PD-AAJ-455 PN-959 650-0041

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT DATA SHEET

1. TRANSACTION CODE: A (A = Add, C = Change, D = Delete) — Amendment Number

DOCUMENT CODE: 3

2. COUNTRY/ENTITY: SUDAN

3. PROJECT NUMBER: 650-0041

4. BUREAU/OFFICE: AFR — 06

5. PROJECT TITLE (maximum 40 characters): RURAL RENEWABLE ENERGY

6. PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 09 DD 30 YY 86

7. ESTIMATED DATE OF OBLIGATION (Under 'B.' below, enter 1, 2, 3, or 4)

A. Initial FY 81 B. Quarter 4 C. Final FY 85

8. COSTS ($000 OR EQUIVALENT $1 = LSO.80)2.5 DM = $1

A. FUNDING SOURCE	FIRST FY 81 B. FX	C. L/C	D. Total	LIFE OF PROJECT E. FX	F. L/C	G. Total
AID Appropriated Total	1000		1000	4600		4600
(Grant)	(1000)	( )	(1000)	(4600)	( )	(4600
(Loan)	(-)	( )	( )	( )	( )	(
Other U.S. 1.						
Other U.S. 2.						
Host Country	-0-	910			3000	3000
Other Donor(s) West German				1400		1400
TOTALS	1000	910	1000	6000	3000	9000

9. SCHEDULE OF AID FUNDING ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	C. PRIMARY TECH. CODE 1. Grant	2. Loan	D. OBLIGATIONS TO DATE 1. Grant	2. Loan	E. AMOUNT APPROVED THIS ACTION 1. Grant	2. Loan	F. LIFE OF PROJECT 1. Grant	2. Loan
(1) ST	740B	878		1000		1000		4600	
(2)									
(3)									
(4)									
TOTALS				1000		1000		4600	

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each)

11. SECONDARY PURPOSE COD 742

12. SPECIAL CONCERNS CODES (maximum 7 codes of 4 positions each)

A. Code	BR	BU	RGEN	PART			
B. Amount	1600	1600	1800	1600			

13. PROJECT PURPOSE (maximum 480 characters)

To assist the GOS in developing an applied research and dissemination capability in rural renewable energy technology, with verification through application of results in rural areas.

14. SCHEDULED EVALUATIONS

Interim MM 04 YY 83 MM 05 YY 84 Final MM 08 YY 86

15. SOURCE/ORIGIN OF GOODS AND SERVICES: ☐ 000 ☒ 941 ☒ Local ☐ Other (Specify)

16. AMENDMENTS/NATURE OF CHANGE PROPOSED (This is page 1 of a ____ page PP Amendment.)

* LOP costs only

17. APPROVED BY

Signature

Title: Director USAID Sudan

Date Signed: MM 08 DD 31 YY 81

18. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION

MM DD YY

AID 1330-4 (8-79)

ACTION MEMORANDUM FOR THE DIRECTOR, USAID/SUDAN

FROM : Steven P. Mintz, Capital Projects Officer Steven P. Mintz

SUBJECT: Project Authorization: Rural Renewable Energy
Project No. 650-0041

I . Problem: Your approval is required for a grant to the Government of Sudan (GOS) in the life-of-project amount of $ 4.6 million from FAA Section 106, (Selected Development Problems) for the Rural Renewable Energy Project.The FY81obligation for this project is $ 1.0 million.

II. Discussion: (A) The project is designed to assist the Government of Sudan develop an applied research and dissemination capability in rural renewable energy technology (RET). This is expected to result in the wide-spread use of inexpensive renewable energy technologies which are economically, socially and environmentally sound, thereby conserving energy resources and improving the standard of living of the rural poor majority in the Sudan.

To accomplish these objectives, a Sudan Renewable Energy Center (SREC) administered and controlled by the Energy Research Council (ERC) will be established at Soba. This Center will be responsible for the following activities during the five-year life of the project:

a. preparation of rural energy use studies;

b. development, field testing and dissemination of RETs;

c. assessment of SREC manpower needs and training of Sudanese counterparts;

d. evaluation of technologies;

e. installation of RETs;

f. support and encouragement of private sector organizations, government organizations and PVOs active in RET dissemination;

g. establishing a RET information center;

h. procuring, developing and publishing training materials;

i. evaluating dissemination channels for RETs; and

j. evaluating project results.

The project is consistent with A.I.D.'s energy policy. Moreover it supports USAID/Sudan's CDSS strategy to assist GOS efforts to institutionalize an ability to meet the alternative energy needs of the poor. Primary project beneficiaries will be rural population who adopt the RETs developed and disseminated by the Center.

(B) Funding for the project will be drawn from A.I.D. ($ 4.6 million) and supported by LS 2.4 million in local currency to be drawn from CIP generations and GOS budget contributions. The West Germans are contributing $ 1.4 million to the support of the Center.

The project will be partially funded in FY 1981 with LOP requirements totalling $ 4.6 million. The components of the project are as follows:

	$000 FY 81	$000 LOP
Technical Assistance	364	1230
Training	114	458
Commodities	219	323
Other Costs	65	65
Inflation	-	316
Contingencies	76	207
Renewable Energy Development Grants	162	2001
Total	1000	4600
Host Country contribution	910	3000

(C) Socio-economic, technical and environmental analyses:
The project analyses relating to socio-economic, technical and environmental acceptability have been reviewed and found to be appropriate. No engineering review is required as AID funds will not be used for construction. At the time of PID approval, a negative determination was made regarding the need for an Enviromental Assessment prior to project authorization. However, an IEE will be performed prior to AID approval of each renewable energy development grant during the implementation of this Project. There are no human rights issues currently facing the Sudan.

(D) The conditions precedent to initial disbursements for this project include:

(1) A statement of the name(s) and specimen signatures of the GOS representative(s) for the project; and

(2) Evidence that the necessary foreign exchange will be available from the FRG (or another source) to assure construction of the Center at Soba.

Additional conditions precedent have been added as follows:

(1) Prior to disbursement of funds for the prime technical assistance contract, evidence will be submitted that the Sudan Renewable Energy Center is being adequately staffed; and

(2) Prior to disbursement for renewable energy grants, adequate documentation, analyses & certifications on the proposed activity will be submitted to and approved by USAID.

Covenants have been included to indicate GOS responsibilities for establishing an evaluation program, assuring the timely availability of counterpart funds to support local costs, providing interim office space and establishing a coordinating committee. These responsibilities have been discussed with the appropriate GOS authorities. The Energy Research Council (ERC) is the principal implementing entity of the GOS. Dr. Yahia Hamid has been charged by ERC with overall project direction. U.S. technicians assigned to the project will function in a collaborative style, working jointly with GOS counterparts in an advisory capacity.

(E) The project was reviewed by the project review committee on August 13, 1981 and recommended for authorization. A Congressional Notification was sent to Congress on July 14 and expired on July 29, 1981.

(F) The principal officer responsible for the project at USAID is James Beebe. It is expected that upon his arrival the USAID engineer will assume responsibility for the project. The AFR/DR backstop is Alex Newton.

III. Recommendation: That, based on the authority delegated to you by State 080748 dated March 31, 1981, you sign the attached Project Authorization and thereby authorize the project.

PROJECT AUTHORIZATION

Name of Country: Sudan

Name of Project:

Rural Renewable Energy

Number of Project:

650-0041

1. Pursuant to Section 106 of the Foreign Assistance Act of 1961, as amended, I hereby authorize the Rural Renewable Energy Project for Sudan involving planned obligations of not to exceed $ 4,600,000 in grant funds over a five year period from the date of authorization, subject to the availability of funds in accordance with the A.I.D. OYB allotment process, to help finance foreign exchange and local currency costs for the project.

2. The project consists of assistance to the Grantee to strengthen the capability of Sudan Renewable Energy Center to develop and disseminate renewable energy technologies. AID funding will be used to assist in financing technical assistance, participant training, commodities, renewable energy development grants and other costs in support of project activities.

3. The Project Agreement which may be negotiated and executed by the officer(s) to whom such authority is delegated in accordance with A.I.D. regulations and Delegations of Authority shall be subject to the following essential terms and covenants and major conditions, together with such other terms and conditions as A.I.D. may deem appropriate.

4. a. Source and Origin of Goods and Services

Goods and services, except for ocean shipping, financed by A.I.D. under the project shall have their source and origin in the Cooperating Country or in countries included in A.I.D. Geographic Code 941 except as A.I.D. may otherwise agree in writing. Ocean shipping financed by A.I.D. under the project shall, except as A.I.D. may otherwise agree in writing, be financed only on flag vessels of the United States of the Cooperating Country.

b. A procurement source waiver from Geographic Code 000 (US only) to Geographic Code 935 (Special Free World) for 6 Suzuki motorbikes, for a total of US dollars 12,000, is attached.

c. The following conditions precedent and covenants are included in the project grant agreement:

Conditions Precedent to Disbursement

(a) First Disbursement: Prior to the first disbursement under the Grant, or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made, the Grantee will, except as the Parties may otherwise agree in writing, furnish to A.I.D. in form and substance satisfactory to A.I.D.

(1) A statement of the name of the person holding or acting in the office of the Grantee specified in Section 8.2, and of any additional representatives, together with a specimen signature of each person specified in such statement.

(2) Evidence that the necessary foreign exchange will be available from the Federal Republic of Germany (or such other source) to assure construction of the Sudan Renewable Energy Center at Soba.

(b) Disbursements for Technical Assistance and Training: Prior to the disbursement of funds for the prime contract for technical assistance and training, or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made, the Grantee will, except as the Parties may otherwise agree in writing, furnish to A.I.D. in form and substance satisfactory to A.I.D. evidence that the Sudan Renewable Energy Center is being staffed sufficiently to permit the effective execution of the Project.

(c) Disbursements for Renewable Energy Development Grants: Prior to the disbursement of funds for each renewable energy development grant, or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made, the Grantee will, except as the Parties may otherwise agree in writing, furnish to A.I.D. in form and substance satisfactory to A.I.D. information and documentation describing and analyzing the proposed activity and certification that the proposed activity has been reviewed for technical, economic, and environmental soundness.

The Grantee shall covenant in substance as follows:

(A) To establish an evaluation program as part of the project

(B) To provide adequate counterpart funds on a timely basis to support both the local staff and the local costs of the Project.

(C) To provide suitable interim office space for the expatriate advisors including provision of available electricity, water, etc.

(D) To establish a coordinating committee to ensure effective coordination of the USAID and West German contributions to the Sudan Renewable Energy Center.

Director USAID/SUDAN

Date: August 31, 1981

TABLE OF CONTENTS

		Pages
	Facesheet	
	Project Authorization	iv
I	PROJECT SUMMARY AND RECOMMENDATIONS	1 - 4
	A. Recommendations	1
	B. Project Description	1
	C. Summary Table	4
II	PROJECT BACKGROUND	5 -12
	A. General Demography of the Sudan	5
	1. Present Energy Sources	5
	2. Government of Sudan Efforts	7
	3. Private Voluntary Organization Efforts	9
	4. Private Enterpise Opportunities	9
	5. Sudan Renewable Energy Project	9
	Organization Chart of Sudan Renewable Energy Center	
	6. Other Donor Efforts	12
III	PROJECT DESCRIPTION	13-25
	A. Program Goal	13
	B. Project Purpose	13
	C. Project Outputs	14
	D. Project Inputs	17
	E. Project Organization	20
	F. Renewable Energy Development Grants	23
IV	PROJECT ANALYSIS	
	A. Technical Analysis and Technical Management	26-57
	B. Summary of Social Soundness Analysis	26
	Social Soundness Analysis	38
	I Socio-cultural Feasibility	40
	II Role of Women	40
	III Spread Effect	46
	IV Beneficiaries	47
	C. Economic Analysis	50

		Pages
V	FINANCIAL PLAN	58-62
	A. Summary	58
	B. Budget	60
	C. Local Currency Table	62
VI	IMPLEMENTATION ARRANGEMENTS	62-65
	A. GOS Implementation Responsibilities	63
	B. USAID	63
	C. Contracter Selection and Responsibilities	63
	D. Evaluation Arrangements	64
	E. Conditions and Covenants.	65

ANNEXES

I	LOGICAL FRAMEWORK
II	PID APPROVAL CABLE
III	TRAINING SCHEDULE
IV	JOB DESCRIPTIONS
V	IER STAFF
VI	STATUTORY CHECKLIST
VII	LIST OF ACRONYMS
VIII	GOS LETTER OF REQUEST
IX	PRIVATE VOLUNTARY ORGANIZATIONS EFFORTS
X	IEE
XI	ILLUSTRATIVE COMMODITIES LIST
XII	FORMATION OF THE ENERGY RESEARCH COUNCIL

SUDAN VILLAGE RENEWABLE ENERGY PROJECT

PROJECT NUMBER 650-0041

1. PROJECT SUMMARY AND RECOMMENDATIONS

Section A. Recommendations

This Project Paper recommends that:

1. AID assist the Government of the Sudan (GOS) in strengthening the ability of the Sudan Renewable Energy Project, hereinafter referred to as the Center, to locally develop, adapt and promote the dissemination of renewable energy technologies through authorization of a grant of $ 4,600,000.
2. AID assistance be administered over a five year period (FY 1981 - FY 1986)
3. The grantee be the Government of Sudan (GOS) represented by the Energy Research Council. The primary executing agency will be the Sudan Renewable Energy Center represented by the Office of Director of the Sudan Renewable Energy Project.
4. The Project be given following waivers and approvals:
   a. A procurement source and origin waiver from AID Geographic Code 941 to Code 935 for approximately $ 12,000 of commodities (motor-bikes).

Section B. Project Description

1. The Problem

Sudan has significant hydroelectric, solar, wind and biomass energy potential in addition to petroleum resources. However, economic costs, lack of trained manpower, technical and enviromental limitations, and rapid population growth have had a dampening effect on the ability of the Sudan to meet its energy requirements with indigenous energy resources.

Currently, almost all of Sudan's commercial energy is supplied by imported oil, roughly 22 percent of the total energy consumed in the country. About 2 per cent is supplied by hydroelectric power. The oil import bill has risen dramatically over the last seven years so that it is now approximately equivalent to the nation's total annual foreign exchange resources. Wood provides about 75 percent of the nation's energy. Wood consumption has been accelerating at a rate of 2.2 percent per year. This level of use is not presently sustainable. Afforestation efforts would have to increase 16 times over 1980 levels in order to keep pace with projected consumption. Associated deforestation, desertification, and soil degradation is severe and potentially irreversible. The loss of productive land and wood as a cheap and easily available source of fuel for the rural population, and the rising cost of charcoal to urban users, have long term adverse implications for Sudan's development. Solutions are politically difficult and economically costly and will require a coordinated response on the part of GOS international donors over the next twenty years.

2. Program Goal

The widespread use of inexpensive renewable energy technologies which are economically, socially and enviromentally sound, thereby conserving energy resources and improving the standard of living of the rural poor majority in the Sudan.

3. Project Purpose

To assist the GOS in developing an applied research capability in rural renewable energy technology, with verification through application and dissemination of research results in town and village projects.

4. The Project Strategy

The Sudan Village Renewable Energy Project is directed primarily at efforts to reduce the consumption of wood through more efficient utilization of the resource. The development and dissemination of efficient wood and portable stoves will be major project components. These efforts may include development of local small-scale reforestation efforts and the substitution of other inexpensive renewable energy technologies for wood, where feasible.

A lesser objective is to reduce the effort and/or money spent in performing energy-related tasks at the village level. Thus laborsaving technologies which lessen dependence on increasingly expensive and increasingly vulnerable fossil fuels will be developed and disseminated where feasible, e.g. renewable energy technologies for water lifting, grain dehulling and grinding, and use of animal motive water. A third and more limited project objective is to promote renewable energy technologies (RETs) which benefit the rural population indirectly by providing economically substitutes for fossil fuels at government institutions such as healthcare centers and schools. A few other RETs will potentially benefit a broader spectrum of Sudanese, including urban dwellers, through the substitution of renewable energies for fossil fuels evaporative cooling, commercial solar water heating, ethanol production).

To accomplish project objectives, a Sudan Renewable Energy Center is to be establed at Soba, approximately 20 Km. from downtowm Khartoum. The Center will have the following functions:

- to ensure that village energy studies are conducted to identify potentially useful and desired technologies.
- to develop and field-test prototype equipment.
- to evaluate the economic, social and enviromental soundness of the technologies at various stages of development.
- to solicit the interest and support of the indigenous (and foreign) private sectors to the commercial potentials of producing and distributing renewable energy technologies.
- to support and train PVO's and other organizations wishing to bring about the dissemination of the rural energy technologies developed at the Center and elsewhere.

The Center's technology development will be carried out by a Research and Development Division (RDD), largely supported through funds and personnel provided by the Federal Republic of Germany (FRG). The Center will also have an Economic, Social and Enviroment Division (ESED) and a Dissemination/

Implementation Division (DID) both supported by AID. The three division heads will report directly to the Director of the Sudan Renewable Energy Project.

Because the Sudan lacks an appropriate governmental extension infrastructure for the purpose of this project the DID will serve as the Center's contact point with the private sector , PVOs and governmental organizations active in the rural areas of the Sudan,providing them with support in the dissemination of proven technologies. The Division will also focus on the development of training materials and media to promote dissemination of field-tested technologies. Also, DID support will include a program of renewable energy development grants.

The ESED will be responsible for:

- ensuring that village energy studies are conducted,
- evaluating the economic, social and enviromental feasibility of candidate prototype technologies, field-tested equipment and subsequent village modifications, and
- overall project evaluations.

To meet project objectives, the activities must include rural businessmen/craftsmen/producers who are able to build and maintain RETs and who can teach others similar skills. Major indicators of project success will be the number of RET units actually being used and the number of trained artisans who are producing working RETs.

The Project will provide long-term technicians (An Extension/dissemination Specialist and an Economist) and 45 person-months of short-term consultants who will strengthen the capacity of the Sudan Renewable Energy Center to develop and disseminate renewable energy technologies. Project funds will also be used to promote dissemination or research on promising RETs through grants and contracts with the private sector, existing government structures and outside institutions such as the Sudan Council of Churches and the Sudanese Council of Volunteer Agencies.

5. <u>Project Outputs</u>

a. Rural Energy use studies completed.

b. RETs developed, field-tested and disseminated.

c. SREC manpower needs assessed.

d. Training of Sudanese counterparts provided.

e. RET technologies evaluated.

f. Rural technologies installed.

g. Businessmen/craftsmen/producers making RETs.

h. Private sector institutions, governmental organizations and PVOs (active in RET dissemination) supported.

i. Dissemination channels for RETs tested/assessed.

j. RET publications made available and utilized.

k. Training materials procured and/or developed and published.

l. Sudanese management capacity to carry on RET program developed.

m. Project results evaluated and shared with others.

6. Project Inputs

AID funds ($ 4,600,000) will be provided for Technical Assistance ($1.230,000), Commodities ($323,000), Training ($458,000), Other ($ 65,000), Renewable Energy Development Grants, ($ 2,001,000) and Contingencies and Inflation ($ 523,000).

The GOS will provide $ 3,000,000 for the following: Personnel costs ($ 285,000), commodities ($ 174,000), training ($ 54,000), renewable energy development grants ($ 1,250,000) and construction ($ 500,000), other project-related costs ($ 737,000).

The FRG will provide approximately $1,400,000 in support for the Center for the following: technical assistance: ($578,000), Commodities ($228,000), training ($58,000), construction ($140,000) and other costs ($396,000).

7. Conditions Precedent and Covenants

The project has been designed in close collaboration with the GOS. All Conditions Precedent and Covenants have been discussed in detail with the GOS and are acceptable to that government.

C. SUMMARY TABLE
Total Project Funding ($'000)

		AID FUNDING	GOS			
		FX	LC	CIP	FRG*	TOTAL
A.	TA and other personnel	1230	405	285	578	2498
B.	Commodities and Equipment	323		174	228	725
C.	Training	458		54	58	570
D.	Construction	-	-	500	140	640
E.	Other costs	65	-	332	396	793
F.	Renewable Energy Development Grants	2001	-	1250	-	3251
G.	Contingency and Inflation	523	-	-	-	523
	T O T A L	4600	405	2595	1400	9000

* FRG assistance will be provided in DM
The figures shown above have been converted at 2.5 DM = $1.

I. PROJECT BACKGROUND

A. General Demography of the Sudan.

The Sudan is the largest country in Africa covering an area of almost one million square miles which is approximately one-third the size of the United States. The terrain varies from humid tropical forests to vast swampland and open semi-tropical savannah and scrub lands in the south to the sandy, arid hills and deserts between the Red Sea and the Libya and Sahara Deserts in the north. Through these diverse regions flow the White and Blue Niles which meet at Khartoum to form the main Nile. Most cultivation in the central and northern sections depend on these rivers but further south the natural rainfall is sufficient for cultivation and grazing.

Sudan's population is composed of two distinct cultures and effective collaboration between them poses one of the country's principal internal problems. The 12 northern provinces cover about two-thirds of the Sudan and include most of the urban centers. The 12 million Sudanese who live in this area are predominantly Arabic speaking Muslims. The three southern provinces have a population of about four million and are a predominantely rural subsistence economy. The south contains over 100 separate languages and dialects. The Dinka (approximately 1.5 million population) is the largest of these tribes. Other nilotic tribes include the Nuer, Bari, Marindi and Shilluk.

The official government is a republic ruled by a President and an elected People's Assembly. The Sudan Socialist Union (SSU) is the sole legal political organization in the Sudan. The Southern Region has its own legislative body. It now has considerable local autonomy as part of the 1972 Addis Ababa Agreement which ended the 17 year civil war between the Arab north and the African south.

Administration is formally decentralized. Since 1974, President Nimeri's government has made efforts to alter the previous centralized administration by breaking the previous six northern provinces into 12, by conferring more power to Provincial Governors and by expanding the establishment of local people's councils.

1. Present Energy Sources

Sudan's principal sources of energy are, in descending order of importance, wood, oil and hydroelectric power. Over three quarters of the energy consumed in fiscal year 1979/80 was derived from wood and charcoal, 22 percent from oil and only 2 percent from hydroelectric stations.

It is estimated that over 14 million tons of wood are removed from Sudan's forests annually. Consumption is growing at approximately 2.2 percent per year and currently is not sustainable. Extensive deforestation, desertification and soil erosion are occurring. Almost all firewood consumed is used for fuel in rural areas, including households and bakeries. Lesser amounts are used in brick-making, pottery, and tobacco curing. Almost all

firewood is obtained from natural forests and desert scrub. Only about 1.3 percent is obtained from wood fuel plantations. About 8 percent of total wood fuel consumption is in the form of charcoal, but this figure is misleading, since it is produced by primitive local earth kilns which consume 6.7 tons of wood for every ton of charcoal produced. Energy losses are on the order of 85 percent.

Oil consumption in fiscal year 1979/80 amounted to about 1.2 million tons. From 1975 to 1980 oil consumption increased at an average annual rate of 6.3 percent. While all of this was imported in 1979/80, recent discoveries of oil and gas fields will allow Sudan to meet a substantial portion of oil requirements with domestic production by the mid to late 1980's. Fifty-five percent of the nation's commercial energy is consumed in the transport sector, industry consumes 18 percent, and agriculture 14 percent.

A total of 892 GWH of electricty was generated in 1979/80 of which nearly three-fourths was produced by Sudan's three main hydroelectric power stations. Unaccounted for in this figure is the large and increasing amount of electricty produced by private diesel generators. Frequent power outages have accelerated this trend in both private homes and commercial/industrial and institutional enterprises. Major World Bank support is being provided to strengthen power generation reliability and to increasy hydroelectric capacity. Because of the lack of rainfall over much of the country a major need is for water-lifting technologies which do not rely on diesel fuel driven engines to provide irrigation and domestic water.

