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RENEWABLE ENERGY PROGRAM FOR AFRICA
A SUMMARY

by

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INTRODUCTION

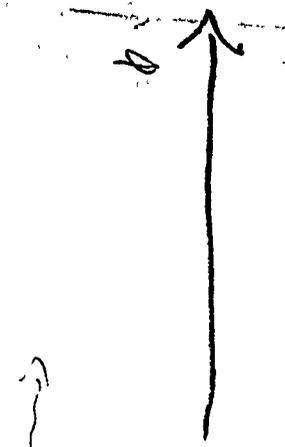
This paper has been prepared in partial fulfillment of Contract No. AID/afr-C-1453. It describes the evolution of the Renewable Energy Program in Africa,* which has been nurtured by the Division of Special Development Problems in the Bureau for Africa. To obtain the information contained in this report, I have drawn heavily upon AID documents, including the FY 1980 Annual Budget Submissions for Africa, and for the Development Support Bureau (Energy Program). I have also drawn from the report entitled "Energy for the Villages of Africa," written by the Overseas Development Council with a grant from AID.

The report contains a number of appendices. Appendix 1 contains a brief description of proposed renewable energy projects in Africa, based primarily upon Project Identification Documents submitted in the FY 1980 ABS. A summary of the proposed program of the AID Office of Energy, located in the Development Support Bureau, can be found in Appendix 2. Although this office is relatively new, it has already begun to define its role vis-a-vis its constituency, which are the regional bureaus and the AID field missions. It has the responsibility for providing technical support on matters relating to energy, and therefore its programs will have a direct impact on the Africa regional program. Appendix 3 outlines the current status of Peace Corps activities in the field of renewable energy. I have included this information in light of the considerable discussion over the past few years regarding the desirability of increased AID-PC cooperation. Although both AID and PC's energy programs are still at the infancy stage, a number of possibilities for cooperation already exist. Appendix 4 provides background information and recommendations for a small project in support of nonconventional energy for Cape Verde.

I am indebted to James Tarrant of the ODC, and Paul Jankura, a consultant to the Peace Corps, for the updated information on the Peace Corps Energy Program; and to Sam Bosken, DS/EY, for information on the proposed program for AID's Office of Energy. My special thanks goes to John Blumgart, Director of the Special Development Problems Division, who has spearheaded the renewable Energy Program for Africa and has provided me with invaluable guidance and support.

* I have not included forestry as a source of energy in my discussion, as this will be the subject of a separate report.

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The U.S. Congress has given AID a clear mandate to assist developing countries in meeting their energy needs through increased production and conservation (Sections 103, 106, 107 and 119 of the Foreign Assistance Act). Emphasis is to be given to renewable and nonconventional energy.



The pertinent sections of the legislation are cited below:

Section 103(c). Food and Nutrition: Assistance provided under this section shall be used primarily for activities which are specifically designed to increase the productivity and income of the rural poor, through such means as ...expansion of local or small-scale rural infrastructure and utilities such as ...energy.

Section 106(2). Technical Assistance, Energy, Research, Construction and Selected Development Problems. The President is authorized to furnish assistance for the following activities: ...programs to help developing countries alleviate their energy problems by increasing their production of suitable energy sources and conservation methods, collection and analysis of information concerning countries' potential supplies of and needs for energy, and pilot projects to test new methods of production or conservation of energy.

Section 107. Intermediate Technology. ...Twenty million dollars may be used for activities in the field of intermediate technology, ...to promote the development and dissemination of technologies appropriate for developing countries.

