ENERGY AND RELATED DEVELOPMENT ASSISTANCE ACTIVITIES
IN EA AND BLS AREAS (EAST AND SOUTHERN AFRICA)

RECOMMENDATIONS TO U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT
(WITH SPECIAL ATTENTION TO RENEWABLE & IMPROVED TRADITIONAL ENERGY TO MEET RURAL NEEDS)

Special Development Problems Division
Office of Development Resources
Bureau for Africa
(AFR/DR/SDP)

Regional Economic Development Services Office
for East & Southern Africa
(REDSO/EA)

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(The views presented within this report represent those of the author alone, and do not represent the views of the U.S. Agency for International Development.)
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"Rural areas will continue to depend on charcoal and wood for their energy requirements...the provision of electricity is still a very expensive business in developing countries due to the scarcity of resources...It is necessary, therefore, to intensify afforestation efforts to provide adequate wood and charcoal as well as improving traditional charcoal and wood appliances with a view to enhancing their efficiency in the utilisation and preservation of energy...The importance of developing non-conventional energy sources, such as biogas, solar energy, wind, power and exploiting the hydro-electric potential of small rivers to provide energy in the rural areas must also be stressed now if they are ever to be used in the future significantly."

Minister of Power and Communications Omolo Okero
The Eleventh Eastern and Central Africa Electricity Conference

PREFACE

This report was commissioned and prepared with the intent of briefing USAID's Regional Economic Development Service Office (REDSO/EA) in Nairobi on energy activities and development cooperation needs in the East and Southern African countries, with recommendations for REDSO/EA action to help meet those needs in the coming years. Special attention was to be given to the role of renewable and improved traditional energy technologies to meet rural needs.
First and foremost, I wish to acknowledge and thank my wife, Barbara, a graduate student in cultural anthropology, who participated in and contributed to the numerous field visits and over forty substantive official meetings during our six weeks of work in Kenya, Tanzania, and Sudan to help research and prepare this report. Her contribution of insights, challenges, observations and ideas, especially in the area pertaining to women and improved traditional energy, easily merit her the acknowledgement as co-author of this report.

John Blumgart and David French of Africa Bureau's Office of Development Resources (Chief and Energy Advisor respectively of the Special Development Problems Office) and Ray Love (Director, Regional Economic Development Services Office for East and Southern Africa) collectively initiated and sponsored the preparation of this report.

James Howe of The Overseas Development Council has provided me with invaluable inspiration and professional guidance, first while a Research Assistant and then Associate Fellow over the past five years, which provided me the opportunity to work in renewable and improved traditional energy development in ten African countries. Robert Nathans of The Institute for Energy Research at the State University of New York at Stony Brook granted me leave of absence from my current position as Deputy Director of the Energy Management Training Program for Developing Countries, which allowed me the time to conduct the field work with my wife necessary for the report preparation.

In Kenya, Joseph Pastic of AID/Nairobi, Larry Hausman of REDSO/EA, Christopher Aleke-Dondo and Tom Tuschak of National Council for Science and Technology, W.W. Mbote of National Environment Secretariat, Principal Michael Manthini of Karai Village, Mr. Manyindo of UNICEF and Essam El-Hinnawi of UNEP were most helpful. In Tanzania, Dick and Joyce Stanley of Arusha Appropriate Technology Project and the Audio Cassette Listening Forums Project welcomed us into their project sites, while Keith Openshaw of Faculty of Agriculture at Morogoro went out of his way to brief us on forestry and fuel wood problems. In Sudan, Fattah Saleh of Petroleum General Administration, Farouk Ahmed of DECARP and especially Yahia Hamid of the National Research Council's Institute of Energy Research cooperated under the most difficult of circumstances to make our work with them extremely productive.

Dr. Priscilla Reining of the American Association for Advancement of Science, Dr. Charles Steadman of University of Michigan, Dr. J.D. Walton of Georgia Institute of Technology, Dr. Jack Allison of Oklahoma State University, Dr. Clarence Kooi of Lockheed Laboratories, California, Dr. Maurice Raiford of North Carolina State University, Thomas Graham of Donovan, Hamester, and Rattien, and Ms. Carol Ulinski each contributed valuable suggestions, insights or materials which helped in the preparation of this report.

But most importantly, I thank the villagers of Magu and Majengo in Tanzania, Karai in Kenya, Fissel in Senegal, San in Mali and so many others for their cooperation and friendship over the years. It is my deep-felt hope that in some way they and their children may in their lifetimes benefit by the contributions they have made to the ideas in this report.

Of course, final responsibility for any information in this report rests with me and do not represent the views of USAID.

James A. Bever 18 Garden Drive August 30, 1979 Stony Brook, NY 11790
ABBREVIATIONS

UNCNRSE - United Nations Conference on New and Renewable Sources of Energy
AID - Agency for International Development
DECARP - Desert Encroachment Control and Rehabilitation Project
REDSO/EA - Regional Economic Development Service Office/East Africa
EA/BLS - East Africa/Botswana, Lesotho, Swaziland
CEAER - Centre d'Etudes et d'Activites d'Energie pour le Rwanda
UTAFITI - Swahili name for National Scientific Research Council
SEVPP - Solar Energy for Villages Pilot Project
PRC - Peoples Republic of China
IDRC - International Development Research Council
SERI - Solar Energy Research Institute
PID - Project Identification Document
PP - Project Paper
OECD - Organization for Economic Cooperation and Development
DAC - Development Assistance Committee of the OECD
AID/W - AID's Washington Headquarters
SOFRETES - Société Francaise d'Etudes Thermiques et Electriques Solaires
PGA - Petroleum General Administration
AFR/DR - Africa Bureau's Office of Development Resources
DS/EY - Development Support Bureau's Office of Energy
IQC - Indefinite Quantity Contractor
CIDA - Canadian International Development Agency
SIDA - Swedish International Development Agency
AATP - Arusha Appropriate Technology Project
R&D - Research and Development
UNICEF - United Nations Children Fund
ILO - International Labor Organization
UNDP - United Nations Development Program
EEC - European Common Market
KW - Kilowatt
KG - Kilogram
UNEP - United Nations Environment Programme
PCV - Peace Corp Volunteer
NCST - National Committee for Science and Technology
PVO - Private Voluntary Organization
AIP - Accelerated Impact Program
IRT - Improved Rural Technology
VITA - Volunteers in Technical Assistance
IDRC - International Development Research Center
UNECA/Addis - UN Economic Commission for Africa in Addis Ababa
NGO - Non-Governmental Organization
GOB - Government of Botswana
RET - Renewable Energy Technology
EXECUTIVE SUMMARY

Report Organization

This report begins with reflections on energy and development in East and Southern Africa, then moves on to present a summary of energy-related activities in these countries and an illustrative survey of international donor activities. Following these, four informal African energy consensuses are presented after which a number of options are presented to REDSO/EA for consideration to meet the needs expressed through these consensuses and other forums.

Next, a description of the consultant's work in Kenya, Sudan, and Tanzania as part of this report preparation is presented, with proposed projects in each country and recommendations to AID for action. After this, a more detailed summary is presented of each country for which AID has approved renewable or improved traditional energy projects (Rwanda and Lesotho): of each country for which AID has investigated the potential for such projects to the point of at least the PID stage for most of them (Botswana, Swaziland, Tanzania, Mauritius and Ethiopia); & those countries for which AID assistance may be possibly needed but no such investigation has yet occurred (Somalia, Uganda, Zambia, Djibouti, Malawi, Burundi, & Seychelles.)

Major Recommendations of the Report

1.) That REDSO/EA should create an Energy Development Liaison Extension Office (ENDELEO), based in Nairobi, to provide accelerated capability to respond to field mission requests and to initiate region-wide energy-related services to benefit all field missions and their countries. The Office would be initially staffed either from within AID or via personal service contracts by two development generalists with experience in East African energy project design and administration: of consulting services and project design teams. One person would serve as a Country Energy Development Officer, with responsibility for: a) improving communication between field missions, REDSO and AID/W on energy issues and activities; b) participating and mobilizing energy project design services using a small team of consultants; c) building REDSO and field missions' energy capabilities through short-term in-service training of staff. The other person would serve as a Regional Energy Development Officer, with responsibility for the initiating of region-wide services above and beyond individual mission requests, including: a) a National Energy Training Program; b) an African Energy Commission; c) a National Energy Assessment & Planning Program; d) an Energy Development Assistance Coordination Council; and e) support for region-wide multilateral efforts such as through UNICEF or UNEP. (See pp. 31-40.)

2.) That energy project proposals identified by this consultant for Kenya, Sudan, and Tanzania be followed-up by AFR/DR/SDP, REDSO/EA and the corresponding country missions with PID design team efforts to further investigate and develop a PID based on further negotiation of the proposed project elements:

In Kenya, this would include an effort to: a) strengthen the new Department of Energy in the Ministry of Power and Communication with technical advisors, new analytical planning tools (eg., ability to develop and use the Reference Energy System) and financing for critical energy
studies, data collection, and analysis; b) promote a Pilot Rural Energy Project, which would include the creation of a Rural Energy Research Center based at the University of Nairobi; a Rural Energy Fund and Office of Technology Assessment to finance and assess field test efforts; Execution and Evaluation of Rural Energy Field Tests of energy technologies to meet rural needs which have first satisfied appropriate technical, economic and social requirements. (See pp. 44-61.)

In Sudan, the design effort would focus on the Desert Encroachment Control and Rehabilitation Project (DECARP) and the potential for the National Research Council's Institute of Energy Research (IER) to contribute to research and field testing and development of technologies to meet DECARP's goals. These would include development of improved cook stoves, charcoal kilns, reforestation techniques and tree varieties, solar food dryers, etc. Some complementary building of IER's staff, facilities and research program is envisioned as well, as is involvement of Ms. Turi Hammer (formerly Digernes) in the PID design effort with DECARP and IER, upon her return to study energy use in the village of Bara, located in the area where AID would like to concentrate its DECARP efforts. (She plans to return to Bara in November or December 1979.) (See pp. 62-75.)

In Tanzania, an effort should be made to document Arusha Appropriate Technology Project activities over the past few years for the benefit of other EA/BLS countries who are working in village technology. Further investigation should also be made of the possibility to initiate a rural fuelwood project with Keith Openshaw of the Faculty of Agriculture of the University of Dar es Salaam at Morogoro and the Tanzanian Forestry Department to develop and field test improved cookstoves, charcoal kilns, tree species, and reforestation techniques. (See pp. 76-78.)

3.) That the EA/BLS countries which have not yet been investigated for renewable and improved traditional energy project activities, which are Somalia, Uganda, Burundi, Malawi, Zambia, Djibouti, and Seychelles, should be visited over the coming year (with AFR/DR/SDP, REDSO/EA, and field mission support) by energy project design teams active in neighboring countries. This should be done in an effort to investigate any ongoing activities which may be of use to other EA/BLS countries and to identify project possibilities. At the minimum, to the extent that REDSO/EA or AID/W provide financial and technical support to UNICEF village technology training and extension work in these countries, AID will have made a good first step toward meeting some rural energy needs at a very low administrative and bureaucratic investment on its part. (See pp. 94-100.)
1. Not by Oil Alone

East African and Southern African countries can no longer depend increasingly upon imported oil to fuel either future survival needs or economic growth needs. They must use more indigenous energy resources, especially major and small hydropower, coal and gas and geothermal, peat, wood and agricultural wastes, improved animal power, and in the coming decade, biogas, wind and solar for exceptional uses. Oil will be too expensive and too costly politically to rely upon as greatly as today to fuel economic growth, especially in the urban industrial sector. In the rural sector, increasingly scarce firewood cannot be replaced by increasing supplies of petroleum imports, thus efforts must be made to expand fuelwood supplies and to improve efficiency of their use. Improved maintenance of existing diesel equipment for pumps, grinders and power generation is imperative.

Energy, it must be remembered, is a continuum - its use is not static, but rather extremely dynamic and inter-related as a flow throughout the economy from rural to urban and from the subsistence farm to the industrial assembly line. What occurs at the macro-economic level in energy in one sector affects the micro-economic level in another sector, and vice versa. For example, the increasingly scarce availability of higher quality imported crude oil results in "cuts of the barrel" from the refinery such that kerosine is increasingly scarce, with consequential increasing price of kerosine and increasing demand on and price of woodfuels, used mostly by the rural sector and informal low-income urban sector.

2. No Forest for the Trees

In ever-increasing number of areas of EA/BLS countries, people can no longer "see the forest for the trees" - the rapid, uncontrollable cutting of trees for fuel and agricultural purposes without sufficient regard to coppicing or reforestation is leading to severe deforestation. This is exacerbating the soil erosion problems already critical in many areas due to poor rangeland management. Unless checked and reversed by a quantum jump in effort, many will soon exceed the carrying capacity of the land, leading to diminished agricultural productivity, increased dependence upon agricultural residues for fuel which are more valuable for fertilizer, and eventually increasing pressures to abandon the land and resettle elsewhere or move to the urban areas.

3. Women and Children First

Unlike the lifeboat ethic of "women and children first", cultural practice reinforced by the lack of improved animate and inanimate energy technology (e.g., improved draft animal availability and techniques,
improved hand and foot-powered implements, and fossil fuel or renewable energy-powered equipment) available to perform tasks necessary both for survival and for increased rural productivity have resulted in women and children serving as the fundamental "beasts of burden" in rural Africa. For the foreseeable future, the majority of rural women's role in life will continue to be based in the village around the family, local market, farm, and the garden, but improved access to labor-saving devices and techniques could result in increased productivity, increased time for income-earning activities and better care of children or strengthened community involvement, and more opportunity to take advantage of and be responsive to available social services and amenities. Children may even be able to attend school at an earlier age, stimulating their young minds at an even more formidable age.

Naturally, introduction of such improved labor-saving devices should benefit the men, as well, with similar advantages. All too often, however, it is only the men who benefit from such improvements but it is time for the women and children to benefit more directly.


All too often, the approach to improving quality of life in the rural setting is a "technology-push" endeavor, in which people from outside a given community pre-determine which needs will be focussed upon by a pre-determined technology. All too often, this approach fails. But, it is repeated again and again, although based on good intentions, largely because it is the easiest approach.

The much more difficult and challenging approach, but one which appears to have much higher chance of success, is the "needs-led" technique. Through deliberate planning, people outside the community can stimulate the community to internally determine their own priority needs, their own internal resources available, and their own preferences on how to organize themselves and what characteristics any new or improved traditional technology should have to meet those priority needs.

There is room for both of these approaches, and indeed each has had its share of success (e.g., the "technology-push" success with metal utensils, bicycles, portable radios, etc.). But the "needs-led" approach certainly merits increased attention by development workers.
5. **Running the Energy Gauntlet: The Arusha Declaration Ten Years After**

In confronting energy problems, AID must be extremely wary about introducing new technical solutions to meet problems, until it has assured itself that improving the old technical solution or the old organizational/institutional structure would be futile. For example, everyone complains that the diesel engine technology is a less than desirable one, especially in the rural area. One can observe that in many areas, diesel systems (for pumping or electric generation) are usually not functioning in 50% to 75% of the cases—thus, the solution is always to introduce windmills, solar power systems, mini-hydro, etc. Or fuelwood is being depleted rapidly, so biogas units are introduced for cooking, etc. But if the problem is really that the diesel systems are not being maintained properly, or that the people are not using their wood judiciously or coppicing their trees or planting new ones, then these are critical institutional, organizational and cultural problems which may doom any effort to introduce new technology as well.

This is not to say that a new technology might not be superior to the old one and easier to maintain or more consistent with the culture, it is just to say that all too often these critical non-technical issues are overlooked—either because they are not glamorous solutions or because they are fundamentally complex and cannot be solved in the time-frame of a two, three, or five year project, or because they do not fall within that year's special Congressional mandate.

For example, if one is to lift water from a deep well, then the technology developed to do the job should first run an energy gauntlet: can it be done by hand? If it cannot be done by hand, then can it be done by a hand machine with a pulley or hand-pump? If not that, can it be done with use of a pedal pump? If not that, can it be done with a draft animal? If not that, can it be done with a non-animate energy source which uses local resources, but is still easy to operate and maintain and develops local skills? In the Arusha Declaration Ten Years After, President Nyerere said that villages should have been putting the resources they had into providing oxen and plow equipment, etc. for each family instead of one tractor for the whole village, his recommendation ten years earlier. Going "pole-pole sana" (very slowly in Swahili) and advancing in incremental steps is far preferable to taking great leaps forward, then falling on one's face.

6. **Accelerating the Learning Curve & Building Collective Energy Self-Reliance**

All too often, in training African energy specialists and policy-makers, USAID and other donors send the people to the U.S. or elsewhere in the developed world, or bring the expatriate developed country experts into the country for in-country on-the-job training. In almost 100% of the cases, there is no money for, or attention to, the opportunity to train Africans in other African or Third World countries, or bring in other African or Third World experts to do the training or technical assistance. Countless East Africans have gone to US and France for solar energy training, but have never been to ONERSOL (Niger Solar Energy Lab) in Niger where they could have accelerated their learning curves much more rapidly because some of the technology has already been adapted to the difficulties of the African setting.
Countless windmills are in use for water pumping in Zambia—on commercial farms. Numerous small hydro-electric systems are in use in Africa over the past two decades, but at missions and police stations, etc. Numerous biogas units have provided energy for cooking, lighting, and running internal combustion engines—but for expert teams on development projects of the Peoples Republic of China. Then why aren't the African villages using these, one must ask?

Numerous improved cooking stoves are in use in Karai Village, but why isn't the whole village using them? And why did it have to wait until this consultant had to come over from America for their experience to be relayed to energy experts in downtown Nairobi 18 miles away who claimed no such work was underway?

Somehow, Africans are not learning enough from one another in neighboring countries or even from the human resources within their own borders.

7. Energy for Survival & Energy for Development

For many people in Africa, more energy is needed just to meet survival needs: fuel for cooking, for keeping warm. But all the improved cookstoves and all the reforestation efforts will not help a country develop and progress economically—though they may help keep it from slipping backwards. Energy technology and organizational systems are also needed to improve agricultural production and processing and transport—let alone for fueling the industrial sector and services. REDSO/EA can not afford to be myopic in its service to missions in the energy field, concentrating only on the AID mandates of rural and small-scale. Indeed, it can put its financial resources emphasis in that direction, but at least it should leave funds as well for technical assistance, feasibility studies and training, etc. in helping these governments cope with the macro-economic and institutional requirements necessary.

8. Improved Energy Economy vs. Energy Austerity

Conventional wisdom dictates that there is no room for energy conservation in the modern sector in Africa—in the rural sector the only opportunity is to perhaps improve use of firewood. Politically, the spectre of "cutting back" is a disastrous one for these governments—or of removing subsidies on kerosene or raising price of kerosene or diesel or gasoline. The concept of making better use of what one uses, without cutting back, but rather fueling more activity on the same amount of wood or the same amount of imported oil, is a potentially enormously useful one which benefits the economy at both the micro and macro scale. But up to now, hardly any foreign assistance has gone into this activity.
9. Appropriate Bureaucracy

All too often, most of the AID missions in Africa are so swamped with bureaucratic requirements that they can barely manage to execute their projects. Similarly, efforts to stimulate appropriate technology and new development approaches for rural communities or small enterprises are frustrated or impossible due to the bureaucratic requirements necessary for funding and implementation. For both of these, it seems that a new movement of "appropriate bureaucracy" is needed as desperately as appropriate technology. Within the framework of energy for rural development, such appropriate bureaucracy should be the rule, not the exception. Indeed, AFR's AIP and IRT programs and DS/EY's PVO programs with "ITA are highly commendable steps in this direction. The recently approved Rwanda Renewable and Improved Traditional Energy Project contains a Rural Energy Self-Help Fund, to be administered by AID/Kigali but implemented through a local institution, using small amounts of funds not to exceed $10,000, with brief, straight-forward application and approval procedures for funding designed to respond quickly to requests by local communities and institutions with minimum paperwork demands on AID/Kigali. Such "energy self-help funds" should be made more widely available, administered by AID missions but implemented through Peace Corps or other local institutions.

