PD-ACB-797

AGENCY FOR
INTERNATIONAL
DEVELOPMENT

ANNUAL BUDGET SUBMISSION

FY 1980

DEVELOPMENT SUPPORT BUREAU

OFFICE OF ENERGY

DEPARTMENT
OF
STATE

MAY 1978

BEST AVAILABLE

Office of Energy

Establishment of the Office of Energy

The Office of Energy of the Development Support Bureau was established in March 1978. It has the principal responsibility within the Agency for providing technical support to the Missions and Regional Bureaus on energy matters and administering research and development programs in the energy field. Agency policy coordination in energy will be carried out jointly between the Office of Energy and PPC.

The decision to create the Office of Energy was based on three major factors:

1) The Agency recognized that the fundamental importance of energy availability to continued development required specific concentration or this technical sector.
2) Congress, in recent amendments to the Foreign Assistance Act and in other legislation, has emphasized its strong desire for an augmented energy assistance program for the developing countries. This desire is based on the intimate relationships among energy consumption, international development and overall U.S. foreign policy.
3) The Development Coordination Committee supported the position taken by AID, State and the Department of Energy that AID should be the lead Agency for bilateral energy programs in developing countries and that AID should organize a core staff to use outside resources and to relate energy programs to other aspects of development cooperation.

Congressional interest in an expanded energy assistance program continues and elements of the Department of Energy continue to seek a greater involvement in and an independent mandate for energy assistance activities.

A prime role of the Office of Energy will be to assure that all U.S. government energy assistance to the developing countries is properly merged into overall social and economic development efforts conducted by AID under the policy guidance of the Department of State.

Long Range Goal:

Consistent with the above, the long range goal of the Office is the development of a U.S. program of assistance to developing countries that can have a significant impact on the energy problems confronting them. This program will aim at increasing the energy available for overall development efforts and at providing needed energy for specific development sectors, such as food production, in which progress has been traditionally constrained by limited energy consumption.

Special emphasis shall be placed on the use of renewable energy resources and the decentralized generation of energy. Energy systems with these characteristics have the potential of being of great value to social and economic development efforts: they will reduce the expenses of importing oil; they will provide alternatives to dwindling global oil supplies; they can reduce adverse environmental effects associated with fossil fuels and they can be designed to make use of local technical and managerial skills. Because such systems have not formed an important part of traditional energy assistance, innovative approaches to renewable and decentralized energy assistance are required.

However, where development can be advanced by providing assistance in conventional energy areas, appropriate assistance activities will continue to be supported by the Agency.

Main Objectives:

The main objectives of the program of the Office of Energy will be to:

1) Assess energy needs of developing countries, both overall needs and sector-specific needs.
2) Develop and demonstrate technologies suited to those needs.
3) Develop the manpower necessary to conduct appropriate LDC energy activities which will include personnel from the U.S. and from the LDCs.
4) Strengthen existing and develop needed new U.S. and foreign institutions to work on LDC energy problems including exploration for and assessment of national energy resources.
5) Develop innovative approaches to the greater participation of U.S. and LDC private sectors in efforts to increase the supply of energy and the availability of new energy technologies.

The Office will seek to meet these objectives through a balanced program of augmenting Regional Bureau capacity to establish Regional and country-specific energy programs and increasing Central Bureau activities including general assessment, new technology development, management of outside resources and liaison with other organizations.

Factors Influencing U.S. Energy Assistance Programs

Since the Arab oil embargo of 1973, much has been said and written about the global energy crisis. These statements are characterized by three principal themes: the multiple implications of the escalated price of petroleum, the possibility of a future global shortage of petroleum and the potential danager of the proliferation of nuclear weapons as more nations acquire nuclear power plants.

From the U.S. perspective in particular, additional factors play a role in formulating positions on global energy issues including the environment, new business opportunities and the interconnection between domestic energy plans and the international energy situation. The concern for the environment encompasses nuclear radiation fears and pollution from fossil fuels. The private sector is interested in manufacturing a wide variety of energy devices for both domestic and overseas markets. Large corporations and small firms are or wish to be involved. In some cases the cost of emerging technologies will be reduced as markets expand. To the extent that developing countries can provide part of that market expansion, activities in LDCs will help U.S. energy planners and manufactures meet their program goals of reduced cost of the technology for increased U.S. utilization.

All of the above factors have been influential contributors to the desire for augmented U.S. assistance in energy for the developing countries. They indicate the complexities of energy discussions, the spread of political interests that are involved and the interdependence between the U.S. and the developing countries.

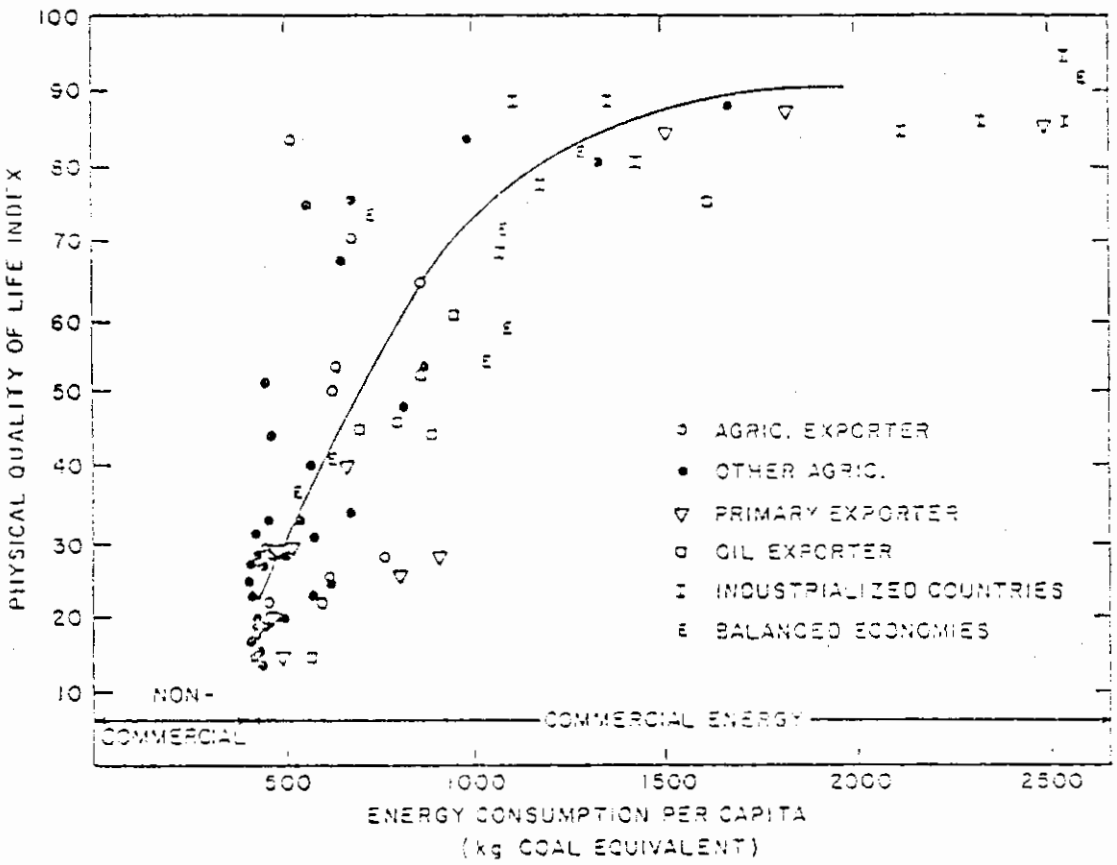
When preparing strategies and programs of U.S. assistance to developing countries however, the primary consideration must be the development of the countries involved. Energy, per se, is not the central issue; development is. And the energy implications of development programs are the important questions that need to be addressed. Operating under the overall policy guidance of the Department of State, AID has the responsibility to formulate and execute U.S. assistance programs including energy assistance.

