698-0410

Africa Regional

(Rwanda)

Accelerated Impact Program

PP - 698-0410.22

Rwanda Renewable/Improved

Traditional Energy/

FY 79

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT PAPER FACESHEET

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PP

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7. PROJECT TITLE (Maximum 40 characters): Renewable/Improved Traditional Energy

8. ESTIMATED FY OF PROJECT COMPLETION: FY 82

9. ESTIMATED DATE OF OBLIGATION: A. INITIAL FY 79; B. QUARTER 4 (Enter 1, 2, 3, or 4); C. FINAL FY 79

10. ESTIMATED COSTS ($000 OR EQUIVALENT $1 –)

A. FUNDING SOURCE	FIRST FY B. FX	C. L/C	D. TOTAL	LIFE OF PROJECT E. FX	F. L/C	G. TOTAL
AID APPROPRIATED TOTAL	205,500	282,000	487,500	205,500	282,000	487,500
(GRANT)	(205,500)	(282,000)	(487,500)	(205,500)	(282,000)	(487,500)
(LOAN)	( )	( )	( )	( )	( )	( )
OTHER U.S. 1.						
OTHER U.S. 2.						
HOST COUNTRY		176,850	176,850		176,850	176,850
OTHER DONOR(S)						
TOTALS	205,500	458,850	664,350	205,500	458,850	664,350

11. PROPOSED BUDGET APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C. GRANT	D. LOAN	E. 1ST FY 79 F. GRANT	G. LOAN	H. 2ND FY 80 I. GRANT	J. LOAN	K. 3RD FY 81 L. GRANT	M. LOAN
(1) ST	742	850		487.5					
(2)									
(3)									
(4)									
TOTALS				487.5					

A. APPROPRIATION	N. 4TH FY 82 O. GRANT	P. LOAN	Q. 5TH FY 83 R. GRANT	S. LOAN	LIFE OF PROJECT T. GRANT	U. LOAN
(1)					487.5	
(2)						
(3)						
(4)						
TOTALS					487.5	

12. IN-DEPTH EVALUATION SCHEDULED: MM 11 YY 80

13. DATA CHANGE INDICATOR. WERE CHANGES MADE IN THE PID FACESHEET DATA, BLOCKS 12, 13, 14, OR 15 OR IN PRP FACESHEET DATA, BLOCK 12? IF YES, ATTACH CHANGED PID FACESHEET.

1 (1 = NO, 2 = YES)

14. ORIGINATING OFFICE CLEARANCE

SIGNATURE

TITLE: Terry Barker, Acting AAO/Kigali; Alexander R. Love, Director/REDSO/EA

DATE SIGNED: MM 08 DD 13 YY 79

15. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION: MM DD YY

AID 1330-4 (3-76)

PROJECT AUTHORIZATION AND REQUEST FOR ALLOTMENT OF FUNDS

PART II

Name of Country: Rwanda

Name of Project: Renewable and Improved Traditional Energy

Number of Project: 698-0410.22

Pursuant to Part I, Chapter I, Section 103 of the Foreign Assistance Act of 1961, as amended, I hereby authorize a Grant to Rwanda (the "Cooperating Country") of not to exceed four hundred eighty eight thousand United States dollars ($488,000) (the "Authorized Amount") to help in financing certain foreign exchange and local currency costs of goods and services required for the project as described in the following paragraph.

The project will assist Rwanda to improve its capacity to understand Rwanda's rural energy needs and to institutionalize an ability to conduct research, field test, and analyze renewable and improved traditional energy technologies. A.I.D. assistance will consist of financing for technical services, commodities, participant training and certain other costs including a Rural Energy Fund.

The entire amount of the A.I.D. financing herein authorized for the project will be obligated when the project agreement is executed.

The initiation of negotiations and execution of the Project Agreement by the Ambassador, Charge, or officer to whom such authority has been delegated in accordance with A.I.D. regulations and delegations of authority is hereby authorized subject to the following essential terms and covenants and major conditions; together with such other terms and conditions as A.I.D. may deem appropriate.

Goods and services, except for ocean shipping, financed by A.I.D. under the project shall have their sources and origin in the cooperating country or in countries included in A.I.D. geographic code 941 except as A.I.D. may otherwise agree in writing. Ocean shipping financed under the grant shall be procured in the U.S. or the cooperating country except as A.I.D. may otherwise agree in writing.

Terry Barker 8/31/79

Terry J. Barker
Acting AID Affairs Officer
Rwanda

Concurrence: Alexander R. Love
Director, REDSO/EA
Per Nairobi 15243,
dated August 29, 1979

RWANDA RENEWABLE & IMPROVED TRADITIONAL ENERGY PROJECT

PROJECT PAPER

(IN ACCELERATED IMPACT PROGRAM FORMAT)

13 AUGUST 1979

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APPENDIX E: List of Other African Energy Research Institutions

I. BACKGROUND AND SUMMARY

A. Background

This PP, proposed as an Accelerated Impact Program Activity, is the result of a response by AID/Rwanda to AFR/DR/SDP's inquiry to all AFR missions to determine the need for assistance to host country institutional efforts to develop indigenous energy resources for the benefit of the rural population. In the spring of 1978, the Overseas Development Council fielded a PID Team to Rwanda which conducted an intensive series of meetings with Rwandan and U.S. officials and visited a number of Rwandan institutions. Director General for Bilateral Affairs of the Ministry of Foreign Affairs and Cooperation, Mr. Athanase Gatanasi, requested that the PID Team concentrate on areas where AID could provide additional funding and other support for Rwanda's existing Centre d'Etudes et d'Applications de l'Energie au Rwanda (CEAER) based at the National University of Rwanda in Butare. In response to Mr. Gatanasi's request, the PID Team visited CEAER and its director, Dr. Ference Kalos, who requested AID consideration of a proposal, "Support of Research on Renewable Sources of Energy at the Experimental Center (CEAER) In Rwanda", which the UNEP had been unable to fund.

Dr. Kalos expressed the desire of CEAER's staff to shift from its former expatriate-directed status, emphasis on solar water heater commercialization, and limited laboratory R&D (on a wide range of other energy activities) to a new effort to develop an eventual all-Rwandan staff and to concentrate upon R&D and field testing of renewable and improved traditional energy technologies to meet pressing rural needs. Special attention would focus on cooking, space heating, high temperature processing (i.e., charcoal manufacture and kilning), agricultural production and processing, food preservation, and sanitation.

B. Project Summary

In response to Dr. Kalos' request, this PP proposes AID assistance to strengthen CEAER's institutional capacity to research, develop, field test, and evaluate the potential for renewable and improved traditional energy technologies to meet Rwandan rural needs. The project focus will be determined through an on-going dialogue and participation process involving three representative rural communities which will serve as field test sites.

Technologies to be tested will include, under "renewable" energy, improved uses of solar pumps (for rural water supply and irrigation), biogas refrigerators (for human vaccines and other medicines in rural dispensaries), mini-hydroelectric turbines, and solar crop dryers -- and under improved "traditional" energy, such things as improved stoves and charcoal or brick kilns using local fuels such as wood or peat and solar drying -- i.e., for fish, etc. The improved traditional technologies may also include such things as water distillation or heated water for rural dispensaries.

Proposed features include inputs in the form of equipment, materials, imported prototypes, instruments, foreign expert consultation, in-country and foreign training, and documentation and international information exchange mechanisms to assist CEAER in the (1) identification of three representative rural communities for field testing (2) dialogue with, and surveys of the communities to determine their rural needs*, via help of Rural Energy Committees and Rural Energy Technician trainees to be selected by the community and trained by CEAER (3) R&D and laboratory testing of imported, adapted, or locally developed technologies, with involvement by Rural Energy Technician trainees (4) field testing (conducted by CEAER and the trained Rural Energy Technicians in the selected rural communities) of technologies approved by the Rural Energy Committees and AID interim project evaluation team, (5) end-of-project evaluation by CEAER, Rural Energy Committees and an AID final project evaluation team encompassing the pre-determined evaluation guideline questions in an assessment of the potential for renewable and improved traditional energy technologies to meet rural energy needs (see pp. 14-15 and App.A). The evaluation would be submitted to the Government of Rwanda (GOR) and AID/Rwanda with recommendations. A follow-up phase of perhaps as much as five years should be considered, the purpose of which would be to assure technical servicing and maintenance of the equipment installed by the project, especially in rural areas.

A Rural Energy Fund to be overseen by AID/Rwanda, with technical assistance by CEAER on a consulting basis, is also proposed as a supplementary activity to provide other public or private institutions active in rural development with the opportunity to explore the use of renewable and improved traditional energy technologies to meet their rural energy needs. Illustrative candidates for the Rural Energy Fund would include peace corps volunteers, rural cooperatives, missionary schools, and rural clinics. Recipients would be required to follow procedures similar to those of CEAER outlined above, including local indigenous decision-making and participation, and the preparation of end-of-project evaluation reports according to the pre-determined evaluation guideline questions mentioned above, to be submitted to CEAER, AID/Rwanda, and the GOR.