10. Climb the Mountain Slowly

Above all, as in climbing Mt. Kilimanjaro, one must go slowly building ones strength and ability to adapt to the altitude, one day at a time and with short steps if one ever wishes to reach the long term goal of reaching the top. The same might be said of reaching the goal of improving availability of improved traditional and new sources of energy to the rural majority. Developments should be made incrementally, meeting short-term needs quickly while at the same time building institutions and "planting the seeds" to support longer-term objectives. Thus, for example, the policy of improved energy demand management and increased efficiency of use of energy can quickly help meet short-term pressing energy needs in both the rural and urban sectors, using largely, local capabilities and incremental improvements over the existing technology. Simultaneously, new trees, woodlots, plantations should be planned and planted in rural areas; solar, wind and biogas research and field-testing expanded; and government institutions strengthened through new training and facilities all to form the basis for longer term needs.

Improved and expanded availability and use of energy for the majority of the rural population and enhanced supply of indigenous conventional and non-conventional fuels to power national economic growth cannot be expected to occur over the normal five-year length-of-project for AID projects. Rather, it is likely to require at the least a full human generation of continuous diligence and investment more likely to stretch over the next four five-year development plans of these countries and the remaining productive lifetimes of the people who wrote this report and those who read it.

With this overview in mind, the report proceeds to a summary of ongoing activities in East and Southern Africa.
CHAPTEI TWO

ABBREVIATED SUMMARY OF ACTIVITIES IN EAST AND SOUTHERN AFRICA

Kenya

Kenya has a number of activities underway in the new, renewable and improved traditional energy development area especially for rural use. In particular, the National Council on Science and Technology and the National Environment Secretariat wish to initiate, with foreign technical and financial assistance if possible, a Pilot Rural Energy Project. The NCST wishes to also promote increased support for the new Department of Energy in the Ministry of Power and Communications, as well as a number of other initiatives, such as an Energy Bank with its own Office of Technology Assessment, and an Energy Research Center, to coordinate and rationalize the ad-hoc activities underway and to assist the execution of the Pilot Rural Energy Project. See pp. 44-61.

Sudan

Sudan has basically two opportunities to investigate and develop renewable and improved traditional energy technology to meet rural needs especially. First is the Institute of Energy Research, which has been working on solar and related wind research and a few field testing efforts (SOFRETES pump) for a number of years, affiliated with the National Research Council. In addition, there is the DECARP Project (Desert Control and Rehabilitation Project) affiliated with the Ministry of Agriculture, which AID/Khartoum has planned to assist for FY'82-'85, through numerous activities including improved cookstoves, reforestation and solar/renewable technologies. The Institute of Energy Research has agreed to consider a project in which it would assist the DECARP in meeting its energy related needs, provided the institute can be strengthened to do this. See pp. 62-75.

Ethiopia

In 1978, the consultant prepared a pre-PID report to AID recommending assistance to the National Energy Committee (of the Ministry of Mines, Energy and Water Resources) for the preparation of a national comprehensive energy assessment to cover both use and resource assessment, supply enhancement and demand management possibilities. Furthermore, the pre-PID report outlined assistance for a rural energy pilot project which would help Ethiopia determine the potential role for renewable and improved traditional energy. As of July, 1979, the National Energy Committee had approached EEC, UNDP, and France for help on these two projects, unable to proceed further with AID, due to the invocation of the Hickenlooper Amendment prohibiting further U.S. foreign assistance to Ethiopia until such time as nationalized or expropriated U.S. commercial property is compensated for. See page 93.
Somalia

Somalia solar energy is limited to work on solarp stills and drying. There is interest in Somalia in cooperation with U.S., but the consultant was unable to follow this up. See pp. 94–98.

Burundi

AID has a number of small projects underway, including some reforestation and a peat energy project. The latter will be used mostly for commercial uses. It is believed that the former has no special energy uses intended. UNICEF will soon be more active in village technology here. See page 100.

Rwanda

In 1978 the consultant prepared a PID in AIP format for a $500,000 renewable and improved traditional energy pilot project for Rwanda which has recently been approved by AID/W. The project will involve the C.E.A.E.R. of the University of Rwanda at Butare. See pp. 79 & 80.

Tanzania

In 1978, the consultant led a team which prepared a background project paper for use by AID and UTAFITI (the National Scientific Research Council) for a Solar Energy for Villages Pilot Project. Aimed at concentrating on problems in the central arid zone in Dodoma, the project was to use six field test villages for rural energy needs and skills assessment, technology transfer to meet needs and monitoring. By the end of project, a strategy for regional and national meeting of rural energy needs was to be established, based on this experience. In the meantime, UTAFITI has consulted with the PRC, West Germans, IDRC and SERI for assistance.

The only other USAID involvement is with a 1978 plan for village photovoltaic use, which has yet to materialize, and the Arusha Village Development Project which is soon to be underway.

Potential exists for a rural fuelwood project through Keith Openshaw of the Faculty of Agriculture at Morogoro and the Forestry Department. See pp. 76–78 and 88–90.

Malawi

Malawi has come a long way toward gearing up a plan to meet its village water/sanitation goals for 1990. In the renewable energy area, it has a few low-cost biogas experiments underway which bear further investigation, such as at the Bunda College in Lilongwe, which is also investigating solar water heating for up to 100 people in community systems. See page 100.
Botswana

Botswana has one of the outstanding concentrations of village technology work underway in Africa, from which many countries adapt their own efforts. In 1978, Malcolm Lillywhite of Domestic Technology, Inc. and Cecil Cook, of Inter-culture Associates, Inc. designed a PID for a renewable energy project which is still under consideration by Botswana government. See pp. 84-86.

Swaziland

Swaziland also had a PID prepared by Lillywhite and Cook in 1978, which is also still under consideration by AID and Swaziland governments after being revised. See page 87.

Lesotho

Lesotho's 1978 PID prepared by Lillywhite and Cook was followed-up in 1979 by the former into a PP which is significantly scaled down and is likely to be approved by both governments. See pp. 81-83.

Mauritius

This consultant prepared a pre-PID report in 1978 to AID for assistance to ongoing Mauritius renewable energy work and AID sent a follow up consultant there August, 1979. See pp. 91 & 92.

Uganda

UNICEF is active in attempting to promote village technology training and extension work. See page 99.

Zambia

Some solar work has been under research at the University in Luaka, and windmills are in wide use on commercial farms. See page 100.

Djibouti and Seychelles

No known work is underway in either country in the renewable energy area to the knowledge of this consultant, who knows little of these countries and was unable to work in them. UNICEF may be doing some village technology work in the coming years in these countries. See page 100.
With the abbreviated summary of activities in East and Southern Africa in mind, an illustrative survey of donor activities is presented below. This is by no means meant to be a comprehensive account, which is beyond the scope of this report. Such an effort is scheduled to be presented by Francis Gulick at the African Energy Donor Workshop in Paris in late November, 1979.

Multilateral Donors

World Bank

The World Bank is still in the midst of planning a solar-powered pumping field testing project with UNDP involving a number of countries, including Sudan. The specific details of the solar pumping equipment to be tested in Sudan are yet to be worked out and agreed upon. The Bank is also becoming quite active in reforestation and fossil fuel development projects. For example, in Tanzania, the Bank is providing funds for reforestation schemes in western arid areas and is mobilizing lignite coal development in southern areas for use by Tabora Region tobacco driers instead of woodfuels. The Bank is also playing a role in the initial drilling phase for geothermal power development in Kenya.

United Nations Development Programme

UNDP has participated in the World Bank solar pump field test project described above. UNDP has assisted in funding of solar still field trials in Somalia. Most outstanding, UNDP has assisted in the successful exploration for geothermal energy in both Ethiopia and Kenya.

UN Industrial Labor Organization/UN Educational Scientific Cultural Organization/ UN Childrens Fund

In 1976, UNILO, UNESCO, and UNICEF combined in an effort to develop village technology education programs, mostly in Lesotho, Somalia, and Tanzania. The effort was spearheaded by Mr. George Green (P.O. Box 60598, Nairobi, phone #61738) with whom the consultant met. The aim of the effort was to conduct village needs surveys, determine major income sources and development bottlenecks of the village, then improve local skills to better use local resources to remove the bottlenecks and meet the needs. Although the project met with some success, overall it could have been much more successful if the organizations had worked more with adult males over 15 years of age, which was inhibited by UNICEF's emphasis strictly on women and children instead of the key decision makers in these societies.

The project has now phased itself out as a UN-sponsored effort, but the Swedish International Development Association will be re-funding the effort as described below.

UNESCO on its own, has funded a regional solar technical training program through Niger's Solar Energy Laboratory, ONERSOL.

European Common Market

The EEC may assist Ethiopia with geothermal field development.
UN Environment Programme

UNEP with help of Dr. Essaim El-Hinnawi of UNEP/Nairobi, has been active in sponsoring a solar, wind, biogas energy project in Sri Lanka and may do a similar project in Senegal.

UNEP is now active in Philippines with windpumps and a 60 Kw hydroelectric project to provide daytime power for cottage industries and night-time domestic uses. It will use a turbine from People's Republic of China, at 10% cost of a European or American unit. The Chinese sell a 2.5 Kw aluminum unit, about 8 cubic feet in volume and 20 Kg for $500. Dr. El-Hinnawi related the Chinese principle that nothing goes to waste, "there is no such thing as waste", and first priority is agriculture. They use human refuse, pig dung, etc. for biogas. He saw hundreds of biogas units, in many houses and villages of cement/brick construction buried in the ground with cement covers and polyethylene tubes. They make their own ceramic burners and lamps and make brief biogas booklets available in all local shops. Their reforestation effort is very successful now. Such successful efforts are almost directly related to the Chinese ability to mobilize their human resources. UNEP would like to see the East Africans learn more from the Chinese experience.

Dr. El-Hinnawi would like to help sponsor an African energy training seminar for policy-makers to be followed by an African Study tour. Focus would be on rural energy, national energy analysis, and planning, and improved energy economy. He also would like to get an Ethiopia, Somalia, Sudan Regional Energy Assessment underway with Beijer Institute. USAID would direct its funds to UNEP or Beijer Institute, and Ethiopia could be funded elsewhere if needed due to the Hickenlooper Amendment.

Finally, Dr. El-Hinnawi feels the international donors should meet in Nairobi in 1980 or 1981, with Africans, and UNEP would do logistics and co-sponsor the meeting, with USAID assistance and co-sponsorship.

UNICEF

Mr. Manyindo of UNICEF/Nairobi feels appropriate technology is really an approach. He says one must make four assumptions:

1. Technology can solve true problem
2. Equipment mostly made locally from local materials
3. Must be able to use locally trainable skills
4. People like the equipment
Kenya's Ministry of Housing and Social Services has a village polytechnics youth program and the Ministry sponsors the Karen Center for Research and Training, which works collaboratively with the UNICEF Karen Village Technology Unit.

In May, 1977, UNICEF found requests so great in village technology that it got $450,000 more funds. Now they plan to do training like always, but add extension and outreach. However, even this will be spread too thinly. Some 400-600 visitors see Karen's Village Technology Unit monthly, mostly missionary groups and small farmers, but more often now government officials and skilled people. UNICEF has village technology activities ongoing or planned in:

1. Ethiopia
2. Kenya (there are four other centers besides Karen: two are at agriculture training centers and one at the Nakuri Fair Ground and one at the Kenyan Family Life Training Center.)
3. Uganda (focus on food preservation)
4. Rwanda
5. Burundi (especially the water jar projects in Gitaiga)
6. Lesotho (food preservation project at Agriculture College)
7. Swaziland (Pigg's Peak Women's Group with Linda Vilikati)
8. Botswana (Farmer's Training Center of Ministry of Agriculture)
9. Mozambique
10. Tanzania (Iringa and Mtwarra village technology education)
11. Malagasy
12. Comoro Island
13. Djibouti

By 1980, he hopes the Karen Unit will be a wholly Kenyan center. In November-December, 1979, UNICEF will hire consultants to visits all its active country projects to evaluate the effort. In 1980, he then hopes to organize a UNICEF inter-regional workshop on village technology in Nairobi. Unfortunately, Manyindo finds that once people are trained at Karen and return to their village, there is little extension activity even though the technologies may cost as little as 200Kshs. or 150Kshs. The only successful extension effort he knows is the Karai village nearby with private European help of a few thousand dollars doing village water jar and cook stove projects on a 30% - 50% matching fund basis.

Bilateral Donors

Sweden

The Swedish International Development Association sponsors some of the most outstanding work in village level technology, with some
energy applications. Most prominent is the Arusha Appropriate Technology Project in Tanzania, doing implementation work on windpump, handpump, biogas, and development work on numerous other technologies. The village technology education work formerly funded by UNILO, UNESCO, and UNICEF will now be carried out by SIDA, again with George Green as mentioned above. The work is funded at $1.1 million from SIDA for 7 countries for two years. It will use the FAO Series, Home Techniques, but will do a core of information drawing units for its village work. Green will first be going to Zambia and Swaziland, and now will aim at needs. He will need four people on the project for training, methodology, government policy, and technical consulting.

France

France has concentrated its solar energy assistance in Francophone West Africa, but has provided SOFRETES solar pumps in Sudan and Kenya and has assisted Rwanda with a small photovoltaic pump for lab testing at the University of Butare.

West Germany

West Germany has assisted with reforestation projects in numerous countries, some technical assistance to University of Addis Ababa for renewable energy, and funded biogas training in India for Small Industrial Development Organization staff in Tanzania.

Switzerland

The Swiss have been active in a number of countries with small reforestation projects, such as in western Rwanda.

Ireland

The Irish have sent a small technical assistance team to Rwanda to investigate the potential for development of its peat resources to substitute for woodfuel in the pyrethrum industry.

Norway

Norway is funding a project in Arusha, Tanzania to pyrolyze maize cobs to produce charcoal for local fuel.
Canada

Canada has been active in the planning and development of Dodoma, Tanzania's new capital city in the country's central arid zone. The city is designed with energy needs in mind, and solar water heaters are to be field-tested in the city. Canada's Brace Research Institute is assisting University of Dar Es Salaam with renewable energy experiments on a small-grant basis. IDRC is financing a clay charcoal stove project in Tanzania with Keith Openshaw at the Faculty of Agriculture in Morogoro.

People's Republic of China

The Chinese may assist Tanzania with part of its Solar Energy for Villages Pilot Project, and have offered to consider assisting Rwanda with development of mini-hydroelectric and biogas.

United Kingdom

The British-based organizations ITDG and Ox-Fam have been very active in promoting village-level technology, much of which have labor saving aspects. ITDG has attempted to promote intermediate technology centers at universities and other institutions in numerous countries (e.g., Mauritius) and ITDG and Ox-Farm played a critical role in the sail-windpump irrigation project at the American Presbyterian Mission on the Omo River among the Gelleb people of Ethiopia.

The UK is also sponsoring support of a small pilot project to investigate wave - tidal power on Mauritius.
Now that an illustrative review of African and donor activities has been presented, it is necessary to consider a few different insights into what might very informally be considered four consensuses of some experts, both African and expatriate, on energy issues, institutional needs, and action recommendations.

CONSENSUS #1: THE INTERNATIONAL WORKSHOP ON ENERGY & ENVIRONMENT IN EAST AFRICA

An International Workshop on "Energy and Environment in East Africa" was held in the Kenyatta Conference Centre, Nairobi on May 7-10, 1979. The conference was sponsored by the Beijer Institute (Royal Swedish Academy of Sciences), Stockholm, and the United Nations Environment Programme (UNEP). The aim of the workshop was to study future research and development needs in the field of energy and environment for East Africa, with particular reference to Kenya.

Highlights of Issues

1. Participants confirmed the general concern that lack of readily available energy will continue to hinder both urban and rural development. Furthermore, although energy demand in both sectors is expected to increase significantly, even present patterns of energy consumption indicate the development of crisis situations, both with respect to imported fossil fuels and indigenous wood fuels.

2. Wood fuel is a basic source of primary and derived energy for most rural residents, but it is being mined at rates greater than those for replenishment. There is a grave threat of loss of fuel available to most rural residents associated with severe environmental degradation.

3. Technologies do exist which can be applied to increase the use efficiency and availability of energy in rural and urban areas. These include improved cookstoves, charcoal kilns, biogas, small and major hydropower, solar and wind-powered equipment, and geothermal equipment.

Policy Recommendations for African Governments

1. Develop integrated fuel and electricity pricing policies and consider the cost of fuel, the cost of using fuel, hidden costs such as labor for wood gathering, and concerns related to fuel substitution.

2. Develop detailed energy accounting systems.

3. Reduce private automobile use and improve public transport through bus and mutatu.

4. Promote industrial and municipal co-generation of heat and electricity and co-use of waste products among industries and settlements.
5. Regulate existing and new industries so as to effectively insure that new energy using equipment is the most economical, through energy pricing policy, subsidies and energy taxes.

6. Regulate new buildings for energy conservation through careful design of building shell, glazing, orientation, and air systems.

7. Conduct both urban and rural energy demand/supply studies related to energy flows, fuels substitution, colocation, and energy use by urban/rural/industrial sectors.

8. Implement bicycle paths in downtown urban areas.

9. Require solar water heating where practical in government financed housing projects.

10. Conduct energy management seminars for public and private officials of government, industry, and agriculture.

11. Require reporting by industrial users of fuels and expenses for fuels related to output.

12. Utilize existing wastes in cities for biogas plants and pyrolytic/conversion.

13. Require energy plans for any new settlement or development.

14. Repeal existing national laws that might be discouraging energy conservation.

15. Set up bodies with high executive powers (department, commission, ministry) to integrate and execute energy development in relation to socio-economic goals and political realities.

16. Set up or improve national energy research and development institutes.

17. Develop education programmes for urban and rural people to conserve energy resources and to adopt more efficient energy technologies.

18. Set up small-scale and national corporations for large-scale production, distribution and marketing of charcoal, wood, and other renewable energy utilization devices.

19. Expand oil, gas, coal, and geothermal exploration.

20. Examine changing fuel requirements and refinery mix problems, to re-evaluate energy subsidies and pricing policies.
CONSENSUS #2: THE AFRICAN SOLAR ENERGY WORKSHOP

This workshop was held in May 1979 in Atlanta, Georgia and sponsored by AID, UNDP and UNEP. It was designed to bring African solar energy scientists together with each other and with their social scientist colleagues, in an effort to improve their appreciation of the need for the two disciplines to cooperate, as well as to yield some consensus on institutional needs in the energy field. These recommendations represent the collective views of Africans from over 20 countries. Unfortunately, the workshop was unable to attract sufficient number of social scientists to balance the attendance by technical scientists.

Recommendations

1. A journal of energy options for Africa be initiated and published on a regular basis. This publication would focus on technical, policy, social, and economic aspects of alternative energy options. In addition, an annual or biennial review of energy-related research should be published as a special issue of the journal.

2. Regularly scheduled workshops be held in Africa or African scientists and technologists (including social scientists) to share their experiences in research and development, field testing, and other aspects of energy innovation.

3. Energy information exchange networks be established and made available to all African scientists and technologists. These exchanges should concern both technological developments and successful methods of technology transfer and exchange.

4. Agencies and donors who support energy-related research and development should focus on the strengthening of institutions, both national and regional, in Africa which currently are involved in energy work (e.g., research centers, universities, planning agencies). In particular efforts should be made to establish regional energy centers with the possible creation of one center to serve as the linkage and information clearing house for all the centers.

5. Donors should support intra-African and African-Third World collaboration in all energy projects including training, funding of individual research projects and study tours. For example, project travel funds should allow visits to other third world countries and funds for technical consultants should be provided to pay for African and other third-world experts to work on projects.

6. Greater efforts should be made to expedite energy needs and resource assessments, as well as field testing of socially or technically promising innovations.

7. Cooperate with current UNECA and OAU efforts to establish an Energy (solar and other alternative) Society for Africa and to present the results of the Atlanta meeting to the OAU and UNECA scientific committees.
8. To hold a workshop in Africa in late 1980 or early 1981 as preparatory to the 1981 UN Conference on Renewable Energy Technologies. This meeting is to involve all the member countries of the OAU.

9. Form a Working Committee (of workshop participants) to consider these and other future activities. Such a committee was elected:

Yahia Hamid, Sudan; Chairman; with responsibility for North and North Eastern Africa.

Suresh Hurry, Mauritius; Secretary.

Mohammed Kaba, Guinea; with responsibility for Anglophone West and Central Africa.

Simon Nkonoki, Tanzania; with responsibility for East and Southern Africa.

Cheickne Traore, Mali; with responsibility for Francophone West and Central Africa.

Kofi B. Bota, Atlanta University (ex officio) as Interim Vice-Chairman.