Magnitude of the Energy Problems in Developing Countries:

AID, through Brookhaven National Laboratory conducted an overview of the energy needs, uses and resources in LDCs which was presented to Congress in March. This report concluded that the energy problems faced by the LDCs are very severe, that the prospects for solution are grim but that there are opportunities for assistance programs that can be very effective in helping the LDCs find solutions to these problems.

If no significant change occurs in their development paths, the non-OPEC LDCs will more than couble their oil consumption in the next twenty-five years. At that time they will be using as a group about as much oil as the U.S. uses today. Deviation from this projection will be due either to significant change in the way energy is used in agriculture, industry and other economic sectors or to a slowing of the economic growth rate of the LDCs. The first alternative is possible; the second is more likely. In addition to the overall energy demand, of particular poignancy is the energy needed to meet basic human needs. The following figure depicts the relationship between per capita energy consumption and the Physical Quality of Life

RELATIONSHIP BETWEEN
PHYSICAL QUALITY OF LIFE INDEX AND
ENERGY CONSUMPTION PER CAPITA



Index (PQLI) which represents a composite index reflecting infant mortality, life expectancy and literacy. The majority of the countries most in need of overall development assistance appear in the lower left corner of the plot - low energy consumption and low PQLI.

The general conclusions of the Brookhaven study were threefold.

1. The development of the LDCs will require increased oil consumption at a time when this fuel is becoming more scarce and more costly.
2. Shortages of capital and technical manpower will hinder attempts to exploit indigenous fossil fuel reserves.
3. In the absence of major actions to increase the effectiveness with which non-commercial fuels are used and to replace these fuels, a large fraction of the LDC rural population will not be able to raise their energy usage above subsistence levels.

Summary of Proposed Program:

The program proposed for the Office of Energy is designed to spearhead a concerted Agency effort that will address the energy problems of the developing countries. It contains four basic interconnected activities that mutually support each other: a training program for national energy planners; support to Regional Bureaus, Field Missions and DS/EY for energy analyses, program development and project definition; technology development and demonstration; and assistance in conventional energy areas, in particular, to strengthen LDC geological institutions.

The Training project will assist LDC policy makers to analyze their national energy needs, formulate national energy plans and manage the

utilization of their energy resources. By providing energy support to PVOs we hope to achieve early demonstration of a wide range of small-scale technology suitable to meeting basic human needs of the poor majority. Technology development and demonstration of decentralized hydropower, fuels from biomass and photovoltaics will prove the feasibility of alternatives to continued reliance on conventional electrical generation and distribution schemes and on petroleum fuels. If successful, these field proofs of non-conventional energy approaches, coupled with more complete national energy planning, will encourage other donors and in particular the international financial institutions to support similar projects for energy production. In this way AID's efforts will have a multiplied effect in providing the energy assistance needed by the LDCs.

AID cannot ignore the potential for assistance to LDCs in the field of conventional energy, in particular fossil fuels. While it is unlikely that AID would currently support capital intensive energy production facilities or would finance exploration for new petroleum deposits, it is proper for AID to strengthen the institutional capability of LDCs to manage this exploration and resultant exploitation. Consequently we have proposed, as an essential element of a comprehensive assistance program, a program of Conventional Energy Assessments and Assistance that stresses strengthening LDC geological institutes so that the countries involved will be better able to know the extent of and manage the use of their energy resources.

The development of a program such as this will require the acquisition of a significant amount of outside technical resources. Studies, analyses,

evaluations of technologies and proposals, contract with interested groups and organizations in the LDCs and in other countries will all be necessary. Both the Office of Energy and the Regional Bureaus will need a variety of technical support to perform these tasks. To provide this support we have proposed the creation of a number of Energy Development and Support Centers that would focus on particular regions of the world corresponding to AID's Bureaus. Also we have identified the need for Technical Support from the Department of Energy to assist AID in developing specific assistance projects and to provide state-of-the-art technical skills for needed consultations.

A variety of opportunities will arise requiring timely response. These will include participation in international conferences, tours to the U.S. of energy experts from LDCs, studies and papers to be prepared on short notice. To respond to such tactical requirements we propose an Energy Program Support activity to be managed by the Office of Energy but to be available to support, on an as-available basis, all appropriate energy needs of the Agency.

The full development of this central program will require manpower. We have planned for 14 professionals and 6 secretaries for FY 79 and 17 professionals and 7 secretaries for FY 80. We view the program and the manpower as a minimum program. Effective energy assistance to the LDCs will require significant increases in the manpower and funding levels of the Regional Bureaus. The central program is constructed to provide needed support to the Bureaus while they build up their resources. A strong central program will be needed to achieve maximum movement in this initial phase of AID's augmented energy assistance efforts.

Accomplishments to Present:
(Projects undertaken or proposed while energy activities were in DS/ST)

I. Current Projects

A. Energy Needs in Food System (931-11-995-234)

1. Summary of Approved Project

A two-part project was approved in May 1976 for a total of $1,100,000. Proposed completion date was January 1979. The major section called for a study of four countries to determine energy use in the food system with an overview analysis summarizing the four studies. Each country study was estimated to cost $200,000 with the overview at $100,000 for a total of $900,000. In addition, a set of smaller projects was included (estimate of $200,000): use of photovoltaics to pump water and grind grain in Upper Volta ($75,000), research on solar cooking for Haiti ($39,000), use of biogas in Nepal ($27,000) and (later added) preparation of a bibliography on energy use in agriculture worldwide ($9,000).

2. Status of Project (In Reverse Order)

(a) Bibliography:

Purchase Order approved on 1/14/77 called for submission of final version of bibliography with 2000 entries on January 15, 1978. Final version (25 copies) submitted on March 7, 1978. (Bill Stout, Michigan State University)

(b) Solar Cooking for Haiti:

Contract signed June 30, 1976, estimated June 30, 1977 as completion date. This was later amended to October 30, 1977. Final report was submitted on December 19, 1977 (Notification of project completion sent to Contracts on March 10, 1978). Study surveyed literature of solar cooking, purchased, built and tested models; TDY team visited Haiti to learn cultural cooking patterns. Two models for possible Haiti use

were built and tested and recommendations made for construction of prototypes for actual use in Haiti. (Thomas Bowman, Florida Institute of Technology)

USAID/Haiti has expressed interest in this project and would like to include wide field test as part of appropriate technology project. In particular they would be interested in large units to be used in rural schools and nutrition centers. FIT has proposed a follow-on project (September 1977) to develop solar cooker prototypes for Haiti field tests. Total - $51,000. We have taken no action on this follow-up proposal but endorse it as a valid activity. The lack of action has been primarily due to limited manpower. We would recommend the following action - that the Mission in Haiti include this phase in their appropriate technology project since the purpose is to build prototype units specifically for Haiti field test.

(c) Biogas in Nepal:

Proag signed with GON on June 30, 1976. Estimated completion date September 1978. Funding of $30,000. Joint project with Peace Corps (Brot Coburn) as joint principal investigator. Effort has included research conducted by Ministry of Agriculture, a paper presented at World Energy Congress (Turkey, September 1977), construction of community latrines/biogas digestors at two sites in Nepal. Periodic informal progress reports filed; on-site evaluation conducted in November 1977 during Bosken TDY to Nepal (trip report pending). Summary of status: progress was good when original Nepali was joint investigator. Personality conflicts quickly arose between Coburn and Nepali replacement as investigator

which slowed joint work. Attempt was made during TDY to resolve conflicts and redefine tasks and responsibilities. Agreement (verbal) reached with Minister of Agriculture on this work breakdown. The research has been fruitful: identifying ways to reduce cost of digestor, providing decision makers and general public in Nepal with needed familiarization on biogas, surveying farmers complaints about installed systems, testing of effluent as fertilizer, training of Agriculture Officers and Peace Corps volunteers. In addition work was undertaken on construction and testing of solar ovens in Kathmandu. The most successful aspect of the project has been the construction and acceptance of a community latrine in the lowest-caste section of Kathmandu. Although little gas is being produced, the latrine is being used by the intended women residents. They traditionally had used a small open lot in the congested area. The latrine provides a potential dramatic improvement in a basic public health area. The technical difficulties of gas generation have been apparently identified and steps are being taken to increase gas production. A similar latrine is under construction in a rural area of Nepal, again with Peace Corps involvement funded by this project.

