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CHAPTER I

INTRODUCTION

The goal of the Agency for International Development (A.I.D.) is a world in which economic growth and development are self-sustaining and the extremes of poverty have been eliminated. Energy is a critical input to attaining those goals.

The Office of Energy, in A.I.D.'s Bureau for Science and Technology, shares with the Agency's Missions and Regional Bureaus the responsibility for helping assisted countries obtain appropriate energy services. This Program Plan explains the programs of the Office in pursuit of that goal and how the Office is organized to implement those programs.

This introductory chapter briefly describes the importance of energy in development and how energy pertains to the overall emphases of A.I.D., summarizes the chief problems that LDCs encounter in obtaining sufficient energy, and then outlines the general role and goals of the Office of Energy. The subsequent two chapters describe the programs of the Office, grouped by strategic themes, and then explain how the Office is staffed, budgeted, and organized.

A. Energy as an Input for Development

Energy in its many forms provides services essential to development. Society needs energy to heat, cool, and move objects and materials, and for production, communication, comfort, health, and recreation, and needs a special form of energy--electricity--for lighting and power.

Primitive economies develop with human muscle; slightly more developed societies use animal muscle. The average citizen in countries assisted by A.I.D. has access to only 50 watts of electric power--less power than can be generated by one human being. In contrast, each citizen in the U.S. has access to approximately 3,000 watts, the equivalent power of forty human beings.

To lend focus to the ultimate goal of economic growth and development, A.I.D. has aimed its efforts at five chief problems in the less developed countries (LDCs): inadequate income growth; hunger; health deficiencies, especially infant mortality; illiteracy and lack of education; and unmanageable population pressures.[1]

Achievement of the goals for each of these five problem areas involves energy. Increased income growth means economic growth, which requires additional energy services. Allaying hunger requires energy for cooking as well as for greater agricultural productivity, and the agricultural sector requires several forms of energy input--for irrigation, for operation of on-farm equipment, for processing, and for transport and distribution. The third area--health--requires

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[1] See *Blueprint for Development: The Strategic Plan of the Agency for International Development.*

important energy input in order to deal with specific health problems--pumping of safe drinking water or refrigerated storage of vaccines, for instance--that are particular challenges when dealing with regions not connected to utility grids.

The fourth and fifth areas, education and family planning, require obvious energy services--electricity for lighting, space heating at facilities, and transportation energy for moving staff and materials around.

Considerable amounts of energy are needed to meet income and food goals. A.I.D.'s quantitative goals for the assisted LDCs are a sustained 2 percent per capita growth in income and 3.7 percent annual growth in the agricultural sector.

Based on past trends, meeting these development targets would require that the supply of energy in A.I.D.-assisted countries grow each year by approximately 7 percent or more:

- Analyses of development experience indicate that each increase of 1 percent in gross domestic product (GDP) requires an increase of 1.3 percent or more in energy inputs. At this ratio, attaining A.I.D.'s goal of a 2 percent real increase in per capita income will, given expected population growth rates of 2.5 to 4 percent, require energy growth rates of 6.5 to 10.4 percent. With highly efficient energy uses, this rate can be reduced to 4.5 to 7.2 percent.

- Similarly, the Agency's goal of increasing caloric intake would require agricultural growth of 3.7 percent per year, according to the Food and Agriculture Organization. Each increase of 1 percent in agriculture requires an additional energy input of more than 2 percent. Thus, if A.I.D. is to attain its goals for nutrition and agriculture, it must ensure that LDCs increase their energy supply for agricultural development by at least 7 percent annually.

B. Problems

Energy resources and energy conversion are not free, and the costs--economic and environmental--present a myriad of problems:

- Most of the swelling demand for energy will be met in the mid-term by imported oil. Three-quarters of A.I.D.-assisted countries rely on oil for 50 percent or more of their commercial energy requirements. These imports create a serious foreign exchange problem. Low-income countries use 20-30 percent of their export earnings for energy imports. This drain, coupled with the serious debt crisis, leaves little for investment in agriculture, industrial development, and other critical development programs.

- One of the fastest growing portions of the energy sector is electricity. During the past couple of decades, electricity capacity in LDCs has been growing at a rate of greater than 7 percent. India, A.I.D.'s largest assisted country, has been expanding at greater than 9 percent per year. But these rates of growth are probably unsustainable for financial

reasons. LDCs invest an average 25 percent of their total development investment budget in electricity infrastructure. Because much of the equipment needs to be imported, and much of the money needs to be borrowed abroad, this represents another significant draw on foreign exchange.

- An overwhelming majority of electric utilities in LDCs are operating at a loss; not only because of subsidized electricity tariffs but also because of dramatically inefficient operations. This puts added strain on government budgets that are usually already in deep trouble.

- The Food and Agriculture Organization reports that nearly half the world's population today lives in areas where fuelwood is acutely scarce, and yet a majority of these people depend on fuelwood for the bulk of their energy needs. 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; a doubling in many places. These price rises place an intolerable burden on those least able to afford it.

- Most forms of energy conversion extract an environmental cost. In economic terms, these costs are often difficult to track, but they affect the health of numerous eco-systems that in one way or another are critical to human welfare. Human health and agricultural productivity, among other areas of interest, require that environmental considerations be included in energy development plans.

C. The Role of A.I.D. and the Office of Energy

A.I.D.'s role is to help ensure an adequate energy supply to meet its goals in agriculture, rural development, health, and other areas. Through its energy activities, A.I.D. can help to substitute indigenous energy sources for fuelwood and imported oil, introduce more efficient ways of using existing energy resources, and help countries make economically and environmentally wise energy-system choices and investment decisions.

The design and implementation of A.I.D. projects to help meet the development goals of assisted countries are primarily the responsibility of the A.I.D. Missions in the individual assisted countries. Numerous energy-related issues are considered and acted upon, then, at the Mission level.