10. Seek funds to enable members of the Working Committee in the intervening period between the Atlanta meeting and the next meeting to coordinate cooperative efforts and technical exchanges on energy related matters in their various regions. Members of the Working Committee were urged to conduct study tours of their regions within the next year and before the next meeting.
This report was sponsored by the West African Development Bank and by the Ministries of Cooperation of France, Netherlands, and West Germany, and carried out by ORGATEC of Dakar, Senegal, SEMA of Montrouge Cedex, France, Lahmeyer International GMBH of Frankfurt, West Germany, and Dr. Eric Fergusen of Eindhoven, Netherlands on behalf of the Club des Amis du Sahel and the Communauté Interétats pour Lutter contre la Secheresse Sahelien (CILSS.) Although some of the study's recommendations are specific to the Sahel, one can observe that most are likely equally applicable to EA/BLs countries.

Summary of the Study and Main Conclusions

The main ideas and conclusions of the report are as follows:

1) Energy is an essential component of development; to plan development while omitting to take account of energy problems can entail serious difficulties.

2) The Sahel countries' energy supply does not consist solely of oil products, electricity, etc; it also, and indeed first and foremost, includes firewood, used mainly for cooking.

3) Over the next 20 years, the price of imported oil products will very probably double, and possibly treble, compared to present prices.

4) If the consumption of oil products continues to increase at the present pace (which is far faster than the growth of GNP), the Sahel countries will encounter serious economic problems in the long run (the crushing burden of oil import costs).

5) Each Sahel country should formulate an energy policy. This does not mean imposing a ceiling on energy consumption, but consists of deliberate action to achieve:

   - systematic development of national energy resources (supply);
   - more efficient use of energy (demand).

6) Unless substantial efforts are made in the short term, the outlook for supplies of firewood will be disastrous. The situation can be summarized as follows:

   - today, firewood is the Sahel countries main energy source, and covers 60 to 90% of demand for energy;

   - the wood supply position is deteriorating seriously around the cities, and also in the country;

   - population increases (the number of urban dwellers will treble and the total population will double by the end of the century) will accelerate the process of deforestation;

   - every simulation model leads to the conclusion that in the absence of vigorous action now, much of the Sahel region will have become desert by the year 2000, and many projects aiming at food self-sufficiency will be endangered;
desertification must be taken very seriously. In other parts of the world, whole regions have become deserts in a few decades;

firewood is vital for the population of the Sahel. It cannot be economically replaced on a large scale by imported fuel, for the costs would be too high to be borne by the economies of the Sahelian countries.

7) This dangerous position can be avoided, if action is taken very rapidly and on the necessary scale:

the demand for firewood should be reduced markedly. This is possible by generalizing the use of improved cooking stoves burning one-third as much wood as the present open fires;

firewood supplies should be increased through massive reforestation programmes.

The present afforestation programmes are utterly inadequate by comparison with the size of foreseeable needs. The situation calls for 150,000 hectares of new forest plantations annually, i.e., 50 times more than at present. Programmes of such dimension cannot be executed using the approach obtaining today; they call for a new approach in which rural dwellers are effectively associated with integrated development projects. Examples such as Southern Algeria or China show that the Sahelian countries can achieve reforestation.

International aid has a determinant role to play in preparing and financing these programmes.

The use of charcoal should not be encouraged, as it leads to the wastage of forest resources that are already inadequate. Oil and butane ggs are too expensive for the community, although the use of coal in coastal towns may be worth promoting. The solar cooking stove as presently designed is not adapted to the population's needs.

8) Little use is presently made of hydroelectricity, but it constitutes a national energy source of major importance:

by the year 2000, additional demand for electricity will have reached more than 1,000 MW;

the hydroelectric potential already identified exceeds 1,700 MW;

hydroelectricity can an should be the medium for satisfying these additional needs. Hydroelectric power (production and long-distance transmission) has been competitive with electricity from thermal
power plants since the 1973 crisis; its relative advantage will grow further as the cost of imported oil products rises.

- consequently, the installation of hydro plants in the Sahel region should be accelerated by adopting a new basis for their development (transmission of energy over longer distances, account taken of future price of imported energy, etc.);

- international aid should convey massive support for the achievement of this programme for energy self-sufficiency, which is closely linked to the food self-sufficiency programme.

9) The Sahel countries are still poor in oil and gas resources, although the outlook is promising for some countries. Prospection for oil fields should be given support. "Non-commercial" discoveries may nevertheless be able to produce at a cost which offers an economic return in the conditions prevailing in the Sahelian region.

10) Nuclear power is badly suited in the Sahel countries' electrification requirements (too large unit capacity of plants).

11) The new energy sources will only account for a small portion of the Sahel countries' energy balance in the year 2000; however, certain applications are so promising that a start on their implementation should be made now: wind power in the Cape Verde Islands, solar pumps, water heaters.

12) Substantial energy savings can be made in industry; energy diagnoses should be performed in large industries, and approval for industrial projects should be subordinated to prior review of their energy aspects.

13) Transport consumes a high share of imported energy. Certain means of transport (railroad or river) use one-third as much fuel as road transport.

The tacit priority which road transport currently enjoys vis-a-vis the railroads exacerbates the Sahel countries' energy dependence. Rail and river transport which use much less energy, should be rehabilitated and promoted.

14) The food self-sufficiency programme of the "Club du Sahel" implies a level of direct and indirect energy demand that can be borne by the Sahelian economy at the end of the century, if in the future, agricultural projects would be appraised from an energy standpoint also, for certain technical processes use significantly less imported fuel.
15) Air conditioning of buildings and dwellings engenders heavy consumption of energy, costly both for the user and the community: to obtain the same service, there are simple measures that would allow use of energy to be reduced considerably.

16) A "Sahelian Agency for Energy Saving and the Development of National Energy Resources" should be created in order to promote concrete implementation of the recommendations made.

17) The formulation and implementation of national energy policies should be carried out at the highest level of government (the President, the Prime Minister's Office) to secure a sufficiently broad approach backed by unquestioned authority.
### Summary of Recommendations

Excerpted from "Energy in the Development Strategy of the Sahel"

#### LEGEND:
- Low/weak
- Average/favourable
- Strong/very favourable
- No sign: unimportant or not applicable criterion

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Better charcoal ovens  
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Broadened forest working around towns  
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| 6 TRANSPORTS | Master plan promoting river and rail transport  
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| 7 INDUSTRY | Diagnosis, improvement and monitoring  
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This report was prepared for AID, Contract # AFR-G-1356 by Eastern Africa Environmental Trends Project of the Program for International Development, of Clark University, Worcester, Mass. August 22, 1978. Although it is not possible to cite or quote from this draft report, which was over two years in the making, one can say that it concentrates on the fuelwood/reforestation challenge in Botswana, Kenya, Zambia, Sudan, Tanzania, Ethiopia, and Malawi. It focuses on wood as the majority's fuel, which is both renewable and local; on the fact that reforestation is a complex social, economic, and technical challenge; that baseline surveys of soil quality, economy, and wood use are needed, especially for cooking, space heating, and industrial/commercial uses. Thus, it forms a useful foundation upon which a far more detailed country-by-country regional energy assessment could be conducted, perhaps modeled initially on the report "Energy in the Development Strategy of the Sahel" discussed in Consensus #3.
CHAPTER FIVE

OPPORTUNITIES TO RESPOND TO THE CONSENSUSES

Within the scope of this report, it is important to point out two opportunities for AID through its AFR/DR/SDP and its REDSO/EA to respond to these consensuses, beyond the myriad activities which AFR has already initiated (see Renewable Energy Program for Africa: A Summary—by Carol Ulinski, Sept. 6, 1978, AID-AFR-C-1453.) First, the opportunity for AFR to contribute to and act on the recommendations forthcoming from the African Energy Donor Workshop, and second, the opportunity for REDSO/EA (with AFR and DS/EY assistance) to initiate new energy services to EA/BLS countries through EA/BLS missions and centrally or regionally through its offices in Nairobi.

OPPORTUNITY TO RESPOND #1: THE AFRICAN ENERGY DONOR WORKSHOP

The idea for this workshop originated in late Spring—early Summer 1978 through the simultaneous efforts of AFR/DR/SDP and a meeting this consultant had with UNECA/Addis' Gerard Saunier. Now the Overseas Development Council is organizing the workshop, to be funded by AFR/DR/SDP with participation from DAC members.

This workshop is scheduled to be held in Paris in late November or early December, 1979, consisting of 25—30 people from donor agencies active in African energy assistance and a few selected African energy experts, likely to represent Senegal, Nigeria, Ethiopia, Kenya and Tanzania or Sudan. It is to focus on fuelwood and other renewables and improved traditional energy within a framework of comprehensive national energy and development needs. The agenda will feature:

1. Exchange of information on ongoing activities,
2. Specific project experiences on fuelwood,
3. Survey and evaluation methods,
4. New proposals for financing energy projects and organization of projects,
5. Coordination of projects between donors.

Four papers will be commissioned:

1. Existing African energy projects funded by donors — by Mrs. Francis Gulick
2. Energy Survey Techniques — by Mr. Tom Graham of Donovan, Hamester and Rattien, Inc.
3. Fuelwood projects — by Mr. George Burrill, a consultant from Vermont
4. Social issues in rural energy projects — by Mrs. Marilyn Hoskins, consultant.

REDSO should consider contributing some of the initiatives proposed in this report in the following few pages to this workshop. It should also offer to play a role in helping to implement the recommendations which will hopefully be forthcoming from the workshop regarding renewable and improved traditional energy and donor coordination.
OPPORTUNITY TO RESPOND #2: REDSO/EA SERVICES TO EA/BLS COUNTRIES

REDSO/EA is regarded by missions most importantly as an "in-house consulting firm." REDSO/EA has an Engineering Division, a Project Division, and an Analysis Division. Among the latter two are an environmental officer and a few social scientists. REDSO/EA also provides legal services to missions.

REDSO/EA assists the smaller posts, especially, such as:

- Burundi: 2 AID officers
- Rwanda: 2 AID officers
- Djibouti: 2 AID officers
- Seychelles: No AID officers
- Malawi: 1 AID officer
- Mauritius: No AID officers
- Zambia: 1 AID officer

The environment officer said he wanted to recommend an Office of Energy and Environment at REDSO/EA, with an energy specialist as the head of it who also had a broad background in economic development, preferably in Africa.

REDSO/EA has on occasion responded through its staff or consultants to a few mission requests for assistance in energy project design, such as with the Lesotho Renewable Energy Project PP preparation, the Rwanda Renewable Energy & Improved Traditional Energy Project AIP PID preparation, and the Mauritius Alternative Energy Project PID preparation. However, at this point REDSO/EA has no engineers, economists, or sociologist/anthropologists trained in specific skills and interdisciplinary concepts necessary to consistently provide anything but a bare minimum response to mission requests for energy assistance, which in no way competes with the talent obtainable on short term contract basis through AFR/DR/SDP or DS/EY.

In this consultant's mind there is no question but that energy is a critical problem now, and will get much worse in the period which will be covered by these countries' next two five-year development plans and AID's next generation or two of three-to five year projects. The next few pages will outline a number of initiatives for AID to respond to these needs. However, REDSO must consider its internal bureaucratic difficulties itself, and its relationship with AID/W and with the field missions. REDSO/EA must consider the fact that because hardly any AID officers in REDSO or in the field are qualified technically or even as generalists in energy, that it is not surprising that there is little interest in or willingness to respond aggressively to expressed needs for assistance and cooperation by these countries in the energy development area.

The set of situations touched upon above point to a good opportunity for REDSO to play a valuable role in making up for the missions' deficiencies in the energy field on their staff, provided REDSO trains and builds its staff accordingly and catalyzes a number of different contractors, both African and expatriate, who are highly competent, to respond to requests by these countries, and catalyzes a number of region-wide initiatives of service to all missions without burdening them with further bureaucracy or unwanted "expert visits" or intrusive "middle-men."
There are a number of options presented for REDSO/EA consideration, although this consultant has expressly identified his recommended option:

**Option I: Minimal Response Option (Not Recommended)**

This option assumes energy is not a critical development problem, or at least it is not worthy of AID priority attention—that AID has no mandate to work on the conventional, macroeconomic aspects of the problem and that in the rural areas other problems are far greater in importance: health, population, agriculture, nutrition and that energy has little to contribute to these. This status quo option would argue for REDSO to continue to minimize its role in providing energy-related services to field missions, relying on AID/W to focus on energy with individual missions, a relatively new area of priority concern, while REDSO continues to support its traditional activities. It would assume that responsibility for missions would be met internally with AID/W help and that its role in assisting with energy service to posts would be minimal.

This option would maintain the existing level of activity, wherein REDSO assists missions in back-stopping energy PID and PP efforts, supplementing design teams as needed with existing staff. No new officer or existing officer would be assigned on energy from REDSO staff. Ad-hoc response to field or AID/W request would continue, but no new initiatives from within REDSO would take place. Some training of REDSO staff in energy issues would occur, but there would be no REDSO-sponsored training for mission staff.

**Option II: Cautious Expansion Option (Not Recommended)**

This option recognizes energy as an important problem, which merits expanded REDSO attention and leadership, even if the field missions are "behind the eight-ball." REDSO would assign a full time officer or personal service contractor to follow energy affairs & coordinate AID technical assistance in the field of energy, and make frequent field trips on request to identify country projects. REDSO would focus especially on smaller posts, with attention to larger posts only as required on a requested basis. A few consultants on an IQC-type basis would be arranged to assist in project identification, project paper preparation and project evaluation design teams. Training of REDSO staff would occur as in Option I. Most of the work would be done in-house, with minimal use of IQCs. Training for field mission staffs would be sponsored by REDSO.

**Option III: Accelerated Expansion Option (The Recommended Option)**

This option recognizes energy as a critically pressing problem, necessary but not sufficient to development. It would feature REDSO creating a special Energy Development Liaison Extension Office (ENDELEO), with one full time officer or personal service contractor to work on mission requests and one to work on REDSO initiated region-wide services. Both sets of activities would be largely coordinated "in-house," but executed largely by contractors and consultants, both Africans and expatriates living in Africa, US, or elsewhere in the world, including Third World. REDSO & mission staff would be trained as in Option II, but there would be new programs to do energy development work, to coordinate both AID and donor energy work, and to do regional training programs and activities. This option recognizes that REDSO is the best place to coordinate, serve, and provide genuine initiatives to the EA/BLS countries, through the field missions and its Nairobi office. This option further recognizes that energy-induced problems will likely multiply and intensify greatly in the near future, both at the macro-economic national level and at the rural development level—and that it is far better for REDSO and field missions to prepare themselves in advance to deal with these problems while they are still manageable, rather than wait until they become dire emergencies.
SPECIFIC COMPONENTS FOR REDSO/EA ENERGY SERVICE OPTIONS

OPTION I: MINIMAL RESPONSE OPTION (NOT RECOMMENDED)

The only new activity in this option would be training for REDSO/EA engineers, social scientists and environmental officers in energy technical, economic, social and policy issues. Such training could take place at REDSO in Nairobi using short-term consultants or by involving REDSO staff in a number of ongoing energy related training programs in Africa or sponsored by USAID (e.g., at the Karen Village Technology Unit outside Nairobi sponsored by UNICEF, at the Arusha Appropriate-Technology Project in Tanzania sponsored by Swedish International Development Agency, at the DS/EY funded Energy Management Training Program for Developing Countries at State University of New York at Stony Brook, or at the DS/EY funded Energy Technology Program at University of Florida at Gainesville.)

OPTION II: CAUTIOUS EXPANSION OPTION (NOT RECOMMENDED)

This option incorporates REDSO staff training in energy as in Option I above, but also features REDSO hiring a full-time Country Energy Development Officer (from within AID or as a personal services contractor) with responsibility to: 1) coordinate and improve communication between AID/W and field missions and REDSO in energy related activities; 2) participate in and mobilize energy project design efforts and consulting services; 3) mobilize the strengthening of energy capability at each field mission, through use of existing AID training programs and consulting services. Such a person should be a development generalist with experience in designing energy projects in EA/BLS countries, familiar with AID bureaucracy, and experienced in mobilizing, leading, and administering project design teams and consulting services. Specific elements include:

1) Improve Communication Between AID/W, Field Missions, and REDSO/EA Energy Activities

REDSO, located in Nairobi, is in an ideal location to improve information exchange and communication regarding AID funded renewable and improved traditional energy projects in EA/BLS countries and AID/W services. The Country Energy Development Officer would take responsibility for keeping each field mission informed of other EA/BLS energy activities, as well as of AID/W's initiatives, services and funding mechanisms.

2) Mobilize, Participate In, and Administer Energy Project Design Work & Consulting Services

The Country Energy Development Officer would mobilize an IQC-type of arrangement of preferably a few Nairobi-based energy consultants who could work as a team and respond quickly as a team to requests for assistance by posts which would include project identification, PP preparation, evaluation, trouble-shooting, short-term advisers, or trainers—especially for, but not limited to, the small field missions. The team would include engineering capability as well as economic and sociology/anthropology capability.
3) **Strengthen Energy Capability at Each AID Mission**

Through short-term training in the field or in Nairobi by the consulting services mentioned above, or at ongoing AID energy training programs, each field mission's energy officers, other officers, and contractors should be educated on current energy issues, needs, and technologies, as they related to their fields:

- **a) Energy Training for AID Energy Officers**

  There is currently no training facilities available for AID officers who must work on energy but have no basic technical familiarity with the subject. REDSO/EA could provide a very useful service by arranging for either short-term technical training in Nairobi or for a traveling team to brief the missions.

- **b) Energy Education By Topic for Non-Energy AID Officers and Contractors**

  AID missions should be offered the opportunity to have their officers in numerous disciplines, e.g., agriculture, health, population, etc., educated as to the energy implications and characteristics of their work.

- **c) Energy Grafting**

  Each mission should be trained to review existing, planned and new projects in population, health, agriculture, etc. to determine where renewable and improved traditional energy technologies can be "grafted" so as to be tested and compared with otherwise conventional approaches.

- **d) In-House Energy Reviews**

  Missions should be trained to review all existing and upcoming projects so as to determine the energy requirements of the projects and the extent to which they are going to make the country more dependent upon increasingly scarce and expensive imported fuels or exacerbate rural deforestation. This process could take place through careful consideration of PID, PP, or Initial Environmental Evaluations with a view toward energy aspects.
OPTION III: ACCELERATED EXPANSION OPTION (THE RECOMMENDED OPTION)

This option would incorporate the elements of OPTION II above into a much more accelerated and initiative-oriented approach to meeting the energy development requirements in EA/BLS countries. To do this, REDSO would create an Energy Development Liaison Extension Office (ENDELEO), based either within REDSO or contracted out but charged with working in close coordination with REDSO while at the same time avoiding much of the bureaucratic problems of REDSO and AID/W. The Office would include the Country Energy Development Officer and the duties as described in Option II, but would also include a Regional Energy Development Officer (from within AID or as personal services contractor and same background qualifications as Country Energy Development Officer) who would be responsible for mobilizing a number of energy initiatives of service to all EA/BLS countries, above and beyond the individual mission requests. These initiatives include: 1) a National Energy Training Program; 2) an African Energy Commission; 3) a National Energy Assessment & Planning Program; 4) an Energy Development Assistance Coordination Council; and 5) Support for Region-wide Multilateral Efforts. Although these activities would be coordinated in-house, they would largely be implemented through Nairobi-based consultants and contracts, with the exception of the Energy Development Assistance Coordination Council. Further description follows:

1.) National Energy Training Program

This would provide training in-service for African professionals at the mid-career or executive level, as well as for junior entry professionals and for African technicians and artisans, where feasible. In some instances, even AID staff could participate, especially if accompanied by a host-country counterpart:

Energy Management Training for Junior & Mid-career Professionals

Precedent exists for REDSO/EA to assist regional professional training seminars, such as at the East African School of Management in Arusha located in the facilities of the East African Community. For example, REDSO/EA contributed recently to a public finance seminar successfully there. Likewise, ENDELEO would initiate, either in Arusha or Nairobi, a short-term (two week to six week) national energy management training program for both AID and energy officials of the EA/BLS countries, which can focus on giving either an integrated, interdisciplinary course or can focus on giving shorter courses on specific topics on a year-round basis: e.g., national energy planning, energy assessment, investment, finance, rural energy development, energy demand management, etc.

Executive Training

ENDELEO would administer fielding a short-term team (few days to a week) per country on request to provide specialized training in national energy planning and energy assessment techniques to the top energy executives of EA/BLS countries (these might include numerous other energy topics, as well.)

