iv) to increase in marketable products
(v) to health, sanitation and other improvements
(vi) to education, communication etc.

(e) What should AID's role be in the various geographical regions and how should the Agency implement its policies?

AID 1020-25 (1-78)

Appendix 8.4

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Project Title & Number: RENEWABLE ENERGY APPLICATIONS AND TRAINING PROJECT

Life of Project: From FY 85 to FY 89
Total U.S. Funding $8.2 Million
Date Prepared: 4/2/85

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Program or Sector Goal: The broader objective to which this project contributes: To promote the economic growth and social progress of developing nations by providing energy for economic development through the expanded deployment of economically viable renewable energy and power options.	Measures of Goal Achievement: Economic indicators such as the ratio of oil imports to export earnings, direct and indirect employment benefits, increased production and new enterprises brought about by expanded energy availability. Social indicators such as improved health, education, transportation and communication.	Information and statistics generated within the project, project evaluations and reports by the World Bank, the UN and other international organizations.	Assumptions for achieving goal targets: That economic growth will be significantly enhanced when the energy inputs necessary for development are provided in a reliable and economically viable fashion.
Project Purpose: To develop renewable energy and power systems and related policy guidance which contribute significantly to: Removing energy constraints to production, strengthening developing country institutions, involving the U.S. and indigenous private sector, developing an investment portfolio of "bankable" projects, improving agro-industry, health, communications, education and rural development.	Conditions that will indicate purpose has been achieved: End of project status. Financial Commitments from public and private financial institutions; existence of institutions to manage, operate, and maintain renewable systems; existence of country policies to encourage economically viable systems; a published body of authoratative reports, case examples, monographs, software.	Evaluations at end of FY 87 and 89. National energy and economic development plans; evaluations of institutional capability, financial commitments from international lenders and private capital sources.	Assumptions for achieving purpose: That governments have been motivated by: increased oil and fuelwood prices, the foreign exchange required to develop indigenous energy supplies, and the impossibility of development without economically viable, adequate, reliable supplies of energy; and are committed to improving the efficiency of their institutions and attracting external capital for development.
Outputs: 1. Country-level energy investment portfolios, plans and policies, leading to financial commitments. 2. Studies and "state-of-the-art" reports on renewable energy and power systems 3. Training manuals, case studies, data-bases and computer software on systems and projects. 4. Conferences and workshops for country energy policy-makers and technical experts.	Magnitude of Outputs: An estimated 8 country investment portfolios, 8 major technology evaluation reports, 5 case studies, training monographs, a data-base, and 5 workshops/conferences.	Project implementation documents, including PIO/Ts, contractor reports, and project manager's annual reports.	Assumptions for achieving outputs: That adequate host country government commitment, personnel and funds will be available.
Inputs: 1. Information on country energy demands markets, needs, and prices. 2. Data on capital investment, manpower and resource requirements to implement renewable energy and power systems. Data on competing options. 3. Analytical methods, such as energy demand forecasting based on development targets, economic and financial analysis, risk assessment, decision theory, social and environmental impact, optimal engineering design procedures.	Implementation Target (Type and Quantity): FY 85: Two country portfolios, three state-of-the-art reports, one workshop. FY 86-89: Additional investment portfolios, technology evaluations, case studies, data-base and conferences.	Evaluation and monitoring by A.I.D. project office, contractor reports.	Assumptions for providing inputs: That project budgets are sufficient to procure the necessary technical services; that direct-hire staff will provide effective management, and that the required expertise can be obtained from private sector, national laboratory, university or non-profit sources.

APPENDIX 8.5

DONOR COORDINATION

I. REPORT OF A MEETING BETWEEN A.I.D. AND WORLD BANK STAFF

MEMORANDUM

January 25, 1985

TO: S&T/EY, Staff
PPC/PDPR, Patricia Koshel
AFR/TR/SDP, Shirley Burchfield
AFR/TR/SDP, Weston Fisher
AFR/RA/II, Val Mahan

FROM: S&T/EY, David J. Jhirad

SUBJECT: Report of Meeting between A.I.D. and World Bank Staff

Staff from S&T/EY and the Africa Bureau met January 8 with Mr. Kenneth J. Newcombe and Mr. Gunter Schramm, senior staff members in the Eastern and Southern Africa Projects Division of the World Bank to explore opportunities for fruitful USAID/World Bank collaboration on addressing energy problems facing Sub-Saharan Africa. The Bank has conducted a number of energy assessments in that region and wishes to convert study findings into effective energy projects. This broad, integrated approach represents a shift in the Eastern and Southern Africa Projects Division from an exclusive emphasis on power sector lending. The Bank would welcome A.I.D. assistance in fielding short term consultant teams to complete the necessary planning and pre-investment analysis to identify projects and define their scope. The Bank people suggest that this may be a role that A.I.D. could fill.