C. Project Costs

Total cost over the two year length-of-project is estimated to be approximately $644,350, of which it is proposed that USAID fund $487,500 and the GOR fund $176,850.

D. End of Project Status

The project should provide the GOR and other Rwandan institutions with an evaluation of the potential for meeting pressing rural energy needs by

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* and baseline socio-economic data for end-of-project comparison

the use of renewable and improved traditional energy technologies. Such an evaluation is critical to the ability of the GOR and other Rwandan institutions to make an informed decision as to the value of making further such investments in the effort to meet rural energy needs.

In carrying out this evaluation, CEAER will have provided up to 300 rural families with the benefits of new energy technologies. Apart from making large numbers of rural Rwandans aware of the technologies, CEAER will be able, through observation of benefits, use patterns, social reactions, etc., to evaluate social, technical and economic acceptability as well as actual economic and environmental savings. It is estimated that the pilot activities under the project will save up to 700 tons of firewood (worth about $7,000) and produce up to $16,400 worth of energy each year. Assuming a ten-year lifespan for the pilot equipment, the predicted economic savings (fuel not consumed or purchased plus alternative energy produced) will be enough to amortize original equipment costs.

By the end of the project:

- 150 families will be using alternative energy cookers or stoves-

- 3 dispensaries will be equipped with solar water heaters, water distillation devices or be involved with other health-oriented pilot energy experiments;

- two 8 kilowatt biogas power systems will be installed to produce cooking heat, light and power for rural communities;

- two 2 kilowatt photovoltaic power stations will be installed in rural communities;

- one 5 kilowatt hydro system will be in operation to serve rural needs; and

- various drying systems and increased-efficiency charcoal production units will be demonstrating to Rwandans fuel-saving ways of carrying out traditional drying and baking activities.

- Rural Energy Fund Projects will be established in 5 or 6 communities providing a total alternative energy output of about 10 kilowatt hours/day.

The Project will also have provided for 2 full-time bachelors-level research fellowships and 1 masters and 3 bachelors-level summer research fellowships, as well as several study tours designed to provide the basis for increased Rwandan participation in the Rwandan alternative energy program.

II. PROJECT DESCRIPTION

A. The Problem

One of Rwanda's most serious national challenges, in light of its rapidly increasing population and limited foreign exchange reserves, is how to make the most effective use of its indigenous natural resources to meet its development needs.

Rwanda's GNP per capita ranks among the lowest in the world at $110. Its literacy rate is 23%. Life expectancy at age one is 46 years, and infant mortality is 133 per thousand live births. Rwanda is a land-locked nation, 750 miles from the nearest post (Mombasa, Kenya) where the reliability of transport across Uganda and Kenya (and soon Tanzania) has often proved unreliable. Internally, no railroad exists, and road transport is slow and occasionally hazardous. Of the food harvested each year, at least 20%-30% is lost to rodents and vermin as a result of improper food preservation techniques and storage. Approximately 95% of Rwanda's 4.8 million people live in rural areas, typically pursuing subsistence agricultural livelihoods. Population density approximates 386 per square km of arable land -- the highest in Africa. More than 90% of the arable land is already in intense cultivation. With an annual population growth rate of over 3.0%, it is clear that it will become increasingly difficult to improve the above features of national economic welfare and individual standard of living -- and under some situations even maintain them.

The Rwandan dilema of rapidly increasing population in the face of efforts to distribute the benefits of resources for development is particularly serious in the case of energy. As can be seen in Appendix C, Rwanda's indigenous conventional energy resources are limited at present to major hydropower and some natural gas (from Lake Kivu). The remaining energy to meet urban, industrial and transport needs is derived from imported refined petroleum products. (Rwanda has no refinery). Commercial energy consumption has increased 40% between 1971 and 1975, which was met by an increase in hydroelectric production of 70% and increases in imports of refined petroleum products of 30%. In 1975, these imports represented approximately 68% of total consumption, a slight decline from the 73% of 1971. During 1971-75, use of energy petroleum imports indicated a 30% increase in gasoline use, 50% increase in kerosene and jet fuels, and 25% increase in fuel oils. Fuel oil represented 40% of petroleum imports, gasoline 35%, and kerosene jet fuels 25% during this period. 97% of installed generating cap city is hydropower based. Electricity production increased 60% during 1971-75, and exports of power ceased in 1975. Rwanda has abundant major hydropower resources which remain to be tapped. However, only 5% of the country's population (mostly urban) benefit from the electricity generated by the major five developed hydropower sites and the small thermal generating capacity. It has been estimated that at the current rate of hydroelectric power development,

only 10-15% of the population will benefit from electricity by the beginning of the next century (see Gerard Saunier, "Energie et Development ou Rwanda", A Propos des PVD, July 1976). Clearly this situation is due to the widely scattered, isolated and difficult-to-reach rural population.

It is evident that there is a need for Rwanda to investigate further the potential for improving the use of and utilizing indigenous energy resources which are more easily accessible, more widely distributed naturally, and more affordable to its dispersed rural population. The Rwandan rural population relies primarily upon traditional sources of energy to meet its subsistence energy needs -- wood fuels, crop residues, and human muscle power. (There is also some use of the conventional commercial fuel, kerosene).

As indicated by trends in the following chart, prepared by Meta Systems, Inc. of Cambridge, Massachusetts, based upon FAO data, some kind of acceleration of the work of reforestation and improved use of woodfuel, peat, livestock residues and crop residues is called for. The estimates indicate that, given current rates of energy use, a population increase will lead to significantly reduced per capita availability of traditional rural energy fuels by 1990.

Year	Population	Fuelwood & Charcoal Use	Non-Fuel Wood Use	Sustainable Forest Yield	Livestock Residue	Cereal Residue
	(10^6)	(industrial & domestic)			amount source	amount source
		10^9 Joules/capita/year				
1976	4.35	9.68	0.15	5.00	.95 (cattle, sheep, goats, pigs)	1.66 (sorghum & maize
1977	4.47					
1990	6.34	8.75	0.11	3.19	.75	1.69

The pressures of population are taking their toll, as less land is available per capita and as diminishing returns to scale come into effect, so is more pressure placed on the supplies of traditional energy per capita from the forest and fields.

As woodfuels (the preferred energy source) become scarcer, both in absolute and per capita terms, there will be a tendency to use more alternative traditional supplies such as crop residues and cow dung. This

tendency is likely to contribute to the increasing momentum of erosion and ecological damage -- resulting in declining soil fertility and declining agriculture productivity. Already, the forest southeast of Kigali is almost clear-cut, largely to serve the city's need. With the trend to charcoal production and transport, the forest depletion accelerates. The forest in the Cyangugu area of south-west Rwanda is the only extensive forest area remaining, and it has been estimated that this, too, will be depleted within the next ten to twenty years. There are some Government of Rwanda and some traditional forces at work to evolve techniques to preserve and make efficient use of woodfuels. The Government of Rwanda has entered into a reforestation effort of replanting 15,000 hectares over the next five years.

There are a variety of other new and renewable sources of energy available (i.e., peat, cattle dung, small streams, wind, sunshine) which would lend themselves to decentralized exploitation. Non-renewable peat resources are currently being used near Ruhengeri as fuel for pyrethrum processing. Although Irish development assistance experts recently described Rwanda's peat resources as low in quality and quantity, there was enough potential to warrant another more detailed investigation. To our knowledge, there has been as yet no investigation of the possible use of peat for a cooking and space heating fuel to supplement or replace woodfuels -- at least in the R&D and field testing stage.

There are reported to be between 650,000 - 1,000,000 cattle in Rwanda (FAO estimates 740,000). Not only could more use of these cattle be made for draft animal purposes, but their dung can be used in a biogas fermentation process to generate methane gas and then recovered as a semi-sterilized fertilizer whose nitrogen is more available to the soil. Temperatures at 15 recording stations (according to the Bulletin Climatologique Annee 1977) indicate that conditions are adequate for biogas, although not ideal.

The potential to exploit small hydropower resources may be abundant. Indeed, at least four small hydroelectric generators in the 100 Kw-135 Kw range are known to have been installed over the past twenty years. It is reported that the People's Republic of China has agreed to help build at least one small hydroelectric generator. Annual rainfall data (from the Bulletin Climatologique Annee 1977) for 85 recording stations reflect a range of 100-200 rainfall days and an average of 150 days of rainfall during the periods February to May and October to December, amounting to a range of 850-2000 mm and an average of over 1000 mm. The combination of abundant rainfall and mountainous topography in the populated areas of Rwanda indicate promising potential to develop small hydropower for rural uses.

Wind data available to the PID Team was too limited to give any general picture of potential to develop wind resources. However, there is some evidence of wind suitable for mechanical windmachine operation in

the Kamembe and Kigali area, especially during the May to September dry season. There do not seem to be favorable conditions for windelectric operations among the three recording sites given.