Although this was an inexpensive project and will be somewhat difficult to properly document (since the reports have been so informal), I feel that it is an excellent example of <u>appropriate technology</u>, <u>improvement of the plight of women</u> and in general a project devoted to <u>basic human needs</u> especially due to the latrine aspect. It deserves, upon completion, to be well publicized.

(d) Use of Photovoltaics to Pump Water and Grind Grain

Proag signed June 1976, estimated completion date 1978, total $75,000. This project will use a photovoltaic system (P/V) to provide domestic energy needs (pump water and grind grain) in order to examine the socio-economic effects of the introduction of mechanical power for such needs. The stated purpose is to perform the socio-economic study; this was done in order to remove from consideration any question of the cost-effectiveness of P/V to provide the needed energy. However a second purpose was to test P/V's in a harsh environment in order to prove to AID decision makers that P/V's are ready for field implementation in developed projects. The "harsh" environment is a rural village in Upper Volta. If the system should fail, the villagers will return to their traditional ways: drawing water from the open village well and hand-grinding grain.

Although the implementation of this project was delayed by confusion in DOE (although they expressed an initial interest in participating in the demonstration by providing the solar cells as part of its program of terrestial application of P/Vs, they finally decided not to participate May 1977), a PASA with NASA has finally been arranged and approved by AID/W. NASA Headquarters is expected to sign in near future. This will permit NASA's Lewis Research Center (the prime DOE contractor for demonstration of relatively small sized P/V systems) to purchase needed equipment for expected installation in Upper Volta in September 1978. Much work has already gone into the formulation of the PASA including two extensive field visits to Upper Volta with the relevant NASA Lewis personnel.

DSB is committing $55,000 to NASA for hardware & initial technical services and $20,000 to a study of socio-economic affects to be done by anthroplogist residing in Upper Volta. (She will also have responsibility to define management structure for the village system.) In addition USAID/UV is planning to commit an additional $80,000 to the PASA to provide more PV arrays, this increasing power, and to support NASA's operational expenses for one year. This second transfer of money is expected in June 1978. The final system will include a 1.5 Kw array, storage batteries to level the load during the day, grinding facility and shelter, pump and water storage tank. On site management will be provided by former Peace Corps volunteer in Upper Volta who is now under personal services contract to USAID.

(e) Overview and Country Studies:

A PASA was arranged with DOE to acquire the services of Brookhaven National Laboratory to prepare the overview analysis and manage the conduct of the country studies. This PASA has been amended several times but currently commits a total of $946,000. We have had difficulty in getting countries selected for these studies. Senegal will be the first country to be studied. BNL prepared an RFP which was published in November 1977. The RFP was mailed to 140 prospective bidders on November 18, 1977. The initial closing date for response was January 23, 1978 but this was extended twice to February 13, 1978. In all a total of 18 proposals were received. A review of these proposals was made by BNL personnel with the selection (March 15) of a competitive winner Checchi & Co. Their

proposal was sent to USAID/Dakar for Mission and GOS review on April 11. At this time we are awaiting comments from USAID/Dakar in order to incorporate them into final contract negotiation with Checchi. Proposed cost was $288,000.

Action is needed on identifying the other desired countries (3) as soon as possible.

The FAA amended in July 1977 required AID to submit a report to Congress on "Energy Needs, Uses and Resources in LDCs." The report was prepared by BNL under an amendment to this PASA (12/12/77, no additional funding included but expected cost of $270,000 to come from existing funds in PASA).

This activity has been completed. What still remains to be done however is:

(1) to correct the project paper to include the required Congressional study, and

(2) to add additional funding to cover the cost of the Congressional study and compensate for increased costs expected for the remaining, now delayed, country studies, or

(2') to modify the project by reducing the number of country studies to be undertaken.

B. Training in Energy Management (I), (931-1160)

1. Summary of Approved Project

The project was approved in August 1977 for a total of $325,000. It is being implemented through a PASA with DOE to acquire the services of Brookhaven National Laboratory. Overall responsibility

will rest with BNL but the project paper stipulates that the Institute of Energy Research of SUNY at Stony Brook will be a full collaboration in the execution of the project. The project consists of three phases. In Phase I (10 months) the course will be prepared and participants selected; in Phase II (6 months) the course will be given to 20 funded participants; a subsequent evaluation of the resultant application of the training (14 months) will permit needed modifications in following courses.

2. Status of Project

Course development has proceeded well. A course outline has been developed which stresses a modular approach. Specific modules will be prepared by qualified people whether at SUNY, BNL or elsewhere. An advisory group has been formed to provide needed guidance during the project. An initial airgram was sent to the USAIDs to solicit their interest. Very receptive responses were received. A packet of materials describing the course and including participant application forms was sent to the USAIDs in March 1978. TDY visits will be made to the field by the course organizers to interview potential participants. These trips are anticipated to occur in late Spring 1978. Outside funds are being sought to provide more support including international travel for the participants.

The Office of International Training was initially informed of the program but they have not been kept fully informed. Action is needed to give them a report of status and to see if there is any need or desire for a closer collaboration between them and Stony Brook.

II. FY 78 & 79 Budget and Proposed Projects

Total Budget - $1,330,000 (FY 78)

$3,575,000 (FY 79)

A. Energy Technology Demonstration (931-1216)

PID approved at ABS stage only in May/June, 1977. This is basically an unbrella project that affords a way to reserve money for as-of-yet undefined demonstrationsof energy technology. It was designed with an eye to Congressional interest in an augmented AID energy program and therefore was intended to be flexible and responsive to an expanding budget. It would primarily be demonstrations of off-the-shelf technologies using renewable energy sources. The approved budget for FY 78 was $780,000, and for FY 79 $2,250,000.

Status of Project

No Project Paper has been prepared.

B. Energy Analysis Methodology (931-1217)

PID approved at ABS stage in June 1977. The project would develop a methodology to evaluate a country's overall energy needs in such a way that USAID's could use the approach to prepare energy assessments. It will include testing of the methodology by applying it to four countries. Project is split-funded $350,000 for FY 78, $350,000 for FY 79. It was envisioned that each country study would cost $150,000 and the initial US based development work would cost $100,000.

C. Field Support & Energy Assistance (931-1083)

PID approved at ABS stage in June 1977. In response to Mission requests, project would provide technical experts for TDY to field,

technical assessments of specific technologies, general information, resource assessments. Would include technical material for multi-country use, technology summaries and technology seminars for Mission staffs. Split funded with $200,000 budgeted for FY 78 and $900,000 in FY 79. (PASA with DOE was included here.)

III. Summary

Project	FY 78	FY 79	Total
En. Tech Demo	$ 780,000	$2,250,000	$3,030,000
En. Analysis Method	350,000	350,000	700,000
Field Support	200,000	900,000	1,100,000
*(Training in Energy Management (I))	----	75,000	----
Total	$1,330,000	$3,575,000	

*(The project was approved at $325,000 of which $320,000 was obligated by a PASA in 1977. This additional money is an arbitrary figure used to keep the books open for the project for now until final decision is made on follow-on.)

