PD-AAM-988

1. AGENCY FOR INTERNATIONAL DEVELOPMENT
PROJECT AUTHORIZATION AND REQUEST FOR ALLOTMENT OF FUNDS PART I

1. TRANSACTION CODE: A (A = ADD, C = CHANGE, D = DELETE) — PAF
2. DOCUMENT CODE: 5

3. COUNTRY/ENTITY: World wide

4. DOCUMENT REVISION NUMBER:

5. PROJECT NUMBER (7 digits): 936-5709

6. BUREAU/OFFICE: A. SYMBOL: DS; B. CODE: 936

7. PROJECT TITLE (Maximum 40 characters): Energy Expansion through Biomass Production, Conversion and Use

8. PROJECT APPROVAL DECISION — ACTION TAKEN:

A = APPROVED
D = DISAPPROVED
DE = DEAUTHORIZED

9. EST. PERIOD OF IMPLEMENTATION: YRS. 1 | QTRS. 2

10. APPROVED BUDGET AID APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C. GRANT	PRIMARY TECH. CODE D. LOAN	E. 1ST FY 79 F. GRANT	E. 1ST FY 79 G. LOAN	H. 2ND FY ___ I. GRANT	H. 2ND FY ___ J. LOAN	K. 3RD FY ___ L. GRANT	K. 3RD FY ___ M. LOAN
1) F/N		1,100		1,100					
2) 106		500		500					
3)									
4)									
TOTALS									

A. APPROPRIATION	N. 4TH FY ___ O. GRANT	N. 4TH FY ___ P. LOAN	Q. 5TH FY ___ R. GRANT	Q. 5TH FY ___ S. LOAN	LIFE OF PROJECT T. GRANT	LIFE OF PROJECT U. LOAN
1) F/N					1,100	
2) 106					500	
3)						
4)						
TOTALS						

11. PROJECT FUNDING AUTHORIZED (ENTER APPROPRIATE CODE(S): 1 = LIFE OF PROJECT, 2 = INCREMENTAL, LIFE OF PROJECT) — A. GRANT; B. LOAN

C. PROJECT FUNDING AUTHORIZED THRU FY

12. INITIAL PROJECT FUNDING ALLOTMENT REQUESTED ($000)

B. ALLOTMENT REQUEST NO. ___

A. APPROPRIATION	C. GRANT	D. LOAN
1) F/N	1,100	
2) 106	500	
3)		
4)		
TOTALS		

13. FUNDS RESERVED FOR ALLOTMENT

TYPED NAME (CAM/, SER/FM/FSO)

SIGNATURE

DATE

14. SOURCE, ORIGIN OF GOODS AND SERVICES: ☐ 000 ☒ 941 ☐ LOCAL ☐ OTHER ___

15. FOR AMENDMENTS, NATURE OF CHANGE PROPOSED

FOR IDCA/AIAS USE ONLY	16. AUTHORIZING OFFICE SYMBOL	17. ACTION DATE MM / DD / YY	18. ACTION REFERENCE (Optional)	ACTION REFERENCE DATE MM / DD / YY

Project Authorization and Request for Allotment of Funds

Part II

ENTITY : Worldwide

PROJECT : Energy Expansion Through Biomass Production, Conversion, and Use

PROJECT NUMBER : 936-5709

I hereby authorize a grant financing of not to exceed $1,600,000 for the above named project as described in the Approval Memo and attached PP.

Assistant Administrator
Development Support Bureau

Clearance:
DS/PO:RSimpson BC Date 8/17/79

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT PAPER FACESHEET

1. TRANSACTION CODE: A (A = ADD, C = CHANGE, D = DELETE)

PP

2. DOCUMENT CODE: 3

3. COUNTRY/ENTITY: Worldwide

4. DOCUMENT REVISION NUMBER:

5. PROJECT NUMBER (7 digits): 936-5709

6. BUREAU/OFFICE: A. SYMBOL: DS; B. CODE: 936

7. PROJECT TITLE (Maximum 40 characters): Energy Expansion Through Bioresource Production, Conversion and Use

8. ESTIMATED FY OF PROJECT COMPLETION: FY 81

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

10. ESTIMATED COSTS ($000 OR EQUIVALENT $1 =

A. FUNDING SOURCE	FIRST FY B. FX	FIRST FY C. L/C	FIRST FY D. TOTAL	LIFE OF PROJECT E. FX	LIFE OF PROJECT F. L/C	LIFE OF PROJECT G. TOTAL
AID APPROPRIATED TOTAL	1,600		1,600	1,600		1,600
GRANT	1,600		1,600	1,600		1,600
LOAN						
OTHER U.S. 1						
OTHER U.S. 2						
HOST COUNTRY						
OTHER DONORS						
TOTALS						

11. PROPOSED BUDGET APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE	E. 1ST FY 79		H. 2ND FY		K. 3RD FY	
		C. GRANT	D. LOAN	F. GRANT	G. LOAN	I. GRANT	J. LOAN	L. GRANT	M. LOAN
1. F/N				1,100					
2. 106				500					
3.									
4.									
TOTALS									