Given the high cost and, in some cases the impossibility of reforestation, measures to reduce deforestation are of value. Both higher efficiency in wood and charcoal use, as well as substitution of other renewable fuels such as solar or hydroelectricity will help slow current trends. Renewable sources of energy have an additional appeal in the Sudan for new energy demands as well as traditonal ones in that the majority of them are inherently decentralized. The vast distances between energy sources and demand centers and the low population density in the Sudan make centralized energy systems prohibitively expensive in many cases. Large infrastructure costs can be avoided through the use of decentralized systems, in addition to relieving some of the burden on Sudan's already inadequate transportation network. A decentralized development stratégy for the energy sector is also compatable with the expressed desire of the GOS to decentralize many of the functions of the Government.

To achieve the project purpose and establish the link between renewable energy technologies and the end user, the project has developed a strategy that focuses on:

a. the feed back information link that insures village participation in identification of needs.

b. the capability to evaluate technologies for economic, social and environmental soundness.

c. the mechanism for large scale dissemination, and the role of private sector, PVO's and governmental institutions in dissemination/implementation activities.

2. Government of Sudan Efforts

Awareness of the potential contribution from renewable energy in the Sudan is high and the nation is strongly committed to development of a coordinated approach to energy planning, policy and management of both conventional and renewable energy resources.

a. The National Energy Administration

In May of 1980 the Ministry of Energy and Mining began a reorganization designed to separate operational and policy functions and to significantly strengthen the latter. The National Energy Administration (NEA) was formed and given a broad mandate in research and policy formulation, and for the implementation of both conventional and renewable energy projects. The NEA now has a staff of 36 professionals with at present approximately 8 working in renewable energy. Since early 1981 the NEA has been the counterpart agency for an AID funded Energy Policy and Planning Project. This project includes analysis of village energy requirements and resources based on selected village level energy studies.

b. The Institute of Energy Research

The Institute of Energy Research was established in 1976 as an organ of the National Council for Research. It was an outgrowth of the Solar Energy Institute which was established in 1973. From its beginning, the IER viewed its role as one of conducting research and development in the field of new energies and the popularization of their application. The IER has placed its emphasis on the development of a technically competent staff and by May of 1982 will have 9 Ph.D's and additional technical staff. (See Annex re IER personnel). The laboratories of the IER have been housed in the Faculty of Engineering and Architecture, University of Khartoum. A station for collecting meteorological data and limited workshop facilities are located on an eight acre site in Soba, approximately 20 miles south of Khartoum. The Soba site will eventually contain both laboratory and office facilities and will be the primary site for the Sudan Renewable Energy Center. IER ability to carry out projects has been seriously constrained by lack of resources and much of its experience to date is based on participation in joint projects largely implemented by foreign donors. The IER's lack of success with various solar and water pumping technologies has provided convincing evidence of the need for initial adaptive testing of technologies, even if these technologies have proven successful elsewhere in Africa. IER technically trained staff have become increasingly aware of the importance and potential role for economists, social scientists and environmentalists.

c. Institute for Environmental Studies

The Institute established in 1979, as part of the University of Khartoum, offers a Master of Science degree in Environmental Studies. Its staff is drawn mainly from departments of the University. The Institute publishes a newsletter and holds conferences as part of its effort to promote a wider understanding of environmental problems. As a result of a recent

conference on women and the environment, the IES is encouraging action-oriented research. Fuelwood and energy has been identified as one of the four principal areas of research. IES is currently seeking funds to finance the studies, a portion of which might be used to finance proposals submitted to IES on fuelwood and energy.

The objectives of the IES include:

- encouraging, coordinating and disseminating information about research teaching and training in environmental studies at the national and regional level,
- encouraging and promoting interdisciplinary research,
- offering post-graduate studies, and
- undertaking contract studies on environmental problems for government and private agencies.

d. The Economic and Social Research Council

The Economic and Social Research Council (ESRC) is one of the few specialized councils under the auspices of the National Research Council. Its staff are drawn from technical and support units. ESRC functions are to:

- determine priorities in scientific research work in the domain of economic and social studies,
- execute research projects by specialists working within the ESRC or cooperating with it, and
- supervise necessary coordination in the fields of economic and social research.

The ESRC has been active in research and publication efforts. To date the only related research has been recent assessment of the probable impact of petroleum production upon the country. The ESRC is planning to send two of its members for training in energy economics.

e. Forestry

The Forestry Department has been active for many years in research efforts relating to improved species of drought resistant trees, and reforestation and desertification. They have also recently developed a proposal for a project to modernize charcoal production throughout Sudan. The long term objectives of the project are 1) to replace the traditional method of earth kiln production with modern kilns in the present production area of Central Sudan and 2) extend modern production methods to new areas in Western and Southern Sudan.

A second proposed project would protect the existing forest resource, and create new forests at the rate of 75,000 feddans a year. Both projects lack GOS or international donor financing.

3. Private Voluntary Organization Efforts

Because of the great distances involved and the lack of transportation infrastructure and GOS extension services, the project will utilize PVO involvement as one method for dissemination of renewable energy technologies and their modification in the rural setting. (See Annex for description of existing private voluntary organization efforts in Sudan).

4. Private Enterprise Opportunities

The project will attempt to utilize appropriate private enterprises that exhibit interest and capability in applied research and dissemination of renewable energy technologies. A representative of the private sector will serve on the Energy Research Council. The Dissemination and Implementation Division (DID) will coordinate the project's involvement and encouragement of the private sector's role in the development/dissemination of renewable energy technologies (RETs). It is recognized that the private sector will have an important role in the long-term dissemination of RETs.

5. The Sudan Renewable Energy Project

In April 1981 the Government of Sudan established the Sudan Renewable Energy Project (SREP). This action was in response in the Federal Republic of Germany (FRG) request for a decision on the designation of a unit to work with their renewable energy project.

The SREP is charged with establishing the Sudan Renewable Energy Center (SREC) to develop locally proven renewable energy technologies and to promote their dissemination.

The specific tasks identified for the SREC are:

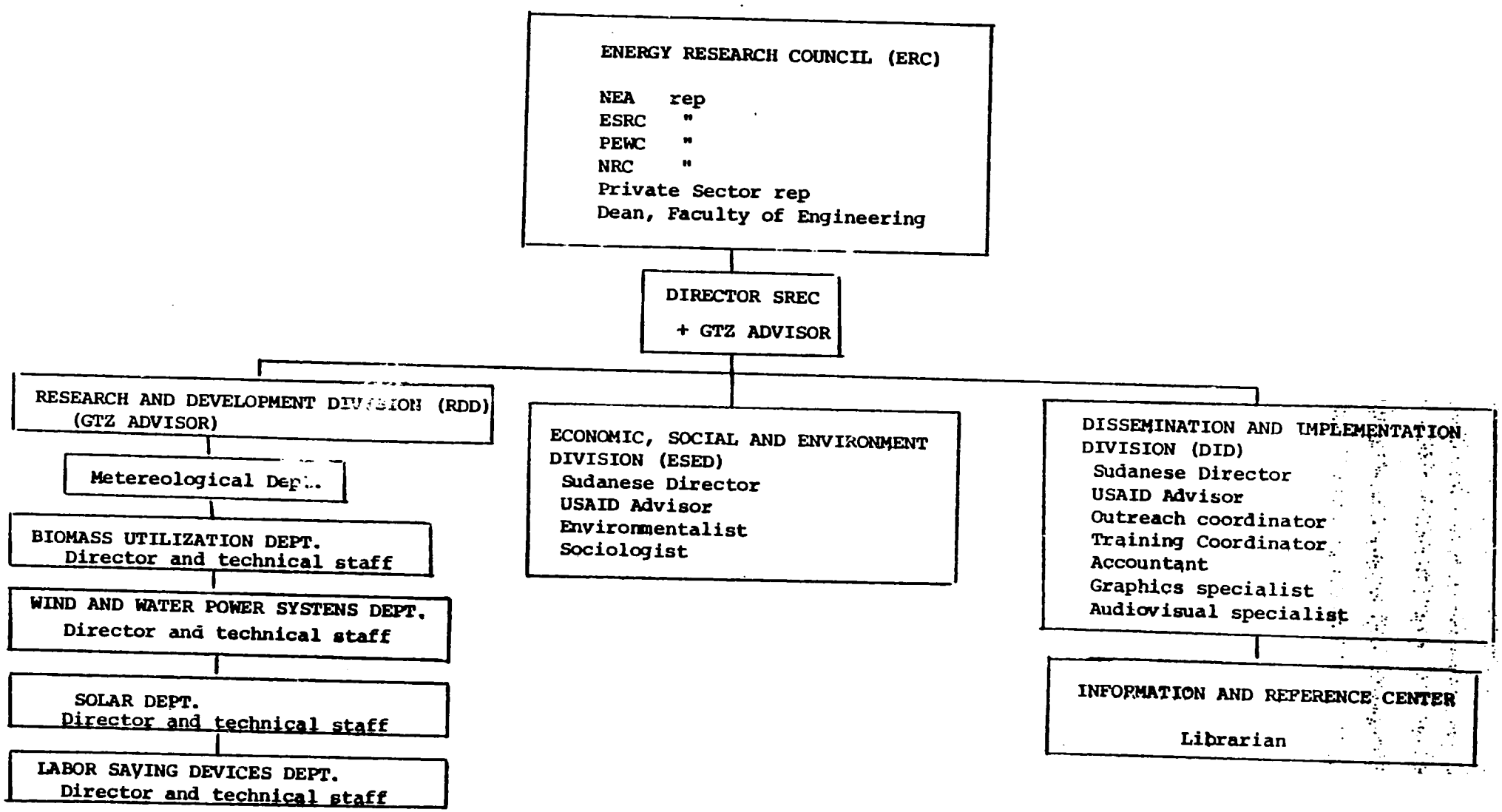
a) Carry out Research and Development (R and D) activities relating to renewable energy.

b) Provide economic, social and environmental analysis of technologies.

In addition to the above tasks, the SREC will be responsible for coordinating all foreign assistance in renewable energy development including renewable energy development grants and creation of institutional links between agencies concerned with renewable energy within the GOS.

The SREP combines personnel and other resources from the Institute of Energy Research (IER) and the National Energy Administration (NEA). All personnel of the IER and those of the NEA concerned with renewable energy become part of the SREC. The Minister of Energy and Mining is responsible for channeling funds to the SREP and for ensuring that the SREP will be able to meet counterpart demands of foreign donors.

The SREC is responsible to the Energy Research Council (ERC). The ERC has representatives of the Faculty of Engineering, University of Khartoum, the National Energy Administration, the Council for Scientific and Technological Research of the National Research Council and the Public Electricity and Water Corporation. The Minister of Energy and Mining, in his capacity as member of the National Council for Research is a member of the ERC. Dr. Yahia Hamid has been appointed Director of the SREC. The project proposes to include Economic and Social Research Council, (ESRC) and private enterprise representation.


ENERGY RESEARCH COUNCIL (ERC)
NEA rep
ESRC "
PEWC "
NRC "
Private Sector rep
Dean, Faculty of Engineering
DIRECTOR SREC
+ GTZ ADVISOR
RESEARCH AND DEVELOPMENT DIVISION (RDD)
(GTZ ADVISOR)
Metereological Dept.
BIOMASS UTILIZATION DEPT.
Director and technical staff
WIND AND WATER POWER SYSTENS DEPT.
Director and technical staff
SOLAR DEPT.
Director and technical staff
LABOR SAVING DEVICES DEPT.
Director and technical staff
ECONOMIC, SOCIAL AND ENVIRONMENT
DIVISION (ESED)
Sudanese Director
USAID Advisor
Environmentalist
Sociologist
DISSEMINATION AND IMPLEMENTATION
DIVISION (DID)
Sudanese Director
USAID Advisor
Outreach coordinator
Training Coordinator
Accountant
Graphics specialist
Audiovisual specialist
INFORMATION AND REFERENCE CENTER
Librarian

6. Other Donor Efforts

Federal Republic of Germany

Special Program for the Utilization of Renewable Sources

The FRG Renewable Energy Project will provide long term technical assistance (two advisors for 48 months each) and 8 PM of short term assistance. The two technical advisors will help to establish the technical research and development division at the Center, including identification of priorities, evaluation of regional activities, coordination with other donors, and supervision of individual projects.

This activity will complement the USAID RET Project. In addition the West German Project will finance the foreign exchange costs of the construction and equipment of a workshop and laboratory at the Center, support training of Sudanese personnel in Sudan and abroad and provide funds for a variety of individual projects. Possible projects include:
a) a photovoltaic and hot water system at Maridi b) wood utilization c) solar TV sets for the Gezira educational TV d) small hydroelectric generator station on the Yei river e)a photovoltaic system for Sudan Railways f) propagation of improved charcoal ovens and testing of solar cookers. A total of 14.5 million DM ($ 5.8 million) is available for the FRG project. The first German advisor is expected to arrive in January 1982.

NETHERLANDS

The Dutch are interested in supporting creation of a wind energy center to design, develop and test water pumping windmills suitable for manufacture. Local manufacture is deemed feasible, although maintenance of the installed windmills is considered a potential problem. Economics appear to favor wind pumping over diesel engines. Windmill pumping for irrigation is estimated to cost LS. 012 per cubic meter of water vs, LS. 019 per cubic meter for diesel, while for drinking water the estimate is LS. 16 per cubic meter for windmill pumping vs LS. 22 for diesel. Research on wind characteristics, water and agriculture is considered essential. The Project would be carried out in cooperation with the Institute for Energy Research and last five years pending the success of the first two years of effort.
Total funding for technical assistance is estimated at $ 800.000.
The Dutch are also supporting reforestration efforts in Sudan.

II. Project Description

A. Program Goal

The program goal is to achieve the widespread use of inexpensive energy technologies which are economically, socially and environmentally sound thereby conserving energy resources and improving the standard of living of the rural poor majority.

B. Project Purpose

The purpose of the project is to assist the GOS in developing an applied research and dissemination capability in rural renewable energy technology, with verification through application of results in rural areas.

Restated the project has two related objectives:

(1) to ensure that renewable energy technologies developed in the Sudan are appropriate to rural needs and are economically, socially and environmentally sound prior to their wide scale dissemination.

(2) to ensure effective dissemination of field-tested renewable energy technologies to rural areas of the Sudan.

Development and dissemination of RET technologies by the Sudan Renewable Energy Center will focus primarily on improved use of or substitution for wood, including wood and portable charcoal stoves of improved efficiency and possibly more efficient charcoal kilns, charcoal manufacturing techniques, solar ovens and hayboxes. Small scale afforestation efforts may also receive support in conjunction with projects promoting more efficient wood utilization. As discussed above wood is an increasingly scarce resource in many areas of the Sudan and there is an urgent need to reduce wood use (and increase wood production.) There is presently little awareness at the village level that inexpensive RETs are available which can save labor (wood collection) and money (to purchase charcoal or fossil fuel). Thus project action will include training and media support and grants to the private sector, government entities and PVOs. There must be businessmen active in promoting and implementing renewable energy technologies throughout the country.

To fulfill project objectives, RET craftsmen/producers in rural areas who will build and maintain RETs and who can teach others the same skills. Major indicators of project success will be the number of trained villagers who are able to produce working RETs and the number of RETs actually being used.

As indicated by the project's second objective RETs will also be developed and disseminated which save time and labor, thereby improving the living and working conditions of the rural population. These may include, where appropriate, hand pumps, foot pumps, water wheel lifters, pedal powered grain dehullers and grinders, wind systems for community water supplies, equipment which utilizes animal motive power, and evaporative coolers.

Certain RETs may be included as appropriate within the project because of indirect benefits to the rural population through increased RET use by government institutions such as health care centers and schools (batch solar water heaters, photovoltaic electrification).

C. Project Outputs

1. Summary

The achievement of the project purpose will depend on the accomplishment of seceral project outputs plus the validity of a number of assumptions concerning rural and institutional energy use, social and cultural practices (cooling, heating, etc) in Sudan. The outputs of the project may be summarized as follows:

a. Rural energy use studies completed.
b. RETs developed, field - tested and disseminated.
c. SREC manpower needs assessed.
d. Training of Sudanese counterparts provided.
e. RET technologies evaluated.
f. Rural technologies installed.
g. Businessmen/Craftsmen/Producers making RETs.
h. Private sector institutions, governmental organizations (active in RET dissemination) supported.
i. Dissemination channels for RETs tested/assessed.
j. RET publications made available and utilized.
k. Training materials procured and/or developed and published.
l. Sudanese management capacity to carry on RET program developed.
m. Project results evaluated and shared with others.

2. Detailed Outputs

a. Rural-Energy Use Studies completed

Rural energy use studies are to be carried out by the University of Khartoum. These studies will collect and analyze data pertaining to cooking practices, fuel types and quantities, water lifting, and use of animal power. The studies will also attempt to determine the cost of labor due to increased hours of wood collection, and other energy-related tasks. The SREC project will provide some short-term training assistance to this effort. The indicator will be completed studies in at least five regions.

b. RETs Developed, Field-tested and Disseminated

The project will finance a portion of RET research development and field-testing costs, and provide full support for evaluation and dissemination of the technologies. The indicator will be six RET technologies with direct impact on the rural Sudanese, developed, field-tested and disseminated.

Of the six, efficient wood and charcoal burning stoves will be priority RETs, followed by water-lifting technologies. Other potentially attractive RETs include improved charcoal kilns, solar cookers, pedal-power grain dehulling and grinding equipment and technologies to increase use of animal motive power. The selection of these technologies will have to await detailed cost/benefit analysis by the Economic, Social and Environment Department described under 2. e. below.

c. SREC Manpower Needs Assessed

After the first year's operation, a comprehensive manpower study will be performed to reassess short-term and long-term manpower requirements for the duration of the project. A major element of this study will be a consideration of the cost and technical requirements for different levels of staffing and different RET prototype developments. Approximately 30 percent of the total training provided by the project is reserved for implementing recommendations from this study. The indicator will be the completed study report.

d. Training of Sudanese Counterparts Provided

At the heart of the project is the training of RET project personnel to manage, develop, build, field-test and evaluate RETs and to provide support to the private sector, other governmental organizations and PVOs in disseminating renewable energy technologies, both during and upon project completion. The indicator will be the successful completion of 108 person months of long-term and 40 person months of short-term third country training, including observational tour training to RET centers in other developing countries.

e. Technologies Evaluated

The project will have an Economic, Social and Environmental Division (ESED) responsible for establishing the economic, social and environmental soundness of technologies at every stage of their development and dissemination. The project indicator will be a success rate of 90% in the acceptance of disseminated technologies with no significant adverse impacts.

f. Rural Technologies Installed

An important measure of the project's success will be the actual number of RET units installed and being used by the rural population. The indicator will be 1000 units affecting 7,000 people.

g. Businessmen/Craftsmen/Producers Making RETs

Another key measure of success in meeting project objectives will be the number of businessmen/craftsmen/producers actually trained and making RETs in rural Sudan.
The indicator will be fifty businesmen/craftsmen/producers actually making RETs by the end of the project.

h. Private sector institutions, Other Governmental Organizations and PVOs Active in RET Dissemination Supported

Support from SREC will be fourfold:

(1) Renewable energy dissemination grants to support projects to disseminate to the rural Sudanese population those technologies developed and field-tested by SREC.

(2) Renewable Energy demonstration grants to develop and field-test a promising technology not being developed by SREC.

(3) Training of Private sector, GOS and PVO personnel, as trainer/facilitator through the use of written and audiovisual training materials and training seminars both at SREC and in the field.

(4) Providing an exchange of information and an opportunity for coordination between the private sector, governmental organizations and PVOs and international donors active in RET development and dissemination in Sudan.

The indicator will be fifty active provider/disseminators trained in fieldtested technologies.

i. Dissemination Channels for RETs tested/assessed

One of the key questions to be answered by this project is how best to disseminate appropriate technologies in the Sudan. A number of channels through the private sector, the GOS and PVOs will be tested. By the project's completion, the efectiveness and limitations of these various dissemination mechanisms should be known for wider replication in the future.

j. RET Research and Development Publications Made Available and Utilized.

The project provides for a RET library and for the acquisition of research materials through NTIS. Both written and audiovisual meterials will be obtained. The indicator will be 500 information requests ment for center staff each year using the RET library resources.

k. Training Materials Produced and/or Developed and Published

Written and audiovisual training materials to promote dissemination field-tested technologies could be an extremely important component if of good quality and in sufficient quantity to make wide distribution and use possible. The indicators will be preparation and publication of training manuals and slide tapes on field-tested technologies as determined by SREC.

Manual and slide tapes will be developed for a minimum of six technologies and manuals provided to a minimum of 500 individuals active in RET development, field-testing and dissemination.

l. Sudanese Management Capacity to Carry on RET Program Provided

At the heart of the project is the capacity of RET project personnel to manage, develop, build, field-test and evaluate RETs and to provide support to the private sector, governmental organizations and PVOs in disseminating renewable energy technologies both during and upon project completion. It is anticipated that after USAID financial support has ended the trained Sudanese will be able to continue operations of the RET program with GOS funding. The following Sudanese staff will be required for the project and will have received specialized training:

1. Economist
2. Sociologist/Anthropologist
3. Environmentalist
4. Extension/Dissemination Specialist
5. Outreach coordinator
6. Training coordinator
7. Libririan
8. Book keeper
9. Graphics Specialist
10. Audio-visual Specialist
11. Local Craftsmen/Producers (6)

m. Project Results Evaluated and Shared with Others

The ESED will be responsible for monitoring and evaluating overall project progress and will prepare annual reports to GOS as well as a final end of project document for the purpose of sharing lessons learned with other persons active in the RET field and with other RET centers. The indicator will be completion of 3 annual evaluation reports and the final evaluation document and distribution of 500 copies to individuals and organizations specifically requesting copies.

D. Project Inputs

Major project inputs and their costs are summarized in the Table below:

Summary of USAID Project Inputs

Inputs	LOP Costs $'000s
Technical Assistance	1230
Training	458
Commodities	323
Other	65
Renewable Energy Devlopment Grants	2001
Inflation	316
Contingencies	207
TOTAL	4600

1. Technical Assistance ($ 1,230.00)

The project will include two long-term technicians for 54 and 36 months respectively. These are:

(1) Extension/Dissemination Specialist (Chief of Party) (54mo)

(2) Economist (36mo)

A total of 45 person months of short term consultant services is anticipated to include: commodity procurement, (2mo), manpower study (3mo), charcoal stoves (4mo), charcoal prodcution (4mo), information specialist (2mo), evaluation (9mo), anthropologist/sociologist (6mo), data management (1mo), environmentalist (4mo), survey specialist (2mo), energy performance specialist (8mO).

2. Training ($ 458,000)

Training costs will include t foreign exchange costs of long and short term training in the U.S. and third countries. It does not include the cost of in country training to be undertaken both at the University of Khartoum and by the Dissemination and Implementation Division (training seminars). These will be local LS costs covered by CIP local currency generations.

3. Commodities (323,000)

This will include vehicles and motorbikes, office, data analysis, and workshop equipment, field test materials (imported), and training materials (graphics, cameras, film) and information center materials.

4. Other (65,000)

The only item included is the project contribution to the USAID air charter.

5. Renewable Energy Development Grants ($ 2,001,000)

These grants will total approximately $ 2 million over the 5 year life of the project. For a full description of the purpose and implementation of these grants see Section

6. Inflation ($ 316,000)

7. Contingencies ($ 207,000)

E. PROJECT ORGANIZATION

The Sudan Village Renewable Energy Project will be administered by the Director of the Sudan Renewable Energy Center (The Center), assisted by the Chief of Party/extension specialist. These individuals will be responsible for all administrative, fiscal and personnel activities. The Director of the Center will report to the Energy Research Council (ERC) established and chaired by the Minister of Energy and consisting of the following members: 1. The Dean of the Faculty of Engineering, 2. Director of the Council for Scientific and Technological Research, the National Council of Research, 3. Director of the National Energy Administration, 4. Deputy Director Planning and Research, Public Electricity and Water Corporation. This body will provide overall policy guidance to the Center.