There is a clear need to investigate more rigorously the potential to improve traditional energy use and to tap renewable decentralized sources of energy in order to meet rural energy needs. So little is known about the performance of renewable and improved traditional energy in actual rural communities that a Rwandan program of research, development and field testing is necessary in order to provide the Government of Rwanda with the information which it will need to wisely plan for future investments in meeting energy needs for rural development.

B. The Project

1. Purpose

The purpose of this project is to assist the Government of Rwanda (GOR) in support of institutional mechanisms and activities to improve its understanding of the country's rural energy needs and to conduct research, development, field testing and analysis of renewable and improved traditional energy technologies to meet those needs. The project should be designed to provide GOR at the end-of-project with recommendations and strategy as to options for meeting longer term energy needs for rural development.

Before Rwanda policy makers can decide whether to invest large sums of money in renewable and improved traditional energy, it seems wise to recall that past efforts to transfer such technology to low-income rural areas have revealed the need to first answer certain questions. Already there has been a good deal of ad hoc experience with alternate energy technology transfer of the varieties appropriate to developing country rural needs. But all too often these efforts have been conducted with little or no thought given to designing the effort in such a way as to learn answers to questions which would be of use to policy makers concerned with national development goals and public sector investment decision-making. In order to broaden and expand its program to include selection of three representative rural communities for field tests, base-line socio-economic study and energy needs profile with field test communities, R&D and field testing of technologies, training of Rural Energy Technicians from among field test communities, and evaluation, CEAER will need significant increases in the following areas to complement existing facilities and expertise: (1) equipment and material support, (2) social scientist

(anthropology, sociology, economics) participation from the University or other institutions, (3) in-country and foreign training, (4) international information exchanges, and (5) short-term foreign consultants (from U.S., East Africa, West Africa, etc.). Training is particularly important since Rwandan staff will have to take over administration of CEAER in the near future.

2. The Lead Rwandan Institution

The lead Rwandan institution to be involved in this project is the Centre d'Etudes et d'Applications de l'Energie au Rwanda (CEAER) of the National University of Rwanda in Butare (hereafter referred to as the University). CEAER was created by the Government of Rwanda (GOR) in 1974 and is funded jointly by the Government and the University in order to achieve the following three objectives:

- Study and develop technologies to use local indigenous energy resources to meet needs for national economic development.

- Demonstrate the potential for mass extension and use of these technologies via field testing of prototypes.

- Train students to be able to carry on both the work of CEAER and to acquire the skills to meet the nation's energy manpower needs.

See Appendix B and Section III.B. below (Relationship to Rwanda Government Priorities) for more detailed description of CEAER activities, collaborating institutions, research output, staffing, and funding. In brief, the CEAER is clearly the most qualified Rwandan institution to carry out this project and has demonstrated its ability to conduct quality studies, research, and development in the field of energy. The research laboratory has a full-time professional staff of three Rwandans with advanced training in physics, engineering, and other energy related disciplines. There is also a Rwandan research intern, four other Rwandans from the University's science, agronomy and education faculties and five Canadian, French, and German faculty members who contribute actively to CEAER's scientific research. Organizations which have contributed financially to and collaborated with CEAER include CIDA, the Service of German Volunteers, the French Volunteer Service, and UNESCO, in addition to the National Development Budget and the Research Commission of the University. CEAER's activities have included R&D on solar water distillation, wind energy resources, biogas, peat, mini-hydropower resources, appropriate technology alternatives, solar photovoltaic cell applications, and solar water heaters. The solar water heaters are currently being commercially produced on a small scale by the Society Socomerwa under a license from CEAER. A recently constructed

stockroom, instrument room, office and outdoor workshop space supplement the former R&D physical facilities on the University campus.

Having solved the basic design problems for solar water heating under Rwandan conditions and initiated a commercial venture, CEAER is now turning its attention to other activities with more specifically rural applications. CEAER wants to upgrade its preliminary work on other applications for rural areas, including solar cell pumping, biogas, solar crop dryers, solar refrigeration, and peat processing for use as fuel. CEAER also wants to work on areas, as yet untouched, such as improved traditional stoves.

With its background in energy research established, CEAER should be able to translate AID assistance into benefits for Rwanda's rural poor -- and advances in knowledge achieved through this project should be able to be communicated rapidly to other countries as well.

3. Project Elements

a. In-country and Foreign Training

i. In-country Training

(a) CEAER Research Staff

An on-the-job training program featuring scientific collaboration and counselling by expatriate scientists should contribute to the development of an improved competent and productive research team. In-country consultants in the social sciences will also contribute to training of CEAER staff.

(b) Students and Rural Energy Technicians

Some promising university students will be provided with research fellowships to work with CEAER on this project both at the University and in the field test sites. Two bachelors-level fellowships (one year each), and one masters and three bachelors-level "summer" fellowships (three months) will be granted through the project. Also, a number of Rural Energy Technicians will be selected by the CEAER staff and trained at CEAER and/or in the field on-the-job. It will be these Rural Technicians' job to implement the rural field tests.

ii. Foreign Training

Study for CEAER staff elsewhere in Africa and short international study tours for CEAER senior staff in Africa and overseas will be important activities of the project. Not only will this component of the project be important to development of Rwandan expertise, but will contribute to information exchange as well. This program will include:

- Two two-month training programs for Rwandan participants at West

African alternative energy research facilities like the Solar Energy Lab (ONERSOL) in Niger, the University of Ouagadougou Solar Institute in Upper Volta, the Kumasi Center in Ghana, and/or the Laboratoire d'Energie Solaire in Bamako; and

- One-month study tours for three persons to U.S. and/or other African alternative energy research centers. (A summary of some of the activities in which other African Energy Research Institutions are involved is provided in Annex E.)

b. In-country and Foreign Expert Consultants

i. In-country

In-country consultants from the University or other institutions will be obtained by CEAER from the fields of economics, sociology and anthropology to complement CEAER expertise in the physics and engineering disciplines. Such skills will be needed especially for CEAER cooperation with rural communities and for conducting socio-economic baseline studies for end-of-project comparison.

ii. Foreign

For an institution operating, like CEAER, on the frontiers of its discipline, it is desirable to promote scientific and technical cross-fertilization. Such a process is provided for within this project in the form of short-term visits to Butare of a number of experts in renewable and improved traditional energy technology as well as energy economics and applied anthropology. These experts will come from elsewhere in Africa and from the United States. Rwandan and expatriate forestry and appropriate technology experts will also be consulted by CEAER.

The role of the project advisor and visiting experts consists of participation in the short and medium term planning of the research program; of scientific counsel on the program and individual projects; and in professional development of the CEAER staff.

Experts called to help with the project would have considerable and relevant research experience, be familiar with developing country and Africa conditions, and speak French. The advisor will also be responsible for control of the technical and scientific soundness of CEAER research and publications.

c. Equipment and Commodities

The existing research and testing facilities will be built up in order to enable CEAER to efficiently tackle target problems. New instruments, materials and equipment will be used in three ways: (1) for scientific research to improve understanding of renewable and improved traditional energy characteristics in Rwanda; (2) to develop new solutions for problems in renewable and improved traditional energy technology; and (3) to test actual devices (whether produced and designed at CEAER or manufactured elsewhere), first in the laboratory and then in the field, for reliability,

efficiency, durability, economic and social feasibility, etc. Further insight in the tests is offered in the illustrative pre-determined project evaluation guideline questions on page 14 and in Appendix A.

d. Rural Energy Fund

Supervised by the AAO/Kigali, a small Rural Energy Fund will be made available to Rwandan public and private groups working to improve rural development. CEAER will be responsible as a consultant for technical assistance where needed. The Banques Populaires program may also be consulted by the AAO for assistance on this component. (See Appendix C).

e. Information Exchange

A Rwandan Information and Documentation Administrative Assistant will be hired by CEAER to assume all routine administrative work related to documentation and information exchange concerning the project activities for the benefit of CEAER, the University, the Government, and USAID. The following information activities are proposed for the project:

- A program of CEAER research seminars,open to the public to inform students and interested individuals and institutions about CEAER's work.
- As equipment and methods become ready for dissemination, the CEAER will request Government assistance in the distribution of written communications and will ask for time on the radio to publicize these facts.
- Visitors will be hosted at the CEAER, and with permission of Rural Energy Committees, at the field test sites.
- Two colloquia are planned: one national colloquium at the end of the first year of the project, and one inter-African colloquium at the end of the second year.
- Improvement of the CEAER library.
- Semi-annual technical journal of CEAER for Africa-wide distribution.
- Preparation and distribution of CEAER technical reports and interim and end-of-project evaluation reports and recommendations for AAO/Rwanda, the University, and the GOR.

f. Illustrative Implementation Plan

1979 Aug. - Project Paper revised, per AID/W instructions in State 170009, and sent to Nairobi for REDSO revisions and approval.