A. APPROPRIATION	N. 4TH FY		O. 5TH FY		LIFE OF PROJECT	
	O. GRANT	P. LOAN	Q. GRANT	R. LOAN	S. GRANT	T. LOAN
1. F/N					1,100	
2. 106					500	
3.						
4.						
TOTALS						

12. IN-DEPTH EVALUATION SCHEDULED: MM 08 YY --

13. DATA CHANGE INDICATOR. WERE CHANGES MADE IN THE PID FACESHEET DATA BLOCKS 12, 13, 14 OR 15 OR IN PRP FACESHEET DATA BLOCK 21? 1 = NO, 2 = YES: 1

14. ORIGINATING OFFICE CLEARANCE

SIGNATURE

TITLE

DATE SIGNED: MM DD YY

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

A.I.D. 1330-4 (9-78)

BUDGET

		Total
1.	Core Staff (USDA)	
	Salaries plus fringe benefits	
	4 senior scientists	270,000
	1 admin. asst/secy.	27,000
	Travel for senior scientists	53,000
	Consultants (fees)	96,000
	(travel)	9,500
	Secretarial help (part-time)	18,000
	Total	473,500
2.	Technical Assistance Services	294,500
3.	Regional Meetings to identify/set priorities @20,000	80,000
4.	Technology Assessment/Program Development	
	Consultants (fees, per diem, in region travel) @100,000 per region)	400,000
	Overseas Travel @18,000/region	72,000
	Mid project review meeting	25,000
	"State of Art" meetings, 2 @10,000	20,000
	NAS panel review	15,000
5.	Manual Preparation (3)	70,000
6.	Overhead	150,000
	Total	1,600,000

MEMORANDUM

TO: AA/DS, Mr. Sander Levin

THRU: DS/DAA/DT, John Bruce

FROM: DS/EY, Alan Jacobs

Problem: To approve the use of funds, in the amount of $1,600,000 to:

1. Establish a core assistance capability within the U.S. Department of Agriculture on the use of bioresources for energy in LDCs.

2. Initiate an 18 month analytic appraisal of the suitability and/or adaptability of existing bioresources technologies, and development of new technologies, that will assist LDCs in meeting their energy needs.

3. Assist missions and LDCs in the design of bioresource energy programs, that are either freestanding or intergrated with other development projects.

Discussion: Renewable bioresources represent a high percentage of the energy used in the rural areas of LDCs. Until recently, rural populations found that that fuelwood was readily available. That situation is rapidly changing. Increasing populations, increasing agricultural demands and the increasing world demand for lumber and pulp and paper are accelerating forest destruction. Deforestation and the resulting ills—erosion, reduced agricultural production, and lack of fuelwood are becoming endemic in the LDCs. In certain situations, bioresources also are seen as feasible substitutes for petroleum, the cost of which again is severely straining the capital resources of most LDCs.

Improved bioresource management, production and utilization, in combination with careful attention to the socio-economic impact of technological changes, could provide a useful approach to alleviating the energy and capital constraint to LDC development. The breadth of the subject matter combined with the diversity of the energy needs and interest of LDCs requires that a core bioresource program be carefully constructed. This project provides for the necessary, comprehensive planning and program development as the first action toward a systematic and substantially increased Agency-wide bioresource program.

The sequence of principal actions foreseen during the 18 months of this project are as follows:

IV

A. The Mobilization Phase (Month one through six)

1. The identification and recruitment for a period of not less than 18 months of the core USDA staff of four senior scientists and one secretary. $ 406,000

2. Identification and recruitment, for as needed periods over the 18 months of the project of about 640 days of consultant services @ $150/day plus travel and overhead). 143,000

3. Solicitation (by the core USDA staff and consultants) from the geographic bureaus, field missions and LDCs—by means of field work shops, seminars and other means—detailed recommendations on key region and country specific bio-resource interest areas. 93,000

4. Technical assistance to provide geographic bureaus and missions project design services (available over life-of-project). 294,500

TOTAL COMPONENT A $936,500

Successful completion of item three will result in definition of the analysis work (i.e., the so-called technical assessments which are anticipated to be about 20 discrete activities) to be performed during the remaining 12 months of the project.

B. The Implementation Phase (months 7 through 18)

1. A combination of twenty varied and discrete technology analyses applicable in either a worldwide, regional, subregional, or country context. The scope of work for each of these exercises will be defined under item A.3 above. However, for the total effort it is anticipated the following inputs will be required in addition to the ongoing activities under items A.1 and 2 above.