The Center will consist of three major divisions: The Research and Development Division (RDD), the Economic, Social and Environmental Division (ESED) and the Dissemination and Implementation Division (DID).

1. Research and Development Division:

This division will contain four departments - Biomass Utilization, Wind and Water Power systems, Solar, and Labor-Saving Devices. During the preparation of the annual work plans for the Center the RDD team will meet to establish priorities for development of renewable energy technologies. In cooperation with the ESED which will make a preliminary assessment of the cost benefit of these technologies, the technical staff will be responsible for prototype development and initial field testing in villages. The RDD team will also provide technical advice to the PVOs and government entities involved in the first phase of dissemination of these field tested technologies.

2. Economic, Social and Environmental Division (ESED)

This division will be headed by a Sudanese, assisted by an expatriate economist. In addition to the director of the ESED, the permanent staff will include one anthropologist and one environmentalist with a masters degree.

During the initial years of the project it is expected that a member of the university community will be seconded to the ESED to help provide direction and professional expertise while some of the permanent members are on leave for training.

Six to ten individuals will be selected from the current research community, active in energy-related issues to be affiliate staff members. The affiliate members, together with the Director of the SREC and the ESED "Senior Staff," seconded researchers, and the USAID economist to ESED will constitute a research committee responsible for providing advice on research problems and priorities.

The primary function of the ESED will be to assure the collection of economic, social and environmental data for the following purposes:

a) pre-feasibility assessment of proposed R & D technologies to assist in setting of priorities;
b) rural energy use studies and policy analysis and
c) monitoring and evaluating field trials and pilot demonstration. The ESED will also monitor and report on women involvement in SREC activities and make recommendations for increased participation by women. It is not intended that the ESED permanent staff conduct all the research. Rather it will solicit research proposals from existing organizations such as the Institute for Environmental Research, the Economic and Social Research Council and University departments.

The ESED will be responsible for ensuring that the research proposals accepted for funding and the proposals for renewable energy development grants address women related issues, and the needs of the poor majority.

Dissemination and Implementation Division (DID)

This division will be headed by a Sudanese extension/dissemination specialist assisted by the contractor Chief of Party. In addition to the director of the DID, the permanent staff will include a deputy director, primarily responsible for training an oureach coordinator, a graphics designer, an audiovisual specialist, a librarian and a bookkeeper.

The primary function of the DID will be to coordinate and support existing institutions and organizations (including the gov't PVOs, entities of the private sector organizations, receiving renewable energy development grants) to promote demonstration and dissemination of RETs. Once awarded, the renewable energy development grants (REDG) will be coordinated by the DID. These responsibilities will include:
a) establishment of accounting procedures for monitoring funds;
b) ensuring that a simple financial, technical and management assessment is conducted at least once for each grant awarded;
c) receiving final report.
For a full description of the REDG procedures see Section F.

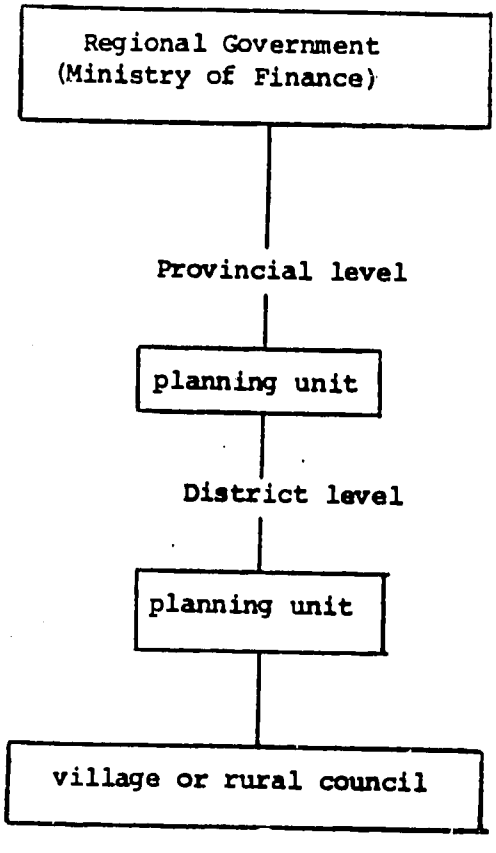
The DID will also have primary responsibility for evaluating the efectiveness of various means of disseminating RETs with a view towards developing replicable and effective systems which can be utilized for further appropriate technology dissemination in the Sudan.

The DID will also be responsible for the implementation of training activities and the development of training materials and media to promote dissemination of field tested RETs including:

a) preparation of training manuals for each of the RETs developed at the Center (estimated 6 technologies).
b) training seminars for PVO, GOS, organization personnel and the private sector as trainer/facilitators for RETs both at the Center and in the field.
c) preparation of slide tapes showing the development and use of the various field tested RETs.

An important function of the DID will be the development of linkages and contacts with individuals in the planning units at the various levels of the existing decentralized government structure throughout the country (see table below). This will be the responsibility of the outreach coordinator and should be initiated early in the project.

Establishing linkages with these various government entities will help to ensure cooperation and support for the project, as well as providing a means of disseminating RETs as widely as possible.



Once the contacts have been established the DID will participate in a RET awareness campaign. As part of this effort members of the DID staff will travel to the provinces and regions to explain the prototype RETs being tested and introduced throughout the country by the recipients of renewable energy development grants.

F. RENEWABLE ENERGY DEVELOPMENT GRANTS (REDGs)

The purpose of the grants is to promote demonstration and dissemination of feasible renewable energy technologies. The grants will be provided to private enterprises, governmental and non-governmental organizations who meet the criteria specified below.
The grant activities will fall into three categories.

(A) dissemination and production of technologies which have undergone field-testing by the SREC and been shown feasible.

(B) research, development and/or field-testing of RET prototypes which can be shown to be potentially feasible but which are not part of the work plan agenda for the SREC, and

(C) afforestation and deforestation efforts using innovative strategies for community or household ownership which are proposed in conjunction with RET's to improve the efficiency of wood fuel use. The list below provides examples of the types of activities which might qualify for grant assistance:

- Tree nurseries and extension services to promote smallholder or community agroforestry or afforestation.
- Use of hand pumps or water wheels for small-scale community supply systems.
- Training brick-makers to make improved traditional kilns which have been proven to be economically, technically and socially feasible.
- Low cost refrigeration or heating/sterilizing devices for rural health centers.
- Energy efficient manufacture of bricks.
- Demonstration of energy efficient manufature of bricks, pedal pump, grain grinders or new ox plow technology.

1. Grant Proposals

The information which the proposals should contain, as well as the criteria to be used in awarding grants will vary slightly between the three categories of grant activities. All proposals will be expected to contain:

(a) detailed budget, including contributions from requesting entity and others.

(b) plans for documenting activity.

(c) likelihood for replicability and spread effect.

(d) mention of linkages which will be established with SREC to obtain any needed technical advice and to feedback results of the activity.

Grant A type activity proposals ought also to address:

a. information on how the technology will be produced and delivered within a cost range which is likely to make it economically attractive to the potential users/beneficiaries.

b. the strategy to be used including method of generating awareness and the process of dissemination.

c. information about the participation of and benefits to be derived by the poor majority.

d. evidence which shows that the technology activity meets the need of and is considered feasible by intended end-users.

Grant B category proposals should also include:

a. the strategy to be used.

b. cost/benefit analysis.

c. information on how the technology will be developed and field-tested and subsequent production of the technology.

d. evidence which shows that the technology meets the needs of and is considered feasible by intended end-users.

e. resumes of technical staff.

Grant C category proposals should also include:

a. the strategy to be used.

b. explanation of innovative~~s~~, cost-reducing aspects.

c. implementation plan.

d. evidence which shows the activity has the support of the intended participants including agreements on who has rights to foraging, cutting and harvesting.

2. <u>Grants Criteria</u>

For a grant to be awarded the proposed activity must meet the following criteria:

a. Maximum use is made of local materials, skills and labor.

b. It is responsive to the needs of the poor majority as perceived by them.

c. The technology or product is affordable by the intended end-users.

d. When applicable, the users ought to be capable of maintenance and repair.

e. The strategy and/or technology should have potential for widespread replication/dissemination.

f. The requesting organization/entity demonstrated the capability of implementing activities in the Sudan or a similar activity in a Third World Country.

g. Except in special cases, no proposal may receive more than $ 150,000.

h. Prior to signing the Grant Agreement a letter of approval must be submitted to the Director of SREC from the governmental authority in the area where the activity is to be implemented.

3. Approval Process

All proposals will be reviewed by a committee consisting of:

the Director of SREC - Chairperson and Voting Member
the USAID Project Manager
the USAID Chief of Party
a representative of National Energy Administration.

The FRG RET technologist will be an ex-officio member of the committee. It is expected that members of the committee may seek advice from others regarding aspects of the proposal and specialists may be requested to submit comments or attend meetings. Final approval will rest with the four persons listed above, who will have equal voting powers. Proposals should be reviewed and voted upon within three months after their submission. As part of the review process the decision of the committee shall be relayed in writing to the requesting committee within ten days of the final decision. The approval committee is charged with ensuring an equitable distribution of implemetation sites between regions.

As part of the review process an Initial Enviromental Examination (IEE) must be prepared for each activity being considered for a grant. The IEE will be reviewed by the Committee and approved by USAID.

4. Grant Activity Agreements

Grant activity Agreements will be structured, to the extent possible on the model of the AID cooperative agreement. The proposal is developed in collaboration with the GOS and AID, reviewed to assure conformity with any applicable AID regulations and then a cooperative agreement is signed either by USAID or the DIS, as appropriate, and the Proposer. The cooperative agreement mechanism requires a contribution on the part of the Proposer but does not define it as a minimum of 25% of the value of the Agreement. Monitoring of the cooperative agreements will be the responsibility of the DID in collaboration with the contractor and USAID Project Officer. Disbursement of cooperative agreement proceeds will be directly to the Proposer in accordance with AID regulations subsequent to USAID Project Officer's approval of appropriate vouchers. AID regulations regarding procurement within the cooperative agreement are applicable. A separate implementation letter will be issued providing further detail.

Fund Administration

The SREC DID will establish suitable accounting procedures for disbursing funds and assuring that funds are properly spent. The DID will be responsible for ensuring that a simple financial, technical and management assessment is conducted at least once for each grant awarded. It will also ensure that all grants are closed out, including receipt of final report and final invoices. For grants over $ 50,000 ten per cent of the amount will dispersed only after receipt of a suitable final report and all necessary financial documents.

IV. PROJECT ANALYSIS

A. TECHNICAL ANALYSIS AND TECHNICAL MANAGEMENT

The renewable energy technologies have been selected based upon preliminary rural energy studies conducted by PID and PP teams, and an economic analysis performed by the PP team; and upon the degree to which the team believed that these technologies could be developed and maintained using PVO's and existing governmental organizations in Sudan.

The sophistication of technologies considered for the RET project varies from rural household technologies to capital intensive institutional technologies. In fuel supply needs, the technologies range from wood burning stoves to commercial harvesting and utilization of biomass from water hyacinth (feasibility study only supported under the renewable energy development grants program.)

The selected technologies are placed into three groups: priority technologies, candidate technologies and research and development technologies.

1. Priority Technologies

These RETs were selected because they are technologies for which research and evaluation has been sufficient to allow the PP team to recommend their immediate development and field-testing by SREC. They are broken into two groups:

(1) Rural technologies which supply new or improved sources of thermal energy for cooking. These include the development, field testing and dissemination of efficient wood and charcoal stoves.

(2) Rural technologies which provide improve present water lifting capability in rural villages. These include hand pumps and a variety of water wheel lifters.
(See Annex IV for diagrams).

a) Selection of Rural Technologies. The following criteria were used to identify the Renewable Energy Technologies and tentative designs proposed by the PP team. The RET designs:

(i) must use only renewable energy sources.

(ii) must meet a rural expressed or abstract need.

(iii) must be well understood by the technological community (proven).

(iv) must improve the thermodynamic efficiencies or time expended by at least a factor of two.

(v) must be very low cost.

(vi) must use indigenous or locally available materials and skills.

(vii) must be environmentally benign or result in environmental enhancement.

(viii) must show potential of being accepted such that a natural demand for the RET could occur.

(ix) must be presented and designed to permit innovation on behalf of the user

(x) must have the potential for marketing of skills and services within rural areas.

b) The rural technologies proposed herein are based on sound scientific principles. However, their dissemination to the rural population will require that SREC ensure that the private sector, PVOs and governmental organizations interested in implementing RET programs in rural Sudan are trained in how to directly raise the awareness of rural communities in RETs and how to involve villagers from the beginning in the identification and design modification of technologies to meet specific economic, cultural and social needs. Individuals from the rural community are to be active participants in the production of the technologies at the village level, and must thoroughly understand the technology and the design process in order to be able to judge for themselves whether the technology is of genuine benefit to the community. Active involvement is also essential in order to provide the community with individuals who will be able to service, repair, and build RETs after technical assistance is no longer available.

c) Rural Technologies

(i) Earthen Wood Stoves

Presently mud stoves are in limited use in the Sudan. The Lillywhite Pre-PID team mentions stove use in Wadi Halfa, and the traditional domed mud stove of the Nubians. A project at the College of Women (AFHAD) in Khartoum has involved local women in testing wood stove designs. The stoves have been built by the laboratory of the Institute of Energy Research with the women assisting in tests on a weekly basis.

The stoves to be used in Sudan will be designed to burn brushwood and small wood logs. The stoves will be primarily sand, clay (dung) with designs for indoor and outdoor systems. The number and size of pots normally used in cooking will influence stove design and number of fire boxes. Attention will be paid to factors such as the degree to which the stove has a "modern" appearance e.g. height and shape. Cement outer coatings may be applied for decorative purposes and to improve durability (in outdoor settings the stoves should be rainsheltered).

For stationary wood stove design the following criteria are suggested for consideration during early field testing:

Draft-Fast burning wood sticks do need a draft control, while the log fire may burn more efficiently with only a slight draft. Improper use of draft could actually increase wood consumption.

Size and Shape of Combustion Chamber-Slow burning logs require a high combustion chamber with the large main cooking pot located directly above the fire. For faster burning wood sticks a shallow, deep (long) chamber is preferable.

Materials-The clay soils of Sudan in most cases are suitable for stove construction. The addition of sand and dung could make the mud more workable, less prone to crack, more porous (for better insulation) and more resistant to scratching and chipping.

Construction-The materials necessary to build an earthen stove are: mud, stone of any kind preferably flat faced (preshaped mud blocks can also be used), dung, sand, some pieces of flat metal which can be made by cutting and flattening empty cans to tunnel into the mud, pick, sledge hammer to break boulders, wheel barrow (not essential), small builder's trowel and measuring device.

Construction Time-The actual constuction time for a single mud stove is not long but curing of the mud takes several weeks. One week should be allowed for the initial base to set and another two to four weeks are necessary for the stove tunnel to dry. For demonstration only, a mud stove can be built and fired in two days. For training purposes, two weeks should be allowed.

The economic analysis provided for efficient wood stoves is for a purchased cement/mud stove, since this would be of higher cost than a sand/clay stove made using family labor. Economic analysis for the cement/mud stove provides a very favorable net present value (PV) of 189 LS over 9 years, resulting largely from labor saved in collecting wood.

(ii) Portable charcoal stoves

While charcoal use represents only 8% of total energy supplied from wood-fuels efforts to introduce a more efficient portable stove for both wood and charcoal could have quick paybacks because they can mass produce and sell through normal marketing channels. Charcoal stoves are currently used in urban areas and rural towns. As economic development progresses and rural incomes rise, it is expected that more rural people will switch from traditional 3 stone fires to more efficient charcoal stoves. The objective is to market a stove that costs no more than LS 4.0.

The Institute for Energy Research has already developed the prototype of a stove, similar enough to the conventional model used in Sudan to be acceptable, but which has twice the efficiency. A likely candidate for evaluation and adaptation is a Thailand model which has double the efficiency of Sudanese stoves, but with little added cost. Features include an insulated clay ash blanket sandwiched between the exterior metal housing and an interior ceramic lining and a grate.

(iii) Another technology which may have an immediate effect in reducing fuelwood consumption, is improvement in brick-making methods or the substitution of other building materials for bricks. It is suggested that adobe and stabilized adobe be considered as possible substitutes.

(iv) Water pumping

Water lifting technologies to lessen the labor burden have been identified as the most important rural energy need by rural communities in the Sudan. Handpumps, footpumps and water-wheel pumps are therefore considered priority technologies.

Animal powered pumps and integrated wind/handpump or wind/diesel pumps with water storage are considered candidate technologies. A great range of water lifting systems may ultimately be field-tested under this project. The most readily available of these, the hand water pump, is common throughout the developing world. It is considered too expensive for individual families but has applicability at the community level. It cannot be locally manufactured and occasionally cannot be serviced locally. Maintenance will depend both on the availability of materials and tools and on the level of need as perceived by the community. Hand pumps effectively draw water from a depth of 90 meters (300 feet).

Hand pumps in general have a record of unreliability when used in community well water supplies. Even the most robust tend to break down with hundreds of people continually using them. Two types of foot pumps have been shown to provide reliable service over the years. One is a bellows pump promoted by the International Rice Research Institute in the Phillipines and manufactured and sold by a number of companies in that country. The other is the vergnet hydro pump. Both of these pumps require minimal maintenance. Foot pumps make use of human power most effectively since leg muscles are stronger than the muscles in the upper part of the body.

Handpumps however, appear to be economic investments for rural communities everywhere in the Sudan where prices for the pumps are under LS 600. Acceptance may be hampered where villagers have been used to operating diesel pumps with government subsidized fuel. It has been estimated that about 90 percent of the rural water needs in the Sudan can be met with cost effective hand water pumps. (See Annex)

A water wheel design recommended by the PP energy technologist for flowing rivers, is a spiral tube pump. A paddle water-wheel is used to create circular motion. At the circumference of the wheel a spiral tube of about 6cm diameter is affixed, with an open end that dips into the water, and takes on water each time the wheel makes a rotation. The other end of the spiral enters the axis of the wheel and connects with a stationary vertical pipe that brings the water up to the desired height. The system is expected to cost a maximum of 250 LS. and could be used for community scale water lifting or for a cooperative of farmers. Local manufacturability is questionable without considerable training, and manufacture may require some imported materials (pipe, fittings, rotary joint, bushings). The system is rather simple so that local serviceability is expected after training. Since most surface water is

polluted, this system might not be viable for community drinking water.

2. Candidate Technologies

The technologies in this group require either more detailed cost/benefit analysis and/or further technological development or packaging prior to selection by SREC for field testing and dissemination. They may also require development of a comprehensive operation and maintenance training program. These technologies are generally straight forward, in their operation but maintenance is somewhat more complex and in some cases they would probably result in communally or institutionally owned and maintained systems. The technologies in this group include:

- improved charcoal kilns
- portable wood stoves
- solar earth ovens and heaters
- fireless cookers
- portable solar cookers
- animal powered pumping systems
- integrated hand/wind pump and water storage systems
- small scale forest management and afforestation
- pedal power grain dehulling and grinding
- animal motive power technologies for agriculture and transport
- photovoltaic refrigeration for rural health centers
- evaporative coolers for retaining perishable foods
- solar crop dryers
- passive solar water heating for institutional use

It is contemplated that some of these technologies will receive further development and field testing by SREC, while others may be developed and tested by the private sector, PVO's and other government organizations under the SREC renewable energy development grants fund.

a) Improved Charcoal Kilns. The bulk of the charcoal produced in the Sudan is manufactured by private entrepreneurs who cut trees on public lands at no cost to themselves. The wood is stocked and covered with earth and ignited. Although labor intensive, there are no significant out-of-pocket expenses and no incentive for purchasing more expensive steel retorts or for improving traditional manufacturing techniques. Some types of French metallic kilns were introduced in the country, but they are difficult to transport and have small production capacity.

If the government takes legislative action requiring charcoal makers to pay for trees felled there will then be an incentive to invest in increased efficiency. The development and dissemination of more efficient

charcoal manufacturing technologies would then become a priority technology of SREC. Techniques applied in Senegal and elsewhere significantly reduce the wood needed for charcoal production and improve the quality of the charcoal produced.

Improved traditional methods differ greatly in technique, but the new methods can provide yields of up to 30 percent charcoal by weight compared to the weight of the dry wood at the beginning of the process. Traditional methods yield recovery rates of only 8-15 percent.

A prototype improved traditional Kiln, described by G.E. Kasdi, USAID's Senegal renewable energy development project, is known as the Casamance Kiln.

Instead of building the stack directly on the ground, an air space is built underneath by means of a network of logs. A circumferential air chamber is also created by laying an apron of brush on the outside and a chimney is placed beside the stack. The air spaces and chimney result in better com bustion of the volatile bases and/or less heat loss from the stack. The chimney (purchased and/or fabrication) costs reportedly can be recovered the first time it is used.

Other advantages of the Casamance Kiln include am ability to mix wood size, density and moisture content without adverse effect. The Casamance Kiln has demonstrated that smaller or less dense logs will stop burning when carbonization is complete (i.e. they will not turn to ash) even though logs next to them are still burning. Finally tests of the Kiln in comparison with traditional kilns reveal that the former takes 0.5 to 0.7 hours to carbonize one remove (stacked cubic meter) of wood whereas the latter takes 3.6 to 7 hours. This is a significant saving for the charcoal makers.

b) Portable Wood Stoves. Another candidate wood conserving technology which could be of significant importance in the Sudan would be an acceptable small portable wood stove that could be locally manufactured. Suggested for possible prototype development is a one-pot ceramic stove with good insulation, little thermal mass, and the fire box and at least 20 centimeters of draw after the point of fire, and a controllable air intake. Currently it is believed only 10-20% of open fire users will find a stove acceptable. Nevertheless, the depletion of wood resources may increase the attractiveness of this type of stove in the future. It is expected that portable charcoal and wood stove design and field testing will be done simultaneously, since their development and manufacture would be very similar. For example, breakthroughs in charcoal stove technology may be able to be transferred directly to wood stove construction.

c) Solar Earth Ovens and Heaters. Mud solar ovens are recommended on a trial basis for cost/benefit analysis by SREC. These solar heating devices are miniature solar greenhouses made of mud and darkened with wood ash to achieve temperatures as high as 140°C (300°F). The solar

oven will operate at about 50°C (122°F) higher than the water heater due to its design and due to the large mass of cool water being heated in the latter system. The north sloped mud structures must be covered or glazed with a two square meter piece of fiber-glass or glass sections to trap the solar energy. This structure can collect approximately 238,000 BTUs/day for heating or baking or the equivalent of about thirty-one pounds of firewood or about one head bundle. The primary difficulty with this technology is that it provides only low grade heat and therefore it takes longer to bake bread or heat water than when using a fire. Furthermore, bread baked at 300°F may be of a different texture than that baked over the fire. This solar system can also be built with a wood fire "back up" feature as part of the unit to help overcome some of these factors. The solar oven technology will also undergo many innovative changes in both the baking recipe and unit design once village women get interested in using it. Therefore if cost/benefit analysis proves favorable for this technology from both a economically and culturally, the designs of these units may not be finalized until late in the RET project.

d) Fireless Cookers. This rediscovered technology has attracted much attention because of its simplicity and cost effectiveness - it pays for itself in a few weeks with fuel savings. Also called "hay box" or "wonder box" it is simply an insulated enclosure into which a boiling pot of food can be placed. Since the pot loses a minimal amount of heat, the temperature stays close to the boiling point and actually cooks the food.