Mission staffs confront a broad array of problems and face inevitable constraints on gaining access in the many relevant disciplines to the latest ideas and technologies, and lessons learned in other countries. The Office of Energy, as the other specialized offices in the Bureau for Science and Tehcnology, plays a crucial role within the Agency. In support of Agency energy objectives, the Office develops new approaches to energy problems through research and adaptation; it applies these new approaches worldwide in collaboration with Missions. In addition, it helps formulate energy policy for the Agency.

To carry out its responsibilities, the Office of Energy has set four goals and corresponding objectives:

1. **Goal: Reduce economic instability caused by oil shortages**

   Objectives: Expand use of indigenous energy, both fossil and renewable; and increase energy productivity.

2. **Goal: Ensure availability of energy for sustained rural development**

   Objectives: Satisfy basic energy needs of rural populations for cooking and heating; agriculture; and for rural industries, especially agroprocessing.

3. **Goal: Foster private enterprise energy development and management**

   Objectives: Promote policy reform to improve functioning of energy markets; build local private-sector capabilities; and increase the flow of technical and financial resources from the U.S. private sector.

4. **Goal: Increase consideration of environmental criteria**

   Objectives: Integrate environmental criteria into the energy planning process; encourage efficient energy conversion; promote the use of less environmentally damaging energy sources and conversion processes when cost-effective.

This Program Plan outlines and schedules the actions that the Office of Energy intends to take to help ensure that sufficient energy is available to meet the Agency's development targets. The plan covers the current fiscal year, FY88, and the following, FY89. Successive two-year plans are prepared on an annual basis.

The Program Plan is a means rather than an end. It is a working document to be used by Agency energy officials to define the Office program in accord with the objectives of the Agency and the Bureau for Science and Technology (S&T). It specifies near-term achievements expected of the Office. It is a guide for resource allocation among Office projects. It sets priorities for the Office and describes where special emphasis will be placed. It provides an indication of the resources available from the Office to the Missions to support initiatives with host countries. It also serves to describe the Office program to interested persons outside the Agency.

The planning of Office activities incorporates input from within and outside the Office of Energy. The Office's director and various program managers solicit the views of other individuals in S&T, specialists in A.I.D.'s regional bureaus, individuals from private companies, universities, the non-profit environmental and development communities, the National Laboratories, the World Bank, the Inter-American Development Bank, and energy experts from LDCs.

Much of this Program Plan is based on extensive analyses of energy needs in developing countries and on experience with various technologies and approaches to meet those needs. In part, however, the plan charts new courses developing new approaches to old problems or adapting tested solutions to new problems. Considerable additional analysis is thus required to complete the design and planning of any program activity. This analysis will continue over the coming year in the detailed program plans for each initiative, and in some cases, for major components of an initiative.

The following chapter describes the principal activities of the Office and the third chapter presents organizational information regarding how the Office bureaucratically accomplishes its objectives. For more detailed descriptions of Office programs, the reader is invited to request from the Office any of the thirteen "Program Papers" listed in Appendix A.

CHAPTER II

PROGRAM DESCRIPTION

A. Introduction

To meet its four goals in A.I.D.-assisted countries (reduction in oil imports, adequate energy for the rural sector, increased participation of the private sector, and environmental sensitivity), the Office of Energy has identified four programs for priority attention:

- o Energy policy and planning
- o Energy efficiency and conservation
- o Energy and rural development
- o Indigenous fossil fuels and advanced technology

To set priorities and define the substance of projects, the Office systematically analyzes the development needs of its client countries. The priority areas were selected in consultation with A.I.D. Missions, Regional Bureaus, and outside parties, and they take into account the activities of other international aid and lending institutions.

This chapter summarizes the thrust of our strategy and activities in each program area. In addition to these program areas, two important methodological approaches to development assistance are private sector development and training. Private sector development is encouraged whenever appropriate in our projects, and is touched upon in several of the topical discussions later in this chapter. A separate section of this chapter describes the Office's efforts in training. Training programs help build the institutions of LDCs for the long haul, and have always been a critical part of A.I.D.'s work.

Each category includes a number of relatively discrete activities. Although this chapter gives a flavor of those programs, a more detailed account, disaggregated into thirteen more specialized efforts, is included in the Annex.

B. Energy Policy and Planning

Energy-related decisions are made at many different levels, from users to suppliers to regulators and by all the persons, agencies, or enterprises that impinge on the process. In most LDCs, a majority of supply-side decisions, at least for modern commercial fuels, are made by people in government or government-affiliated agencies. And a sizable proportion of demand-side decisions are heavily influenced by government actions and policy.

The Office has several programs that offer assistance to decision-makers in developing, and using, rational criteria for energy policy and energy-system planning. These programs focus on (1) power-sector planning, where the greatest needs are perceived and where U.S. expertise can be applied most appropriately

and productively, (2) energy pricing policies, which can profoundly affect energy supply and demand behavior, and (3) the environmental management of energy systems, again an area in which the U.S. has significant experience and knowledge. A fourth relevant program is a small policy research effort.[2]

As mentioned in Chapter 1, LDCs face serious problems in the power sector. Repeating the historical experience of the industrialized countries, the electricity sector of LDCs is often the most dynamic energy component in the development process. Growth in electrical generating capacity has been greater than 7 percent annually, and some countries forecast growth of 10 percent or higher. But the daunting capital requirements and significant environmental implications of such increases call for a hard look at how to deliver energy services at the lowest possible cost (when "cost" includes environmental effects).

That hard look must include strong efforts to improve the productivity of the *present* power systems in LDC's. Those systems tend to be much less efficient, in the broadest sense, than utility systems in the industrialized countries. Power quality and reliability is low, and losses at many stages of the systems are great. Revenues are woefully inadequate not only because of these technical and management problems, but also because of government pricing policies. When governments shield consumers from the real cost of energy by means of subsidies or price controls, on the theory that greater amounts of energy use lead to greater economic development, the government or producers pay an important cost and a shortage almost inevitably develops.