- Consultants (1,300 days @ $150/day plus per diem and overhead) $464,000
- Consultant travel 83,500

Total Consultants $ 547,500

2.	Mid project review meeting (month 8) to, inter alia, specify activities for the remainder of the project.	29,000	
3.	Preparation of "State of Art" papers, field manuals, and a Bioresource Strategy Paper for years FY 81-84.	70,000	
4.	NAS Panel Review	17,000	
	TOTAL COMPONENT B		$ 663,500
	TOTAL ESTIMATED PROJECT COST		$1,600,000

The geographic bureaus are in agreement that a centrally funded bioresource program is needed. Each bureau, however, has indicated an intention to use the program to differing degrees. All expressed general agreement that a core USDA staff and on-call consultants for project design assistance will be an important service, as will the preparation of the State of the Art Surveys, Field Manuals, and a Bioresource Strategy Paper. The N.E. Bureau will use all elements of the project. The Africa Bureau indicates it is well into defining the problems and priorities anticipated for item A.3, and therefore would look more toward use of the elements anticipated under the Implementation Phase. The LAC Bureau would concur in all elements, except those in the Implementation Phase that are country specific. The ASIA Bureau would look to the project for short term design services.

Recommendation: That you approve the proposed 18-month project, to be implemented by PASA with the Forest Service of USDA, at the requested level of $1,600,000.

Approved: _____

Disapproved: _____

Date: _____

Attachments:
1. PAF
2. Project Paper

Drafted: DS/PO:TO'Keefe

Clearance: DS/PO:RSimpson Date 8/17

VI

BIORESOURCE PROJECT PAPER

Background

The challenge is immense for those LDCs that meet a substantial part of their energy needs from imported petroleum. The cost of oil has risen five fold in the period 1973-78 and the increase in cost is accelerating in 1979. This escalation has caused serious dislocations in the economies of non-oil producing developing countries. Foreign exchange earnings are diverted to the purchase of petroleum products restricting the purchase of other imports essential to development. The cumulative ill-effects of excessive expenditures for imported fuel provide an overwhelming incentive for increased utilization of indigenous fuels both fossil and renewable.

Bioresources can serve as an economically feasible energy substitute for commercial fossil fuels both in developed and developing countries. The immensity of the resource is only equalled by its underutilization.

Bioresources supplied most of the energy needs in the United States just century ago and today supply more than half the energy used in LDCs. However, LDC bioresource/energy conversion is in the noncommerical sector. The generation in the LDCs of electricity and of the energy used in industrial applications and in transportation, as in the developed countries, is primarily derived from fossil fuels.

Bioresources represent an undervalued and underdeveloped renewable energy source that can reduce dependency on fossil fuels. The magnitude of the resource is immense. The weight of all living plant matter on the earth's

land surface is estimated at 2400 billion dry tons. Annual growth adds another 170 billion tons. All of this plus aquatic and marine vegetation are potentially convertible into energy.

Forest biomass, the major bioresource reserve, constitutes 98% of terrestrial plant matter, and represents 20 times the worlds current annual energy consumption. More important, the annual production rate of forest biomass is more than the worlds total consumption of fossil fuels. The largest forest areas, 2.5 billion hectares (half the worlds total), are in the tropics. The annual unused forest increment in the LDCs is equivalent to one-half the worlds total energy consumption. The grassland areas of the developing world approximate the forested land area. Grasses may be as suitable for energy conversion as the more promising tree species and the annual growth yields may be comparable.

Cost estimates for the U.S. show that bioresource/energy is more economical than energy derived from fossil fuels. Studies indicate that raw wood biomass - collected, pellitized, dried and transported to a utilization site will cost about $22/ton, equivalent to about $1.33/million BTU. This is more than competitive with natural gas, fuel oil or gasoline.

Serious studies as to large scale use of biomass for fuel in the U.S. have been made and there are applications under way in both municipal power companies and industry to use wood as a fuel for electric power and industrial heat. The city of Burlington, Vermont has a 10MW generator powered by steam produced with wood fuel and will soon move up to 50-60MW. The cost of electricity from this generation is two cents a KWH as opposed

to three cents for oil fired generation. Burlington uses waste wood but is studying cultivated wood as a source of continuing supply. The wood products industry is 70% self sufficient in electricity supply. Puerto Rico has a plan to ultimately become almost energy self sufficient based on the efficient utilization of various biomasses for energy supply.

With cost factors as they are and growing conditions constrained to some extent, there is still a strong drive to introduce biomass into the U.S. as an alternative to some of our fossil fuel uses. In the LDCs, cost factors for cultivation, harvesting and conversion are much more favorable and benefits greater for introducing bioresources as a major supplier of energy.

Tropical climates are characteristic of almost all of the LDCs. This offers a wide variety of potential plants that are suitable for fuel purposes, i.e., 20-30 species of wood, 8-15 species of tropical grasses, root crops, fresh water, and marine vegetation. Many of these are fast growing, grow in abundance and can be repeatedly harvested from their original root stock. Although growing conditions are generally favorable many of the plants will grow under adverse soil and climatic conditions. Plant species will provide raw material for solid, liquid and gaseous fuels. Conversion technology is well advanced in all of these areas but needs adapting to specific local conditions.