Theoretically, if all cooking in the Sudan were done with a fireless cooker, it would cut total wood consumption by approximately 1/3 since at least that much heat is normally added after a pot comes to a boil.

The construction can be as simple as two gunny sacks filled loosely with dry grass. The boiling pot is nested into the lower sack and covered with the upper one. A cardboard box can be lined with 10 or 15 cm of hay and covered with a pillow or an insulated lid. Fancier versions may consist of colored cloth pillows sewn to the shape of a pot, filled with cotton, with a pillow over the top.

The top lining of the lower pillow or hay box could be made of an impermeable material (high temperature plastic, grease cloth) so as to be easily cleanable in case of soot and food spills. A wide variety of insulating materials can be used including: chicken feathers, uncarded wool, dry leaves, cotton residue, bagasse (excellent), wood shavings, old cloth. The hay box might also be sold as a package with a stove and a metal pot. A fourth item, also part of the original hay box concept is a round slab of thermal mass (stone, dense masonary) that can be heated up in the fire and placed in the fire and placed in the fireless cooker under the pot, if long and continuous boiling is required. The thermal mass can be brought upto 200°C or so and store sufficient heat for this process.

A slightly more sophisticated adaptation would be to use a simple pressure cooker to reach temperatures above atmospheric boiling which would be inserted in the fireless cooker. Low pressures could be achieved with a rubber gasket and simple snap buckle closures. A comparative demonstration of such a combination would show faster cooking time and significant fuel savings.

e) Portable Solar Cookers. While their application has been limited, it is possible that solar cookers could prove acceptable in Sudan for the following reasons:

1. Sudan's solar resources.
2. Lower material prices ($ 10-16).
3. They can be used in conjunction with fireless cookers and heat storage slabs.
4. The fact that many Sudanese have their main meal at 2:00 pm before siesta.
5. Increasing fuel needs, especially in the north where the sun is the most reliable and in refugee camps where there is virtually no available wood fuel.

Solar cooking will never entirely replace conventional cookers, but their range of usefulness can be extended with the fireless cooker concept which can keep food warm for hours after the sun has gone down. The basic components of the cooker are: dark colored, conductive pots, exterior insulation, glazing, and at least one reflector to speed up the heat input. The reflector can also serve as an insulated door, making the entire unit into a fireless cooker. The interior can be made of an opened 5 gal or 2 gal can, surrounded by organic insulation and clay housing. Two layers of glazing cover the opening, and the reflector is hinged to the can with a thermal barrier (or the reflector becomes a heat-loss fin). The cooker also serves as a water heater. Blackened 1 gal cans of water can be placed inside.

f) Animal Powered Pumping Systems. Animal power with geared power take off units can be used in areas of the Sudan where tradition permits. The largest single tribal group in Sudan, the Dinka, own most of the cattle but their affection for their animals has generally eliminated them as beasts of burden. Donkeys and camels are presently used by nomads (the Shenabla) and others in the northern and western areas. A strong camel can produce about one horsepower until the animal begins to tire. A donkey or ox and man produce less than half that amount of power each. This level of power is sufficient to pump from 4 to 6 gallons of water per minute at a depth of 60 meters (175 feet). This amount is a sufficient quantity for human and animal consumption or a small garden but inadequate for irrigation of a field. These animal driven units appear to be economical if they can be assembled locally from used automotive parts or if long term loans can be arranged coupled with bulk buying and shipping. Local merchants will not be able to purchase this type of equipment without financing outside. Similar purchasing arrangements would also be necessary for wind and photovoltaic water pumping systems.

g) Integrated Hand/Wind Pump and Water Storage Systems. The components of this technology are available commercially. The systems are generally economical and will perform adequately if two conditions are met:

1. comprehensive installation and maintenance training has been provided through merchants and local technicians and

2. the wind pump is part of an overall water supply system which includes storage with a hand pump and animal power, or diesel power, as backup when wind is not available. The cost of these systems will vary with each rural application. In general, installation, training and equipment costs will be from $ 2000 - $ 10,000 per community.

An example of wind pumping technology suggested by the PP energy technologist is the sail wind mill. Abundant information exists on this technology. A series of the most promising designs could be built and evaluated for local appropriateness, perhaps at a high wind site removed from Soba. Windmills have an advantage over spiral tube pumps in that they do not require flowing water, but in many parts of the country wind speed and reliability may be insufficient to justify their application. Costs vary according to size and pumping capacity with a 30,000 liter/day capacity at 8 mph wind average and 70m. depth, costing around $ 2000. Considered too expensive for irrigation, these windmills find applicability of community drinking water source in shallow to medium depth wells.

h) Small Scale Forest Management and Afforestation. Woodlot promotion and development will be vital factor in slowing current rates of deforestation and may lend themselves well to a combined effort to introduce more efficient wood utilization in rural communities. They will therefore be considered eligible for funding under the SREC renewable energy development grants program.

i) Pedal Power Grain Dehulling and Grinding. This RET responds to one of the most often expressed needs of village women, reducing the labor of preparing sorghum flour and other grains. The objective would be to produce a mobile, human powered system with performance characteristics sufficient for womens' grain grinding cooperatives or small business applications. The pedal power grain grinder can process a quantity of grain in one-third to one fifth the time required by hand systems for roughly the same investment.

System components for the grain grinder are a simple high efficiency grinder, a framework of metal or wood to carry one or two persons, a chain (or V-belt) drive to link the pedals to the shaft of the grinder and in many cases a fly-wheel to overcome load shocks which may occur during operation of the mill.

Chain drive is most suitable for high torque, low speed. For high speed, low torque the V-belt is more suitable and is also best for quick ratio change. The chain has a higher transmission efficiency than the V-belt.

Fly wheels are preferably made of metal but concrete filled scrap tires and similar improvisations can be used for low speed. Fly wheels must be very well balanced and well supported.

Two types of mills are suitable for this purpose. The first is the type used for coffee grinding made of two burrstone plates with grooves. This is the simplest and most appropriate to the Sudan and therefore is the type suggested. This type of grinder is efficient and relatively inexpensive to build. The second type is the roller mill which crushes the grain. Though extremely efficient, it primarily produces flakes. Several stages are required to grind it into flour and presently are not popular in Sudan. These mills are also much more complicated and expensive than the burrstone mill described above.

j) Animal Motive Power Technologies for Agriculture and Transport. Increased attention to technologies which substitute animal power for human labor in farming and the movement of goods, will again depend on the availability of loan financing from GOS to rural villages. Should such financing become available, it is anticipated that cost/benefit analysis for these technologies would prove very favorable, and local manufacture would increase. Under these conditions SREC could play an important role in developing and field-testing alternative equipment and machinery of this type and in promoting the dissemination of new field-tested designs.

k) Photovoltaic Electrification and Communication. NASA has initiated a photovoltaic demonstration program in developing countries to test the technical and economic feasibility of using photovoltaics to provide refrigeration at remote rural health centers for vaccine storage and emergency night lighting. Photovoltaic refrigeration may serve on important function in improving the vaccine cold chain at Health posts and clinics. The ultimate objective would be to provide better health services to the rural poor in very remote areas.

Other potential applications for photovoltaics might include remote railroad switching and communication. SREC could serve in a coordinating role for pre-feasibility and site identification. Photovoltaic pumping may be a candidate technology based on results of other existing or planned demonstrations in the Sudan and elsewhere in Africa.

l) Evaporative cooling. This method of providing cool air for preserving food and milk for short periods of time is based on the cooling effect of evaporating water dripped over charcoal stacked between wire screens. While the technology and technique involves very little expense, usefulness in the Sudan may be limited due to the scarcity of water in most of the country.

m) Solar Food Dryers. Food preservation is a great problem in large areas of the Sudan and particularly troublesome in the South. While Northern people already dry their food by simply leaving it out in the sun, little or no preservation is done in the South. Food dryers would last about 6 years and would cost about 16 LS. There are, however,

serious problems with the social acceptability of such a technology among many Southern people. Given very primitive conditions prevailing in many areas it is not clear that an adequate perception of the benefits of solar food dryers could be communicated to the people. Even if this were possible, there are a wide variety of needs which may well rank higher than the need for solar food dryers. An additional problem is the fact that the majority of rural southerners have not yet entered the money economy. There is therefore little hope that they could or would spend the requisite 16 LS on this technology unless it were cooperatively owned. Other problems include:

- Transportation networks and extension services are currently non-existant in many areas. Dissemination costs could well be prohibitive.
- In other areas, such as the North, there is little perception of the need for such a technology given the extremely dry and hot climate.
- Glazing or plastic may have to be imported, using scarce foreign exchange.

n) Commercial Batch Solar Water Heaters. This RET would be handled in the same manner as the portable wood burning stoves, however the primary market would be institutions such as clinics and schools. A solar water heater concept is proposed that integrates heating and storage hardware into one unit and therefore reduces the cost of building and installing the unit while still heating ample quantities of water to temperatures of 48°C (120°F) or higher. The target market price for this "breadbox" unit installed would be LS ($360) or about one-half the cost of conventional flat plat collector systems.

3. Research and Development Technologies

The Research and Development Technologies have been identified as technologically feasible, but relatively expensive and in some cases too sophisticated for non-institutional use, and as technologies which require continual maintenance. In spite of these limitations, there appear to be situations where the use of this type of technology would be warranted and would have significant benefits for rural Sudan. Therefore, the following types of technologies are suggested for further cost/benefit analysis: 1) photovoltaic water pumping, 2) methane production from concentrated wasters, 3) ethanol production from water hyacinth, 4) power alcohol from sugarcane, 5) alternative housing construction.

a) Photovoltaic Water Pumping. Under isolated conditions the overall cost of owning and operating photovoltaic or solar cell power pumping systems may compare favorably with diesel power systems. The technology is extremely sophisticated, but routine rural operation does not present a problem. Potential problems may be significant if the systems, malfunction or need electrical maintenance. Provision would have to be made by SREC to ensure training of engineers able to maintain and repair systems, and of rural water technicians responsible for daily operations and performance checking. This same requirement exists for photovoltaic refrigeration at rural health centers, and other photovoltaic applications.

Since there are a number of existing or planned photovoltaic pumping systems in Eastern and Southern Africa, it is recommended that prototype development be deferred until operating results are available on these systems.

b) Methane Production From Concentrated Waste. Installation of anaerobic digestors for concentrated animal or plant wastes to produce methane (BIO-GAS) may have applicability in certain settings. A digestor of 13,000 gallons handling the equivalent of 440 pounds of dry organic volatile matter per day (1800 pounds of fresh manure) has been suggested for the Wadi Halfa feedlot. It is estimated this system would produce about 2.3 million BTU/DAY. An operation on this scale, might be sufficiently large to be justifiable economically. The resulting fuel might be used for running rural pumps and machinery or for small industries, such as bread baking or glass manufacture.

c) Ethanol Production From Water Hyacinth. This activity would begin with a examination of a range of indigenous plant feedstocks as potential sources for large scale ethanol production. Water hyacinth is suggested only because of its rapid growth and nuisance quality.

d) Power Alcohol. The Petroleum General Administration of the Ministry of Energy has established a technical committee to investigate the possibility of using different mixtures of power alcohol and gasoline to operate cars and other engines. Present plans call for two distilleries, one at Sennar Sugar Factory to process 72,000 tons of molasses into 16,000 tons of power alcohol, and another at the Kenana Sugar Factory to produce 23,000 tons of power alcohol from 105,000 tons of molasses. This process requires further cost benefit, and technical analysis.

e) Alternative Housing Construction. Alternative construction techniques may be considered an appropriate topic for R and D under this project, particularly those designs which eliminate the need for wooden rafters used in traditional housing. Because of Rot and termites, rafters are typically replaced every three to five years. This task is time-consuming and the impacts on forest resources not insignificant.

Some of the technologies in the "candidate" and "research & development" technology classifications may be available in the U.S. and other countries. The Project will therefore seek to search the U.S. marketplace to see what it has to offer in these areas. Potential technlogies would consequently be purchased and field tested in the Sudan under this project.

Summary of Social Soundness Analysis

The main rural use of energy is for cooking and preparing beverages. Rural women usually perform these tasks outdoors, over an open hearth, using firewood. Existing data reveal that rural households are experiencing increasing difficulties in acquiring fuel because of deforestation. The demand for fuelwood by households and informal sector activities in towns and urban areas places further pressure on the supply, which is in rural areas. Most town and urban households rely on charcoal for cooking. To lessen the rate of depletion of wood in the Sudan, this project places priority emphasis on wood conserving technologies.

The project has been designed taking into consideration the Sudanese context. To help ensure that the renewable energy technologies which are developed and promoted are socially feasible, as well as financially and environmentally sound and that the parameters of these are specified, the project will assist in the establishment of an Economic, Social and Environmental Division (ESED), within the SREC. The staffing and operations of this department are specifically planned with the context of the local situation.

The technologies developed , tested and demonstrated for households are expected to be widely disseminated if they meet the criteria of a) social acceptability b) affordability, c) use of locally available materials and d) production and dissemination on the commercial market. Certain measures are built into the project to help ensure that these criteria are met.

The rural persons, including those in towns are expected to be the main direct and indirect project beneficiaries. Approximately 15,000 of them (or roughly 2,800 households) will be directly involved in the field trials and demonstration of stoves, low lift water devices and other technologies expected to be financed by the project. An estimated additional 7 million are anticipated to be indirectly benefit through adoption of the technologies which are diffused. Since improved cooking appliances for domestic use are of top priority, women will be the end users. They will benefit from a savings in time spent in collecting fuel, or in money spent purchasing it.

The introduction of technologies at the institutional level to conserve fuelwood or substitute for its use will indirectly benefit rural dwellers through diminishing the rate of deforestation which affects availability, and hence price of wood and charcoal, soil fertility and rainfall.

Other direct beneficiaries will be some service institutions, such as health centers. Those technologies introduced at this level are expected to indirectly improve services to the rural and town populations. Another group of direct beneficiaries will be approximately 50 artisans who will receive training in the manufacture of certain devices. In particular, those currently making charcoal stoves are expected to be reached so that they can produce the improved model. By this strategy these informal sector

manufacturers are not expected to be driven out of business; rather, they will be assisted in changing their product.

Others will directly benefit from training. Approximately 7 SREC persons will be sent for degree training and 30 people, sent for short term courses and study tours. Also, approximately 200 private sector, GOS and PVO personnel will benefit from seminars/workshops given by the Srec. A further 50 persons will be trained through RED Grants as trainers/ promoters of renewable energy technologies.

It is anticipated that one of the project impacts will be a greater understanding of energy problems facing the poor majority and identification of viable strategies for addressing their problems. It is expected that the activities of the SREC will influence policy which will impact on GOS allocation of resources and the financial contribution of other donor agencies.

SOCIAL SOUNDNESS ANALYSIS

I. Socio-cultural Feasibility

A. Introduction

The Sudan contains about 18 million inhabitants dispersed over 967,000 square miles. Approximately 66 percent of the population resides in rural areas, 24 percent in towns and urban centers, and 10 percent are nomadic. The per capita income averages $320 per annum. Availability of water is directly related to the location of the population and its economic activities. The country is primarily a plain constituted in the North by a desert, covered by poor soils which receive little rainfall, in the West by undulating sand dunes, in the East by clay formations, and in the South by tropical forest mountains and extensive swamps. The Southern Sudan has 57 percent of the country's forests and 27 percent of the inhabitants; nevertheless, some areas, like Juba, experience a shortage of fuelwood and poles, due to poor distribution and cost of transport. The North has 43 percent of the forests but 73 percent of the country's population. There is no movement of fuelwood or poles from south to north due to poor roads, costs of transport and so forth. Because of the arid conditions in the north there is a slower rate of regeneration of trees and hence lower sustainable yields than compared with the south.

There are numerous ethnic groups in the Sudan and while there are variations among them in regard to habits and preferences affecting energy use, the purposes for which energy is employed is less varied.*

B. Energy and Households

Rural Areas: The main household use of energy is for cooking and preparing beverages. Rural women usually perform these tasks outdoors, over an open hearth, using firewood. Households also use fuel for fires to roast meat, to provide heat and light, to keep away insects, to ward off animals, to warm water for washing, and to provide an atmosphere for social gatherings. One fire may serve multiple functions. In areas where firewood is scarce, households use agricultural residues and dung as supplemental fuels. In some areas, dung is preferred for making kisra, an unleavened bread.

Only a very small proportion of rural households, primarily those along the Nile rivers, have pumps for irrigating their fields. These pumps are usually run on diesel, the old pivot-type of irrigation having largely been abandoned.

---

* Herein the term energy applies only to inanimate energy.

It is difficult to make generalizations about rural households' energy use patterns in a country as large and diverse as the Sudan. To date a few studies have been conducted, focusing on energy use, supply and procurement, with the household as the unit of analysis. None of these specifically dealt with habits and preferences surrounding energy use. One of the Project outputs will be greater data collection and analysis of factors which influence the acceptability by rural women of wood/agricultural residue burning stoves.

Existing data reveal the extent to which rural households are experiencing increasing difficulties in acquiring fuel and other impacts of deforestation. Anwar Sheikh El Din Abdu carried out a study in Umm Buweisa village, White Nile Province, located in a low rain woodland savanna on sandy soil. The village, with a total number of fifty households, has an abundant water supply, mainly from surface wells which attract nomads and their herds. There are only six trees within the village and the nearest cluster of trees is approximately 13 kms away. About 75 percent of the households gather wood to meet at least part of their needs. Collection is done by women in the early morning hours; donkeys help with transporting the load. Due to the scarcity of wood, the women do not limit themselves to collecting fallen branches or cutting off dead branches; they resort to cutting off small branches and eventually chopping down whole trees. One donkey load of wood (55-65 kilograms) lasts a family of 7 persons about two days when it is used with other fuels.[1]

Umm Buweisa households depend on other fuels as well as wood. Animal dung is commonly used for cooking, especially for making unleavened bread. Dura (millet) stalks, which remain after thatching huts, as well as other crop residues, such as bullrush millet stalks, are used by the households of agriculturalists or sold by them as fuel. Charcoal tends to be purchased only in small quantities or made by women for their use by burying a piece of burning wood. Among the wealthier households, diesel oil tends to be used for lighting since kerosene disappeared from the area seven years ago. Poorer households, whose annual income is about LS. 35 as compared to LS. 140 for higher income groups, have difficulty meeting their energy needs.

The impact in such situations as Umm Buweisa can be severe since there are competing demands upon trees and on women's time. Trees also serve the following purposes: building materials for houses and animal enclosures; food for browsers; herbal medicine; food for sauces; and manufacture of kitchen and domestic utensils. Demands on women's time for agricultural and domestic tasks mean that they either work more hours as it takes longer to collect firewood, and hence risk fatigue and its health hazards, or they forego other important tasks. And, as fuel becomes more of a purchased commodity, money is either reallocated or there is greater necessity to sell food crops or labor.

As wood becomes scarcer in northern Sudan, acacia senegal trees are cut down for building materials, charcoal production and firewood. Acacia senegal is the source of gum arabic, an important export for the Sudan, which meets 70 percent of the world's demand. Moreover, acacia senegal as a leguminous tree is nitrogen fixing so that as the trees

are cut down, the soil quality is decreased.

Towns and Urban Areas: The demand for fuelwood by households in towns and urban areas places further pressure on the supply, which is in rural areas. Most of these households rely on charcoal for cooking. Even in Khartoum amongst middle and upper income groups, there is an increasing use of charcoal as the availability of gas and electricity has become less reliable. Kerosene used to be a popular fuel for providing light, but due to its unavailability outside the main urban centers, families have switched to diesel or fuelwood for lighting. Consumption patterns of energy vary to some extent between households of different socio-economic status. Those of higher status use more energy per member than do the others.

Information on Bara, a town about of 10,000 inhabitants, in Northern Kordofan, illustrates the extent to which town and urban households are affected by a shortage of energy, and the impact on rural areas. The data were collected by Turi Hammer Digernes in 1976/77 and in the summer of 1978. In 1976/77 she found that three-fourths of the lower income households used kerosene for lighting and one-fourth owned (but probably not always used) primus stoves. The following table shows differences in energy consumption between groups with Group One being of the lower strata.[2]

Monthly Consumption of Energy Calories Per Person

	Group 1	Group 2	Group 3
Kerosene	12,952	22,745	28,431
Wood	78,352	81,184	94,400
Charcoal	243,750	258,750	273,750
TOTAL	335,054	362,679	395,581

Table 28, Turi Hammer Digernes Wood for Fuel, PhD Thesis, University of Bergen, November 1977.

The main difference was that the households of the higher socio-economic status used more lamps and primus stoves.

Only a small percentage of the Bara households actually collect firewood for their own use: those who do not have the cash to purchase wood and those who are rich enough to employ servants to go far away to procure it. For the most part wood is purchased from sellers, the majority of whom are women and children, who come to the house. Ten years ago, however, the females of the households collected their own wood some 15 to 30 minutes away on foot. Today the source of supply is one to two hours away by foot.

Firewood is used mainly for cooking a dukhn porridge, making unleavened bread and, for some, brewing the local durra wine. Charcoal is used extensively for preparing other foods and beverages, heating houses, and ironing. Charcoal is used in a small portable stove made locally from

used tins. Cooking is done in a special hut, made of straw. A few women make their own charcoal by burying wood. The rest buy it from door-to-door sellers.

The demand for fuelwood by Bara residents had led to the removal of vegetation around the town, competition with other centers of consumption and deterioration of the environment. Especially many poor families are not able to meet their basic needs as energy has become too scarce and too expensive. For these, they do not use enough lamps to obtain sufficient light for satisfactory working conditions, they live in cold rooms during the winter and hence their health is impaired and some do not cook food properly.

Information on Babanusa, which has a population of 15,000, shows the average distance to wooded areas has extended from 2-3 kms in 1963 to 7-9 kms in 1980.[3] In Wadi Halfa town, as a result of the acute shortage of fuelwood, households have resorted to animal dung as a substitute. The main source of dung used to be monopolized by some merchants, who bought it from the veterinary quarantine station on a tender basis. Some housewives in the town organized themselves into a cooperative and successfully competed with the merchants to obtain the tender in the late 1970s so they could buy dung for domestic use at a more reasonable rate.[4] However, currently the station is not used so this source of fuel supply is no longer available.

C. Public Institutions and Private Enterprises

Fuelwood plays an important role in public institutions and private enterprises. For example, boarding schools, prisons and hospitals rely on wood and charcoal for cooking meals. Whereas hospitals usually have electricity, the other institutions tend to depend on kerosene, when available, or diesel, for lighting. In the informal sector, small bakeries, local wine houses and tea shops are common in towns and urban areas. In Bara the bakeries and beer makers only use wood as fuel, whereas the tea shops depend on charcoal. Blacksmiths tend to use charcoal. And brickmakers consume a great deal of wood.

Particularly in a radius around Khartoum, one finds boreholes with pumps driven either by electricity or diesel. These wells provide drinking water for school children, mosques, missions, and residents. Electric and diesel pumps are also used on irrigation sites, including irrigated forests.

Information on fuel consumption in Wadi Halfa town shows that consumption of gas, oil, kerosene and benzine in the public sector, i.e. government units, schools, hospitals and fish factory, is actually higher than its official quota. Ten percent of the allocated quota finds its way to areas outside of Wadi Halfa and the deficit is made up by purchases on the black market.

The availability and distribution of gas, oil, kerosene, benzine and electricity has a detrimental impact on the public sector and private enterprises. For example, factories have to lay off workers when production falls due to a lack of fuel or electricity. In boarding schools, students are unable to study at night because of a lack of light. And, the services of medical facilities are impaired due to lack of refrigeration and hot water.