- Congressional Notification sent to Congress and 15-day waiting period satisfied.

1979 Sept. - Signature of project agreement between USAID/Rwanda and GOR.

1980 Jan-Apr
- Recruitment of in-country and foreign expert consultants begins.
- Selected CEAER staff leave for short-term training in solar, wind, biomass (i.e., biogas, peat, improved stoves, woodlots, draft animal use) and mini-hydro -- at East African or West African institutions.
- Information exchange within Rwanda and international (esp. African) institutions begins. Work is begun on CEAER library.
- Initial order of equipment, prototypes, instruments, materials.

1980 July
- Rural Energy Self-help Fund publicized and applications accepted from interested individuals and institutions.
- CEAER, with University social science consultants, selects three rural communities for field test activities. Rural Energy Committee (REC) established by each rural community. Each REC, with CEAER advice, selects two Rural Energy Technicians (RETs) to be trained by CEAER.
- CEAER and social science consultants work with RETs and RECs to establish dialogue and create scientific profile on each of the three communities' energy needs, priorities among those needs, local energy and material resources, local skills, institutional strengths, baseline socio-economic data.
- Short international study tours for CEAER senior staff.

1980 May-Oct
- Short-term visiting scientists begin arriving.
- Initial equipment, material, instruments, and prototypes begin arriving. Other equipment ordered.
- Initial recipients of Rural Energy Fund assistance are selected, funds and equipment alloted, and CEAER advice begins. (May be done in November.)
- R&D lab testing of renewable and improved traditional energy devices begins in order to meet field test community needs determined above.
- RETs training by CEAER begins at CEAER and/or in communities.

1980 Nov.
- Interim progress report prepared by CEAER for University, USAID/Rwanda, and GOR.
- Interim Project Evaluation Team arrives.

- Interim Project Evaluation Team evaluates progress of project, makes recommendations on future of project, and in collaboration with CEAER and RECs, reviews prospective renewable and improved traditional energy devices to be field tested. Social, economic, technical analyses required.
- National Colloquium held at University. Interim Project Evaluation Team gives lectures to attendees, so do CEAER, visiting project consultants, and other speakers.

1980 Dec - 1981 May
- Remainder of Rural Energy Fund activities are publicized, approved and funded.
- Short-term visiting scientists continue to arrive through to May 1981, as needed.
- CEAER begins field testing of approved devices in rural communities with the REC cooperating and RET involvement (devices may or may not be built in community). Monitoring, maintenance, and re-design of devices continues, with RET maximum involvement in collaboration with CEAER.

1981 March - Rural Energy Fund activities begin.

1981 June - CEAER prepares Field Testing Progress Report for University, USAID/Rwanda, and GOR. (To include Rural Energy Fund activities.)

1981 Nov.
- CEAER prepares Final Report for University, GOR, USAID/Rwanda, including comments from RECs, RETs, and Rural Energy Fund participants according to illustrated predetermined guideline questions. (See p.4 and Appendix A.)
- Project Final Evaluation Team arrives and conducts final evaluation, also using guideline questions above.

1981 Dec.
- CEAER hosts International Colloquium for Africans. CEAER, visiting consultants, and other speakers, and Final Evaluation Team give lectures for attendees.
- End of Project.

C. Beneficiaries

The most immediate beneficiaries of this project will be the CEAER staff, the people served by the devices to be installed in field test rural communities, and recipients of the Rural Energy Fund.

Currently less quantifiable are the benefits that would extend to rural people throughout the country if GOR decides that CEAER-tested systems are to be eventually developed for wide use after this project.

Almost all of CEAER's areas of concern are applicable to rural needs: pumps, crop dryers, refrigerators, stills, water heaters, improved stoves using local fuels such as wood or peat, etc.

In this project, CEAER R&D and field tests will be aimed at the rural population which exists on a low cash subsistence basis. If CEAER systems gradually come into more common use, it will be important for the GOR to examine with greater care the extent to which benefits reach the most needy groups within the rural population as a whole. Investigation of this issue should be an integral part of possible future GOR projects designed to support widespread use of CEAER systems in rural Rwanda.

As is customary in African countries, women in Rwanda transport on foot most firewood for cooking and most water for use in homes and gardens. Possible CEAER activities in rural water supply and improved stoves would therefore serve the interests of women in important ways. In addition, CEAER might also adapt new devices to provide power for grain milling and food grinding as well, an advance that would help relieve women of one of their most arduous tasks. Finally, provision of solar water heaters at clinics, solar cell or biogas refrigeration and improved drying of produce should all contribute to maternal and child health.

D. Project Evaluation

Below are illustrative pre-determined evaluation guideline questions recommended for this project: (see Appendix A for detailed discussion of these questions).

(1) How well does a given device perform technically within the physical conditions of its rural community setting? Are the necessary human skills and local physical resources available?

(2) How do its costs compare with other energy technologies -- and is it affordable in the rural Rwandan context?

(3) How acceptable is the device in terms of attitudes and preferences?

(4) How does it provide an advantage to existing or prospective rural community institutions that would own, operate, and maintain it? At the family level?

(5) What can be learned about the best techniques for determining the needs of the rural community residents and for selecting and introducing a technology to meet these needs? Are implementation procedures responsive to rural community resident's expressed needs, economic means, technical capabilities, and degrees of willingness to participate? Are women involved in decision-making aspects as well as men?

(6) What is the effect of the increase in available energy upon such indicators of well-being as literacy, infant mortality, income, migration, birth rates, and improved productivity? Is the distribution of such benefits specific to the nature of each device? Do women benefit from the project questions vis-a-vis the men?

USAID interim and end-of-project evaluation teams will be composed of a renewable energy technologist, an economist and a sociologist. During their stays, they will consult with CEAER, Rural Energy Committees in field test communities, and participants in the Rural Energy Fund activity, and give lectures and talks at the University during colloquia. Evaluation Teams shall use the illustrative pre-determined project evaluation guideline questions as a framework for analysis of the project. (Depending upon evolution of the project, forestry and appropriate technology skills may also be needed by evaluation teams.) If evaluation is positive, consideration should be given to a follow-on phase of five years at a cost of as much as $30,000 per annum.

III. RELATIONSHIP OF THE PROJECT TO U.S. AID AND RWANDA GOVERNMENT PRIORITIES

A. Relationship to U.S. AID Priorities

In Rwanda, renewable and improved traditional energy has obvious relevance to several problems of concern to U.S. AID, notably deforestation, food production, food preservation, and health.

This project is consistent both with overall U.S. AID priorities and with concern of USAID/Rwanda's country program.* Furthermore, results of the CEAER work may also be applied in areas where similar geographic and social conditions prevail: Burundi, regions of Kenya, Tanzania, Uganda and Zaire, and possibly in other African countries.

B. Relationship to Rwanda Government Priorities

The CEAER is an institution of the Universite Nationale du Rwanda. The Ministry of Natural Resources, Mines and Quarries of the Government of Rwanda is a supporting agency.

Financial support by the University and the Government of Rwanda for CEAER has risen stadily since the organization was established in 1974. Between 1974 and 1977, budgetary allotments to CEAER averaged about $33,000 per year. By 1978 CEAER's annual budget input from the Government and the University had probably reached between $50,000 and $60,000. See CEAER's budgetary support below:

	National University of Rwanda	Development GOR Budget
1974		$ 11,000
1975	$ 10,000	11,000
1976	13,000	33,000
1977	16,000	38,000
1978	16,000	51,000
1979	16,000	54,000

The Government has granted permission to CEAER to install solar water heaters in a few National Park facilities and the University has given permission for CEAER to install solar water heaters in University affiliated housing. This type of commercial activity amounted to $25,000 in 1978. AID's assistance, however, will be aimed at building CEAER's institutional capacity. This project will associate USAID with an area of growing concern to the Government of Rwanda.

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* See FY 1981 CDSS for additional information on AID/Rwanda objectives and strategy.

IV. POLICY ISSUES

The project presents no discernible problems in terms of U.S. AID policies. Brief comments follow with respect to the project's feasibility and environmental impact.

A. Feasibility

Within the limits of analysis appropriate to an Accelerated Impact Program activity, the project appears to be feasible in technical and administrative, economic, and social terms.

1. Technical and Administrative

Initially, until July 1977, the Centre coordinated the part-time research activities of some members of the teaching staff of the University and provided support in the form of a shop, a test site and a budget. As most members of the teaching staff in science stay with the University only for a 2 to 3 year period, there were fluctuations in research output and there was little assurance for the continuity of the program. This need for continuity required the University to provide the Centre with a core of permanent and full-time research staff. This has been recently accomplished by hiring Rwandan research associates (two engineers and a physicist). The work of this group, supervised by the Director, is expected to have an effect on the group of scientific collaborators from the teaching staff which is both stabilizing and stimulating.

The creation of the CEAER may now be considered successfully completed: a core of research staff, basic material and infrastructure have been provided by the Rwandan Government and by the University. This project endeavors to meet the present need for additional input in senior scientific personnel, in training, in research support, in field testing, and in information exchange.