Bioresources in addition to their potential for making a major impact on the energy needs of the developing world can offer additional environmental and economic benefits. For example:

(1) Biomass is widely used in LDCs primarily as fuelwood in rural households. Significant amounts are also consumed in urban areas and by smaller industries. The extent of this usage varies with income and in the poorest countries wood may supply as much as 75-90% of total energy consumed. This use of wood as fuel particularly in the poorest LDCs is linked to deforestation, an issue of increasing ecological and agricultural concern. A.I.D. and other donors have launched projects to test the hypothesis that through fuelwood oriented planting programs, more efficient stoves, and improvements in charcoal manufacture, deforestation due to fuelwood can be reduced. A central bioresource program can contribute to the effectiveness of these programs by supplying technical know-how and appropriate expertise both in the production of biomass and conversion to energy.

(2) Commercial production of biomass fuels can provide income and employment in rural areas. In many ways it is like adding a new agricultural crop with a steady market to be produced on land formerly considered marginal. The IBRD has estimated that a fuelwood tree farm project in the Philippines averages about 65 man-days of labor per hectare per year (over a nine year period).

(3) Systems based on bioresources hold promise for delivery of certain productive energy services (industrial heat, electricity) at low cost to small decentralized loads in rural areas and small towns that can also contribute to increased income and employment opportunities.

DS/EY can bring together a solid force of experts to advance the use of biomass in the LDCs. Their research and personal advice would be available to the USAIDs and LDCs in a planned and systematic manner. Institutions and individuals from academia, government and the private sector working together under AID funding could investigate the state of art, identify areas for concentrated study, correlate information for availability to field use, conduct adaptive research on specific biomass production and conversion both in the U.S. and at LDC locations agreed upon by Geographic Bureaus and supply specialist advisors for bioresource programs proposed under AID's assistance.

Coincidentally, in a draft report "Survey of Biomass Energy programs and Use in the Developing Countries," prepared for the "Comprehensive Assessment on Energy from Biological Processes" undertaken by the Office of Technology Assessment, the need for utilizing U.S. expertise is emphasized. The authors of the report state:

> "We conclude that the most effective assistance that could be given by the United States to the developing countries, in the biomass technology area, is likely to be basic scientific and engineering information..... The laboratory facilities and technical experience to acquire much of this information can often be expected to be much more accessible in the United States than in many developing countries."

The authors also argue for U.S. support and participation in "widescale" efforts to "network" information related to biomass management "via information distribution systems and in-depth seminars.

These are the very types of activities that the proposed bioresource/ energy program can provide.

II. Project Description

A. Program Goal

The goal of the AID energy program is to assist LDCs approach self-sufficiency in energy production through the use of indigenous conventional and non-conventional energy sources.

B. Program Purpose

1. To develop a coherent, well structured bioresource/energy resource composed of institutions and individuals that will provide as needed short and long term expertise to assist Bureaus/USAIDs/LDCs in creating and implementing appropriate bioresource programs and projects.

2. To utilize existing U.S. institutional capabilities in bioresource/energy to improve or develop appropriate technologies for urban and rural use patterned to LDC needs, and resources.

3. To assist AID's rural development objectives where bioresource development may be relevant, this includes support for initiatives to arrest deforestation resulting from fuelwood use by the incorporation of a fuelwood component in reforestation, and the provision of a supply of mechanical, electrical, or agro-industrial process heat for small decentralized rural loads. Thus, direct combustion could be used to generate electricity; pyrolyses could produce oil for use in diesels. Biogas could be used to operate stirling-type engines, etc.

C. Basic Considerations

Assumptions

Assumptions underpinning the proposed bioresource program include the following:

a. Bioresource materials can be produced on a large enough scale to have a major impact on meeting LDC energy needs.

b. There is enough of a net energy gain in the production and conversion of bioresource/energy to justify the large scale production of bioresources.

c. For the foreseeable future land allocated to production of bioresources for energy production will have no adverse effects on food production. In fact, a beneficial effect will result in instances where bioresource programs inhibit or reverse the process of deforestation.

d. Bioresource/energy production provides a reasonable economic choice as compared to other energy alternatives (e.g., hydro, solar, conventional).

e. Analysis of country energy needs and resources will be used to indicate whether a bioresource program is the technology of choice before specific projects are initiated.

2. Functions

Two distinctive functions are envisaged for the DS/EY bioresource/energy program.

The first is to provide a field oriented services for Bureaus/USAIDs/LDCs. This includes such diverse activities as organizing seminars and workshops, providing appropriate consultants both for short and long term consultancies, information dissemination, etc.

The second is to develop an adaptive Rand D bioresource program that generates analytical and experimental work responsive to field requests and addresses problems of concern to LDCs in general.

The bioresource program is not perceived as being limited to the development of demonstration or pilot projects. Research to provide key knowledge that can hasten the implementation of bioresource programs and applied research programs that will help adapt existing technologies are equally essential.

Keeping these functions in mind, program activities will be divided into four broad groupings. The first is a major effort on bioresource production that cuts across all activities; and three subprograms that emphasize the end uses of biomass and simultaneously focus on the major distinctions between users. These three subprograms include the following:

a. Small users' subprogram, which addresses biomass use in households (urban and rural), in small commercial and

anc industrial enterprises. and in villages. Very roughly such a program would be directed to users of nc more than 0.5 - . gigajoule per hour (by comparison a cooking fire is about 0.02 gigajoule per hour).

b. Industrial and electrical applications subprogram. This subprogram is oriented towards larger scale stationary applications of biomass for heat, steam and electricity. The scale of units may in fact overlap, however, with the small users subprogram.

c. Transportation fuel and chemicals subprogram. This subprogram is oriented towards fuel for internal combustion engines which are largely, if not entirely, used for transportation. The emphasis in a chemical product (fuel) maybe extended to other chemicals such as ammonia and ethylene.