D. Charcoal and Wood Suppliers

Charcoal producers can be classified into four categories: those who make the commodity from trees in their own fields; those who buy the right from others to cut their trees and produce charcoal for sale; those who cut trees or use fallen ones on communal land; and those organized by a wholesaler. While the burners are almost always men, sometimes women, often from the same household, sell the product. Relatively few families are dependent upon charcoal production as their main source of income throughout the year. However, the activity itself results in greater dependency upon it as a source of income: deforestation causes soil erosion which in turn results in declining soil productivity and eventually lower rainfall which affect both agriculturalists and pastoralists, which forces people to migrate and settle where one of the options for earning an income is charcoal production or selling of firewood.

For those who are members of a wholesalers team, usually composed of three to five members, the wholesaler provides them advances in the form of food, tools, and drinking water. The organizer also provides the bags and arranges transport to a central storage place near a main road or railway line. This type of organization of production is common in the Suki region of Blue Nile Province. [5]

One of the main trees used in northern Sudan for charcoal is acacia senegal, the source of gum arabic. Whereas these trees should not be cut until they are 20-30 years old, Turi Hammer found that trees of 9 years or less are being used for charcoal production. Also, although trees on communal land are not supposed to be cut, except for clearing land for cultivation, this regulation is ignored since the demand for fuelwood can not be met through other nearby sources.

Because acquisition of wood is less arduous than production of charcoal, women and children are often found as wood sellers. In the Bara area, Kababish people who lost their animals during a prolonged drought which began in 1968 settled in tents on the outskirts of the town and took up wood cutting and selling as their main livelihood. These people, although aware of regulations, resort to cutting trees on communal land or land belonging to someone else, and cutting immature trees because of the necessity to make a living.

E. Perceptions of Desertification and Environment

Studies conducted in Bara and Babanusa areas contain information on people's perceptions of their environment. In Babanusa information was obtained both from nomads who tend to spend 4 to 6 months on the edges of the town, and from the settled residents. Both groups acknowledge a deterioration of their environment. The settled towns people view degradation of the hinterlands in terms of a decline in crop production, rising firewood and charcoal prices, an increase in distance to wooded land, and increased desert conditions. They consider an increase in both human and animal populations as the main cause of the environmental deterioration. The nomadic people regard the deterioration as caused by fluctuations in rainfall, continuous cultivation by settled people, and an increase in population leading to expansion of the settled area.

In Bara town, in 1976/77, the men were more aware of environmental conditions than the women. The majority of women thought that desertification was occurring in their area, but about one-third offered no explanation. For those giving a cause, most blamed the wind. Bara men were more knowledgeable about the complex reasons for desertification and suggested that shelterbelts be planted. Village people in the hinterland of Bara were well-aware of the process of desertification which was occuring, and most believed that the recent drought was decisive in accelerating the process. When asked about remedies, the villagers are reported to have pleaded for the planting of trees, like the El Beshiri project with which they are familiar. In El Beshiri inhabitants and school children planted 300,000 seedlings of different species, between 160 tons of dry branches placed in criss-cross patterns on the bare sand dunes. As a result 275 hectares have been stabilized.

F. Project Implications

The project is designed to benefit the rural majority, directly and indirectly, by taking into consideration the financial implications of each technology for the targeted adopters as well as the cost of reaching the intended producers and users. Moreover, the social feasibility of technologies will play an important role in the identification and design of them. For example, the description above on rural household energy use reveals the need to conserve wood, which can be accomplished through introducing stoves for burning wood and/or agricultural residues. The design of low-cost, portable stoves which can be sold on the commercial market will be the most feasible since (a) it will not rely on more production which would require a massive extension effort to teach people how to build them and (b) culturally rural women prefer cooking outdoors for at least most of the year, hence permanent clay stoves are not suitable. Moreover, because the current charcoal stoves are extremely inefficient in their use of energy, improved charcoal stoves will receive priority attention for use by town and urban households.

To help ensure the setting of priorities for design and development of renewable energy technologies as well as to monitor and evaluate the social feasibility of designs being tested and demonstrated, the project will assist in the establishment of an Economic, Social and Environmental Division (ESED) within the SREC. The Division will be organized with affiliate members so that it has the services of the most qualified research specialists in the Sudan. The studies carried out through the ESED are expected to stimulate more research interest, especially in socio-cultural aspects.

II. Role of Women

As discussed in the previous section, women are the gatherers of fuel for domestic use and the cooks. Women are also the producers of local wine and beer, and Southern women make shea nut butter; all these activities require large quantities of fuelwood. In order for stoves for domestic use to be acceptable, the relevant habits and preferences of women must be taken into account. The project will do this in its data collection efforts, and in the field testing and demonstration phases. Hence, in these ways, women will be actively involved in identifying suitable stove models for wider dissemination.

The ESED will contain female affiliate members and staff. And, research proposals and requests for funding pilot demonstrations will be required to address women related issues.

III. Spread Effect

The project is designed to have a wide spread effect. First, it focuses on the development of low-cost technologies, particularly stoves, for the rural majority and urban poor. To help ensure that these devices are more than just technically sound, but also economically and socially feasible under various conditions, the ESED will assure the collection of data on a various cultural groups and ecological zones to indicate the feasibility of certain technologies and design requirements based on a study of habits and preferences. This is needed to identify designs with wide-spread potential since the project-financed field testing and demonstration activities for each technology are expected to take place only in a few sites.

Second, taking into account the weak government linkages into rural areas, the project focus is on technologies which can be produced in the commercial sector, particularly the informal sector, using locally available materials and tools. In this way, the commodities will flow through normal patterns of distribution. For example, a study of rural informal sector industries by Abdel Bagi A. Babiker reveals that goods produced in Mahmiya-Dama, located 200 kms north of Khartoum, which has access to the railway line, find their way to centers outside the areas, such as Atbara, Wad Medani and Khartoum.[6] Particularly improved stoves for town and urban dwellers are expected to diffuse rapidly, if the training of artisans is conducted on a sufficient scale.

The main consumers or purchasers of stoves for domestic use will be women. Since the fuelwood problem is more serious in northern Sudan than the south, it is in this former geographic area where the demand is expected to be greatest. Yet, since the northern women are predominately Muslim, who are supposed to be secluded from unrelated males, how will they become aware of this new product? The system of sexual segregation and seclusion of women which characterizes towns and urban centers, is less marked in rural villages. In a village, social and kinship ties are largely co-terminous so that women are able to pursue many activities outside the house. For any specialized services they call upon neighbors and domestic servants. In the towns and urban areas, most Muslim women are more restricted from social activities outside their domestic quarters. However, they are engaged in strong networks of women. Membership in zaar cults, a spirit possession group, by Muslim women is common. The cult group provides women with a basis for association in addition to kinship and tribal relations, which are the more traditional means of social interaction. Membership in cult groups gives women contact with a large network of women from different ethnic and socio-economic groups.[7] Information about stoves is expected to flow through such contacts among women. Also, women may learn about them from door-to-door sellers.

The interest shown in improved charcoal stoves at a recent conference on Women and the Environment attended by Sudanese from various organizations, and including a large percent of women, demonstrated an acute concern about identification of more efficient technologies for cooking. It is anticipated that initially a great impetus for diffusion will come from the urban professional men and women who are well-aware of the fuelwood problems faced by extended family members in towns and rural areas.

The renewable energy technologies for households developed, tested and demonstrated under the project will spread rapidly if they meet the criteria of (a) social acceptability, (b) affordability, (c) use of locally available materials, and (d) production and distribution on the commercial market.

For those technologies proven viable for service institutions diffusion should occur through the supporting organizations and future donor agency activities. For example, designs of solar cookers and heaters for health facilities, once proven feasible, are expected to be adopted in plans for new facilities. And, if the cost justifies it, existing institutions will change from their current practice and appliance in order to save money. At the institutional level, information about feasible technologies is expected to spread through word of mouth, as well as written documents.

IV. Beneficiaries

The rural majority and urban poor are expected to be the main direct and indirect beneficiaries of the project. Approximately 15,000 of them (or roughly 2,800 households) will be directly affected by field tests, demonstrations and dissemination activities on stoves, low-lift water devices, and reforestation

expected to be financed by the project. An estimated further 7 million (about 1.2 million households) will indirectly benefit through the diffusion of these technologies at the household or village level as the unit of adoption. In particular, the identification of improved cooking appliances is of top priority. Women will be the end-users of the improved charcoal stoves and the introduction of wood/agricultural residue cookers. Women will benefit from a savings in time spent collecting fuel, which has an indirect health benefit, or in money spent on purchasing fuel.

The nomadic population is expected to be affected by the project in the following manner. First, many of the nomads have members of their immediate family residing on the borders or periphery of towns. These resident members are expected to be reached through REDG activities and the diffusion of technologies. Second, nomads may benefit through water-lifting devices developed under the project. Third, they will indirectly benefit through efforts to reduce the rate at which deforestation is occuring. Attention will be given to this segment of the population in rural energy use studies to identify more precisely any other ways to directly involve them in project benefits.

The introduction of stoves for domestic use to conserve fuel and technologies at the institutional level to conserve fuelwood or to substitute for its use, eg. solar energy, will indirectly benefit rural dwellers through diminishing the rate of deforestation which affects not only availability and hence price of wood and charcoal, but also soil fertility.

A few service institutions, such as health centers, are anticipated as direct beneficiaries. Those technologies introduced at this level are expected to be disseminated so that more institutional centers are indirect beneficiaries. The main benefit for them will be financial, i.e. a savings realized from their current mode of energy use.

Another group of direct beneficiaries will be approximately 50 artisans, anticipated to be in the informal sector, who will receive training under the project, in the manufacture of certain technologies. In particular, those currently making charcoal stoves are expected to be reached so that they can produce the improved model. By this strategy these informal sector manufacturers are not expected to be driven out of business; rather, they will be assisted in changing their product.

Also, directly benefiting from the project will be the members of the SREC. Approximately 7 persons will be sent for degree training and 30 for short term courses and study tours. Also, approximately 200, GOS and PVO personnel, will benefit from training and seminars given by the DID. private sector

The project may have some negative effect on wood and charcoal sellers if the demand for their products is diminished. But, for most of these people selling wood or charcoal is not their main source of income so the impact should not be severe.

It is anticipated that one of the project impacts will be increased knowledge about the energy problem facing the poor majority and identification of viable strategies for addressing the problem. With a modest amount of financing, the project through the ESED will seek to involve some of the best researchers in the country, and their students, to focus on the problem. It is expected that their findings will influence policy which will impact on GOS allocation of resources and the financial contribution of other donor agencies. Also, the Project's Renewable Energy Development Grants are expected to attract the collaboration of non-governmental organizations. The experience gained under the project may influence these organizations to play a greater role in addressing the dissemination of proven renewable energy technologies under different conditions and, when necessary, make the needed modifications.

Footnotes:

1. Abdel B.A.G. Babiker and Anwar S. El Din Abdu, "Rural Energy Use and the Environmental Impact on Women in Semi-area Sudan", Paper presented at the Women and Environment Conference, Khartoum, April 1981.

2. Turi Hammer Digerne, "Wood for Fuel", unpublished PhD University of Bergen, 1977 and Addendum to Thesis, October 1978. All further references to Bara are from these sources.

3. Salah E. O. Ahmed, "The Environmental Impact of the Growth of Babanusa Town on its Hinterland", unpublished MA Thesis, University of Khartoum, April 1981. All further references to Babanusa are from this source.

4. "Socio-economic Survey of Wadi Halfa and Lake Nuba", Economic and Social Research Council. Research Report No. 6, Khartoum, October 1978. A further reference to Wadi Halfa is also from this report.

5. Edmond Uhart, "Charcoal Industry in the Sudan", Addis Ababa: UNECA, Jan. 1976.

6. Abdel B.A.G. Babiker, "The Role of Rural Industries in the Arid and Semi-Arid Areas of the Sudan". Paper presented to the Workshop on the Management of Arid Land in the Sudan, Hamburg, October - November 1979.

7. Pamela Constantinides " Women's Spirit Possession and Urban Adaptation", in ed. P. Caplan and J. Bujra Women United, Women Divided London: Tavistock Publ., 1978.

ECONOMIC ANALYSIS

One of the primary aims of this project is to install the institutional capacity in the Sudan to perform financial and economic analyses of energy projects. Currently, there are few projects which have been developed to the extent where an adequate cost-benefit analysis can be performed. Virtually all proposed technologies will require extensive research for local adaptation before their cost characteristics can be determined. Needless to say, without such information, no final judgement can be made as to the desirability of dissemination. For instance, a wide variety of charcoal stoves are available from various sources, including several examples from Africa. While it is clear that many of these stoves represent an improvement on current technology, it is not at all clear which is the best for the various regions of Sudan in terms of social acceptability, ability to manufacture them locally, etc. In addition, little cost data in Sudanese pounds are available as few of these stoves have been constructed in Sudan. Figures reported in foreign currency are not comparable with other elements of the cost/benefit analysis. Indeed, many components of the cost benefit analysis have no price per se since much of the economy operates on a barter basis. In such cases estimates must be made, but it should be noted that one of the most important tasks of the SREC will be to firm up these estimates. These issues must be investigated before any given technology is recommended for widespread dissemination. At the absolute minimum, at least one prototype constructed with local materials must be made and tested in situ before a final cost-benefit analysis can be performed. The wide disparity in regional conditions in the Sudan narrows the scope for nationally applicable projects.

Despite the above problems, some preliminary studies have been performed for some technologies in the Sudan. These first-cut analyses are valuable to the engineer/technology specialist in that they provide some guidance as to the probable range of feasibility and desirability of a given type of technology. As more information is obtained in the course of field testing and implementation, the analyses can be modified accordingly. The methodology used is described in " The Economics of Renewable Energy Systems for Developing Countries" by David French. In those cases where data required for this analysis are not available in the Sudan approximations have been made and so noted.

As described more fully in the French paper and in the project papers prepared for the Lesotho and Botswana renewable energy projects, the analysis is carried out on several levels. First, where appropriate, is an analysis of the technology in terms of its economic attractiveness for the consuming unit, in most cases the household. If a technology is not attractive to the user, it cannot be considered for dissemination unless the government is willing to enforce its use for overriding societal reasons. In order to make a judgement as to the desirability of the different technologies on this more general level, account must taken of the benefits accruing to the region or nation. Often the benefits of a technology accrue mainly to society in general, while remaining unattractive at the individual or household level. For example, the use of improved retorts for charcoal manufacture may not be economic for the individual who can cut down unlimited trees and use earthen kilns for free. However, the benefits to society of halting environmental degradation

may outweigh this and provide sufficient cause for legislative action.

Many factors are not quantifiable and, as such, cannot be adequately analysed in a cost benefit framework. In these cases, a reasoned analysis will prove more helpful to decision makers than any attempt to squeeze such factors into a monetary framework. Important among these factors is the degree to which a given technology will conflict with established social traditions and folkways.

Finally, some consideration must be given to the cost of dissemination. Given Sudan's low population density, poor transport and communications networks, and wide diversity in cultures and languages, these costs are likely to be quite high in nearly all cases. For this reason, particular attention must be paid to technologies which are amenable to manufacture and marketing by villagers or townspeople. In this way, those entrepreneurs who stand to gain from increased sales of new technologies will themselves make extensive efforts to disseminate them.

While there are many technologies with a great potential in the Sudan, 5 were felt to be particularly interesting, and are analyzed in some detail here. Three of these had reached a stage of development in which a cost/benefit analysis on an individual investor basis was appropriate. The remaining two are discussed in more general terms since a more quantitative analysis must await further research.

1. Improved Charcoal Stoves

Charcoal stoves are currently used in urban areas and among higher income households in rural areas. As economic development progresses and rural incomes rise, it is expected that more and more rural people will switch from traditional 3 stone fires to charcoal stoves. There is a great incentive on the national level to encourage more efficient modes of charcoal combustion to avoid ever increasing rates of deforestation in the future. Several important assumptions were made in order to compare the traditional metal charcoal burner with a new metal and ceramic version.

- Both the traditional stove and the improved version have lifetimes of about three years.
- The traditional stove costs from 1.50 to 2.00 LS; depending on the size of the stove and the distance from point of manufacture.
- The modified metal and ceramic stove will cost from 3.50 to 4.00 LS.
- Charcoal consumption per household (family of 5) per year is about 1200 kg. Although estimates vary widely, this figure is the national average cited by T.H. Mohammed Ali of the NEA in June 1981 (mimeo). It should be noted that consumption in Khartoum was estimated to be about five times this amount.
- Extra maintenance required by the new stove is about 1 hr per month.
- The wage for unskilled labor in Sudan is approximately 30 LS/month, or 1 LS/day.
- Labor used to maintain stoves is valued at about 3/4 of this rate, as it is assumed that the maintenance time will not detract significantly

from labor in other activities.

- Charcoal costs from 6-7 LS per 100 lbs.
- The improved stove will cut charcoal requirements by 50%.

	1	2	3
Costs			
Labor for maintenance	1.0	1.0	1.0
Benefits			
Savings from decreased charcoal use	85.8	85.8	85.8
Discounted value (30%)	65.2	50.2	38.6

PV = 154 Net Investment = 2.0 NPV = 152 LS

Dissemination Costs

Initially, these should be low, as many users are concentrated in urban areas and can readily afford the higher first cost of the improved stove. They will rise over time, however, as the rural market begins to be penetrated and lower income customers with greater cash flow problems are reached.

However, given family consumption of charcoal of 1200 kg. per year, or the equivalent of 8000 kg. of wood, a halving of wood requirements would yield substantial benefits in checking deforestation, since it is estimated that about 5 1/4 tons of wood can be recovered per acre, and reforestation costs from 60-75 LS per acre.* Thus, from a national economic point of view, this project appears well worth undertaking.

Sensitivity

This analysis is in some degree sensitive to the estimated cost of the improved stove, and to its estimated lifetime. However, even substantial variations in these parameters still yield a positive NPV.

Scarce Resources

This project makes use of abundant resources (ceramics) and yields large benefits in conserving wood, an increasingly scarce resource.

---

* ref. Interview with Mohammed El Amin Mukhtar, Director NEA.

2. Wood Stove

The wood stove proposed is made of a mixture of cement and earth and would replace the traditional three stone open fire currently in use by many of Sudan's rural poor. The increase in efficiency is from about 5% for the open fire to about 25% for the stove, representing a reduction in wood needs by a factor of five. Since many households gather their own wood and, of course, pay nothing for the open hearth they currently use, the initial cost of the stove must be weighed against the value of labor used in collecting firewood. It has been estimated that many villagers have stripped the land of trees to a distance of over 10 kilometers from their villages, necessitating a walk of 2 to 4 hours daily in search of wood. Thus there is reason to believe that many villagers would look favourably upon a reduction in the number of trips required to maintain an adequate supply of wood. Several important assumptions were made:

- The stove would cost from 4 to 12 LS.
- It would last about 9 years.
- About 20 hours weekly is spent in search of firewood.
- Use of the stove would reduce the time spent in firewood collection to about 4 hours weekly.
- Maintenance requirements for the stove are negligible.
- Labor is valued at about 75 pt. per day, or about 8 pt. per hour.

	1	2	3	4	5	6	7	8	9
Costs	0	0	0	0	0	0	0	0	0
Benefits									
Labor savings	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5
Discounted (30%)	51.1	39.4	30.3	23.2	17.9	13.8	10.6	8.2	6.3

PV= 201 Investment = 12 NPV = 189 LS

Dissemination Costs

Initially, these costs will be quite high since it will be necessary to carry out extensive demonstrations to stimulate demand. The existence of a certain threshold level of demand will be necessary in a given area to support the local entrepreneur who will manufacture the stoves. It will also be necessary to provide examples and instruction to those who will manufacture them. However, once the business has been set up, dissemination costs should drop off quite rapidly as it is expected that the local entrepreneurs themselves

and the force of examples will provide their own advertisements. Since the costs of deforestation noted above in the case of the charcoal stove apply equally in this case, this technology represents a clear benefit in terms of national or regional social and economic welfare.

Sensitivity

This analysis is very sensitive to both the rate of discount used and the value placed on labor. Another problem is the high initial cost of the stove relative to the cash flow of the majority of rural Sudanese.

Scarce Resources

The scarcest reource utilized by this technology is local entrepreneurship. It may be difficult to find enough villagers willing to become wood stove manufacturers. This is an area that needs further research as initial field tests and demonstrations are performed.

3. "Low" Technology Water Lifting

The vast majority of small scale irrigated agriculture in the Sudan makes use of small (3-5 hp) pumps called "wabours". Crops grown include citrus, vegetables, wheat, sorghum, onions, garlic, fenugreek, fava beans, alfalfa and garbanzos. There are two main growing seasons, summer and winter. Pump usage is much greater in the summer due to greater evaporative losses as well as higher water requirements for more water intensive summer crops. This project proposes to substitute a simple pump based on a water wheel design powered by the strength of the river current alone. The pumps used are mostly 3-5 hp Listers of English or Indian manufacture. This analysis will make use of the 3 hp pumps for comparison purposes. The figures used in the assumptions below are based on seasonal averages, and may differ for the various regions and for differing crop patterns.

- In the winter pumps run for an average of 8 hours daily for a two month period and about 3 hours daily for another month for a seasonal consumption of about 82 imperial gallons of diesel.
- In the summer, pumps run an average of 12-16 hours a day for a four month period. This results in a seasonal consumption of diesel of about 480 imperial gallons.
- Although the official price for diesel is about 1 LS/gal. the vast majority of the fuel purchased by small farmers is obtained on the black market. A conservative estimate of the black market price is about 2.00 LS per gallon.
- It is assumed that both the diesel pump and the waterwheel will last about 8 years.
- The cost of a 3 hp pump is 2000 LS.

- The cost of a water wheel pump is about 200 LS.
- Although it is assumed that both technologies will require similar amounts of time for maintenance, the simpler technology used in the water wheel will result in savings in spare parts of about 5 LS per year.
- It is assumed that the speed of the current in the river is sufficient to allow the use of the water wheel pump.
- It is assumed that installation of the pump will require 3 days of labor valued at 1.50 LS per day.

	1	2	3	4	5	6	7	8
Costs								
Installation	4.5	0	0	0	0	0	0	0
Benefits								
Fuel Savings	1124	1124	1124	1124	1124	1124	1124	1124
Spare parts	5	5	5	5	5	5	5	5
Discounted (30%)	865	668	514	395	304	234	180	106

PV = 3266 Net Investment = (1800) NPV = 5066

Dissemination Costs

It is anticipated that dissemination costs will remain moderate to low throughout the life of the project due to the concentration of potential sites along rivers. This allows both easy access and easy transport.

Sensitivity

All of the assumed parameters can be altered significantly without altering the positive assessment reached by the cost-benefit analysis. One important factor, however, is the assumption that water flow speeds are high enough year round to allow use of the pump. If this were not true, or if it were only true in certain seasons, the analysis would have to be substantially modified. A judgement on this point cannot be reached until a preliminary hydrographic survey has been performed. However, even if the pump can only be used half the year with a diesel used for the balance of the year, savings in fuel clearly outweigh the cost of the pump (see alternative calculation below).

Scarce Resources

It is not anticipated that the proposed pump will make extensive use of scarce resources. It will, however, result in substantial savings both in imported petroleum products and in imported Lister pumps.

Cost/Benefit Calculation for Water Wheel Pump under Alternative Assumptions

This calculation assumes that the waterwheel pump will provide only half of the necessary water lifting. Thus, only half of fuel consumption will be saved, and the farmer will still be required to purchase a diesel pump as before. An additional measure of conservatism is inherent in this calculation since the longer life of the diesel pump resulting from lower usage has not been factored in.