Rural Needs Assessment and Energy Technology Training

Such training would be located at one or all of these three existing village technology training centers, and made available thru ENDELEO to energ
technicians, artisans, or other people involved in rural energy development work:

a) The UNICEF Karen Village Technology Unit at Karen outside Nairobi
b) The Arusha Appropriate Technology Project in Tanzania
c) The Rural Industries Innovation Center in Botswana.

2.) African Energy Commission

ENDELEO would sponsor and support an African Energy Commission with headquarters in Nairobi, consisting of a Board of Directors of prominent African energy experts and scholars, with a staff of Africans and experienced expatriates resident in Africa for many years. The Commission would sponsor in turn a number of activities, including:

a) Regional African Energy Technical Workshops

The Commission would support semi-annual meeting of technical experts, including social scientists, working in the area of rural energy and renewable and improved traditional energy.

b) Energy Clearinghouse/Technical Reference Service

The Commission would serve as an African energy information clearinghouse and technical reference service. Organized as if it were a VITA field office, it could keep current addresses and bio-sketches of African and expatriate energy experts and refer African assistance request on to the experts.

c) Cooperation with Solar Energy Research Institute

The Solar Energy Research Institute of the U.S. DOE is already active in implementing the Mali Renewable Energy Project and in building a Solar Energy Data Information System which will be available to African countries. However, further cooperation with, and use of SERI's professional staff and knowledge should be institutionalized to provide a continuous exchange of information and expertise between it and African research institutions. The Commission would initiate this.

d) Energy Digest

A regular, quarterly or monthly digest of articles and reprints on energy technology or technology transfer techniques would be very helpful at keeping African experts up-to-date on the state-of-the-art applicable to them. The Commission would edit and publish this digest.
e) **African Energy Journal**

There is no regular, quarterly publication of the current state-of-the-art in Africa in renewable and improved traditional energy, or on national energy policy problems either. A journal supported by the Commission and edited by an African institution based in Nairobi, with a Board of Directors from all EA/BLS countries, would be initiated. Indeed, the Commission could instead serve as that African institution.

f) **African Energy Expert Travel Grants**

Almost without exception, donor-assisted energy projects in Africa limit their travel funds either for African participants to travel to the donor country or for experts from the donor country to travel to the African one. Yet, the African experts have just as much to benefit from traveling to visit, advise, consult with, and work with each other (as well as other Third World countries) as they do from traveling to the donor states. Indeed, in many cases, their "learning curves" would accelerate faster by benefitting from fellow Africans who had already adapted donor technology to the African setting. The Commission would administer and grant the travel funds, preferably in the form of professional fellowships.

g) **Support for 1981 UN Conference on New and Renewable Sources of Energy**

Support would be given by the Commission to EA/BLS countries for preparing national papers on the potential for use of renewable and new sources of energy (solar, wind, hydropower, geothermal, ocean tidal, wave, and thermal energy, and biomass). Each country would be allocated planning funds to be made available to in-country institutions to prepare the research and documentation necessary, which in itself could serve as a useful mobilizing force for an increased role of renewable energy in each country's national energy strategy.
3.) National Energy Assessment & Planning Program

ENDELEO would provide the channel through which each EA/BLS country could strengthen its capability to determine, analyze, and plan energy demand and supply options which would be consistent with economic development planning. Country energy institutions would be kept up-to-date on funds, techniques, and enterprises available to assess and develop new supplies of indigenous energy, as well as to assist in the management of energy demand and the improved efficiency of energy use in various sectors. Energy assessment and planning tools for analysis of energy situations under varying scenarios would be made available, and data collection improved so as to be able to use them more productively, such as the Reference Energy System developed at the Brookhaven National Laboratory in the U.S. (See next page for a Reference Energy System developed for India.)

The report "Energy in the Development Strategy for the Sahel" prepared by a number of European and West African energy consultants (see pp. 24-28) for the Club des Amis du Sahel and the C.I.L.S.S., could well serve as a model for one or a number of EA/BLS national energy assessments. This report was a sectoral analysis of energy demand and supply, country-by-country, with special emphasis on effective energy demand management.

As such, it has served as a useful tool for both Sahelian and donor policy-makers in planning energy projects, other development projects and international intra-regional collaborative efforts. The same could hold for the countries in East Africa and Southern Africa.

The report "Fuelwood and Energy in East Africa" by Clark University (see Consensus #4 on page 29) could form at least the foundation for a country-by-country program of national energy assessment and planning assistance activities over the next few years.

4.) Energy Development Assistance Coordination Council (EDACC)

ENDELEO would initiate a means by which the major donor organizations would form an Energy Development Assistance Coordination Council, based in Nairobi, to coordinate and rationalize the use of their funds so as to maximize progress and minimize duplication, competition and gaps in critical areas. The Regional Energy Development Officer at ENDELEO would represent USAID on EDACC. Hopefully, the African Energy Donor Workshop (see page 30) will recommend some coordination office similar to this in DAC in Paris, but certainly such coordination should also take place in the field, on the continent, at least among the EA/BLS countries and preferably in West Africa, as well.
REFERENCE ENERGY SYSTEM - COMMERCIAL AND NON-COMMERCIAL ENERGY
INDIA - 1972

UNIT: 10^18 JOULE

1. Nuclear: 13.4
   - Extraction: 11.4
   - Conversion: 0.85
   - Storage: 9.25

2. Hydropower: 118.3
   - Dam: 117.2
   - Hydroelectric: 1.7

3. Coal: 301.1
   - Strip Mine: 285.5 (0.32)
   - Underground: 35.6

4. Wood: 119.7

5. Animal Waste: 960.4

6. Crop Res.: 312.2

7. Crude Oil Production: 328.1
   - Exports: 312.2
   - Imports of Crude: 13.2
   - Imports of Petroleum: 6.6

8. Natural Gas: 47.7
   - Exports: 4.5
   - Injected: 4.5
   - Production: 42.2

9. Animal Power: 280.1

10. Human Power: 177.1

TOTAL RESOURCE CONSUMPTION: 5267
COMMERCIAL ENERGY: 26412.5 (IMPORTS: 678.4)
NON-COMMERCIAL ENERGY: 2525
ANIMAL ENERGY: 457.2

TOTAL DEMAND: 1303.2
5.) Support for Region-wide Multilateral Efforts

ENDELEO would support financially and technically, as needed, ongoing and proposed multilateral efforts in energy, especially those of UNICEF and UNEP. UNICEF requires increased support for village technology extension, not only at the Karen Village Technology Unit, but at all of its village technology activities in over a dozen countries in East and Southern Africa. UNEP has proposed a regional energy assessment project for Ethiopia, Sudan and Somalia as well as a regional energy planning training program and follow-up African energy study tours. It has also proposed a 1980 or 1981 preparatory conference of donors and African renewable energy experts, both technical and social scientist, to be held in Nairobi prior to the 1981 UNCONFERENCE on New and Renewable Sources of Energy.) (See pp. 16 & 17.)

In particular, ENDELEO would have small self-help funds (e.g., $50,000 - $100,000) to be made available to UNICEF, Peace Corps Missions, PVJs, or African local institutions to extend field testing of renewable and improved traditional energy technologies to meet rural or urban poor needs. No particular activity would be allocated more than up to some limit in general, e.g. $10,000 per activity per year. Baseline surveys, needs assessments, and monitoring and evaluation requirements would be built into the self-help funding process, in order to ensure that valuable lessons are learned from the efforts for others' benefits as well.
A SURVEY OF USAID FUNDING MECHANISMS TO SUPPORT REDSO ENERGY SERVICES

Without further follow-up and discussion with REDSO/EA and AFR/DR/SDP and African scholars and AID missions, it would be premature to estimate the scope and therefore the budget of the activities on pp. 31-40. However, until that time, it is useful to present a survey of some of the funding mechanisms available now or likely in the future to assist REDSO/EA in the financing and implementation of these recommended activities:

I. Africa Bureau Funds

Ongoing Activities:

1) Accelerated Impact Program (#698-0410) - (see 1977 State Cables 266868, 070354 through AFR/RA) - designed to provide funds for critical projects of up to two or at most three years duration up to a maximum of $500,000. Requires PID approval in Washington, with PP approval in the field. The Rwanda Renewable and Improved Traditional Energy Project is an example of a recently approved AIP project.

2) Improved Rural Technology Project (#698-0407) - (see AIDTO CIRC.A-96, April 14, 1979, through AFR/RA) - designed to provide funds for up to $50,000 for improvement of technology to meet rural needs, with maximum use of indigenous institutions and minimum paper work.

Future Activities:


2) Energy Project Design - AFR/DR will likely procure either independently or through DS/EY, short-term consulting services such as recently with DHR, Inc. for design of African Energy Survey Methodology and Mauritius PID.

II. Development Support Bureau Funds

(The following is an update of AIDTO CIRC.A-81, March 22, 1979 and State 71222 of March 22, 1979.)

Ongoing and Upcoming Activities:

1) Non-Conventional Energy Technology Training - designed to provide approximately 15 weeks of training to developing country technical personnel in the field of energy technology with special attention to solar and wind technologies. This is going to be assigned to University of Florida at Gainesville, and should be operational by March 1980.

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2) **Small Hydroelectric Development** - designed to provide assistance in the area of small hydropower resource assessment and development, funded at about $5 million over next five years, likely to be assigned to the National Rural Electric Cooperative Association.

3) **Bioresource Utilization** - designed to provide assistance for the assessment and development of bio-resources for energy use, such as forestry, agricultural wastes, and agro-processing residues. To be funded at about $1 million - $2.5 million over next 18 months, likely to be through the U.S. Forest Service.

4) **Solar Photovoltaic Project** - designed to provide assistance for assessment and development of solar photovoltaic electricity for appropriate high priority development needs. To be funded at approximately $10 million over next five years, likely to be assigned to the National Aeronautics and Space Administration's Lewis Research Center.

5) **Energy Data Collection, Analysis, and Policy Development** - designed to develop energy behavior studies, developing country energy surveys, and a methodology for donors and developing countries to compare non-commercial energy data and to build baseline data. To be funded at approximately $1 million and likely to be assigned to National Academy of Sciences (NAS) and Resources for the Future (RFF).

6) **Private Voluntary Organization Energy Education and Small Grants Project** - designed to deliver educational services and small grants to developing country institutions and other small-scale energy activities. Special attention will be given to small-scale renewable and improved traditional energy, with development of documentation, information exchange networks, regional field representatives, and two small grants channels, one up to $5,000 per activity and one up to $100,000 per activity. Likely to be assigned to Volunteers in Technical Assistance (VITA) at approximately $10 million over five years.

7) **Peace Corps Energy Survey** - designed to assist Peace Corps conduct rural and urban-poor energy use, needs, and resources surveys using Peace Corps Volunteers and local counterparts in up to seven developing countries (in Africa this will initially be limited to Mali and Senegal). Funded at approximately $1 million over three years.

8) **Energy Management Training Program** - designed to provide nine weeks of inter-disciplinary training in national energy analysis and planning, for mid-career and senior-level energy and economic planning officials. Already into its second session.
at The Institute for Energy Research of the State University of New York at Stony Brook, in conjunction with the National Center for the Analysis of Energy Systems of Brookhaven National Laboratory of the U.S. Department of Energy, this program will offer a third session in Spring of 1980. Officials from Sudan, Kenya, Zambia and Somalia have already participated or are expected to participate.

9) **Energy Engineering and Technology Assistance** - designed to provide short-term technical consulting services in development of energy equipment accompanying hardware, and equipment design. This activity is assigned to Mitre Corporation through January 31, 1980 on an Indefinite Quantity Contractor basis.

10) **Energy Assessment and Planning Assistance** - designed to provide short-term technical consulting services in energy assessment and planning, this activity was assigned to Donovan, Hamester and Rattien, Inc.

**Proposed Activities Beginning FY '80 or FY '81:**

1) **Expanded Short-Term Technical Assistance** - designed to provide additional consulting services in energy engineering and technology, as well as energy assessment and planning, divided into technical, economic, and social/cultural areas of specification. Up to 13 more Indefinite Quantity Contractors are to be selected in the Fall of 1979.

2) **Energy Efficiency and Conservation** - designed to assist in development of improved energy demand management through more efficient techniques, equipment and systems, both rural and urban. No contractors yet under consideration.

3) **Identification and Assessment of Energy Resources** - designed to concentrate primarily on geothermal energy, likely to be assigned to the U.S. Geological Survey.

4) **Fossil Fuel Resource Management Training Program** - designed to provide in-service training to developing country officials in the area of fossil fuel resource assessment and analysis to improve capability to develop promising fields. No contractors yet under consideration.
RESULTS OF THE CONSULTANT'S WORK IN KENYA, SUDAN & TANZANIA

The following pages present background on meetings held, projects visited, and energy project proposals as a result of field work by the consultant and his wife on this contract from June 13-July 16, 1979.

KENYA

The consultant worked in Kenya from June 13-29th.

AID/Nairobi

The consultant first met with Kevin O'Donnell of Engineering Staff, AID/Nairobi. He said there was talk in the government of forming a Ministry of Energy out of the new Department of Energy in the Ministry of Power and Communications. In the meanwhile, Kenya is forming a National Energy Committee, the National Council on Science and Technology under Professor Gracii, with Dr. Tom Tuschak of the United Nations as its energy advisor, trying to perform an energy advisory role for the government.

Tuschak sees AID working with the Department of Energy to form an advisory team to help organize the Kenya Government to coordinate energy policy and development. Perhaps a four-person team would be needed over two years. Also he feels an Energy Bank is needed, and pilot projects must be initiated using biomass and solar energy for small rural uses.

However, any such initiatives must be consistent with AID/Nairobi's Country Development Strategy Statement (CDSS). The CDSS focuses on semi-arid lands and western Kenya, with priority given to increasing small holder income via increases in agricultural productivity, off-farm employment, and small holder support services in the area of health (potable water and sanitation) nutrition, and family planning. AID/Nairobi intends to selectively draw on centrally funded projects such as rural energy and appropriate technology which can complement this overall strategy. Any projects designed to benefit part of Kenya's 1.35 million households (7.3 million population) must recognize the income limitations, less than $235 per household and less than $44 per capita. AID/Nairobi's Proposed Assistance Planning Level (PAPL) for energy, research, reconstruction, and selected development problems, is presented below for 1982-85:

<table>
<thead>
<tr>
<th>Year</th>
<th>1982</th>
<th>1983</th>
<th>1984</th>
<th>1985</th>
<th>TOTAL</th>
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<td>$1 m</td>
<td>$3 m</td>
<td>$10 m</td>
<td>$10 m</td>
<td>$24 m</td>
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</tbody>
</table>
Peace Corps/Nairobi

The consultant then met with Ms. Coralie Turbit, Peace Corps Director. She is very interested in labor saving devices, such as solar driers, solar water heaters, and relief of female drudgery work. Peace Corps has rural women development and horticulture extension agents. She says an AIP she wrote for AID to consider months earlier has still to be acted upon. Volunteers have few vehicles and few houses, therefore, she wanted housing, vehicles, and self-help equipment funds for ten volunteers in FY '81, situated near village polytechnics, using their houses as demonstration houses in the villages. Grace Wagema of Home Economics Service at Ministry of Agriculture is responsible for cooperating with other Ministries to disseminate technical assistance, but she has not had much success yet with these Ministries.

Meanwhile, Peace Corps intends to send new volunteers thru UNICEF's Karen Village Technology Unit for technology training for one week, for all 200-250 volunteers a year who arrive in Kenya for 3 month training before working in villages. Once a year, all volunteers come together for a meeting while regional and special subject meetings are held more frequently. Kenya has Peace Corps volunteers in rural health, fisheries, forestry, agriculture extension (plant nurseries and fruit trees), water development, maternal health education, science and math teaching, carpentry, masonry, electronics and rural development. Volunteers are in each province and heaviest in the central area. The U.S. Ambassador gave a volunteer $2,000 for a forestry project from his discretionary funds, and she would like to see such self-help funding expanded to others.

UNICEF Karen Village Technology Unit

The consultant met with Peter Scribener of Karen Village Technology Unit. They have week long training sessions for village technology people at Karen Village Technology Unit, conveniently located adjacent to the National Research and Training Center for all the village polytechnics. Now there are three agriculture training colleges in western Kenya and eastern Kenya where agriculture extension officers are trained in village technology. Also the Kenya Family Life Training Center teaches village technology to improve nutrition.

He said more emphasis needed on field work and support in the field. He said Karai Village principal Michael Mathini has funds channeled through UNICEF from a Dutch private group which he uses to support a water jar project. UNICEF used the $5,000 for cement for the jars and the principal got local matching funds from each family involved to pay local village costs. Now some money from NORAD is also helping.
A social survey and evaluation person, on half-time has just started working for the UNICEF project, but it has not worked out well yet.

He feels Peace Corps volunteers should be given a half-day exposure to Karen at their first training, then brought back with village counterparts 6 months later for specific week-long training.

The Kenya Ministry of Housing and Social Services will take over the Village Technology Unit next year. Mr. Warinda is head of the Center that is part of the Ministry. There are 200 polytechnics in Kenya, and often the polytechnic instructors go through training at the Karen Center. There are funds for village polytechnic extension available collaboratively between UNICEF and Ministry of Housing and Social Services, but the funds have not yet flowed. Virginia Hazzard, Kenya Program Officer for UNICEF and the Women's Development Program, will supervise the Karen Village Technology Unit when it transfers to Ministry of Housing and Social Services. She would be the one to discuss future use of center for international training for other East African countries.

The Karen Village Technology Unit is providing training for construction and use of the following:

1) Lorena mud stove varieties - made of local clay and mineral cement and steel chicken wire reinforcement and tin stovepipe. Capable of cutting wood use in half and cooking two or three dishes at same time, plus heat water and reduce smoke.

2) Evaporation charcoal cooler - box made of charcoal briquettes held by chicken wire or wood screen. As water drips through charcoal, in a ventilated area, water will evaporate off the charcoal and the inside space will be cool relative to the ambient temperature.

3) Small biogas demonstration - only designed to demonstrate the principles, these 42 gallon empty barrels are placed inside one another, one floating top down in the other, with dry cow dung and water mixed equally. (One bucket of dung and one bucket of water, when fermented over a number of days, will yield enough gas to light one stove burner for 20 minutes). Need dung from five cattle minimum to maintain a family-sized biogas system to meet most domestic cooking and related fuel needs. The gas can also be used for lighting or any other use natural gas is normally used for.

4) Cinvan ram blocks for low cost housing

5) Cement like building material made of ash and cow dung

6) Hand operated corn sheller

7) Hand operated groundnut sheller

8) Solar parabolic reflector cooker
9) **Plastic and wood and chicken wire solar food drier** - reaches 75° C temperatures; although vitamin C may be lost from certain vegetables in the process, food is dried in 1 - 2 1/2 days, thus minimizing the vagaries of the weather and inhibiting pests while food is still easily penetrable.

10) **Hydraulic ram pump** - both a Blakes "hydram" of John Blake, Ltd. Engineers of Accrington, England and a locally made one pump 10% of flowing water in a stream back to the top of the fall of water.

11) **Hand water pumps** - a number of varieties of hand pumps, including the Uganda water pump capable of 300 meter depths and the rope washer pump to to 25 meter depth.

12) **Pedal pump** - basically a stationary tandem bicycle type arrangement without the wheels where the pedal action does the pumping.

13) **Windpumps** - both the cloth sail windpumps of Crete (using a rubber tire valve) and the VITA windmill (or Arusha Appropriate Technology Project windmill) made of tin blades. Both capable of pumping 300 meters.

14) **Domestic water filter jar** - clay jar layered from top to bottom respectively with gravel, sand, pebbles, charcoal and gravel and a spigot at the bottom.

15) **Water storage jar** - made of local woven basket as an armature and coated in cement, these jars range from 200 gals. to 500 gals. capacity. Designed to collect rainwater runoff from roofs, they can also be filled from the top. A filter and spigot near the bottom make the system convenient and more sanitary.