The provision of "household energy" supplies to East African markets at affordable prices has been identified as a major priority for future World Bank lending. There appear to be significant opportunities for A.I.D. to sponsor pre-investment studies and activities in this area, maintaining close collaboration with World Bank staff in order that the work meets World Bank criteria for subsequent lending operations.

It was stressed in the meeting that the strengthening of institutions to deliver household fuels in East Africa would require the adoption of a "market-oriented" approach, the support of local entrepreneurs, and hybrid institutions involving public and private sector roles. Specific countries mentioned included Sudan, Uganda, Madagascar, Botswana, Malawi, Mauritius and Kenya.

Both A.I.D. and World Bank staff present expressed considerable interest in joint actions and initiatives, and a follow-up meeting will be held in a few weeks. Meanwhile, Mr. Schramm and Mr. Newcombe will send A.I.D. a brief list of specific projects where A.I.D. participation is sought.

MEMORANDUM January 11, 1985

TO Messrs. Harold Wackman, ESPEG, F. Bauer, WAPEG

FROM: Ken Newcombe and Gunter Schramm, ESPEG

SUBJECT: USAID - Bank Cooperation in Energy in Sub-Sahara Africa

1. On January 8 1985 we attended a meeting with AID officials from the Office of Energy and a number of African Country offices to explore possible cooperation in the energy field in Sub-Sahara Africa. Available US AID funds are limited to two major initiatives, a (originally) US$17.5 million, five-year project called "Energy Initiatives for Africa" and a general world-wide energy activity program with an annual budget of US$10.5 million which has been kept constant in nominal terms for the last 7 year. Almost all of these funds are tied to actual field activities of major projects or studies, including the training components. The latter funds are allocated according to a priority ranking of: (1) Institutional Development or Training; (ii) Policy Planning; (iii) Technology. The Energy Initiative for Africa Project is managed by Energy Development International (EDI) of Washington, D.C., who maintain two permanent offices in Nairobi and Abidjan, staffed with three professionals each.

2. Because of various budget cuts, neither fund can now be used to finance actual projects. However, AID would be very much interested to utilize its available resources for project preparation purposes provided there is some assurance that this could lead to actual projects financed by others, e.g., the World Bank. While individual allocations for discrete projects will have to be small (in the US$20 to US$150,000 range), the advantage of these funds are that they are readily available and would require a minimum of bureaucratic preparation. This could be very useful for us if new, potential project components have to be evaluated quickly to meet pre-determined overall project preparation timetables (e.g. Malawi energy, Madagascar energy, etc).

3. AID is most anxious to collaborate with us in utilizing their funds in collaboration with us.

4. AID readily agrees to Bank involvement in the design of terms of reference, and the selection and supervison of consultants.

5. Project activities would have to be limited to countries with active AID programs. This would currently exclude, for example, Ethiopia or Tanzania (which is in default on AID loans). In eastern/southern Africa preferred countries are Malawi, Madagascar, Sudan, Uganda and Kenya.

6. AID is most anxious to see projects materialize both in the Bank's Eastern and Southern and Western Africa Regions.

7. It was agreed that the most useful way to proceed would be to present actual projects to AID for consideration. The designated contact person at AID is Mr. Val Mahan, tel. 632-6951. AID's Washington office would handle all details, including presentation of the specific project details to their own regional/country mission which have to approve each project (this, of course, also requires a country request for undertaking the respective study.

8. A list of people met is attached.

cc: Messrs. Bronfman, Loh, Christoffersen, Bouhaoula

GSchramm:aba

Distribution List

APPENDIX 8.6
SUMMARY OF MISSION RESPONSES TO THE RENEWABLE ENERGY REASSESSMENT WORK PLAN (AS OF MAY 1, 1985

Cairo

Characterization of renewable energy technologies are a first crucial point. The characterization would indicate the parameters under which the technology is technically, financially and economically viable, where it can be viable and where it is not viable. Also, this characterization will indicate the state of development of the technology's hardware and its penetration into traditional engineering designing practice.