	1	2	3	4	5	6	7	8
Costs								
Installation	4.5	0	0	0	0	0	0	0
Benefits								
Fuel Savings	562	562	562	562	562	562	562	562
Spare parts	2	2	2	2	2	2	2	2
Discounted (30%)	430	334	257	197	152	117	90	69

PV = 1646 Investment = 200 NPV = 1446

4. Retorts for Charcoal Manufacture

Currently, charcoal is manufactured mainly by private entrepreneurs who fell trees on public lands at no cost to themselves. The wood is then stacked and covered with earth. This is a labor intensive method, but one which results in no out-of-pocket expenses whatsoever. Although the recovery factor is 15% or less, there is no incentive to improve efficiency since the trees are free to the charcoal makers, and there would be no private gain in buying a more efficient steel retort. In the opinion of Mohammed El Amin Mukhtar, head of the NEA, there will be no improvement in the situation unless the government takes legislative action. Only if charcoal makers are forced to pay for trees felled will there be an incentive to invest in increased efficiency. (The improved retorts will double efficiency to about 30%). With an estimated 250,000 acres yearly being stripped of forest cover, and with reforestation costs estimated at 60-75 LS per acre, it is clearly worthwhile to try to correct the current situation. However, a prerequisite for positive action is recognition by the GOS of the problem, and a willingness on their part to implement the necessary measures.

5. Solar Ovens

The vast majority of cooking is currently done using either firewood or charcoal. As noted above in the sections discussing charcoal and wood stoves, the degradation of Sudanese forest resources because of wood cutting is a serious and growing problem. Thus, any measures which could alleviate this problem would be of immense value to the country. The proposed solar cookers would cost about $ 10 each. On a purely economic basis, this investment seems quite attractive given the large amounts of time that must be spent daily in search of fuel. There are, however, some qualifications to this assessment.

In the first place, the analysis is very sensitive both to the discount rate used and to the value placed on the labor used in wood collection. (See the section on wood stoves above; the analysis is very similar). Another problem is the alteration in traditional cultural patterns required to make use of the solar ovens. Chief among these factors is that the ovens work best in the middle of the day, but the main meal in Sudan is traditionally eaten later on in the afternoon. Equally troublesome is the fact that cooking is often done indoors but would, of course, have to be done outside with a solar oven. Another possible problem is the greater amount of time required to cook food with a solar oven. Dissemination costs could be fairly high, but should be comparable to those for the wood oven discussed above since the target population is identical.

Despite these potential problems, there is reason to believe that many of them could possibly be overcome in time. Further field research is needed to see just how much of an obstacle these considerations represent. One possibility is the use of solar ovens by institutions such as schools or hospitals.

FINANCIAL PLAN

Summary

A. The total AID contribution to this project is $4,600,000; the total GOS contribution is $ 3,000.000 in local currency (see Local Currency table); the FRG contribution amounts to $ 2,030,000.

B. AID Inputs

1. Technical Assistance $ 1,230,000

The project will provide two long term technical advisors a) an expatriate extension/dissemination specialist (chief of party) for 54 months and b) an expatriate economist (36 months). The chief of party will assist the Sudanese counterpart who is head of the Dissemination and Implementation Division. The economist will assist the Sudanese counterpart who is head of the Economic, Social and Environmental Division. Short-term consultant sources (45 months) will also be provided. Cost estimates for long and short term technical assistance include US dollar support costs (transportation, allowances, housing, etc. The contractor will be responsible for support of all expatriate personnel. Funding for local currency costs of contractor support will be provided by the CIP Trust Fund.

2. Commodities $323,000

AID will fund the foreign exchange costs of commodities required by the project. Vehicles (140,000), Data analysis equipment ($ 40,000), workshop equipment ($ 46,000), office equipment ($ 30,000), field test materials ($ 30,000), training materials ($ 12,000), and information center materials ($ 25,000) will be funded. USAID will initiate procurement of vehicles as soon as the project agreeement is signed. The contractor, once selected, will be responsible for all remaining U.S. and local procurement.

3. Training Costs $458,000

U.S. and third country training will be funded by the project. The contractor will be responsible for coordinating and implementing all aspects of U.S., third country, and local training.

4. Other $65,000

This includes the project contribution to the USAID charter, to be funded directly by the project.

5. Renewable Energy Development Grants $2,001,000

These grants are intended to promote dissemination of renewable energy technologies. (See Section III.E)

The grants will be funded directly by the project, and will not be included in the contract.

6. Inflation $316,000

Inflation is calculated at 10 percent compounded for all foreign exchange costs, excluding the renewable energy development grants.

7. Contingencies $207,000

Contingencies were calculated at 10% of the total USAID contribution, excluding the renewable energy development grants.

SUDAN RENEWABLE ENERGY PROJECT

BUDGET

(US $000)

USAID INPUTS	PY1 FX	PY1 LC	PY2 FX	PY2 LC	PY3 FX	PY3 LC	PY4 FX	PY4 LC	PY5 FX	PY5 LC	TOTAL '000 FX	TOTAL '000 LC
A. Technical Assistance												
1. Long term (90PM)	220	40	220	40	220	40	110	20	55	10	825	150
2. Short term (45PM)	144	48	108	36	54	18	45	15	54	18	405	135
	364	88	328	76	274	58	155	35	109	28	1230	285
B. Training												
1. Long term US (132 PM)	66	3	110	2	44	2	22	1			242	8
2. Long term Local				6		3		3				12
3. Short term US (40)	32	4	56	7	32	4	24	3	16	2	160	20
4. Short term Third Country (56)	16	4	16	4	16	4	4	1	4	1	56	14
SUBTOTAL	114	11	182	19	92	13	50	8	20	3	458	54
C. Commodities												
1. Vehicles (7)	68						15		15		98	
2. Motorbikes (6)			12								12	
3. Spares	20						5		5		30	
4. POL		15		15		15		18		21		84
5. Data Analysis	40										40	
6. Workshop Equipment	40						3		3		46	
7. Office Equipment	20		3		3		2		2		30	
8. Field test Mater.	6	18	6	18	6	18	6	18	6	18	30	90
9. Training Mater.	8		1		1		1		1		12	
10. Info Center	17		2		2		2		2		25	
SUBTOTAL	219	33	24	33	12	33	34	36	34	39	323	174

USAID INPUTS	PY1 FX	PY1 LC	PY2 FX	PY2 LC	PY3 FX	PY3 LC	PY4 FX	PY4 LC	PY5 FX	PY5 LC	TOTAL $'000 FX	TOTAL $'000 LC
D. Other												
1. Local Seminars				5		5		5		5		20
2. Printing				5		5		10		10		30
3. Field test support		11		11		11		11		11		55
4. Slide Tape Prod.				2		2		4		4		12
5. Rural Training Exhibits				2		2		3		3		10
6. Subcontracts		25		35		35		35		35		165
7. Aircharter	65										65	
SUBTOTAL	65	36		63		66		77		77	65	319
TOTAL PROJECT INPUTS	762	168	534	191	378	170	239	156	163	147	2076	832
CONTINGENCIES (10%)	76	17	53	19	38	17	24	16	16	15	207	84
INFLATION (10% COMPOUNDED)			59	21	87	39	87	57	83	75	316	192
RENEWABLE ENERGY DEVELOPMENT GRANTS	200		300		500		600		401		2001	
TOTAL	1038	185	946	231	1003	226	950	229	663	237	4600	1108

Local--Currency Breakdown
(in LS'000)

	PY 1			PY 2			PY 3			PY 4			PY 5			TOTALS		
	GOS	CIP	TF	GOS	CIP	TF	GOS	CIP	TF	GOS	CIP	TF	GOS	CIP	TF	GOS	CIP	TF
TA																		
Contractor Support			90			60			46			28			22			226
TRAINING																		
Participants		9			15			10			6			2			42	
Project Training Activities		20			20			20			22			26			108	
COMMODITIES																		
POL		12			12			12			14			17			67	
Field test materials		15			15			15			15			15			75	
CONSTRUCTION		400															400	
OTHER																		
R.EDG		100			150			250			300			200			1000	
Salaries + per diem	65			65			65			65			65			325		
Field rest-supp.		11			11			11			11			11			66	
Subcontracts		25			35			35			35			35			165	
TOTAL	65	592	70	65	258	60	65	353	46	65	403	28	65	306	22	325	1923	226

V Implementation Arrangements

A. GOS Implementation Responsibilities

The primary GOS implementing organization will be the Center which is responsible for coordinating all renewable energy activities in Sudan, including both the West German and USAID projects. An Energy Research Committee, composed of representatives from the National Research Council, the National Energy Administration, the Institute for Energy Research, and the Public Electricity and Water Corporation, has policy making responsibility for the Center. The Center director, Dr. Yahia Hamid of the Institute for Energy Research, will be the primary counterpart for the USAID project. He will be responsible with the contractor for the day to day implementation of the project including assuring that the funding from the regular budget and from CIP generated counterpart funds are available in a timely basis.

To ensure effective coordination between the USAID and FRG projects, the Center director will be responsible for establishing and coordinating a committee to include the West German advisors, the USAID advisors and their respective counterparts. This committee will periodically review progress under the projects, coordinate field testing, especially where similar technologies are concerned, facilitate exchange of relevant socio-economic information.

The Center will be responsible for all accounting and disbursing procedures related to the CIP generated local currency with the exception of that amount being placed in the USAID trust fund for direct contractor support.

B. USAID

USAID monitoring and supervision will be the responsibility of the USAID Energy Officer. Monitoring will primarily be accomplished through review of periodic contractor reports, (quarterly or monthly as determined by the Energy Officer) and periodic meetings with the Chief of Party and the GOS counterpart, plus site visits as necessary.

An independent evaluation will be conducted after the first full year of project activities (see Evaluation Arrangements)in addition to a final evaluation.

The USAID Controller's office will review disbursement and reimbursement requests for conformity with AID regulations and ensure that adequate financial control methods are followed. It will also establish, according to AID regulations, procedures for disbursement and monitoring of the local currency Trust Fund. The Trust Fund will include only those elements required for direct support of the prime contractor.

C. Contractor Selection and Responsibilities

Given the project emphasis on institution building, and dissemination of renewable energy technologies the contractor should be an organization with prior experience in establishing Third World renewable energy institutions.

The prime contractor will be a direct AID contract as the Ministry of Energy is or as yet in such a fluid state of organization that negotiation and management of the contract would exceed their contracting capability. The GOS will, however, participate in the contract selection process with AID. The contractor will identify the chief of party and the energy economist/ sociologist in their proposal. For a description of individual responsibilities, see Scopes of Work.

The contractor will be responsible for all long and short-term technical assistance recruitment. This responsibility includes all administrative and logistical support arrangements related to recruitment, transportation, shipment of household effects etc. In addition the contractor will be responsible for implementing all project funded long and short term participant training. (US., third country and local).

Procurement of all commodities except vehicles, and some technical equipment and materials will also be the responsibility of the contractor. However, due to long delivery periods from the U.S. the initial PIO/C for vehicles will be issued by USAID prior to contracting.

The local currency funded sub contracts for performance of economic and social research under the ESED will be managed by the center as there is considerable precedent for this type of contracting in the National Research Council.

D. Evaluation Arrangements

This will be an important aspect of the project and will include regularily scheduled annual evaluations under taken by the USAID evaluation officer, in cooperation with the GOS and contractor staff, an independant outside evaluation in April 1984, and a final evaluation.

In addition a manpower study will be conducted after the first year of project operations, to reassess short-term and long term manpower requirements for the duration of the project, and make training recommendations. A major element of this study will be a consideration of the cost and technical requirements for different levels of staffing and different RET prototype developments.

Conditions and covenants

The following conditions precedent are to be included in the project documentation:

A. Prior to First Disbursement:

1. The Grantee shall designate its representative (or representatives) for the project and provide appropriate specimen signatures.

2. The Grantee shall provide evidence that the necessary foreign exchange will be available from the Federal Republic of Germnay, or such other source to ensure construction of Sudan Renewable Energy Center at Soba.

B. Prior to Disbursements for Technical Assistance and Training:

The Grantee shall provide evidence that the Sudan Renewable Energy Center is being staffed sufficiently to permit the effective execution of The Project.

C. Prior to Disbursements for Renewable Energy Development Grants:

The Grantee shall provide information and documentation describing the proposed activity and certification that the proposed activity has been reviewed for technical, economic and environmental soundness.

The Grantee shall also covenant in substance as follows:

1. To establish an evaluation program as part of the Project.
2. To provide adequate counterpart funds on a timely basis to support both the local staff and the local costs of the Project.
3. To provide suitable, interim office space for the expatriate advisors including provision of available electricity, water etc.
4. To establish a coordinating committee to ensure effective coordination of the USAID and West German contributions to the Sudan Renewable Energy Center.

ANNEXES

I	LOGICAL FRAMEWORK
II	PID APPROVAL CABLE
III	TRAINING SCHEDULE
IV	JOB DESCRIPTIONS
V	IER STAFF
VI	STATUTORY CHECKLIST
VII	LIST OF ACRONYMS
VIII	GOS LETTER OF REQUEST
IX	PRIVATE VOLUNTARY ORGANIZATIONS EFFORTS
X	IEE
XI	ILLUSTRATIVE COMMODITIES LIST
XII	FORMATION OF THE ENERGY RESEARCH COUNCIL

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTION
Program Goal Wide-spread use of inexpensive renewable energy technologies that economically, socially and environmentally sound, thereby conserving energy resources and improving tha standard of living of the rural poor majority.	Number of rural households, and community institutions using improved renewable energy technologies which (a) reduce demand for wood and (b) improve the standard of living of rural majority.	Household and community surveys.	1. GOS energy policies and programs are concerned with renewable energy technologies for rural households, and community institutions. 2. GOS is able to successfully marshall the cooperation of various ministries, parastatal and privitae entities to effectively implement its renewable energy policies and program. 3. Economically and socially feasible technologies can be identified for adoption by the rural majority.
Project Purpose: To assist the GOS in developing an applied research and dissemin action capability in rural renewable energy technology, with verification through application of research results in rural areas.	Conditions that will indicate purpose has been achieved: End-of-Project status. 1. SREC developing and field testing renewable energy technologies to meet needs of the majority of rural-Sudanese. 2. System funcitoning for identifying priorities for development of renewable energy technologies. 3. ESED assuring the collection and analysis of social, economic and environmental data required for identifying appropriate technologies for dissemination. 4. DID (a) supporting and coordinating existing institutions and organizations to promote demonstration and dissemination of feasible renewable energy technologies (b) developing promotional and training materials, and (c) conducting demonstration projects.	Project evaluations Project reports ESED reports	1. Ministry of Energy and Mining commitment to renewable energy activities continuous. 2. Willingness of appropriate entities to demonstrate and disseminate renewable energy technologies, and to feedback findings including suggestions for modifications to SREC. 3. GOS provides local funds to support SREC

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTION
	5. Sudanese capacity to manage and implement successful renewable energy technology activities in rural areas.		4. Trained personnel remain with SREC.

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTION
Project Outputs:	Magnitude of Outputs:		
1. Establishment of facilities and an information center.	1.(a) l cility construction completed. (b) Information center collection of 250 documents, training manuals and films. (c) Information Center using NRC documentation center to tie into world wide information systems.	1.(a) Site visit observations. (b) Project reports	1. Other requisite assistance for construction and equipping of facilitie provided in a timely manner.
2. Functioning SREC Sudanese divisional heads and staff.	2.(a) Manpower study assessing staffing and training needs. (b) Divisional heads with requisite training. (c) ESED containing at least one economist, environmentalist and anthropologist each with an MA and at least three trained research assistants. (c) ESED containing at least one economist, environmentalist and anthropologist each with an MA and at least three trained research assistants. (d) ESED with at least four affiliate members. (e) DED with trained graphic artist, audio-visual specialist, and extension/dissemination specialist. (f) Librarian regularly securing materials for information center.	1.(a) Project Reports (b) Project evaluations	2.(a) Requisite Personnel are provided by GOS in timely manner. (b) Trained personnel return to positions

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTION
Project Outputs: 3. ESED rural energy use cost/benefits, monitoring, evaluation and policy analysis reports.	Magnitude of Outputs: 3.(a) 10 sub-contract reports received. (b) Simple cost/benefit analysis on all models selected for adaptive research. (c) 5 studies of rural energy use in 5 regions of Sudan, 10 monitoring and evaluation, and 2 policy analysis reports.	3.(a) Project reports (b) Project evaluations	3.(a) Affiliate members recruited (b) Cooperation of researchers obtained to conduct studies needed by ESED.
4. Development and field testing resulting in feasible technologies which benefit the rural majority and urban poor.	4.(a) Identification of least one feasible prototype of Wood-burning stove and of improved charcoal stove. (b) 3 other RETs of direct benefit to rural Sudanese field tested. (c) 3 institutional and commercial RETs field tested. (d) 200 rural families participating in field tests.	4.(a) Project reports (b) Project evaluations	4.(a) SREC personnel commitment to RETs which benefit rural majority and urban poor. (b) Cooperation between RDD and ESED in monitoring field tests.
5. SREC promotion of and training in RETs proven feasible by field tests.	5.(a) Report identifying existing planning structures and other GOS entities, and PVOs appropriate for promoting and disseminating RETs. (b) 5 training manuals and slide tapes produced to support dissemination of feasible RETs. (c) 5 seminars/workshops with participants from all regions. (d) At least two DID seminars/training sessions in each region. (e) Production of 3 sets of posters.	5.(a) Project reports (b) Project evaluations	5. Interest by Sudanese entities in RETs can be generated if feasible RETs identified.

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTION
Project Outputs: 6. Demonstration and dissemination of feasible RETs which benefit rural majority and urban poor,	Magnitude of Outputs: 6.(a) 12 RED Grants awarded (b) 1800 rural families using RET units (c) 1,000 urban families using RET units (d) 3 rural communities benefiting from village-level renewable energy activities, (e) 2 institutional and commercial RETs in use (f) 50 artisans/technicians trained in production of RETs for rural areas, (g) 50 promotors/disseminators actively disseminating field-tested RETs,	6.(a) Contractual agreement with grant awardees (b) ESED evaluations (c) Project evaluations	6.(a) Feasible RETs are identified by mid-project by SREC to allow for evaluation results of REDGs demonstrating and disseminating these, (b) RETs proven feasible in a particular area may not be feasible in other areas of the Sudan. Hence demonstration dissemination efforts must begin with testing feasibility under local conditions,

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTION
Project Inputs:			
Tech. Assistance Long Term (90 pm) Short term (45 pm)	See detailed budget table	USAID Controller records AID/W Controller records.	1. AID funding available on timely basis. 2. GOS and related budget support continues.
Training Long term US (132 pm) Short term US (40 pm) Short term third country.			
Commodities Vehicles Office, Workshop, field test, training, equipment and materials			
Other: Air charter Renewable Energy Development Grants.			

25 MARCH 1981

TO: AMEMBASSY KHARTOUM
AMEMBASSY NAIROBI

PRIORITY

UNCLAS STATE 075072

SUBJECT: SUDAN VILLAGE RENEWABLE ENERGY PID (650-0041)
REF: (1980) STATE 191142

1. PID APPROVED BY ACTING AA/AFR. APPROVAL OF IEE DEFERRED PER PARA 5 BELOW.

2. PROJECT COMMITTEE, WITH PARTICIPATION OF MUDGE AND DEMBOWSKI OF USAID, REVIEWED SUBJECT ON 3/11/81. USAID AUTHORIZED TO PROCEED WITH PP DEVELOPMENT FOR FIELD APPROVAL THIS FY.

3. AID/W GENERALLY ENDORSES PROPOSED STRATEGY OF ADDRESSING VILLAGE LEVEL ENERGY NEEDS BY SUPPORTING CENTRALIZED INSTITUTION COUPLED WITH APPROPRIATE OUTREACH EFFORTS. MAJOR TASK OF PP TEAM IS TO ASSESS EXTENT TO WHICH THE INSTITUTE OF ENERGY RESEARCH (IER), LOCATED IN KHARTOUM, CAN INDEED ACCOMPLISH THIS OBJECTIVE. PP SHOULD CAREFULLY EXAMINE METHODS THAT IER -- IN CONJUNCTION WITH OTHER LOCAL ORGANIZATIONS AND PVOS -- WILL ADOPT TO IDENTIFY VILLAGE NEEDS AND TO DISSEMINATE APPROPRIATE TECHNOLOGY TO RURAL RESIDENTS.

4. FOLLOWING ADDITIONAL CONCERNS SHOULD BE ADDRESSED IN PP:

A. CLARIFY ROLE OF IER VIS-A-VIS OTHER HOST COUNTRY INSTITUTIONS (MINISTRY OF ENERGY/NATIONAL ADMINISTRATION AND NATIONAL RESEARCH COUNCIL) INVOLVED IN DETERMINING AND CARRYING-OUT ENERGY-RELATED DEVELOPMENT ACTIVITIES. PARTICULAR ATTENTION SHOULD BE PAID TO THE POTENTIAL ROLE OF THESE INSTITUTIONS IN THIS PROJECT. IT WAS SUGGESTED ON THE ONE HAND, THAT NEA SHOULD BE INCLUDED IN THE PROJECT TO STRENGHTEN ITS ROLE IN THE RENEWABLE ASPECTS OF ITS MANDATE, AND ON THE OTHER HAND, THAT NEA/IER RELATIONSHIPS BE CLARIFIED IN ADVANCE OF PP TEAM ARRIVAL.

B. TO FACILITATE PP DEVELOPMENT AND TO ENCOURAGE THE RURAL ENERGY EMPHASIS OF IER, AID/W SUGGESTS THAT THE HEAD OF VREU BE IDENTIFIED AND ON BOARD PRIOR TO ARRIVAL OF PP TEAM. PLEASE ADVISE MISSION COMMENTS.

C. MORE CLEARLY RELATE IER AND PROJECT CONCEPT WITH GOS' DECENTRALIZATION OBJECTIVES. PP SHOULD, FOR EXAMPLE, DEMONSTRATE HOW THIS PROJECT IS A QUOTE CRITICAL STEP UNQUOTE (P. 14) TOWARDS ULTIMATE GOAL AS EXPRESSED IN LILLYWHITE REPORT OF 2/80.

D. ANALYZE CAPACITY OF IER TO EFFECTIVELY ABSORB PROPOSED FRG AND A.I.D. ASSISTANCE (SEE PARA 4 REFTEL). BUREAU FEELS STRONGLY THAT CLOSE COORDINATION WITH FRG THROUGHOUT DESIGN AND IMPLEMENTATION PROCESS IS MANDATORY.

E. TO ENCOURAGE LOCAL PARTICIPATION, IT IS AGREED THAT SUB-GRANTS FOR PILOT PROJECTS DIRECTLY TO INDIGENOUS INSTITUTIONS AND U.S. PVOS.

5. IEE NOT APPROVED AND MUST BE REVISED, SUBMITTED TO AND APPROVED BY THE BUREAU ENVIRONMENTAL OFFICER PRIOR TO PROJECT AUTHORIZATION. REVISIONS SHOULD:

A. COVER MAIN INSTITUTIONAL ASSISTANCE FULLY.

B. INCLUDE AN ENVIRONMENTAL REVIEW OF THOSE SUBPROJECTS WHICH ARE CURRENTLY IDENTIFIED. THIS SHOULD ADDRESS BOTH PRIMARY AND SECONDARY IMPACTS. FOR EXAMPLE, A PHOTOVOLTAIC MOTOR WILL HAVE NO PRIMARY ENVIRONMENTAL IMPACTS, BUT IF THE MOTOR POWERED AN IRRIGATION PUMP

WHERE PREVIOUSLY THERE WAS ONLY A HAND DRAWN WELL, THE POTENTIAL SECONDARY IMPACTS COULD BE GROUND WATER DEPLETION AND SALINIZATION OF IRRIGATED SOILS. THE REVIEW WOULD THEN DESCRIBE MITIGATIVE MEASURES TO PREVENT SUCH IMPACTS.