The UNICEF Karen Village Technology Unit's outstanding quality is its technology training. Its outstanding deficiency is its lack of extension work, lack of needs assessment training, and lack of feedback from the people it trains.
AREA UNDER DEVELOPMENT TO INCLUDE FOOD STORAGE, HOME SANITATION AND NATURAL ENERGY SOURCES

Excerpted from Village Technology Unit literature.
Karai Village — Water Storage Jars & Lorena Clay Stove Project: "Human-Energy Save

The consultant then met with Michael Manthini, principal of Njumbi Primary School (Box 19, Karai Village, Kikuyu, Kenya.) He is organizing construction of cement/sand basket jars of 500 gallon capacity at 200Shs. owner price and sawdust jars of 200-250 gallon capacity at 100 Shs. owner price. The village leaders had seen the jars at the Karen Village Technology Unit and had learned how to build them. 82 tanks have been built so far on a matching fund basis, using 40,000 Shs from UNICEF. For example, for the 500 gallon units, the village owner pays 250 Shs to the principal, who pays for the basket at 130 Shs and pays the remaining 120 Shs for local fundis (craftsmen) who build the jar. Now NORAID (Norwegian Aid) has given 10,000 Shs to the village so that more of the 220 gallon jars can be given free to most of the needy.

The villagers, and especially the women, realize the jars are really human-energy savers, an intermediate step between going to the well and indoor plumbing. The jars can be filled slowly as rainwater washes off the roof of the home, and filled the rest of the way when needed by making a few trips a week with a donkey cart to the well. Thus, the woman does not have to make numerous trips each day to the well. Also, the jar has a simple water filter and spigot at the bottom, thus partly filtering the water.

The principal has a working committee which helps him get the names of needy families to qualify for the matching funds. The committee helps him check the level of poverty, especially selecting those who have no help to get water. Some villagers are so poor that they had to pay installments over many months to gather the 250Shs for the 500 gallon tank or the 100 Shs for the smaller tank. (The conventional large aluminum water storage tanks are clearly unaffordable for these people, at 1,500-5,000 Shs each, even though they may be more durable.)

The village still needs 300 more tanks built. There are 700 families in the village, with about 1/4 acre each. The consultant was told that donkeys are used to fetch water and fill the jars when roof collection is not sufficient. Donkey carts cost 700 Shs each, and the consultant was unable to determine how many of the very poor own the carts and how many have to rent the use of the donkey carts to fill their jars or how much such service costs.

The consultant also visited the homes of two families, unannounced, who had been using Lorena clay stoves since September 1978 and early Spring 1979, built by local fundis paid by the local women's group who had seen the Lorena stove at the Karen Village Technology Unit. The stoves cost a total of 160 Shs (100 Shs for the stove and 60 Shs for the stove-pipe.) The Lorena stoves were being used by the women the consultant saw, replacing the traditional multi-stone open-fire style of cooking and cutting wood consumption in half, according to the women. Some families pay 250Shs normally per year for firewood, thus the stove almost pays for itself in the first year. The women like the stove also because it burns less smoky and has two or three burners and thus cuts cooking time. However, the charcoal jiko was still being used by these women because it served as a portable space heater, as well as a source of heat for tea, etc. Villagers have to go 20 miles to find seasoned wood (eight miles for water in the dry season), and the local price to buy a tree, dead or alive, is 30 Shs.
Drawings excerpted or adapted from Lorena Owner Built Stoves by Ianto Evans--A Volunteer in Asia Publication.
National Council on Science & Technology (NCST)

The consultant met numerous times with Dr. Tom Tuschak of NCST, seconded to NCST by the UN to serve as an energy advisor, and with his colleagues, Mr. Christopher Aleke-Dondo and Mr. Patrick Nyoike. NCST was set up in 1977 and only recently in the summer of 1978 became actively interested in energy. Basically, NCST has observed that there are five pressing areas which need attention related to energy in Kenya. First, research and development and field-testing of renewable and improved traditional energy technology is ad-hoc, chaotic and needs to be integrated and brought to yield prototypes and extension techniques which can become adapted and commercialized. This is believed to be especially true of improved cookstoves and of biogas, the latter of which there are known to be at least forty units in Kenya.

Second, reforestation efforts are woefully inadequate to meet future woodfuel needs alone, to meet the 85% of Kenya's rural energy demand for cooking. This is especially urgent because Kenya is 80% arid, and the population growth rate of 3.9% annually is putting tremendous pressure on existing wood stocks. Both capital and technical assistance is needed to accelerate reforestation on the quantum jump scale which is needed. Third, rural electrification efforts, if continued at the present rate, will not reach even a significant minority of the rural population until well into the next century. The 4.7 million Kw in the 1979-83 Five Year Development Plan is inadequate to even begin to meet this challenge, when compared to the budget for other electrification projects which will serve urban-industrial needs (114Kw.) Fourth, a source of indigenous financing is needed for energy development, which could be supplemented with external financing. Such an Energy Bank could provide finance for non-conventional energy projects and for commercial rural electrification projects. A meeting of donor organizations has generally been approving of such a concept, but the Ministry of Finance has yet to approve the idea. Fifth, improved methods must be developed to assess national energy needs, both rural and urban, and integrate such needs plus resources into planning at the national level.

The National Energy Committee, an inter-ministerial committee, met once in 1978 and again in July 1979. Prior to the second meeting, the committee considered and reviewed a number of recommendations which were combined with others of the NCST and forwarded through Tuschak and NCST to the Cabinet. These recommendations included: such suggestions that the government should:

1) Lower octane level of gasoline
2) Introduce cracker at refinery, either a thermal or catalytic unit
3) Improve refinery efficiency
4) Improve both intra-urban and inter-urban transport systems
5) Improve reliability of the railroad
6) Strictly enforce speed limits
7) Selectively raise prices on higher distillate fuels
8) Increase efficiency of woodfuel use, especially using improved cookstoves and charcoal jikos.

Some of these recommendations have found their way into speeches of Kenyan officials, but it is too early to judge the extent to which any will be actively pursued.
Kenya has 480 MW theoretical capacity, while current demand is less than 300 MW capacity. Much of Kenya's electricity is imported cheaply from Ugandan hydroelectric resources, while another 20% is oil generated. But Kenya in the future will barely be able to meet its demand with indigenous resources, even when its geothermal and hydro resources are used fully. Nor can Kenya rely on imported oil as conveniently as it used to, such as in 1972, when the value added to oil exports refined by Kenya equaled the cost of all of the oil imports which it consumed locally. In 1978, even though 40% of total imports was re-exported, the value added by refining did not make up for the tremendous differences in markup of the imported crude. (Kenya consumes 11.7 million barrels, out of 18 million barrels which it imports.)

Key Kenyan officials or agencies involved in energy include:

Mr. Gechau - Chairman, East African Power & Light Co. (Energy Policy)

Mr. Mwiraria - Permanent Secretary - Ministry of Power and Communication (Energy Policy)

Dr. Githinji - Chairman, Mechanical Engineering Department - University of Nairobi, (solar and wind)

Director Autut - Industrial Service Promotion Center --Phone # 332811 (doing wood waste energy)

Tana River Development Authority - small hydro systems

Mr. J. D. O. Onyanga - Department of Forestry

Mr. Hindpal Jabbal - Chief Planning Engineer, East Africa Power and Light

The consultant made a number of attempts to meet with these people. He succeeded in speaking on the phone with Dr. Githinji, Onyanga's assistant, and Autut's assistant, all of whom were quite willing to discuss possible energy project development, given enough advance notice to prepare background material and arrange schedules.

Dr. Tuschak wanted to see AID assist Kenya in five areas which were seen to merit the support of the Kenyan government:

1) Strengthen and advise the new Department of Energy, over a two year period with up to a four person technical assistance team who would serve as advisers and on-the-job trainers, especially for mobilizing national energy planning and national energy assessment.

2) Investigate and field test decentralized alternatives to conventional rural electrification, especially in Western Kenya--could be mini-hydro.

3) Provide support for an Energy Bank, and accompanying Office of Technology Assessment--at least for rural needs in the form of a Rural Energy Fund.

4) Support creation of a central energy research institution, likely at University of Nairobi, at least to focus on rural energy problems.

5) Support training of extension workers, and field testing of improvements on and alternatives to conventional and traditional rural energy sources and techniques, such as field testing of improved stoves and biogas. Field testing would lead to a national strategy for mass extension after proper technical, economic, and social soundness analysis.
National Environment Secretariat

The consultant then met with Mr. W.W. Mbote, Deputy Director, National Environment Secretariat and his assistant, Mr. Chapeda (National Environment Secretariat, Office of the President, PO Box 30510, Nairobi.)

Mbote and Dr. Gacii, Director of the National Council on Science and Technology, went on a Kenya tour to investigate rural energy problems and ongoing technology in use. They afterwards recommended a Department of Energy be created from the Ministry of Power & Communications (Mbote recently became Director of the Department in August 1979.) The Department was formed, and later the NCST initiated an inter-ministerial committee on energy, which sought out Dr. Tom Tuschak of the UN as its Energy Advisor.

Mbote said both the Ministry of Power and Communications and the Vice-President Kibaki noted in the Five Year Development Plan and related speeches how non-conventional energy is worth serious further investigation.

The National Environment Secretariat, which reports directly to the Head of the President's Cabinet, has done a number of USAID projects before. It now hopes to develop a Rural Energy Pilot Project to determine rural energy needs, then develop renewable and improved traditional energy technology with villagers through the Ministry of Agriculture with numerous cooperating agencies. A number of other institutions are involved in or interested in the use of biomass and waste products for energy use. Already, some Village Polytechnic and Peace Corps Volunteers have worked with biogas at Egerton College and at a Meru hospital. Thika Tannery has consultants for how to use biomass and waste products for energy through biogas. Hutchinson Farms sugar estates and tea estates have burned bagasse or processed biogas for years. Coffee industry may make pellets of wastes for boiler fuel. Dr. Githinji at the Department of Mechanical Engineering is doing some solar and improved cookstove work, while the Department of Electrical Engineering is doing some mini-hydroelectric work and windmill work (both departments are at the University of Nairobi.) Windpumps are being field-tested in Machakos and Nyanza, and a solar thermal pump is in use by the Ministry of Water Development in Marsabit.

Dr. Lea Marangu, Head of Home Economics Department at University of Nairobi Teachers College, has returned from a biogas study tour of China, encouraged by the possibility of its use in Kenya. Meanwhile, the Egerton College is doing work also on improved clay/mud stoves for cooking, through Home Economics using seven varieties of stoves. The Women's Bureau of the Ministry of Social Services is responsible for village technology development and extension, but although technical advice is supposed to come from ministries, follow-through always seems to break down. The community extension workers in each area are supposed to work in village technology with technical support from the operational ministries.

Most of the above activities, however, are ad-hoc, disparate, and uncoordinated. The National Environment Secretariat would coordinate all these efforts within the proposed Pilot Rural Energy Project.
PROPOSED ACTION PLAN TO USAID FOR ENERGY DEVELOPMENT IN KENYA: AN OUTLINE

Two part program to be conducted simultaneously:

PART ONE: BUILD DEPARTMENT OF ENERGY INTO EFFECTIVE INSTITUTION

Step 1: Expand staff
Step 2: Train staff, providing overseas and on-the-job training and a small team of energy advisers for two years.
Step 3: Provide analytical facilities, improved data collection activities, and equipment so as to develop and use the Reference Energy System as a planning tool.
Step 4: Provide finance to facilitate funding of critical policy studies and National Energy Assessment

PART TWO: INITIATE AND EXECUTE A PILOT RURAL ENERGY PROJECT

(See specific proposal on next page.)

Step 1: Form a Rural Energy Research Center based at the University of Nairobi.
- assess rural village energy needs, skills, resources and institutional factors
- build and train staff from Center and from village to execute rural energy field tests
- provide workshop, prototype, and fabrication equipment and material and instruments and buildings and vehicle/staff housing

Step 2: Form a Rural Energy Fund to finance field test projects
- build staff
- train staff
- incorporate an Office of Energy Technology Assessment which includes economists, sociologists, and engineers

Step 3: Execute & Evaluate Rural Energy Field Tests: Illustrative Activities

A) Improved cook stoves, utensils and techniques
B) Biogas for household community and institution
C) Village managed woodlots
D) Improved use of draft animals
E) Improved hand/food implements and human energy saving devices
F) Solar heat and electric applications
G) Wind mechanical and electric
H) Small hydro electric
I) Improved diesel/gas engine maintenance and power grid transformer step down uses for rural areas
SPECIFIC PROPOSAL: KENYA PILOT RURAL ENERGY PROJECT

This is adapted from a proposal by the National Environment Secretariat in the Office of the President, and should serve as the basis for further project design team identification activities:

Project Identification

Kenya and the world as a whole is experiencing a crunch on availability of energy in all forms. Fossil fuel upon which Kenya had depended on is increasingly becoming more and more out of reach monetarily and unfortunately Kenya has no indigenous source of fossil fuel.

Future dependence on major hydro energy is certainly focussed to cater for urban industrial centres. This means that the rural population would continue to depend on charcoal and firewood as a source of energy mainly for cooking. Inevitably this will cause deforestation, impoverishment of agricultural land and serious environmental problems such as soil erosion and water loss. Coupled with the rising population especially in the rural areas, serious social instability may very well be expected. It is high time therefore that an alternative source of cheap energy is developed to meet the demand immediately. In this case, renewable and improved traditional energy technologies seem to offer an alternative which may be suited to most of the Kenyan rural conditions.

1) Project Title: The Pilot Rural Energy Project
   Project Leader: Under the auspices of the Department of Energy, Ministry of Power and Communications

2) Supporting U.S. Agency: U.S.A.I.D.

3) Executing Agency: National Environment Secretariat

4) Supporting Organizations:
   - Agricultural Engineering Department, University of Nairobi
   - Kenya Agricultural Research Institute, Muguga
   - Coffee Research Foundation, Ruiru
   - Egerton College, Njoro
   - Ministry of Agriculture's AMTU, Nakuru
   - Kenyatta University College, Home Economics Department

5) Duration: 5 years
   - 3 phases: 1979-80; 1980-82; 1982-84
   - completion 1984
The Problem

Recently renewable and improved traditional energy technologies and techniques have attracted the attention as alternative sources of fuel and fertilizer (e.g., biogas, windmills, cookstoves). However, much of the information regarding system design are misleading and complex. Much of the information on small scale use comes from other countries, especially India.

The socio-economic structure and climatic conditions in Kenya are often different from those countries that to date have accumulated information on such systems. This information from other countries though workable may not necessarily be suitable for Kenya.

Currently available designs are inappropriate for rural areas because they are too expensive for individual family use and community use systems have not been developed. The basic problem is to develop a design that will utilize as much indigenous resources as possible from an individual household or community unit namely; wind, sunshine, green vegetable waste, human and animal waste, to produce sufficient fuel for cooking, lighting, and other needs.

Objectives

Specifically, the immediate objectives of this project are:

1. To establish the energy needs of individual households in terms of domestic, agricultural, and industrial use. The needs must be matched with the basic resources of land and labor available to them.

2. To assess the potential of the energy resources in meeting the identified energy needs. This would include biomass production potential, wind power and solar energy.

3. To select and test appropriate devices for individual family uses.

4. To monitor and evaluate the systems under various environmental conditions for long time study and prepare a code of practice for establishment, operation and maintenance.

This is to be achieved by establishing several devices in the rural areas under the operation of the farmers.

5. To identify the socio-economic, socio-psychological, situational, factors leading to the incentives and disincentives as perceived by the rural community in successful adoption and continued use of the devices.
6. To evaluate the effects of the devices on agriculture. This will focus on achieving a biologically balanced ecosystem less dependent on chemical fertilizer.

7. To investigate the feasibility of devices as a source of domestic fuel, agricultural and industrial power for rural people.

8. To develop a training centre for extension workers, rural artisans and users for the devices.

9. To prepare training materials and organize training programmes for the rural communities.

Methodology and Data

This will include:

1. Intensive literature review to determine how certain designs may perform under local environmental conditions.

2. Specific designs would be selected on the basis of the above review and installed so that they can be closely evaluated under local conditions and substrates. At this stage certain modifications may be done from the point of view of the needs to use locally available construction materials and also with a view to permit the use of available resources.

3. Determination of precise operating data under varying environmental conditions. The operating and environmental conditions would be selected on the basis of other socio-economic information that might have been generated by related socio-economic study.

4. It is proposed that if individual family size units do not become viable it will be necessary to try community units. In this case, it will be necessary to link very closely with the socio-economic group in order to study the social problems that will arise in attempting to change the village social structure. Although the technical problems of energy resource collection and distribution of energy are important, it is felt that the social problems will be more limiting. For this part of the study a pilot project can be initiated in the villages.

5. Once the devices are operationally reliable, the next step is to look into its use as a domestic fuel, agricultural and industrial power source.
Locations

1. The Agricultural Engineering Department of the University of Nairobi will experiment with engineering designs of the actual devices.

2. Kenya Agricultural Research Institute will do device trials based on the systems developed, i.e., they will test biogas slurry source (substrate) and method of its production. The Agricultural Engineering Division - KARI - will deal with the appliances relevant to small-scale farming.

3. The Egerton College - Njoro will have a strong orientation on training extension workers whom they will use to reach farmers. They will have to be "everything" in so far as device production and use are concerned for the sake of comprehensive training programme but of course they will liaise with other participants in the project.

4. The Coffee Research Foundation will continue with the work they have been doing on coffee pulp as a substrate that is otherwise a nuisance at coffee factories and survey ways of recycling the inherent nutrients while biogas would be used as a possible power source for the factory mills.

5. The Ministry of Agriculture's AMTU, Nakuru, will be the best point for extension work. The FAO have a provision for device production. AMTU may be asked to generate a code of practice for general device production.

6. Kenyatta University College - Department of Economics - will take care of the socio-economic studies focussed on the adaption of devices for domestic fuel in rural homes especially for the rural poor.

7. Finally, a pilot project between the Department of Agricultural Engineering - University of Nairobi, KARI and KUC Home Economics Department will be set up to study the feasibility of a community approach to device use.

Personnel (Job Descriptions)

Project Coordinator

Work will include coordination and supervision of the overall project. He will be particularly involved in ensuring that the project is in harmony with the other related national projects and programmes.
The candidate must be a qualified scientist who has held a position of substantial responsibility. Experience in developing countries is essential.

**Technical Director**

Work will include supervision of research and pilot projects in their total context. He will be available to advise project research workers on the design, operation testing and product utilization. He will organize seminars and information publication and insemination.

The candidate must be a qualified engineer with considerable research and practical experience in device design, operation and testing. Experience in developing countries would be an added advantage.

**Research Fellow (Engineering) for KARI, University and Egerton College**

Work will include design and development and testing of devices and accessories such as fittings, gas cookers, etc.

The individual must have good university training in engineering and practical experience in device operation would be an added advantage.

Total annual emoluments equal Ksh 8,500.

**Research Fellow (Home Economics/Sociology) for Egerton and Kenyatta University College**

Work will include a study of the rural household energy patterns and assessment of the socio-economic and cultural feasibility of the devices.

The candidate must have a good university degree in home economics. A strong bias in sociology and practical experience would be an added advantage.

Total annual emoluments including basic salary, housing, medical and international travel allowances; equals Ksh 8,500.

**Pilot Project Engineer for AMTU**

The candidate would work with agricultural engineers engaged in the development and testing of a wide range of field machinery, processing of equipment and farm structures. His job would be to assist farmers, institutes or communities interested in trying designs that are considered appropriate.
Good training in engineering and substantial practical experience in farm structures is essential.

Total emoluments equal Ksh 8,500

Technicians

Work shall include construction, installation, and operation of devices.

The candidate should be in possession of at least part II of the technician certificate. Total annual emoluments including housing, medical, local travel allowances equal Ksh 4,000 each.

Ancillary Staff

This cadre of jobs shall include artisans, drivers and manual workers, unskilled labor, etc. Emoluments including housing, medical, and local travel allowances equal Ksh 1,000 each.

Project Phasing

The five year project may be phased as follows:

Phase I - one year

August 1979-June 1980

Literature review, preliminary design and ordering of equipment, recruitment of staff and installation of basic research facilities at KARI, University, Egerton and CRF. A case study of rural energy demand, supply and use by KUC and identification of suitable pilot projects by AMTU.

Phase II - two years

July 1980-June 1982

This phase will include running of controlled tests at KARI, University, CRF, Egerton, and preliminary field trials by AMTU monitored closely by Egerton College home economists. Further study of device adoption at individual farm or community level will also be conducted by KUC.