Each of these three subprograms will be concerned with elements extending from the end-users to the primary bioresource, though in practice most of the work will be concerned with conversion technology. The program is defined in this manner to focus attention on the energy user and the service which energy provides since this, rather than an energy technology per se, is what is of interest to AID in allocating resources.

No division is entirely satisfactory in such a complex area as biomass. While an end-user approach tends to incorporate

more systems and economic concerns, it may fragment work or technical issues if this work appears in each subprogram. The outstanding example of this is the primary production of biomass. Not only is primary production the single most important aspect of bioresource utilization it is likely to ramify into many areas such as reforestation which may extend considerably beyond energy concerns. For purposes of planning, therefore, it is essential to keep bioresource production together as distinct subprogram even though it cuts across the user-oriented sub-programs. In addition, it explicitly delineates how resources are allocated between production and conversion programs.

D. Program Activities

1. Bioresource Production

Very generally the goals of this effort will be to supply raw material for subsequent conversion at a variety of scales of use at as low an economic and ecological cost as possible, to develop guidelines for selecting among alternatives in the various unit operations involved from production to utilization, and to strengthen the institutions that would be involved. There are two broad sources of raw materials - waste residues and materials which are grown. It is anticipated that this task group will focus primarily on systems where biomass is grown but will include waste residues to the extent feasible.

In considering how the primary production task group will interact with the end-use oriented groups (which can also have interest in primary production), one principal will be that scientific experimental work on raw material production will be almost entirely the responsibility of the primary production task group. Very small scale production systems (such as village woodlots) will be the primary concern of the small users' task group particularly, in the phases after the more basic R&D since the major problems may be similar to those encountered in the rest of the small users' program rather than in the primary production program.

There is a need for rather fundamental conceptual and experimental work to select appropriate species or combinations of species and to improve management practices suited for different purposes. It is expected that the program will initially focus on silviculture. However, work on aquatic plants, bushes, and grasses will also be pursued.

Primary production is site specific. As a consequence, an effective experimental program will have to be conducted in large part in the developing countries.

The primary production group's adaptive research will go beyond technical experimentation to include work where necessary on all issues bearing on the successful management of ecosystems to yield energy. It will thus be concerned

with a diverse range of issues such as the relation of reforestation in general to expanding the use of forests for energy, or the problems which may be encountered in attempting to organize a group of small-landholders for reliable tree production, etc.

More specifically the types of problems to be addressed are both technical and cultural and will require the development or identification of techniques to best do the following:

- Involve communities and individuals in the biomass program despite their realization that fuel will not be free or gathered at will.
- Select appropriate species and growth sites.
- Maximize dry matter production (e.g., spacing, rotation periods, maintenance of soil quality, etc.).
- Harvest biomass both manually and mechanically.
- Transport the harvested biomass to point of utilization.
- Manage and store biomass prior to utilization.

2. Industrial, Electrical, Transport and Chemical Applications

This subprogram arises from a combination of two subprograms oriented towards industrial scale conversions. Of these two, the industrial and electrical applications subprogram must be regarded as having a higher priority.

3. Industrial and Electrical Applications Subprogram.

The two primary objectives are demonstration of relatively well developed technologies and feasibility analysis. The task group will have the engineering capabilities for detailed design and implementation. This will permit the inclusion of a realisitic engineering element in the feasibility analysis, and will provide a foundation for demonstration project implementation as resources may be made available.

Two distinct "markets" are envisaged here:

- Industrial process heat, either in urban or rural areas with or without electrical co-generation.

- Electrical generation in plants ranging from 500 to 20,000 kw.

The key fuel conversion technologies will be direct combustion, char-oil production, and small gasifiers in addition to systems to convert these various heat or chemical products to mechanical work (steam turbines and piston engines, internal combustion engines, gas turbines and fuel cells). These markets are basically to substitute for fuel oil used as a boiler fuel. Boiler fuel is the largest single end use of petroleum products in LDCs almost without exception. In many countries that do not use large amounts of natural gas, the use of fuel oil (heavy distillate and residual oil) is

approximately equal to total petroleum use in the transport sector. These markets therefore represent an important possibility for petroleum substitution using conversion processes which are simpler and more efficient than those characteristic of the transport subprogram. There are many instances where biomass is used in this way today. The objective will be to expand these applications by,

a. Upgrading the quality of the fuel (e.g., by drying).

b. Improving its transportability (densification, pyrolysis), and,

c. Improving the systems designed to use biomass.