C. DETAIL A MECHANISM FOR ENVIRONMENTAL REVIEW OF THOSE SUBPROJECTS IDENTIFIED AFTER THE PROJECT BEGINS. THE MISSION'S SUGGESTION OF USING THE UNIVERSITY OF KHARTOUM'S INSTITUTE OF ENVIRONMENTAL STUDIES TO CONDUCT THE REVIEW IS STRONGLY ENDORSED: HOWEVER, THE IEE NEEDS TO OUTLINE JUST HOW THIS WILL OCCUR AND WHO IN THE MISSION WILL (1) REVIEW ANALYSIS FOR ADEQUACY AND (2) APPROVE IEE. ALSO, WHAT WILL BE THE ROLE OF IER IN THIS PROCESS?

D. IDENTIFY CONDITIONS PRECEDENT AND/OR COVENANTS NECESSARY TO AVOID IRREVERSIBLE COMMITMENT OF FUNDS FOR THE UNIDENTIFIED SUBPROJECTS UNTIL ADEQUATE ENVIRONMENTAL REVIEW IS COMPLETED. REFER TO REGULATION 16, SECTION 216.3(A)(7) FOR GUIDANCE.

UPON APPROVAL OF REVISED IEE, IT IS UNDERSTOOD THAT OBLIGATION OF FUNDS CAN THEN PROCEED WITH IEE ON UN-IDENTIFIED ELEMENTS BEING CARRIED OUT PRIOR TO SUB-OBLIGATION AND INITIATION OF ACTIVITY.

6. A WAIVER OF FAA SEC. 110(A) IS NOT REQUIRED AS GOS CONTRIBUTION IS MORE THAN 25 PERCENT OF A.I.D. BILATERAL PROJECT. FYI: LOCAL CURRENCY (LC) CONTRIBUTION FROM CIP IS NOT SUBJECT TO SAME CONSIDERATIONS AS LC FROM PL 480 TITLE III PROGRAM. END FYI.

7. USAID SHOULD PROVIDE AFR/DR/EAP WITH SOW AND BUDGET ESTIMATE FOR PP TEAM ASAP. SEPTEL ADVISES RE PDS ALLOT-MENT TO REDSO.

8. REQUEST USAID'S COMMENTS ON TIMING OF PP DESIGN AND AUTHORIZATION IN ORDER TO ESTIMATE WHEN OBLIGATION OF DOLS 382,000 IN OYB COULD BE EXPECTED. HAIG

PARTICIPANT TRAINING SCHEDULE

	Year 1	Year 2	Year 3	Year 4	Year 5
LONG TERM: US (132 pm)					
Bio-chemistry					
Bio-mass					
Applied Anthropology					
*Economics					
*Implementation/Extension					
LONG TERM: LOCAL (48 pm)					
Environmental Studies					
*Physical Science					
+SHORT TERM: US (40 pm)	8 pm	14 pm	8 pm	6 pm	4 pm
+SHORT TERM: Third Country (56 pm)	16 pm	16 pm	16 pm	4 pm	4 pm

* Need to be assessed in manpower study

\+ Types to be identified by GOS/Contractor and by manpower study.

JOB DESCRIPTION

Chief of Party. The Chief of Party shall be an employee of the US contractor who will assist the GOS in implementing the Sudan Renewable Energy Project. The Chief of Party reports programmatically to the Center Director and coordinates with the USAID Project Manager. The Chief of Party also reports through normal corporate channels of the contractor to insure that contractual obligations are met.

1. Scope of Work

The Chief of Party will assist the GOS project director to :

(a) Manage and supervise project and project personnel.

(b) Supervise fiscal management of project funds.

(c) Recommend and coordinate the inputs of short-term consultants for the project.

(d) Recommend, coordinate and manage local training programs and production of training materials.

(e) Establish and maintain relationships with PVOs and selected GOS entities to promote renewable energy technologies.

(f) Make regular verbal and written progress reports to appropriate GOS personnel and to USAID, including preparation of the annual workplan.

(g) Assure that technical information regarding research findings at the Center flows to the individual micro-projects under the renewable energy development grants program. Similarily assure the flow of information to the Center regarding field experience within the micro-projects.

(h) Serve as acting head of the implementation division at the discretion of the GOS project director.

In addition: the Chief of Party will:

1. Supervise contract funds.

2. Arrange procurement of equipment/supplies using contract funds.

3. Arrange for participants training using contract funds.

Minimum Qualifications:

1. M.A., or appropriate experience in management, information dissemination, and development of training programs and materials.

2. 3 years experience in Africa in a position requiring the credentials in 1 above.

3. Practical experience in the implementation of development projects and

the ability to work in an interdisciplinary team.

4. Administrative experience or ability.

5. RET experience, language ability in Arabic, and past experience in the Sudan desirable.

JOB DESCRIPTION - ENERGY ECONOMIST

Economist: The economist shall be an employee of the US contractor who will assist the SREC, in particular, its Economic, Social and Environmental Division (ESED). The economist will report to the Center Director through the Head of the ESED. The individual will be under the supervision of the Contract Chief of Party for all matters related to the contract. The Economist will assist the Director of the SREC to:

a) Help the Economic, Social and Environmental Division (ESED) of the Sudan Renewable Energy Center to formulate its program and identify its manpower requirements; have responsibility for identifying appropriate institutions for long - term and short - term training of ESED members.

b) Help the ESED establish and maintain linkages with individuals doing related work, both within the Sudan and elsewhere; establish a close working relationship with other divisions of the SREC and the National Energy Administration.

c) Carry out:

- Prefeasibility studies of selected renewable energy technologies to help in establishment of priorities for other SREC divisions. Studies will emphasize the economics of given technologies, both on the level of the individual user, and in terms of potential contributions to economic development and the overall national energy situation.

- Rural energy use studies and policy analysis in the area of renewable energy strategies and their relationship to economic planning.

- Monitoring and evaluation of field trials and renewable energy development grants.

d) Provide on the job training of ESED members. Help supervise other studies funded by the ESED.

e) Perform a leadership role soliciting research proposals, following established criteria. Serve on the ESED research committee.

f) Advise the ESED in recruitment of affiliate members.

g) Help in the dissemination of ESED research findings.

h) Serve both as an operating member and advisor to the Head of ESED and as an acting head of the ESED at the discretion of the GOS project director.

II Minimum Qualifications

1. MA in Economics.

2. A minimum of one year residing in a developing country working with a local organization on energy-related issues.

3. Must have conducted field research in an African country and demonstrated skills in research methods and techniques, and administration.

4. Preference will be given to candidates who have a strong background in the social sciences and greater work experience in developing countries.

5. The individual is expected to spend considerable time in rural areas and towns conducting and supervising research.

PROFESSIONAL STAFF, INSTITUTE FOR ENERGY RESEARCH (IER)

Presently Available:

1. YAHIA HAMID, Director
   BA U. of Khartoum, MSc NorthWestern, PhD Wisconsin

2. HASSAN WARDI, Deputy Director
   PhD Moscow Power Institute, Solid State Physics

3. SHOMO SHAA EL DIN, Chemical Engineering
   BA U. of Khartoum, MSc U. of Florida, Chemical Engineering/Solar dehydration

4. EL TAYEB IDRIS
   BA U. of Khartoum, PhD Reading U., Wind power (Expected to return June 81)

5. MOHAMMED EL TAYEB MANSOUR
   BA U. of Khartoum, Mechanical Engineering, MSc candidate U. of Khartoum. Part time IER currently taking U. of Florida short course.

* This information was provided by Dr. Yahia Hamid during a conversation with James Beebe and Michele Foster, May 12, 1981.

Expected to be Available

6. MOHAMMED ALI ABDUL RAHMAN
   BA, MSc. U. of Khartoum, PhD Lausanne
   Currently in Saudi Arabia, expected to return in 1 year.

7. EL HAG HASSAN SHAABAN
   BA, MSc U. of Khartoum, Electrical Engineering, obtaining PhD U. of Florida. Photovoltaics. Expected to return December 1981.

8. MOHAMMED OSMAN SAYED AHMED
   BA U. of Khartoum, Physics, MSc Reading U. Obtaining PhD reading U., Metereological Physics/solar applications. Expected to return September 1981.

9. AHMED HASSAN MOHAMMED
   BA U. of Khartoum, Chemical Engineering Obtaining PhD Toulouse U. Expected to return February 1982.

10. AZMI ZEIN EL ABDIN
    BA U. of Khartoum, Electrical Engineering
    Obtaining PhD Lyon U., Expected to return 1983.

11. AHMED ABU SAYED
    BA U. of Khartoum, Chemical Engineering, Obtaining MSc U. of Florida in Biomass. Date of return 1985?

5C(1) - COUNTRY CHECKLIST

Listed below are, first, statutory criteria applicable generally to FAA funds, and then criteria applicable to individual fund sources: Development Asistance and Economic Support Fund.

A. GENERAL CRITERIA FOR COUNTRY ELIGIBILITY	Section A
1. FAA Sec. 116. Can it be demonstrated that contemplated assistance will directly benefit the needy? If not, has the Department of State determined that this government has engaged in a consistent pattern of gross violations of internationally recognized human rights?	yes
2. FAA Sec. 481. Has it been determined that the government of recipient country has failed to take adequate steps to prevent narcotics drugs and other controlled substances (as defined by the Comprehensive Drug Abuse Prevention and Control Act of 1970) produced or processed, in whole or in part, in such country, or transported through such country, from being sold illegally within the jurisdiction of such country to U.S. Government personnel or their dependents, or from entering the United States unlawfully?	no
3. FAA Sec. 620(b). If assistance is to a government, has the Secretary of State determined that it is not controlled by the International Communist movement?	yes
4. FAA Sec. 620(c). If assistance is to government, is the government liable as debtor or unconditional guarantor on any debt to a U.S. citizen for goods or services furnished or ordered where (a) such citizen has exhausted available legal remedies and (b) debt is not denied or contested by such government?	no
5. FAA Sec. 620(e)(1). If assistance is to a government, has it (including government agencies or subdivisions) taken any action which has the effect of nationalizing, expropriating, or otherwise seizing ownership or control of property of U.S. citizens or entities beneficially owned by them without taking steps to discharge its obligations toward such citizens or entities?	no

A.

6. FAA Sec. 620(a), 620(f); FY 79 App. Act, Sec. 108, 114 and 606. Is recipient country a Communist country? Will assistance be provided to the Socialist Republic of Vietnam, Cambodia, Laos, Cuba, Uganda, Mozambique, or Angola?

a) No

b) no

7. FAA Sec. 620(i). Is recipient country in any way involved in (a) subversion of, or military aggression against, the United States or any country receiving U.S. assistance, or (b) the planning of such subversion or aggression?

a) no

b) no

8. FAA Sec. 620 (j). Has the country permitted, or failed to take adequate measures to prevent, the damage or destruction, by mob action, of U.S. property?

no

9. FAA Sec. 620(l). If the country has failed to institute the investment guaranty program for the specific risks of expropriation, inconvertibility or confiscation, has the AID Administrator within the past year considered denying assistance to such government for this reason?

no

10. FAA Sec. 620(o); Fishermen's Protective Act of 1967, as amended, Sec. 5. If country has seized, or imposed any penalty or sanction against, any U.S. fishing activities in international waters:

a. has any deduction required by the Fishermen's Protective Act been made?

b. has complete denial of assistance been considered by AID Administrator?

N/A

11. FAA Sec. 620; FY 79 App. Act, Sec. 603. (a) Is the government of the recipient country in default for more than 6 months on interest or principal of any AID loan to the country? (b) Is country in default exceeding one year on interest or principal on U.S. loan under program for which App. Act appropriates funds?

a) no

b) no

12. FAA Sec. 620(s). If contemplated assistance is development loan or from Economic Support Fund, has the Administrator taken into account the percentage of the country's budget which is for military expenditures, the amount of foreign exchange spent on military equipment and the

no, assistance is neither a loan nor from Economic Support Fund

A.12.

amount spent for the purchase of sophisticated weapons systems? (An affirmative answer may refer to the record of the annual "Taking Into Consideration" memo: "Yes, as reported in annual report on implementation of Sec. 620(s)." This report is prepared at time of approval by the Administrator of the Operational Year Budget and can be the basis for an affirmative answer during the fiscal year unless significant changes in circumstances occur.)

13. FAA Sec. 620(t). Has the country severed diplomatic relations with the United States? If so, have they been resumed and have new bilateral assistance agreements been negotiated and entered into since such resumption? — a) no; b) no

14. FAA Sec. 620(u). What is the payment status of the country's U.N. obligations? If the country is in arrears, were such arrearages taken into account by the AID Administrator in determining the current AID Operational Year Budget?

15. FAA Sec. 620A, FY 79 App. Act, Sec. 607. Has the country granted sanctuary from prosecution to any individual or group which has committed an act of international terrorism? — no

16. FAA Sec. 666. Does the country object, on basis of race, religion, national origin or sex, to the presence of any officer or employee of the U.S. there to carry out economic development program under FAA? — no

17. FAA Sec. 669, 670. Has the country, after August 3, 1977, delivered or received nuclear enrichment or reprocessing equipment, materials, or technology, without specified arrangements or safeguards? Has it detonated a nuclear device after August 3, 1977, although not a "nuclear-weapon State" under the nonproliferation treaty? — no

B. FUNDING CRITERIA FOR COUNTRY ELIGIBILITY

1. Development Assistance Country Criteria

a. FAA Sec. 102(b)(4). Have criteria been established and taken into account to assess commitment progress of country in effectively involving the poor in development, on such indexes as: (1) increase in agricultural productivity through small-farm labor intensive agriculture, (2) reduced infant mortality, (3) control of population growth, (4) equality of income distribution, (5) reduction of unemployment, and (6) increased literacy? — yes

B.1.

b. FAA Sec. 104(d)(1). If appropriate, is this development (including Sahel) activity designed to build motivation for smaller families through modification of economic and social conditions supportive of the desire for large families in programs such as education in and out of school, nutrition, disease control, maternal and child health services, agricultural production, rural development, and assistance to urban poor? N/A

2. Economic Support Fund Country Criteria

a. FAA Sec. 502B. Has the country engaged in a consistent pattern of gross violations of internationally recognized human rights? N/A to all elements B 2

b. FAA Sec. 533(b). Will assistance under the Southern Africa program be provided to Mozambique, Angola, Tanzania, or Zambia? If so, has President determined (and reported to the Congress) that such assistance will further U.S. foreign policy interests?

c. FAA Sec. 609. If commodities are to be granted so that sale proceeds will accrue to the recipient country, have Special Account (counterpart) arrangements been made?

d. FY 79 App. Act, Sec. 113. Will assistance be provided for the purpose of aiding directly the efforts of the government of such country to repress the legitimate rights of the population of such country contrary to the Universal Declaration of Human Rights?

e. FAA Sec. 620B. Will security supporting assistance be furnished to Argentina after September 30, 1978?

5C(2) - PROJECT CHECKLIST

Listed below are statutory criteria applicable generally to projects with FAA funds and project criteria applicable to individual fund sources: Development Assistance (with a subcategory for criteria applicable only to loans); and Economic Support Fund.

CROSS REFERENCES: IS COUNTRY CHECKLIST UP TO DATE?
HAS STANDARD ITEM CHECKLIST BEEN REVIEWED FOR THIS PRODUCT?

A. GENERAL CRITERIA FOR PROJECT

1. FY 79 App. Act Unnumbered; FAA Sec. 653 (b); Sec. 634A. (a) Describe how Committees on Appropriations of Senate and House have been or will be notified concerning the project; (b) is assistance within (Operational Year Budget) country or international organization allocation reported to Congress (or not more than $1 million over that figure)?	Congressional notification process was completed 1981
2. FAA Sec. 611(a)(1). Prior to obligation in excess of $100,000, will there be (a) engineering, financial, and other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?	yes
3. FAA Sec. 611(a)(2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance?	N/A
4. FAA Sec. 611(b); FY 79 App. Act Sec. 101. If for water or water-related land resource construction, has project met the standards and criteria as per the Principles and Standards for Planning Water and Related Land Resources dated October 25, 1973?	N/A
5. FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability effectively to maintain and utilize the project?	N/A
6. FAA Sec. 209. Is project susceptible of execution as part of regional or multilateral project? If so why is project not so executed? Information and conclusion whether assistance will encourage regional development programs.	Project is being implemented in cooperation with West Germans.

B.1.a.

basis, using the appropriate U.S. institutions; (b) help develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward better life, and otherwise encourage democratic private and local governmental institutions; (c) support the self-help efforts of developing countries; (d) promote the participation of women in the national economies of developing countries and the improvement of women's status; and (e) utilize and encourage regional cooperation by developing countries?

b. FAA Sec. 103, 103A, 104, 105, 106, 107. Is assistance being made available: (include only applicable paragraph which corresponds to source of funds used. If more than one fund source is used for project, include relevant paragraph for each fund source.)

(1) [103] for agriculture, rural development or nutrition; if so, extent to which activity is specifically designed to increase productivity and income of rural poor; [103A] if for agricultural research, is full account taken of needs of small farmers; — N/A

(2) [104] for population planning under sec. 104(b) or health under sec. 104(c); if so, extent to which activity emphasizes low-cost, integrated delivery systems for health, nutrition and family planning for the poorest people, with particular attention to the needs of mothers and young children, using paramedical and auxiliary medical personnel, clinics and health posts, commercial distribution systems and other modes of community research. — N/A

(3) [105] for education, public administration, or human resources development; if so, extent to which activity strengthens nonformal education, makes formal education more relevant, especially for rural families and urban poor, or strengthens management capability of institutions enabling the poor to participate in development; — N/A

(4) [106] for technical assistance, energy, research, reconstruction, and selected development problems; if so, extent activity is: — Project will provide for Renewable Energy Center to develop necessary energy technologies.

(i) technical cooperation and development, especially with U.S. private and voluntary, or regional and international development, organizations;

(ii) to help alleviate energy problems;

(iii) research into, and evaluation of, economic development processes and techniques;

(iv) reconstruction after natural or manmade disaster;

B.1.b.(4).

(v) for special development problem, and to enable proper utilization of earlier U.S. infrastructure, etc., assistance; — N/A

(vi) for programs of urban development, especially small labor-intensive enterprises, marketing systems, and financial or other institutions to help urban poor participate in economic and social development. — N/A

c. [107] Is appropriate effort placed on use of appropriate technology? — Yes

d. FAA Sec. 110(a). Will the recipient country provide at least 25% of the costs of the program, project, or activity with respect to which the assistance is to be furnished (or has the latter cost-sharing requirement been waived for a "relatively least-developed" country)? — Yes

e. FAA Sec. 110(b). Will grant capital assistance be disbursed for project over more than 3 years? If so, has justification satisfactory to the Congress been made, and efforts for other financing, or is the recipient country "relatively least developed"? — N/A

f. FAA Sec. 281(b). Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civil education and training in skills required for effective participation in governmental and political processes essential to self-government. — The project is directed primarily at reducing wood consumption, a rapidly dwindling resource in the country. Development of natural alternative sources of energy will be emphasized.

g. FAA Sec. 122(b). Does the activity give reasonable promise of contributing to the development of economic resources, or to the increase or productive capacities and self-sustaining economic growth? — yes

2. Development Assistance Project Criteria (Loans Only)

a. FAA Sec. 122(b). Information and conclusion on capacity of the country to repay the loan, including reasonableness of repayment prospects. — N/A

b. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete in the U.S. with U.S. enterprise, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan? — N/A

B.

3. Project Criteria Solely for Economic Support Fund

a. FAA Sec. 531(a). Will this assistance support promote economic or political stability? To the extent possible, does it reflect the policy directions of section 102? N/A

b. FAA Sec. 533. Will assistance under this chapter be used for military, or paramilitary activities? N/A

5C(3) - STANDARD ITEM CHECKLIST

Listed below are statutory items which normally will be covered routinely in those provisions of an assistance agreement dealing with its implementation, or covered in the agreement by imposing limits on certain uses of funds.

These items are arranged under the general headings of (A) Procurement, (B) Construction, and (C) Other Restrictions.

A. Procurement

1. FAA Sec. 602. Are there arrangements to permit U.S. small business to participate equitably in the furnishing of goods and services financed? N/A

2. FAA Sec. 604(a). Will all commodity procurement financed be from the U.S. except as otherwise determined by the President or under delegation from him? Yes

3. FAA Sec. 604(d). If the cooperating country discriminates against U.S. marine insurance companies, will agreement require that marine insurance be placed in the United States on commodities financed? N/A

4. FAA Sec. 604(e). If offshore procurement of agricultural commodity or product is to be financed, is there provision against such procurement when the domestic price of such commodity is less than parity? N/A

5. FAA Sec. 608(a). Will U.S. Government excess personal property be utilized wherever practicable in lieu of the procurement of new items? N/A

6. FAA Sec. 603. (a) Compliance with requirement in section 901(b) of the Merchant Marine Act of 1936, as amended, that at least 50 per centum of the gross tonnage of commodities (computed separately for dry bulk carriers, dry cargo liners, and tankers) financed shall be transported on privately owned U.S.-flag commercial vessels to the extent that such vessels are available at fair and reasonable rates. yes

7. FAA Sec. 621. If technical assistance is financed, will such assistance be furnished to the fullest extent practicable as goods and professional and other services from private enterprise on a contract basis? If the yes

A.7.

facilities of other Federal agencies will be utilized, are they paritcularly suitable, not competitive with private enterprise, and made available without undue interference with domestic programs? — yes

8. International Air Transport. Fair Competitive Practices Act, 1974. If air transportation of persons or property is financed on grant basis, will provision be made that U.S.-flag carriers will be utilized to the extent such service is available? — YES

9. FY 79 App. Act Sec. 105. Does the contract for procurement contain a provision authorizing the termination of such contract for the convenience of the United States? — Yes

B. Construction

1. FAA Sec. 601(d). If a capital (e.g., construction) project, are engineering and professional services of U.S. firms and their affiliates to be used to the maximum extent consistent with the national interest? — N/A

2. FAA Sec. 611(c). If contracts for construction are to be financed, will they be let on a competitive basis to maximum extent practicable? — N/A

3. FAA Sec. 620(k). If for construction of productive enterprise, will aggregate value of assistance to be furnished by the United States not exceed $100 million? — N/A

C. Other Restrictions

1. FAA Sec. 122 (e). If development loan, is interest rate at least 2% per annum during grace period and at least 3% per annum thereafter? — N/A

2. FAA Sec. 301(d). If fund is established solely by U.S. contributions and administered by an international organization, does Comptroller General have audit rights? — N/A

3. FAA Sec. 620(h). Do arrangements preclude promoting or assisting the foriegn aid projects or activities of Communist-bloc countries, contrary to the best interests of the United States? — Yes

4. FAA Sec. 636(i). Is financing not permitted to be used, without waiver, for purchase, long-term lease, or exchange of motor vehicle manufactured outside the United States, or guaranty of such transaction? — Yes

5. Will arrangements preclude use of financing: N/A

a. FAA Sec. 104(f). To pay for performance of abortions or to motivate or coerce persons to practice abortions, to pay for performance of involuntary sterilization, or to coerce or provide financial incentive to any person to undergo sterilization?

b. FAA Sec. 620(g). To compensate owners for expropriated nationalized property?

c. FAA Sec. 660. To finance police training or other law enforcement assistance, except for narcotics programs?

d. FAA Sec. 662. For CIA activities?

e. FY 79 App. Act Sec. 104. To pay pensions, etc., for military personnel?

f. FY 79 App. Act Sec. 106. To pay U.N. assessments?

g. FY 79 App. Act Sec. 107. To carry out provisions of FAA sections 209(d) and 251(h)? (Transfer of FAA funds to multilateral organizations for lending.)

h. FY 79 App. Act Sec. 112. To finance the export of nuclear equipment, fuel, or technology or to train foreign nations in nuclear fields?

i. FY 79 App. Act Sec. 601. To be used for publicity on propaganda purposes within United States not authorized by the Congress?