2. Economic

Most of the project involves activities to which formal economic analysis is inapplicable, i.e., R&D and field testing of devices, purchase of laboratory equipment, visits to Rwanda by U.S. experts, information exchange, training of CEAER personnel. The devices to be developed locally or imported for local field testing should be considered experimental until CEAER has made any modification necessary to ensure their reliability under Rwandan conditions. Only when this work has been completed will it be possible to make accurate estimates of costs and benefits of these systems. At least in a preliminary way, however, such estimates will be carried out by local and visiting economists in the context of pre-field tests, and interim and final evaluations of this project. Any prototype found to be economically unaffordable for the local population will not be fabricated.

(See Evaluation Procedures, p.14-15.) Budgets for equipment for the field tests are based upon estimates of 100 families per community and expenses of $250 per family averaged out.

3. Social

As indicated above, ultimate beneficiaries of the project will be members of Rwanda's poor, rural population. Direct social impacts during the life of the project, however, will be limited to a number of rural people associated with renewable and improved traditional energy technologies in field test communities.

There may well be some localized social and economic impact from using these devices, and thus, CEAER, in cooperation with appropriate staff from the sociology and anthropology disciplines of the University and the Project Evaluation Teams' sociologists, will conduct social evaluations prior to and after field testing activities. Prototypes will not be funded if they do not meet social and cultural criteria indicated by positive response to questions raised in Project Evaluation guidelines noted in section 3D above and in Appendix A. In-country and expatriate social service consultants are to be used by CEAER throughout the life of the project.

B. Environmental Impact (See Initial Environmental Examination)

Construction of devices under the project will take place on vacant land nearby and adjoining the existing CEAER workshop. Should they prove economically, socially, and technically acceptable after interim evaluation, devices will then be installed in rural community settings for field testing. Other project activities (training, laboratory equipment, expert consultations) do not raise environmental issues.

This project should have no negative environmental consequences. To ensure that this is the case, USAID/Rwanda will review the expected environmental impact of the devices when testing is completed at CEAER's laboratory and decisions are made as to specific field test community locations in which these systems will be placed.

Over the longer term, the project may have significant positive effects on the environment. For example, through new systems designed to cook food, CEAER could help cut demand for firewood, thus relieving pressure on Rwanda's remaining woodlands.

V. PROJECT COSTS

Total cost of this project is approximately $664,350, of which it is proposed AID will fund up to $487,500 and the Government of Rwanda the balance, estimated at approximately $176,850. Not included in these figures are the substantial contribution which the Government of Rwanda will make in the form of:

1) office space, laboratory space, workshop and lab test site space;
2) housing for research associates and volunteers;
3) research input by teaching staff of University;
4) legal and administrative advice;
5) normal student projects and support;
6) anticipated Government assistance in communication activities;
7) general administration (e.g., accounting, lights, water, etc.) and overhead.

ILLUSTRATIVE BUDGET

		YEAR ONE Salaries & Lodging	YEAR TWO Salaries & Lodging	SUBTOTAL	SOURCE
I.	CEAER STAFF				
	Director	10,500	10,700	21,200	
	Assistant Director	10,000	10,100	20,100	
	Senior physicists or engineers (2)	19,500	19,800	39,300	
	Research assistants (2)	18,800	19,100	37,900	
	Administrative assistant	2,700	2,800	5,500	
	Secretary	1,800	1,900	3,700	
	Typist	1,200	1,200	2,400	
	Foreman	3,000	3,100	6,100	
	Assistant foreman	1,700	1,750	3,450	
	Social science consultants (2)	2,000	2,100	4,100	
	Welders & plumbers (6)	8,400	8,700	17,100	
	Aides & guards (4)	3,700	3,800	7,500	
	Fringe benefits	4,200	4,300	8,500	
		87,500	89,350	176,850	Rwanda

ILLUSTRATIVE BUDGET (cont'd)

		YEAR ONE	YEAR TWO	SUBTOTAL	SOURCE
II.	Training*				
	University student research fellowship	3,500	3,500	7,000	
	Short study in Africa for CEAER staff	7,500	2,500	10,000	
	Intl.study tour for CEAER staff	8,000	---	8,000	
	Rural energy technicians	4,000	4,000	8,000	
		23,000	10,000	33,000	USAID
III.	Information, Exchange & Library				
	Library	2,500	2,500	5,000	
	Correspondence & semi-annual tech.journal	3,500	3,500	7,000	
	National colloquium	2,000	---	2,000	
	International colloquium	---	12,000	12,000	
		8,000	18,000	26,000	USAID
IV.	Travel on Official Business/ CEAER Staff	6,000	10,000	16,000	USAID
V.	Project Evaluation	(To be provided directly by USAID)			
VI.	Rural Energy Fund	20,000	40,000	60,000	USAID
VII.	CEAER Equipment, Materials, Prototypes & Instruments**				
	Field test equipment, materials and prototypes	100,000	25,000	125,000	
	4-wheel drive vehicle	15,000	---	15,000	
	Shop machinery & tools	15,000	5,000	20,000	
	Instruments	25,000	5,000	30,000	
		155,000	35,000	190,000	USAID
VIII.	Expatriate Scientific Advisors				
	Project advisor (18 months)	80,000	40,000	120,000	
	Short-term (4 + 1)	34,000	8,500	42,500	
		114,000	48,500	162,500	USAID
	Total	413,500	250,850	664,350	
	of which USAID	326,000	161,500	487,500	100%
	of which Gov't of Rwanda	87,500	89,350	176,850	36%

* For additional details of training program, see pp.9-10

** A more detailed breakdown of CEAER equipment, materials, prototypes and instruments is provided in Annex D

CEPOL

TO: ACTION MEMORANDUM FOR THE DIRECTOR, REDSO/EAST

FROM: USAID/RWANDA

SUBJECT: Request for Procurement Source Waiver from Geographic Code 000 (U.S. only), to Geographic Code 935 (Free World)

(a) Cooperating Country: Rwanda

(b) Authorizing Document: PAF

(c) Project: Rwanda Renewable and Improved Traditional Energy Project/ Accelerated Impact Program

(d) Nature of Funding: Grant

(e) Description of Commodity: One water pump adapted for use with photovoltaic cells

(f) Approximate Value: $10,000.00

(g) Probable Origin: France

(h) Probable Source: France

Discussion: At the present time, the French company Pompes Guinard is the only reliable supplier of water pumps adapted for use with photovoltaic cells. Although the solar cells are manufactured in the U.S., the U.S. does not have a proven pump on the market that can be powered by photovoltaic cells. Guinard is currently working with an American solar cell manufacturer, Solarex Corporation of Rockville, Md., to find a suitable pump manufacturer in the U.S. who could produce Guinard pumps under license. This would enable U.S. Government organizations to procure solar pumps without waivers.

While it will be necessary to seek a waiver for the pump, it appears possible to purchase the solar cells and their ancillary hardware directly from Solarex Corp. The manufacturer will ship the panels to Rwanda, where they will be connected to the Guinard pump. Because Guinard is now working exclusively with Solarex Corp. in the U.S., a sole source procurement waiver for the panels will be necessary.

Primary justification: The photovoltaic water pump is an important and promising element of alternate energy technology and of this project. If the price of solar cells falls are expected, such pumps are likely to become a viable alternate to fossil-fuel or traditionally powered systems. This is a very important concern for the countries of Africa especially landlocked nations such as Rwanda, which pay heavily for the fuel they use. It is essential to the success of this project that this technology be included and tested.

Recommendation: It is necessary to authorize procurement of the equipment described above from Geographic Code 935 countries because the exclusion of procurement from these sources would seriously impede the attainment of U.S. Foreign policy objectives and the objectives of the Foreign Assistance Program. I recommend that certification be granted for this waiver request.

Approved: _____ Disapproved: _____

Date: _____ Signature: _____

CEPGL

TO: ACTION MEMORANDUM FOR THE DIRECTOR, REDSO/EAST

FROM: USAID/RWANDA

SUBJECT: Vehicle Procurement Waiver (Source/Origin)

Problem: Request for procurement source/origin waiver from Geographic Code 000 (U.S. only) to Geographic Code 935 (Special Free World).

(a) Cooperating Country: Rwanda

(b) Authorizing Document: PAF

(c) Project: Rwanda Renewable and Improved Traditional Energy Project/ Accelerated Impact Program

(d) Nature of Funding: Grant

(e) Description of Commodities: One 1½ ton, 4-wheel drive, Land Rover vehicle

(f) Approximate Value: $15,000.