The strategy of the Office of Energy is to assist the major actors in energy systems, and to focus on actual investment decisions, rather than paper plans. In addition, the intention is to attend to program and project implementation in the assisted countries, instead of analysis in isolation. Within this context, the Office is pursuing the following:

- Promoting the concept of investment planning under capital constraints
- Supporting technology assessment and prefeasibility studies
- Encouraging policies to ensure efficient pricing, institutional reform, and environmental management
- Developing and strengthening institutions to promote technology innovation and commercialization programs
- Establishing new institutional capabilities and arrangements, such as an international analog to the Electric Power Research Institute (EPRI)
- Promoting new joint U.S./host country industry initiatives (joint ventures in manufacturing, licensing)

During FY88 and FY89, the Office will be active in each of these areas.

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[2] Each of these four programs is described in more detail in Program Papers # 1, 2, 3, and 4 as listed in Appendix A.

To assist with investment planning in a capital-short environment, the Office will help develop approaches, including computer-based tools, for least-cost analysis.

The Office is helping agencies in India, Pakistan, Jordan, and elsewhere assess the potential for using at least two advanced technologies developed in the U.S.--integrated coal gasification combined cycle and fluidized bed combustion--to exploit the countries' significant coal and oil shale reserves. This could lead to joint ventures between U.S. and local companies for manufacture of equipment.

The topic of pricing reform is fraught with risk because removing subsidies can result in serious political protest by consumers. Governments often understand the economic problem with their current policies. but are afraid to act. The Office recognizes, therefore, that the *approach* is critical, and is publishing a guidebook for A.I.D. Missions on the topic and two case studies of successful implementation, and holding two regional workshops.

In the environmental category, the Office has historically integrated environmental considerations into a number of its other projects, but during the next two years there will be a concerted effort to assess further needs. Meetings are being organized with representatives of the non-governmental environmental community and with energy and environment specialists from other donor and lending institutions, to assure better communication on relevant issues and to better inform project development and implementation. The Office's training program is being reviewed to determine what current courses can be modified or new courses adopted to bring environmental criteria into decision-making and to increase relevant technical or economic skills.

Institution-building will be pursued through three avenues. First, the Office is supporting the new Program for the Acceleration of Commercial Energy Research (PACER), in India. PACER's goal is to establish a productive relationship between the research and development community, the energy sector, and the business community in that country, particularly to help respond to the serious shortage of power. Secondly, the Office is organizing meetings among decision-makers in the multilateral financing community to explore opportunities for fruitful collaboration and innovation in LDC electric power sectors. The Multi-Agency Group on Power Innovation (MAGPI) will also pursue the possibility of establishing international activities similar to those of the Electric Power Research Institute (EPRI) in the U.S. EPRI plays an important role as a clearinghouse for information and as a home for cooperative research. Thirdly, the Office is investigating the potential for setting up a "sister utility" program between U.S. and LDC utilities.

C. Energy Efficiency and Conservation

The historical truism that increased energy input, or energy supplies, is critical to economic growth sometimes obscures an important insight. Over-emphasis on the growth of energy use and supply, combined with relatively low prices for energy, can result in systems or technologies that use energy *inefficiently* when the real prices of energy increase. The energy price increases

of the 1970s clarified this phenomenon. Recognition of these inefficiencies in a number of countries was reflected both in legislation (such as fuel efficiency standards for automobiles) and, when and where the increased prices were passed through to consumers, a significant degree of voluntary conservation (in terms of behavioral change or technological adjustment). And with regard to economic growth, people discovered that there was no absolute energy supply coefficient for a given dollar of GNP.

All nations have numerous cost-effective improvements in efficiency that still remain to be implemented, but among the slowest to do so, unfortunately, are a majority of the LDCs. A desire to accomodate as rapidly as possible the commercial energy requirements of societies moving from "traditional" to "modern" has placed a political premium on increasing supplies. But the very rate of growth being experienced, combined with shortages of capital and especially foreign exchange, argue for serious attention to efficiency and conservation.

Energy conservation is a cheap, quick, and relatively painless way for most developing countries to stretch energy supplies, slash energy costs, and save foreign exchange. By producing more output with the same energy input, energy conservation promotes economic efficiency and improves the productivity, profitability, and competitiveness of energy-consuming enterprises. It is also an excellent vehicle for promoting private-sector development and can alleviate both the growing shortages of electric power supply and the capital constraints of building new generating capacity.

Another important result of conservation or improved efficiency is much-reduced environmental degradation. If less coal is being dug up and burned, if less gasoline is required for transportation, or if less fuelwood is required for domestic cooking, for instance, then less land (some of it arable) is scarred, fewer unhealthy residuals are emitted into the atmosphere, and LDCs' declining forests are less pressured. Among the emissions to the atmosphere, CO_2 has been receiving increasing attention because of possible climatic change. Conservation of any carboniferous fuel, including all three of the above examples, reduces that potential threat.

One of the principal economic "signals" that induces greater efficiency is, of course, higher prices for energy. The previous section of this chapter, on government policies, summarized the problem with current systems that subsidize energy for consumers. That section described the efforts of the Office of Energy to affect energy and economic efficiency by persuading LDC governments to "make the prices right"; this section describes the assistance that is given in terms of technical and management advice to accomplish the same conservation goal.