Phase III - two years

July 1982-June 1984

Full specification of the code of practice for a set of designs will be completed. Integration of technical and socio-economic research findings will be taken a stage further at farm and community level jointly by all participants in selected areas in Kenya. Final recommendations for national programmes will be completed during this last phase.
## Total Cost of Project:

### Estimates

1. **Personnel (emoluments and training expenses)**
   - KARI: 25,120
   - Egerton: 38,632
   - University: 35,500
   - CRF: 28,800
   - AMTU: 30,000
   - KUC: 15,000
   - **Total:** Ksh 173,052

2. **Capital Expenditures (Designs, tools, and materials)**
   - KARI: 29,350
   - Egerton: 20,000
   - University: 20,000
   - CRF: 4,600
   - AMTU: 10,000
   - **Total:** 83,950

3. **Operating Expenses**
   - (e.g. travel, seminars, workshops, documentation, and data analysis)
   - KARI: 17,200
   - Egerton: 32,680
   - University: 16,000
   - CRF: 2,500
   - AMTU: 15,000
   - KUC: 5,000
   - **Total:** 88,380

4. **Miscellaneous Expenditure**
   - KARI: 7,000
   - Egerton: 1,200
   - University: 1,500
   - CRF: 1,200
   - AMTU: 1,300
   - KUC: 1,000
   - **Total:** 13,200

**Total:** Ksh 358,582
The consultant worked in Khartoum, Sudan from July 13-16, in order to investigate critical energy assistance needs as viewed by AID/Khartoum's Acting Director, Jim Holtaway, in two priority areas: 1) the need to expedite petroleum management training for the Petroleum General Administration, 2) the need to expedite desert encroachment control and rehabilitation through the proposed Northern Darfur-Kordofan Agricultural Production/DECARP Project (#650-0017), using renewable and improved traditional energy technologies as appropriate to meet DECARP goals.

1. Petroleum Management Training

Jim Holtaway explained that Dr. Hashim El-Tohami, Chief of Staff, of the Ministry of Energy and Mines had briefed the U.S. Embassy and AID one year ago (upon his return from USAID-funded training with the Energy Management Training Program for Developing Countries at the State University of New York at Stony Brook) on a request by the Ministry for help with training to improve the management of the Ministry of Mines to prepare for a role in administering Sudanese energy resources, especially petroleum through the Petroleum General Administration (PGA). This request had received serious attention by AID/W and USDOE, which had just sent a plan on July 13, 1979 to AID/Khartoum to send a DOE/AID team to Khartoum in August, 1979, to develop a PID for training PGA staff. This was made all the more urgent by an oil discovery, July 13, the fourth indication of oil out of 6 test wells drilled, this one with capacity of 500 barrels/day up to few thousand barrels/day. Three or four more wells were to be drilled soon. This most recent strike was good oil of high density, with lots of light hydro carbons, low in sulfur, low in wax crude, thus commanding the highest retail value on the world market.

Jim Holtaway requested the consultant to meet with PGA staff to determine their response to the DOE/AID offer of sending a team in August, and to relay their response upon his return to AID/W in mid-July.

The consultant then met with Larry Nelson of the U.S. Embassy and with Petroleum General Administration Officials: Fattah M. Saleh (Director General) Ishaq Adam Beshir (Head of Statistics and Forecast Section), Osman Babiker (Deputy Director General) and Hassan El-Zubeir (Head of Technical Department).
Mr. Saleh explained that private oil companies do marketing and distribution of oil in Sudan, but the Government of Sudan has the controlling share at the refinery. The Petroleum Products Pipeline Corp., a parastatal of the Ministry of Energy and Mines, runs the Khartoum-Port Assad pipeline. Drilling operations are the responsibility of a different division in the Ministry of Energy and Mines.

PGA is responsible for all import, export, transport, refining, pricing, distribution, and marketing policy.

PGA started with three staff in 1970, and now has 60 university graduates, over 50% of whom are engineers and the rest are technicians.

Mr. Saleh said that refined fossil fuel product "cut of the barrel" and pricing policy was a very touching political economic issue. Kerosine supplies had been cut back from between 90,000 and 60,000 metric tons/year to only 20,000 metric tons/year -- thus rural areas must revert to using dung or wood for their energy needs. Heavy residuals are re-exported due to lack of demand. PGA wanted to encourage industry to switch to using these heavier oils for boiler fuel instead of diesel.

To provide PGA with improved capability to make these and other pressing decisions, PGA embarked on an effort to improve training for its staff. In April, 1978, Saleh went to the International Executive Management Program at University of Houston sponsored by Chevron. He liked its Director, Dr. William Kretlow, and since then had him to Khartoum to advise PGA and had sent numerous PGA staff to him. Then the Geology Department of the Ministry of Energy and Mines gave authority to PGA to send one or two staff a year to the U.S. for training at this International Executive Management Training Program, at Chevron expense. (When Chevron signed its exploration agreement, it agreed to pay for training, although mostly for exploration-related work, and thus mostly not for PGA.)

PGA's and Dr. Kretlow's recommendations for future training needs, led to the request for AID/DOE training for PGA staff.

Upon reviewing with the consultant the proposed AID/DOE plan to send a team in August 1979 to develop a PID for PCA training, Mr. Saleh responded:

1) That any team which did not include Dr. Kretlow, or at least consult him, prior to work in Sudan would be unacceptable.

2) That the original AID/DOE and PGA strategy to have the training take place intensively over a six-week period (Phase I -- In-country training) would have to be revised to be stretched more evenly over a one-year period so as not to upset the normal PGA operations.
The consultant then proposed and developed an illustrative one-year long training schedule with Mr. Saleh (see following chart) which he asked to be communicated to AID/W along with the request to include Dr. Kretlow on the team.

Upon returning to AID/W in mid-July, the consultant successfully catalyzed a meeting between Dr. Kretlow and AID and DOE officials and contractors. This led to a team including Dr. Kretlow which went to Khartoum in late August that agreed on a training project with Mr. Saleh quite similar to that on the chart, scheduled for funding October 1, 1979, to begin training January 1980.

2. Northern Darfur-Kordofan Agricultural Production/DECARP Project (#650-0017)

The consultant was told by Jim Holtaway that DECARP is the Sudan National Research Council sponsored Desert Encroachment Control and Rehabilitation Program, designed with assistance of a geographer from Clark University who taught at University of Khartoum. Sudan has put DECARP in the Ministry of Agriculture and AID sent Farouk Ahmed, the new head, to the U.S. for brief training.

AID/Khartoum has budgeted (see May 1979 report on its 1981 ABS) $4.7 million for FY '81-84 for the Northern Darfur-Kordofan Agricultural Production/DECARP Project (#650-0017) accordingly:

- FY '81  $1 million
- FY '82  2 million
- FY '83/84 1.7 million

The purpose of the project is to improve agriculture production and reduce desertification through use of anti-erosion cultural practices, soil-fixing vegetation, range/herd management, income-producing commercial crops, water conservation and renewable and improved traditional energy use (especially solar and woodfuels). Two AID documents are relevant to this project, both on traditional agriculture in the fragile environment of North Kordofan (see AID/AFR/DR - contract # AID/AFR-C-1142, May 1977 by American Technical Assistance Corp. of McLean, Virginia).

Due to the scope of work for the consultant, he was interested in investigating the possible role of renewable and improved traditional energy in contributing to the DECARP project. Thus he had a meeting with Farouk Ahmed, Director, DECARP Coordination Unit, Natural Resources Administration, Ministry of Agriculture. (PO Box 1942, Khartoum.)
# PGA ILLUSTRATIVE PETROLEUM MANAGEMENT TRAINING SCHEDULE

**Khartoum - July 16, 1979**

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- Distribution
- Programming Techniques
- Financial Analysis
- Int'l Petrol. Marketing
- Energy Rationalization

Jim Bever, Consultant
Faithah M. Saleh
Director, PGA
Mr. Ahmed said that overgrazing and over-cultivation were large contributors to desertification, but that improper tree cutting, deforestation and deliberate burning of savannah also exacerbated the problem.

Originally, DECARP was to be a separate agency, but too little money was available from Sudan's budget. Furthermore, the UN donors, UNDP and UNEP, had allocated their funds to a UN Sudan-Sahelian Office located in Ouagadougou. (They sent a mission in April 1979 and he met with them then and in late June 1979 again. UN contact is Mr. Maynard, UNDP or UN Sudan-Sahelian Office in UN Plaza.)

Mr. Ahmed closed the meeting by saying that he would be eager to work with the Institute of Energy Research, an institution of the National Research Council, to begin work on renewable and improved traditional energy which could be helpful in the DECARP effort.

The consultant then went to the Institute of Energy Research and met with Director Yahia Hamid (also the Head of Faculty of Mechanical Engineering at University of Khartoum), Dr. Mohammed Ali Abedlrahaman and Dr. Wardi at the Institute of Energy Research, National Research Council. In 1973 the Institute for Solar Energy Research and Related Environmental Research was created, originally with the Faculty of Engineering and Architecture in order to benefit from their laboratories, workshops, and students. It then had three research assistants. (Dr. Hamid had done his MSc at Northwestern and his Ph.D. at University of Wisconsin with Jack Duffie and Farrington Daniels.) In 1976, it became the Institute of Energy Research and now has three Ph.D. researchers and eight research assistants, to be expanded to include more specializing in wind, biomass, and small hydropower.

It is now using the Faculty of Engineering and Architecture for some experiments and also has a 20 hectare area at Soba (20 km south of Khartoum) for ongoing work and expansion. The Technical University of Denmark is assisting it with a solar thermal solid absorption refrigeration cycle experiment, and the French Ministry of Cooperation has donated a SOFRETES pump at the Soba site and at Hilat Hamed Village (120-150 km south of Khartoum). The Soba site has a solar still, SOFRETES, water heater, meteorological equipment. Two French technical assistants attached to the National Research Council occasionally monitor and inspect the Soba site.

The UNDP/World Bank solar pump project is still pending after a number of years. Originally, it was to be a few small 200-300 watt/peak solar cell pumps and one 2 KW peak solar thermal unit, but this is yet
to be finalized. The West Germans have offered energy help, but no details of such offer are available yet.

The Institute has a Mr. Shabban studying solar cells in U.S. Mr. Ali just returned from doing solar drying study at University of Florida with Dr. Erich Farber. One Institute technician is studying wind energy with Professor Dunn of U.K., and two technicians are studying in France on solar furnace and solar cells. Dr. Hamid wants to have a chemical engineer trained in biomass energy in the U.S., one engineer trained in small hydropower, and Dr. Wardi trained in solar cells.

Professor Dunn of Reading University-U.K. sent a proposal for improved facilities to him back in 1976, but although the Sudan budget then allocated him half a million $b for 6 years to build the Institute, the economic crises have prohibited such effort. Dr. Hamid looked to OPEC for help, but found them primarily interested in investments. EEC was too commercial and he has not found U.K., France, or West Germany as helpful as he had hoped. Hamid wants assistance in

- training
- improving facilities for research at Soba
- improved renewable energy data collection
- in-country ability to fabricate technologies to suit local conditions.

Dr. Hamid says Forestry Department collects statistics on firewood and deforestation, but the department recognizes its lack of facilities, staff, and engineering/physics background to do energy analyses. His Institute has already collaborated with the department's Forestry Research Office, when he recently sent (via U.S. National Academy of Sciences) some iple -- iple improved tree seed varieties offering to test them at this Soba site.

Dr. Hamid mentioned the Nile watershed of southern Sudan and Gezira Scheme as a vast mini-hydroelectric potential to stimulate industry. The Ministry of Agriculture is interested in mini-hydro, but its engineering staff is too weak to do such work. Central Electric and Water Corp was responsible for urban thermal electricity and Ministry of Works for rural thermal electricity. Then in 1977 the Ministry of Energy and Mines was formed to coordinate energy activities, although it is mostly concerned with oil.

Hamid was active in the National Research Council role in energy contributions to the 6-year Development Plan. Hamid has suggested to Minister of Energy and Mines, Sharif El-Tuhamie that a Department of Energy should be formed to plan energy, an idea still being considered.
SOFRETES has installed a 1 KW Freon 114 unit in the Gezira Cotton Scheme Village of Hilat Hamid to pump a head of 42 meters under Institute of Energy Research direction. Village used to have diesel pumps, and when diesel failed often, the people sought water in the canals, and blunted the bilharzia disease control effort. However, the SOFRETES has failed too, due to poor design features: the pump is worn out and aluminum collectors have corroded. This is very embarrassing to the French Ambassador, who donated $45,000 for the pump and had presented it to the village, so apparently the French will substitute a better thermal or photovoltaic unit soon.

There is some commercial private, interest in solar distillation, water heaters and onion drying.

The consultant then made a visit to the Institute's Soba Solar Energy Experiment site with Mr. Ali of the Institute of Energy Research, whom the consultant had met in November, 1977. The Soba site has been slowly developed over the past six years. Now it doubles as a meteorological site and a solar energy testing site. Data collected synoptically varies between 1 1/2 - 5 1/2 years coverage for total diffuse and total direct radiation, sunshine, and anemometer recordings. (Sudan gets ten hours of sunshine daily; almost 360 days a year. Annual radiation averages 1150 watts/m². February to June there is 30% - 40% diffuse light, July and August occasional cloudiness, and September - January almost completely direct radiation.)

The solar still is flushed every week, designed for 100 m² area and yield of 100 U.S. gallons/day, but now only 40m² area. It is all glass, with two-ply black polyethylene materials to absorb heat (the top layer has corroded because it was not maintained while Ali was in U.S. -- it should be cleaned quarterly.) The price of imported glass is now very expensive: earlier it cost 1.5 Sh/m², but now costs 4Sh/m². Maintenance requires only one person to flush and clean the still per week.

The SOFRETES pump is a 1 Kwpk unit using Freon 115 built in November 1976. It pumps 10 meters deep from 9 am to 4:30 pm, with peak reached between noon and 2:00 pm. A storage tank of 15m³ capacity about 5 meters high is built nearby. It should pump 3-5 m³/hour but due to sand in the well and dust on the glass it probably yields half that. Workshop and storage space exists beneath the flat plate system. SOFRETES French technical aides check the site every two months. Numerous eucalyptus trees are on site, and an irrigation canal exists near site which could be used to demonstrate mini-hydro.

Ali will go to Agricultural Research Center to build a 40m² solar still for use by it lab, and there is also a unit at its Food Process Center.
The consultant then met again with Dr. Yahia Hamid, who wished to discuss the needs of his Institute and the possibility of AID assistance and working with the DECARP effort.

At University of Khartoum there is 750 m² office space and 800 m² roof space for equipment testing and an instrument shack. There the Institute is testing solar stills, solar water heater, a solar steam generator, a Danish solar refrigerator, and has an anemometer, and an inclined solarimeter.

Fabrication equipment needed by the Institute includes: sheet metal equipment, metal drills, spot welders, shears, stampers, rollers, benders, lock formers, solderers and electrical/electronic equipment. The Institute has an acetylene welder, and some of this equipment occasionally available at University or through a private contractor but the reliability of availability is unsatisfactory. There is an auto-battery manufacturing company in Khartoum, but the quality is poor. Woodwork equipment availability (planes, saws, drills) is satisfactory.

Materials availability is very unsatisfactory, especially for copper, aluminum, sheet metal, ribbons, metal tube.

Polyethylene sheets and PVC piping and polyethylene piping are obtained through the Rural Water Corporation or locally, but supply bottlenecks interrupt experiments.

The only insulation available is 1" - 5" thick polystyrene board, not good for temperatures over 80°C -- not even good for flat plate systems, because a single glaze solar water heater reaches 125° - 130°C. Aluminum for flat plate collectors does not work so well, causing evaporation. Copper is very expensive, but better. He probably will try galvanized finned steel piping to avoid welding which leads to corrosion. Metal sheets and pipes are available locally.

Glass is imported from Egypt and India, but is very costly. Once 3.5 Sudan £/m², now it is up to 8.5 £/m and 3 mm thick (with levies.)

Local soft woods and hardwoods cost 180-350 Sudan £/m³. Imports cost 500-600 Sudan £/m³.

Electric switches, wiring, etc, is imported. There are two cement factories with 2 million tons/year production, but still insufficient to meet demand. 55 Sudan £/ton is the official price but really pay 120 Sudan £/ton in the market place. Fire-cured local clay brick is very expensive. In 1978, it cost 10 Sudan £/1000, now 25 Sudan £/1000 due to wood shortage and labor wage rise. Dung is used locally in bricks, which use good local clays. Steel rods and chicken wire availability is satisfactory.
The biggest problem is a labor loss syndrome, in which 100,000 skilled labor of Sudanese descent are now working in Saudia Arabia and Gulf States due to OPEC-induced labor needs.

Dr. Hamid discussed a number of ongoing or potential activities, such as a solar onion drying project with the Food Process Center, sponsored by UN. The Sudan project leader is at MIT training. The aim is to produce 5 m² solar collector areas to do 25 Kg onion/batch, using forced air with electric fan with 90° C air. It reduces 80% moisture at 57° C in two days. Sudan exports dried onions to Mideast, as well as large use in Sudan. Now oil-steam heat is used in the onion drying industry.

Hamid discussed the traditional charcoal technique in which a ditch is dug, short branches and thick branches are placed in it and covered with dirt and a fire is started. After a few days, recover 15% of original energy as charcoal. Agriculture wastes 10,000,000 tons/year by burning cotton stalks in the field. This could be made into charcoal in a small holder scheme for extra cash and fuel on the Gezira Scheme. The Gezira Scheme also has 4 million acres of irrigation land with small farmers or 10-20 acres per farmer. Great potential exists to use some of the irrigation canals for run-of-river mini-hydro power.
Background

The Institute of Energy Research was established in 1976, as an organ of the National Council for Research. The Institute's objectives aim at R&D in the field of new energies and at the popularization of their application. They also aim at establishing within the Institute a base for training and expertise in these fast-growing areas of technology.

The Institute has three departments:

1-Solar Energy Department
2-Wind and Small Hydropower Department
3-Biomass Department.

In the field of solar energy, the Institute has been active in all areas of research pertaining to application of solar energy to the long-term energy needs of the country. These include water desalination, water heating, steam generation, drying processes, refrigeration, and water pumping.

Concurrently, a concentrated effort of development of staff and research facilities has been in progress. Bilateral co-operative programs with European countries have been established, with priority for training, exchange of information and joint project undertakings. The NCR is presently embarking on a six-year plan of development of the Institute's premises at Soba (20 Km south of Khartoum) including facilities for its three departments. At the same time, a program of recruitment and training of staff in the new departments of Windpower and Biomass is underway.

The Solar Energy Department (formerly Institute of Solar Energy, established in 1973) is comparatively well established, with ten graduate staff (3 physicists and 7 engineers) of whom 4 are being further qualified abroad in Europe and the United States. The Solar Energy Laboratory now housed in the Faculty of Engineering and Architecture, University of Khartoum has been conducting R&D work, taking measurements and making records since 1973. Some necessary laboratory facilities have been procured, and more facilities and equipment are anticipated when the laboratory is moved to Soba site. A team of 10 supporting staff is helping to execute the research programs in this department while considerable use is made of the facilities and manpower available at the Faculty of Engineering, University of Khartoum. The Biomass
Department has a Ph.D. in Chemical Engineering as head of it, with training sought for a recent undergraduate chemical engineer. The Wind and Small Hydropower Department has one person doing post-graduate training in wind, and needs training for a small hydropower specialist.

International assistance is specially needed for the establishment of research facilities and laboratories to handle research projects in the areas of activity of the three departments. Many friendly and interested governments have been approached to assist in the development of Institute. Areas of assistance to this end are:

1- Development of the Institute buildings at Soba (20 Km south of Khartoum) where a piece of land 20 hectares has been allocated for premises for the Institute.

2- Development of laboratories and facilities (workshop, library, etc.)

3- Training of staff and exchange of experts in the field of renewable energy sources engineers, scientists, technicians, etc.

4- Joint Research Projects between the Institute and counterpart institutions in the country of Sudan in the area of renewable energy. These projects shall tackle specific social and economic problems in the Sudan. It is hoped that implementation of such projects will result in development of some of the Institute's infrastructure. In particular, the Institute would like to work on the opportunity to help meet some of DECARP's goals through judicious use of renewable and improved traditional energy technology, including such activities as improved cookstoves, kilns, reforestation efforts, etc.
OUTLINE FOR PROPOSED SUDAN PROJECT WITH DECARP

Six months
In-country energy resource assessment and travel
Order equipment and material and design buildings

Six months
Short-term training in-country and overseas and select staff for long-term training
Identify villages or rural towns for pilot projects
Determine energy needs, skills, resources and uses

Six months
Import prototypes, adapt designs, and build locally to match pilot village needs, then train trainees

Twelve months
Install and build in village
Monitor and evaluate

Three months
Prepare national strategy and portfolio of projects for funding

Project Design

Ms. Turi Hammer will be back in Sudan in November-December to follow-up her village energy study of Bara in the Northern Kordofan area north of El-Obeid, and Dr. Hamid would like to involve her in project design for this proposed Sudan energy project.