(g) Probable Procurement Origin: United Kingdom

(h) Probable Procurement Source: United Kingdom or Rwanda

Discussion: Section 636 (i) of the Foreign Assistance Act of 1961, as amended, prohibits A.I.D. from purchasing motor vehicles unless such vehicles are manufactured in the United States. Section 636 (i) does provide, however, that "...where special circumstances exist, the President is authorized to waive the provision of this act in order to carry out the purpose of this act." Criteria for such waivers are contained in Hand Book I, Supplement B, chapter 4. In addition, Hand Book I, Supplement B, chapter 5, provided that commodities procured under grants must be U.S. source and origin, unless a waiver is obtained. The Hand Book provides that waiver may be granted when necessary to carry out the purpose of the FAA and if, inter alia, there is present or projected lack of adequate service facilities and supply of spare parts for U.S. vehicles. The authority to determine that special circumstances exist for purpose of Section 636 (i) and that there adequate justification for a waiver under Hand Book 1, Supplement B, has been deligated to you.

The Government of Rwanda (GOR) has requested A.I.D. assistance to assist in meeting Rwanda's rural energy needs. The above project vehicle is required to provide mobility for the project technician who will be required to work in areas where roads are usually rugged unimproved track in steep mountain areas interpersed with marshes. In these remote areas, the Land Rover is the only vehicle that can be maintained and serviced adequately to meet regular transportation requirements for the project. The vehicle will be used outside of Kigali so that a good deal of maintenance will have to be done in the field. Outlying service areas are not familiar with U.S. vehicles and are geared to service the Land Rover - a common vehicle in Rwanda. There are, additionally, no representatives for U.S. manufactured vehicles in Rwanda and, thus, even in Kigali service and spare parts would be difficult if not impossible to obtain, to considerable detriment of the project.

Recommendation: For the reasons stated above, it is recommended that you (1) find that special circumstances exist in the case of this vehicle procurement, and do hereby waive the requirement of Section 636 (i) of the FAA and (2) that you certify that the exclusion of procurement from Free World countries other than the cooperating countries and countries included in Code 941 would seriously impede attainment of U.S. foreign policy objectives and objectives of the foreign assistance program.

Approved: _____

Disapproved: _____

Date: _____

Drafted by: GLaBombard, REDSO/EA

Clearance: RLester (draft)_____

GRublee _____

VII. Initial Environmental Examination

Project Location: Rwanda

Project Title: Rwanda Renewable and Improved Traditional Energy Project (Accelerated Impact Program)

Funding: Two years, June 1979-June 1981, Cost of Project $664,350, of which USAID $487,500 and Government of Rwanda $176,850

IEE prepared by: James A. Bever, Overseas Development Council and H. Jack Allison, Oklahoma State University, of ODC Visiting Solar Energy Team.

Date: 31 January 1979.

Recommendation: A negative determination should be made, with the provision that USAID/Rwanda will review environmental impacts of experimental pumping, biogas, and mini-hydroelectric systems when decisions are made to place these in specific field test locations after Interim Project Evaluation.

Concurrence:

John Patterson,
AID Affairs Officer

Date: 5/10/79

Alexander Love,
Director, REDSO/EA

Assistant Administrator's Decision: Approved: _____

Date: _____

Disapproved: _____

Date: _____

Project Description

The Project is designed primarily to support Rwanda's Centre d'Etudes et d'Applications de l'Energie au Rwanda (CEAER) for accelerated renewable and improved traditional energy research and development activities to meet rural energy needs. Project elements include:

- Rural Energy Self-Help Fund supervised by USAID/Rwanda with consulting assistance from CEAER.
- Provision of test equipment, materials, and instruments for use both in the field and at CEAER's laboratory.
- Testing of renewable and improved traditional energy devices first in CEAER's laboratory and then (upon determination at end of Year One that the systems are economically, socially, and technically acceptable under Rwandan conditions) in the field.
- Travel by American experts to Rwanda for scientific consultation with CEAER officials.
- In-country and African training of CEAER staff.
- International Information Exchange activities.

Environmental Analysis

Construction of devices under the project will take place on land adjoining the existing CEAER building. Should they prove technically, socially, and economically acceptable, devices will then be installed in field test communities. Additional project activities (training, equipment, technical consultations) do not raise environmental issues.

The only component of the project which could affect the environment directly would be the use of renewable energy powered pumps for irrigation, biogas systems, and mini-hydro systems. Since these, in some cases, would simply replace diesel systems of equivalent capacity in an existing project, we can expect their environmental impact to be benign. As to these and others, no firm conclusions can be reached, however, until CEAER laboratory testing of these systems is completed and decisions have been taken as to exactly where they are to be placed in the field for testing. At that point, USAID/Rwanda will make a final determination as to the device's environmental acceptability during the Interim Project Evaluation.

IMPACT IDENTIFICATION AND EVALUATION FORM

Impact Areas and Sub-areas	Impact Identification and Evaluation
A. LAND USE	
1. Changing the character of the land through:	
a. Increasing the population	N
b. Extracting natural resources	N
c. Land clearing	N
d. Changing soil character	N
2. Altering natural defenses	N
3. Foreclosing important uses	N
4. Jeopardizing man or his works	N
5. Other factors	N
B. WATER QUALITY	
1. Physical state of water	L
2. Chemical and biological states	N
3. Ecological balance	L
4. Other factors	N
C. ATMOSPHERIC	
1. Air additives	N
2. Air pollution	N
3. Noise pollution	N
4. Other factors	N
D. NATURAL RESOURCES	
1. Diversion, altered use of water	L

2.	Irreversible, inefficient commitments	N
3.	Other factors	N

E. CULTURAL

1.	Altering physical symbols	N
2.	Dilution of cultural traditions	N
3.	Other factors	N

F. SOCIOECONOMIC

1.	Changes in economic/employment patterns	L
2.	Changes in population	N
3.	Changes in cultural patterns	L
4.	Other factors	N

G. HEALTH

1.	Changing a natural environment	L
2.	Eliminating an ecosystem element.....	N
3.	Other factors	N

H. GENERAL

1.	International impacts	N
2.	Controversial impacts	N
3.	Larger program impacts	N
4.	Other factors	N

I. OTHER POSSIBLE IMPACTS (not listed above) ..... N

N - No environmental impact
M - Moderate environmental impact
U - Unknown environmental impact
L - Little environmental impact
H - High environmental impact

APPENDIX A

Details of Illustrative Pre-Determined Project Evaluation Guideline Questions

1. Physical Conditions. The selection of technology must match the physical circumstances of the rural community. A windmill requires a certain velocity of wind for a reliable period of time to function. Sandstorms may damage the glass on a photovoltaic cell, hydroelectric generators will not work if the stream is dry for several months during the year, humidity may corrode metal parts, bio-digesters are less effective at low temperatures and require the right mix of organic wastes and water. Such a test should match various kinds of hardware with a range of physical conditions and measure and record technical performance, maintenance problems, safety record, breakdowns, etc.

2. Costs. Initial capital costs are easiest to measure. Other costs include maintenance, repair, and the costs of operating personnel. For example, solar equipment tends to have relatively high costs for purchase and installation but in many instances it costs very little for maintenance and operation over the remainder of its life. It is, therefore, important to know as soon as possible the approximate lifetime of the equipment in order to compare it with diesel which may cost less to install but a great deal more to operate.

3. Local Social Mores, Taboos and Preferences. Some devices may be less acceptable to local residents than others because they offend local beliefs. For example, the design of a device may be reminiscent of an evil omen. Some devices may stir up family problems. For example, men may resent it if the first device introduced is one that only helps women. Since the men may be dominant in the locality this may hurt the prospect of a successful experience with the device. The device may require the handling of cow dung which in some societies may be unacceptable.

4. How does it Fit Community Institutions? Some technologies can be operated by an individual family. This might be true, for example, of a bio-digester in a culture where families own several cattle each, pen them up at night, and are willing to handle dung. A solar cooker that cooks by concentrating the sun's rays on a cooking pot could also be operated by an individual family in those cases where cooking is done in a pot, where there is no objection to cooking out of doors when the sun is high overhead. Other technologies are not amenable to management by single families. Thus, a technology that produces electricity usually calls for some kind of community public utility. In some communities there may be already a tradition of carrying on activities on a collective basis. In others there may be no such tradition and hence it may be necessary either to avoid such a technology, or have it operated by a unit established from outside the community, or experiment with forming untried forms of communal organization. Some technological applications might lend themselves readily to private enterprises.

The range of applications is great and the cultural-institutional variations within and among communities are almost limitless. In order to give the technology the best chance of performing well, at low cost, and being well maintained, a great deal of thought needs to be given to the best institutional arrangement within the community for "owning" and operating the device. A great deal of field research has been done in many cultures and individual communities by sociologists and anthropologists. Techniques need to be found to draw upon this knowledge during the period when the project is being conducted. The field test should make provision for observing and recording the performance of various kinds of community institutions in utilizing various kinds of hardware.