Activity	FY 79	FY 80	FY 81	Other Years	Total
A. Training					
Training in Energy Management	$ 400	$ 440	$ 490		$ 1,330
B. Support to Regional and Central Programs					
1. Energy Development and Support Centers	2,400	2,400	2,400		7,200
2. Technical Support from DOE	500	500	500		1,500
3. Institutional Factors in National Energy Planning	200	200	200		600
4. Energy Program Support	500	500			1,000
C. Conventional Energy					
Conventional Energy Assessments & Assistance	600	4,000	6,000	($12,000)	22,600
D. Renewable Technology Development and Demonstration					
1. Energy Technology Support to PVOs	400	600	800		1,800
2. Decentralized Hydropower	1,500	4,000	8,000		13,500
3. Photovoltaic Demonstration Program	1,000	4,000	5,000		10,000
4. Liquid Fuels from Biomass	2,000	2,000			4,000
5. Biomass Production for Energy	1,275	2,100	2,850		6,225
6. Conversion of Biomass to Non-Liquid Fuels	1,000	1,000			2,000
7. Coastal Zone Energy Systems	650	1,500	1,500		3,650
8. Electric Arc Generation of Nitrogen Fertilizer	750	500			1,250
TOTAL	$13,175	$23,740	$27,740	($12,000)	$76,655

TRANSACTION CODE: BUREAU CODE:

ILE V - PROPOSED PROGRAM RANKING FY 79

DECISION UNIT: DS/EY

NAME OF DECISION PACKAGE: DS/EY

RANK	DECISION PACKAGES/PROGRAM ACTIVITY/SUPPORT ITEM: DESCRIPTION	APPROP ACCT	RESOURCE REQUIREMENTS: PERSONNEL INTENSITY	WORKYEARS (XX.X) OPERATING EXPENSES: MISSION	TOT	FUNDED FROM: PROGRAM ACCOUNT	PROGRAM FUNDING (000): INCREMENT	CUMULATIVE
	Training in Energy Management						$ 400	$ 400
	Energy Development and Support Centers						2,400	2,800
	Technical Support from DOE						500	3,300
	Biomass Production for Energy						1,275	4,575
	Energy Technology Support to PVOs						400	4,975
	Decentralized Hydropower						1,500	6,475
	Conventional Energy Assessment and Assistance						600	7,075
	Electric Arc Generation of Nitrogen Fertilizer						750	7,825
	Photovoltaic Demonstration Program						1,000	8,825
	Liquid Fuels from Biomass						2,000	10,825
	Conversion of Biomass to Non-Liquid Fuels						1,000	11,825
	Coastal Zone Energy Systems						650	12,475
	Institutional Factors in National Energy Planning						200	12,675
	Energy Program Support						500	13,175

TRANSACTION CODE: BUREAU CODE:

TABLE V - PROPOSED PROGRAM RANKING FY 80

OPERATING UNIT: DS/EY

NAME OF DECISION PACKAGE SET: DS/EY

RANK	DECISION PACKAGES/PROGRAM ACTIVITY/SUPPORT ITEM		RESOURCE REQUIREMENTS				PROGRAM FUNDING ($000)	
				WORKYEARS (X.X) FUNDED FROM				
	DESCRIPTION	APPROR ACCT	PERSONNEL INTENSITY	OPERATING EXPENSES MISSION	OPERATING EXPENSES TDY	PROGRAM ACCOUNT	INCREMENT	CUMULATIVE
	Training in Energy Management						$ 440	$ 440
	Energy Development and Support Centers						2,400	2,840
	Technical Support from DOE						500	3,340
	Biomass Production for Energy						2,100	5,440
	Energy Technology Support to PVOs						600	6,040
	Decentralized Hydropower						4,000	10,040
	Conventional Energy Assessment and Assistance						4,000	14,040
	Electric Arc Generation of Nitrogen Fertilizer						500	14,540
	Photovoltaic Demonstration Program						4,000	18,540
	Liquid Fuels from Biomass						2,000	20,540
	Conversion of Biomass to Non-Liquid Fuels						1,000	21,540
	Coastal Zone Energy Systems						1,500	23,040
	Institutional Factors in National Energy Planning						200	23,240
	Energy Program Support						500	23,740

AID 1209-P (6-77)

FY 1980 Work Force Allocation Table
(In Person Months)

Work Category	4 Sec	Clerk 3 Typist	Director	Admin Assistant	Planning 2 Officers	Geologist	Economist	Regional Program 4 Support	Tech Develop 4 Officers	Training 3 Officers	Total
Field Support			2.0		8.0	4.0	3.0	24.0	16.0	9.0	66.0
Technical Representation			1.0		2.0	1.0	1.0	2.0	3.0	3.0	13.0
Administration			4.0	5.0	4.0	2.0	2.0	4.0	8.0	6.0	35.0
Clerical Support	48.0	36.0		3.0							87.0
Program Management											
Training			1.5	1.0	1.0		1.5	5.0	4.0	9.0	23.0
Support to Regional & Central Bureaus			1.0	1.0	4.0		1.5	6.0	4.0	3.0	20.5
Conventional Energy Assessment & Assistance			1.0	1.0	3.0	3.0	1.5	3.0	2.0	3.0	17.5
Technology Development & Demonstration			1.5	1.0	2.0	2.0	1.5	4.0	11.0	3.0	26.0
TOTAL	48.0	36.0	12.0	12.0	24.0	12.0	12.0	48.0	48.0	36.0	288.0

B 2
Office: DS/LY

Summary FY 1980 Workforce Allocation Table
(In Person Months)

Activity	($000) FY '79	Field Support	Technical Representation	Administrative	Clerical Support	Program Management	Total
Director		2.0	1.0	9.0	15.0	9.0	36.0
Planning		15.0	4.0	8.0	18.0	21.0	66.0
Regional Support		24.0	2.0	4.0	23.0	18.0	71.0
Technology Development		16.0	3.0	8.0	18.0	21.0	66.0
Training		9.0	3.0	6.0	13.0	18.0	49.0
TOTAL		66.0	13.0	35.0	87.0	87.0	288.0

B3

FY 1979 Work Force Allocation Table
(In Person Months)

Work Category	3 Sec	Clerk 3 Typist	Director	Admin Assistant	Planning Office #1	Planning Office #2	Economist	Regional Program 4 Support	Tech Develop 3 Officers	Training 2 Officers	Total
Field Support			2.0		4.0	4.0	3.0	24.0	12.0	6.0	55.0
Technical Representation			1.0		1.0	1.0	1.0	2.0	2.0	2.0	10.0
Administration			4.0	5.0	2.0	2.0	2.0	4.0	6.0	4.0	29.0
Clerical Support	36.0	36.0		3.0							75.0
Program Management											
Training			1.5	1.0	1.0		1.5	5.0	4.0	6.0	20.0
Support to Regional & Central Bureaus			1.0	1.0	2.0	2.0	1.5	6.0	4.0	2.0	19.5
Conventional Energy Assessment & Assistance			1.0	1.0	2.0	1.0	1.5	3.0	2.0	2.0	13.5
Technology Development & Demonstration			1.5	1.0		2.0	1.5	4.0	6.0	2.0	18.0
TOTAL	36.0	36.0	12.0	12.0	12.0	12.0	12.0	48.0	36.0	24.0	240.0

Office: DS/LY

Summary FY 1979 Workforce Allocation Table
(In Person Months)

Activity	($000) FY '79	Field Support	Technical Representation	Administrative	Clerical Support	Program Management	Total
Director		2.0	1.0	9.0	15.0	9.0	36.0
Planning		11.0	3.0	6.0	15.0	16.0	51.0
Regional Support		24.0	2.0	4.0	20.0	18.0	68.0
Technology Development		12.0	2.0	6.0	15.0	16.0	51.0
Training		6.0	2.0	4.0	10.0	12.0	34.0
TOTAL		55.0	10.0	29.0	75.0	71.0	240.0

Training in Energy Management

Discussion:

An FY 77 project developed a course to train LDC personnel in techniques and approaches to analyze their countries' energy needs and formulate national energy policy suited to those needs. The course will be tested on 30 LDC participants in 1978. The very high level of initial interest in the course indicates that it can be of significant help to LDC energy planners.