(Originally Mrs. Turi Digernes)

Proposed Soba Site Improvements:

- Proposed New Administrative Center: 1000 m² area
  - Office library, lecture hall more prototype workshop and storage space
  - Existing meteorological house
  - Existing solar still
  - Existing SOFRETES pump and storage area
  - Proposed new tree varieties
  - Proposed Canal (new mini-hydro unit)
ILLUSTRATIVE BUDGET
(Requires modification to add emphasis on DECARP research effort.)

**Item 1 - Buildings to house solar wind, biomass, small hydro departments**
- Design of the building (floor area = 1000 m²),
- Provision of skeleton frame,
- Provision of prefabricated floors, walls and partitions,
- Services,
- Furniture.

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**Item 2 - Labs and Facilities**

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<td>Lab for Wind and Small Hydropower</td>
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<td>-</td>
<td>Central Workshop with sheet metal and light mechanical workshop facilities</td>
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<td>Meteorological Laboratory</td>
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<td>-</td>
<td>Central library and documentation unit</td>
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**Item 3 - Training and Exchange**

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<td>2 Research and Post-doctorate leaves 3-9 months</td>
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<td>3 Training courses for technicians 6-12 months</td>
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<td>U.S. institutions 3-12 months</td>
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<td>Item 4 - Projects -Illustrative</td>
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<td>Improved fuelwood technologies and reforestation techniques</td>
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<td>Fish drying by solar energy in Upper Nile Province</td>
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<td>Low velocity wind mills for pumping in Northern Sudan and Red Sea areas</td>
<td>12,500</td>
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<tr>
<td>Pyrolysis of agricultural waste for power generation or direct heat application</td>
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</tr>
<tr>
<td>Low head water (10Kw) for application in the south and irrigation canals in the Gezira</td>
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</tr>
<tr>
<td>Solar or biogas refrigeration for cold storage of food and medicines</td>
<td>15,000</td>
</tr>
<tr>
<td>Solar steam generation for agro-industrial process heat</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>£S 493,000</strong></td>
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TANZANIA

Background

The Arusha Appropriate Technology Project with Dick and Joyce Stanley

AATP organized a village Project Development Center and then a Pump Group Center in Majengo Village, ten miles from Kilimanjaro International Airport. Now the Pump Group Center is training trainees from other villages, and is building water pumps for other villages. The hand pump cost 1500 Tshs. and pumps up to 50 meters. A windpump marketing and production cooperative is also in business on a small scale at AATP.

AATP uses Friesian technique, during which the first month no mention of technology is allowed -- only observing, listening, and stimulation of village consensus on prioritizing their problems. Out of the original 3 villages AATP worked in, one is no longer actively involved, but 12 more villages have become involved in village needs technology project.

At school in Majengo, teachers use biogas for cooking. They needed dung from five cows to start the process after which dung from two cows (brought by pupils) keeps the gas continually available. Cost is 700 Tshs for materials for AATP multi-barrel biogas unit, compared to 1900 Tshs for Indian variety.

Joyce Stanley says in the two villages she worked in to determine needs, the questionnaire approach failed to provide an accurate reflection of villagers' needs, when compared to a village dialogue effort which stimulated local discussion and problem-solving efforts to reach a consensus from within the village. (Technique used at the beginning to stimulate the village was to perform two skits - one showed a development worker telling a village what they needed, while the other showed a development worker consulting the village and asking them to decide among themselves their needs, their own resources to meet the needs, and the gap that requires outside assistance.)

AATP plans to begin work on improved cookstove projects/reforestation soon.

Faculty of Agriculture at Morogoro

Keith Openshaw of the Faculty of Agriculture at Morogoro is actively involved in the International Center for Research in Agro-Forestry. The Director is Ken King, former Deputy Director of FAO. (PO Box 30677, Nairobi). Openshaw strongly recommended the book, Village Afforestation: Lessons of Experience in Tanzania by E. M. Muzava, Dar Es Salaam (1979 61 pp), which can be obtained through the Division of Forestry, Ministry of Natural Resources, Box 643, Dar Es Salaam.
To Town Centre...

Mafunzo kijijini. Training in village.

ARUSHA APPROPRIATE TECHNOLOGY PROJECT
Tel: 3594 Cable: ATARU

Excerpted from AATP literature.
Openshaw has a Tanzanian Ph.D. candidate, Mr. R. C. Ishengoma, who will begin his thesis research in August, 1979, on the potential for use of clay charcoal stoves in rural areas, concentrating on field test in a few Dodoma and Morogoro villages, to be financed by I.D.R.C. (He did his MSc on charcoal production of softwoods.) Although clay charcoal stoves are used widely in Asia, the only ones Openshaw has heard used in Tanzania are through SIDO efforts in prisons.

Openshaw says his Faculty of Agriculture is going to try developing some new species of fast-growing tropical trees and relocating some indigenous species to Dodoma. (E.g., the Calliandra Calothyrus of Indonesia matures in 18 months and can be coppiced and used for fuel wood as early as 12 months.) He says Dodoma will face severe land conflict problems when local grazing rights conflict with the planned greenbelt. Traditionally, forestry is restrictive, in which villages, clans, and tribes consider forest area in their territory as their property or under their use rights.

Openshaw mentioned the Shamba system practiced in one area where crops are grown for 2 or 3 years, then trees are planted, and rotated a number of years later to crops. He has also heard of inter-cropping food crops with young trees.

He feels he needs 3-5 year field test pilot project to say anything meaningful in Tanzania on this whole forestry/fuelwood improved stove area. He mentions a variation of the Thailand metal charcoal stove which burns efficiently and can be made for about $1.00 could be developed for Tanzania. It is the size of a bucket, has a scrap metal outside, ash insulation and clay and ash cement interior. He feels the approach in this effort must be through home economics services of the government and through Ministry of Agriculture's Education Department where teachers are trained for primary and secondary school. John Morris (American born in Tanzania) at Faculty of Agriculture in Morogoro (Head of Department of Agricultural Education and Extension) may be of assistance. Could base training at Agriculture Colleges or at Forestry Training School in Arusha, or Forest Training College in Kenya or new Department of Forestry at University of Nairobi. But funds oriented at these specific problems are needed because existing budgets are for basics and traditional forestry approaches only.

He figures annual per capita fuelwood consumption in Tanzania is 1.5m³. He also attributes much of deforestation to slash and burn land clearing techniques of agriculture, especially under population pressure. The rest is from regular burning to kill insects, rodents, disease and to allow for fresh grass (for herders) just before the rains. A very small portion of damage is due to demand for pole-wood for building (less than 10%) and maybe 20% is due to fuelwood demand.

**Action Recommendation**

That AID/Dar es Salaam, with assistance of REDSO/EA, AFR/DR/SDP and DS/EY further document the work of Arusha Appropriate Technology Project for the benefit of other EA/BLS posts and investigate the potential for developing a 3-year to 5-year project on improved fuelwood use/reforestation with Keith Openshaw at the Faculty of Agriculture at Morogoro and the Forestry Department. This should be designed to complement any planned Peace Corps work in the area.

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CHAPTER EIGHT

EA/BLS RENEWABLE & IMPROVED TRADITIONAL ENERGY PROJECTS APPROVED BY USAID

RWANDA

(Excerpted from AID's Rwanda Renewable & Improved Traditional Energy Project PID.)

Approved as an Accelerated Impact Program Activity, the Rwanda Renewable and Improved Traditional Energy Project 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. Subsequently, the Overseas Development Council fielded a PID Team to Rwanda which conducted an intensive series of meetings with Rwanda and U.S. officials and visited a number of Rwandan institutions during the week of 10-17 June 1978. 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 its 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 Centre CEAER in Rwanda", which the UNEP had been unable to fund.

Dr. Kalos expressed the concerns 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 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 tasks and processing, food preservation, and sanitation. Illustrative technologies might include mini-hydroelectric turbines, improved draft animal use, solar or wind pumps (for rural water supply and irrigation), bio-gas refrigerators (for human vaccines and other medicines in rural dispensaries), solar crop dryers, or improved stoves and charcoal kilns using local fuels such as wood or peat (including possibly rural community-managed wood-lots).

Project Summary

In response to Dr. Kalos' request, the project proposed 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 rural energy needs as determined through an ongoing dialogue and participation process with three representative rural communities as field test sites.
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) dialogues with, and surveys of the communities to determine their rural energy needs and baseline socio-economic data for end-of-project comparison, 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 pre-determined evaluation guideline questions in an assessment of the potential for renewable and improved traditional energy technologies to meet rural energy needs. 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 Self-help 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 Self-help 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.

Cost of Project

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.
LESOTHO

(Excerpted from USAID's Lesotho Renewable Energy Project PP.)

Project Summary

The project proposes to meet expanding energy demand, primarily among lower income groups, in ways that minimize national requirements for scarce, expensive or non-renewable energy. This will be done by disseminating a set of renewable energy technologies in rural pilot areas, while simultaneously developing the institutional basis for more general distribution of systems found to be technically, economically and socially feasible.

More specifically, the project will, on the one hand, minimize demand for combustible fuels through village level conservation measures such as (a) fuel efficient wood and dung burning mud stoves, (b) pedal power grain grinding, (c) thatch insulation and weatherization, and (d) passive solar greenhouses. On the other hand, research into increasing technologically appropriate energy production will be undertaken through introduction of (a) a feedlot anaerobic digester system for production of methane gas and sludge fertilizer (b) a mini hydroelectric production scheme. Success with these measures will mean achievement of the project purpose of disseminating renewable energy technologies, establishing their feasibility, and providing the basis for their dissemination nationwide.

This purpose can be achieved through the use of existing GOL personnel and facilities. Consequently, the project will not represent significant additional strain on GOL absorptive capacities and, especially, it will not involve increased recurrent costs.

The technologies will be introduced through an "in place" village implementation process using traditional village meetings and GOL community development staff and procedures. The introduction process involves the villagers in sociological, technological, and economic decision-making concerning possible technologies. Given the complexity of this process and the need for feedback as it proceeds, particular attention will be given to the project's implementation and evaluation procedures.

Project outputs will center on (1) trained field and headquarters staff, (2) establishments of a village-centered implementation and evaluation process, (3) village technologies introduced and evaluated, (4) research and development technologies introduced and evaluated,
(5) an operational research and development laboratory, and (6) construction of an energy efficient demonstration house. Inputs center on a three-person long-term technical assistance team, commodities, in-country training, and construction of the house.

The analyses undertaken in final project design indicate the project is technically, economically, socially and financially feasible.

Introduction of alternative technologies will represent the only way for many of the rural poor to meet their energy needs as supplies of coal, oil, and wood diminish and prices increase.

The environmental impact is benign. The negative determination given with the PID remains in order.

The GOL is firmly committed to the project and has already budgeted increased staff for full support.

Project Description

1. Project Goal and Purpose

The project proposes to meet expanding energy demand, primarily among lower income groups, in ways that minimize national requirements for scarce, expensive, or non-renewable energy. This will be done by disseminating a set of renewable energy technologies in rural pilot areas, while simultaneously developing the institutional basis for more general distribution of systems found to be technically, economically and socially feasible.

More specifically, the project will, on the one hand, minimize demand for combustible fuels through village level conservation measures such as (a) fuel efficient wood and dung burning mud stoves, (b) pedal power grain grinding (c) thatch insulation and weatherization, and (d) passive solar greenhouses. On the other hand, research into increasing technologically appropriate energy production will be undertaken through introduction of (a) a feedlot anaerobic digester system for production of methane gas and sludge fertilizer; (b) a mini hydroelectric production scheme. Success with these measures will mean achievement of the project purpose of disseminating renewable energy technologies, establishing their feasibility, and providing the basis for their dissemination nationwide.

The purpose of this pilot project can be achieved through the use of existing GOL personnel and facilities. Consequently, the project will not represent significant additional strain on GOL absorptive capacities and, especially, it will not involve increased recurrent costs. A follow-on nationwide program would involve increased recurrent costs, but the pilot program will have provided a clear picture of costs and benefits.
2. Outputs

Outputs can be grouped into six basic categories:

(1) A renewable energy technology staff trained and in place both at headquarters and in the villages and more importantly an institutional connection between village and headquarters activities.

(2) A village renewable energy technology implementation process established which is based on village definition of needs.

(3) Introduction and evaluation of the village renewable energy technologies and the associated social and economic factors.

(4) Establishment and evaluation of the research and development renewable energy technologies.

(5) A research and development laboratory made operational in existing facilities at headquarters and at rural RET training centers.

(6) Construction and evaluation of an energy efficient house for habitation by the Chief of Party, but also for project demonstration purposes.

It is estimated that 75% of the activity performed in achievement of these outputs will occur in the villages. Over 70% of the headquarters activity will be in direct operational support of the village level activity. Only the feedlot activity and headquarters operations in support of the feedlot activity do not directly support and benefit villagers. However, spinoff benefits of this experiment (such as employment, inexpensive fertilizer, and better veterinary services and marketing channels) may be realized by villagers. This activity is included for its significant long range potential.

Cost of Project

The Lesotho project budget is approximately $1.6 million over three years.
CHAPTER NINE

PROPOSED EA/BLS RENEWABLE & IMPROVED TRADITIONAL ENERGY PROJECTS IN VARIOUS STAGES OF DEVELOPMENT

BOTSWANA

(Excerpted from the USAID Botswana Renewable Energy Project PID.)

General Approach - The Renewable Energy Technology (RET) Program Study

The RET Program strategy is to support the GOB, parastatals and NGO's and small business private sector in the full exploration of RETs with significant development potential. Specifically, the RET Program will work with a variety of governmental and non-governmental organizations to demonstrate the superior performance of RETs as tools for development in different socio-economic sectors. The next step is to collaborate with these organizations, be they ministeries or small businesses as they successfully incorporate particular RETs into on-going programs reach the poor majority.

The first year of the RET Program is necessarily an exploratory phase when a series of small controlled technology and community development experiments will be conducted. The Botswana liaison staff will also receive their US and in-country training in RETs during this start up year.

The program will have three major linkages - one with the GOB and the energy problems of its different ministeries through the Appropriate Technology Center under the guidance of a parastatal board of governors, another with NGO's like the Rural Industries Innovation Center (RIIC), Pelagano Village Industries (PVI), and Brigade types organizations, and lastly with small business persons through BEDU and other private sector development organizations. The RET Program approach will be characterized by the following methodological principles:

(1) the core of RET experts from the U.S. will constitute an inter-disciplinary design and work group composed of a solar architect/engineer, a social scientist/technology transfer specialist, a small business developer and an applied technology trainer/workshop expert.

(2) the program will use a hands on community centered workshop approach to field test the technology and its acceptance by various target groups whether villagers of GOB field personnel; technologies will be reduced to user constructed and maintained systems where ever possible.

(3) the program will attempt to demonstrate relevant RETs in those GOB programs and in community settings with the highest felt need for energy innovations and the greatest willingness to help themselves; the idea is to fund demonstrations at sites and through constituencies with a high probability of success and replication, i.e., the interest of the BHC in solar water heaters.
(4) the across the board training of DOB field personnel, low income folks and representatives of organizations serving them in basic RETs aims at creating a network of Botswana RET experts who act as liaison between their organizations and the RET Program. Some of these persons will be seconded to the RET Program directly and with PCVs will constitute the RET training and demonstration cadre.

(5) whenever sustained demand for RETs is identified, the program will support the formation of a private or co-operative business to meet this need; likewise, the program will attempt to institutionalize reliance upon renewable energy sources by transmitting RET knowhow to persons teaching in schools, professional researchers, extension workers, etc. and by incorporating RETs into the craft traditions of villagers, i.e., high thermal performance owner built homes.

(6) the program will build upon and work through existing organizations to the fullest extent feasible; where ever possible the adaptive research and field testing of complex RETs should be conducted by NGO's and local businesses under contract.

It must be emphasized that each RET will be carefully studied, adapted, field tested and redesigned before Botswana are trained extensively in its use. Likewise, not all the recommended RETs will be developed simultaneously; rather, each year additional RETs will be brought into the program and disseminated. All demonstrations will be localized initially and become regional or national in scope in subsequent years.

The Proposed Renewable Energy Technologies

The RETs proposed in this program are based upon sophisticated applications of scientific knowledge about renewable energy processes. The methods for introducing these systems to Botswana "synthesize" this complexity by directly involving low income Botswana and DOB field personnel in the construction, installation, operation and maintenance of a specific system which is already well understood and proven under Botswana conditions. The "science process" is therefore experientially absorbed by the Botswana technology trainees as they discover how the system functions; they master the technology by learning how to reproduce it. This community technology development process has proven to be an effective way to introduce and sustain both new ideas and technologies. It involves the end user from the very beginning in defining their felt needs and learning technological solutions to these same needs under controlled workshop conditions. This method of turning technology development over to trainees allows the participants to thoroughly understand a given RET system from their cultural economic and social viewpoints; it becomes "their" solution. Once
people understand how the system works through building it, they can maintain the technology on their own. This is the "do it yourself" or self help technology process upon which the RET Program is largely based.

It is important to point out that RETs become most effective when the technologies are properly integrated to form complete systems. For example, in order to utilize a wind driven water pump at a borehole, a hand pump may be needed as a back up for periods of calm. Hand techniques for drilling shallow boreholes may be needed to make the whole system cost effective. If solar water heating, cooking, and space heating can be integrated into one system, the practical value and overall cost performance are dramatically increased by combining functions.

Technologies have been identified by the PID team as relevant responses to high priority needs of low income Botswana and the country's energy connected development problems. The technologies are categorized as 'in use' in the country, 'proven' utility within the country, 'requiring adaptation' to the people and environmental conditions, and 'developmental' technologies in need of further in-country research.

Cost of Project

The project, which was originally budgeted at $6 million for five years, is likely to be revised to the $1 million level over a three-year length-of-project.
The original Swaziland Renewable Energy Project PID is in a second draft, as a Mini-PID on Alternative Energy for Swaziland. It is to be a pilot research project under central funding through the regional project AIP, "Energy (931-9035)". It will be titled, "Alternative Energy Substitute for Electricity and Conservation Natural Resources."

The goal is to test interest and ability of GOS organizations as past managers to implement an alternative energy technology project and the level of interest and acceptance by rural poor. AID is to contract with a U.S. institute to implement the pilot effort, and eventually if warranted, prepare a full-scale project. The U.S. contractor is to provide an Alternative Energy Physical Scientist and a Social Scientist for 2-6 weeks in Swaziland, to contract with a Swazi firm/institute to implement the pilot project under the Swaziland National Resources Council. The following institutions will be involved:

1) Swaziland consultant engineering firm with experience
2) Ministry of Education - rural education centers
3) Ministry of Health - rural health center
4) Ministry of Agriculture - rural development areas
5) also Ministry of Agriculture's Extension Field Office, the Research Division of UBS College of Agriculture, and the Rural Education Coordinator.

The Swazi contractor is to manufacture, install and maintain devices; spread information; do workshops. The U.S. firm is to return periodically over 2 years for 1 - 2 weeks at a time to review, adjust, evaluate and guide the project. The project will total 24 months with ten man months by U.S. firm. It is hoped over the length-of-project to have 80-100 energy devices installed.

Cost of Project

The budget is likely to be in the range of $350,000-$500,000.
Proposed Solar Energy for the Villages Pilot Project (SEVPP)

The purpose of the proposed Solar Energy for Villages Pilot Project (SEVPP) is to provide Tanzanian policy makers with information and sufficient field test experience in villages in order to present them with guidance on how to improve the quality of life in rural Tanzania through the use of renewable and improved traditional energy technologies:

1. to relieve human drudgery, associated especially with domestic water and cooking fuel needs;

2. to ease the economic burden at the national level associated with dependency upon imported fossil fuels, especially to meet rural water pumping and domestic cooking fuel needs;

3. to ease the pressure on the environment associated with use of firewood, brush, crop residues, dung, and charcoal for fuel purposes;

4. to ease the financial burden at the village level associated with ever-increasing prices of both fossil fuels, wood and charcoal;

5. to help meet other priority Tanzanian goals, such as improved agricultural productivity, off-the-farm employment, nutrition, literacy, and sanitation through use of critical inputs of energy in more abundant, affordable, convenient, or reliable form than would conventionally be available.