The strategy of A.I.D. in energy conservation during the past decade was shaped primarily by the urgent need of A.I.D.-assisted countries to save foreign exchange by cutting energy waste in facilities that use large quantities of imported petroleum products. A.I.D.'s strategy for the coming decade will no longer be just to conserve oil, but also to ensure that LDCs adopt least-cost energy alternatives. Although all sectors--industry, electric power, buildings, transport, agriculture, households--offer ample opportunities for energy conservation, the greatest potential for energy conservation is in the industry and

electric power sectors. The Office of Energy focuses its attention on these two sectors, although some specific efforts are also made in the transportation and building sectors. Emphasis is being placed on leveraging private investments and developing local private-sector capabilities to design, finance, and implement energy-saving programs.[3]

Major accomplishments planned for FY 88 include the following:

- Assistance in the implementation of major energy efficiency and technology projects in Egypt and Morocco

- One "bankable" project demonstrating electricity conservation and management. Possible country applications: India, the Dominican Republic, Costa Rica, or Morocco

- Private power strategy and implementation program. Possible country applications: Dominican Republic, Indonesia

- Pilot project to demonstrate investment in private power generation. Possible country applications: India, the Dominican Republic, Pakistan, the Philippines, or Indonesia

- Prototype load management program for an electric utility. Possible country application: Costa Rica

D. Energy and Rural Development

Rural areas contain the majority of LDC citizens and that economic sector central to human society--agriculture. The maintenance and development of rural standards of living and rural productivity (including, but not limited to, agriculture) are one of the priority goals of A.I.D. Delivering energy services to rural areas for agricultural and small industry development, as well as for village and household needs, is thus one of the chief goals of the Office of Energy.

Energy conditions can determine the success or failure of development initiatives in rural areas, as in urban and industrial sectors. For instance, expanding the arable farmland of a country in Sahelian Africa by five percent via small perimeter irrigation could require the equivalent of 5 to 8 percent of the country's total current energy consumption in additional energy supplies for pumping.

But as Chapter I explained, LDCs are finding it difficult to expand energy supply fast enough to satisfy the needs of development. In the Sudan, $100 million (US) in agricultural output was lost in 1984 when a shortage of energy supplies brought irrigation and tillage to a halt. A shortage of diesel fuel for pumped irrigation reduced the yield of irrigated crops in some parts of Somalia by 40 to 60 percent during 1984.

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[3] More detail on these programs can be found in Program Papers # 5, 6, and 7 listed in Appendix A.

In a remote part of Madagascar, more than 1,100 hectares had to be taken out of rice production because a lack of energy limited the capacity to pump water for irrigation. In Sri Lanka, rubber and rice milling industries have suffered from unreliable electricity supplies, undercutting A.I.D.'s plans to assist in installing modern processing equipment.

In a number of countries, unreliable electricity supply systems have also reduced the effectiveness of both child and livestock health programs which rely on refrigeration for vaccines. The number of development activities in rural areas, especially by the private sector, which have been stillborn because of a lack of reliable energy systems is legion.

The Office of Energy wishes to identify opportunities in the rural sector for the establishment or expansion of energy services for agricultural, industrial, and other commercial uses and for household and social service (health, education) end-uses. In some cases, the solution may be extension of existing centralized grids for power; within the Office of Energy that approach is left to programs working on power sector planning (see section B of this chapter). Assuming that in many cases, if not a majority, such extension currently is too expensive for the national power systems of A.I.D.-assisted countries, our rural-oriented programs are looking at other perspectives on rural energy needs. During FY88 and FY89, the Office is focusing on four approaches:[4]

- The use of biomass residues from various productive activities as a source of energy for electricity generation
- The options available for reducing fuelwood demand--more efficient cookstoves or substitute fuels
- The non-grid options available for water pumping (for irrigation and for household and institutional water supply)
- The options available from other renewable energy resources for local industrial and commercial needs

Biomass-Fired Power

In the rural sector, of course, biomass residues abound, chiefly from agricultural activities and to a lesser extent from the wood-products industry. To some degree, the decay of these residues serves an important function as a soil nutrient. But much of it does not serve that function and is either burned openly or hauled away. The use of biomass residues for generation of electricity thus has several potential payoffs: the benefit accruing to the farmer or timber company resulting from sale of the residue to the generation facility and/or of the electricity gained therefrom; the value of the electricity for local off-farm

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[4] The reader who is interested in more complete descriptions of the Office's programs in these areas is directed to Program Papers # 8, 9, 10, and 11 as listed in Appendix A.

productive and social uses, which result in additional local income; and the potential for "agri-refining," in which the residue is treated like a petroleum feedstock, leading to additional energy (ethanol) and non-energy products.

The Office of Energy is developing appropriate technology and is applying that technology to commercial generation of electricity using sugar cane residues, rice husks and rice straw, and wood wastes. With all three of these biomass fuels, technology has already been commercially demonstrated.

The technology and the program for sugar cane are furthest along, and during FY88 and FY89, the Office is helping with pre-investment activities in Jamaica, Thailand, and the Philippines. More preliminary consultations have been requested by a number of countries in all three of A.I.D. geographic regions.

Feasibility studies and other consultancies are being pursued with regard to rice residues in the Philippines, Indonesia, India, and Thailand. The Office is working with the U.S. Trade and Development Program and the Overseas Private Investment Corporation on trade and investment opportunities. In addition, support is being given to research on new combustion technologies, such as fluidized-bed combustion and solid-fueled and steam-injected gas turbines.

Although the use of wood wastes for self-generation by timber companies is common in the U.S., it is rare in LDCs. The Office of Energy has only recently begun exploring opportunities with this fuel. We have funded a 150kW project in Costa Rica, and will continue monitoring its performance, and during the next two years will perform feasibility work and consultancies in Indonesia and Honduras, where timber firms have expressed some interest. Another important dimension of wood use that will be stressed in Office work is the integration of the timber activities and wood-fired power into effective forest management.

Household Fuels

A larger wood-related energy problem exists, of course--that pertaining to wood shortages and the resulting stress on household fuel needs. In most rural areas of LDCs, fuelwood is the major, often the only, source of fuel for household uses (principally cooking, followed by space heating and lighting). As populations increase and forest areas decrease (chiefly as a result of clearing for agriculture and pasture), scarcities occur in more and more regions.