5. Introducing the Technology. Although there is much evidence that several technologies work, there is also a disquieting record of failures at the rural community level in many developing countries. Anyone who has travelled in developing countries extensively has come across the skeltons of windmills or the remains of abandoned bio-digesters. Although the reasons for these failures are not well documented, they probably include the normal quota of bad design and bad management by the project directors. One may also generalize that a leading cause of failure had to do with the technique for transfering the technology from the lab to the rural community's residents. Outside experts may have come to the community with a pre-selected piece of hardware to do a pre-selected task (e.g., a windmill to pump). They probably erected the device, operated it for a time, tried to enlist the interest of certain residents and then left. Shortly after their departure the device fell into disuse. Perhaps its parts were cannibalized for other purposes. The failure may not have been technical or even economic. Rather it may have been a failure of the technique of transfer to enlist the enthusiasm of local persons or institutions so that they would incorporate the new device into the economy and the cultural practices of the community. The device was brought in by aliens and it remained alien. It never became part of the community.

No doubt the technique for introducing a project into a community will affect importantly the success of the project. Involving innovative residents in the very early stages of a project will increase the enthusiasm and involvement they have over the life of the project. It will increase the likelihood that the project will be incorporated into the life of the community, and the residents maintain and operate the new device well and get the most out of it. Moreover, involving residents will improve the design of the project because they may have the most reliable opinions on (1) what task to select for energizing (e.g., pumping, grinding or cooking), (2) what primary energy source and device to use (e.g., wind pumper, wind generator, solar pump, or solar cell) and (3) what local institutional arrangements to make for the operation of the device.

On the other hand, involving rural residents in project planning has some drawbacks. It may be time consuming and hence unattractive to aid officials or to host country operators. It calls for skills not always possessed by energy technologists. In many countries the normal method of

dealing with rural communities is to impose change from above. This normal technique, of course, requires the governmental office that imposes the change to supply a corps of people to operate and maintain the new technology. It is a much greater budgetary burden than if rural residents could be motivated to take over maintenance, operation and simple repairs.

It is for the government to consider these advantages and disadvantages and decide whether to impose technology from above or to attempt to involve rural communities in designing and implementing the changes. The fifth purpose of a well-designed test would be to furnish the government objective data on the advantage and disadvantages of each technology transfer technique. Hence, the test should attempt to determine whether involving local residents in the early stages of the project enhances the prospects for success.

6. Impact on Community Well-being. Finally, the tests should be able to tell policy-makers something about the impact of new energy sources on the life of the rural residents and therefore ultimately upon the nation.

What is the impact of more energy on agricultural production? Is a substantial portion of the labor released from other tasks devoted to raising additional crops or livestock? Does employment occur as a result? Are small industry or handicrafts stimulated by the coming of more energy to the community? Does the provision of lights for reading improve the pace of quality of education? What effect is there with respect to health services or the incidence of disease (for example, from clean drinking water)? What effect is there on the role of women? Is there an increase, a decrease, or no change in the number of babies born each year? Is there a change in infant mortality? What changes, if any, take place in the patterns of migration? Does energy set up a demand for imported items that drain limited foreign exchange? These and other evidences of the impact of energy on community life should be measured and analyzed in order to better understand the importance of energy in rural communities, to anticipate problems and opportunities introducing more energy may create and to diffentiate among the effects of different uses of energy (lighting, clean water, cooking fuel , for example, contrasted with irrigation) and different forms (electricity versus gas, charcoal or mechanical energy).

APPENDIX B

DETAILED DESCRIPTION OF CEAER

1. Other organizations which have contributed to or collaborated with the CEAER:

- CIDA. Many of the researchers are Canadians and experts of the CIDA having the teaching of science at the University as their principal task. Dr. Kalos is funded by CIDA.

- The Service of German Volunteers. A volunteer is provided as technical advisor for the CEAER workshop.

- UNESCO. This organization has assisted travels to meetings and granted some equipment (a solar pump) in 1976. A request for equipment was presented in 1977, but the response by UNESCO is unknown.

- UNECA. The University requested the help of this organization in formulating the long-term plans for the CEAER and in connection with the present project. The UNECA Regional Advisor on Solar Energy, Mr. Gerard Saunier was the first Director of the CEAER.

- UNEP. CEAER proposed to UNEP a project similar to this one in October 1977, but there was no positive response.

- The University prepared a project of collaboration between CEAER and Belgian universities. There is interest in this collaboration particularly at the Environmental Studies Program, Faculty of Applied Sciences, Universite de Liege. There has been no positive response, however, from Belgium.

- Past visits of Professor P. Worsoe-Schmidt (Copenhagen) and of J. F. Pellerin, Engineer, had very positive effects on the work of the CEAER.

- The Society Socomerwa contributes a financial input to the CEAER by virtue of a commercial contract on solar water heaters concluded between the University and Socomerwa.

2. Research and development and related activities:

a. Solar Water Heaters

CEAER has built solar water heaters for a number of private residences

in Butare, for a 500 liter unit for Butare's Hotel Ibis, for the hotel on Lake Ihema and a 1200 liter unit for the Hotel de Gabiro in the national park. All of the hotel installations replace woodfuels which would have been used, and CEAER calculates the solar water heaters will pay for themselves in six years.

The CEAER has built so far $90M^2$ of solar collectors: $65M^2$ were commercial installations and the rest for useful functions at the University. Current projects for solar water heating to be implemented by Socomerwa under CEAER license amount to about $300M^2$ collectors. During the project CEAER will continue to optimise the design for Rwanda, improving the lifetime and reducing costs. Most of the work on solar water heaters will be self-financed by the anticipated royalties.

The Center will continue to work in collaboration with the manufacturer Socomerwa toward vigorous commercial development of locally made solar water heaters in Rwanda. The technology is well established, and the potential of implantation is fairly large in urban areas. The impact on rural development would be limited to hot water needs for hospitals, health care units, schools, and perhaps community facilities.

b. Other Solar Energy Technologies

Solar stills have been experimented with and used to provide distilled water for the University's chemistry labs. Solar distillation may be implemented for garages (to improve lifetimes of car batteries), laboratories, and clinics.

Other uses of solar energy, such as for refrigeration, drying of produce, process heat, pumping, electricity for communications, and cooking, have not yet passed the research and laboratory testing stage at CEAER. (Process heat is interesting from the environmental point of view, because part of the Rwandan industry relies on firewood for it.) A solar concentrating absorption cycle refrigeration system has been experimented with. Plans are under way to collaborate with the College of Agriculture at the University to work on solar crop dryers. A Pompes-Guinard 140 watt-peak photovoltaic water pump has been tested at CEAER and plans have been drawn up to work on photovoltaic flat and concentrating applications for radios and other pumps once funding is available.

c. Biogas

CEAER has built a number of small biogas units using cow dung at the lab. In connection with the Ecole Technique Agricole at the University, CEAER has built a 12 m^3 batch system with solar heated supplement. Plans have been drawn up for collaboration on biogas design for use by the Project Agropastorale de Nyabisindu. Plans have also been given by CEAER to French volunteers in Mbazi.

d. Mini-hydropower

Small mountain rivers abound in Rwanda and CEAER believes that low-head turbines could be put into use on these rivers for rural development (mills, pumping, electric power) perturbing only very little the water levels and the ecosystem. The CEAER is in the process of gathering information on the subject and putting it into a form for presentation to the school population. CEAER staff have visited two Ossberger-Turbinenfabrik mini-hydroelectric installations at Pfunda and Kilinda. They have done preparatory design work for an installation at Nyiranshura with the local commune Shyanda. CEAER has also done plans for a hydraulic ram installation, but details were unknown to the PID Team.

e. Peat

Institutions other than the CEAER are expected to work on the extraction of Rwandan peat for commercial industrial use. The Centre's interest lies in the rural use of peat, and in its potential as a household fuel in both rural and urban areas. So far, CEAER has worked on cokefying and pressing of peat into briquettes for testing purposes.

f. Appropriate Technologies

The CEAER is keeping contact with institutions world-wide who are active in this field and collects their documentation with a view toward future concentration on energy-related aspects, such as labor-saving hand tools and machinery, improved draft animal machinery, improved stoves, and depending upon other ongoing activities, perhaps also community-managed family-cultivated woodlots.

g. Studies

CEAER has made preliminary studies of the solar, wind, hydropower and biogas potential in Rwanda. It has concluded that wind potential is poor, solar potential is modest but workable especially during the four months of the drying season, biogas is workable (but less than optimum due to mild ambient temperatures), and minihydro potential appears excellent. Some technical and economic studies of energy alternatives are planned, pending further funding, and some for solar water heating and mini-hydropower have been done. CEAER reported it has done a solar energy study and Director Kalos reported that CEAER's peat studies would be completed by fall 1978.