Mogadishu

1. All of the examples are in fact technology driven. A greater emphasis should be given to responding to specific requests from recipient countries.
2. Institutional issues do not seem to be stressed in any of the specific country studies.
3. In most countries of Africa, woodfuels are the most important energy resources. Projects with ultimate goals of increasing the delivery of economic firewood and charcoal will necessarily fulfil an energy need.
4. In Somalia, small decentralized energy sources are needed for electric power, water pumping, and domestic use. Substantial data collection efforts are needed.
5. Due to lack of mission funds for project that are energy focused, it would be useful to associate energy projects with other topics, such as agriculture and refugee affairs. Energy projects in Agriculture could include water pumping for irrigation and post-harvest processing. Refugee related projects could include water pumping for domestic energy use, and fuel efficient stoves.

Gaborone (Botswana)

1. A rigid reliance on private sector could eliminate rural poor as project beneficiaries.
2. The results of the Botswana Renewable Energy Technology Project (BRET) could provide ST/EY with results that may have relevance to the reassessment.

San Jose

1. Mission concurs with proposed renewable energy reassessment work plan.
2. The dendrothermal and wood-fired project at Horquetas, Costa Rica, should be examined as a possible candidate for assessment.

Guatemala

1. Mission highly supportive of new initiative to assess renewable energy technologies with emphasis on agriculture and rural industry.

2. Mission suggests that AID/W focus future year energy funding to Los Alamos National Laboratory to obtain additional energy related information in Central America as well as to undertake the actual installation of some of the identified technologies.

Maseru (Lesotho)

A report prepared by the Appropriate Technology section of the Ministry of Cooperatives and Rural Development is being pouched to ST/EY.

Lome (Togo)

1. Mission is very supportive of the methodical, open and seemingly reasonable approach which, as outlined in Work-Plan, will be use to identify renewable activities which have, or could have, a significant impact on development.

2. AID Togo program, over last five years, has to date been able to include series of discrete centrally-funded studies or activities in renewable energy which make sense within the context of what is outlined in the Work-Plan.

3. USAID/Togo would like to give particular support to the following proposed individual assessments:
   a. decentralized hydropower
   b. solar refrigeration for medical applications in remote areas
   c. solar heat for agriculture applications such as crop drying and food processing with particular reference to Solar Ponds.

4. USAID/Togo welcomes any future opportunity which may permit Mission either to participate actively in assessment studies or in review of findings.

Tegucigalpa (Honduras)

1. Potential results form the renewable energy assessment study could be very useful to AID/Honduras since the Mission is in the process of formulating its energy strategy.

2. Renewable energy and alternate energy technologies could have an impact on Honduras.
3. Mission intends to develop an energy strategy. Some AID/W assistance may be required in this effort.

Bridgetown (Barbados)

1. The Alternative Energy Systems Project which covers the English speaking Caribbean has an evaluation scheduled for the next few months with a draft final report due at the end of August. The evaluation will address, among other matters, the objectives of the Administrator.

2. Knowledge of renewable energy from an industrial point of view is lacking in the region, especially at the technical management and craftsman levels. There is an effort to address this issue now through training.

3. The reassessment should address the following:
   a. Granting small loans to companies for energy conservation
   b. There needs to be some guidance on evaluating the various alternative forms of energy from an economic view point.
   c. The issue of selling electricity to the utility companies should be addressed.
   d. The issue whether to support one large scale alternative energy project or many small scale projects needs to be addressed.
   e. Should the technical expertise in a country be studied first and remedied through training or should the whole proposal be looked on as one package and implemented on a concurrent basis.

Sana (Yemen)

1. Information on other LDC's energy assessments and programs would be useful to the Mission.
2. Mission is interested in technology assessment for:
   a. Solar Refrigeration for Perishables
   b. PV for water pumping and remote power supply.

Islamabad

1. Scope and activity schedule outlined in Work-Plan appear reasonable.
2. Would like to see plan give emphasis on realistic role of renewables in comparative analysis of centralized vs decentralized options.
3. Mission intends to conduct own evaluation of past and on going renewable energy activities in Pakistan.

AID/ST/EY:DJhirad:SSchweitzer:cj:2329p