Much of this technology is rather well developed but could use additional engineering (e.g., improved driers, gasifiers, and internal combustion engines). Work on these technologies is accelerating in domestic United States programs at the State and Federal levels. The primary activity of the task group will therefore initially consist of a detailed review and screening of technologies that exist or are becoming available in order to assess their appropriateness and to identify adaptive changes that might be made. Another activity, common to all task groups but perhaps most prominent here, would be the development of manuals accessible to field engineers for easy reference on information not readily available in standard sources (e.g., impact of gas composition or engine compression ratio on efficiency). This activity

may involve a limited amount of experimentation.

In many developing countries, fuel oil is heavily subsidized. As a consequence it is frequently difficult for any alternatives to compete, unless there is some compensating subsidy. Evaluations of the feasibility of expansion of biomass into the fuel oil market will therefore involve careful analysis of how governments may deal with the problems posed by artificially low fuel oil prices, as well as the more usual factors considered in feasibility studies.

4. Transport Fuel and Chemicals

Initially this effort will be primarily analytical and will be oriented towards methanol and ethanol. The following issues would be considered:

a. The cost, import components and operating problems of methanol/ethanol plants.

b. The problems of introducing methanol/ethanol into the market.

c. Environmental, safety and health implications of the use of alcohol as fuels.

d. Means to increase the by-product credit from methanol/ethanol production, including increasing efficiency.

e. Evaluation of extractable oils and oleoresins for diesel substitution.

As part of this effort, a competent thermochemical group would review, experiment with and eventually install gasifiers. The goal of gasification is to produce low BTU gas from biomass. The gas can be used directly, upgraded to synthetic natural gas, or used as a feedstock for the production of methanol, ammonia or petrochemical substitutes. Improved gasifiers are central to any program of thermochemically derived transport fuels. Developing a good technical nucleus on gasifier technology would receive high priority. Other high priority efforts would include measures to increase by-product credit and/or efficiency of methanol/ethanol production. A basis is to be laid for larger scale commitments if these emerge. In general, the minimum goal is to collect together, make available what is known or ongoing and explicitly identify where research is needed and where constraints lie. Higher funding levels would permit more in the way of support for experimental development work in specific areas. Highest priorities for such support are:

a. Gasification.

b. Bagasse driers.

c. Techniques to minimize aldehyde and unburned alcohol emissions.

d. Engine design for blends and "pure" alcohol with attention to fuel modification.

e. Vegetable oil extraction techniques.

f. Fermentation processes.

Work is going on in all these areas, so it is important to assess where AID involvement in hardware experimentation design or demonstration would add. The case for (a) gasification, (b) bagasse driers, and (e) oil extractions is perhaps strongest. After experimental work is begun, the thermochemical group will maintain a review function and be available for additional support services.

It is possible that in addition to transport fuel, this subprogram would eventually involve work on "energy intensive chemicals" where biomass is used as a substitute feed stock for oil or gas in the production of certain petrochemicals.

5. Small Users' Task Group

This task group is directed towards the diverse needs of small energy users, both urban and rural. The type of end-uses which would be prominent are cooking, some small industrial/commercial heat loads (e.g., bakeries), and some small mechanical drive applications (e.g., a small generator or pump driven by gas from wastes). The main feature is the small size of the conversion device. In practice, however, there may be some cases where there is an overlap with the industrial and electrical applications subprograms.

Projects of the type that would fall under the purview of the small users' task group constitute the bulk of the new initiatives taken by AID bureaus. Technical experimentation,

initial demonstration, creation of reference materials and assistance in training would appear to be the most valuable contribution that DS/EY could make.

Areas of technical interest include biogas digesters, cooking devices, driers and other devices used for process heat in small rural industries, heat engine systems to produce mechanical or electrical work (including engines under development such as small Stirling cycle engines which promise minimal maintenance) and village primary production systems. In all of these areas some experimental work remains to be done, including the development of improved cooking stoves. Note also, that as already discussed in the description of the primary production group, much technical work on village primary production systems should be explicitly part of the domain of this task group.

Most of the DS/EY subprogram will be technically oriented. This is because much of the feasibility, institutional, survey, and socio-economic analysis will either be funded by the geographic bureaus or by the Survey and Assessment Program in DS/EY. In addition, the DS/EY project with VITA will develop applied projects at the grass-roots level. However, the task group should be structured to have strong capabilities in these areas in order to assist in performing this work coming from other programs.

In selecting institutions and programs for experimental work, a major consideration should be the establishment of nuclei

for a training program, and individual projects should be structurec to contribute to the development of a training capability spread over several institutions. small gasifier systems, biogas systems, and combustion systems (including cooking) appear to be three appropriate nucleii. Such training centers could be domestic or located in LDCs.

III. Implementation

A. AID Project Management

The project will be managed by the Office of Energy, DSB. This will provide centralized project supervision and a mechanism for dissemination and interpretation of results that can be used for Agencywide policy and programming purposes. A DS/EY energy officer will be the project manager

The project manager will be assisted by a technical advisory committee composed of a representative from each of the regional Bureaus, DS/EY officers representing different energy areas and specialists from other disciplines whose expertise may be needed on specific issues and projects.