The course will be repeated each year for the next three years. Each year 40 participants will attend a 6-month session of lectures, seminars and an optional internship. A fundamental selection criterion will be the participant's potential for application of his training in an official position in his home country.

The course will emphasize energy policy issues, the structure of energy utilization in developing countries, analytic techniques for energy assessment, energy sources and technologies and national and international energy issues. Each participant will be encouraged to undertake an internship at the Energy Analysis Center of the Brookhaven National Laboratory as a part of his training.

Budget:

FY 79	$ 400,000
FY 80	440,000
FY 81	490,000
TOTAL	$1,330,000

Energy Development and Support Centers

Discussion:

The increasing importance of energy to AID activities will require the establishment of centers of technical resources needed to develop and support new energy programs. These Energy Development and Support Centers (EDSCs) will have full-time personnel knowledgeable in energy analysis, energy technology and the development process. In addition they will be able to acquire short-term consultants on an as-needed basis.

Although the specific arrangements for each EDSC will depend upon the institution involved, it is anticipated that each EDSC will be associated with a University or Educational Institute. However, the staff members of the Center will be expected to devote full-time to the tasks of the AID-funded Center and should not have a teaching or research responsibility that will detract from those tasks. One EDSC will be established to support DS/EY central activities. Four other EDSCs will be established to support Regional Bureaus and Field Missions.

The EDSCs will be modelled after the successful Department of Defense approach of creating a selected number of Federal Contract Research Centers to assist in technical analysis, evaluations and assessments of new technologies. The EDSCs will be funded to provide a capability to carry out the tasks defined in their annual contracts. As needed, clarification of specific tasks will be accomplished by the Office of Energy's Project Manager and the Principal Investigator of the EDSC coordinating with the Regional Bureaus. This method will permit quick response to needed analysis

and studies in the energy area. Needed consultants will be acquired by the EDSC out of its operating expense budget.

Each Regional EDSC will be expected to perform the following general tasks for the countries of their region:

1) Monitor general energy needs.
2) Assess energy R&D programs and plans.
3) Compile information on energy activities of other donors.
4) Maintain contacts with critical LDC governmental, university and private sector personnel on energy activities in their area.
5) Identification of potential development opportunities to demonstrate new energy technologies.
6) Provide technical consultancy to AID Missions in their area.

The EDSC supporting central energy programs will be expected to provide the Office of Energy with similar updated information on the global energy situation and how it relates to development prospects of developing countries. In addition it will maintain liaison with each of the Regional EDSCs.

Each EDSC will start with a staff of four professionals as the needed critical mass. As the Agency's energy activities increase, the staff of some EDSCs might be increased to provide the increased level of support required.

Budget:

Estimated costs are:

Region Supported	Annual Cost	Three Year Program
DSB	$ 400,000	$1,200,000
ASIA	500,000	1,500,000
ASIA/PACIFIC	500,000	1,500,000
CAR/LA	500,000	1,500,000
NEAR EAST	500,000	1,500,000
TOTAL	$2,400,000	$7,200,000

Technical Support from Department of Energy (DOE)

Discussion:

As recommended by the National Academy of Public Administration and as supported by the DCC and in particular AID, State and DOE, AID will finance DOE to provide technical advice and assistance in implementing energy program activities. The expansion of AID's energy program will require technical manpower with expertise in specific energy areas in addition to the technically trained development officers required to manage the energy program and incorporate energy efforts into the overall development program of the Agency.

DOE, if it is willing, can be a valuable source of the needed energy technologists. When ERDA was asked if they could detail a limited number of personnel to AID to assist in establishing an accelerated AID energy program, they refused citing personnel limitations as the reason. With the creation of the larger Department of Energy, perhaps this reason no longer applies.

As AID's initiates its accelerated energy program, it can greatly benefit from the assignment of DOE energy technologists to AID's Office of Energy to provide technical advice and assistance in establishing expanded energy activities for the Agency. DOE personnel employed in this way can bring with them an understanding of energy technology and an awareness of DOE technology development programs that would be important inputs to AID energy projects. As the program advances the initial DOE personnel would be rotated back to DOE where they might be charged with managing the development of specific technologies that AID found to be needed for

international development. Alternatively their new-found awareness of the problems of international development might best be utilized in field assignments where they would be AID's on-site technical monitor of the energy aspects of country'specific development projects.

By rotating DOE personnel in this way, both Agencies would benefit; AID would be assured of a continuing supply of top quality technologists with state-of-the-art knowledge of energy technology. DOE would be assured of personnel with an intimate knowledge of the energy technology needed to enhance the progress of developing countries.

Importantly, the system would be of significant benefit to the DOE energy technologists involved. While on assignment to AID, they would have an opportunity to broaden their knowledge and to apply their technical skills to the vastly different but complex and challenging problems of international development. But their periodic return to DOE would permit them to keep abreast of the current advances in technology so that their professional technical skills would not be endangered.

The initial focus of the Office of Energy will be on biomass utilization, decentralized hydropower systems and small applications of direct solar power. The Office will need six full-time DOE technologists assigned to it to develop and implement projects in these areas. As appropriate, these technologists would also serve the rest of the agency as technical experts in their particular fields. Each person would be assigned to the Office for a two year period, subject to recall by the Department of Energy in accordance with the terms of the PASA to be negotiated.

The six technologists will be assigned to the following areas:

biomass conversion technologies (solid and liquid fuels)	2
decentralized hydroelectric generation	1
demonstration of direct solar technology	1
development of photovoltaic demonstration	1
development of solar heating/cooling program	1

As the Agency's energy program grows in future years, additional personnel will be assigned to work with Regional Bureaus. At the initial stages the DOE personnel assigned to the central Office of Energy will be available to provide needed technical support to the Bureaus.

Budget:

For each of the initial three years, six people will be needed. As the program increases, more support will be needed.

FY 79	$ 500,000
FY 80	500,000
FY 81	500,000
(to be continued in following years)	
TOTAL	$1,500,000
(for first three years)	

Institutional Factors in National Energy Planning

Discussion:

Country energy programs will require a complete assessment of that country's energy resources, needs and ability to formulate and implement plans and projects designed to address these needs. An important factor to be considered then is the responsibility and capability of the governmental, quasi-governmental and educational institutions involved in this process.

The question of the interplay among the interested institutions is primarily one of public adminstration. Although many developing countries have an adequate public administrative infrastructure, others do not.

This project will support a continuing effort by the National Academy of Public Adminstration (NAPA) to examine these institutional issues in selected developing countries. This analysis will form an integral part of in-depth country energy assessments which will be undertaken as part of all energy assistance efforts. NAPA will produce case studies of selected countries that can be used as models for establishing effective governmental administration in the energy area as well as examples of the problems to be encountered in attempting to establish or improve energy administration. In addition NAPA will participate as members of selected country assessment teams and advise other teams on matters relating to public administration.

A core NAPA effort will be funded. As needed, additional funds can be added to this project by Missions and Bureaus requiring specific assistance.

Budget:

FY 79		$200,000
FY 80		$200,000
FY 81		$200,000
	TOTAL	$600,000

Energy Program Support

Discussion:

AID's accelerated energy program and the outside interest in it will require the acquisition of outside resources and the timely response to emergencies and opportunities that cannot be programmed through regular project procedures.