Section 119. Renewable and Unconventional Energy Technologies. The President is authorized to furnish assistance under this chapter for cooperative programs with developing countries in energy production and conservation, with particular emphasis on programs in research, development, and use of small-scale, decentralized, renewable energy sources for rural areas carried out as integral parts of rural development efforts in accordance with section 103 of this Act. Programs under this subsection shall be undertaken, whenever appropriate, in cooperation with the Energy Research and Development Administration or its successor and shall be carried out, to the greatest extent possible, through and in conjunction with activities under section 107 of this Act. ~~These programs shall be directed toward the earliest practicable development and use of energy technologies which are environmentally acceptable, require minimum capital investment, are most acceptable to and affordable~~

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sources which meet the following criteria:

- Responsive to rural needs
- Environmentally sound
- Minimum capital investment
- Inexpensive
- Simple to use and maintain
- Replicable

Wherever appropriate, these activities are to be integrated into rural development projects. The Department of Energy, as well as other public and private sector specialized institutions, are to be sources of technical support for designing and implementing renewable energy activities.

In response to Congressional interest, the Africa Bureau of AID commissioned the Overseas Development Council (ODC) to draft a paper on "Energy for the Villages of Africa,"² which would provide the starting point for a program in renewable energy. The report concluded that a major question to be addressed is the extent to which rural energy sources (sun, wind, flowing water, vegetation) can be tapped to meet rural needs, and whether this approach can provide a technically, economically and socially feasible alternative to reliance on conventional sources of energy.

To address this question, the ODC proposed a course of action designed to generate knowledge and experience at the village level. The approach consists of three key elements:

1. Data Collection and hardware testing: to identify energy needs and resources at the village level, and to test a variety of small-scale technologies.
2. Institutional Development: to strengthen existing institutions or to assist in creating new institutions for undertaking energy planning, research and development.
3. Increase in foreign assistance: to provide increased technical and financial support for research, development and production of small-scale, renewable energy technologies, both in the U.S. and developing countries.

by the people using them, are simple and inexpensive to use and maintain, and are transferable from one region of the world to another. ...Up to \$18,000,000 (will) be used for carrying out this subsection.

²Overseas Development Council. 1977. Energy for the Villages of Africa. Washington, D.C.: Overseas Development Council. February.

The ODC further recommended that the above-mentioned activities be carried out wherever possible by individuals and organizations based in the host country.

The ODC report was circulated to African AID missions for dissemination to interested public and private organizations (April 1977). Shortly thereafter, AID/W sent out a cable to all Field missions (September 1977) offering the services of a joint ODC/AID team. This team would assist interested host countries and USAID's in identifying: (1) potential energy-related rural activities, and (2) national and regional energy-related organizations capable of implementing these activities. In addition, the team would assist in identifying renewable energy projects (including smaller projects) which could be implemented in FY '78 and '79 under the Accelerated Impact Program or Regional Improved Rural Technology Project). The response from the field was overwhelming favorable. Subsequently, three teams traveled to 13 countries:

- November 1977: Niger, Upper Volta, Mali, Senegal, Nigeria.
- Spring 1978: Kenya, Tanzania, Rwanda, Ethiopia, Mauritius.
- Summer 1978: Botswana, Lesotho, Swaziland.

One result of the team visits has been the submission of 7 PID's to AID/W for review and approval. It is expected that 3 more will be submitted in early FY 1979. Two of these projects (Mali, Niger) will actually begin this year. A brief description of the proposed activities, including estimated funding, is included in Appendix 1 to this report.

In addition to the above-mentioned activities, the Africa Bureau is participating in a cooperative effort with the French and Senegalese to install a solar pump for irrigation in Northern Senegal (Bakel). This activity is part of a larger US-supported project to irrigate small perimeters in northern Senegal, using diesel pumps. The installation of the solar pump will provide an opportunity to undertake a comparative analysis of the technical, economic and social feasibility of using solar versus diesel pumps in remote areas in Africa. In Upper Volta, the Africa Bureau and the Development Support Bureau are jointly financing the installation of a solar cell power system in a remote village of Tangaye. The purpose of this effort is to determine the socio-economic effects of reducing the energy required to perform daily tasks. In Ghana, the Bureau is supporting an experimental project to test a pyrolytic converter developed by the Georgia Institute of Technology. The converter transforms agricultural and forestry wastes into high energy fuels (char, oil and gas). In Burundi, the US is supporting an effort to develop peat reserves for non-industrial thermal use, and to design approaches to encourage rural consumption of peat.