Because wood has many non-energy uses, the issues of wood supply are under the jurisdiction of the Office of Forestry, Environment, and Natural Resources, a sister office in the Bureau for Science and Technology. But the Office of Energy looks at the demand side of the fuelwood problem and focuses on two approaches--more efficient cookstoves and the possibilities for substitute fuels.

Only a small proportion of the improved cookstoves that have been developed over the past decade have been disseminated in any significant quantity, even on a local basis. The Office believes that in most cases, dissemination is more likely if (1) the market for the fuel--wood or charcoal--is commercial (in a great many areas, wood is gathered by the users rather than purchased), and (2) private entrepreneurs market the stove. With this in mind, the Office will fund

marketing studies and training for dissemination of improved charcoal stoves in East Africa, based on a successful experience in Kenya, and similar studies and training in Central America for woodstoves.

In pursuit of its strategy of developing substitutes for fuelwood, the Office has investigated the potential for producing and using smokeless coal briquettes (with indigenous coal), and has focused its efforts on Pakistan and Haiti. During FY88 and FY89, the Office will work with private sector entrepreneurs in each country to establish demonstration plants for manufacture.[5] In addition, the Office will begin looking at another option--the use of biomass or hybrid biomass/coal briquettes. FY88 will be devoted to reviewing what has been learned by others in the field and in preparing a more active plan for implementation in FY89. Also in FY88, the Office will collaborate with the World Bank in convening two regional workshops (one in Africa, one in Asia) to discuss options for fuelwood substitutes.

Water Pumping

As was mentioned above, energy constraints have had tragic results for agricultural production in several countries in recent years. Lack of reliable grid power or diesel supplies have hamstrung efforts to supply food for local populations and for export. The high rate of population growth in most LDCs calls for greatly increased food production. Most of this increase will require irrigation and therefore rural power needs could grow dramatically.

The Office of Energy has had a program focusing on energy for irrigation for three years. This program has investigated the technical and economic aspects of water lifting, supported demonstrations and monitoring of a variety of technologies, and contributed to the preparation of a manual for prospective irrigators.

During FY88, the program will follow up on earlier preliminary assessments of irrigation issues in the Dominican Republic and Egypt and help to identify specific energy needs for the near-term. Staff is completing the final drafts of contributions to the Handbook for Comparative Evaluation of Technical and Economic Performance of Water Pumping Systems and then assist in dissemination of the published handbook. At conferences and workshops the Office will raise the level of awareness of energy-related irrigation issues and to discuss options for project design. One of these meetings will be a regional workshop for irrigation project managers from A.I.D. Missions in Asia and the Near East.

Other Renewable Options

A number of renewable energy resources are available in LDCs, and numerous projects in this area have been attempted during the past decade by lending and donor agencies. Successful application of renewable energy (such as with the

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[5] The implementation of all A.I.D. projects in Haiti is contingent upon the stabilization of the political situation in that country.

biomass-fired power described above) has economic and environmental benefits for the countries involved.

Many, but not all, of those past projects have had too little lasting effect. This deficiency is partly a reflection of the inevitable and merciless weeding-out process when new technologies are being developed, and partly a result of the unexpectedly dramatic drop in oil prices since 1981. But part of the reason is also overly ambitious project planning. In a well-intentioned desire to respond to the oil price shocks of the 1970s, demonstrations of renewable technologies sprouted up without consistent attention being paid to real end-use needs or to long-term economic and institutional issues.

A.I.D., partly through the Office's Renewable Energy Applications and Training project, is completing a review of A.I.D.'s renewable energy activities during the last decade (with some reference to the experience of other donors) and the study is being published in FY88. The report will discusses the lessons referred to, and sets out some guidelines for future activities.

During the coming two years, the program will attempt to identify those circumstances in which end-uses and available renewable technologies offer the greatest hope for near- or mid-term commercial success. These efforts will include both the preparation of short guides for promising applications (such as the use of photovoltaic-powered refrigerators for vaccine storage in rural areas) and the identification of site-specific project opportunities. The program intends to take two of the latter through the stage of pre-feasibility studies.

All of these efforts, whenever appropriate, promote technology transfer from the U.S. These efforts are being coordinated with the work of the multi-agency Committee on Renewable Energy Commerce and Trade (CORECT, whose lead agency is the Department of Energy). The Office supports CORECT by providing data bases on renewable energy experience, preparing market reports on selected countries, and assisting in the development of a training program that offers courses to LDC nationals connected to joint ventures with U.S. renewable energy technology manufacturers.

E. Indigenous Fossil Fuels and Advanced Technology

To reduce the economic strain caused by oil imports, LDCs must explore the potential for exploiting their own indigenous fossil fuels. They also must have access to the best available technology, in order to optimize capital expenditures, efficiency goals, and environmental concerns.

The goals of the Office of Energy in this area are three-fold: to provide developing countries with technical assistance in exploring and evaluating their indigenous conventional energy resources; to facilitate their access to appropriate technologies and services; and to determine useful strategies for attracting capital investment so that the needed development will occur.

The Office's direct involvement is limited to pre-exploratory studies and exploratory work up to but not including on-structure exploratory drilling, and to advisory services, short term-practical training in technical fields, and

institutional support. However, activities undertaken within the Office project are designed to assist countries in locating other public and private sources of capital, technology, and expertise in order to ensure that groundwork laid within the project can lead ultimately to resource development (assuming successful geological exploration).

The fossil fuel options potentially available to LDCs include petroleum, natural gas, and coal, and new sources such as oil shale and tar sands. In a few instances, geological studies may also include analyses of the potential for geothermal energy, in light of the similar geological techniques required for geothermal exploration.