Outside resources will be needed to compile timely status reports of the Agency's energy activities, to prepare technology synopses for distribution to the field missions and to create special exhibits for display at appropriate meetings.

Augmented participation of LDC technical personnel at international technical meetings can spread information about appropriate applications of new energy technologies. But travel funds for potential participants are frequently not available.

International energy conferences held in the U.S. can be made more suitable for AID purposes if special workshops or tours for LDC participants are included.

This project will provide a continuing mechanism to acquire the needed short time resources and respond to opportunities that might arise.

Budget:

FY 79	$ 500,000
FY 80	500,000
TOTAL	$1,000,000

Conventional Energy Assessments & Assistance

Discussion:

Under Sections 106 and 119, AID is authorized programs to increase energy production and conservation in LDCs. The 106 authorization specifically calls for programs outside of the rural development activities of 103 that address overall energy problems of LDCs. This call is echoed in the Non-Proliferation Act of 1978 which also authorizes a program of overall energy assistance to LDCs.

The accelerated AID energy program will examine overall energy needs as part of country specific energy assistance projects. Such studies will include assessments of conventional energy needs and resources including fossil fuels. It is not expected that large capital expenditures would be made to support exploration and exploitation of conventional resources. The World Bank is beginning to finance activities like this.

What does appear necessary however is to re-examine AID's role in supporting and strengthening national institutions charged with assessing the reserves and managing the exploitation of conventional energy resources. The National Geological Survey would be the type of institution so charged. In many cases these institutions could profitably be improved in order to be better able to manage additional inflow of resources for conventional energy exploitation. Such resources could have their origin in the World Bank or other development banks or in the international private sector or in their domestic private sector.

AID has supported the establishment of such institutions in year's past. The "New Direction" policy resulted in cessation of those activities but the pervading influence of energy including conventional energy resources would argue for the necessity to renew efforts to develop the needed LDC institutional capability to know their energy picture and to manage the exploitation and utilization of their internal reserves.

We propose a multi-year effort to utilize the expertise of the United States Geological Survey, Department of Energy and NASA to enhance LDC capability in the field of conventional energy resources. The activity would make full use of remote sensing satellite technology and would require coordination with DSB's remote sensing program and its natural resource program, both of the Office of Science and Technology.

The first phase would be a preliminary appraisal of the extent and quality of data on known conventional energy resources in LDCs and an evaluation of the institutional capability of the geological surveys of the AID countries. This would be done primarily in the U.S. Limited foreign travel might be necessary (FY 79).

The second phase would be a fuller evaluation of each of the 20 countries selected from the results of the first phase (FY 80).

The third phase would be a three year effort to assist in strengthening the instituions in four countries (FY 81-83).

The full activity would be managed for AID by the USGS.

Budget:

FY 79	$$ 600,000	Phase I
FY 80	4,000,000	Phase II
FY 81	6,000,000	Phase III
FY 82	6,000,000	Phase III
FY 83	6,000,000	Phase III
TOTAL 5-Years	$22,600,000	

The activity could be terminated at each phase if the results so warranted. Therefore we would budget now only for Phase I & II, (a total submission of $4,600,000).

Energy Technology Support for Private Voluntary Organization

Discussion:

An essential component of demonstrating energy technologies of potential interest to developing countries is the management of the actual field applications of the technology. Finding an existing indigenous organization to perform this function is frequently very difficult. Many available energy technologies are simple to operate, easy to maintain and can produce needed energy for specific end uses. Such technologies include wind mills for pumping water, solar hot water heaters and small biogas generators to produce cooking gas.

These technologies can be very useful in providing important improvements in the quality of life of the major AID target groups.

There are many private voluntary organizations that have operational units in place in the developing countries providing improved health care, education, nutrition and other basic human needs. Many of these are supported by AID/W's Office of Private Voluntary Cooperation and others are supported by the Field Mission Operational Program Grants.

DS/EY's program of support for private voluntary organizations will be designed to provide funds and hardware for the field demonstration and use of appropriate energy technologies as applied to basic human needs. It would include the provision of solar heated water systems at schools, medical posts and small hospitals; solar and wind water pumps at similar institutions; biogas generators to produce cooking fuel for nutrition centers and schools; isolated small hydropower units to generate electricity at rural hospitals.

The field demonstrations of this technology would serve to introduce the people of the area to the value of the technology; the use of existing operating institutions with personnel at a reasonable level of technical competence would alleviate the management aspects of the field demonstrations.

An example of the value of such an approach is Nepal. Twenty years ago a Mission Priest at a boarding school outside of Kathmandu developed biogas generators and solar water heaters for the school. The water heater designs are now being used by the government and units are being manufactured at a local factory for sale to private homes, schools, hospitals and tourist lodges. The biogas digestor forms the basis for the governmental program to provide such digestors to farmers through loans from the Agriculture Development Bank and using the technical services of the agriculture rural extension agents.

Selection:

In collaboration with the Office of Private Voluntary Cooperation, we would contact attrative PVO's to determine their interest in AID providing the type of assistance described above. AID/W would arrange for the provision of the hardware and technical consultants to install the units; operation and upkeep would be the responsibility of the individual PVO.

Budget:

FY 79	$ 400,000
FY 80	600,000
FY 81	800,000
	$1,800,000

Decentralized Hydropower

Discussion:

Generation of electricity through the use of decentralized hydropower is a proven technology. Before the advent of rural electrification networks in the U.S., many U.S. farms and rural industries used small local dams to generate their own power. With the introduction of wide-area distribution systems, it became cheaper to tie into the network rather than operate one's own generation system.

The rise in the cost of energy in the U.S. and the limited number of large hydropower installations available have resulted in a rebirth of interest in the potential of smaller hydropower installations. Regional energy planning units (in particular New York State and New England), DOE and the National Rural Electrification Cooperative Association are all currently involved with assessing the present-day cost-benefits of decentralized hydropower.

The developing countries are often ideal areas for the use of decentralized hydropower. The frequent criticism of traditional rural electricity distribution systems is that the small electrical load does not warrant the cost of transmitting power from central generating facilities. Many of the AID-countries are characterized by mountains, and tropical climates. Thus there are frequently many sites for small hydropower installations in the rural areas and sufficient local demand to justify the system.

Certain countries, notably Peru and Nepal, have taken the first halting steps to demonstrate in a limited number of sites the potential of small

hydroelectric generation. China already has extensive systems of small hydroelectric units.

This program would fund three large demonstrations of regional electricity generation through small hydroelectric installations. The first phase would be to select three countries that are interested in this approach and to perform the necessary feasibility studies and technical assessments to define the specifics of each project. The second phase would be to install the systems and train local technicians to operate them. The third phase would monitor the operations of this unconventional approach to rural electrification.

The cost of electricity from small hydropower units is roughly $1000/Kilowatt. A nominal size would be a 100 Kw unit that would cost $100,000. Such a unit could provide village lighting, electricity for schools and health posts and small industry including agri-industry applications.

Each feasibility study would cost $500,000. Each system would have a hardware cost of $2,000,000 to provide a total power potential of 2000 Kilowatts. Operating and management costs are estimated to be equal to the hardware costs. Therefore the total system cost is estimated to be $4,500,000. The full cost for three systems would then be $13,500,000.

Budget:

FY 79	$ 1,500,000
FY 80	4,000,000
FY 81	8,000,000
TOTAL	$13,500,000

Photovoltaic Demonstration Program

Discussion:

Photovoltaic technology holds much promise for site-specific generation of electricity. Although the current cost of photovoltaic cells are high ($11/watt), the DOE program promises significant cost reduction within five years. ($1-2/watt by 1982 and $0.50/watt by 1985.) Even at the current high price, however, the technology can be cost-effective in remote areas for priority application. For example, in Africa remote generation of electricity, through small diesel generators, costs at least $0.45/Kw hr and perhaps as much as $1.25/Kw hr. (Figures are documented in recent survey of USAID for electricity costs in their countries.) Photovoltaics can produce electricity for a cost as low as $0.20/Kw hr.