The Africa Bureau's program in renewable, small-scale energy has blossomed overnight into a \$4,384,000 effort for FY 1978. Current estimates, which are conservative, indicate that the program will more than double by

FY 1980 to \$8,837,000. As noted above, the interest on the part of host country governments and USAID missions is considerable. During the month of August 1978, for example, representatives from the Cameroon and Cape Verde visited AID/W and requested U.S. assistance in this sector.³ Also, the potential is great for incorporating energy activities into ongoing or proposed rural development projects, or substituting renewable energy technologies for systems run on fossil fuels. As an example, the U.S. is planning to install a combined desalination and power generating unit on the island of Sal in the Cape Verde Republic. The annual fuel bill for this facility will be approximately \$500,000. Given the abundance of wind resources in Sal, the installation of a windmill to generate some of the power requirements should be carefully examined.

Up to this point in time, AID/W has played a catalytic role in developing the renewable energy program in Africa. This approach served the important function of communicating to the field U.S. interest and support for the development of alternative energy sources. This objective has been accomplished, and it is now the responsibility of the USAID's to identify projects and submit PID's, much as they do in other sectors. There is a recognition on the part of AID/W that for the most part the missions do not have the staff with sufficient knowledge in energy to begin a dialogue with the host country. It is essential that the missions have access to technical expertise, perhaps resident in the REDSO's East and West.

The interest of African countries and USAID's in the renewable energy sector exceeds the capability of AID/W to respond. Additional staff will be required in AID/W to manage the rapidly expanding program. And there is a need for developing flexible mechanisms whereby the Bureau can respond promptly to field requests for design teams and technical backstopping. The Africa Bureau Management has approved staff additions for a position in Washington and in each of the REDSO's, but these positions remain to be filled. Qualified individuals to fill these posts should be identified as quickly as possible.

³Appendix 4 contains background information and recommendations for a potential nonconventional energy project in the Republic of Cape Verde.

APPENDIX I : RENEWABLE ENERGY PROGRAM PROJECTIONS

		78	(\$000) 79	80
Burundi -	Alternative Energy Peat - AIP (698-0410)	490	-	-
Burundi -	Alternative Energy Peat II (695-0103)	-	-	2,509
Senegal -	Small Irrigated Perimeter/Solar Pump (685-0208)	700		
Senegal -	Operation Energie Renouvelable (685-0238)	d/	500	500
Mali -	Renewable Energy (688-0217)	2,174	800	800
Cameroon -	Assistance to ONAREST (AIP)	-	200 ^{a/}	-
Tanzania -	Renewable Energy Resources	e/	1,500 ^{c/}	500
Cape Verde -	Non-Conventional Energy - AIP	-	500 ^{a/}	-
Cape Verde -	Non-Agricultural Options (655-0010)	-	150	400
Rwanda -	Renewable Energy	-	500 ^{b/}	-
Mauritania -	Rural Industries (682-0208)	-	-	586
Botswana -	Alternative Energy (633-0207)	b/	500 ^{a/}	580
Lesotho -	Alternative Energy Project (632-0206)	b/	574	382
Swaziland -	Alternative Energy Research (645-0207)	b/	446	130
Niger -	Solar Energy - AIP (698-0410)	500	-	1,000 ^{a/}
Ghana -	Pyrolytic Converter - Science and Technology for Rural Development (641-0097)	83	-	500
Upper Volta -	Solar Cell Power System (698-0410)	80	-	-
Mauritius -	Renewable Energy - AIP	b/	500	-
Ethiopia -	Energy Survey	b/	500	500
Project Design Services		357	400	450
Sub Total		4,384	7,070	8,837
Grand Total		\$20,291		

- a/ Estimate - not included in ABS
- b/ FY '79 PID in preparation
- c/ Estimate - included in Table VI of ABS
- d/ PID approved - funding included in supplement to ABS
- e/ PP in preparation

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RENEWABLE ENERGY PROJECTS (EXCLUDING REFORESTATION)