LIST OF ACRONYMS

AID/W	AID Washington D.C. headquarters
DID	Dissemination and Implementation Division
ERC	Energy Research Council
ESED	Economic, Social and Environmental Division
ESRC	Economic and Social Research Council, National Council for Research
GOS	Government of Sudan
GTZ	Gessellschaft für Technische Zusammen arbeit (Programme of the Federal Republic of Germany's Ministry of Economic Cooperation)
IER	Institute for Energy Research
IES	Institute for Environmental Studies, University of Khartoum
NEA	National Energy Administration, Ministry of Energy
PID	Project Identification Document
PP	Project Paper
PVO	Private Voluntary Organization
REDG	Renewable Energy Development Grants
RET	Renewable Energy Technology
RDD	Research and Development Division
SREC	Sudan Renewable Energy Center
SREP	Sudan Renewable Energy Project
USAID	USAID Sudan Office

Ministry of National Planning

P.O. Box 2092, KHARTOUM.
Cables (EIMAR)
TELEX 324

ص.ب ٢٠٩٢ – الخرطوم
تلغرافيا : (اعمار)
تلكس : ٣٢٤

Ref.: : 330/8/121/3 — النمرة

Khartoum : 14/6/198[illegible] — الخرطوم في

BEST AVAILABLE DOCUMENT

ANNEX VIII

Mr. Arthur W. Mudgé,
Director USAID Mission,
American Embassy,
Khartoum.

Dear Sir,

Subject :- Sudan Village Renewable Energy Project
Energy Research Council

Reference is made to our [illegible] correspondence and discussion to the abovementioned project.

I would like to inform you that the Energy Research Council has been established as an autonomous agency of the National council for Research under the direct supervision of his excellency Dr. M[illegible] Altohami, Minister of Energy and Mining in his capacity as a member of the Board of directors of the National Council for Research and the Minister responsible for the Energy Sector; Prof. [illegible] has been appointed as Chairman to the council, [illegible] Mohi [illegible] Ahmed as Secretary General.

Consequently this Energy [illegible] council is now the sole executive and administrative [illegible] all activities pertaining to Energy Research, including, of course, the Village Renewable Energy Research Project to be financed through USAID.

Regretting the inevitable [illegible] due to your proposal, we are now happy to inform you also, that copies of the draft agreement on the project have been sent to the council and the Attorney General's Chamber, hope-[illegible] for speedy processing.

Best regards.

Yours sincerely,

[illegible]
Under Secretary
Ministry of National Planning

c.c. Prof. [illegible] Ali
Chairman
Energy Research Council
Khartoum.

MINISTRY OF ENERGY AND MINING
MINISTER'S OFFICE
P.O. Box 2087
CABLE: TAQTADEEN
TELEX: 75595
KHARTOUM

وزارة الطاقة والتعدين
مكتب الوزير
ص. ب ٢٠٨٧
تلكس : ٧٥٥٩٥
عنوان تلغرافي : طاقتعدين
الخرطوم

BEST AVAILABLE DOCUMENT

Annex VIII
2

No. MEM/MO/63/A/6

Khartoum, 19.1

Mr. Arthur W. Mudge,
Director of US AID,
Khartoum.

Subject: Sudan Village Renewable Energy Project

Reference to the above project identification documents received and the discussions we had with your representatives, we feel that the project will prove to be very beneficial for all concerned and fits very well within our plans for the development of renewable energy resources in the Sudan.

We therefore strongly support the project and will be very grateful if the various arrangements are finalised as soon as possible for the project to go ahead.

Thank you.

Yours sincerely,

Dr. [illegible]
Minister

c.c. To:-

PRIVATE VOLUNTARY ORGANIZATION EFFORTS

SUDAN COUNCIL OF CHURCHES

The SCC is the main private organization working at the village level throughout Sudan.

The SCC is very strong in the South, but works all over the country with both Christian and Muslim groups. The SCC has a budget of LS 3 million for development activities, LS 2.5 - 3 mill. for refugee and relief, most of which is foreign Church-donated.

It has a successful afforestation (wind, sand, protection) dune stabilization program around over 70 agricultural schemes in the North, using mesquite Prosopischilisis and some eucalyptus for fuelwood. This is a joint project with the GOS. SCC is also interested in reforestation as part of refugee resettlement schemes.

SCC interest is highest in (1) water lifting (2) woodstoves (3) grain grinding. The organization is also interested in windmills for water pumping and solar irrigation pumps. SCC is adding an energy component to an integrated rural development project in Yirol Lakes Province, in the Southern Region. The project has two thrusts. A community development program is to be closely linked to a practical project, providing well water (mainly with hand pumps). Water-lifting has been rated the top priority by the villages in this area. Second, a village technology center is to be established to learn from traditional technology, and to select, develop and demonstrate alternate techniques, starting with ox draught methods already adopted in nearby districts. The project will include an extension program and model farmer approach and will respond to the needs identified through the community development and water program. The SCC is very interested in including woodstoves development in their activity and needs a consultant to assist in adapting local models and teaching testing techniques, after the center is set up and staff recruited. There was special interest in mud stoves and chimneys since smoke is a big problem and using clay for water jars, bricks, home construction, etc., is a well-established traditional activity.

SCOVA - Sudanese Council of Voluntary Agencies

Scova is a fairly new coordinating body of twenty-two PVOs, of which four are expatriate. Most of these are relief organizations but a few do serve a role in information dissemination. The Norwegian Refugee Council has provided financial support. They are quite interested in Energy but have no activities as yet except SCC. They are strongly backed by the government and are looking for an expatriate staff coordinator.

Sudan Interior Mission

This organization operates halfway between Khartoum and Juba (the other center of assistance activities in the South), in remote areas of Sudan. They work mainly in health clinics, but are beginning to work with agriculture, and there is an interest in handpumps.

Norwegian Church Aid

NCA has worked for eight years in Eastern Equatorial Province, and has been called the "single most influential force for development" in the area. The organization has a network of cooperatives, health clinics, rural development centers (RDCs), water holes, wood construction. RDCs serve tribal groups with agricultural experimentation and extension; animal power development for agricultural transport, oil milling; and working with village polytechnics to produce appropriate tools and equipment for local farmers. At Hilieu Village Polytechnic they have developed a local ox plough, water pots, bicycle trailers, wheelbarrows, groundnut and maize shellers, winnowers, and ox carts. There are 5 RDCs and Hilieu is the administrative center.

Lutheran World Relief LWR

LWR is active in the south, especially in Wau, Malakal and Upper Nile. They are fairly closely linked with NCA and have a similar pattern of operation.

INITIAL ENVIRONMENTAL EXAMINATION

Project Country: Sudan

Project Title: Village Renewable Energy Project

Project Number: 650-0041

Funding: $3 million

IEE Prepared by: Dr. J. Gaudet, Regional Environmental Officer, REDSO/EA

Environmental Action Recommended: Negative Determination

Action Recommended by: Mission Director

APPROVED: James S. Horton

Concurrence:
Bureau Environmental Officer DISAPPROVED: _____

DATE: 1 July 1981

Clearance: GC/AFR _____ Date 6/29/81

I. Project Description

The purpose of this project is to strengthen ability of GOS Renewable Energy Project (SREP) to develop and to disseminate locally proven renewable energy technologies to end users through existing institutional and administrative structures. Also, USAID project assistance will help establish the Economic, Social and Environment Department (ESED) of the R and D Division of the SREP and the Renewable Energy Implementation Unit (REIU) of the Dissemination and Implementation Division. The project will be done in close collaboration with the West Germans, and will have two project components: (a) assistance to strengthen the institutional capability of the Institute for Energy Research (IER) to do research in renewable energy especially in developing renewable energy resources for use by villagers and (b) assistance in undertaking several pilot projects aimed at testing applications of renewable energy technology at village level.

The project area for (a) above is Khartoum while for (b) above is to be determined. Pilot project activities are not funded until the second year of the project and will pass through two stages of definition prior to funding. The PP team will work to develop initial pilot activities suggested in this PID and part of such planning will include an Initial Environmental Examination of each specific pilot project.

In accordance with the Revised Regulation 16 Section 216.3(a)(7)(IV), the present IEE will:

- Identify those aspects of the project for which environmental review has been completed, including:

- (a) main institutional assistance; and
- (b) identified pilot projects;

- State the reason for deferral of environoment reviews for unidentified pilot projects, and the timing and mechanism for these environmental reviews;

- State how an irreversible commitment of funds will be avoided for any given pilot project, until the environmental review is completed and approved; and

- Identify the AID Mission's officer responsibile for reviewing, assessing and approving pilot project environmental reviews.

II. Nature, Scope and Magnitude of Project Impacts

A. Main Institutional Assistance

Institutional support will be provided for the Institute of Energy Research (IER). Project inputs include technical assistance, scientific research equipment, 2 vehicles for the expatriate staff, funds for training and other costs. Of all inputs only the following would have any environmental impact:

- construction of facilities at IER,

- commodities for minimally equipping the IER, including laboratory equipment, office furniture and a vehicle for the long-term technician;

- commodities for adaptive research projects to be implemented by the IER.

1. Construction of facilities - This will be largely financed by the Federal Republic of Germany with some support in local currency to be made available by the sale of items imported under the U.S. Commodity Import Program. Construction itself will involve 1,000 square meter combined research laboratory, office and workshop in SOBA. Smaller facilities will be built in the south and west.

2. Equipping IER - Here the equipment is to be standard laboratory equipment with little or no local environmental impacts.

3. Adaptive research subprojects - Three subprojects have already been identified as cooperative subprojects involving IER and the:

   - Ministry of Health for Support of the Primary Health Care Program by establishing facilities for cold chains and providing heat for hot water and sterilization of rural health care centers.

   - National Water Corporation - For development of village safe water systems based on renewable energy and, to the extent possible, capable of being maintained by village people.

   - Ministry of Agriculture - For developing local power systems that utilize the biomass coversion of agricultural wastes.

   Since they involve primary health care, safe drinking water and waste recycling, respectively, the potential impacts of these subprojects will be predominantly positive.

B. Identified Subprojects - Other than the three subprojects listed above in 1C, the subprojects to be carried out by the Village Renewable Energy Unit (of the IER) have not yet been identified. Pilot project activities will not be funded until the second year of the project, and of these only one has been identified, but has not yet been approved by GOS. The activity would be implemented by Care in North Kordofan in conjunction with project of Forestry Department and Provincial Government. This activity would field test wood and charcoal burining cookstoves and popularize proven fuel efficient models. The project would operate in conjunction with GOS-UNDP reforestation program to restock the Gum Arabic (Acacia Senegal) belt in the eastern part of North Kordofan.

III. Unidentified PVO Pilot Projects and Deferral Review

A. Unidentified Projects - Many suggestions have been offered by PVO's regarding potential pilot projects. But to date, these suggestions have not been reviewed and remain as unidentified (potential) pilot projects. Among those suggested are:

- International Volunteer Service (IVS). Renewable energy for a village water system at Wadi Halfa.

- Sudan Council of Churches. Wood lot expansion and improved storage in villages in the Nile Province.

- Overseas Education Fund. Income generating activities for rural women based on renewable energy, in the west (possibly El Obeid).

- Development Alternatives, Inc., in cooperation with the Regional Ministry of Agriculture. Improved storage and other appropriate intermediate technology at Yambio.

- Experience Incorporated. Renewable energy activities that would tie into integrated rural development project activities in Dama ine area.

- Consortium for International Development - Application of renewable energy for supporting agricultural research activity in the western Sudan.

- Volunteers in Technical Assistance (VITA). Assisting IER in setting up a technical documentation and information response service; arranging training/observation visits to other African at/re dissemination centers; providing expert personnel for short-term, in-country training programs; acting as a technical information and expertise back-up throughout the program.

- International Union for Child Welfare. Reforestation and expertise back-up throughout the program.

- International Union for Child Welfare. Forestation, improved stoves and more efficient charcoal production in N. Kordofan, particularly among the Nomadic population. Some of these will be reviewed at the time of the preparation of the Project Paper.

B. Deferral of Review of Unidentified Project or Subprojects

1. Reason for deferral - Some pilot projects may be reviewed later in the project, and will not be fully developed in the PP. This is because the state of the art of renewable energy and the targets of opportunity in Sudan may change radically by

that time. Such later pilot activities will require approval by USAID/Sudan and the IER, including USAID endorsement of the environmental reviews done by the Institute for Environmental Studies, University of Khartoum.

2. Timing and mandate for Environmental Reviews of unidentified projects - In accordance with Regulation 16 (216.3(A)(7) (I and II), the unidentified pilot and subprojects will be reviewed at the earliest time possible during project implementation. This will be stated as a covenant in the project agreement. The project agreement will also contain a second covenant to the effect that if, for any unforeseen reason, an environmental review of any particular identified pilot or subproject must be deferred, that its review will be completed and taken into account prior to implementation of that pilot or subproject (in accordance with Regulation 16-216.3 (A) (7) (III).

3. Mechanism for Environmental Reviews - The subprojects of the Village Renewable Energy Unit and the pilot projects to be implemented by PVO's will be reviewed by both IER and USAID. The Environmental Reviews (ER) will address both primary and secondary impacts and will be based on technical information, studies, trials, etc., from the Institute for Environmental Studies (IES) at the University of Khartoum. The IES has already been recommended as a potential source for such reviews (see memo to John Smith from the Regional Environmental Officer, REDSO/EA, February 27, 1981, which describes capabilities of (IES). On the basis of the information from IES, the Environmental Review will then be written in the form of an IEE by IER and sent to USAID for review and approval.

4. Project Administration - Project will be administered by the Sudan Renewable Energy Project (SREP) established early 1981 to serve as a focus for all renewable energy activities in Sudan. SREP combines Institute of Energy Research and Renewable Energy Units of the National Energy Administration and answers to the Minister of Energy and Mining; its mandate includes R and D, Policy Analysis, Dissemination of Renewable Energy Activities and Coordination of Donor Assistance. There are two divisions of the SREP, one for Research and Development and one for Implementation and Dissemination. As per PID the Institute of Environmental Studies (IES) University of Khartoum will conduct Environmental Reviews of all future USAID funded pilot activities, including those conducted directly by the SREP. Project will help establish a Department of SREP responsible for Economic, Social and Environmental Studies, but its role relating to environment will be largely limited to providing a link between SREP and IES.

IV. Commitment of Funds

Irreversible commitment of funds for activities without adequate Environmental Review will be prevented by a Condition Precedent to disbursement in the ProAg with GOS that states that funding for pilot activities will require (a) prior approval by the Director of the SREP, certifying that they have reviewed the activity for Technical, Economic and Environmental Soundness, and (b) approval by the Mission that the IEE is satisfactory. After approval by both SREP and USAID Mission, final decision will rest with the Energy Research Council, a five member committee appointed by the Minister of Energy and Mining.

V. Mission Officer Responsible for Approval of Reviews

After receipt of the Environmental Reviews for a particular pilot or subproject from the IER, it will be reviewed by the Mission Environmental Officer (MEO) and then passed with comments to the project officer who has decision-making authority for the other aspects of implementation, in this case James Beebe (Mission Energy Officer) would be the project officer.

VI. Recommendation

In view of the above it is recommended that a Negative Determination be approved with regard to the Research and Institution-Building component of the project. Individual Environmental Reviews will be submitted and approved for each pilot or subproject before funding is obligated for such an activity.

ILLUSTRATIVE COMMODITIES LIST

Laboratory and Scientific Equipment, Workshoptools and Material for field testing.

Estimated total cost for the following preliminary list of laboratory and Scientific equipment and workshop tools needed for the SREC is $90,000. The West German budget allocates approximately $50,000 and the USAID budget allocates $40,000 for general laboratory equipment and Scientific supplies under the line them "Workshop scientific equipment."

I. Laboratory and Scientific Equipment

Article	Units
1) Programable micro-computer, 50 channel	1
2) 30 channel Data Logger	3
3) Hotwire Animometer, handheld digital readout and computer channel lead	3
4) Omega Solar Pyronometer	4
5) Omega Pyroheliometer	1
6) DANA Integrating DVM	3
7) Thermocouple Win CUK	4
8) VTVM	100
9) Dip tube+capillary thermometers 50:range-20°C to 100°C, 50,:-20°C-250°C	100
10) Dip tube+capillary thermometers 50:range-20°C to 100°C, 50,:-20°C-250°C	(15 units)
11) Thermal probes Battery operated	(3 kits)
12) Electornic Maintenance Kits	1
13) Total irradiance Radiometer	3
14) Battery Digital Data Logers	2
15) Soil Analyzer Battery Operated	25
16) Soil Test Kits	4
17) IBM Selectric Typewriter	
18) Laboratory Supplies, Glassware	
19) Dehydration, Descicant Oven	
20) Balance	
21) Miscellaneous Equipment	
22) Casio MC34 metric-british converter pocket calculator	7
23) Compression testing equipment	1
24) Sets of scales with three ranges of weight capacity: postal scale, 0-5kg, 0-100kg	5 sets
25) Microvolt probes for temperature (thermocouple) carbon monoxide, rotation loggers, chemical probes, flow rate probes soil humidity probe and ohters as required	1 set
26) Chemicals for basic chemistry analysis	1 set
27) Microscope, polarizing	1
28) Set refractive index oils for microscopic amalysis of minerals	3 sets
29) Screens, standard particle size measuring	1
30) Kiln firing temperature cones (upto cone 12)	3 sets
31) Soil humidity analyser	2

II. Workshop Tools.

		Quantity
-	Gas welding set	1
-	Table or floor stand drill, radial arm speed	1
-	Hand four speed hammer drill (e.g. Bosch Combi)	1
-	Set of socke wrenches 8mm - 32mm	1
-	Set of flattring wrenches 6mm - 32mm	1
-	Adjustable wrenches 6" , 8" , 10"	3
-	Pipe wrenches 2 x 14" , 2 x 20"	4
-	Pipe wrench/plier-combination 20"	1
-	Bench grinder 200mm	1
-	Set of taps and dies 6mm - 24mm	1
-	Set of taps and dies 2mm - 10mm	1
-	Wall tool cabinet	1
-	Bench vices 100mm & 150mm	2
-	Battery charger 6/12 Volt 3 Amps	1
-	Steel vice	1
-	Pipe cutter	1
-	Set of files for steel	6
-	Wood rasp	2
-	Multi purpose pliers 2 sizes	2
-	Side cutter	1
-	Hack saw & spare blades	1
-	Cross cut saw & spare blade	2
-	Small hack saw & spare blades	2
-	Tank and washer cutter	1 set
-	Drill set 1mm - 13mm x 0,5mm	1
-	Wood chisels 10mm, 20mm, 30mm, "u" veiner, 15mm	2
-	Cold chisels 10mm, 20mm	2
-	Brick bolsters 75mm, 100mm	2
-	Set of drive punches	1
-	Set of marking punches	1
-	Vernier caliper 200mm	1
-	Tape measures 2m, 3m, 15m,	3
-	Steel ruler 300mm	1
-	Spring type divider 150mm	1
-	Tri square 300mm	1
-	Small steel suqare 300mm x 500mm	1
-	Slip joint pliers (channel locks)	1
-	Fencing pliers	2
-	Long chaim nose pliers	1
-	Round nose pliers	1
-	Mechanical roof jack	1
-	Small band saw (W/wood and metal cutting blades)	
-	Table saw	
-	Hand planer, 8" and 4"	
-	Heavy duty diagonal cutter	1
-	Wrecking bar	1
-	Set of flat screw drivers	1
-	Set of philips screw drivers	1
-	Spiral ratchet screw driver	1
-	Set of miniature (watch maker's) screw drivers	1
-	Vice grips 2 types	4
-	Carpenter clamps 2 x 12", 2 x 36"	4
-	G-clamp 2 x 3", 2 x 8"	4
-	Pop riveter & collection of various size rivets	1

- Riveting hammer	250 g	1
- Claw hammer	350 g	1
- 4-pound hammer		1
- Sledge hammer	10 pound	1
- Rubber mallet		1
- Nylon mallet	bounce free	1
- Tool boxes	1 large, 1 small	2
- Tool cabinet	1 floor type	1
- Grinding and cutting discs for above (steel, stone)		10
- Welding shield		2
- Gas welding goggles		2
- Grinding safety goggles		2
- Welding and brazing rods, electric and gas		-
- Accessories		-
- Small 2-speed hand electric drill		1
- Raw materials (angle iron, piping, sheeting,etc.)		-
- Set of bolts and nuts		-
- Nails, etc.		-
- Circular table saw		1
- Shovels		10
- Tree shovels		3
- Pick heads		5
- Wheel barrows		3
- Hoes		8
- Digging forks		5
- Traction animal plough		1
- Pruning shears		5
- Grabing knives		2
- Tree heal (asphalt emulsion)		3 cans

III. <u>Materials for field testing of technologies</u>.

Materials for field tests are expected to include glass, polythylene, teflon silicon sealant, aluminimum pipe, aluminium sheets, cement, corrugated iron, paint, PVC pipe, galvanized pipe and fitting, sheet metal, fiberglass, riverts, screen of various types, bycicle parts, wodd, cement fire clay and miscellaneous hardware.

- Work benches heavy duty with drawers	6
- Cleaning materials	-
- Paint brashes 10, 20, 50, 75mm	4
- Paint rollers 50, 100, 200mm	3
- Extension cable 50m, on reel	1
- Small electrical adaptors (multiplugs,etc.)	1
- Spirit levels 2 sizes	2
- Glass cutters	2
- Odds and ends	-
- Materials for construction, lockers/benches	
- Two types of manual plant fiber shredders	
- Pedal shredder	

ANNEX XII

FORMATION OF THE ENERGY RESEARCH COUNCIL

In accordance with item 16(a) of Chapter VI of the Act, the National Council for Research has decided to form a specialized Council to be named the Energy Research Council. This Council shall patronize research projects in the general field of energy. It shall as well, seek to establish a national R & D base in the field of energy and whose goal will be the rational utilization of the sources and alternatives available to the energy sector in Sudan.

The Minister of Energy and Mining; Member of the Board of Directors, NCR shall be the Patron of ERC.

Aims and Objectives:

Without prejudice to the generality of the statements above the Council shall have the following Aims and Objectives:

1/ Management of energy research projects entrusted to the Council

2/ Endeavor through co-ordination and promotion for the enhancement of fundamental and applied energy research. This shall be done in close collaboration with the various organs of the energy sector, other research institutions and benificiaries.

3/ Communication with organizations of similar interest and establishment of relations with same in such a manner which will serve the Aims and Objectives of the Council.

4/ Co-operation with other organs of the energy sector in laying cut the scientific bases for sound national energy planning and policy-making in Sudan.

5/ Represent the National Council for Research in the regional and international meetings, Seminars, Conferences etc., relevant to energy research.

Constitution and Administration of the Council:

The Minister of Energy and Mining; Member of the Board of Directors of the National Council for Research shall patronize the Energy Research Council.

The Energy Research Council shall be constituted as follows:

1. Chairman, Energy Research Council (appointed in accordance with the NCR Act).
2. Director ERC, (appointed in accordance with NCR Act.)
3. Director, Council for Scientific and Technological Research, (NCR)
4. Director General; National Energy Administration, (M.E.M.)
5. Representative, Public Electricity and Water Corporation.
6. Representative, University of Khartoum
7. Director, Energy Research Institute.
8. Three members, selected from among interested personalities.

Prepared by GOS, August 1981.