We propose a central demonstration program that would field test such systems in a variety of applications. Some would involve a direct substitution of photovoltaic electricity for diesel-generated electricity, the measure of merit being simple costs. Others would enable electricity to be used in remote applications not now served by electricity. A third type of application would be photovoltaic powered water pumps to provide water for irrigation and domestic usage. A final application would be the introduction of electricity into village life to perform specific tasks now done by manual labor.

Large use of photovoltaics in a particular region should be conducted by that Regional Bureau or specific Field Mission. What is proposed here is a comprehensive global demonstration program that will prove the utility of

photovoltaics in a wide variety of development projects. Once proven, extensive use of the technology in individual country or region specific projects should be handled by the country or region staffs. At this stage limited management resources would argue for central management of the demonstration program.

The demonstration program would stress the application of photovoltaics to hospitals, medical posts, irrigation, village water and education centers.

The village demonstrations will profit from the experience to be gained by an initial village demonstration being conducted for DSB by NASA in Upper Volta. The hardware will be installed by September 1978. The system will pump water and grind grain for a village of 2000 people.

Procedure:

This would be an AID program but would be coordinated with DOE's photovoltaic demonstration activities. We would use contractors already working on the DOE program and therefore of proven experience in the technology and its applications.

Budget:

FY 79	$ 1,000,000
FY 80	4,000,000
FY 81	5,000,000
TOTAL	$10,000,000

Liquid Fuels from Biomass

Discussion:

Alcohol fuels can be an effective substitute for petroleum fuels. Brazil has begun a program to produce fuel alcohol from cane and cassava. The blend of 15% alcohol and 85% gasoline will reduce oil import costs while requiring no engine modifications. The State of Nebraska has formulated its own plan for 'gasohol' which will use corn and corn waste as the feedstock. The U.S. Department of Energy is also planning alcohol fuel programs.

The existing plans are designed for the production of alcohol on a large scale. Although the fermentation process is simple and widely known, large scale production of alcohol requires sophisticated operations and equipment. For the approach to be applicable to many developing countries, the technology must be adapted to smaller scale and to feedstocks other than the traditional sugar cane and grains.

Other factors, beside technical ones, need to be considered. Raising the feedstocks needed for the alcohol could compete with food production. While the middle and upper class would benefit from lower gasoline costs, the poor especially would be adversely affected by the resulting food shortages and higher food prices. Small labor-intensive plants could employ numbers of rural workers as opposed to larger capital-intensive operations.

A program to examine the feasibility of alcohol production in developing countries would include:

Phase I - (1) Identification of selected countries where the production of alcohol fuels seems promising. (Central America and the Caribbean seem to be especially attractive areas.)

(2) Preliminary economic analysis of the agriculture system to determine economic potential of alcohol production and identification of specific feedstocks.

Phase II - (3) Technical adaptation of conversion process to a smaller scale .

Phase III - (4) Construction of a demonstration plant in the chosen country.

(5) Operation of the plant and energy production system.

Phase IV - (6) Full analysis and evaluation of the economic and technical performance.

Phases I and II would be performed in the United States. Phase III would take place in the host country. Phase III would not be implemented unless Phases I and II demonstrated the potential of the approach.

Phases I and II would be expected to take 1 1/2 - 2 years for completion. Construction of the demonstration plant would begin at or perhaps shortly before the completion of Phase II. The entire project would require 4-5 years.

The conduct of such a program would require an institution with expertise in agriculture, engineering, economics and experience in developing countries.

While the program has not been costed out in great detail, we anticipate that $2,000,000 would be required for completion. The sequential nature of the program would permit early project termination if the progress of the effort warranted it.

Budget:

FY 79	$2,000,000
FY 80	2,000,000
FY 81	0
TOTAL	$4,000,000

DS/EY:ABJacobs:4/28/78

Biomass Production for Energy

Discussion

Utilization of biomass for energy can constitute one of the largest single energy sources in the developing world. Today about 50% of the energy used by the developing countries comes from biomass (wood and agricultural waste.) Unfortunately, what should be a renewable energy resource is being used at a rate that far exceeds its replacement rate--making it virtually a nonrenewable resource.

During the past ten years great progress has been made by scientists interested in the development of biomass to be used for fuel. The idea of cultivating biomass that can be raised in great quantity, grown on marginal agricultural land, and harvested periodically has reached a development point that should make deliberate production of biomass for energy possible.

In the United States and elsewhere new strains of trees and other vegetation have been developed and many more are underway that can be successfully planted under a wide variety of climates and soil conditions. The new strains produce such a substantial yield of material that using this biomass becomes very competitive with conventional levels. With the increased cost of conventional fuel and with decreasing biomass costs (large plantings), there is little reason not to enter this avenue of energy source.

Conversion of biomass to heat is as old as the first fire. Continued development in utilizing biomass has resulted in significant use in the U.S. wood product industries and even in municipal electric generating stations. Conversion to liquid fuel (alcohol, methanol) has reached an advanced stage.

Biomass

Growing and using biomass can be undertaken on a very large scale. Benefits will reach all elements of the population, with direct economic gain to the rural poor. The environment will be served by the removal of fuel-gathering pressure on natural wood resources, thereby protecting watersheds and reducing stream damage and flooding.

There needs to be a systematic effort to put the idea of biomass production into the forefront of energy production in the LDCs. Knowledge of its potential exists only to a very limited extent, and there is an urgent need for stimulation, guidance, technical expertise, and adaptive research. Fortunately there are focal points in a good many of the LDCs. These points should be supported and expanded to the extent that large-scale country growing and utilization is a major factor in energy production.

A program is proposed that would create a dynamic force for continued advancement in biomass improvement, in LDC planning for biomass planting and use, and in the technology of planting, cultivation, and harvesting. This program foresees the use of a consortium of seven U.S. universities that are leaders in fast-growth short-rotation biomass, and with U.S. Forest Service presence in the Office of Energy under a PASA arrangement.

The biomass for energy consortium would consist of:

University of Washington
University of Arizona
University of Idaho
University of Michigan
Syracuse University
University of Georgia
North Carolina State University

Biomass

These universities have the widest experience in developing rapid-growth short-rotation biomass that is available in the United States. They also have faculties with wide experience in developing countries, and they have ongoing contacts with LDC forestry institutions and with wood product and agricultural institutions. They are capable of giving sustaining support to a continuing program for biomass production. The activities to be supported by the consortium would be as outlined:

A. Accentuated research on biomass material for utilization as fuel

This research would be done at the individual members' research laboratories or at laboratories of LDC-affiliated institutions. Findings would be exchanged and would be propagated by the leadership of the consortium (University of Washington). Research would be focused on biomass related to LDC growth and utilization for both arid and humid climates.

B. Biomass expertise provided to AID missions and host country governments

This would be in the form of resident representation in each of the four AID geographic areas, and short-term representation for specific subjects under discussion. This representation would made in close cooperation with AID missions and would be intended to provide them and host country officials with a more continuing support for program development and implementation.

C. U.S. Forest Service

The Forest Service would place one staff member on the AID Office of Energy staff to act as a specialist coordinating the program and bringing into play the services and expertise of the Forest Service.