<u>Country / Project No. / Title / Description</u>	<u>Obligation (\$000)</u>		
	<u>FY 1978</u>	<u>FY 1979</u>	<u>FY 1980</u>
AFRICA REGIONAL			
698-0410 <u>Accelerated Impact Program</u>	3380	3000	3000
<u>Burundi</u>	490	-	-
---Development of peat reserves for non-industrial thermal energy use; design of approaches to encourage rural peasant consumption of peat as alternative thermal energy source.			
<u>Upper Volta</u>	80	-	-
---Demonstration/evaluation of solar energy as power source for common village tasks (grain milling, water pumping). Additional funding, amounting to \$75,000, is being provided under DSB-funded project entitled "Studies of Energy Needs in the Food System."			
698-0407 <u>Improved Rural Technology Project</u>	500	1000	1205
---To adapt appropriate western technologies (including energy) to local use.			
BURUNDI			
695-0103 <u>Alternative Energy - Peat II</u>	-	-	2509
---To assist GOB to exploit peat as alternative form of energy for rural and light commercial consumption.			

a/ Estimate - not included in ABS

b/ FY - 79 PID in preparation

c/ Estimate - included in Table VI of ABS

d/ PID approved - funding included in supplement to ABS

e/ PP in preparation

<u>Country / Project No. / Title / Description</u>	<u>Obligation (\$000)</u>		
	<u>FY 1978</u>	<u>FY 1979</u>	<u>FY 1980</u>
CAMEROON			
xxx-xxxx <u>Alternative Energy (AIP)</u> ---To provide assistance to ONAREST (Center for Energy Research). Project to include: compilation of wind and insolation measurements; assessment of energy demand; construction of solar energy lab; and testing of solar drying techniques.	-	200 ^{a/}	-
CAPE VERDE			
655-0010 <u>Development of Non-Agricultural Options</u> ---Research, development and testing of non-agricultural technologies, including wind and solar energy.	-	150	400
xxx-xxxx <u>Non-Conventional Energy (AIP)</u> ---To collect data on wind fields and solar radiation. ---To develop and test renewable energy technologies for pumping water, drying agricultural products, desalination, and domestic cooking.	-	500 ^{a/}	-
ETHIOPIA			
xxx-xxxx <u>Energy Survey</u>	b/	500	500
GHANA			
xxx-xxxx <u>Ghana Pyrolytic Converter</u>	83	-	500
641-0097 <u>Science and Technology for Rural Development (Pyrolytic Converter)</u>	-	-	500

<u>Country / Project No. / Title / Description</u>	<u>Obligation (\$000)</u>		
	<u>FY 1978</u>	<u>FY 1979</u>	<u>FY 1980</u>
MALI			
688-0217 <u>Renewable Energy</u> ---To develop/strengthen national institutional capacity. ---To test alternative technologies. ---Proposed outputs include: village studies; construction of solar energy laboratory; training; testing of experimental energy devices.	2174	800	800
MAURITANIA			
682-0208 <u>Rural Industries</u> ---To develop and encourage indigenous, rural-based, labor-intensive industries. Products or services could include: construction of methane gas units, solar stills, and windmills.	-	-	586
MAURITIUS			
xxx-xxxx <u>Renewable Energy (AIP)</u>	b/	500	-
NIGER			
698-0410 <u>Solar Energy (AIP)</u> ---To provide institutional support to Niger's solar energy laboratory (ONERSOL). ---Post-graduate training.	500	-	1000 ^{a/}