B. Contractor

To carry out the desired activities we propose to contract with an appropriate institution to serve as the supervising entity for the program. It is anticipated that this entity will not only be responsible for program supervision but will play a key role in (a) formulating program priorities; (b) subcontracting

with institutions that have expertise in the priority areas; (c) arranging workshops and seminars and disseminating information in LDCs concerning the magnitude of the energy problems and of the bioresource production and conversion technology available for solving their problems; (d) identifying and supporting short term and long term consultants for specific field activities.

Alternatively, because of the complexity of the program, two lead institutions could be selected that have respectively the requisite basic skills in the two areas of prime concern:

a. Production of bioresource materials

b. Conversion of bioresources to energy use.

These two institutions would serve as closely collaborating management entities."

C. Field Support

The supervisory entity and the collaborating institutions form a bioresource program support group that will assist the Bureaus/USAIDs/LDCs in the development, implementation and evaluation of bioresource programs and projects. The resource established will provide a "critical mass" of basic knowledge and practical know-how that will assure LDC bioresource programs to be well-conceived, technically and economically feasible and relevant to LDC needs.

There is a critical need for 'energy' expertise located on a long term basis in the LDCs. Since it is not feasible at this time for USAIDs to support energy officers in each of the Missions, long term consultants hired by DS/EY and based regionally can be substituted. The magnitude and nature of this assistance will vary with energy needs as perceived by the Bureaus/USAIDs. DS/EY is prepared to support a spectrum of options ranging from one man in one region to 2-3 regional centers within a geographic region with multiple expertise in bioresource utilization, water power, solar technology, conventional energy development and energy planning. Such 4-6 member staffs will be under the direction of direct hire Bureau Personnel. These individuals will work with the USAIDs/LDCs to analyze energy needs and develop relevant assistance projects that meet their identified needs. Project development will be under direction of USAIDs in cooperation with LDC counterparts and key LDC government officials.

The regional energy advisors will also assist in arranging seminars and workshops and in disseminating information within the region(s). Periodic meetings of these individuals and U.S. scientists actively engaged in energy research and applications will provide a mechanism for exchange of experiences and new information that would improve existing or proposed projects. An important output of these meetings will be recommendations suggesting suitable research and pilot projects that have universal application and are suitable for DS/EY funding.

D. Adaptive Research Applications

The U.S. institutions engaged in adapting bioresource production and conversion technologies described in the previous section will work closely with LDC institutions. Knowledge of LDC limitations and an understanding that technologies advocated must relate to LDC needs and capabilities are essential to program success.

At this point it is impossible to justify any very precise allocation of adaptive research effort among the subprograms. It will be important to maintain flexibility in these allocations. It is useful, however, to bring out factors that could influence a preliminary estimate. These factors lead to something very roughly like the following distribution of effort for adaptive research:

(a) primary production = 40-50%

(b) industrial, electrical, transport, and chemical applications = 25-30%

(c) small user's subprogram = 20-30%.

Primary production is conceived as the largest of the subprograms. The basic reason is that primary production is the most site specific part of the bioresource program -- hence there is relatively less to transfer and there is a greater need for repetition of work in different regions. Furthermore, if we are interested in a significant impact from planted biomass, it is almost certain that

R&D or primary production will be the key initial factor pacing the entire program. Thus, there is a premium for giving relatively more resources at least initially to this subprogram.

The industrial application and small users' task groups are shown to cover similar ranges of effort. A tentative recommendation is that the industrial applications task group should receive a slightly larger fraction of funds than the small users' task group. One reason for this recommendation is that there is a rather vigorous development of several small user oriented programs which incorporate some adapative research (as in the Ghana pryolysis project). Thus, there may be overall less justification for a technical and catalytic role for DS/EY in this area than with industrial applications. This could be counter-balanced to some extent on the service side where there may be more demand for small users' consultants as compared to industrial applications consultants.

IV. Funding and Time Frame

The bioresource program is envisioned as a four year $10.0 million program. The rationale for "funding and time frame" follows:

Field Support - It is anticipated that one bioresource "permanent" advisor in the field plus his travel, etc., will cost approximately $80,000/year. If an average of six experts per year were supported over the four-year period, this would represent an investment of approximately $1.9 million.

Short term consultants, workshops, etc., would add another $400,000/ year or $1.6 million for the four year period. Total set aside for field support, $3.5 million for four years.

Adaptive Research/Applications

Funding for the adaptive research/applications program will roughly follow allocations of effort.

Primary Production, even though larger than the other subprograms, is nevertheless a relatively small program in terms of the job to be done. Our interest is in maximizing growth under a variety of climates and soil types; a number of studies will therefore be required at different sites. Illustrative of the potential program cost is an unsolicited proposal for an R&D program and training center for silviculture that requests $5.0 million for a comprehensive program in one Central American country. Since experimental work on site must be an important component of primary production programs, an effort will be made to "piggyback" to the greatest extent possible, existing AID projects.

Funding for the primary production subprogram is estimated at $3.25 million for four years.