UTAFITI (the Tanzanian National Scientific Research Council) should ensure that all parts of this project should be designed to the greatest extent possible so as to answer the project guideline questions listed below, which will serve as the foundation for the initial, interim, and final evaluations scheduled during SEVPP:

1. How well does a given device perform technically within the physical conditions of the village? Are the necessary human and physical resources available?

2. How do its costs compare with other energy technologies?

3. How acceptable is the device in terms of attitudes and preference?
(4) How does it provide an advantage to existing or prospective village institutions that could own, operate, and maintain it? at the family level? at the communal level?

(5) What can be learned about the best techniques for determining the needs of the village and for selecting and introducing a technology into the village to meet these needs? Are implication procedures responsive to villagers' expressed needs, capabilities, and degree of willingness to participate?

(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?

In questions 3, 4, 5, and 6 special attention should be given to the consequences for village women of the introduction of the new technology, and to the extent to which village women are involved in design and implementation of activities at the village level.

Since this is a pilot project, only a small number of field test villages (up to 33) are envisioned in its initial Phase I and II. If warranted, the number of field test villages will be expanded substantially in Phase III (up to 50) in order to test broader regional application of lessons learned from the initial field tests. The combination of these extended field tests and the substantial emphasis to be given to institution building and training is designed to help prepare Tanzania itself for a later phased acceleration of efforts after the end of this pilot project, if so decided by the Government, to meet priority energy needs for the majority of villages during the next four five-year development plan periods.

SEVPP should be an inter-agency effort coordinated by UTAFITI, with policy directives set by the National Energy Committee, in collaboration with the University of Dar es Salaam to set up a Solar Energy Unit at the UTAFITI Secretariat under the proposed Industrial and Technological Research Department.

This Solar Energy Unit would serve as SEVPP headquarters and coordinate the four major parts of the SEVPP strategy, described below:

**Part 1: Develop a Rural Energy Research Center (RERC) in the Dodoma Region in the Dodoma/Kongwa area probably located on Chamwino or Hombolo.** The RERC will import, adapt, and develop prototypes of technologies after careful preparation (social, economic, and technical) suited to the needs of at least six nearby villages (representative of the Dodoma Region) as
determined jointly by RERC staff and a Village Energy Committee from each village. The technologies will be field tested under the guidance of the RERC, but they should be installed, operated, maintained, (and in some cases owned) monitored, modified, and repaired by local village participants (including trained Village Energy Technicians) to the greatest extent possible. After an evaluation with input from Village Energy Committees, UTAFITI will decide whether successful devices and introduction techniques are worth encouraging the Dodoma Region authorities to extend throughout the POMO to other regions with proper modifications to suit local conditions.

Part II: Expand the Ongoing Promotion of Biogas in Rural Areas by both the Small Industries Development Organization (SIDO) and the Ministry of Water, Energy, and Minerals (MAJI).

This part II of the strategy will seek to evaluate ongoing biogas work, train more SIDO biogas technicians, supplement MAJI's water pumping efforts using biogas, and test biogas for household and village communal needs.

Part III: Introduce and Monitor Mini-Hydroelectric Units in up to one dozen villages in the most promising areas of the country to consist of:

(a) Evaluation of existing mini-hydroelectric installations.

(b) Investigations of existing data to pinpoint potential new sites.

(c) Organizing Village Energy Committees and training of TANESCO and/or MAJI staff and Village Energy Technicians to install, operate, repair, maintain, monitor, and evaluate mini-hydro units.

(d) Installation and monitoring of units.

(e) Evaluation of units and recommendation to the Government of Tanzania for new sites for extension, if so warranted.

Part IV: In order to facilitate rapid extension of renewable and improved traditional energy technologies deemed successful after evaluation of Parts I-III of this project, this Part IV of the strategy will seek to conduct Village Energy Profiles in Dodoma Region, in Arusha Region, and elsewhere in order to:

(a) Evaluate existing meteorological data and socio-economic data where relevant.

(b) Improve and expand such data collection.

(c) Monitor and analyze new data collected.

(d) Select specific villages for extended field testing in Phase III.

Cost of Project

Estimated project costs would have been approximately $7.5 million over five years, funded on a multi-donor basis with likely AID contribution. Currently, the project is still under consideration by the Government of Tanzania, but is expected to go ahead eventually with a project centered on the arid Dodoma region only, at least at first.
MAURITIUS

(Excerpted from the Mauritius Alternative Energy Project PID submitted by Dr. Maurice Raiford, August, 1979 to USAID.)

Recommendations

Mauritius seems to be a country that is well enough organized, manageable-enough in size, and keen-enough in interest to achieve real accomplishments in implementing renewable energy usage in a fairly short time and in relatively significant amounts. It could thus not only benefit the country itself but also serve as a good example or model for other countries in Africa and elsewhere.

That USAID provide funding to the Government of Mauritius as soon as possible, for a 3-year period initially, for alternative energy development. These funds would be channeled through the Ministry of Energy to support the development of a solar database and handbook, the installation of test and demonstration equipment for the various existing technologies, the creation and operation of a Mauritius Alternative Energy Research Institute, and provision of consultants and faculty exchange.

A National Energy Board, on the other hand, can be set up immediately by the Government of Mauritius and begin its planning and policy-making functions, without need of any funds - except those which would be channeled through AERI for services required from it.

AERI would be operated by the University of Mauritius under contract to the Ministry of Energy with AID funds. As proposed, AERI initially would operate largely using existing University faculty and facilities to the extent available, with modest addition of staff and funds. Then, after the initial 3-year period, the whole set-up should be reviewed. If it has grown as hoped, a more full-time staff and larger, permanent quarters and facilities could be considered at that time for the next phase. AERI may begin attracting some of its own research funds, and the Government of Mauritius may be able to allocate funding to it, by that time. However, AID should be prepared to continue funding of the Institute if needed, so that it is not just dropped at the end of the initial period or possibly become a difficult burden on the Government's limited resources if dropped in its lap.

The Director of AERI should be a Mauritian, chosen perhaps from the University itself, by the Minister of Energy, the NEB, and the Vice-Chancellor of the University. It would probably be a good idea
for an American energy expert to serve as advisor, feeding him necessary information and advice by mail from the U.S. during the year, making a short visit each year to Mauritius. There should also be a faculty exchange set up between the University of Mauritius and a suitable American university, preferably North Carolina A&T State University, with a Mauritian coming over the first summer for a 2-month's stay, and then an American going there for a similar stay the following year, etc.

Meanwhile, this first year the solar data base and handbook could be compiled and generated by the computer program already operational at North Carolina A&T State. This should be done immediately so that the solar workers in Mauritius have the basic data necessary for their solar and related research and design work.

Concerning the large-scale schemes for sea-wave, geothermal, and wind energy, USAID funding should not be recommended at this time despite their merit, since they are costly and Mauritius is currently under negotiation with the U.K., Russia, and France for finance of these projects, respectively. AERI should support this work. Production of alcohol from sugar juice or molasses should be financed locally by the sugar industry and possibly the government. A lot of background study has already gone into it.

Cost of Project

AID funding for the 3-year period recommended for AERI, demonstration units, etc. comes to $328,500.
Ethiopia

(Adapted from the pre-PID documents submitted to USAID by James Bever in 1978.)

The Ethiopian National Energy Committee (a new and as yet unproven entity within the Ministry of Mines, Energy, and Water) considers assistance in the energy field imperative in order to improve the quality of life in the rural areas and increase productivity in agriculture, to arrest deforestation and resulting soil erosion, and to relieve dependence upon imported fossil fuels. From 1978 discussions with officials there does seem to indeed be a great deal of interest in the potential of assistance especially in the area of developing renewable energy technologies using solar, wind, biogas, small hydroelectric, and small geothermal sources, in the area of improved traditional energy techniques such as cook stoves and draft animals, and in the area of conducting a nationwide comprehensive energy survey as a prelude to design of a national energy plan. Some discussions in 1978 seemed to indicate potential for serious and possibly positive consideration of project proposals developed by USAID in these areas by the Minister of Mines, Energy and Water and perhaps by the Planning Commission, although no talks were held with any officials of the latter. The suggestion was offered that to whatever extent USAID merged its efforts with major multilateral donor agencies such as IBRD or UN, the better its chances of success with the Planning Commission. Alternatively, or in conjunction with this, to whatever extent any of these activities which could be channeled through the Relief and Rehabilitation Commission, the better the chances for successful consideration by the government.

A proposal from EELPA had been submitted to USAID/Addis in 1974-76 period, to which USAID never responded apparently.

USAID priorities would be to offer to prepare a feasibility study/proposal for the government in detail for the national comprehensive energy survey and to offer to assist in the investigation of and development of alternatives to fossil fuel and current traditional fuel use techniques in the rural areas. The latter would include rural energy studies, training of researchers on renewable technologies, support of pilot projects and field tests in village settings, renewable and traditional energy data collection, and eventually support of mass production and extension schemes for successful technologies. Of lower priority would be assistance to EELPA for training its engineers and other items related to grid extension and electric cooker development, as there are more likely to be of interest to IBRD and successful on their own merits, respectively.

Cost of Project

The mission had internally prepared a $500,000 AIP and had earmarked in its planning documents for an energy project budgeted at $10 million over a five year period from FY '82-'86. However, the invocation of the Hickenlooper Amendment has indefinitely suspended the momentum well underway for further development of energy assistance to Ethiopia.
CHAPTER TEN

EA/BLS RENEWABLE & IMPROVED TRADITIONAL ENERGY ACTIVITIES YET TO BE INVESTIGATED BY AID

SOMALIA

(Adapted from a paper submitted to the 1979 African Solar Energy Workshop in Atlanta.)

PROSPECTS OF SOLAR ENERGY UTILIZATION IN SOMALIA

by

Ali Hagi Aden
State Planning Commission

Energy Situation

Somalia has not been able to undertake, so far, commercial exploitation of oil and mineral resources which are known to exist. Located in the equatorial region, with an annual rainfall below 600 mm in many areas, being devoid of irrigation facilities in the northern and central parts and with only some portion of the land being arable, the country is considered to be in the semi-arid zone. A vast majority of the people are pastoralists, depending upon livestock rearing. About 15 percent of the population are engaged in small scale agriculture, fishery, and forestry. The economy of the country is mainly dependent upon livestock and agriculture.

Conventional sources of energy like oil, coal, etc. are almost lacking in the country. The potentialities of hydroelectric power are uncertain. Only firewood and charcoal are available local raw materials, meeting some part of the domestic fuel requirements. The annual consumption of firewood and charcoal is about 17,000 and 25,000 tons respectively in Mogadishu city. The continued use of firewood and charcoal in an uncontrolled manner cannot be encouraged as it depletes forest wealth and causes environmental problems. The country is now mainly dependent upon imported oil for meeting its energy needs. In 1977, over 104,000 tons of petroleum and petroleum products were imported at a heavy cost in foreign exchange. Against this background, Somalia has to look for alternate sources of energy within the country, in order to minimize dependence on imported oil supplies.

Work Done in Somalia in Solar Energy Utilization

In spite of great potential for utilization of solar energy, no systematic plans have yet been drawn for solar energy as an alternative to conventional energy sources. However, a few isolated attempts have been made in the country to study and understand the potential of solar energy.

Solar Water Distillation

With assistance from UNICEF, a project has been recently carried out by UNIDO for the installation of a solar distillation plant of 5,000
lit/day capacity at a village Kuda (Kulmis) in the southern part of Somalia, with a view to supply drinking water to fisherman rehabilitated from other places. The technical know-how developed in India has been made use of in the project. In addition to the main plant, the project envisaged setting up an experimental station of 200 square meter area and installation of smaller stills of about one square meter area at ten different locations in the country. The principal construction materials are bricks, cement, sheet glass, plastic, tar, mastic tank paper, aluminum profile sheets and galvanized pipe. The findings of the project are that there is a good scope for using solar distillation techniques, that the required materials could mostly be locally and that the climatic conditions are quite favorable. However, the training of personnel for the construction of the plant, using locally available materials, has been considered necessary. The project had also recommended setting up an experimental station to gain experience and build up capability to use indigenous materials.

Solar Drying

The UNDP/FAO Project on Grain Marketing, Storage and Price Stabilization in Somalia may experiment with the possibility of sun drying of farm produce.

At Faculty of Engineering

The Faculty of Engineering, Somali National University is proposing to take up some theoretical and experimental work in the area of solar energy utilization. It is expected that the Faculty of Engineering, in its programme of activities, will make use of the research and development work and the technologies developed in other countries and undertake modifications, to the extent necessary, to suit local conditions and to use locally available material.

Possible Areas of Solar Energy Utilization in Somalia

Solar Water Pumps

Water supply for domestic needs, especially in remote villages in arid regions, is a serious problem requiring urgent attention. At present, considerable hardship is being experienced by people living in rural areas, due to lack of adequate water supply. The use of mechanically operated pumping equipment has limitations due to factors like cost, uncertain fuel supply, maintenance and repair and skilled workers. In this situation, provision of solar pumping station, as a part of the community development programme would be a practical and worthwhile means of ensuring domestic water supply to villages.
As stated already, the nomads are the backbone of the economy of the country. They are constantly on the move towards watering places to sustain themselves and their cattle. But the watering places are generally a few in number and are in distant and remote locations. The nomads tend to concentrate in these few places, which are not only inadequate but also lead to certain social problems. It is possible that by employing small solar water pumping equipment, which requires no external fuel supply, the watering places could be multiplied several folds in the remote areas and the question of adequate provision of water to the nomadic population and their precious cattle, could thus be solved.

There is also scope for using solar pumps for irrigation. Solar pumping systems could prove to be more economical than a system using diesel engine. It is also comparatively free from pollution. The cost in foreign exchange and uncertainties in the supply of diesel oil should encourage use of solar pumping systems.

Notwithstanding the initial cost of investment, the solar pumping system has advantages like low operating cost, local generation and availability of energy sources, and environmental safeguard. Further, no skilled workers are necessary for operation and maintenance of the system. It is possible to obtain from other countries the technology already developed and use it with proper adaptation to suit local conditions.

**Solar Water Distillation**

Frequent drought conditions are not uncommon and acute shortage of drinking water prevails in some parts of Somalia. One of the possible solutions to overcome this problem is to distill sea water or brackish water to obtain potable water. Somalia could perhaps make a beginning with similar type of solar stills for desalination and supply of drinking water. Small scale production may very well meet the requirements of the rural communities. From the cost point of view, solar stills may be more expensive than the conventional distillation plants. However, for small units to be installed in remote areas in the arid regions, solar stills may be the only choice. It is expected that the results of the UNIDO Solar Distillation Project carried out in Somalia would pave the way for widespread use of solar stills for solving the complex problems of supplying safe drinking water to the rural communities.

Solar salt production has been in existence in the Hafun and Gezira areas for a long time. It is essentially a process of desalination of sea water to produce salt. In this process, drinking water can be made available. It may be worthwhile to integrate the solar salt manufacture with the production of drinking water.
Solar Drying

Sun drying of grains, fruits and vegetables, meat, fish, hides, and skins, etc. is an age old practice in Somalia, as it is so elsewhere also. In recent years, more systematic processes have been developed for sun drying. A variety of solar driers have been fabricated. Somalia could very well adopt more scientific methods of sun drying to improve efficiency, quality and economy. There is scope for small scale as well as large scale systems for dehydration of agricultural products. Individual farmers with small holdings, meat producers, and fishermen who are mainly concerned with the sale of their modest surpluses in the local and nearby markets, need simple, inexpensive and small scale systems. Marketing on a large scale of grains, bananas, livestock products, and fish and marine products are extremely important from the point of view of export earning. At present, artificial drying process requiring imported fossil fuel power sources are employed. The technologies being developed in other parts of the world for using solar energy singly and in conjunction with conventional power systems can be profitably adopted in Somalia for dehydration of agricultural products.

Other Applications

Solar water heating to produce hot water for domestic or agro-processing purposes, and solar-powered or biogas-powered refrigeration for medicines are some of the other applications worth considering by Somalia.

Some Techno-Economic Considerations

In the present stage of development, Somalia could not possibly go in for sophisticated, high technology areas in the matter of application of solar energy. The level of indigenous technology is such that commercial exploitation of solar energy on a large scale would not be practical. The more relevant and purposeful approach is to make use of simple, inexpensive and low technology applications. The emphasis should be to make use of locally available materials in the techniques of utilizing solar energy. The technology must also be capable of being used by local people with local skills.

Conclusion

It would be appropriate, at this stage, to frame a national policy and draw a programme of action for utilizing solar energy to supplement the existing energy supply. In this connection, the socio-economic condition of Somalia and the capability of indigenous technology to absorb the foreign know-how should be kept in mind.
It is advisable to initiate some experimental and theoretical work in the area of solar energy utilization. To begin with, adaptation of foreign technologies to suit local conditions may receive attention. Later on, problem-oriented original research and development work could be taken up. A suitable institution is required to be designated for being responsible for research and development in solar energy application. Technical assistance from other countries may be necessary in the initial setting up of the institution.

Somalia needs technical assistance from other countries and international organizations for transfer and absorption of technology, for developing prototypes, for initiating manufacture of equipment and for training of personnel. It is fervently hoped that such technical assistance will be forthcoming soon, while we still have time to develop our alternative energy institutions before the energy crisis worsens further.

Action Recommendation

That AID/Mogadishu, with REDSO/EA and AFR/DR/SDP and DS/EY assistance, investigate the potential for AID assistance to Somalia in building their energy institutions and in projects aimed at field testing technologies designed to meet pressing rural needs. A one-week to two-week visit by an energy development specialist would probably suffice to determine the advisability of whether a PID design team should follow. More emphasis should be given to improved traditional energy, such as improved cookstoves, kilns, etc.
UGANDA

Uganda has UNICEF assistance in village technology project in Mukono. UNICEF is the only group doing anything in village technology. Jim McDowell of UNICEF will be in charge of UNICEF in Uganda. (He had been promoting use of local solar driers in Kitui District in Kenya due to interest in food preservation.)

Mr. Makubuis is Deputy Chief Inspector of Schools and Coordinator of Basic Education Project for Ministry of Education.

Faculty of Technology at University of Makerere is weak on village technology as is the Uganda Teacher's College, designed to train people for post-primary technical schools teaching. Principal Nathan Baryamujura is trying to get away from only the curricular of the East African Certification, which is aimed at preparing industrial workers, and more toward an emphasis needed now on preparing village technology workers.

Action Recommendation

REDSO/EA and AFR/DR/SDP or DS/EY should investigate the potential for providing financial or technical support for UNICEF activities in village technology, especially for extension work in the villages after training in UNICEF training center.
MALAWI, ZAMBIA, DJIBOUTI, SEYCHELLES, BURUNDI

There has been little AID involvement in energy related activities in these countries, except peat project in Burundi and a forest project for Burundi which is still under consideration.

Except for University of Zambia work on solar ponds and a Clark University study which emphasized the abundance of windmills in use on commercial farms, there is little known by the consultant underway in renewable energy in Zambia. Malawi activity is limited to that on p. 1.

Action Recommendation

That the Djibouti effort be part of any Sudan, Ethiopia, Somalia energy regional study which AID may cooperate on with UNEP, or any AID energy project identification effort to Somalia or Sudan, because of the closeness of the areas and of their climate conditions. Any investigative effort in Seychelles should receive low priority due to its relative affluence, but most of all it may be possible to benefit from the Mauritius experience if AID funds an energy project there, due to the relative proximity and economic and climate similarities. The Burundi peat project should be investigated as to the extent to which it is helping ease the fuelwood problem for rural populations, as it has been heard that it concentrated on industrial uses. The opportunity to develop rural reforestation projects for fuelwood use, as well as village technology projects based on or assisting UNICEF work, should be investigated, and the opportunity to benefit from work on renewable and improved traditional energy through the Rwanda AID AIP project should be kept in mind. Activities in Malawi and Zambia should be investigated during the next AID-sponsored project design work in Southern Africa in the BLS countries, for they may very well have activities ongoing which would be of interest to other countries.

To the extent that REDSO/EA or AFR/DR/SDP help support UNICEF village technology extension efforts in these countries, AID will have much more rapid results to show for its financing, because of the fact that UNICEF has already laid some foundation to work at the village level in areas including renewable and improved traditional energy technology.