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<u>Country / Project No. / Title / Description</u>	<u>Obligation (\$000)</u>		
	<u>FY 1978</u>	<u>FY 1979</u>	<u>FY 1980</u>
OSARAC/BOTSWANA			
633-0207 <u>Alternative Energy</u> ---To identify alternative energy sources for production and marketing in Botswana (e.g., solar water heating, solar ovens).	b/	500 ^{a/}	580
OSARAC/LESOTHO			
632-0206 <u>Alternative Energy</u> ---To identify and develop low-cost alternative energy systems. Project to support the following activities: establishment of an Alternative Energy Section within the Ministry of Rural Development; technical assistance; training. Alternative Energy Section to coordinate all activities in alternative energy utilization; and conduct R,D and D (e.g., solar heating, windmill power for water pumping, fuel from animal wastes).	b/	574	382
OSARAC/SWAZILAND			
645-0207 <u>Alternative Energy Research</u> ---To develop and test low-cost systems of alternative energy sources (solar/wind power for pumping water, cooking, milling). Base-line data on energy sources will be compiled. Training component.	b/	446	130
RWANDA			
xxx-xxxx <u>Renewable Energy</u>		500 ^{b/}	

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<u>Country / Project No. / Title / Description</u>	<u>Obligation (\$000)</u>		
	<u>FY 1978</u>	<u>FY 1979</u>	<u>FY 1980</u>
SENEGAL			
685-0238 <u>Operation Energie Renouvelable (not in ABS)</u> ---To strengthen Senegalese capability to test small-scale, alternative energy technologies.	d/	500	500
685-0208 <u>Small Irrigated Perimeters</u> ---Installation of experimental solar pump to determine its social, technical and economic feasibility vis-a-vis diesel pumps.	700		
TANZANIA			
xxx-xxxx <u>Renewable Energy Resources</u> (Narrative not included in ABS, but project reference is included in Table VI.)	e/	1,500 ^{c/}	500
PROJECT DESIGN SERVICES	357	400	450

Appendix 2: Office of Energy, Development and Support Bureau

A central energy office, located within the Development Support Bureau, was established in March 1978. The goal of this office, as stated in the 1980 ABS, is to develop a U.S. program to assist developing countries meet their energy needs. It is responsible for providing technical support to the missions and regional bureaus on matters relating to energy. According to the FY 1980 Energy ABS, this support will include:

- assessment of energy needs in developing countries
- training programs for LDC energy planners and technicians
- technology development and support
- institution building and support
- facilitation of participation of the private sector (U.S., LDC) in the development and production of new technologies
- liaison with organizations working in the energy field.

The office of energy has identified a variety of mechanisms for providing technical assistance to the regional bureaus and missions. These include the following arrangements:

1. Up to 14 qualified organizations will be awarded indefinite quantity contracts (IQC's) in two areas: energy assessment and planning (software); and energy engineering and technology (hardware). The process for selecting these IQC's will probably take about six months. In the interim, AID will negotiate short-term (6 months) contracts with Donovan, Hamester and Rattien to provide planning assistance; and Mitre Corporation to provide technical expertise. Contract negotiations with DHR and Mitre are now underway.
2. The Department of Energy will provide AID with technical support through a Resources Support Service Agreement (RSSA) for an initial amount to \$539,000. Under the terms of the RSSA, DOE will:
 - provide short-term technical consultants and experts;
 - prepare general energy studies and analyses of the energy situation in developing countries;
 - assign DOE personnel to AID;
 - provide administrative staff to support the above-mentioned activities.

The technical experts will provide the following assistance:

- energy planning
- technical project design
- technical advice
- assistance in program implementation
- evaluation
- direct participation in overseas operations.

The RSSA will be signed in FY 1978.

3. A Participating Agency Cooperative Agreement (PASA) with Peace Corps, in support of implementation of a rural energy survey and energy training for PCV's. A more detailed description of the Peace Corps program is included in another section of this report.
4. Additional support to VITA.
5. The Office of Energy has proposed establishing "Energy Development and Support Centers" (EDSC's) to support both central (DS/EY) activities and those of the regional bureaus and field missions. According to the 1980 ABS, these centers would provide the following services:
 - monitor general energy needs
 - assess energy R&D programs and plans
 - compile information on energy activities of other donors
 - maintain contact with key LDC organizations and institutions involved in energy planning and programming
 - identify potential development activities
 - provide technical assistance to field missions.