A study has been done by University civil engineering students for a simple 15 kw mini-hydroelectric installation to power a rural sorghum mill (or coffee processing or timber mill).

h. Expansion of CEAER Physical Facilities

CEAER expansion was completed in 1978, relocating the CEAER to a new nearby site of about 1000m^2. An open workshop of 150m^2 will be built. The site includes an existing building where 120m^2 will be rearranged for a

stock room, an instrument room and office space. The present outdoor site of about 400m^2 will be retained as a test site.

i. CEAER Research Staff

POSITION	EDUCATION	RESPONSIBILITY
Director		
F. Kalos	B.Sc., (McGill, 1966) Ph.D., (McGill, 1971)	CEAER Program
Research Assistant		
J. B. Mabyalimana	B.Sc. (UNR, 1972) Ing.Civil (UNR, 1975)	Solar water heating and hydropower
P. Mpawenayo	B.Sc. (UNR, 1975) Lic.Sc. (UNR, 1977)	Solar panels
C. Ntakirutinka	Ing.Phy. (Liege, 1977)	Solar refrigeration
Intern		
J. B. Kanyamiheto	B.Sc. (UNR, 1977)	Methane Gas Biology
Collaborateurs Scientifiques		
M. Kabay, Fac.Sci.UNR	B.Sc. (Montreal) Ph.D. (Hanover, N.H.)	Statistics
C. Karenzi, Institut Pedagogique National	Lic.Sci. (Kinshasa 1967) D.Sc. (3e cycle),(Strasbourg, 1977)	Photo-electricity
J. Langlois, Fac.Sci. UNR	D.Sc. (Laval)	Solar panels
A. Mukamurenzi, Fac. Sci., UNR	B.Sc. (UNR, 1973)	Peat
E. Ndejuru, Agronomy, UNR	D.Dc. (Gembloux, 1976)	Biogas
G. Niyonizeye, Fac. Sci. UNR	B.Sc. (UNR 1971) M.Sc. (Laval 1975)	Photovoltaics
Ph. Savoie, Agronomy UNR	M.Sc. (Laval)	Hydropower
A. Turcotte, Fac. Sci., UNR	Ph.D (Montreal)	Peat & Economic studies
H. L. Vanderborght, Butare		Algae processing

APPENDIX C

RURAL ENERGY FUND

Ideally, CEAER would assist USAID/Rwanda with the Fund by the following chain of events:

1. The CEAER and AAO/Rwanda make widely known the available technologies (i.e., for biogas or small hydraulic units) and the assistance CEAER can provide;

2. Local interest leads communities and individuals to contact AAO/Rwanda;

3. AAO/Rwanda reviews Fund candidates, selects recipients, and requests CEAER to provide technical assistance in a consulting capacity where it can count on local interest and collaboration.

As part of Fund activities, CEAER would distribute blueprints and manuals on renewable and improved traditional energy technologies in French and Kinyarwanda or Swahili to all applicants.

AAO/Rwanda may wish to consider the involvement of CEAER and the Banques Populaires in administering the Rural Energy Fund, especially for public notification of the Fund; design of criteria for review of applications and selection of final recipients; determination of whether ceilings to be imposed on any award amount, evaluation criteria and procedures, etc.

D. Instruments

Item Number	Description	Cost
1.	Two pyranometers	$ 3,000
2.	Two recorders for pyranometers	2,000
3.	Data scanner and computer interface for existing digital voltmeter	3,000
4.	Computer	5,000
5.	Hydrograph	2,000
6.	Oscillascope (double track, memory)	6,000
7.	Electronic test equipment, cables, connectors	4,000
8.	Heat exchanger	1,000
9.	Batteries (lead acid)	4,000
	Subtotal	$ 30,000

TOTAL FOR ALL EQUIPMENT, MATERIALS, PROTOTYPES AND INSTRUMENTS $ 190,000

APPENDIX E

African Renewable & Improved Traditional Energy R&D Institutions

(Potential Institutions for CEAER Training, Study Tours, and Information Exchange Activities)

Upper Volta

A. Research and Development

1. biogas (I.R.A.T.)
2. solar heat pump (SOFRETES)
3. hot water heaters (Centre Interetats d'Etudes Hydraulique)
4. solar steam cookers

B. Data Collection in 6 Sites

C. Implementation

1. solar cookers for women's cooperatives (UNEP financed)
2. water heaters (Centre Interetats d'Etudes Hydraulique)
3. SOFRETES pumps
4. solar cell GUINARD pump
5. solar cell radio (AID financed)

D. Future Activities

1. Univ.of Ouagadougou Solar Institute
2. AID financed solar cell pump and grinder
3. SAED (private rural development consulting firm) solar cooking

Niger

A. Research and Development
ONERSOL (Niger Solar Energy Lab): Director Moumouni, a pioneer in solar energy in Africa with 20 years experience, has good R&D facilities, accurate donor financing and good fabrication facilities for small industrial production for water heaters, distillers, and solar cookers. Research being discussed on food driers, solar pumps and combined low temperature-high temperature solar heat pumps.

B. Implementation
ONERSOL is beginning rural tests of solar energy cookers in two regions of Niger and is already producing for Bamako and rural markets within Niger water heaters, distillers and cookers.

C. Data Collection in Ten Sites

D. Training -- African training courses offered at ONERSOL.

E. Future Activities
ONERSOL likely to be recipient of USAID finance to improve solar date processing, training, lab facilities, and cooking R&D.

Ghana

A. R&D Implementation
AID financed pyrolitic convertor which produces flamable oil, charcoal, and low pressure gas from wood chips. Kumasi Center has done R&D on improved stoves and charcoal kilning.

Senegal

A. R&D

1. Institute de Physique Meteorologique of Univ.of Dakar
   a. three generations of solar heat pumps (SOFRETES) since 1957; distillers; food driers; water heaters;
2. Laboratoires de Semi-conducteurs of Univ.of Dakar
   a. solar cell pump and applications
3. Institute Universitaire de Technologie of Univ.of Dakar
   a. solar cell pump; SOFRETES pump; Savonius windmill
4. Polytechnical School of Thies
   a. mechanical and electrical windmills
5. Promotion Humaine
   a. food driers; cookers; windpumps - all of indigenous materials

B. Data Collection in Five Sites at Least

C. Implementation

1. peace corps ad hoc; improved charcoal production, windmills, stoves
2. SINAES (semi-public firm charged with fabrication and maintenance of solar energy devices) - three Savonius wind pumps in rural areas; three SOFRETES pumps; Bakel irrigated SOFRETES pump project
3. Ecole Polytechnique de Thies - four windmills for pumping and electric lighting in rural areas
4. Institute Physique Meteorologique - three SOFRETES pumps with SINAES, solar water heaters
5. PVO's - Guinard solar cell pumps (2)
6. Agricultural Research Center - biogas (1950s); Guinard solar cell pump
7. Promotion Humaine - Fissel village solar cooker, drier, windmills

D. Future Activities

1. UNEP - to fund a Solar, Wind, Biogas Demonstration village Ruran Energy Demonstration Center in Niger near Dakar, and a pyrolysis unit for peanuts shell wastes
2. DGRST and University of Dakar likely to be recipient of 5-year USAID project to field test energy devices in rural areas.

Mali

Mali is likely to be the recipient of an AID-funded five-year project to improve the Laboratoir d'Energie Solaire and test its work on solar crop and fish driers, distillers, cookers, heat pumps and water heaters, and new R&D in rural application. The Lab produces and markets water heaters at clinics and elsewhere for Bamako and rural areas. In the 1960s, many windpumps were used for stock water purposes, but have fallen into disuse with demise of a GOM extension service. Lab has assisted in and helps maintain SOFRETES pumps at Diola and new 50 Hp one at Dire. FAC has funded (and FED may fund) a few solar cell pumps of the French Guinard company.

Kenya

Numerous activities ongoing or planned through University of Nairobi and various UN agencies. Windmill, etc. demonstration center through UNICEF. Hutchison Farm biogas systems for fertilizer and internal combustion engine operation ongoing for 20 years.

Ethiopia

University of Addis Ababa doing work on solar stills and windmills. Institute for Agricultural Research doing biogas work. Adult Education agency doing solar cooker field tests. Village woodlots being developed by Forestry Department. Detailed geothermal studies indicate rich geothermal potential. National Energy Committee and other agencies are possible recipients for USAID financing for rural energy field testing and national energy survey.

Mauritius

Sugar cane industry uses biogas for power and for electric grid. Much interest at university, government, and private level in solar water heaters, windmills, and wave power utilization. University possible recipient of USAID financing for solar, wind, biomass or wave R&D

Tanzania

Arusha Appropriate Technology Project in Arusha doing village dialogue with three villages; R&D, lab testing and field testing to meet expressed energy needs; evaluation; small village mass production of energy devices. Pumps, windmills, biogas, etc. University of Dar es Salaam doing R&D on solar cookers, windmills, distillation, solar water heaters. Small Industries Development Organization and Ministry of Water, Energy and Minerals are developing and testing biogas applications. Faculty of Agriculture in Morogoro doing fuelwood studies. National Scientific Research Council planning major Dodoma Rural Energy Research Center and field testing.

Others

Renewable energy R&D ongoing also in universities, research centers, and other public agencies in Botswana, Zaire, Zambia, Cameroon, Sudan, Nigeria, Guinea and Malagasy.