The number of technologies available to exploit these energy resources is vast, and LDC planners do not have easy access to reliable information and to techniques of evaluation. Because of the access that A.I.D. potentially has to such information through U.S. manufacturers and experienced U.S. utility planners, the Office plays a very helpful role in identification, evaluation, and even the actual transfer of technology.

During FY88 and FY89, the Office is concentrating its resource assessment and technology transfer efforts, at the request of the pertinent A.I.D. Missions, on oil shale in Jordan and Morocco and natural gas in Bolivia. As an adjunct to these efforts, the Office is also studying municipal solid waste in India, because advanced technology very similar to that being considered for coal and oil shale may be appropriate.[6]

Assessment work and pre-feasibility studies have already been done in Jordan; work is proceeding on environmental testing of the shale, finalizing the use of fluidized-bed technology, conceptual plant design, and a strategy for private sector development. Lessons learned will be applied to similar projects elsewhere.

Fluidized-bed technology, originally developed for combustion of coal, is applicable to several fuels. One potential use is with municipal solid waste (MSW), the growing production of which is a serious problem for LDC cities, as in the U.S. The Office is investigating the possibilities of using fluidized-bed technology to convert portions of the MSW in Madras, India, to useful energy.

Bolivia has significant reserves of natural gas. This fuel, when available, is the "preferred" fossil fuel because of its lower emissions (no solid residuals, of course, and fewer unwanted gaseous emissions). In addition, recent technological advances in gas turbines offer opportunities for improved conversion efficiencies. Brazil has expressed interest in purchasing electricity from Bolivia, and the Office will assist the latter government in determining the potential for producing that electricity from natural gas.

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[6] For more detailed information on these programs, the reader can request Program Papers # 12, 13, and 14 as listed in Appendix A, from the Office of Energy.

F. Training

True development in the countries assisted by A.I.D. means the acquisition of skills and the building of institutions that make the development process sustainable and predominantly endogenous.

Numerous skills are needed in the energy sector. On the demand side, end-use analysis is critical. The exploitation of specific energy sources requires knowledge of resource assessment methods and of technologies for mining or harvesting and then conversion. At a different level, knowledge of maintenance techniques to ensure durability and reliability of equipment is needed. System managers and planners must possess a combination of such technical knowledge plus economic issues and an understanding of various environmental impacts of different energy technologies, as well as basic management skills. Government policy makers must have some similar broad familiarity with these various areas.

LDCs typically are deficient in persons who possess these various skills. One obvious way to accomplish the important transfer of knowledge is through formal training programs. Although U.S. "trainers" cannot fully understand the needs and culture of each LDC, the transfer of useful skills would enable nationals of those LDCs--who do know their own cultures--to make better energy-related decisions. The trained individuals become an indigenous resource in their own countries, strengthen the private and public institutions with whom they work, and, it is hoped, in turn transfer their knowledge to fellow nationals.

To accomplish these educational goals, the Office of Energy in 1980 established the Conventional Energy Training Program (CETP), which offered a wide variety of courses to nationals of LDCs. Most of these courses have been organized by U.S. contractors, including universities and private sector firms. A by-product of some of the training courses, then, has been to establish a friendly relationship between participating U.S. firms and trainees that can result in business for that firm after the graduates return to their country.

The CETP has sponsored over 700 participants from LDCs. Participants were placed in academic and technical training programs at universities, private energy companies, non-profit institutions, and national laboratories. Training ranged from two months to two years in duration, in such fields as energy conservation, chemical, civil, and electrical engineering, energy economics, engineering systems, geology, and petroleum engineering. Missions have also contributed to the funding of this program through buy-ins.

The CETP ended in 1987, but its success led to the follow-on funding of a similar project--the Energy Training Program (ETP)--with some shifts in emphasis. ETP will depend to a lesser extent on academic degree programs, although standard academic programs are still available when appropriate, and focus more on relatively short courses in technical training that include, whenever possible, "hands-on" experience. Some participants maximize the latter by being placed in internships that are totally work-oriented, devoid of formal coursework.

The new program deals with renewable as well as conventional energy. Trainees are chosen through competitive selection, and the training concentrates

on energy conditions specific to the trainees' countries or regions. Training is conducted mostly in the U.S., but the Office is planning some programs in selected countries for local and/or regional participants.

The heart of the ETP project is the training courses. Existing courses offered by universities or private firms are frequently used, but courses are designed specifically for the program when necessary. The courses are listed below, according to the relevant thematic area (described earlier in this chapter) into which they fall (several of the courses overlap more than one thematic area). Those course titles preceded with a star (*) are newly proposed courses; whether they are actually given depends on whether there is a sufficient level of interest manifested by A.I.D. Missions and their respective host countries.

A. Energy Policy and Analysis

Power Systems Engineering
Advanced School in Power Systems Engineering
ASEAN Energy Planning Training
Energy Planning and Policy
*Private Power Cogeneration
*Energy Management
*Financial Management of Utilities

B. Energy Conservation and Demand Management

Utility and Industry Energy Conservation
Electric Utility Engineering
*Management of Energy Construction Projects
*Construction Project Planning and Preparation
*Refurbishing and Rehabilitating Power Plants

C. Energy and Rural Development

*Sugarcane Energy Technologies
*Geothermal Engineering
*Irrigation Training
*Mini-Hydro Siting (Burma only)
*Preventive Maintenance for Diesel Generators and Steam Generating Plants

D. Indigenous Fossil Fuels

Applied Petroleum Exploration and Production Technology
Managing a National Petroleum Enterprise
*Petroleum Economics
*Petroleum Geology
*Petroleum Management Program
*Petroleum Marketing and Purchasing
*Petroleum Transport
*Gas Management
Coal Utilization (Lignite)

*Coal Mining and Production (Lignite)
*Coal Mine Safety

Additional courses can be designed to meet the expressed needs of any particular A.I.D.-assisted country.