Although the Centers would be based in the U.S., they would provide personnel for long-term assignment in developing countries. In Africa, for example, a core group of technical experts (contractors) might be based in REDSO/Nairobi and Abidjan (perhaps 5 experts in each), under the supervision of a direct hire employee, providing the above-mentioned services to their

respective regions. These experts would be strictly technical advisors, and would not be available to assume management responsibilities. The U.S. Center would provide these experts with institutional support.

The Office of Energy is relatively new and has only recently begun to identify mechanisms for obtaining the technical assistance necessary to support the expanding AID energy program. The majority of the institutional arrangements are still in the design stage. At this point in time the applicability of these sources to the needs of the Africa Bureau is unclear.

However, it is essential that there continue to be a close working relationship between the two offices. This is particularly important in Africa where the energy program is growing rapidly, and where there is a demand for technical expertise to design and manage projects. For example, backstopping these projects may require staff time and/or expertise not currently available in the missions.

One major constraint to expanding an energy program in Africa may well be one of manpower: i.e. a shortage of qualified technicians and social scientists with knowledge of small-scale renewable energy systems, previous experience in Africa, and (in some cases) knowledge of French or Portuguese. Also needed is adequate staff both in AID/W and the field to administer these projects. This staff support is currently lacking, and although the Assistant Administrator for Africa has approved the addition of three energy people, the positions have yet to be created. This constraint should be addressed in the present to avoid unnecessary holdups in the future.

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Appendix 3: Peace Corps

Over the years, Peace Corps Volunteers have initiated small scale renewable energy activities in response to local interests and needs. Examples include biogas digesters in Nepal and Ecuador, windmills in Senegal, and forestry for firewood in a number of countries. These activities have been ad hoc, and no financial or technical resources have been available to these enterprising volunteers to support their projects.

The Peace Corps is now in the process of developing an energy program which will include the following elements:

1. Designing, testing and implementing an energy survey to identify local needs and resources in rural areas;
2. Identification and design of renewable energy activities in developing countries requesting such assistance;
3. A pilot renewable energy training program for Peace Corps Volunteers, to include hands-on experience in fabricating and maintaining these technologies.

The rural energy survey will provide the foundation for the Peace Corps program. The survey is in the process of being designed by an ex-PCV, with financial support being provided by the al Dirr'Iyyah Institute. The purpose of the survey is twofold: to raise the consciousness of all those involved in the survey; and to provide decision-makers (host governments, international donors, Peace Corps) with data necessary for planning programs and projects. It will consist of two major parts:

- Description of tasks requiring energy at the family, farm and small industry level, and the current source of energy for meeting these needs; and
- Identification and measurement of potential energy sources (e.g. wind speed, stream flow, availability of trees). This will entail the use of simple measuring devices.

Once the information has been collected, it will be sent back to the U.S., where it will be computerized and made available to planners and designers upon request. Peace Corps will use this data to identify, design and implement potential village level activities. Plans are underway for a model training program (scheduled for the summer of 1979) for volunteers who will be responsible for developing and implementing these projects.

The survey questionnaire is nearing completion and will be tested in the next few months. Host country governments will be contacted to determine potential interest in participating in the survey. Funding (through a PASA with DSB, for approximately \$250,000) is available to support surveys in up to 12 countries. This will cover the cost of the survey packets, measurement equipment, an initial training workshop in each country for participating volunteers, and ex-PVC's to manage each country project.

Given the emphasis of the AID Africa Bureau's Energy program (small-scale, renewable, decentralized, rural) it would appear that the possibilities for working closely with Peace Corps to achieve mutual objectives would be considerable. It is also important that close coordination occur in order to prevent duplication of effort,* and to share information obtained from surveys and on-site testing and demonstration of various devices.

* AID has recently authorized a Renewable Energy Project in Mali, which includes similar surveys of 25 villages. The Evaluation Unit of the Rural Economy Institute, with Peace Corps participation, will organize this effort, to include the recruitment and training of enumerators.