Industrial application subprogram costs can be substantial. For example, a single test demonstration of a 200kw device with a producer gas gasifier could cost $250,000 or more. On the other hand,

applications involving direct combustion may be less expensive since there is considerable commercial technology available for transfer. Demonstration of a direct combustion system is designed to prove the reliability of the logistics of the raw material supply system rather than the efficiency of the conversion device. Experimentation may, however, be more important and costly for other parts of this subprogram, such as transport fuels and biogas production. Again, the funding request is relatively modest. Funding for the Industrial Applications Program is estimated at $1.75 million for four years.

"Small users'" subprogram can complement and be supportive of ongoing field projects. Assuming that a single four-year project may require $300,000-500,000 and that 3-5 projects will be initiated, then funding for the "small users'" subprogram is estimated at $1.5 million.

FOUR YEAR PROGRAM COSTS BY CATEGORIES (in millions)		ANNUAL BUDGET (in millions)	
Field Support	$ 3.50	FY 79	$ 1.50
Primary Production	3.25	FY 80	2.50
Industrial Applications	1.75	FY 81	3.00
Small Users' Program	1.50	FY 82	3.00
	$10.00		$10.00

It could be argued that a greater emphasis should be placed on the service field support role with a commensurate drop in resources for adaptive research. It may further be argued that the rough two-to-one

split in allocation not only cheats service support, but will tend to make the program less responsive to the "real" problem.

Several points should be made in favor of the rough allocation proposed. First, the distinction between "service" and "adaptive research" is not sharp. An important part of the "adaptive research" work is likely to be on the order of feasibility analysis, development of basic manuals which are only a gradation away from the sort of thing to be done in the service trips. Second, there appears to be an idea that the service function is oriented towards the field while adaptive research is done at home. In the bioresource program at least, this idea is not tenable; an important part of the adaptive research must be done in the LDCs. Adaptive research in itself is not likely to be any less "realistic" than service work. Indeed, it can be argued that it will be easier to get some good quality people into the overseas part of the program (particularly the longer term aspect) if there is the opportunity for experimental work in the field.

Phase I

DS/EY realizes that the bioresource program while comprehensive and appropriate, will require a considerably sharper focus to bring it to manageable proportions. We, therefore, propose that at the completion of a first phase of 18 months the program that evolves during this period be critically reviewed. During the first phase, the following will be accomplished:

(a) The managing entity (ies) and cooperating institutions will be selected and partially funded. Under consideration as the lead agency (ies) are:

National Academy of Sciences

Forest Service, U.S.D.A

Bio-Energy Council

Discussions have been held with key personnel in each of these institutions.

(b) A broad range of applicable technologies will be examined and agreed upon projects will be initiated. Some of these studies will be done primarily in the LDCs, others have substantial U.S. and LDC components, and still others will be carried out primarily in the U.S. Regardless of location, all studies will call for complete cooperation among the DS/EY/Regional Bureaus/USAIDs.

To insure that the bioresource program is responsive to Bureau/USAID/LDC needs, the following steps will be taken once the lead institutions are selected.

(1) Based on their experiences and an initial "state of the art" review, tentative project priorities will be set by the lead institution(s).

(2) Missions will be advised of the proposed bio-resource program and asked to comment on proposed projects in terms of their own perceived priorities.

(3) The Technical Advisory Committee which includes Bureau representation will meet with contract personnel to review, modify, and concur on priorities.

(4) Bureaus will be asked to recommend countries where those projects that have an LDC component can best be implemented. Bureaus will also be requested to identify Regional locations for energy "advisors."

(5) The lead institution(s) will identify and begin to fund appropriate subprogram projects that are predominately U. S. based. In addition, regional bioresource experts will be recruited for the Regional Offices.

(6) USAIDs (based on Region recommendations) will be advised of projects that can be addressed in their countries and invited to participate in the program.

(7) Teams will be sent to LDCs where Missions have expressed an interest in the proposed program to evaluate available resources, institutions, the need for proposed projects and whether existing projects can be "piggybacked" to provide desired results.

(8) Based on team reports, projects with a major LDC component will be initiated.

(9) Regional seminars/workshops will be convened.

The first phase will demonstrate the feasibility and utility of proposed mechanisms to supply permanent field support, and will also provide the time and experience to develop an indepth comprehensive bioresource program.

A review of the bioresource program will be held prior to the completion of Phase I. Based on the results of Phase I, a revised bioresource program will be proposed.

Activities to be initiated during Phase I and a budget are attached.

BIORESOURCE SUPPORT PROGRAM BUDGET

(in thousands of dollars)

	PHASE I		PHASE 2	
	1979	1980	1981	1982
Salaries	350	500	650	700
Travel (domestic & overseas)	50	60	75	75
Adaptive Research (Production)				
Tropical	150	165	175	175
Semi-Arid	150	165	175	175
Coastal	150	165	175	175
Adaptive Research (Conversion)				
Gasifiers		150	160	175
Fermentation		150	160	175
Combustion		150	160	175
Pilot Studies including training	300	500	600	750
Field Consultants	250	400	480	480
Seminars/Workshops (including LDC participants)	150	100	50	50
TOTAL	1,550	2,505	2,860	3,055

PHASE I ACTIVITIES