To improve the probability that the skills acquired by a participating individual are actually put to use when the participant returns to his or her country, the project requires that the individual have a guarantee of a job when he or she returns. This also assures that the skills will become part of the capability of an *institution*, with the greater possibility of widespread application and a transfer of the skills to additional persons.

In addition to these courses, the Office can sometimes arrange internships with energy-related companies (past arrangements have been made with companies such as Pennsylvania Power and Light, Shell Oil, and Ashland Coal Company).

The project can also assist with the placement of LDC nationals in traditional academic programs, if all matriculation costs are covered with Mission or other non-Office funds (only in rare circumstances can the Office project budget be used for such purposes).

CHAPTER III

BUDGET AND ORGANIZATION OF THE OFFICE FOR IMPLEMENTATION

This chapter presents the Office's budget, organization, and staffing.

A. ORGANIZATION AND BUDGETING OF PROJECTS

From the viewpoint of A.I.D. budgeting, the Office consists of five active "projects". All the activities described in Chapter II Are subsumed under these projects:

1. **The Bioenergy Systems and Technology Project (#936-5709)**

   This project funds efforts to use biomass for electricity generation, as summarized in Chapter II, Section D.

   FY 88 Budget: $ 2.10 million

   Proposed FY 89 Budget: 2.096 million

   Years of Project Life: FY 79 - FY 89

2. **The Conventional Energy Technical Assistance Project (#936-5724)**

   This project funds programs summarized in Chapter II, Section E.

   FY 88 Budget: $ 0.60 million

   Proposed FY 89 Budget: 0.975 million

   Years of Project Life: FY 80 - FY 90

3. **The Energy Policy Development and Conservation Project (#936-5728)**

   This project funds several areas of policy and planning work, as summarized in Chapter II, Section B, and the Office's efforts in efficiency and conservation (Chapter II, Section C. The planning portion of this project also contributes a portion of the funding for work in household fuels (Chapter II, Section D).

   FY 88 Budget: $ 4.35 million

   Proposed FY 89 Budget: $ 3.652 million

   Years of Project Life: FY 82 - FY 92

4. **The Renewable Energy Applications and Training Project** (#936-5730)

This project funds some of the activities in Chapter II, Section D, and shares funding for household fuels work with the preceding project.

FY 88 Budget: $ 0.95 million

Proposed FY 89 Budget: 0.408 million

Years of Project Life: FY 85 - FY 92

5. **The Energy Training Project** (#936-5734)

This project funds the administration of the training program described in Chapter II, Section F.

FY 88 Budget: $ 2.0 million

Proposed FY 89 Budget: 2.162 million

Years of Project Life: FY 87 - FY 92

Because of overlapping interests and a desire to tap available expertise in a cooperative fashion, small amounts of funds from one project are sometimes expended in providing assistance to a program that is managed by another project. The technological and financing expertise of persons working for the Conventional Energy Technical Assistance Project, for instance, is solicited to assist the Bioenergy Systems and Technology Project in its development of sugarcane-fired electricity.

The Office's own budget is leveraged by additional funding, particularly from Missions and some regional bureaus. Based on discussions with several Missions and Bureaus during this planning exercise and based on past experience, the Office estimates the level of "buy-ins" for all program activities will be approximately $2-3 million in FY88 and $3-4 million in FY89.

B. STAFFING

The organization of the Office provides a framework for assigning responsibilities to the staff to ensure that the objectives of the various projects and initiatives as described in Chapter II (Program Description) are met.

The Office comprises the following staff persons and assignments:

Director:	*James Sullivan*
Deputy Director:	*Alberto Sabadell*
Program Operations Specialist:	*Shirley Toth*
Program Operations Assistant:	*Carolyn Kiser*
Policy Advisors:	*Ross Pumfrey and Nancy Arneson*

Bioenergy Systems and Technology Project Manager:	*James Sullivan*
Conventional Energy Technical Assistance Project Manager:	*Alberto Sabadell, assisted by Robert Grimshaw*
Energy Policy Development and Conservation, Policy Development Project Manager:	*David Jhirad, assisted by Ross Pumfrey*
Conservation Project Manager:	*Alberto Sabadell, assisted by Robert Grimshaw*
Renewable Energy Applications and Training Project Manager:	*David Jhirad, assisted by Ross Pumfrey*
Energy Training Project Manager:	*Shirley Toth, assisted by Robert Grimshaw*

The FY88 staffing plan calls for eight RSSA and PASA staff to be located on the premises,[7] in addition to the Office's professional and secretarial staff.

C. PROJECT CONTROL SYSTEM

The Office has a formal project control system, which tracks the status of contract obligations and expenditures; provides monthly, quarterly, and annual status reports, including tracking of deliverables and other milestones; and provides information on Mission requests and buy-ins. The system uses a D-Base III+ program format on the Office's Wang PC. The Office has prepared a manual that specifies in detail the procedures for this system and the computer hardware and software requirements.

D. OUTREACH AND INFORMATION DISSEMINATION PROGRAM

The objectives of the outreach and information dissemination program are two-fold:

- To disseminate, systematically and in a timely fashion, program information to AID senior staff, regional bureaus, Missions, other donor agencies, research institutions, and private-sector organizations, both in the United States and AID-assisted countries.

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[7] RSSA stands for Resources Support Services Agreement, and PASA stands for Participating Agency Service Agreement.

- To involve outside public- and private-sector parties in program definition, review, and implementation.

To achieve these two objectives, the Office has defined a program organized around five key components:

1. A formal program planning outreach program
2. A publication program
3. Systematic Mission briefings
4. Private-sector technology transfer teams
5. Regional topical workshops.

Program Planning Outreach Program

The Office periodically convenes small ad-hoc groups of experts from other international institutions (e.g., the World Bank, the United Nations, the Inter-American Development Bank), the private and non-profit sectors, and within the Agency to guide its program planning activities and assist in program implementation and outreach. An example is the Multi-Agency Working Group on Power Sector Innovation. During FY 88 a similar group may be set up to pursue better environmental management within LDC energy sectors.