The design of a Renewable Energy Project for Senegal will commence in October 1978, and as in the Mali project, will include data collection at the village level. The design effort will be preceded by a workshop, to be held in Senegal. The purpose of the workshop is to provide for the participation of interested Senegalese organizations and individuals in project formulation, and to provide guidance to the design team. Peace Corps will be invited to participate in this workshop.

Appendix 4: Proposal for a Cape Verde Renewable Energy Project

Goal: To develop energy alternatives (primarily for solar and wind) which would provide substitutes to the increasingly expensive petroleum-based energy technologies currently in use.

Background: The Government of Cape Verde, and particularly the Ministry of Rural Development, has attached a high priority to developing the renewable energy sector. The GOCV has identified four priority technologies for development:

- solar/wind pumps to replace diesel and hand pumps;
- solar dryers for agricultural produce, especially fish;
- small desalination units to provide potable water. (The islands of Maio and Boa Vista could especially benefit from the introduction of desalination units. Residents of these islands are currently traveling long distances to obtain good water or are forced to drink brackish water from local wells);
- cookers.

The GOCV would also like assistance in constructing a facility for collecting energy data for all the islands, and experimenting with the local construction of windmills.

Other donor activities: The U.N. Office of Technical Cooperation (OTC) is currently implementing an experimental program on the island of Santiago. Financed by the Swiss Government, this project has the objective of assisting the GOCV in developing renewable energy sources to meet national energy needs. The project includes the following key components:

- (1) Wind and solar measurements to establish wind field patterns and performance and solar radiation/cloud cover characteristics;
- (2) Establish a pilot project at San Felipe (Santiago) to test a variety of wind and solar technologies for water pumping and electricity generation;
- (3) Train local personnel to develop alternative energy systems to meet local needs.

Five different systems are in the process of being installed at San Felipe. These include: (1) Dempster windpump; (2) Elektro wind generator; (3) American wind turbine; (4) Darrius machine; (5) SOFRETES solar (thermal) pump. The results of these pilot activities "will provide a firm basis for recommendations as to which system, if any, will be most appropriate to replace diesel engines in a given locality, terrain and application."

The French plan to install an Aerowatt electric wind pump at Achade Baleia (Santiago). They are also proposing to install a 50 Kw Aerowatt machine in a small town for generating electricity, and solar stills and wind pumps for desalination.

The Germans are supporting a large development project in Maio which includes a wind power component.

Potential Projects for U.S. Support: The U.N. effort in Santiago is an important step in exploring possibilities for utilizing wind and solar resources to power water pumps. However, the effort is small (\$100,000) and the U.N. does not have available funding to extend and expand this activity.

The U.S. could make an important contribution in this sector by building upon the work currently underway in San Felipe. A U.S. project could contain all or some of the following elements:

- Evaluation of the U.N. Non-Conventional Energy Project;
- If the results of the evaluation are favorable, extend the project to Tarrafal, the site of an AID-funded project to develop water resources through well-drilling and water storage;
- Design of more powerful wind generators for water lifting/storage;
- Data collection on wind fields and solar radiation for all the islands;
- Design and installation of solar stills.

The initial project should be fairly small, and could be funded under the Accelerated Impact Project (AIP). This would provide the necessary time to obtain sufficient information for proceeding to a full-fledged project. It would also provide time for training counterparts, and would not strain the government's current management capability.

Information for the proposed Cape Verde Project in Renewable Energy was obtained from the following sources: Discussions with Mr. Horacio Soares, Director General of Natural Resources and Conservation, Ministry of Rural Development; Discussions with Ms. Susan Habachy, U.N. official responsible for the Cape Verde Non-Conventional Energy Project; Discussions with Mr. Peter Freeman, team leader for the Agriculture Sector Assessment of Cape Verde; Report by Edward J. Jefferies on the Non-Conventional Energy Project, dated February 1978; Report by Denis Fernandopulle, project manager, on "Future Activities in Non-Conventional Energy Sector," dated February 1978; Discussions with James Maher and Craig Buxton, USAID/Guinea Bissau and Cape Verde.

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