Biomass

Proposed Budget

		FY 79	FY 80	FY 81
A.	Research on biomass for fuel	$ 500,000	$ 750,000	$1,000,000
B.	Service to regional areas	700,000	1,250,000	1,750,000
C.	U.S. Forest Service	75,000	100,000	100,000
	Totals	$1,275,000	$2,100,000	$2,850,000

TOTAL (3 years): $6,225,000

Conversion of Biomass to Non-Liquid Fuels

Discussion:

Solar energy, while offering great promise to the developing countries, has one central drawback, the problem of storing the energy for use at a time and place when needed. Biomass, one form of solar energy, solves that problem since the conversion of the captured energy can take place as convenient.

The people of developing countries already use biomass - in the form of firewood - as one of their principal energy sources. With the growing shortage of firewood however, the efficiency of the various conversion processes must be enhanced.

This project will concentrate on three conversion processes: direct burning of wood, pyrolytic conversion of wood and wood wastes and fermentation of biomass to produce methane gas.

Wood-burning boilers can be used to power regional electrification systems. In New England, the Vermont Power Company is using the cheap wood resources of the region to provide its power. Timber mills are frequently self-sufficient in power due to their burning of wood waste. Technology improvements might be necessary before the existing systems are suitable to full use in LDCs. Efficient wood burning stoves would be included in the program activities.

Pyrolytic conversion produces char, a heavy oil and a combustible gas from wood and wood waste. A small converter designed by Georgia Tech is under construction. A similar unit is under study for Indonesia and the Philippines. Larger units might be more suitable for other applications.

Methane can be generated from the fermentation of organic matter including vegetable waste. We have funded several small activities related to small family size units. The potential exists to apply the technology to large units for village or small industry use.

This project will support efforts to determine necessary modifications to existing designs of wood burning boilers, feasibility studies of large pyrolytic converters and feasibility studies and demonstrations of village and industry sized biogas generators.

Budget:

FY 79	$1,000,000
FY 80	1,000,000
FY 81	0
TOTAL	$2,000,000

DS/EY:ABJacobs:5/1/78

Coastal Zone and Nonconventional Energy Systems

Discussion

A great part of the underdeveloped world lives in an isolated area--the coastal zone area. The fishermen and near-shore farmers in coastal zone communities are at the end of whatever resources their country has to offer, and thus what reaches them is very meagre. They fish and they farm in a subsistence manner; their product is minimal because they have few of the aids that would make their area more beneficial to them and more productive for their country. Yet these communities of shore people account for a substantial percentage of the population in the less developed world, and they could represent a much more positive input to their countries.

The reason for their poor productivity is that they lack the energy to efficiently and cheaply produce the essentials required to sustain or reinforce their capacity to provide for themselves and for their countries. Energy is needed to provide refrigeration, potable water, and fertilizer, and to supply power for illumination, communication, and other tasks dependent on some kind of energy.

The coastal zones are unique in that they represent extraordinary potential for the production of energy from renewable resources. There are winds that prevail at a constant velocity, and there are indigenous shore biomass crops such as the mangrove. There is powerful sunlight, water in its estuarine force, and wave action providing a force that never ceases.

Coastal Zone

Can these coastal zone fringes of the LDCs contribute a share toward national development? They can if enough energy can be provided to meet the basic requirements essential to their own development.

A team of U.S. university and private sector scientists have examined this particular problem and believe that the energy potential of the coastal zones in the less developed world is formidable and that there are many potentials that should be explored to determine how sources of energy can be developed to provide a base for substantial development of coastal zones.

The University of Delaware (as leader) has formed a consortium along with the Massachusetts Institute of Technology, the University of Puerto Rico, and Purdue University in order to study the way that renewable energy resources can be developed into energy systems that will place the isolated people of the coastal zones into an integrated element making a dynamic contribution to national development in the LDCs. This consortium would provide AID with the study and field forces necessary to determine how best to develop energy that would serve these isolated communities.

There are very real potentials. They need to be examined in a systematic way in the context of government development systems, technological devices, and ultimate employment of the energy potential; i.e, biomass, wind, water, and direct solar radiation. There needs to be an outline of the possibilities with different scenarios; and some practical applications should be implemented to show that much can be done.

Coastal Zone

These consortium institutions have given the questions a great deal of thought and are prepared to advance the idea, given sufficient support to enable them to develop a program that would conceptualize utilization of renewable energy resource for development of coastal zones in the developing world. Their program is based on study and research and on placing of project personnel in each of AID's four geographic regions for extension of ideas and collaboration with AID mission and host country officials on programs that would test the research and study conceptions developed.

Proposed Budget

	FY 79	FY 80	FY 81
Research and Study	$ 250,000	$ 500,000	$ 500,000
Field Development	400,000	1,000,000	1,000,000
Totals	$ 650,000	$1,500,000	$1,500,000

TOTAL (3 years): $3,650,000

Electric Arc Generation of Nitrogen Fertilizer

Discussion:

Nitrogen fertilizer, in the form of nitrates, can be formed by combining the oxygen and the nitrogen of air in an electric discharge. The most widely used nitrogen fertilizer today is anhydrous ammonia which is produced from costly natural gas. Increasing prices for the gas and increasing demand for nitrogen fertilizer require that alternative methods of fertilizer production be explored.

The electric arc process is one method that is technically feasible and, in fact, was widely used prior to the introduction of techniques using natural gas. To restore the economic advantage to the electric arc process, a compact nitrogen fertilizer production unit must be designed and developed specifically for installation and use on individual farms or localized farm areas. This approach would result in low transportation costs for the fertilizer produced and could therefore make the product competitive with conventionally manufactured (and transported) fertilizer.

A prototype system has been developed that consumes air, water and electrical energy to produce fixed nitrogen fertilizer. An electric arc reaction cell produces nitric converted to nitrogen dioxide (NO_2) and tetra oxide (N_2O_4). This is trapped in water to form nitric or nitrous acid (HNO_3 and HNO_2). The addition of lime or limestone (CaO or $CaCO_3$) to the water leads to calcium nitrate fertilizer. The water solution of the fertilizer can be stored for use later or can be fed into irrigation water as it is produced.

The reactions are:

$$N_2 + O_2 \longrightarrow 2NO \qquad \text{(heat must be added)}$$

$$2NO + O_2 \longrightarrow 2NO_2 \qquad \text{(heat is released)}$$

$$2NO_2 \longrightarrow N_2O_4$$

or complete equation

$$N_2 + 2O_2 \longrightarrow 2NO_2 \text{ (or } N_2O_4) \qquad \text{(heat as electrical energy must be added)}$$

The economic advantage of producing fertilizer in this fashion depends primarily on the cost of conventional fertilizer delivered to the farm and the cost of the electricity needed to power the process. For many LDCs the first factor is quite high. Unfortunately the second factor is also high where conventional electric power is used. If small-scale power systems using renewable energy resources are available for on-site production of fertilizer, then the cost of electricity can be reduced sufficiently to make the approach economically feasible.

An especially attractive possibility is the use of small hydroelectric generators to produce the power and to provide the water needed for the fertilizer solution. For example a 5 cm diameter pipe carrying water from a head of 120 meters would be adequate to drive a 3 Kilowatt turbine. This could produce 3 tons of Ca $(NO_3)_2$ per year at a cost per ton of \$150-\$200. (Present U.S. prices of Ca $(NO_3)_2$ are about \$150/ton.)

The Charles Kettering Research Laboratory working under a grant from the Rockefeller Foundation has pioneered developmental work on small electric arc reaction cells for this application. With proper funding prototype units could be produced for field testing within 12 to 18 months. A program to produce, field test and evaluate the technology in developing countries

would cost $1,250,000. This would provide ten site demonstrations, each one producing 12 tons of Ca $(NO_3)_2$ per year. (Each would serve 270 acres at 15 pounds per acre.).

Budget:

FY 79	$750,000
FY 80	500,000
FY 81	0
TOTAL	$1,250,000