A summary of the program plan will be published and distributed to the Missions and Bureaus of the Agency, and to international lending institutions and other interested parties.

Publication Program

The second major element of the outreach/information strategy is the timely and systematic publication of reports resulting from every contract issued by S&T/EY directly or through contractors (e.g., Oak Ridge National Laboratory). At least twice a year, the Office program activities are reviewed to identify publishable work and ensure that publication-related activities are properly carried out. To give these reports maximum distribution and impact, the Office has developed a simple, uniform reporting and presentation format for its contractors. A catalog of reports available from the Office is published once a year. As part of this activity, the Office is developing a microcomputer-based mailing list that will allow it to target its publications to specific audiences in the international development community.

Technology Transfer Teams

The transfer of technology is a critical element in development assistance, and for this reason the Office sponsors the creation of private-sector Technology Transfer Teams (TTTs) to implement private-sector projects. These teams, comprising public- and private-sector experts, are intended to assist A.I.D. in designing projects that can be financed and implemented by the private sector. The projects will then serve as prototypes for other private-sector initiatives, while at the same time pursuing the transfer of know-how, technology, and

financial resources between U.S. private-sector parties and those in developing countries.

The Office has formed a TTT for cogeneration and has identified other potential business areas in which to test this concept in FY88 and 89.

Regional Topical Workshops

As the fifth component of the outreach and dissemination program, the Office of Energy either co-sponsors or actively participates in a series of workshops in collaboration with A.I.D.'s Regional Bureaus or other lending or donor agencies. The workshops focus on topics that are relevant, and of interest, to a specific region and are open to both public- and private-sector participants.

Workshops on the agenda for FY88 and FY89 include the following:

Co-Sponsorship

- o Workshop in Kenya in January 1988 on "Improving the Performance of irrigated Agriculture in Africa" (with the African Bureau and the Office of Agriculture in the Bureau for Science and Technology)
- o Workshop in Costa Rica in August 1988 on private sector participation in power generation (co-sponsored with the Costa Rican Institute for Electricity)
- o Workshop in India in January 1989 on innovation in the power sector

Participation

- o Workshop in the Dominican Republic in November 1987 on irrigation and water management (sponsored by the Bureau for Latin America and the Caribbean)
- o Workshop in Zimbabwe in February 1988 on household fuels (sponsored by the World Bank)
- o Workshop in the Sudan in October 1988 on biomass briquetting (sponsored by the Danish foreign aid agency)
- o Workshop in Honduras in June 1988 on opportunities for sugar mills to engage in energy production in Central America (sponsored by A.I.D.'s Regional Office for Central America and Panama)

In addition to the five central components of the outreach and information dissemination program just reviewed, the Office will also pursue a number of other activities. For instance, the Office will continue to encourage its staff to publish articles for A.I.D. and external publications, and will examine the possibility of holding joint energy briefings with A.I.D.'s Trade and Development Program for U.S. private companies. In addition, the Office will continue to

foster the organization of in-country professional groups and associations and work on linking them on an international basis.

E. SUPPORT AGREEMENTS AND CONTRACTS

The Office relies in part on outside support to implement its program activities. The objective of the Office's support agreements and contracts is to develop multidisciplinary teams of experts and continually enhance their capabilities through repeated experience in all key areas needed for program implementation and Mission support.

The following contractual mechanisms are used to help implement the program:

- PASA with Oak Ridge National Laboratory (approved through FY92). ORNL provides management assistance to the energy analysis and policy development activities under the Energy Policy Development and Conservation (EPDAC) project as well as the renewable energy program under the Renewable Energy Applications and Training project.

- RSSA with Tennessee Valley Authority (approved through FY89), which manages the Bioenergy Systems and Technology project.

- Contract with the Institute for International Education (IIE) to manage the Conventional Energy Training project (contract ending June 30, 1992).

- Contract with Hagler, Bailly & Company for technical assistance to the Energy Conservation Services Program funded under the EPDAC project (contract ending July 19, 1992).

- Contract with Bechtel National for services to the Conventional Energy Technical Assistance project (contract ending September 17, 1990).

In addition to these multiyear contracts, the Office also uses purchase orders, indefinite quantity contracts, and 8(a) contracts[8] to carry out unforeseen and small jobs, when necessary. Based on past experience, approximately 15-20 purchase orders are likely to be needed in FY88. The Office is also exploring ways of facilitating Missions' financial participation -- "buy-ins" -- in Office contracts and PASA agreements.

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[8] 8(a) contracts are with firms given preference in government contracting because of qualified "minority" ownership.

APPENDIX A

LIST OF AVAILABLE PROGRAM PAPERS

The following papers, discussing the projects of the Office of Energy in greater detail, can be requested from the Office at the address and telephone number listed at the bottom of the page. Each paper explains a priority activity of the Office by describing the development problem the activity addresses, the goals of the activity and the strategy designed for achieving these goals, and the accomplishments expected in given countries or regions in FY88 and FY89.

Program Paper # 1: Investment Planning in the Power Sector

Program Paper # 2: Energy Price Reform

Program Paper # 3: Environmental Management of Energy Production

Program Paper # 4: Energy Policy Research Program

Program Paper # 5: Energy Conservation and Demand Management in Industry

Program Paper # 6: Energy Conservation and Demand Management in Power Systems

Program Paper # 7: Energy Conservation and Demand Management in the Transportation and Building Sectors

Program Paper # 8: Renewable Energy Applications and Training

Program Paper # 9: Biomass-Fired Power Systems

Program Paper # 10: Household Fuels

Program Paper # 11: Energy for Rural Water Management

Program Paper # 12: Resource Assessment and Development of Indigenous Fuels

Program Paper # 13: Technology Development and Application for Conventional Fuels

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